100 Mile TSA
Type 1
Silviculture Strategy

Version 1.0

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British Columbia
Ministry of Forests and Range

Funded By:

Forests for Tomorrow

FORSITE
Forest Management Specialists

Symmetree
Consulting Group

Mike Fenger and Associates

Strategies at a Glance

General Strategy	The focus of the 100 Mile TSA Silviculture Strategy over the next five years is to treat non lodgepole pine stands to improve midterm timber supply and to mitigate habitat supply impacts brought about by the mountain pine beetle epidemic and associated harvesting. The strategy aims to add volume to existing non Pl stands, bring managed stands online sooner or with more volume, reforest areas with no regeneration obligations, and improve the yields and stand structure in complex drybelt Fd stands. It also recommends that a site index adjustment project be completed, treatments be coordinated with a conservation or retention plan and that an inventory for species and ecosystems of conservation concern be completed prior to, or in conjunction with, planning of silviculture treatments.	
Working Targets	Timber Supply:	<u>Short term (0-20)</u> AAC uplift to level required to capture MPB mortality <u>Midterm (30-70 yrs)</u> Minimize the depth and duration of trough <u>Long term (70+yrs)</u> Maintain long term harvest level at or near the productivity capacity of the land base.
	Timber Quality:	<u>Midterm</u> (2% premium logs – house logs/peelers/MSR) <u>Long term</u> (5% premium logs – house logs/peelers/MSR)
	Habitat Supply:	<u>Short Term</u> - Stand and landscape level retention strategy developed (20% of THLB) for short term retention of environmental values. - 50% of impacted WTP / OGMA / RMA's/ or other retention areas reforested to reduced stocking levels where ecologically appropriate. - Increased levels of broad leaf trees on the land base. - Minimize loss of habitat for species of conservation and management concern. <u>Midterm and Long Term</u> - Recover, maintain or improve the amount of habitat for species of conservation and management concern (Ensure forestry practices do not make species status worse).
Major Silvicultural Strategies	Timber Supply 1. Planting of THLB sites with no reforestation obligations (TS5) 2. Late Rotation Fertilization of Non-Pl (Fd and Sx) (TS1) 3. Young Stand Fertilizations – focus is on Fd (TS2) 4. Spacing of clumped drybelt Fd stands (TS4) 5. Address backlog issues (NSR and impeded stands) (TS7a)	
	Timber Quality 1. Manage for larger logs (house logs/peelers) through long rotations in stands constrained by non-timber objectives (VQO's UWR, etc). 2. Manage for MSR lumber through acceptance of higher stand densities on a portion of the land base.	

Strategies at a Glance

Habitat Supply

1. Planting of impacted non-THLB areas with a habitat focus. (HS1)
2. Spacing/thinning in drybelt Fd stands (HS3)
3. Under-burning in NDT4 (HS5)
4. Rehabilitation of spur roads and landings (HS7b)
5. Manage tree species for diversity
6. Vary regenerated stand spacing
7. Complete inventories and planning required to maintain habitat of species and ecosystems of conservation concern.

Silviculture Program

Idealized funding level ($35.4 million over 5 yrs)

Areas and $'s

Activity	Year 1 (ha)	Year 2 (ha)	Year 3 (ha)	Year 4 (ha)	Year 5 (ha)	Totals (ha)
Studies/Surveys	-	-	-	-	-	-
Fertilize	2,550	2,100	2,100	4,100	14,100	24,950
Spacing/Thinning (timber)	500	2,000	5,000	5,000	5,000	17,500
Spacing/Thinning (habitat)	100	400	1,000	1,000	1,000	3,500
Planting (timber)	-	-	3,000	5,000	5,000	13,000
Planting (habitat)	-	-	1,000	1,667	1,667	4,333
Address Backlog	500	500	500	-	-	1,500
Underburning	200	200	200	200	200	1,000
Totals	3,850	5,200	12,800	16,967	26,967	65,783

Activity	Year 1 ($)	Year 2 ($)	Year 3 ($)	Year 4 ($)	Year 5 ($)	Totals ($)
Studies/Surveys	$ 130,000					$ 130,000
Fertilize	$ 1,020,000	$ 840,000	$ 840,000	$ 1,640,000	$ 5,640,000	$ 9,980,000
Spacing/Thinning (timber)	$ 300,000	$ 1,200,000	$ 3,000,000	$ 3,000,000	$ 3,000,000	$ 10,500,000
Spacing/Thinning (habitat)	$ 60,000	$ 240,000	$ 600,000	$ 600,000	$ 600,000	$ 2,100,000
Planting (timber)	$ -	$ 120,000	$ 1,800,000	$ 3,000,000	$ 3,000,000	$ 7,920,000
Planting (habitat)	$ -	$ 40,000	$ 600,000	$ 1,000,000	$ 1,000,000	$ 2,640,000
Address Backlog	$ 600,000	$ 600,000	$ 600,000	$ -	$ -	$ 1,800,000
Underburning	$ 60,000	$ 60,000	$ 60,000	$ 60,000	$ 60,000	$ 300,000
Totals	$ 2,170,000	$ 3,100,000	$ 7,500,000	$ 9,300,000	$ 13,300,000	$ 35,370,000

<u>Estimated Timber Supply Outcomes</u>

- 204,000 m^3 made available at the front end of the trough
  - Realized from late rotation fertilization
- 286,550 m^3 made available in the middle of the trough
  - Realized from young stands fertilization and thinning of drybelt Fd stands
- 1,674,167 m^3 made available in the back end of the trough
  - Realized mainly though planting of sites with no obligations, but also from addressing backlog areas and a small amount of fertilizing young Pl stands at the end of the 5 yr period.

If this level of funding was continued for 20 years ($142 million total) and similar benefits were achieved throughout, the midterm trough could almost be eliminated. If site index adjustments were also completed, the midterm trough would likely disappear and additional volume could be available.

<u>Estimated Habitat Supply Outcomes</u>

- 21,000 ha of improved stand structure in drybelt Fd stands (spaced/thinned), with 1,000 ha of this also under-burned, effective

Strategies at a Glance

during the front and middle of the habitat trough.
  - Realized in habitats, mostly inside the THLB, used by species and ecosystems of conservation and management concern.
  - Interface fire hazard reduction.
- 4,300 ha of habitat regenerated with habitat focus, and 13,000 ha with timber focus, effective at the back end of the trough and in the long term
  - Habitat focus realized in riparian areas, OGMAs and WTPs for use by species and ecosystems of conservation and management concern, for recovery of general biodiversity, and for restoration of stream channel morphology and watershed stability.
  - Rehabilitation of roads and landings
  - Most of habitat focus area is outside THLB, but within the CFLB (contributes to non-timber objectives). The timber focus area is entirely within the THLB.

Silviculture Program

Constrained funding ($7.0 million over five years)

Areas and $'s

Activity	Year 1 (ha)	Year 2 (ha)	Year 3 (ha)	Year 4 (ha)	Year 5 (ha)	Totals (ha)
Studies/Surveys	-	-	-	-	-	-
Fertilize	2,600	1,700	-	-	-	4,300
Spacing/Thinning (timber)	150	600	300	300	300	1,650
Spacing/Thinning (habitat)	30	120	60	60	60	330
Planting (timber)	-	-	1,000	1,000	1,000	3,000
Planting (habitat)	-	-	333	333	333	1,000
Address Backlog	100	100	-	-	-	200
Underburning	-	-	-	-	-	-
Totals	2,880	2,520	1,693	1,693	1,693	10,480

Activity	Year 1 ($)	Year 2 ($)	Year 3 ($)	Year 4 ($)	Year 5 ($)	Totals ($)
Studies/Surveys	$ 130,000	$ 160,000	$ -	$ -	$ -	$ 290,000
Fertilize	$ 1,040,000	$ 680,000	$ -	$ -	$ -	$ 1,720,000
Spacing/Thinning (timber)	$ 90,000	$ 360,000	$ 180,000	$ 180,000	$ 180,000	$ 990,000
Spacing/Thinning (habitat)	$ 18,000	$ 72,000	36,000	$ 36,000	36,000	$ 198,000
Planting (timber)	$ -	$ -	870,000	$ 870,000	$ 870,000	$ 2,610,000
Planting (habitat)	$ -	$ -	$ 290,000	$ 290,000	$ 290,000	$ 870,000
Address Backlog	$ 120,000	$ 120,000	$ -	$ -	$ -	$ 240,000
Underburning	$ -	$ -	$ -	$ -	$ -	$ -
Totals	1,398,000	1,392,000	1,376,000	1,376,000	1,376,000	6,918,000

<u>Estimated Timber Supply Outcomes</u>

- 25,700 m^3 made available at the front end of the trough
  - Realized from late rotation fertilization
- 68,510 m^3 made available in the middle of the trough
  - Realized from young stand fertilization and thinning of drybelt Fd stands
- 355,000 m^3 made available in the back end of the trough
  - Realized mainly though planting of sites with no obligations, but also from addressing backlog areas and a small amount of fertilizing young Pl stands at the end of the 5 yr period.

Strategies at a Glance	

	If this level of funding was continued for 20 years ($28 million total) and similar benefits were achieved throughout, the midterm trough could be reduced by ~20%. If site index adjustments were also completed, the midterm trough would likely be reduced even further.
	
	<u>Estimated Habitat Supply Outcomes</u>
	• 1,980 ha of improved stand structure in drybelt Fd stands (spaced/thinned), with no area under-burned, effective during the front end and middle of the trough.
	  o Realized in habitats, mostly inside the THLB, used by species and ecosystems of conservation and management concern.
	• 1000 ha of habitat regenerated with habitat focus, and 3,000 ha with timber focus, at the back end of the trough and in the long term
	  o Habitat focus realized in riparian areas, OGMAs and WTPs for use by species and ecosystems of conservation and management concern, for recovery of general biodiversity, and for restoration of stream channel stability and morphology.
	  o Most of habitat focus area is outside THLB, but within the CFLB (contributes to non-timber objectives). The timber focus area is entirely within the THLB.

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1.0 Introduction

1.1 About This Strategy

Type 1 Silviculture Strategies are currently being created or updated for most management units (TSA's and TFL's) in British Columbia's interior to provide a context for land base investment decisions. The strategies will help guide funding allocations between and within management units where that flexibility exists (i.e. Forests for Tomorrow and federal funds). One of the key motivating factors behind the completion of these strategies is the need to mitigate expected future impacts of the mountain pine beetle (MPB) epidemic and recent large scale fires in the interior of BC. More specifically, there is a need to improve midterm timber supply and mitigate impacts to environmental values.

A Type 1 silviculture strategy compiles existing information to identify issues related to timber supply, timber quality, and habitat supply in the TSA, and then engages stakeholders in a workshop setting to identify silviculture strategies/investments that can be used to address the issues[1]. The strategy is based on readily available information and the knowledge of local forestry and environmental professionals. These potential strategies will need to be quantified and/or refined in a more in-depth Type 2 analysis. The results of a Type 2 analysis will be a better guide for on the ground implementation.

Incremental silviculture is part of a suite of strategies, which together may influence the future quality and quantity of habitat and timber supply. This strategy document broadly analyzes the potential range of silviculture activities in order to identify priority treatments for an incremental silviculture strategy. An incremental silviculture strategy should not be confused with the allowable annual cut (AAC) determination process. AAC's are based on current practices at the time of the determination. This strategy is forward looking and is about creating desired future conditions for our forests. The degree to which the strategy proves appropriate and is achieved may influence future AAC determinations.

1.2 Methods

This strategy was prepared through the following process:

- Prior to the district workshop, Forsite and Symmetree prepared a background document, summarizing all available information relevant to a strategy and identified opportunities to improve the future quantity and quality of timber and habitat supply. Mike Fenger and Associates provided input on habitat related issues on behalf of the Ministry of Environment.
- A district workshop was held October 26th & 27th, 2005 in 100 Mile House, attended by representatives of the MoFR, MoE and forest licensees within the 100 Mile TSA. Bryce Bancroft of Symmetree Consulting Group Ltd and Cam Brown of Forsite Consultants Ltd. led the session. Mike Fenger and Associates represented MoE's interests in the workshop.

[1] These Type 1 silviculture strategies build upon those done in the late 1990s funded by Forest Renewal BC. See http://www.for.gov.bc.ca/hfp/silstrat/ for links to previous strategies.

- Participants reviewed the potential opportunities identified in the draft document and provided others as they were discussed. The outcome of the session was a regime table, complete with priorities.
- Two five year budget scenarios were developed; an idealized 'needs' budget, and a constrained 'historical' budget. The constrained budget forced participants to make choices between the identified strategies/opportunities.
- The consultants incorporated the results of the working session into this draft document and added forecasts of future harvest quantity and quality and of job outcomes.

1.3 Acknowledgements

We would like to thank all those who participated in the workshop, without their input this strategy would not have been possible. They are as follows:

Attendee	Affiliation
Guy Newsome	Ministry of Forests, Southern Region
Rocky Chan,	Ministry of Forests, Southern Region
Doug Harris	Ministry of Forests, 100 Mile District
George Williamson	Ministry of Forests, 100 Mile District
Rick Stock	Ministry of Forests 100 Mile - Stewardship
Wayne Nuyens	West Fraser
Kim Peel	Tolko
Roger Packham	Senior Ecosystem Biologist, MoE Cariboo Region
Mike Fenger	Mike Fenger and Associates (MoE representative)
Crispin Guppy	Mike Fenger and Associates (MoE representative)
Cheryl Delwisch	BCTS Planning Forester - Kamloops Timber Sales Office
Dawn State	BCTS Practices Forester - Kamloops Timber Sales Office

Mike Fenger and Associates provided summary information on habitat related issues prior to the workshop, participated in the workshop, and helped to craft this document.

The project was managed by Ralph Winter and Nigel Fletcher of the Ministry of Forests, Forest Practices Branch and funding was provided by Forest for Tomorrow BC.

1.4 Limitations and Assumptions

This strategy is focused on silviculture investments not covered by legislative obligations which can be completed over the next five years (2006-2011). Because of risks associated with the current MPB infestation, investments in Pl stands were avoided. After the MPB epidemic subsides, investment in Pl stands represents a significant opportunity to address many of the TSA's timber supply issues.

Timber supply modeling was not completed in this project and all timber supply projections are from existing published sources or have been estimated based on professional judgment. Sources are indicated with each graph.

This strategy was developed to reflect TSA needs and proposed strategies were not excluded because they did not fit within existing funding sources. The intent is for the TSA to use whatever funding sources are available to address those issues important to the TSA. The strategy itself is assumed to be funding independent.

2.0 Basic Data

This section provides a summary of basic TSA data that describes the land base and related issues. This information is included to provide context for the resulting strategies that are presented later in the document.

2.1 AAC History

Table 1 provides an overview of the AAC since 1981. Pulpwood Agreement 16 stands are included in the TSR2 THLB and have a partitioned cut of 112,000 m^3. Actual performance in the TSA has shown a significant undercut in PA16 (Avg. harvest of 21,000 m^3/yr). The PA16 harvest level and land base are treated as separate from the rest of the TSA until they are harvested for the first time – when they then become part of the regular THLB. Non PA16 licensees have been cutting PA16 stands, indicating the traditional sawlog THLB may be larger than assumed.

Table 1. Historical and current AAC (m3/year).

AAC Type	Pre-TSR (1981)	TSR1 (1996)	TSR2 (2001)
Conventional	1,250,000	1,250,000	*1,222,000
PA 16	0	112,000	112,000
Total	1,250,000	1,362,000	1,334,000

* Difference occurs because of the creation of woodlots since TSR1.

NOTE: An AAC MPB uplift has been applied for but has not yet been approved for the 100 Mile TSA.

2.2 Land Base Characteristics

Approximately 72% of the TSA is considered crown-forested land (Table 2), while 82.6% of this area is considered to be available for long term timber harvest (Figure 1).

Table 2. Land base area statistics

Description	Area (ha)	Area (%)
Total TSA Area	1,234,875	100%
CFLB	885,260	72%
Current THLB	731,027	59%
Long Term THLB	710,329	58%

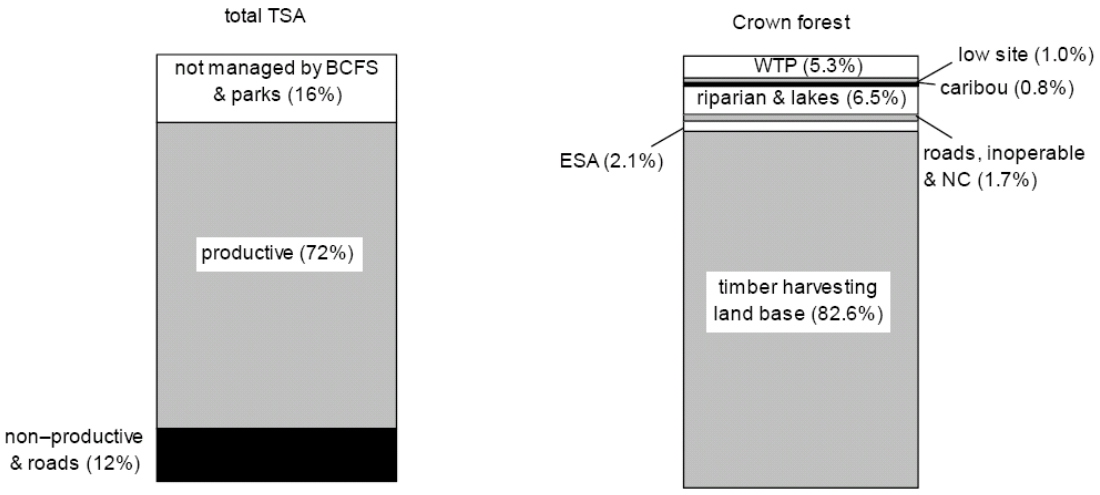


Figure 1. Total and crown forested land bases (TSR2-2001).

2.2.1 Species Profile

Within the THLB, the majority consists of mature Pl-dominated forests (Figure 2), which puts the TSA at high risk for MPB infestation.

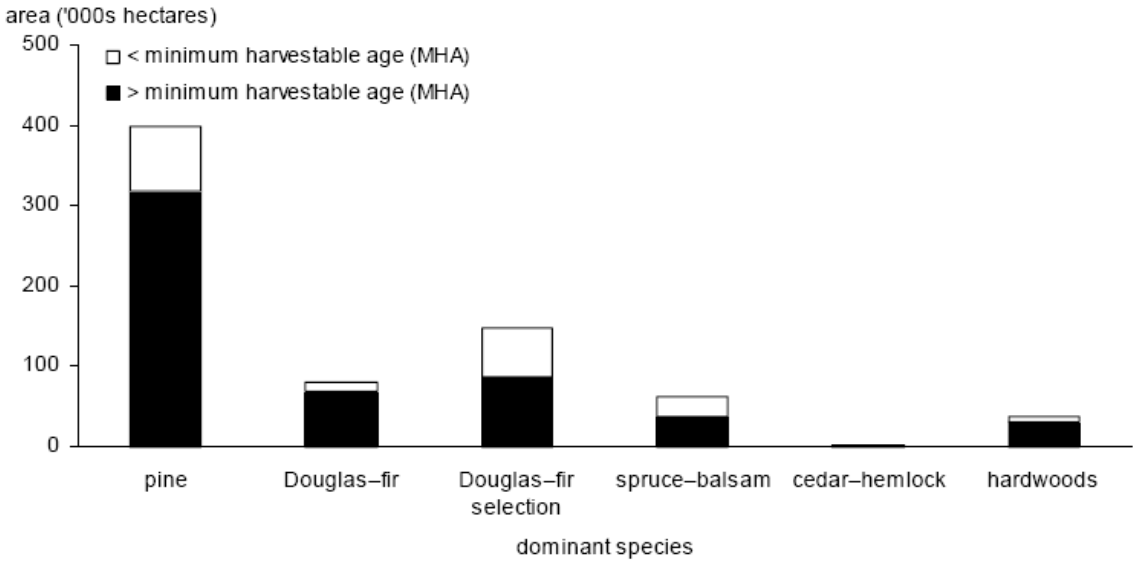


Figure 2. Tree species profile on the THLB (TSR2 – 2001).

Approximately 75% of the stands currently on the land base are older than minimum harvest ages (MHA) (Figure 3). This includes Pl stands where approximately 80% are older than their minimum harvest age (MHA). MHA's in TSR2 were relative young (40-80yrs) as they were based on achieving a 65m^3/ha minimum volume.

2.2.2 Age Class Profile

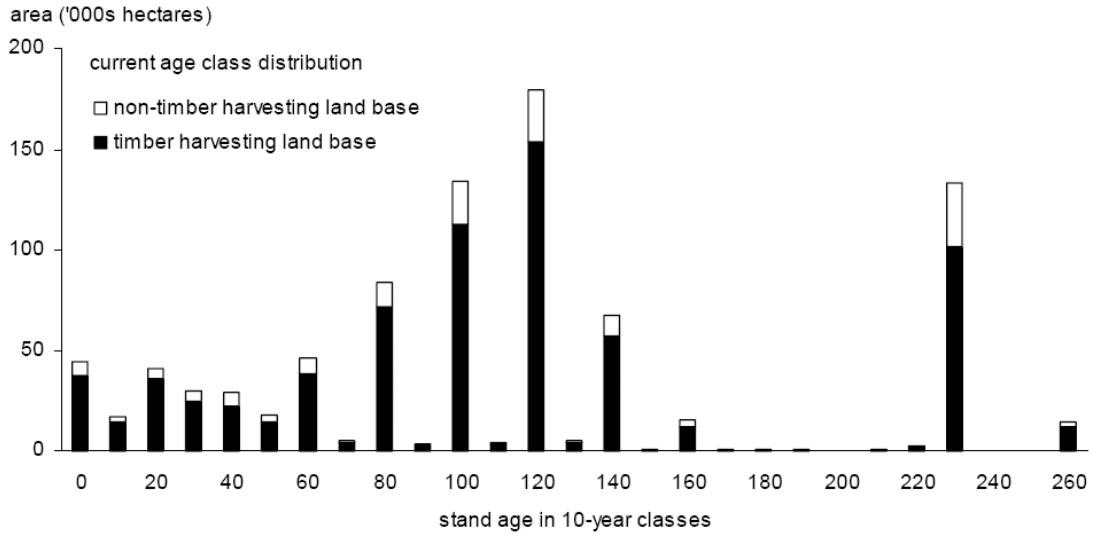


Figure 3. Age class distribution (TSR2 – 2001).

Approximately 70% of the THLB area is between ages 21-140 yrs.

2.2.3 Site Class Profile

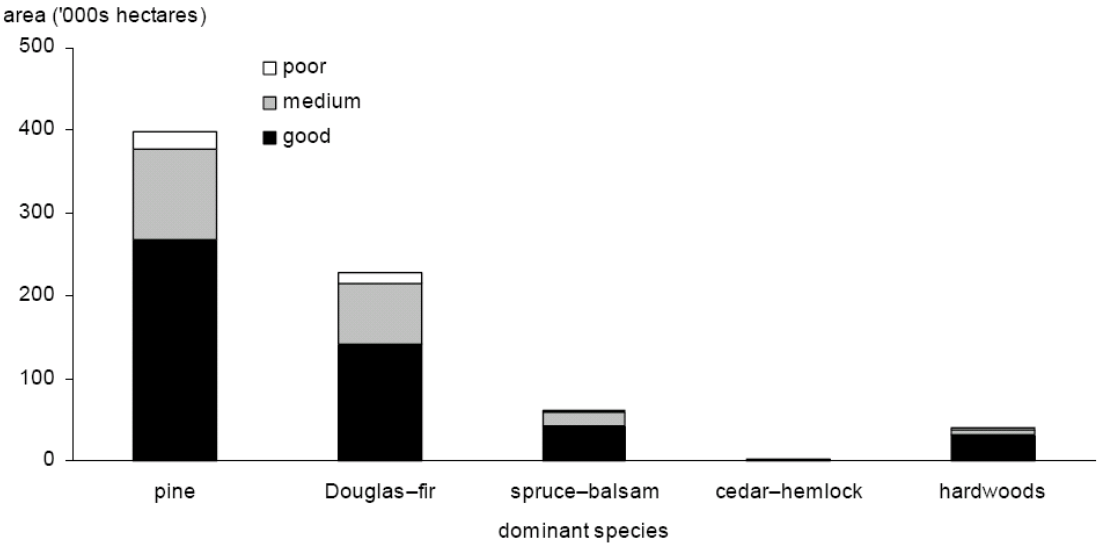


Figure 4. Site class profile (TSR2 – 2001).

Approximately 55% of the THLB is Pl-leading, with most of this area in good site productivity. Overall, 67% of the THLB is in good sites, with 28% in medium and 5% in poor (Figure 4).

2.2.4 Biogeoclimatic Profile

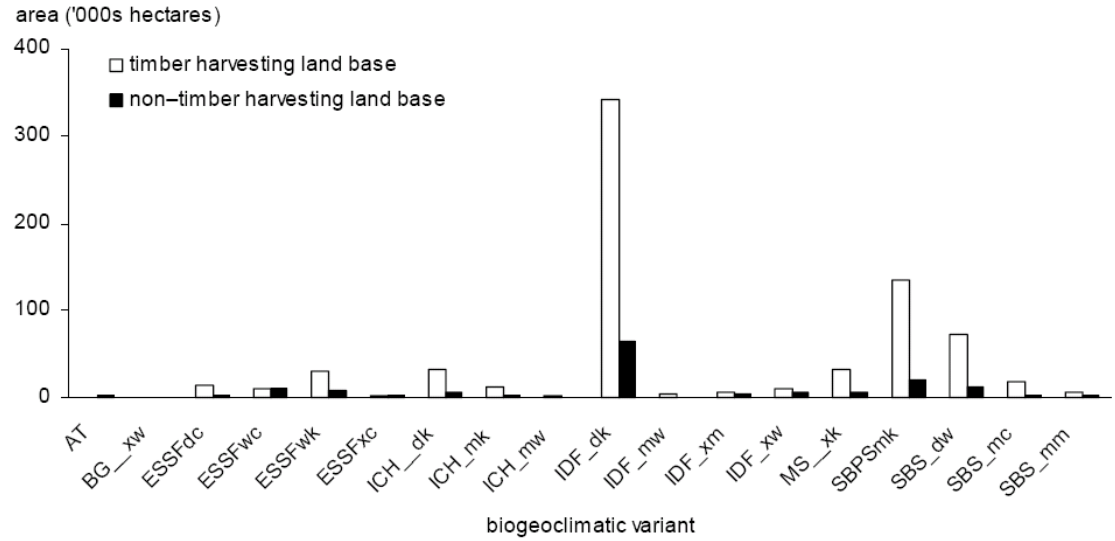
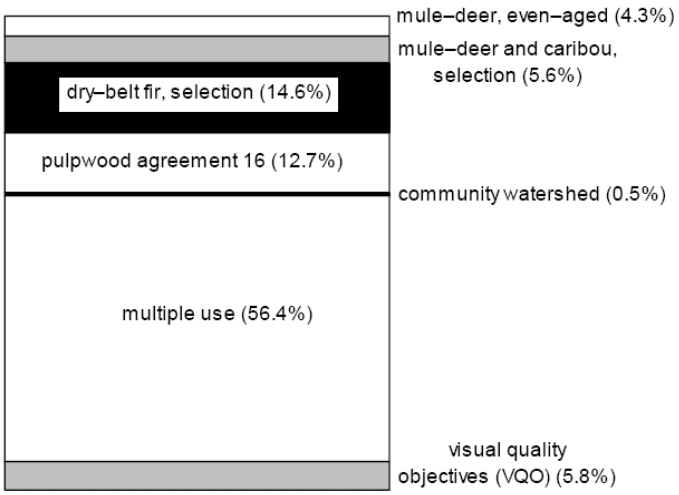


Figure 5. Biogeoclimatic profile (TSR2 – 2001).

The majority of the THLB falls within the IDFdk (47%), SBPSmk (16%), and SBSdw (8%) biogeoclimatic subzones (Figure 5).

2.2.5 THLB Management Emphasis



Note: All VQO's are treated as partial retention.

Figure 6. THLB management emphasis.

Selection harvesting is occurring on ¼ of the THLB.

2.3 Incremental Silviculture History

Table 3 shows the incremental silviculture conducted on the 100 Mile TSA over the past nine years. Juvenile spacing is the only treatment that has occurred. Spacing was focused on dense pine stands, many of fire origin. The total area spaced peaked in

1997 with approximately 2500 ha treated that year (FRBC funding), tailing off to a low of 15 hectares in 2003.

Table 3. Incremental silviculture history for the 100 mile TSA[2]

Year	Incremental Silviculture	Forest Investment Account	FRDA	Forest Renewal B.C. - licensee administered	Forest Renewal B.C. - ministry administered	Ministry Outstanding	Industry Outstanding	Total
1995		-	201	-	495	785	-	1,481
1996		-	-	-	1,110	-	44	1,154
1997		-	-	-	2,499	-	46	2,545
1998		-	-	972	738	-	-	1,710
1999	Juvenile Spacing	-	-	666	125	-	-	792
2000		-	-	500	81	-	-	581
2001		-	-	398	134	32	-	564
2002		-	-	26	57	-	-	84
2003		8	-	7	-	-	-	15
Total		8	201	2,570	5,239	817	90	8,924

2.4 Use of Select Seed

No gains from the use of improved seed were included in TSR2. 2005 seedling requests indicate that all Sx seed used is improved (3% gain), 60% of Fd seed used is improved (11% Gain), and 3% of Pl seed used is improved (3% gain). A higher proportion (34.6%) of Pl seedlings is considered B+ (typically a 3% gain).

Table 4 shows the forecasted gain for genetically superior seedlings from established seed orchards relevant to the TSA, as well as the forecasted availability. In general, projections show:

- Fd seedling gains of ~ 20% and full availability after 2007.
- Pl seedling gains of 8-12% after 2005, with limited availability until after 2025. B+ seed is available at 3% gain. Increased salvage harvesting (uplifts) focused on Pl stands will put further pressure on seed availability in the next 10-20 years.
- Sx seedling gains of 9-28% are projected after 2005, with only limited issues with availability predicted after 2005.

Table 4. Forecasted gain in volume and availability for improved seed for the 100 Mile TSA.

SPU	Elevation (M)	SPU Seedling Need (million)	Gain From Improved Seed/Availability								Gross SPU Areas *
			2005				2010		2015		
			Actual Gain	Actual Percent Class A used (%)	Projected Gain	Est. % Avail.	Projected Gain	Est. % Avail.	Projected Gain	Est. % Avail.	
FDI CT LOW	600-1200	0.9	11%	60%	20%	67%	20%	144%	20%	156%	264,540
FDI QL LOW	700-1200	0.5	21%		9%	60%	12%	160%	16%	220%	61,762
PLI PG LOW	700-1200	30	3%	38%	8%	12%	10%	34%	12%	62%	330,319
PLI PGN LOW	700-1400	33.7	-	-	8%	47%	10%	73%	12%	66%	5,233
PLI TO HIGH	1400-1600	5.3	-	-	11%	21%	14%	42%	16%	85%	18,587
PLI TO LOW	700-1100	13.6	-	-	9%	18%	12%	38%	13%	64%	25,698
SX PGN HIGH	1200-1900	8	5%	100%	12%	133%	13%	175%	14%	184%	42,474
SX PGN LOW	1-1200	26.4			24%	81%	28%	108%	28%	125%	325,531
SX PGN MID	1000-1500	4.5			7%	211%	12%	120%	14%	140%	163,062
SX TO HIGH	1300-1900	3.3	9%	100%	8%	73%	12%	118%	17%	124%	100,053
SX TO LOW	700-1300	1.2			9%	200%	12%	250%	22%	150%	570,049

* The gross SPU areas do not reflect THLB areas but rather reflect the total TSA coverage of each SPU. These SPU units also having overlaping areas.

Note: SPU seedling needs are based on the previous five year average and do not reflect forecasted needs. Availabltiy rating are as follows: Unlimited (100+%) available, 2= Very Good (75-99%), 3=Good (50-75%), 4=Limited (30-50%), 5=Severely Limited (<30%).

[2] This information was extracted from the RESULTS database (October 2005).

3.0 Mountain Pine Beetle Situation

Figure 7 illustrates the extent of the mountain pine beetle infestation in the southern interior as mapped from overview flights in 2004. Note the 100 Mile TSA is predominantly red, indicating high levels of infestation.

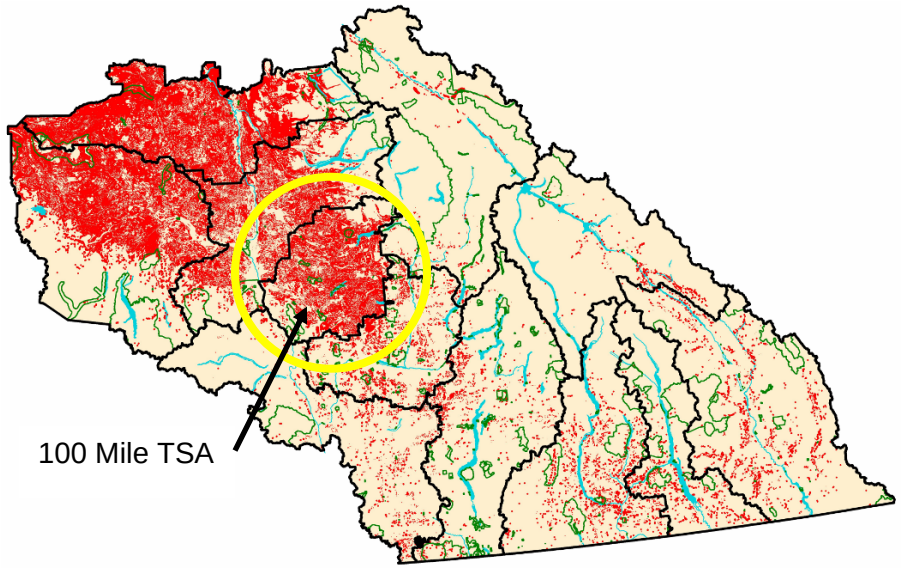


Figure 7. The extent of the mountain pine beetle infestation in the Southern Interior Region as mapped from overview flights in 2004.

Since pine leading stands make up at least 50% of the current mature growing stock in the 100 Mile TSA, the mortality associated with the current MPB infestation has severe implications on timber supply. Figure 8 shows the trend for yearly volume killed peaking in 2007 for this TSA at 6.9 million m^3 killed/yr.

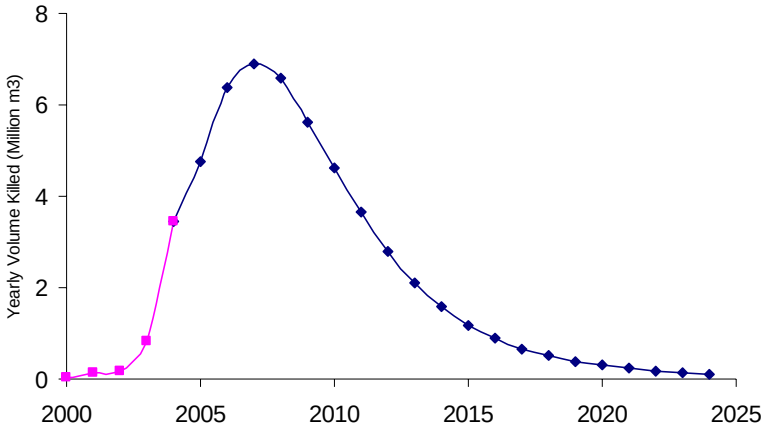


Figure 8. MPB killed volume trend (purple) and predictions of future trend (blue).

Table 5 shows projections of the cumulative pine volume killed by the MPB to 2020 (Marvin Eng 2005)[3]. These projections show a volume of 50 million m^3 killed by 2015 and 54 million m^3 killed by 2020.

Table 5. MPB infestation projections – cumulative volume killed to 2020 (m^3) (from Eng 2005).

		Projection Year							
		2005			*2010*			2015	2020
	Current AAC	Total Effected Area	Equivalent area dead	Equivalent volume dead	Total Effected Area	Equivalent area dead	Equivalent volume dead	Equivalent volume dead	Equivalent volume dead
THLB > 60 years	1,334,000	433,459	62,212	9,682,229	452,058	204,722	33,692,895	50,944,288	53,692,304

*

4.0 Current TSA Situation

4.1 Timber Supply Issues

4.1.1 TSR2 Base Case Harvest Forecast

Figure 9 shows the base case scenario from TSR 2 in 2005. This forecast does not consider the exponential expansion of the MPB that has occurred on the TSA since TSR2 was completed. As a result of the MPB, the timber supply outlook for this TSA will be drastically different.

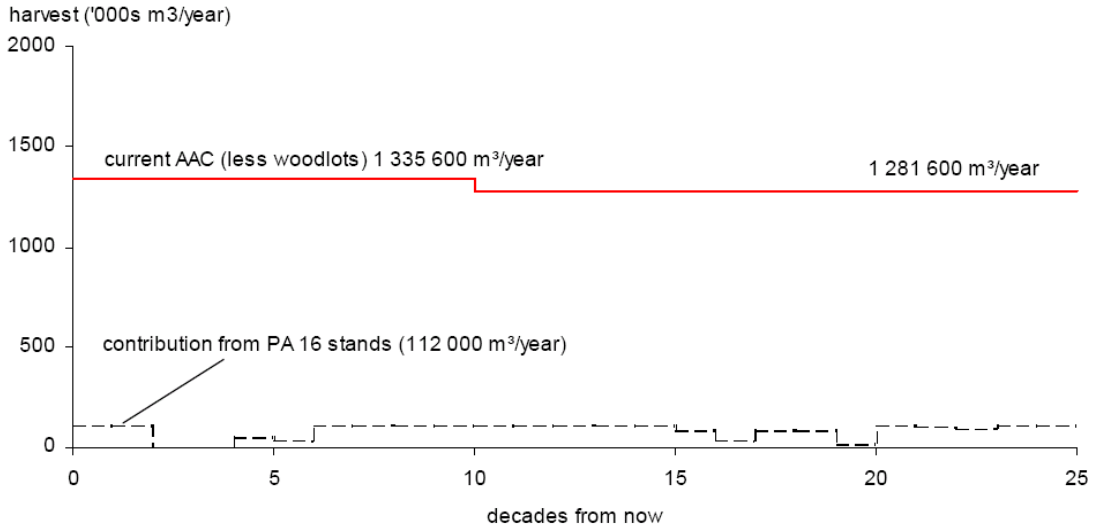


Figure 9. Current harvest forecast (TSR2 – 2001).

Total growing stock on the THLB is approximately 100 million m^3 and the vast majority of this volume is currently merchantable (older than min harvest age). This existing growing stock is metered out until decades 9-10 where managed stands begin to make up the majority of harvest volume (Figure 10). Decades 7-8 are the pinch points in this

[3] Provincial-Level Projection of the Current Mountain Pine Beetle Outbreak: An Overview of the Model (BCMPB v2) and Results of Year 2 of the Project.

analysis (lowest periods of available timber). No midterm trough occurs because the large stock of mature timber allows managed stand volumes to accrue before they are required.

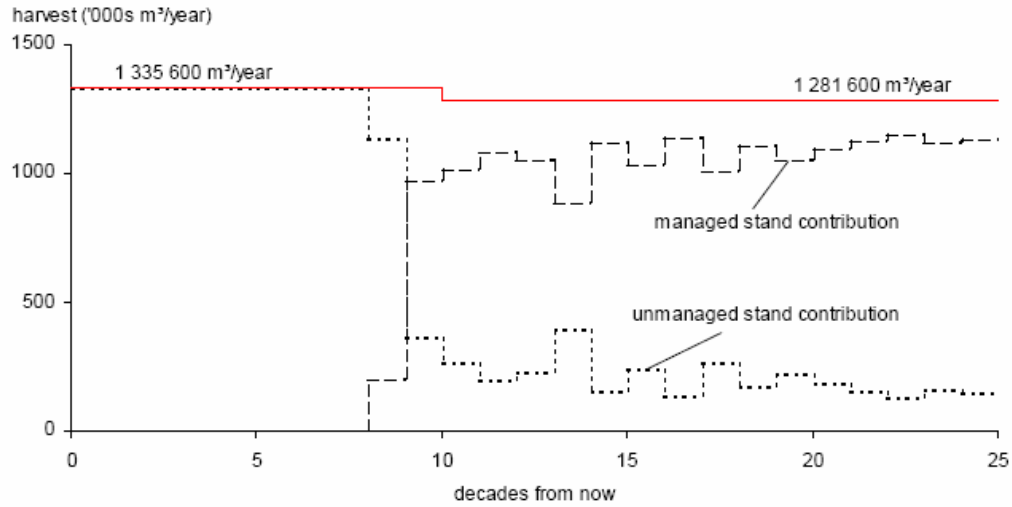


Figure 10. Harvest contribution from managed and unmanaged stands (TSR2 – 2001).

4.1.2 Timber Supply Projection Including MPB Impacts

Figure 11 shows a possible harvest flow scenario based on the above mortality projections and a hypothetical AAC uplift. In this scenario, harvest levels are increased to 2.5 million m³/yr for the next two decades to capture the vast majority of beetle killed volume and then they fall significantly to 1 million m³/yr for the next six decades.

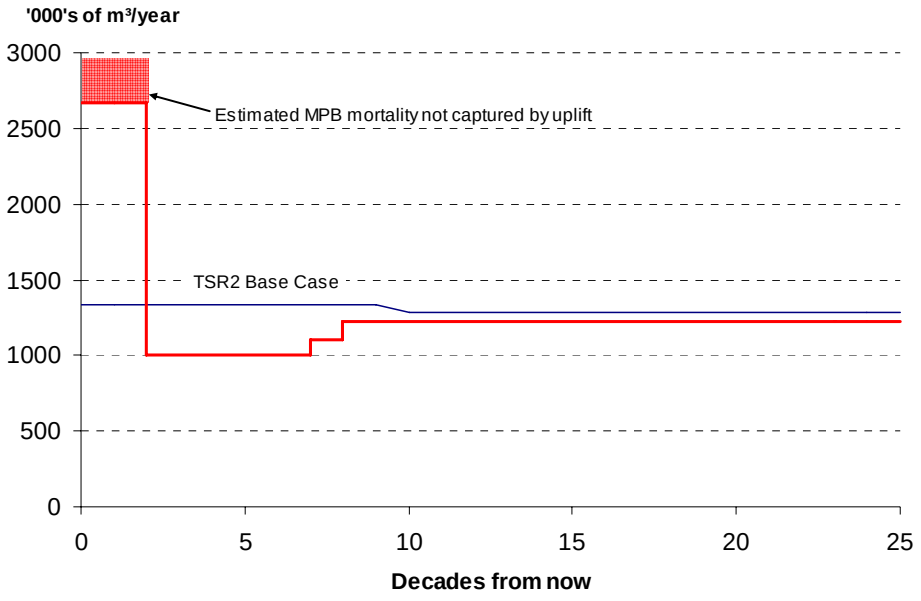


Figure 11. Possible outcome of current MPB infestation reflecting a hypothetical uplift.

Assumptions:

- 54 million m^3 killed by 2015 (10 yrs from now) and volume will have a shelf life of 10 yrs. Thus, need to capture 54 million m^3 in 20 yrs = 2.7 million m^3/yr. The actual AAC required would be higher because of by-catch but not all areas will be salvaged. We can assume that at least 10% will not be salvaged for a wide range of reasons (estimated at 5.4 million m^3 or 3-4% of the THLB area).
- The current AAC is doubled to 2.65 million m^3 for 20 years and harvest is focused exclusively on Pl stands. This will capture 90% of the killed volume, leaving only those stands that were unsuitable for salvage.
- The increased harvest level liquidates the existing mature growing stock and causes a shortfall in available timber in the subsequent 50 years (until managed stand volumes start to come online in significant numbers). The trough is an equivalent volume to that taken in the uplift (best case scenario).

Timber supply issues to be addressed:

1. A midterm timber supply trough will begin approximately 20 yrs from now and could be 25% below TSR2 projections for the same time period.
2. A long term harvest level that is that is 3-4% below TSR2 projections because unsalvaged areas reforest with reduced productivity or do not reforest for extended periods.

4.2 Timber Quality Issues

The current provincial target for premium sawlog production is 10% of a TSA's AAC. Premium sawlogs in this TSA are considered to be house logs, peelers, or logs that will produce MSR lumber and is presently estimated at less than the 10% provincial target.

In general, the average age of harvested stands is declining over time as we move into the harvest of shorter rotation second growth managed stands. The midterm timber supply deficit caused by the MPB will accelerate this trend because very young managed stands will be the primary source of harvest toward the end of this period. As a result, timber quality will decrease during the deficit period along with average piece size.

Timber quality issues to be addressed:

1. Declining piece size and reduced potential for MSR lumber with shorter rotations.

4.3 Habitat Supply Issues

Pressures on the environment will come through direct impacts of pine mortality due to the MPB epidemic and indirect impacts of pine and non-pine mortality due to salvage logging and efforts to minimize reductions in AAC during the "fall down" period. The loss of mature and old forest (pine and pine mixed with other species) over the next 5 – 10 years will have significant impacts on associated aquatic and terrestrial values. Silviculture treatments can reduce environmental impacts.

Significant planning has taken place in the area through the CCLUP to minimize impacts of forest harvesting on environmental values. In some cases, due to changes caused by

MPB, the plans are no longer pertinent and require re-evaluation. Specifically, environmental values managed for under the CCLUP and in the Forest and Range Practices Act are being adversely impacted, such as:

- General Biodiversity – old and mature seral objectives; mature/old forest connectivity and patch size objectives
- Parks
- Visual Quality Objectives
- Tourism/Wilderness Objectives
- Mule Deer Winter Range Objectives
- Lakeshore Management Zone Objectives
- Riparian Reserve Zones
- Wildlife Habitat Areas
- Caribou Habitat
- Wildlife Habitat Features
- Community Watersheds
- Water quality/fisheries values for all watersheds, and especially identified watersheds (Bridge Creek, Bonaparte River)
- Species and ecosystems of conservation concern, including Species at Risk

Two natural disturbances types (NDTs) characterize the area where pine and fir forests dominate in the 100 Mile TSA (Biodiversity Guidebook 1995).

1. NDT 3 (Ecosystems with frequent stand-initiating events)

   Absence of fires has increased the mature and old pine component, which provides the MPB a higher than natural level of host trees. Maintaining or increasing tree species diversity by maintaining spruce, Douglas-fir and aspen not affected by MPB reduces risk to future timber and wildlife values.

2. NDT 4 (Ecosystems with frequent stand-maintaining fires).

   Absence of understorey fires has resulted in a high level of in-growth, resulting in unnaturally high density (especially in the understorey) Douglas-fir stands. There is also concern that catastrophic wildfires may occur due to the high fuel accumulations associated with dense stands, and a shift from ground fires to crown fires. Silviculture spacing in these stands improves habitat and reduces risk of wildfires. Forest biodiversity requirements for old and mature forest dependent species will be adversely affected by the large decline of old and mature seral forest. Table 6 lists representative examples of wildlife species in the 100 Mile TSA that could be negatively affected by MPB salvage logging.

Table 6. Old and mature forest dependent species.

Species/ ecosystems	Forest dependency	Habitat supply implications
Bull trout	Cool streams	Hydrologic recovery, riparain condition, green up
Salmon	Water quality/quantity	Hydrologic recovery, green up
Lewis's woodpecker	Stand structure	Mature trees, aspen, mature/old deciduous
Flammulated owl	Mature/old forest	Old forest habitats
Great Blue heron, herodias subspecies	Mature/old forest	Mature/old stands
Northern goshawk	Mature/old forest	Larger mature/old forest stands
Grizzly Bear	Road sensitive	Access management, road rehabilitation
Fisher	Stand structures, CWD	Continuity of habitats across landscape

	Landscape connectivity	through time
Pine Marten	Stand structure overstory plus CWD Landscape connectivity	Continuity of habitats across landscape through time
Moose	Riparian condition Mature conifer forest	Thermal and hiding cover
Mule Deer	Old forest and understory	Old forest stand structures
lodgepole pine - clad lichens - juniper haircap moss	Mature/old seral stage	Specific soil type/structure and moisture regime; specific sites Mature/old forest stand
lodgepole pine / common juniper - falsebox		
lodgepole pine / falsebox / pinegrass		
lodgepole pine / Labrador tea - velvet-leaved blueberry		
ponderosa pine / bluebunch wheatgrass		
ponderosa pine / red three-awn		
Douglas-fir - lodgepole pine / clad lichens		
Douglas-fir - ponderosa pine / bluebunch wheatgrass		
Douglas-fir - ponderosa pine / bluebunch wheatgrass - pinegrass		

The significant loss of mature/old Pl-dominated forest stands will influence riparian ecosystems through changes such as higher water tables, increased erosion due to increased peak flows, increased late summer drought, decreased shade, increased standing dead trees (short term), increased large woody debris (midterm), and eventually decreased large woody debris (long term). Aquatic ecosystems will be affected by warmer water, changes in flow patterns, channel morphology changes, and increased sediment concentrations. There will also be landscape level watershed effects, including increased peak flows and decreased low flows. Increased road access is a major concern because of the potential to exacerbate higher rates of run-off during the freshet and after major storms during the growing season. Roads provide access for people and livestock, both of which can negatively affect wildlife and ecosystems. Existing issues, such as culverts that block fish passage or are historically undersize and hence may not be able to handle higher peak flows, could be made worse with pine mortality and increased harvest levels. Rehabilitation of roads and landings increases the size of the THLB and benefits species sensitive to disturbance.

There is specific concern regarding where conservation retention areas will be located, should an AAC uplift be approved. The immediate preparation of a comprehensive retention plan is required to ensure that habitat and timber resources are managed effectively. This includes protection of riparian systems and maintenance of mixed wood stands. Suitable areas should be identified as part of the retention plan for specific species or species guilds, such as nesting birds and furbearers. There may be an opportunity to utilize Predictive Ecosystem Mapping (PEM) together with the habitat requirements for the species to identify those ecosystems to be maintained as part of the retention plan.

Improving hydrologic green up in community watersheds is a priority. This can benefit both timber and water quality because when reforestation is done both future timber production is improved and short-term hydrological and habitat impacts mitigated. However, care must be taken that the reforestation is done in a manner that does not adversely impact the community watershed in the short term.

For this TSA approximately 130 species have been identified by the Conservation Data Centre as being of conservation concern, including rare plant communities (ecosystems). For the purposes of the silviculture strategy, most will not be strongly affected by the MPB epidemic or the associated harvesting or incremental silviculture. Of those that are affected, most do not have to be considered individually, for example salmon, bull trout and rainbow trout could be considered together for any type of treatment plan, as can pine-leading rare ecosystems. Specific management strategies should be developed for rare species and ecosystems that do not presently have approved strategies, including mechanisms to determine their presence in an area to be treated.

On sites that can support species other than pine, increasing tree species diversity will provide short, mid- and long term environmental values.

5.0 Summary of TSA Issues by Period

5.1 Short term

No timber supply issues exist in the short term as the current AAC will be maintained or increased to salvage MPB impacted wood. Forest Analysis Branch is currently working on an uplift analysis for the TSA. Timber quality will remain relatively constant with historical levels, although a higher proportion of Pl is expected.

Habitat supply issues exist in the short term as a result of an AAC uplift and salvage and/or MPB mortality. Pressure will be put on habitat values and watersheds by elevated harvest levels, loss of older Pl stand types, and increases in the amount of active road.

5.2 Midterm

The midterm is likely to experience significant reductions in timber supply. Salvage harvesting will have ended and harvest will be focused on remaining mature non Pl stands. Harvesting of these currently existing natural stands will occur in the front and middle portions of the midterm trough, while the back end will be made up of the first managed stands coming online. These stands will be very young and have small piece size, and thus will put intense pressure on the log quality profile.

The supply of habitat needed to maintain current fish and wildlife populations and maintain biodiversity complexity will be at high risk because the remaining mature and old forests will be diminished in extent and fragmented in distribution. In addition, it is expected that remaining mature and older forests will be under pressure to provide timber harvesting opportunities. At the start of the midterm, many watersheds will have high ECA's from the impacts experienced in the short term and further harvesting will create significant hydrological risks. In addition, some of the tools originally designed to help maintain biodiversity will have been severely impacted by MPB (OGMA's, WTP's, Riparian Areas, Parks, etc). Even areas left unharvested and untreated will go through a period where there is little remaining CWD. Species such as pine marten will find little suitable habitat. Only the live tree species left today will be available to bridge the midterm habitat supply gap.

5.3 Long term

Long term harvest levels are projected to be above midterm levels but below the potential shown in TSR2 because of poor or no regeneration on MPB impacted sites that have no reforestation obligations. Long term harvest levels are most sensitive to the size of the THLB, and the productive capacity of the land base. A site index adjustment project is necessary to update the inventory data to better reflect the growth potential of regenerating stands and understand the long term capacity of this land base.

Timber quality may improve over that experienced at the back end of the midterm trough but it will remain depressed relative to current levels because of short rotations and focus on volume production.

Environmental values, including habitat quality and quantity, will likely have recovered somewhat from the worst period near the front of the midterm trough, but will remain under pressure indefinitely due to an extensively roaded land base growing timber on short rotations (50-100 yrs). In addition, climate change has the potential to change ecosystems and species habitats in dramatic ways in the long term.

6.0 Opportunities to Address TSA Issues

Prior to the district workshop, background information was used to identify the following silvicultural strategies as having potential to address timber and habitat issues at the TSA level. Each of these potential strategies was discussed during the workshop to clarify or refine them and/or add new strategies. Each strategy was assigned an effective opportunity area based on data and local knowledge. The impact on Timber Supply, Quality and Habitat were estimated and each strategy was given a ranking of High, Medium or Low in addressing the three targets summarized in Table 7.

Table 7. Summary of potential silviculture strategies to address TSA issues.

Strategy	Opportunity in Next 5 yrs (ha)	Timber Supply Effects			Quality	Habitat	Cost/ha ($)	Rank
		Short	Mid	Long				
TS1a-b. Late rotation fertilization (40-80yrs old) non Pl	17,000	++	++		+	+/-	400	H
TS1c-d. Late rotation fertilization (81+yrs old) non Pl	44,000	+	+		+	+/-	400	H[4]
TS2. Young stand fertilization (non Pl)	9000		+++		+	++	400	H
TS3. Space/fertilize repressed Pl	250			++			400	L
TS4. Spacing (drybelt Fd)[5]	25,000		++	+++	++	++	600	H
TS5. Planting THLB sites with no reforestation obligations (timber focus)	25,000		+	+++		+++	1000	H
TS7a. Address Backlog Issues	1500		+	+		-	1200	H
TS7b Rehab roads and landings	100		+	+		++	5000	L
TS8 BTK spraying	80,000	++	++	++	++	++/--	23	H[6]
TQ 1 Pruning	10,000				++	++	800	L
HS1. Planting NonTHLB sites with no reforestation obligations (habitat focus)	5000					+	1000	H
HS3. Spacing/thinning in NDT4 (ingress/encroachment)	5,000		+	+	++	++	600	H
HS5 Under-burn in NDT4	20,000					++	300	M
HS7b. Rehab roads and landings (habitat focus)	100		+	+		++	5000	H[7]

The following sections provide additional detail on the potential strategies.

[4] High on a trial basis only.
[5] All spacing and planting prescriptions would incorporate habitat direction where applicable.
[6] Considered a high priority to allow for timely recruitment of Fd over time. Has both positive (maintained structure) and negative potential effects (mortality of non target Lepidoptera species, and impacts on rare species using the budworm as food source) on biodiversity. Budworm mortality of some understorey fir will help to achieve HS3. Careful planning must accompany use. While this is given a high priority, funding is to come from outside this strategy.
[7] MoE expressed a high ranking for this as a means of restricting access in areas with significant roading to address salvage. A functioning access management plan is desirable, with an option to rehabilitate roads and landings to restrict all motorized traffic.

6.1 Potential Strategies to Improve Timber Supply

The following table (Table 8) provides detail regarding potential timber supply strategies. It reflects discussions within the workshop and is meant to add clarity around the strategy and how it was ranked.

Table 8. Timber supply strategies.

Strategy	Workshop Comments / Discussion	Anticipated Benefits	Timing of Benefit
TS1a-b Late rotation fertilization of near mature Fd and Sx stands (wetbelt stands 40-80yrs old)	These stands will be candidates for harvesting near the front end of the trough. The intent is to add volume to these stands to reduce the depth of the front end of the trough. Focus is Fd stands first as it has a greater response than Sx. Moisture limited sites (drybelt) should be avoided. Priority = High (one of the few opportunities to influence the front end of the trough)	Fd -17m^3/ha per application.[8] Sx -11 m^3/ha per application. Benefit realized over 10 yr period.	Short to Midterm
TS1c-d Late rotation fertilization of older Fd and Sx stands (wetbelt stands 81-140yrs old)	These stands will be candidates for harvesting near the front end of the trough. The intent is to add volume to these stands to reduce the depth of the front end of the trough. Moisture limited sites (drybelt) should be avoided. Priority = High as a trial. Response is less certain as data is limited on treating older stands; therefore a trial is suggested for stands at the younger end of the range.	No North American data but response could be similar to younger stand benefits described above.	Short to Midterm
TS2 Young stand fertilization (Fd and Sx)	These stands will be candidates for harvesting in the mid-back end of the trough. The intent is to add volume to these stands more quickly through several fertilizations at 10 yr intervals. This will make these stands available sooner or have more volume at time of harvest. Moisture limited sites (drybelt) should be avoided. Priority = High. The intent is to focus on Fd first and Sx as a trial, some concerns around terminal weevil. *Once the risks associated with MPB are reduced, treatment of younger Pl stands will become a high priority with very large potential benefits.*	Fd - 17m^3/ha per application. Sx - 11 m^3/ha per application. Benefit realized over 10 yr period.	Back end of Midterm
TS3 Space and fertilize repressed Pl	Several recent small scale studies have shown spacing and fertilization of these stands has the potential to break them out of their stagnant condition and differentiate. Priority = Low due to the small potential treatment area.	Bring stands back into the THLB (~150m^3/ha) or improve their merchantable volume (~100 m^3/ha).	Mid to Long Term
TS4 Spacing (drybelt Fd)	Spacing in layer 3 to thin out stagnant thickets will help to realize more merchantable volume in subsequent entries. Some stands will also require treatment of layer 2 into order to achieve the objective. Priority = High – lots of potential area and both timber and non-timber benefits achieved (habitat, urban interface fuels reductions, etc)	It was assumed that an additional entry into the stand would be possible if treatment occurs (15-30m^3/ha).	Mid to Long Term

[8] Rob Brockley, pers comm., August 2005. More detailed provided in Fertilization Backgrounder, Forsite et al. 2005. BC interior data on Fd and Sx data is unpublished. Published Pl data for the BC interior is showing average response of 12m3/ha per application (Brockley 2001).

Strategy	Workshop Comments / Discussion	Anticipated Benefits	Timing of Benefit
TS5. Planting THLB sites with no reforestation obligations (timber focus)	Ensuring that all of the THLB is promptly regenerated will have significant timber supply and habitat supply benefits. Candidate areas are stands killed by MPB and/or other natural mechanisms and not salvaged, or areas that are salvaged and have no reforestation obligations on them (i.e. small scale salvage). Planting under dead stems may be an option if done quickly - need to work with WCB to allow access – although there is concern over future access for other treatments (spacing, brushing, etc). Planning will be needed to identify suitable areas and approaches. Priority = High. One of the most cost effective ways to improve timber supply and habitat supply. Habitat supply would benefit most from regeneration in highly impacted/ high risk watersheds.	Maintain productivity of the THLB	Mid to Long Term
TS7a. Address Backlog Issues	Maintaining existing backlog plantations and/or rehabilitation backlog NSR sites is an activity already underway with the MoF in 100 Mile District. Flights and imagery are being used to identify candidate sites for treatment (brushing, fill planting, etc). Assumption is that 20% of area classified as backlog will require treatment. Priority = High (where economics make sense)	Maintain productivity of the THLB.	Mid to Long Term
TS7b Rehab roads and landings	This treatment is aimed at putting more ground into timber production. Also has habitat benefits as the around or open road is seen as a major problem. Priority = Low because of high cost and poor tree growth on these sites. Better to focus efforts on not creating as much road in the first place and/or develop an access management plan.	Increase the size of the THLB	Mid to Long Term
TS8 BTK spraying	This treatment is aimed at protecting stands for other strategies (e.g., spacing of Fd stands) and maintaining volume for use in the midterm trough. The key is to target wisely – moderate to high incidence areas and give consideration to impacts on non target Lepidoptera species, and rare species using the budworm as food source. Priority = High	Maintain existing volume in non Pl stands.	Short and Midterm

6.2 Potential Strategies to Improve Timber Quality

The following table provides detail regarding potential timber quality strategies discussed in the workshop.

Table 9. Strategies to improve timber quality.

Strategy	Workshop Comments / Discussion	Anticipated Benefits	Timing of Benefit
TQ1. Pruning	Clear logs were not a priority for the TSA thus pruning was not deemed an economically suitable treatment at this time.	NA	NA
TQ2. Manage for long rotations	This option does not fit with the objective of managing for a midterm trough. It may be an option where harvest is constrained by non timber objectives that force longer rotations (VQO,s MDWR, etc).	Larger piece sizes, diversity in log products.	Long Term
TQ3. Manage for Higher Densities on a portion of the land base	This was seen as a possible option but must be coordinated with other options that are promoting shorter rotations to fill the midterm trough.	MSR grade timber	Long Term

6.3 Potential Strategies to Improve Habitat Quality

The following table provides detail regarding the potential habitat supply strategies discussed in the workshop.

Table 10. Strategies to improve habitat quality.

Strategy	Workshop Comments / Discussion	Anticipated Benefits	Timing of Benefit
HS1. Planting NonTHLB sites with no reforestation obligations (habitat focus)	Reforestation of non-THLB areas impacted by MPB or other natural disturbances can improve habitat quality. The intention is to plant trees and/or shrubs with a habitat focus (use of broadleaves, diverse spacing, etc). Intent is to treat without removal of dead stems so there is a need to address this quickly by working with WCB to allow access. Potential candidate areas include heavily impacted parks, riparian reserves/management zones[9], WTP's, and potentially OGMA's. Priority = High	Improved habitat quality hydrologic recovery, improved recovery of pine dominated riparian for shade and reductions in stream temperature,	Continuous
HS3 Spacing (drybelt Fd)	An integrated strategy incorporating timber and habitat objectives is needed. Focus on cover objectives (e.g., MDWR) and/or removal of ladder fuels from a habitat perspective. Habitat specific treatments would aim to reduce ingress / encroachment in historically open stands. Priority = High	Improved stand structure in drybelt Fd types. Reduced crown fire risk, a shift back towards stand structures with a range of natural variables (less stems and more undersotry)	Short to Midterm
HS5 Under-burn in drybelt Fd	Areas that have been spaced and/or currently open stands require under-burning to develop 'natural' stand conditions. Not a lot of stands currently available but could start areas now. Priority = High	Improved stand structure in drybelt Fd types.(same benefits as above)	Short to Midterm
HS6 Rehab roads	Restrict access to areas by rehabilitation of dead-end spurs in blocks and landings – especially large landings. Other roads should be looked at within a coordinated access plan. Priority = High	Road density reduced, less access for predators and human disturbance.	Continuous

6.4 General Stewardship Strategies

The following table provides a list of general strategies that will assist in meeting the TSA's issues (timber supply / timber quality, habitat supply) but are not considered incremental silviculture strategies because they:

- fall under basic licensee silviculture obligations, or
- are considered outside the scope of a silviculture strategy (i.e. harvesting practices), or
- are information gathering requirements.

[9] Restoration of riparian ecosystems associated with the following areas will be key: fish bearing streams, wetlands, temperature sensitive streams, and community watersheds.

Table 11. General stewardship strategies.

Strategy	Workshop Comments / Discussion
1. Minimize regen delay	Decrease regeneration delay and get stands online sooner. Planting instead of relying on naturals may be considered in some ecosystems in the TSA. MoE does not want planting to reduce biological complexity.
2. Utilize improved planting stock (best available) whenever possible.	Get stands online sooner or with more volume.
3. Protect growing volume for use in the midterm. (Non Pl species in mature stands and/or advanced regeneration)	Avoid harvest of non Pl during salvage period as this directly affects the midterm trough in wood and habitat supply Retain areas with advanced regeneration as this affect the long term habitat and wood supply. Need to keep green timber growing and available for deficit period (midterm).
4. Improve forest cover inventory.	Previous work indicates that inventory volume estimates are poor in the NDT4. (TSA may be 11% overestimated, NDT4 may be 25% overestimated)
5. Complete a site index adjustment project.	Adjusting site indexes in the inventory to reflect managed stand potentials will have the single biggest impact on timber supply of any strategy discussed in this report.
6. Better define growth and yield predictions for complex stands (drybelt Fd).	Yields for sites under selection management may be underestimated.
7. Look to change stocking standards / free growing standards to include more broadleaves.	Inclusion of broadleaves will provide habitat benefits and will diversify the future log products available to the forest industry.
8. Inventory for locations of species and ecosystems of conservation concern.	In order to manage for these species we need to understand where they are or where they are likely to be. This knowledge is required, in part, to ensure that funded incremental silviculture activities do not adversely impact these species and ecosystems.
9. Develop a forest health strategy	Need a coordinated strategic look at how to address forest health concerns beyond MPB.
10. Vary stand densities	Don't do same thing everywhere. E.g., Tom Sullivan's work – there are certain habitat benefits with lower densities – 1000 sph.
11. Complete a retention strategy to guide salvage operations	Intent is to identify stand level retention objectives and landscape level areas for retention that will guide salvage operations. The planting strategies identified in Section 6.1 will require the completion of this plan in order to identify areas that will not be salvaged. The workshop identified this as a challenge because of the potential for alternative licenses being let for non-traditional salvage operations (i.e. Pellet fuels).

7.0 Working Targets

The following working targets were created using the current TSA situation as outlined in this document. The targets reflect what the TSA would like to achieve through the implementation of this silviculture strategy. It is recognized that it may not be possible to achieve all of the targets because of limited budgets or conflicts between targets, but they are presented to help frame high level objectives of the TSA.

7.1 Timber Supply Targets

Short Term (0-20)

- AAC uplift to a level required to capture most of the MPB mortality.

Midterm (30-70 yrs)

- Minimize the depth and duration of the midterm trough.

Long Term (70yrs+)

- Maintain long term harvest level at or near the productive capacity of the land base.

7.2 Timber Quality Targets

Midterm

- 2% premium logs – house logs/peelers

Long Term

- 5% premium logs – house logs/peelers

Overall the intent is favour timber supply strategies over quality strategies where resources are limited.

7.3 Habitat Supply Targets

Short Term

- Retention strategy developed (20% of THLB)
- Reforest 50% of WTP / OGMA / RMA's / other areas identified by retention strategy, to reduced stocking levels and appropriate alternate species where appropriate
- Increased levels of broadleaf trees and other appropriate species on the land base
- Minimize loss of habitat for species of conservation and management concern

Midterm and Long Term

- Recover, maintain or improve the conservation status of all species (ensure forest practices do not make it worse).

8.0 Silviculture Strategy

This section summarizes the preferred silviculture strategy developed at the 100 Mile TSA workshop. First, the high priority strategies are outlined and then two different 5-year implementation plans/budgets are presented. The *idealized plan/budget* reflects TSA needs over the next five years and was not constrained by anything other than the availability of stands for treatment, desire to complete the treatments, and logical timelines for treatments. The *constrained plan/budget* reflects a five year flat-line budget consistent with historical funding levels for incremental silviculture[10]. This plan/budget illustrates where resources would be allocated if resources were limited.

8.1 High Priority Strategies

The workshop group in the 100 Mile TSA considered the following strategies to be high priority for implementation in the next five years. The treatment of Pl stands was avoided during this time period because of the risk associated with MPB.

Late Rotation Fertilization (40-80 year old Fd and Sx stands in the wetbelt)

Late rotation fertilization was identified as one of the only means of making more volume available at the front end of the midterm timber supply trough and is seen as the most cost effective method of fertilization[11]. Fertilization is restricted to the wet belt other than on a trial basis due to moisture limitations in the drybelt. Fd stands were considered more desirable to treat due to the higher volume gains compared with Sx stands. Stands older than 80 years may also represent an opportunity but it was felt that treatment of these stands should be limited to operational trials only.

Young Stand Fertilization (15-40 year old Fd and Sx stands in the wetbelt)

Fertilization of younger stands was identified as a good opportunity to add volume to the middle and back end of the midterm timber supply trough. Fd was considered the more desirable species to treat due to higher volume gains and the concern of leader weevil attacks in young Sx stands[12]. These stands will provide options for multiple treatments prior to harvest and can therefore provide a larger net impact if funding can be sustained over several decades. The risks associated with this treatment are the long timeframes over which the investment must be held and protected from loss (i.e. pests or other natural disturbances).

Planting for Timber Values

Benefits were identified for planting impacted areas of the THLB that have no reforestation obligations. Planting these sites will provide future volume and ensure timely access to the remaining mature timber in heavily impacted watersheds or landscape units. The assumption is that considerable area will remain unharvested due to AAC capacity and /or marginal economics and, depending upon the site, natural regeneration may be slow or unable to reforest the site. This includes young Pl stands and plantations impacted by MPB.

[10] The 2002 FRBC RMP spreadsheets were used to define this historical expenditure level.
[11] Return on investment analysis often shows positive values for late rotation fertilization because of the short period over which the investment must be held before realizing the gain (~10 yrs). This short period also means less risk of losing the investment to pests or natural disturbances when compared with fertilization of younger stands.
[12] Studies where young Sx stands are fertilized have shown increased weevil damage but the net gains are still positive. This is likely part of the reason why mean Sx fertilization response is lower than that of mean Fd response.

There are numerous logistical challenges for this strategy. First, areas have to be identified that will not (likely) be salvage harvested. Second, areas need to be prioritized to identify those that would benefit from artificial regeneration (i.e. not regenerate naturally for a long period) and would best help non-timber values. Third, work must be coordinated with WCB to ensure safe working conditions for planters and those who follow. Fourth, seedlings need to be ordered and paid for. These concerns need to be addressed as soon as possible to allow for timely implementation of this strategy. A staged approach will be required to deliver this strategy: year one and two funding is identified for planning and seedling orders while planting does not begin until year three.

Planting for Habitat Values

Benefits were identified for planting heavily impacted areas of the NonTHLB where natural regeneration is not expected to occur in a reasonable amount of time (i.e. riparian areas, retention areas, and specific watersheds where hydrologic green will speed recovery and reduce risk to fish). Planting these sites with conifers, broadleaves, and/or shrubs will provide improved habitat values in high risk/high values areas. There is a time limit on making decisions for these areas as it is not considered practical if danger tree falling is required, so a timely under-planting program coordinated with WCB will need to be pursued. Since there are short term benefits to hydrological /aquatic values and long term timber benefits to rapid reforestation this requires coordination of environmental risk and timber salvage. A type 2/3 silviculture strategy will identify and quantity the areas at highest risk and where silviculture treatments will be of most benefit to recover, maintain or improve the amount of habitat for species of conservation and management concern.

Spacing / Thinning in Drybelt Fd stands

Large areas of IDF have regenerated naturally with dense thickets under mature overstories. These ecosystems were adapted to some level of fire, which had the ability to thin the understory, reduce ladder fuels, and create more open conditions for surviving trees. With the exclusion of fire, high understory densities limit individual tree growth, increase ladder fuels, and generally slow recruitment of trees into larger classes over time.

Both timber supply and habitat supply benefits were recognized with the treatment of these stands. It was determined that an integrated strategy is required in the IDF to determine different approaches to varying densities in the understory layers (layer 2 and 3). Layer 3 is the primary concern but a subset of stands may require that layer 2 be addressed. Also, the strategy must be part of a long-term plan for uneven-aged management that considers forest health agents (e.g., spruce budworm), ungulate winter range objectives, and long term sustainable timber flows as each layer recruits into successive layers. This strategy is a high priority as it will yield habitat and timber supply benefits. It also has the potential to integrate with wildland/urban interface fuel treatments

Address Backlog Issues

Both backlog NSR and impeded stands were identified as candidates for treatment. Fill planting or brushing treatments are planned to add additional volume in the mid to back end of the trough. This is an ongoing program that includes prioritizing stands based on their potential for treatment

response/success. In some instances the no treatment option is preferred to promote structural diversity at the landscape scale, and because of low return on investment.

Under-burning in Drybelt Stands

A program of under-burning in open grown NDT stands will help to promote or maintain desired stand structures. The workshop group identified it as a desirable objective but suggested it has several logistical challenges for implementation – specifically around liabilities with initiating fires. There is potential to address this through pile and burn treatment near interface areas.

Spray BTK

Although not funded under this strategy, spraying BTK to control budworm in Fd stands was seen as critical to maintaining non Pl volume on the land base and ensuring investments in Fd stands are not lost. Impacts on non target Lepidoptera species and rare species that use the budworm as food need to be addressed.

Site Index Adjustment Project

Improving the estimates of site productivity for managed stands in the TSA will have the single largest impact on timber supply relative to all strategies presented in this document. It is not an immediate priority because the current (or higher) harvest levels will likely be in place for at least the next 10 years, but it would be extremely helpful to have this information at the time of the next timber supply review as the implications of the MPB mortality will not be fully known until a site index adjustment is incorporated into the analysis.

Retention Strategy Planning

The retention strategy will provide clarity on available harvest/salvage areas, as well as identification of long-term retention areas that may benefit from under-planting. Identifying areas for planting (i.e. dead, unsalvaged areas) will be problematic until a retention strategy is in place. Identification of environmental values at risk and where to apply habitat treatments will be benefited by a type 2/3 silviculture strategy.

Use of Improved Seed

Continuing to maximize use of improved seed will improve timber supply forecasts in subsequent timber supply analyses.

Rehabilitation of Roads

Removing access opportunities on the land base will have long term timber and habitat benefits.

8.2 Silviculture Strategy Program (Idealized Funding Level)

This section describes an idealized (no constraints on $ or manpower) silviculture program in terms of ha treated, budget requirements, and job outcomes. It assumes 35.4 million dollars are available over the next five years.

Proposed Area Treated (ha)

Activity	Year 1 (ha)	Year 2 (ha)	Year 3 (ha)	Year 4 (ha)	Year 5 (ha)	Totals (ha)
Studies/Surveys	-	-	-	-	-	-
Fertilize	2,550	2,100	2,100	4,100	14,100	24,950
Spacing/Thinning (timber)	500	2,000	5,000	5,000	5,000	17,500
Spacing/Thinning (habitat)	100	400	1,000	1,000	1,000	3,500
Planting (timber)	-	-	3,000	5,000	5,000	13,000
Planting (habitat)	-	-	1,000	1,667	1,667	4,333
Address Backlog	500	500	500	-	-	1,500
Underburning	200	200	200	200	200	1,000
Totals	3,850	5,200	12,800	16,967	26,967	65,783

Proposed Budget ($)

Activity	Year 1 ($)	Year 2 ($)	Year 3 ($)	Year 4 ($)	Year 5 ($)	Totals ($)
Studies/Surveys	$ 130,000					$ 130,000
Fertilize	$ 1,020,000	$ 840,000	$ 840,000	$ 1,640,000	$ 5,640,000	$ 9,980,000
Spacing/Thinning (timber)	$ 300,000	$ 1,200,000	$ 3,000,000	$ 3,000,000	$ 3,000,000	$ 10,500,000
Spacing/Thinning (habitat)	$ 60,000	$ 240,000	$ 600,000	$ 600,000	$ 600,000	$ 2,100,000
Planting (timber)	$ -	$ 120,000	$ 1,800,000	$ 3,000,000	$ 3,000,000	$ 7,920,000
Planting (habitat)	$ -	$ 40,000	$ 600,000	$ 1,000,000	$ 1,000,000	$ 2,640,000
Address Backlog	$ 600,000	$ 600,000	$ 600,000	$ -	$ -	$ 1,800,000
Underburning	$ 60,000	$ 60,000	$ 60,000	$ 60,000	$ 60,000	$ 300,000
Totals	$ 2,170,000	$ 3,100,000	$ 7,500,000	$ 9,300,000	$ 13,300,000	$ 35,370,000

Job Outcomes

Activity	Year 1 Person Days	Year 2 Person Days	Year 3 Person Days	Year 4 Person Days	Year 5 Person Days	Totals Person Days
Studies/Surveys	433	-	-	-	-	433
Fertilize	255	210	210	410	1,410	2,495
Spacing/Thinning (timber)	1,695	6,780	16,950	16,950	16,950	59,325
Spacing/Thinning (habitat)	340	1,360	3,400	3,400	3,400	11,900
Planting (timber)	-	-	6,000	10,000	10,000	26,000
Planting (habitat)	-	-	2,000	3,333	3,333	8,667
Address Backlog	2,300	2,300	2,300	-	-	6,900
Underburning	40	40	40	40	40	200
Totals	5,063	10,690	30,900	34,133	35,133	115,920

In addition to the above strategies/investments, a site index adjustment project and a retention strategy plan were considered as high priority for completion. The studies/surveys listed in the tables above reflect the initial setup of specific programs (e.g. identify and prioritize fertilization candidates). Ongoing survey and layout costs associated with specific strategies are included in the strategy costs.

8.2.1 Expected Outcomes (Idealized Funding Level)

If 35.4 million was invested over a 5-year period, the following outcomes could be expected:

Estimated Timber Supply Outcomes

- 204,000 m^3 made available at the front end of the trough
  - Realized from late rotation fertilization
- 286,550 m^3 made available in the middle of the trough
  - Realized from young stands fertilization and thinning of drybelt Fd stands
- 1,674,167 m^3 made available in the back end of the trough
  - Realized mainly though planting of sites with no obligations, but also from addressing backlog areas and a small amount of fertilizing young Pl stands at the end of the 5 yr period.

Timber Quality Outcomes

- None

Habitat Supply Outcomes

- Improved stand structure on 21,000 ha of drybelt Fd stands (thinned/spaced), with 1,000 ha of this also under-burned.
- Regeneration of 4,300 ha of impacted stands with a habitat focus, and regeneration of 13,000 ha of impacted stands with a timber focus.
- Recover, maintain or improve the amount of habitat for species of conservation and management concern

8.2.2 Expected Outcomes for 20yr Investment (Idealized Funding Level)

If similar benefits could be produced by continuously investing at this level for 20 yrs, the midterm trough could almost be eliminated (Figure 12). This forecast is highly speculative and there is no guarantee that enough suitable treatment areas could be found.

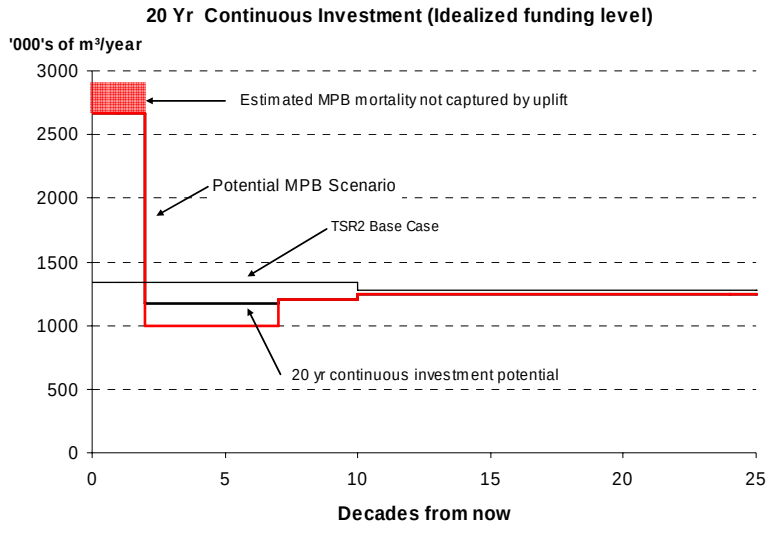


Figure 12. 20 yr continuous investment (idealized funding level).

8.3 Silviculture Strategy Program (Historical Funding Level)

This section describes a silviculture program constrained to approximately 7 million dollars over five years in terms of ha treated, budget requirements, and job outcomes.

Proposed Area Treated (ha)

Activity	Year 1 (ha)	Year 2 (ha)	Year 3 (ha)	Year 4 (ha)	Year 5 (ha)	Totals (ha)
Studies/Surveys	-	-	-	-	-	-
Fertilize	2,600	1,700	-	-	-	4,300
Spacing/Thinning (timber)	150	600	300	300	300	1,650
Spacing/Thinning (habitat)	30	120	60	60	60	330
Planting (timber)	-	-	1,000	1,000	1,000	3,000
Planting (habitat)	-	-	333	333	333	1,000
Address Backlog	100	100	-	-	-	200
Underburning	-	-	-	-	-	-
Totals	2,880	2,520	1,693	1,693	1,693	10,480

Proposed Budget ($)

Activity	Year 1 ($)	Year 2 ($)	Year 3 ($)	Year 4 ($)	Year 5 ($)	Totals ($)
Studies/Surveys	$ 130,000	$ 160,000	$ -	$ -	$ -	$ 290,000
Fertilize	$ 1,040,000	$ 680,000	$ -	$ -	$ -	$ 1,720,000
Spacing/Thinning (timber)	$ 90,000	$ 360,000	$ 180,000	$ 180,000	$ 180,000	$ 990,000
Spacing/Thinning (habitat)	$ 18,000	$ 72,000	36,000	$ 36,000	36,000	$ 198,000
Planting (timber)	$ -	$ -	870,000	$ 870,000	$ 870,000	$ 2,610,000
Planting (habitat)	$ -	$ -	$ 290,000	$ 290,000	$ 290,000	$ 870,000
Address Backlog	$ 120,000	$ 120,000	$ -	$ -	$ -	$ 240,000
Underburning	$ -	$ -	$ -	$ -	$ -	$ -
Totals	1,398,000	1,392,000	1,376,000	1,376,000	1,376,000	6,918,000

Job Outcomes

Activity	Year 1 Person Days	Year 2 Person Days	Year 3 Person Days	Year 4 Person Days	Year 5 Person Days	Totals Person Days
Studies/Surveys	433	533	-	-	-	967
Fertilize	260	170	-	-	-	430
Spacing/Thinning (timber)	509	2,034	1,017	1,017	1,017	5,594
Spacing/Thinning (habitat)	102	408	204	204	204	1,122
Planting (timber)	-	-	2,000	2,000	2,000	6,000
Planting (habitat)	-	-	667	667	667	2,000
Address Backlog	460	460	-	-	-	920
Underburning	-	-	-	-	-	-
Totals	1,764	3,605	3,888	3,888	3,888	17,032

In addition to the above strategies/investments, a site index adjustment project and a retention strategy plan were considered as high priority for completion. The studies/surveys listed in the tables above reflect the initial setup of specific programs (e.g. identify and prioritize fertilization candidates). Ongoing survey and layout costs associated with specific strategies are included in the strategy costs.

8.3.1 Expected Outcomes (Historical Funding Level)

If approximately 7 million was invested over a 5-year period, the following outcomes could be expected:

Estimated Timber Supply Outcomes

- 25,700 m^3 made available at the front end of the trough
  - Realized from late rotation fertilization
- 68,510 m^3 made available in the middle of the trough
  - Realized from young stands fertilization and thinning of drybelt Fd stands
- 355,000 m^3 made available in the back end of the trough
  - Realized mainly though planting of sites with no obligations, but also from addressing backlog areas and a small amount of fertilizing young Pl stands at the end of the 5 yr period.

Timber Quality Outcomes

- None

Habitat Supply Outcomes

- Improved stand structure on 1,980 ha of drybelt Fd stands (thinned/spaced – no under-burning budgeted).
- Regeneration of 1,000 ha of impacted stands with a habitat focus, and regeneration of 3,000 ha of impacted stands with a timber focus.
- Recover, maintain or improve the amount of habitat for species of conservation and management concern

8.3.2 Expected Outcomes for 20yr Investment (Historical Funding Level)

If similar benefits could be produced by continuously investing at this level for 20 yrs, the midterm trough could reduced by ~20% (Figure 13). This forecast is highly speculative and there is no guarantee that enough suitable treatment areas could be found.

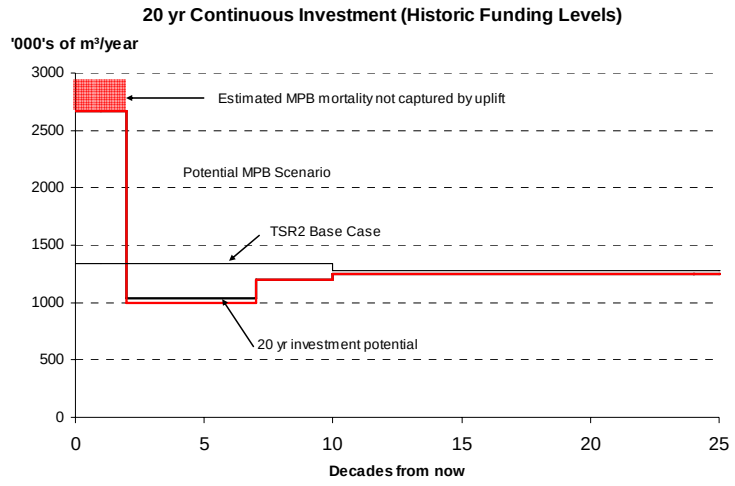


Figure 13. 20 yr continuous investment (historical funding level).

9.0 Summary of Information and Research Needs

During the preparation of this document, the following needs for further information and/or research were identified in support of meeting TSA objectives for timber supply, timber quality, and habitat supply.

1. A site index adjustment project is required. This involves the completion of ecosystem mapping (currently underway), accuracy assessment of the mapping to Forest Analysis Branch Standards, and then application of ecological correlations with site productivity (i.e. SIBEC).
2. Retention planning is required to identify areas where salvage will not occur and to provide guidance around increased retention at the stand level.
3. Improve the accuracy of forest cover inventory volume estimates for complex drybelt stands (NDT4). Better defining growth and yield predictions for these stand types is also desirable.
4. There is a desire to look at changing stocking standards / free growing standards to include more broadleaves.
5. Inventory for locations of species of conservation concern so that management, including incremental silviculture activities, can better address these species.
6. Develop a forest health strategy that looks beyond MPB in order to protect growing volume that will be critical in the midterm trough.
7. Develop an access management plan to limit the amount of open road within the TSA.
8. Develop a seed strategy that identifies seed inventories (natural stand and orchard), seed gaps and seed mitigation strategies over the short and long term.
9. Increased production of non-traditional seed suitable for planting to increase species diversity (i.e. cottonwood)
10. A Type 2/3 Silviculture Strategy is needed to clarify the outcomes for opportunities presented here and to identify areas for treatment. All of the potential opportunities presented here require refinement in terms of areas, timing and impacts.

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Appendix A: Abbreviations

AAC	Allowable Annual Cut
Analysis	Timber Supply Analysis
AU	Analysis Unit
BCTS	BC Timber Sales (Formerly Small Business Forest Enterprise Program)
BEC	Biogeoclimatic Ecosystem Classification
BEO	Biodiversity Emphasis Options
BGB	Biodiversity Guidebook
Bl	Subalpine fir
BMP	Best Management Practices
CF	Chief Forester
CFLB	Crown Forested Land base
CT	Commercial Thinning
CW	Western Red Cedar
DBH	Diameter at breast height (1.3m)
DEO	Designated Environment Official
DFO	Department of Fisheries and Oceans
DM	District Manager
ECA	Equivalent Clearcut Area
ESA	Environmentally Sensitive Area
Fd	Douglas Fir
FES	Forest Ecosystem Specialist
FIP/FC1	Old Forest Cover Digital Files
FMER	Fire Maintained Ecosystem Restoration
FIZ	Forest Inventory Zone
FPC	Forest Practices Code
FRBC	Forest Renewal British Columbia
FSSIM	Forest Service Simulation Model
GIS	Geographic Information System
HLPO	Higher Level Plan Order
Hw	Western Hemlock
ICH	Interior Cedar Hemlock
IWAPS	Interior Watershed Assessment Procedure System
La	Alpine Larch
LTHL	Long Term Harvest Level
LU	Landscape Unit
Lw	Western Larch
MoFR	Ministry of Forests and Range
MoE	Ministry of Environment
MPB	Mountain Pine Beetle
MSR	Machine Stress Rated
MSY	Maximum Sustained Yield
MSYT	Managed Stand Yield Tables
NCC	Non-Commercial Cover
NDT	Natural Disturbance Type
NP	Non Productive
Pl	Lodgepole Pine
PSP	Permanent Sample Plot
PSYU	Public Sustained Yield Unit
Pw	White Pine
Py	Ponderosa Pine (tree species) or person years (economics)
RM	Regional Manager
RMZ	Riparian Management Zone
ROS	Recreation Opportunity Spectrum
THLB	Timber Harvesting Land base
TIPSY	Table Interpolation Program for Stand Yields (growth and yield model)
TSA	Timber Supply Area
TSR	Timber Supply Review
UREP	Use, Recreation, and Enjoyment of Public
VDYP	Variable Density Yield Predictor (growth and yield model)
VEG Ht	Visually Effective Greenup Height
VQO	Visual Quality Objective
WTP	Wildlife Tree Patch