

Okanagan TSA Type 1 Silviculture Strategy

Version 2.0

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British Columbia
Ministry of Forests and Range

Funded By:



Mike Fenger and Associates

Strategies at a Glance		
General Strategy	The focus of the Okanagan TSA Silviculture Strategy over the next 5 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 PI 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 recognizes that setting minimum harvest ages to reflect the timing of stand merchantability could dramatically improve timber supply in the midterm at almost no cost. It also recommends that 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> Harvest at a level that minimizes non recoverable losses. <u>Midterm (20-100 yrs):</u> Minimize the depth and duration of midterm trough <u>Long term (100yrs+):</u> LTHL of 3 million m ³ /yr (inherent capability +/-5%) (long term will be near max productivity-midterm seen as more important)
	Timber Quality:	Maintain diversity of stand types and ages across the land base to support a range of products such as poles/house logs/peelers/MSR. (Identified as lower priority than quantity or habitat)
	Habitat Supply	Overall Objective - Minimize negative impacts on ecosystems and species: <u>Short Term</u> - Develop retention strategy to minimize impacts on watersheds, ecosystems, and species (20% of THLB) for short term retention to improve or maintain environmental values where opportunities exist - Reforest a proportion of impacted watershed, WTP / OGMA / RMA's/ or other retention areas to reduced stocking levels where ecologically appropriate. - Increased levels of broad leaf trees on the land base. <u>Mid and Long Term</u> Maintain or improve the conservation status of all species where possible (Ensure forestry practices do not make species status worse).
Major Silvicultural Strategies	Timber Supply	1. Late Rotation Fertilization of Non-PI (Fd and Lw, Sx as 2 nd priority - TS1) 2. Young Stand Fertilizations – focus is on Fd, then Sx (TS2) 3. Spacing of fire origin PI /Fd /Lw stands (TS3) 4. Spacing of clumped drybelt Fd stands (TS4) 5. Planting of THLB sites with no reforestation obligations (TS5/6) 6. Address backlog issues - NSR and impeded stands (TS7) 7. Rehabilitation of underperforming plantations (TS8b)
	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.

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Habitat Supply

1. Planting of impacted non-THLB areas and retention areas with a habitat focus. (HS1)
2. Thinning / spacing to accelerate old growth attributes (trial only – HS2)
3. Spacing/thinning in drybelt Fd stands (HS3)
4. Treat for invasive species (HS4)
5. Under-burning in NDT4 (HS5)
6. Rehabilitation of spur roads and landings (HS6)
7. Manage tree species for diversity
8. Vary regenerated stand spacing
9. Complete inventories and planning required to maintain habitat of species and ecosystems of conservation concern.

Silviculture Program

Idealized funding level (\$78.9 million over 5 yrs)

Activity	Year 1 (ha)	Year 2 (ha)	Year 3 (ha)	Year 4 (ha)	Year 5 (ha)	Totals (ha)
Studies/Surveys	-	-	-	-	-	-
Fertilize	1,000	11,750	11,750	11,750	13,294	49,544
Spacing/Thinning (timber)	-	2,250	2,250	3,250	3,250	11,000
Spacing/Thinning (habitat)	50	500	500	500	-	1,550
Planting (timber)	1,200	1,292	800	800	800	4,892
Planting (habitat)	50	200	250	1,800	1,800	4,100
Pruning	-	-	-	-	-	-
Rehab underperforming & PFT stands	-	100	100	100	100	400
Address Backlog (NSR and Impeded)	7,100	7,100	7,100	7,100	7,100	35,500
Rehab Roads/Landings	-	300	300	300	300	1,200
Treat for Invasives	2,000	2,000	2,000	2,000	2,000	10,000
Under burning	200	200	200	200	200	1,000
Totals	11,600	25,692	25,250	27,800	28,844	119,186

Dollars

Activity	Year 1 (ha)	Year 2 (ha)	Year 3 (ha)	Year 4 (ha)	Year 5 (ha)	Totals (ha)
Studies/Surveys	385,000	\$ -	\$ -	\$ -	\$ -	\$ 385,000
Fertilize	\$ 600,000	\$ 4,700,000	\$ 4,700,000	\$ 4,700,000	\$ 5,337,600	\$ 20,037,600
Spacing/Thinning (timber)	\$ 125,000	\$ 1,350,000	\$ 1,350,000	\$ 1,950,000	\$ 1,950,000	\$ 6,725,000
Spacing/Thinning (habitat)	\$ 30,000	\$ 300,000	\$ 300,000	\$ 300,000	\$ -	\$ 930,000
Planting (timber)	\$ 1,900,000	\$ 2,038,000	\$ 1,300,000	\$ 1,300,000	\$ 1,300,000	\$ 7,838,000
Planting (habitat)	\$ 20,000	\$ 240,000	\$ 175,000	\$ 1,260,000	\$ 1,260,000	\$ 2,955,000
Pruning	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Rehab underperforming & PFT stands	\$ 170,000	\$ 170,000	\$ 170,000	\$ 170,000	\$ 170,000	\$ 680,000
Address Backlog (NSR and Impeded)	\$ 6,510,000	\$ 6,510,000	\$ 6,510,000	\$ 6,510,000	\$ 6,510,000	\$ 32,550,000
Rehab Roads/Landings	\$ 1,500,000	\$ 1,500,000	\$ 1,500,000	\$ 1,500,000	\$ 1,500,000	\$ 6,000,000
Treat for Invasives	\$ -	\$ 200,000	\$ 200,000	\$ 200,000	\$ 200,000	\$ 800,000
Under burning	\$ 10,000	\$ 10,000	\$ 10,000	\$ 10,000	\$ 10,000	\$ 50,000
Totals	\$ 9,580,000	\$ 17,018,000	\$ 16,215,000	\$ 17,900,000	\$ 18,237,600	\$ 78,950,600

If \$78.9 million was invested over a 5-year period, the following outcomes could be expected:

Estimated Timber Supply Outcomes

- 181,400 m³ made available at the front end of the trough
 - o Realized from late rotation fertilization (mostly Fd/Lw stands)
- 2,974,700 m³ made available in the middle of the trough
 - o Realized from young stands fertilization, treatment of impeded stands, and thinning of drybelt Fd stands.
- 765,000 m³ made available in the back end of the trough
 - o Realized mainly through planting of sites with no obligations and treatment of NSR/impeded stands, but also from spacing of repressed PI (OK fire), rehabilitation of roads, and a small amount from rehabilitation of under performing plantations.

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If this level of funding was continued for 20 years (\$315.6 million total) and similar benefits were achieved throughout, the depth of the midterm trough could be reduced by ~50%. Very large volumes are necessary to make improvements to the trough because of its duration. Again, it should be noted that implementing flexibility around minimum harvest ages in the midterm trough would cost nothing and greatly improve the midterm timber supply.

Timber Quality Outcomes

- Potentially higher output of logs suitable for production of MSR grade lumber.

Habitat Supply Outcomes

- Enhance old forest stand structure on 12,550 ha of drybelt Fd stands (thinned/spaced), with 1,000 ha of this also under-burned.
- Speed hydrologic recovery and improve stream temperature by regeneration of 4,100 ha of impacted stands with a habitat focus, and regeneration of 4,892 ha of impacted stands with a timber focus. Emphasis on under-planting.
- Maintain wildlife and recreation values by removal of 1200 ha of roads/landings from the land base.
- Protect native plants by removal of invasive/noxious weed species from 10,000 ha.

Silviculture Program

Constrained funding (\$25.2 million over 5 years)

Activity	Year 1 (ha)	Year 2 (ha)	Year 3 (ha)	Year 4 (ha)	Year 5 (ha)	Totals (ha)
Studies/Surveys	-	-	-	-	-	-
Fertilize	1,000	2,550	2,750	2,250	2,150	10,700
Spacing/Thinning (timber)	500	-	1,000	1,000	1,000	3,500
Spacing/Thinning (habitat)	250	500	500	250	250	1,750
Planting (timber)	1,200	1,292	800	800	800	4,892
Planting (habitat)	-	200	250	1,350	1,350	3,150
Pruning	-	-	-	-	-	-
Rehab underperforming & PFT stands	100	100	100	75	75	450
Address Backlog (NSR and Impeded)	1,800	500	600	500	500	3,900
Rehab Roads/Landings	-	100	100	50	50	300
Treat for Invasives	-	2,000	2,000	2,000	2,000	8,000
Under burning	200	200	200	200	200	1,000
Totals	5,050	7,442	8,300	8,475	8,375	37,642

Dollars

Activity	Year 1 (ha)	Year 2 (ha)	Year 3 (ha)	Year 4 (ha)	Year 5 (ha)	Totals (ha)
Studies/Surveys	325,000	\$ -	\$ -	\$ -	\$ -	\$ 325,000
Fertilize	\$ 600,000	\$ 1,020,000	\$ 1,100,000	\$ 900,000	\$ 880,000	\$ 4,500,000
Spacing/Thinning (timber)	\$ 300,000	\$ -	\$ 600,000	\$ 600,000	\$ 600,000	\$ 2,100,000
Spacing/Thinning (habitat)	\$ 150,000	\$ 300,000	\$ 300,000	\$ 150,000	\$ 150,000	\$ 1,050,000
Planting (timber)	\$ 1,900,000	\$ 2,038,000	\$ 1,300,000	\$ 1,300,000	\$ 1,300,000	\$ 7,838,000
Planting (habitat)	\$ -	\$ 240,000	\$ 175,000	\$ 945,000	\$ 945,000	\$ 2,305,000
Pruning	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Rehab underperforming & PFT stands	\$ 10,000	\$ 170,000	\$ 170,000	\$ 127,500	\$ 127,500	\$ 605,000
Address Backlog (NSR and Impeded)	\$ 1,740,000	\$ 570,000	\$ 660,000	\$ 570,000	\$ 570,000	\$ 4,110,000
Rehab Roads/Landings	\$ -	\$ 500,000	\$ 500,000	\$ 250,000	\$ 250,000	\$ 1,500,000
Treat for Invasives	\$ -	\$ 200,000	\$ 200,000	\$ 200,000	\$ 200,000	\$ 800,000
Under burning	\$ 10,000	\$ 10,000	\$ 10,000	\$ 10,000	\$ 10,000	\$ 50,000
Totals	\$ 5,035,000	\$ 5,048,000	\$ 5,015,000	\$ 5,052,500	\$ 5,032,500	\$ 25,183,000

If approximately \$25 million was invested over a 5-year period, the following outcomes could be expected:

Estimated Timber Supply Outcomes

- 167,700 m³ made available at the front end of the trough
 - Realized from late rotation fertilization (mostly Fd/Lw stands)

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- 370,000 m³ made available in the middle of the trough
 - o Realized from young stands fertilization and treatment of impeded stands.
- 983,800 m³ made available in the back end of the trough
 - o Realized mainly through planting of sites with no obligations and treatment of NSR/impeded stands, but also from spacing of repressed PI (Ok Fire), rehabilitation of roads, and a small amount from rehabilitation of under performing plantations.

If this level of funding was continued for 20 years (\$100 million total) and similar benefits were achieved throughout, the depth of the midterm trough could be reduced by ~20%. Very large volumes are necessary to make improvements to the trough because of its duration. Again, it should be noted that implementing flexibility around minimum harvest ages in the midterm trough would cost nothing and greatly improve the midterm timber supply.

Timber Quality Outcomes

- Potentially higher output of logs suitable for production of MSR grade lumber.

Habitat Supply Outcomes

- Enhance old forest stand structure on 5,250 ha of drybelt Fd stands (thinned/spaced), with 1,000 ha of this also under-burned.
- Speed hydrologic recovery and improve stream temperatures by regeneration of 3,150 ha of impacted stands with a habitat focus, and regeneration of 4,892 ha of impacted stands with a timber focus.
- Maintain wildlife and recreation values by removal of 300 ha of roads/landings from the land base.
- Protect native plants through removal of invasive/noxious weed species from 8,000 ha.

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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 desire 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 for improving 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 issues¹. 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 November 24th & 25th, 2005 in Vernon, attended by representatives of the MoFR, MoE and forest licensees within the Okanagan TSA. Bryce Bancroft of Symmetree Consulting Group Ltd and Cam Brown of Forsite Consultants Ltd. led the session. Alison Peatt of Mike Fenger and Associates along with Brian Robertson of MoE 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
Rocky Chan	Ministry of Forests, Southern Region
Ivan Listar*	Ministry of Forests, Southern Region
Keith Boyes	Ministry of Forests, Okanagan Shuswap District
Pat Hughes*	Ministry of Forests, Okanagan Shuswap District
Kevin New*	Federated Co-op Limited
Ted McRae*	Ministry of Forests, Okanagan Shuswap District
Kerry Rouck*	Gorman Bros
Sean Curry	Weyerhaeuser
Ed Collen*	Weyerhaeuser
Doug Nelson	Louisiana-Pacific
Alison Peatt	Mike Fenger and Associates (MoE representative)
Brian Robertson*	MoE Southern Interior
Glen Dick*	Okanagan IFPA
Jim Wright*	BCTS

* Several attendees* were only able to attend a portion of the workshop.

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 5 years (2006-2011). Because of risks associated with the current MPB infestation, investments in PI stands were avoided. After the MPB epidemic subsides, investment in PI stands represents a significant opportunity to address 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 1992. In 1992 the AAC was set at 2.615 million m³/year that included a 50,000 m³/year apportionment for harvesting decadent cedar/hemlock or hemlock/cedar. The MPB uplift established in 1987 expired in 1993. The AAC remained stable at 2.615 million until 2001 when the Chief Forester dropped the Cw/Hw partition and replaced it with an 80,000 m³/yr small scale salvage partition. The AAC has been 2.655 million m³/year from 2001-2005.

In November 2004, the Okanagan-Shuswap MoF District Manager requested an AAC uplift in order to deal with the emerging MPB situation. An expedited TSR3 process was initiated and used the most recent timber supply analysis completed for the Okanagan Innovative Forestry Society in support of the determination. A TSR3 determination was published by the Chief Forester January 1, 2006 and an uplift was implemented to address MPB mortality. The new AAC is 3,375,000 m³/yr.

Table 1. Historical AAC (m³/year).

AAC Type	1992	1993	1994	1995-2000	2001 - 2005	Current (2006)
Conventional	2,565,000	2,565,000	2,565,000	2,565,000	2,575,000	2,575,000
MPB Uplift	200,000	189,000				700,000
Partition	50,000	50,000	50,000	50,000	80,000	100,000
Total	2,815,000	2,804,000	2,615,000	2,615,000	2,655,000	3,375,000

2.2 Land Base Characteristics

In TSR3, approximately 65% of the TSA is considered crown-forested land (Table 2), while 71% of this area is considered to be available for long term timber harvest (46% of the total).

Table 2. Land base area statistics (TSR3)

Land Classification	Uplift Basecase (TSR3) (ha)	% of Total	% of Crown forest
Total Area	2,219,037	100.0%	
Non-crown land	349,714	15.8%	
Non-forest	400,799	18.1%	
Non-commercial brush	7,525	0.3%	
Existing roads, trails, landings	21,288	1.0%	
Productive Forest	1,439,711	64.9%	
Goal 1 Protected Areas Strategy (IFPA order)	66,219	3.0%	4.6%
Goal 2 Protected Areas Strategy (IFPA order)	2,687	0.1%	0.2%
Ecological reserves	4,259	0.2%	0.3%
Provincial parks	54,602	2.5%	3.8%
Inoperable areas	118,530	5.3%	8.2%
Low productivity	28,455	1.3%	2.0%
Regeneration ESAs	67,666	3.0%	4.7%
Deciduous forest types	43,991	2.0%	3.1%
Unmerchantable forest types	77,903	3.5%	5.4%
Riparian reserves	52,667	2.4%	3.7%
Enhanced riparian areas	12,669	0.6%	0.9%
PAS TSR II order		0.0%	0.0%
Total reductions		0.0%	0.0%
Current Timber Harvesting Land base	1,022,342	46.1%	71.0%
Plus TL reversions	17,320		
Less future roads, trails landings	24,187		
Future Timber Harvesting Land base	1,015,475		

2.2.1 Species Profile

The majority of stands on the timber harvesting land base in the Okanagan TSA are lodgepole pine or Douglas-fir leading (Figure 1). Approximately 35% of the THLB is occupied by pine leading stands.

It is estimated that the volume of mature timber on the timber harvesting land base of the Okanagan TSA is approximately 197 million m³. Of this, approximately 57 million m³ is lodgepole pine and 55 million m³ (29%) of this is lodgepole pine > 60 yrs old, which puts the TSA at high risk for MPB infestation.

Ponderosa pine is also affected by MPB and makes up ~2% (6400 ha) of the pine component in the THLB. The majority of this Py area is older than 60 yrs.

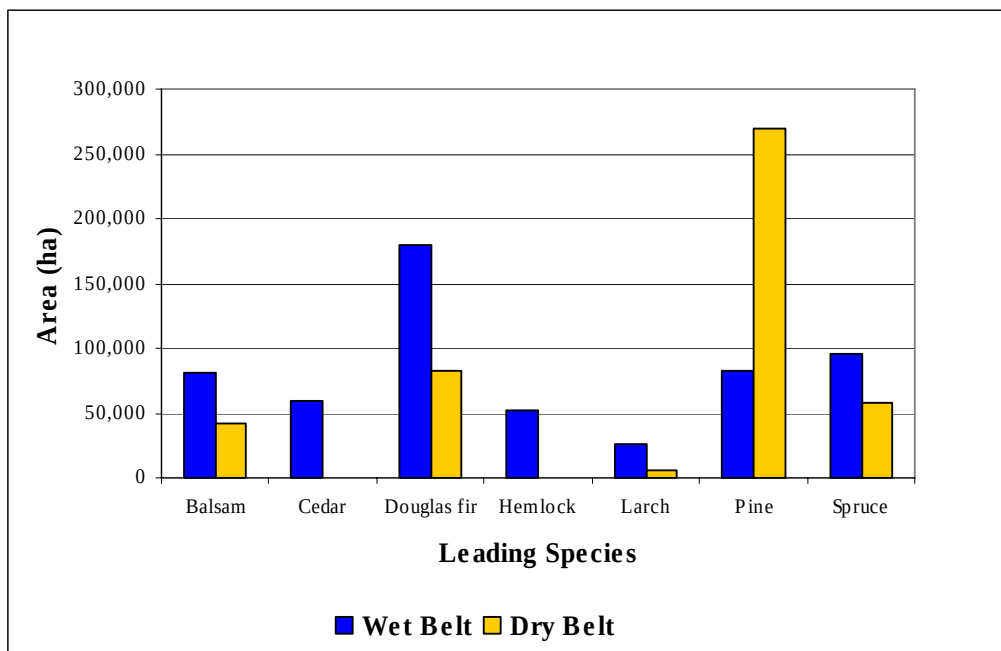


Figure 1. THLB area by dominant tree species by major climatic region

2.2.2 Age Class Profile

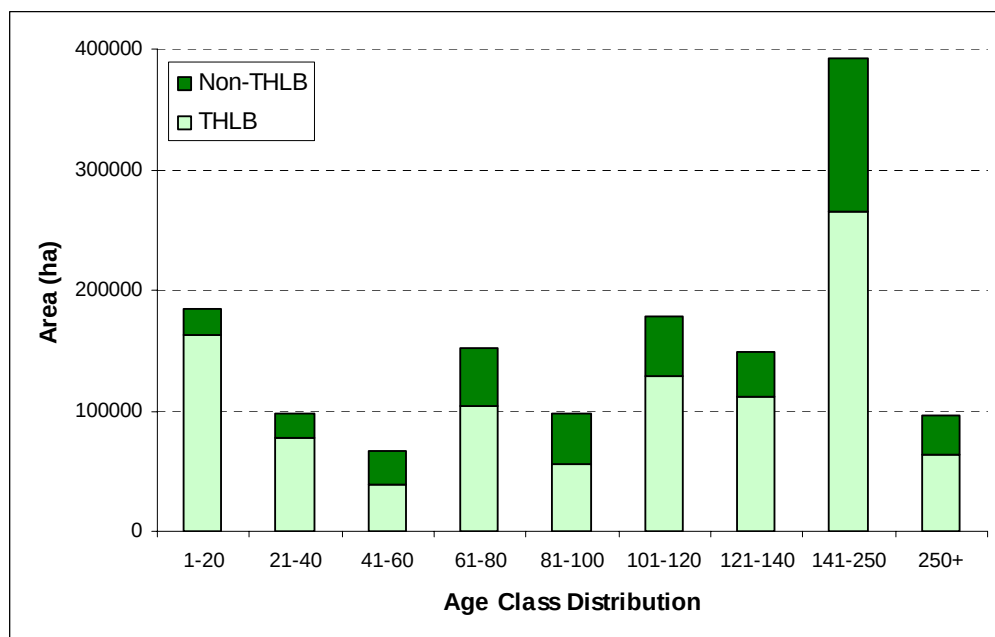


Figure 2. Age class profile (TSR3).

There is a significant portion of the THLB in older age classes (60-250 years). Older stands are more common in the Non-THLB. Of particular concern is the lack of area in the 41-60 year age class (Figure 2).

2.2.3 Site Class Profile

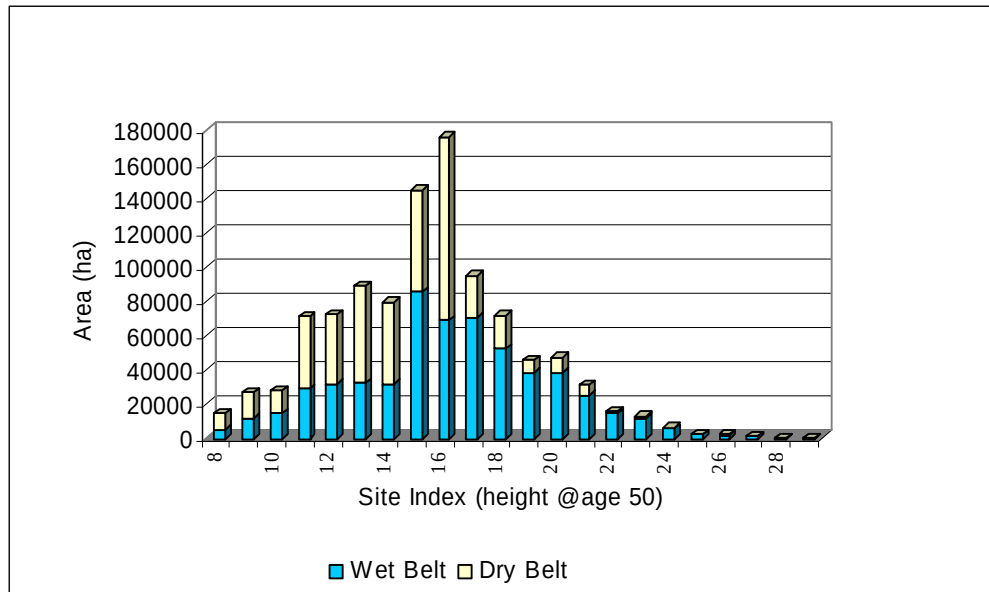


Figure 3. Site class profile (TSR3).

The average site index for the THLB (Figure 3) is 15.7 m (wet-belt = 16.6 m, dry-belt = 14.1 m).

2.2.4 Biogeoclimatic Profile

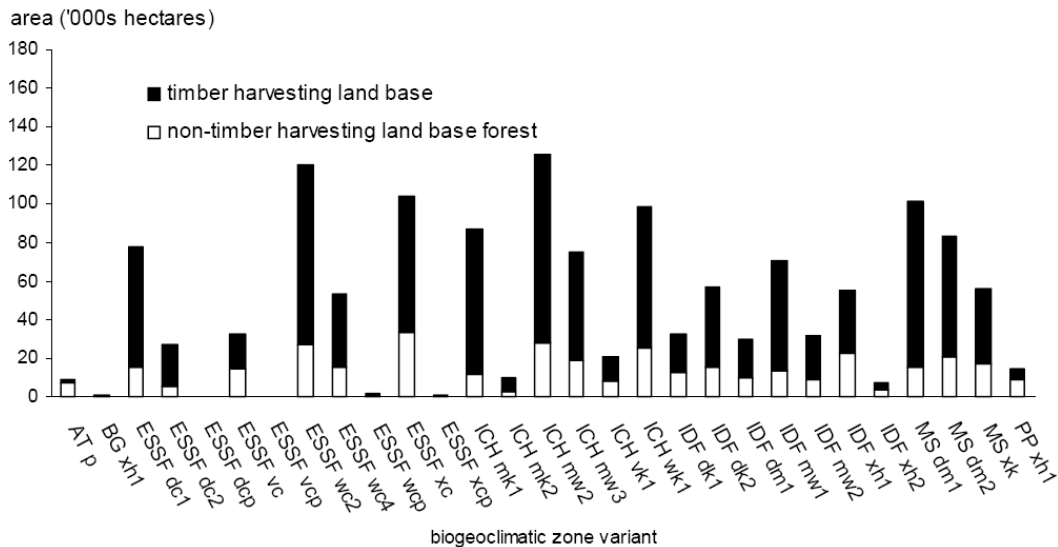


Figure 4. Biogeoclimatic profile (TSR2).

The THLB in the Okanagan TSA has a diversity of ecosystems that typically fall within the ESSF, ICH, IDF, and MS variants. The southern portion of the TSA is typically dominated by drier variants, while the northern portion tends to have wetter variants (Figure 4).

2.3 Incremental Silviculture History

Table 3 shows the incremental silviculture conducted on the Okanagan TSA over the past ten years. Juvenile spacing is the dominant treatment that has occurred. Relatively little area has been fertilized. Treatment area for juvenile spacing and pruning peaked in 1997 and has more or less gradually tapered off since then.

Table 3. Incremental silviculture history for the Okanagan TSA²

Year	Fertilize (ha)	Juvenile Spacing (ha)	Pruning (ha)
1995	19	2787	309
1996	62	2606	964
1997	340	2879	1133
1998	118	1084	528
1999	125	1499	274
2000	128	1213	220
2001	20	909	124
2002		499	133
2003		285	24
2004		344	
Total	811	14106	3709

2.4 Use of Select Seed

The 2005 seedling requests (Table 4) indicate that 99% of the Sx seed used is improved (8% gain), 62% of Lw seed used is improved (29% gain) and 35.5% of PI seed used is improved (7% gain). Pw seedlings are bred for their resistance to white pine blister rust and have no volume gains associated with them. Improved seed orchards for Douglas-fir are just beginning to come online.

Table 5 shows the forecasted gain for improved seedlings from established seed orchards as well as the forecasted availability. In general, these projections show:

- Fd seed gains of 19-29% with availability of 3-4% in the next 5 years and gains of 22-29% with availability of 29-44% in the following 5 years (5 to 10 years from now).
- Lw seed gains of 35% with very good-unlimited availability.
- PI seed gains of 8-11% with good to limited availability in the short term and gains of 12-16% with good to very good availability in the long-term.
- Sx seed gains of 9-21% with very good –unlimited availability in the short term and gains of 11-25% with very good –unlimited availability in the long term.

Table 4. Seedlings requested by species and genetic class for the Okanagan TSA for 2005.

Species	Class A Seedlings Requested (000s)	Class B+ Seedlings Requested (000s)	Class B Seedlings Requested (000s)	Total Seedlings Requested (000s)	Percent Class A seedlings Requested (%)	Percent Improved Seed
Bl	-	-	23.9	23.9	0.0%	0.0%
Cw	-	-	480.6	480.6	0.0%	0.0%
Fd	-	-	2,843.7	2,843.7	0.0%	0.0%
Lw	691.0	-	417.5	1,108.5	62.3%	62.3%
Pli	1,654.0	584.0	4,074.0	6,312.0	26.2%	35.5%
Pw	209.6	-	-	209.6	100.0%	100.0%
Py	-	-	282.5	282.5	0.0%	0.0%
Sx	3,008.5	17.7	33.5	3,059.7	98.3%	98.9%
Grand Total:	5,563.1	601.7	8,155.7	14,320.5	39%	43.0%

Source: Seed Planning and Registry system (SPAR) - 2005 Sowing Year

Note: SPU seedling needs are based on the previous five year average and do not reflect forecasted needs.

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

Table 5. Forecasted gain in volume and availability for improved seed for the Okanagan TSA.

SPU	Elevation (M)	SPU Seedling Need (million)	Gain From Improved Seed/Availability											Gross Area
			2005				2010			2015				
			Actual Gain	Actual Percent Class A used (%)	Projected Gain	Est. % Avail.	Projected Gain	Est. % Avail.	Est. Avail. Rating	Projected Gain	Est. % Avail.	Est. Avail. Rating		
FDI NE HIGH	1000-1600	3.4			29%	3%	29%	29%	5	29%	59%	3	645,218	
FDI NE LOW	400-1000	2.5			24%	4%	24%	44%	4	24%	100%	2	364,996	
FDI QLN HIGH	1000-1600	3.4			29%	3%	29%	29%	5	29%	59%	3	13,232	
FDI QLN LOW	400-1200	3			13%	46%	19%	93%	2	22%	137%	1	2,980	
LW NE LOW	700-1400	3	29%	62%	33%	80%	35%	123%	1	35%	133%	1	548,594	
PLI NE LOW	700-1400	3.7	6%	26%	9%	86%	11%	138%	1	15%	92%	2	329,782	
PLI PGN LOW	700-1400	33.7			8%	47%	10%	69%	3	12%	66%	3	3,511	
PLI TO HIGH	1400-1600	5.3	7%		11%	21%	14%	42%	4	16%	85%	2	158,860	
PLI TO LOW	700-1400	13.6			9%	765%	12%	38%	4	13%	64%	3	202,185	
PLI TON HIGH	1400-2000	8.4	6%		11%	21%	14%	42%	4	16%	85%	2	235,131	
PLI TON LOW	700-1400	17.3			9%	744%	12%	88%	2	14%	72%	3	373,462	
SX NE HIGH	1500-1900	5.4	8%	98%	9%	133%	9%	169%	1	11%	181%	1	246,501	
SX NE LOW	1-800	1.2			0%	0%	21%	92%	2	25%	117%	1	178,209	
SX NE MID	800-1500	4.5			7%	211%	12%	120%	1	14%	140%	1	351,389	
SX TO HIGH	1300-1900	3.3	9%		8%	73%	12%	118%	1	17%	124%	1	352,632	
SX TO LOW	700-1300	9.5			16%	69%	17%	86%	2	21%	97%	2	341,574	
SX TON HIGH	1300-1900	8.7			7%	9%	118%	10%	153%	1	13%	165%	1	160,515
SX TON LOW	1-1300	2.4	0%			9%	200%	14%	208%	1	23%	135%	1	299,485
SX TON MID	1000-1500	4.5	0%			7%	211%	12%	120%	1	14%	140%	1	141,520

Note: Gross areas are provided because THLB areas were not available. Areas can be overlapping between different species SPU's. SPU seedling needs are based on the previous five year average and do not reflect forecasted needs. Availability rating are as follows: Unlimited (100+%) available, 2= Very Good (75-99%), 3=Good (50-75%), 4=Limited (30-50%), 5=Severely Limited (<30%).

In the current TSR3, the use of improved seed was modeled by species by applying gains to specific analysis units (Table 6). Concerns were expressed by MoFR Tree Improvement staff about the unknown bias and uncertainty in applying TSA wide gains to a subset of analysis units.

Table 6. Genetic gain estimates by species and location used in TSR3 analysis.

Species	Wet/Dry belt	Elevation	Genetic gain	Short-term availability	Current genetic gains
Fd	All	All	0%	0%	None
Pl	Dry	All	10%	20%	10% gain to pine in AU 324 and 325
	Wet	All	7%	13%	2.4% gain to pine in AU 123
Sw	All	All	4%	100%	4.0% gain to all spruce

3.0 Mountain Pine Beetle Situation

Figure 5 and 7 graphically illustrate the extent of the mountain pine beetle infestation in the southern interior as mapped from overview flights in 2004. Although not as seriously infested as some of the more northerly TSA's, it is possible that the Okanagan TSA will face a similar fate given the high proportion of pine in the TSA. Pine leading stands make up about 29% of the current growing stock.

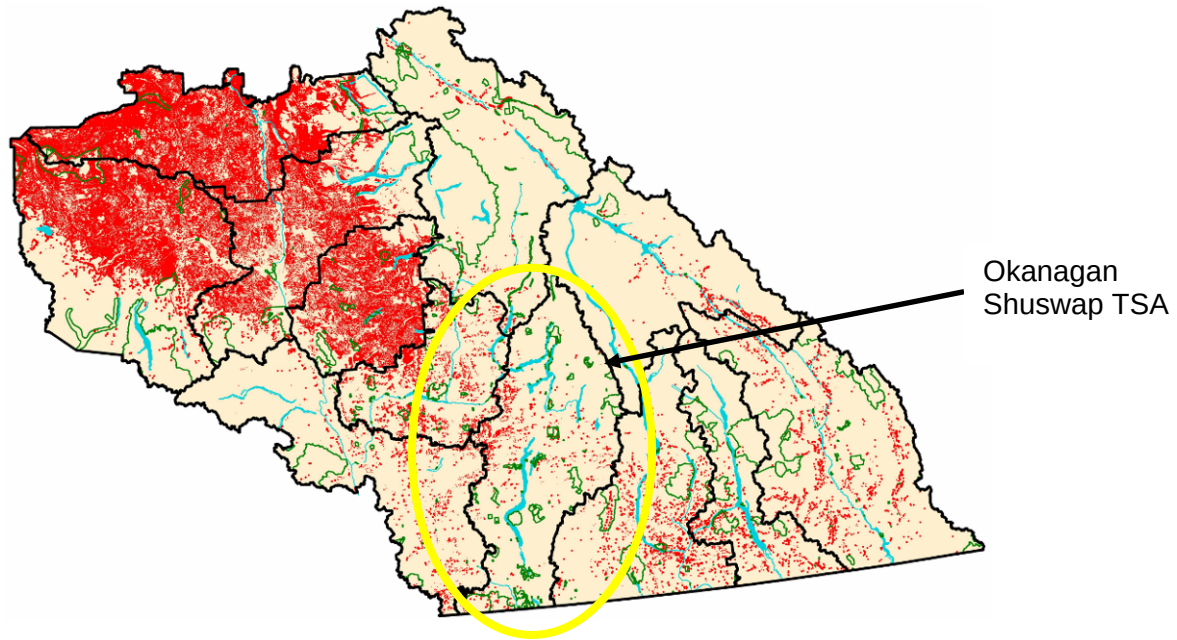


Figure 5. The extent of the MPB infestation in the Southern Interior Region as mapped from overview flights in 2004.

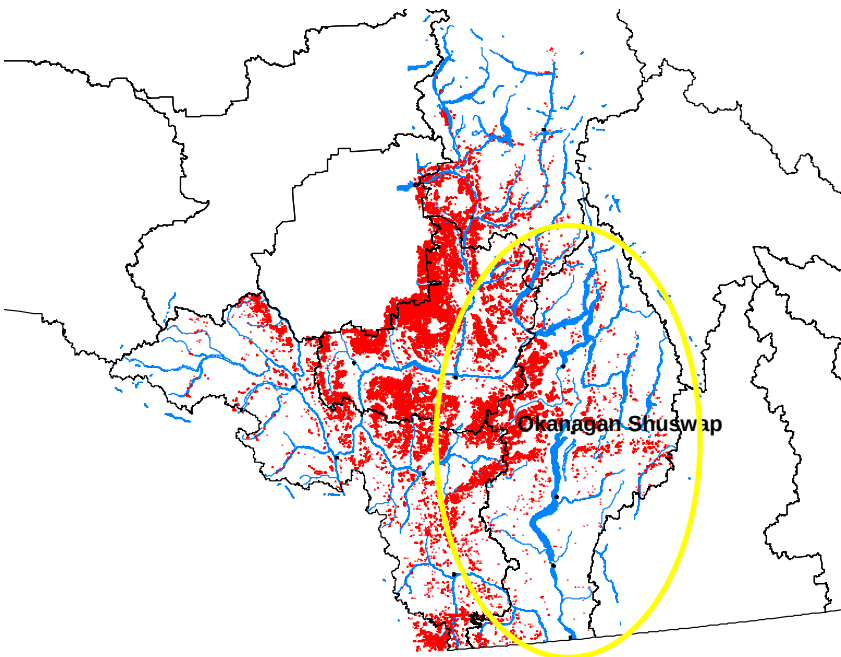


Figure 6. The extent of the MPB infestation in the old Kamloops Region as mapped from overview flights in 2005

Since pine leading stands make up at least 29% of the current mature growing stock in the Okanagan TSA, the mortality associated with the current MPB infestation may have severe implications on timber supply. Figure 7 shows the trend for yearly volume killed peaking in 2010 for this TSA at 5.04 million m³ killed/yr. This level of mortality is well above what can be captured within the historical AAC or potentially even though an uplift assuming the shelf life for these stands.

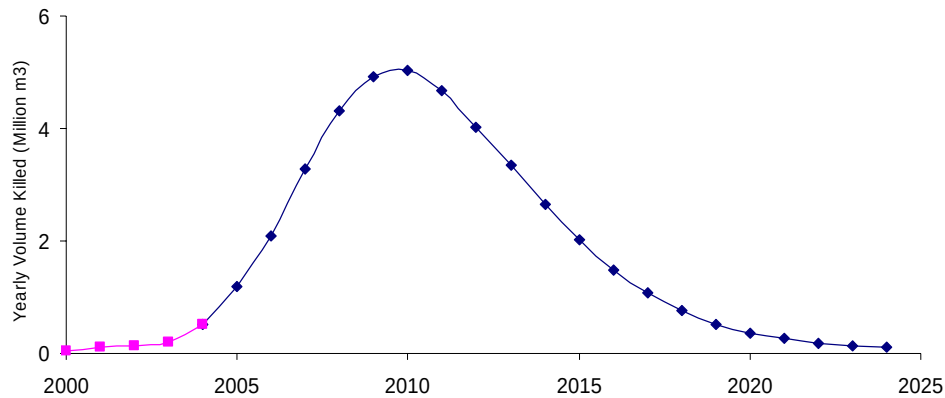


Figure 7. MPB killed volume trend (purple) and predictions of future trend (blue).

Pine volume makes up about 29% (57 million m³) of the current growing stock in the Okanagan TSA, with 55 million m³ currently over 60 yrs old, so there are potentially significant implications on timber supply. Table 7 shows projections of the cumulative pine volume killed by the MPB to 2020 (Marvin Eng 2005)³. These projections show a volume of 57 million m³ killed by 2015 and 54 million m³ killed by 2020.

Table 7 shows projections of the cumulative pine volume killed by the MPB to 2020 (Marvin Eng 2005) if no intervention is undertaken. If harvest levels do not increase within the next five years, dead stands will be left unsalvaged as the AAC will not be able to capture all the mortality.

Table 7. MPB infestation projections assuming no intervention – cumulative volume killed to 2020 (m³) (from Eng 2005).

	Current AAC (m3)	Projection Year							
		2005			2010			2015	2020
		Total Effectuated Area	Equivalent area dead	Equivalent volume dead	Total Effectuated Area	Equivalent area dead	Equivalent volume dead	Equivalent volume dead	Equivalent volume dead
THLB > 60 years	2,655,000	139,381	13,626	2,689,311	403,050	106,609	19,349,696	38,634,576	42,859,776

Marvin Eng's model predicts that within the next 15 years MPB will kill 42.8 million m³ of pine. This does not include the potential impact to pine stands under 60 years old.

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.

4.0 Current TSA Situation

4.1 Timber Supply Issues

4.1.1 TSR 3 Base Case Harvest Forecast

Figure 8 shows the base case scenario from the TSR 3 process. This base case scenario is consistent with the IFPA's 'uplift innovative composite' scenario and includes:

- LRMP assumptions
- Wetbelt / drybelt differences captured in analysis unit definitions
- Use of class A seed in managed stands (current estimates of volume gains)
- Spatial adjacency for first 30 yrs
- Inventory adjustment (constant 7% increase across all AU's)
- Adjusted site index values for both drybelt and wetbelt stands

This scenario indicates that the initial harvest level of 3,000,000 m³ can be maintained for 40 years. After that, harvest levels declines by approximately 10% and then 6% in the following two 10-year periods before reaching the midterm harvest level of 2.55 million m³/year. The long-term harvest level of approximately 2.9 million m³/year is achieved 100 years into the harvest forecast.

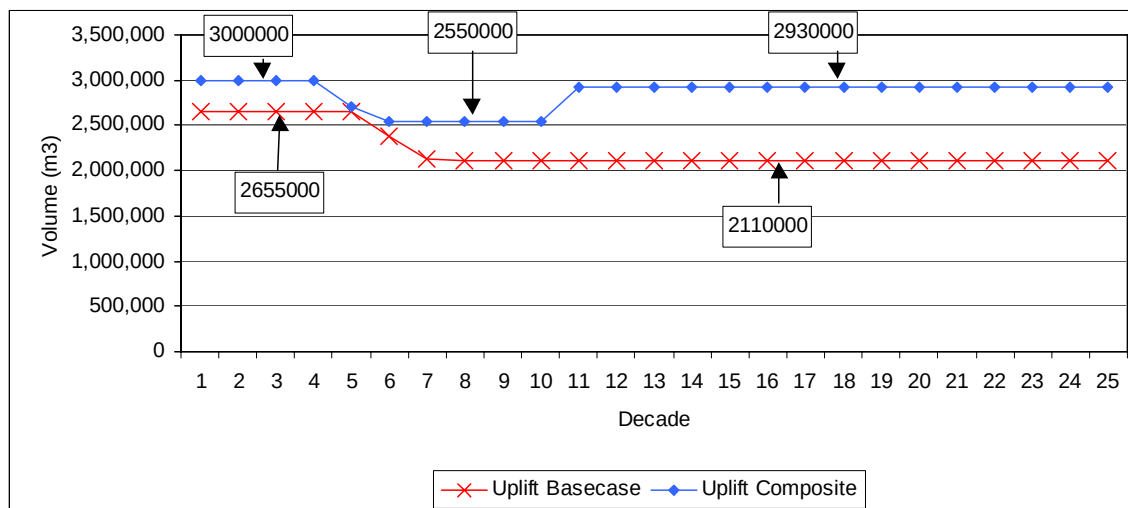


Figure 8. Harvest forecast (TSR3).

Timber availability is at its lowest levels in decades 7-10 (circled in Figure 9 below). These decades correspond with the most constrained periods for timber supply (least available timber) and occur because harvest is transitioning from natural to managed stands and minimum harvest ages for managed stands are reflective of merchantability thresholds. Figure 10 shows that managed stands are first harvested in period 7 and make up the vast majority of harvest by period 9. During this time period, the last of the eligible natural stands and the first of the managed stands are being harvested. There is not enough managed stand volume coming online fast enough to simply fall to the long term harvest level (LTHL) so a midterm trough occurs. If harvest ages were set to reflect

the timing of stand merchantability, this trough would likely shrink significantly because managed stands would be available much sooner.

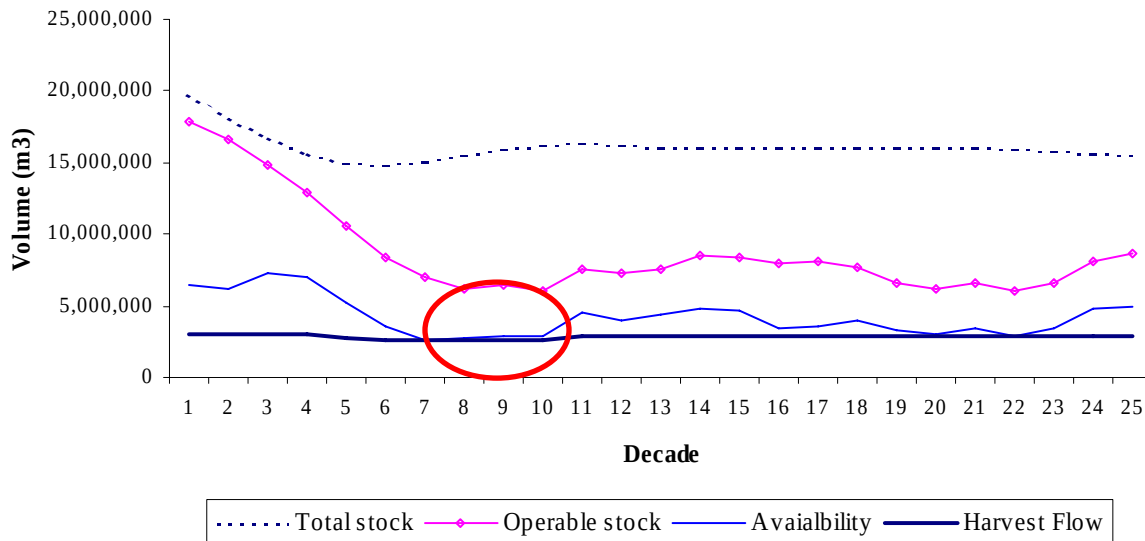


Figure 9. Total and merchantable growing stock (TSR3).

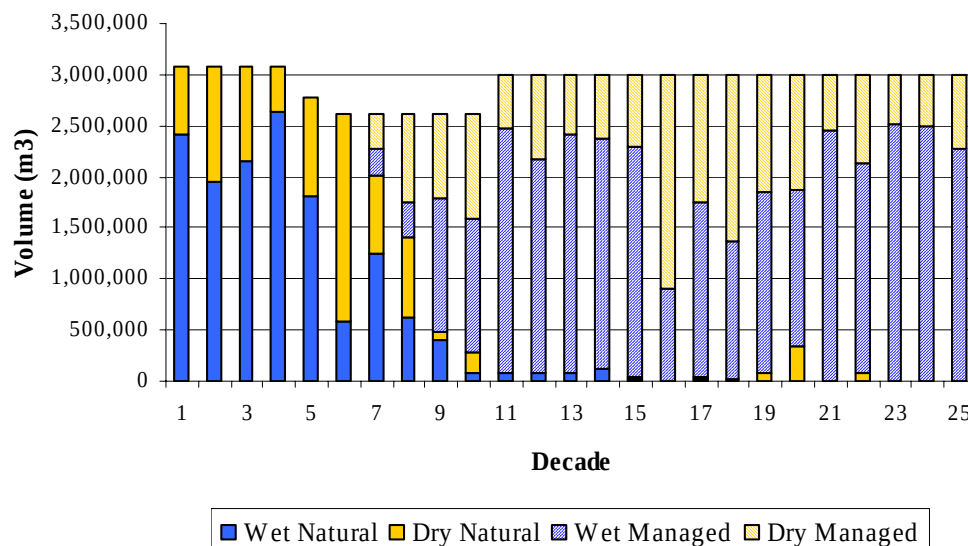


Figure 10. Harvest of natural and managed stands over time (TSR3).

4.1.2 Timber Supply Projection Including MPB Impacts

Figure 11 shows the results of a mountain pine beetle sensitivity run from the TSR 3 analysis. In this scenario, the epidemic is assumed to stop in 2015 and total MPB mortality is assumed to be ~37 million m³ (19% of current growing stock). Harvest levels are assumed to increase to 3.685 m³/yr for the next 15 years and then step down significantly over a ten-year period to 2.6 million m³/yr.

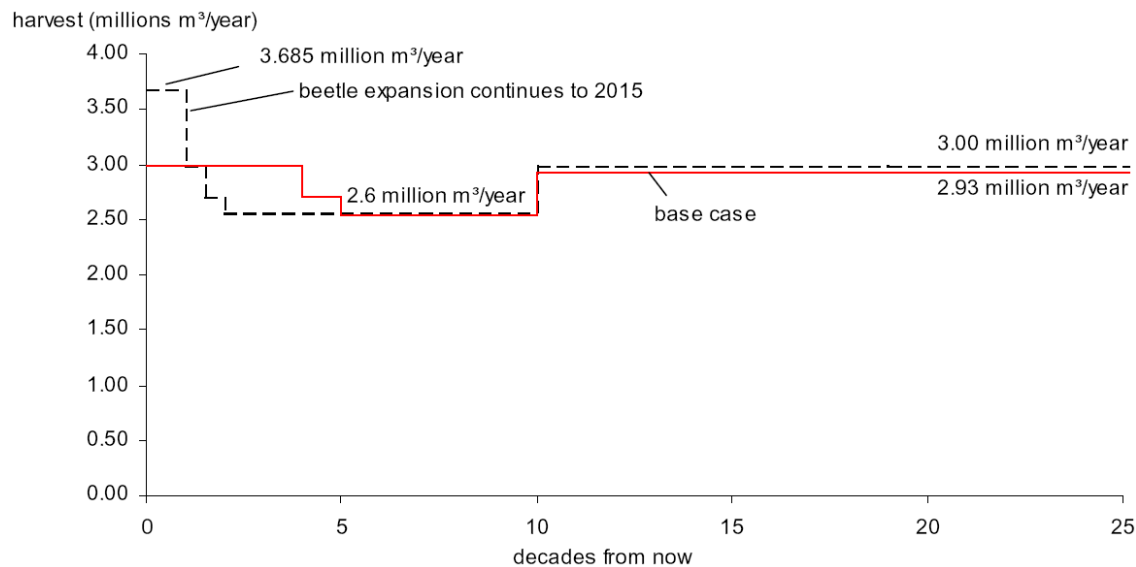


Figure 11. TSR3 mountain pine beetle impact sensitivity analysis (infestation stops at 2015).

Assumptions:

Under this scenario a shelf life of five years is used and it is anticipated that 8.5 million m³ will still remain unsalvaged on the land base. This occurs because mortality in attacked stands with PI as a minor species is a lower priority and is not captured during the five year shelf life. Non-salvaged areas were assumed to have a 15 year regeneration delay and come back as natural stands (VDYP curves). Also, only 73% of the AAC was assumed to be directed at PI to be consistent with mill profiles and additional retention was assumed to be left in very severely attacked stands.

This scenario could be considered optimistic relative to Marvin Eng's projections of mortality (42.8 million m³ dead by 2020) and the understanding that there is likely to be MPB mortality in younger PI plantations.

4.1.3 Midterm Dip in Harvest Levels

As a result of the sudden reduction in growing stock over the next 10-20 years from the MPB infestation, harvest flow will have to drop into a midterm trough sooner than what the TSR3 base case scenario would suggest.

4.1.4 Unsalvaged MPB-killed Timber with Poor/No Regeneration

According to the Marvin Eng projections, the current AAC uplift and harvest priorities will only be able to keep up to the MPB until 2007-2008. After that it is likely that infestation levels will surpass the harvest rate. As well, because of mixed species stands and dispersed mortality, it is likely that a significant amount of volume will go unsalvaged. The area of dead PI stands that will have no reforestation obligations will likely be significant (>5000 ha) and may require intervention to get regeneration established. The mixed stands with low %PI are likely to have the PI volume fall out prior to harvest but will likely still be logged and regenerated in the midterm period. Additionally, there will be some immature stands not currently of merchantable size that will be killed by the mountain pine beetle. This area may also have little or no regeneration.

It will be key to ensure these all impacted THLB sites with no reforestation obligations are regenerated to maximum potential. If not regenerated, it will be critical to understand the extent of the impacts as they are represented in non-recoverable losses or stand volume reductions.

4.2 Timber Quality Issues

The current provincial target for premium logs is 10% of a TSA's AAC. The previous Type 2 Silviculture Strategy had a general goal of "maintain a target average harvested stand diameter of 30cm in the wetbelt and 25cm in the drybelt".

The Type 2 analysis used changes in harvest age and diameter at breast height (dbh) as rough indicators for forest products and quality. Making inferences from these indicators, it is likely that premium log content will drop severely in the midterm and less so in the long term. This occurs because the average age of harvested stands is declining over time as we move into the harvest of second growth managed stands. The midterm timber supply deficit caused by the MPB will expedite this trend because very young managed stands will be the primary source of harvest during this time period. As a result, timber quality will decrease during the deficit period along with average piece size. Figure 12 shows the decline in harvested stand average dbh associated with the preferred silviculture strategy defined in 2002. This projection does not reflect the current MPB situation so the midterm would likely show a more pronounced reduction.

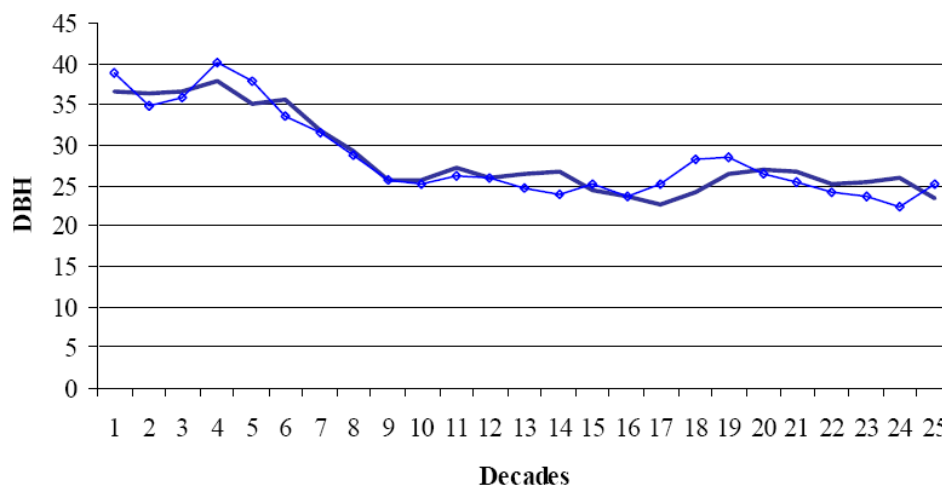


Figure 12. Harvested stand average diameter over time (Type 2 silviculture Analysis)

The intention is to identify incremental silviculture activities that could increase timber quality during this deficit period. These activities could include a range of incremental silviculture activities aimed at increased average piece size at harvest and/or creating clear logs.

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.

The Okanagan-Shuswap LRMP provides a framework for land use in the TSA. Approved in 2001, the LRMP provided for increased protected areas (now 7.9% of productive forest land base), as well as 10,000 ha allocated to Enhanced Riparian Protection, 9500 ha to Caribou Reserves, 10,000 ha deferred harvesting in Caribou habitat and approximately 62,000 ha of draft Old Growth Management Areas in the Timber Harvest Land Base (THLB). These reserves help species and ecosystems sustain the impact of habitat changes resulting from Mountain Pine Beetle and associated salvage harvesting.

Mountain Pine beetle impacts will not be limited to areas available for timber harvest. Lands reserved to provide protection for sensitive species, riparian, wildlife tree recruitment, and old growth will also be affected both directly by increased mortality of pine and indirectly by impacts of roads, water quality/quantity/ECA changes, and associated habitat impacts. Landscape units with low biodiversity emphasis will be a high risk of loss of species diversity because of reduced reserve areas. Species sensitive to changes in pine forest, or indirect forestry related impacts will also be at higher risk, particularly if spreading mountain pine beetle and salvage occurs within reserves designed to protect them.

Planning supports biodiversity and silviculture success: This strategy seeks to identify the best silviculture opportunities to maintain and enhance habitat supply. Reducing impacts will also require high quality planning to design salvage harvest approaches that either avoid or sensitively address watersheds with high value to fish and water users, biodiversity, key habitat values and species at risk or of management concern. If too many habitat elements are removed, or damaged under the pressure to manage mountain pine beetle, even the best silviculture strategies will not be able to create, in the short/medium term, what has been removed. A supply of habitat will be sustained by avoiding salvage in sensitive watersheds, riparian areas, OGMAs, WTPs, and other retained areas designed for mitigating impact to environmental values.. Key habitat elements can be maintained by retaining mature and old spruce, Ponderosa Pine, Western Larch, Douglas-fir, Cottonwood and Aspen. Trees left today will support both habitat and timber supply in the future.

Two NDTs characterize the area where pine and fir forests dominate in the Okanagan-Shuswap TSA (Biodiversity Guide Book 1995).

1) NDT 3 (frequent stand initiating events)

Fire suppression has increased the mature and old pine component providing enhanced supply of host trees for MPB. In this NDT, added retention, strategically located will reduce risk to environmental values.

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

Suppression of frequent understory fires has created extensive in-growth, and fuel levels considered to be beyond the range of natural variability in Douglas-fir and Ponderosa pine stands. This has increased the risk of widespread crown fires in areas where these did not naturally occur. Removing some of this ingrowth mechanically and with managed understory fire will decrease wildfire risk near settlement areas as well as enhance/protect timber and environmental values.

Table 8 lists representative examples of wildlife species in the Okanagan TSA that could be negatively affected by MPB salvage logging.

Table 8. Old and mature forest associated species.

Species/ ecosystems	Forest dependency	Habitat supply implications
Creek resident trout streams	Cool streams	Hydrologic recovery, green up
Bull Trout	Cool streams	Hydrologic recovery, green up
Lewis's woodpecker	Stand structure	Mature trees, aspen, supply of deciduous
Williamson's Sapsucker	Stand structure	Mature trees, aspen, supply of deciduous
Grizzly bear	Road sensitive	Access management, rehabilitation roads
Wolverine	Road sensitive	Access management, rehabilitation roads
Fisher	Stand structures CWD Landscape connectivity	Continuity of habitats across landscape through time.
Northern goshawk	Mature forest stands	Larger old mature forest stands
Flammulated owl	Mature forest	Old forest habitats
Pine marten	Stand structure over-story plus CWD Landscape connectivity	Continuity of habitats across landscape through time.
Moose	Riparian condition Hiding cover	Thermal and hiding cover
Mule Deer	Old forest and under-story	Old forest stand structures
Elk	Migration corridors	Loss of hiding cover
Salmon Streams	Cool streams	Water quality, quantity, riparian and watershed condition
Mountain Caribou	Road sensitive; old growth; stand structure / lichens	See OK-Shuswap LRMP
Mountain Goat	Road sensitive; thermal cover	Maintain thermal cover & kidding habitat
Big horned Sheep	road sensitive; thermal cover	Maintain thermal cover & lambing habitat
Pinus contorta / Alnus viridis ssp. sinuata / Calamagrostis rubescens	CDC blue listed	Requires identification
Pinus contorta / Calamagrostis rubescens - Arctostaphylos uva-ursi	CDC yellow listed	Requires identification
Pinus contorta / Calamagrostis rubescens - Lupinus arcticus	CDC yellow listed	Requires identification
Pinus contorta / Juniperus communis / Calamagrostis rubescens	CDC yellow listed	Requires identification
Pinus contorta / Juniperus communis / Lupinus arcticus	CDC yellow listed	Requires identification
Pinus contorta / Juniperus communis - Paxistima myrsinites	CDC blue listed	Requires identification
Pinus contorta / Vaccinium caespitosum / Sphagnum spp.	CDC blue listed	Requires identification
Pinus contorta / Vaccinium membranaceum / Cladonia spp.	CDC yellow listed	Requires identification
Pinus contorta / Vaccinium scoparium - Calamagrostis rubescens	CDC yellow listed	Requires identification
Pseudotsuga menziesii - Pinus contorta / Calamagrostis rubescens / Pleurozium schreberi	CDC yellow listed	Requires identification

Landscape/Watershed Values Placed at Increased Risk

Aquatic ecosystems, species and supply of domestic water use: Changes in hydrology can be estimated by equivalent clear cut area (ECA) and road density. Significant increases in ECA, road density, kilometers of road ditches, and increased numbers of stream crossings will result from salvage harvest. These changes increase runoff and place infrastructure for water users and stream crossing structures at greater risk due to increased peak flows. This also increases risk to stream channel integrity with possible changes in channel morphology, increased bedload transport potential and stream bank instability. Hydrologic risk can be reduced through speeding hydrological green-up in the most sensitive watersheds and through increased emphasis on maintaining vegetation within riparian ecosystems. This is especially important in the following areas.

1. All fish-bearing streams
2. Wetlands
3. Community watersheds

Loss of mature and old pine: 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, terrestrial and water values. Old growth areas have been drafted for the Okanagan-Shuswap TSA, consistent with the Provincial Old Growth Order, <http://srmwww.gov.bc.ca/rmd/oldgrowth/>. These areas are being avoided for harvest, but resources are lacking to field check, monitor or respond to forest health considerations in OGMAs. Where possible, OGMAs can be designed to minimize MPB risks by selecting mixed species stands, where these are available. Elsewhere, uniform stands of pure pine (e.g. some Montane Spruce subzones) limit opportunities for mixed species retention. In sites like these, replacing OGMAs infested by MPB may be difficult. Silviculture strategies may provide an opportunity to improve future condition of OGMAs.

Reduced landscape connectivity: Clearcut harvesting to remove infested pine from mixed stands, extensive clearcuts in pine-dominated watersheds and intensive large-scale fires limit stand structures that serve to connect habitats across a landscape. This loss can cause disproportionate impacts to species at risk or those confined to isolated pockets of suitable habitat. Connectivity is provided in the Okanagan-Shuswap TSA through various mechanisms including strategies that prescribe retention for specific resource management zones, guidance related to marten and fisher habitat management, OGMAs, and riparian management provisions. Monitoring the impact to stand structure in these areas may be needed to ensure they provide required stand structure over time.

Risk to biodiversity, already higher in low biodiversity landscape units, is likely to increase as a result of losses of mature pine forest to pine beetle. Where a number of low emphasis landscape units are clustered, special consideration may be required for maintaining connectivity between isolated populations of species at risk. Depending on species composition and clear cut levels, areas managed for moderate or high biodiversity may also require additional management for connectivity. Prescribing foresters can help enhance connectivity by increasing retention levels in large cutblocks and focusing silviculture strategies in riparian areas, gullies, connectivity corridors for Caribou and surrounding wildlife habitat

features. Mapping pine stands, OGMAs, retained riparian areas, WTPs and other reserves by watershed and will help identify deficiencies and focus priorities for both retention and silviculture.

Loss of large older and mature sized forest patches: There are no objectives for managing patch size in the Okanagan-Shuswap TSA. Chief Forester guidance⁴ and other large cutblock related direction incorporates some of the concepts related to patch size, but these do not substitute for patch size management. MPB has the advantage of promoting larger patch sizes in landscapes that traditionally experienced large-scale disturbances. However, salvage harvesting is in many ways different from what would occur in nature, and the extent and intensity of current infestations may be exceeding historical scales of disturbance. Managing to maintain a continuous supply of the various patch sizes over space and time poses a daunting task when overlaid by MPB patterns of infestation. Nevertheless, this deserves to be considered as part of silviculture planning.

Wildlife trees and coarse woody debris: Wildlife trees are managed in the TSA through provisions in the Forest and Range Practices Act, and LRMP objectives and strategies. Direct impacts of MPB infestation can enhance supplies of wildlife trees and CWD, at least in the short to medium term but, actions such as salvage, road building, and safety issues associated with roads, replanting and stand tending may result in the loss of higher value large diameter fir, larch, ponderosa pine and deciduous wildlife trees and CWD. Wildlife trees and CWD are also vulnerable to intensive fires promoted by climate change and large supplies of MPB killed pine. Strategies to retain coarse woody debris, wildlife trees and wildlife tree supply through time are a critical part of silviculture planning.

Increase in roads and access: Many species at risk or of management concern are negatively affected by roads and roads could increase significantly to manage forest health and salvage MPB. The potential for impact to many species including grizzly bear, moose, Mountain Goat, Bighorn Sheep and Mountain Caribou is of serious concern. Given the concentration of species at risk in this TSA and the vulnerability of key forest-dependent species like Mountain Caribou, increased emphasis on managing road impacts is warranted.

Cattle use: Cattle use in association particularly with riparian areas and newly planted areas will continue to be a concern for managing both habitat and timber supply. When designing silviculture treatments, consider, retain and enhance existing barriers to cattle access associated with riparian areas.

⁴ (http://www.for.gov.bc.ca/hfp/mountain_pine_beetle/stewardship/cf_retention_guidance_dec2005.pdf)

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. Timber quality will remain relatively constant with historical levels, although a higher proportion of PI harvest is expected.

Habitat supply issues exist in the short term as a result of an AAC uplift and salvage and/or MPB mortality. Changes in hydrology and the impact of environmental values linked to water are most uncertain. Changes in transpiration from loss of pine stands are immediate and elevated harvest levels and the amount of active road is incremental to this. Some watersheds will be more sensitive to loss of pine. The impact on water can be mitigated through salvage planning and prompt planting to speed green-up which aids hydrologic recovery

5.2 Midterm

The midterm (20-100 yrs from now) is likely to experience significant reductions in timber supply relative to short-term harvest levels before rising again to the long-term harvest level. The midterm harvest level is expected to be similar to 2001-2005 harvest levels (2.6 million m³/yr) – the trough exists as a result of the IFPA/MPB uplift at the front end and the elevated long term harvest levels coming from improved managed stand productivity estimates. During the midterm, MPB salvage will have ended and harvest will be focused on remaining mature non PI 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 younger and have small piece size, and thus will put pressure on the log quality (size) profile.

The supply of habitat needed to maintain current fish and wildlife populations and maintain biodiversity complexity will be at risk because the remaining mature and old forests will be diminished in extent and more fragmented in distribution. Water supply will also be at risk because of changes to peak flow timing and magnitude. The road networks will be at their maximum expansion so, in areas not prudently planned, there may be significant impacts related to stream bank stability, stream integrity location of future high impact areas is to some extent weather dependent. In addition in the midterm, 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 impacted by MPB (e.g., OGMA's, WTP's, Riparian Areas, Parks, etc).

5.3 Long term

Long term harvest levels (LTHL) are projected to be above midterm levels and well above the TSR2 LTHL because of better information on managed stand site indexes. Without silviculture investments, the LTHL will be below the productive capacity of the land base because of poor or no regeneration on those 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.

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 (60-100 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 9.

Table 9. 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 Late rotation fertilization (40-80y old) Fd or Lw (wetbelt) ⁵	9,700	++	++		+	+/-	400	H
TS1b Late rotation fertilization (40-80y old) Sx SI 15-24m (wetbelt) ⁵	1,000	++	++		+	+/-	400	M
TS1c-d. Late rotation fertilization (81-140yrs old) non PI (wetbelt) ⁵	2,500 Sx 42,000 Fd/Lw	+	+		+	+/-	400	H ⁶
TS2. Young stand fertilization (non PI) (wetbelt) ⁵	38,000		+++		+	+/-	400	H
TS3. Space and/or fertilize repressed PI	36,000		+	++	+		1000	L ⁷
TS4. Spacing (drybelt Fd)	5,000		++	+++	++	++	600	H
TS5. Planting THLB sites with no reforestation obligations (timber focus) – areas impacted by catastrophic fire	1,100 (within current ROI limits)		+	+++		+++	1500	H
TS6. Planting THLB sites with no reforestation obligations (timber focus) – areas impacted by pests/disease	3,000		+	+++		+++	1500	H

⁵ Can include some drybelt where moisture is limiting (ie better sites or transitional variants)

⁶ High on a trial basis only.

⁷ High for fire origin PI stands with extreme densities. 2003 fire's contain much of this area but it won't need spacing for years.

Strategy	Opportunity in Next 5 yrs (ha)	Timber Supply Effects			Quality	Habitat	Cost/ha (\$)	Rank
		Short	Mid	Long				
TS7a. Address Backlog - NSR Backlog	500		+	+		-	2100	H
TS7b. Address Backlog - Maintain Backlog SR stands (space or brush of impeded stands)	35,000		+	+		-	900	H
TS8a Rehab PI problem forest types	2,000		+	++			1700	L ⁵
TS8b Rehab under performing regenerating stands	450		+	+			1700	H
TQ 1 Pruning	500				+	++	800	L
TQ 3 Manage to higher densities for MSR lumber	500		-	+		-	0	H
HS1. Planting trees and shrubs on NonTHLB sites with no reforestation obligations (habitat focus) – riparian areas, high risk watersheds, WTP's retention areas, critical habitats	4,100					++	700	H
HS2. Thinning / Spacing – to accelerate old growth attributes	500		+	+	++	++	600	H ⁵
HS3. Spacing/thinning in drybelt Fd stands (NDT4) to reduce ingress / encroachment / overstocking	1,500		+	+	++	++	600	H
HS4. Treat for invasive species (spray/pull/plant/etc)	10,000		+	+		++	100	H
HS5 Burn to improve habitat quality	1,000					++	500	H ⁸
HS6. Rehab roads and landings (habitat focus)	300		+	+		++	5000	H ⁹

The following sections provide additional detail on the potential strategies.

6.1 Potential Strategies to Improve Timber Supply

Table 10) 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.

⁸ MoE ranked high. Licensees ranked low because of concerns over liability and overachievement.

⁹ 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.

Table 10. Timber supply strategies.

Strategy	Workshop Comments / Discussion	Anticipated Benefits	Timing of Benefit
TS1a-b Late rotation fertilization of near mature Fd and Sx stands (40-80years old stands where moisture is not limiting)	<p>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 and Lw stands as it has a greater response than Sx. Moisture limited sites (drybelt) should be avoided.</p> <p>Priority = High (Fd) and Moderate (Sx) Is one of the few opportunities to influence the front end of the trough.</p>	<p>Fd -17m³/ha per application.¹⁰</p> <p>(Sx -11 m³/ha per application).</p> <p>Benefit realized over 10 yr period.</p>	Short to Midterm
TS1c-d Late rotation fertilization of older Fd and Sx stands (81-140years old stands where moisture is not limiting)	<p>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. Lots of opportunity (ha) but responses are unproven.</p> <p>Priority = High as a trial. Response is less certain as data are limited on treating older stands; therefore a trial is suggested for stands at the younger end of the range.</p>	<p>No North American data but response could be similar to younger stand benefits described above.</p>	Short to Midterm
TS2a-b Young stand fertilization (Fd and Sx - where moisture is not limiting)	<p>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.</p> <p>Priority = High. The intent is to focus on Fd first and Sx as a trial, because of concerns around terminal weevil and armillaria. <i>Once the risks associated with MPB are reduced, treatment of younger PI stands will become a high priority with very large potential benefits.</i></p>	<p>Fd - 17m³/ha per application.</p> <p>Sx - 11 m³/ha per application.</p> <p>Benefit realized over 10 yr period.</p>	Back end of Midterm
TS3 Space and/or fertilize repressed PI or space fire origin PI / Fd / Lw stands	<p>Several recent small-scale studies have shown spacing and fertilization of repressed PI stands has the potential to break them out of their stagnant condition and differentiate.</p> <p>Priority = Low. Group felt a trial might be beneficial but didn't have much appetite for treating older repressed PI stands. The exception was for spacing of fire origin stands with high densities (i.e. 2003 fire regen).</p>	<p>Bring stands back into the THLB (~150m³/ha) or improve their merchantable volume (~100 m³/ha).</p>	Mid to Long Term
TS4 Spacing (drybelt Fd)	<p>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 in order to achieve the objective.</p> <p>Priority = High – lots of potential area with both timber and non-timber benefits achieved (habitat, urban interface fuels reductions, etc)</p>	<p>It was assumed that an additional entry into the stand would be possible if treatment occurs (15-30 m³/ha).</p>	Mid to Long Term
TS5. Planting THLB sites with no reforestation obligations (timber focus) – areas impacted by catastrophic fire	<p>Substantial areas burned in 2003 but most of the area is regenerating naturally or does not fit current return on investment criteria. Approximately 1100 ha meet the criteria and have a planting program currently underway.</p> <p>Priority = High (continued funding of existing program and a desire to look at a broader range of sites)</p>	<p>Maintain productivity of the THLB</p>	Mid to Long Term

¹⁰ 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 PI 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
TS6. Planting THLB sites with no reforestation obligations (timber focus) – area impacted by pests/disease	Most concentrated MPB mortality is expected to be salvaged but there will likely be some areas that will require preparation and planting. Maintaining the productivity of these sites will be critical to long term timber supply. Planting under dead stems may be an option if done quickly – need to work with WCB to allow access - although there is a concern over future access for other treatments (brushing, spacing, etc). Planning will need to identify suitable areas and approaches. Intent is to prioritize areas with high non-timber values or high site index areas. Leave pockets of snags standing for structure/habitat. Priority = High	Maintain productivity of the THLB	Mid to Long Term
TS7a. Address Backlog Issues - NSR	Rehabilitation of backlog NSR sites is an activity already underway in Okanagan Shuswap District but the consensus is that all of the cost effective sites have been addressed already. Continuation of the activity is still considered important. Priority = High (where economics make sense)	Maintain productivity of the THLB.	Mid to Long Term
TS7b. Address Backlog - Maintain Backlog SR stands (space or brush of impeded stands)	Maintaining existing backlog plantations (i.e. impeded stands) is an activity already underway through the IFPA. Initial data queries suggested over 100,000 ha of impeded stands existed - a contract is in place ID actual areas. Assumption is that ~30% will be 'real'. Priority = High	Maintain productivity of the THLB.	Mid to Long Term
TS8a. Rehab PI problem forest types	Knocking down problem forest types and starting new stands was discussed as a method of improving long term timber supply (more THLB) but the consensus was that investing in these sites gave a poor return. Most PFT sites are low site index. The previous silviculture strategy identified this a high priority but this time the group saw better uses for limited dollars. Priority = Low	Increase the size of the THLB	Mid to Long Term
TS8b. Rehab under performing regenerating stands	There area plantations where poor stock / wrong provenance was used and very poor growth is occurring. These sites can be knocked down and put back into production again – will maintain TSR expectations from these sites. Priority = High (not much area but need to maintain status quo)	Realize expected yields from these sites.	Mid to Long Term

6.2 Potential Strategies to Improve Timber Quality

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

Table 11. Strategies to improve timber quality

Strategy	Workshop Comments / Discussion	Anticipated Benefits	Timing of Benefit
TQ1. Pruning	Ensuring a future supply of clear logs was not a high priority for the TSA thus pruning was not deemed an economically suitable treatment at this time. Pruning was only considered for non-timber benefits (ladder fuels, etc) Priority = Low	Increase in clear log volume.	Mid to Long Term
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	Larger piece sizes, diversity in log products.	Long Term

Strategy	Workshop Comments / Discussion	Anticipated Benefits	Timing of Benefit
	objectives that force longer rotations (VQO's MDWR, etc). Priority = Low		
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. Priority = High	Creation of more 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 12. Strategies to improve habitat quality

Strategy	Workshop Comments / Discussion	Anticipated Benefits	Timing of Benefit
HS1. Planting trees and shrubs on NonTHLB sites with no reforestation obligations (habitat focus) – riparian areas, high risk watersheds, WTP's retention areas, critical habitats	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). The 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 ¹¹ , WTPs, and potentially habitats associated with species at risk. OGMA's were clearly identified as areas that will NOT be planted. Priority = High	Improved habitat quality hydrologic recovery, improved recovery of pine dominated riparian for shade and reductions in stream temperature,	Continuous
HS2. Thinning / Spacing – to accelerate old growth attributes	To be applied to mid seral to mature stands where old growth attributes need to be accelerated (deficit LU-BEC units). Thinning will help to accelerate the presence of old growth attributes in these stands; Areas that contribute to caribou habitat may be a priority. Priority = High (Trial only)	Increased areas with old growth attributes.	Short to Midterm
HS3. Spacing/thinning in drybelt Fd stands (NDT4) to reduce ingress / encroachment / overstocking	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. Reduce crown fire risk, a shift back towards stand structures with a range of natural variables (less stems and more understory)	Short to Midterm
HS4 Treat for invasive species	Invasive species can severely reduce native species abundance and diversity. Large areas are presently affected reducing browse and diversity, and potentially making conifer regen more difficult. Priority = High	Maintain native species mix and distribution. Maintain grazing and browse species abundance.	Continuous

¹¹ Restoration of riparian ecosystems associated with the following areas will be key: fish bearing streams, wetlands, temperature sensitive streams, and community watersheds.

Strategy	Workshop Comments / Discussion	Anticipated Benefits	Timing of Benefit
HS5 Burn to Improve Habitat Quality	Areas that have been spaced and/or currently open stands (NDT4) require under-burning to develop 'natural' stand conditions. Burning of MPB killed PI in NDT3 was also discussed as a means of regeneration by MoE. NDT4 Priority = High (MoE), Low (MoF/Licensees) NDT3 Priority = Low (to many logistical challenges)	More natural stand structures 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

Table 13 below 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.

Table 13. 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 <u>some</u> ecosystems in the TSA. However, provide some area that follows more natural regeneration stocking density so that planting does not reduce biological complexity across the landscape.
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 PI species in mature stands and/or advanced regeneration)	Avoid harvest of non PI 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. Partial Harvest during Deficit Period	Constrained areas (VQO's, MDWR, etc) in deficit period. Help to realize volume and will supply more premium logs (older stands).
5. Base Minimum Harvest Age Criteria on Stand Merchantability Thresholds	Regenerating stands should have minimum harvest ages set based on merchantability limits (dbh, vol/ha, etc). This allows managed stands to contribute to timber supply sooner and when it is critical (midterm trough). This simple change in assumptions will likely yield the biggest improvement in timber supply over all options discussed in this report. MoE identified this as a significant issue as retention strategies are based on present harvest age assumptions. Any revisiting of the minimum harvest age would need to address MoE issues.
6. Better define growth and yield predictions for complex stands (drybelt Fd).	Yields for sites under selection management may be underestimated.
7. Protect growing volume from forest health threats	Need to keep green timber growing and available for deficit period (midterm).

Strategy	Workshop Comments / Discussion
8. Manage for tree species diversity	Retain or establish non PI species, including broadleaves during spacing, thinning or planting. (relates to timber supply strategies)
9. Vary regenerated stand spacing	Leave clumps, low and high densities to also encourage a diversity of products and habitats. (Relates to timber supply strategies).
10. Create an access management plan	Manage access within forested land base when so much of it will be opened up all at one for salvage purposes.
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. Strategic retention can be applied to the most sensitivity watersheds and to target these from prompt under-planting. 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). This should also benefit midterm timber supply by retaining areas with mixed pine overstory and/or advanced regeneration.

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:

- Harvest at a level that minimizes non recoverable losses

Midterm:

- Minimize the depth and duration of the midterm trough

Long term:

- LTHL of 3 million m³/yr (inherent capability +–5%)

7.2 Timber Quality Targets

Mid and Long Term:

- Maintain diversity of stand types and ages across the land base – range of products including cedar poles/house logs/peelers/MSR grade lumber.
- Overall the intent is to favour timber and habitat supply strategies over quality strategies where resources are limited.

7.3 Habitat Supply Targets

Overall Objective

- Minimize negative impacts on water resources, ecosystems and species:

Short Term

- Stand and landscape level retention strategy developed for short-term retention to optimally mitigate impacts to environmental values.
- Reforest a proportion of impacted WTP / RMA's or other strategically identified retention areas to reduced stocking levels where ecologically appropriate.
- Increased levels of broad leaf trees and other appropriate species to increase stand level diversity across the land base.

Midterm and Long Term

- Maintain or improve the conservation status of all species where possible (Ensure forestry practices do not make species status worse).

8.0 Silviculture Strategy

This section summarizes the preferred silviculture strategy developed at the Okanagan 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 5 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 silviculture¹². This plan/budget illustrates where resources would be allocated if resources were limited.

8.1 High Priority Strategies

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

Late Rotation Fertilization (40-80 year old Fd, Lw, Sx stands where moisture not limiting)

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 fertilization¹³. Fertilization is restricted to the wet belt other than on a trial basis due to moisture limitations in the drybelt. Fd / Lw 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.

¹² A value that represents double the 2002 FRBC RMP budget was used because it was believed to be close to what will come available in the next 5 yrs.

¹³ 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.

Young Stand Fertilization (15-40 year old Fd and Lw stands where moisture not limiting)

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 / Lw was considered the more desirable species to treat due to higher volume gains and the concern of leader weevil attacks in young Sx stands¹⁴. 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). Concern was expressed on the impact of armillaria root disease with fertilization. Prior to widespread treatment, the interactions between fertilizer application / response and root disease was recommended for study.

Thinning of Fire Origin Stands Facing Repression

Where fire origin PI /Fd/ Lw stands are experiencing extreme densities, thinning was identified as an opportunity to ensure these stands contribute to timber supply in the future. The areas burnt in the 2003 fires were seen as the prime candidates.

Planting for Timber Values

Benefits were identified for planting impacted areas of the THLB that have no reforestation obligations (recent wildfires, MPB killed stands, etc) . 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 areas 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 PI stands and plantations impacted by MPB.

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. This work is well underway for the recent wildfires but consideration of future MPB impacts is important as well. Planting of small scale salvage areas was considered important but licensees were concerned with the idea of government accessing special funding mechanisms (FIA / FFT / Federal funds) to complete this work.

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, WTPs, retention areas, and specific watersheds where hydrologic green up will speed recovery and reduce risk to fish and water users). Planting these sites with conifers, broadleaves, and/or shrubs will provide

¹⁴ 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.

improved habitat values in high risk/high values areas. There is a time limit on making decisions for these areas as costs increase when pines become unstable and extensive 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 would be useful to identify and quantify the areas of highest risk and where silviculture treatments will be of most benefit.

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. Initial results queries suggest over 120,000 ha of impeded stands could exist but early indications of a study aimed at narrowing down this estimate suggest less than a third (35,000 ha) may actually be impeded. This area is still substantial and ensuring/maintaining stand productivity is critical to future timber supply.

Under-burning in Drybelt Stands

A program of under-burning in open grown NDT4 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.

Rehab Under Performing Regenerating Stands

A program to replace plantations where poor stock / wrong provenance was used and very poor growth is occurring was considered important. These sites can be

knocked down and put back into production again to maintain TSR expectations from these sites. It was recognized that not much area fits this category. It is also recognized that some of these stands provide habitat diversity and function at this time.

Manage For Higher Densities On A Portion Of The Land Base

Managing for stands with higher densities to increase MSR lumber production was the only quality strategy rated high. This was seen as a possible option but must be coordinated with other options that are promoting shorter rotations to fill the midterm trough. Increased stand densities can extend the time period where a stand is considered unmerchantable.

Retention Strategy Planning

A retention strategy is needed to help guide treatment opportunities. 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. The strategy can also benefit midterm timber supply by retaining areas with mixed pine overstory and/or advanced regeneration.

Thinning / Spacing to Accelerate Old Growth Attributes

Where old growth areas are currently in deficit, it was considered a high priority to implement a trial that thinned/spaced mid seral or mature stands in an attempt to accelerate the onset of old growth stand conditions. Areas that contribute to caribou habitat could be a priority. (Trial Only)

Use of Improved Seed

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

Treat For Invasive Species

Invasive species can severely reduce native species abundance and diversity so treatments (hand pulling, backpack spraying, overhead spraying) to remove these species were considered important. This strategy is at least partially funded under non-silviculture government budgets.

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 78.95 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	1,000	11,750	11,750	11,750	13,294	49,544
Spacing/Thinning (timber)	-	2,250	2,250	3,250	3,250	11,000
Spacing/Thinning (habitat)	50	500	500	500	-	1,550
Planting (timber)	1,200	1,292	800	800	800	4,892
Planting (habitat)	50	200	250	1,800	1,800	4,100
Pruning	-	-	-	-	-	-
Rehab underperforming & PFT stands	-	100	100	100	100	400
Address Backlog (NSR and Impeded)	7,100	7,100	7,100	7,100	7,100	35,500
Rehab Roads/Landings	-	300	300	300	300	1,200
Treat for Invasives	2,000	2,000	2,000	2,000	2,000	10,000
Under burning	200	200	200	200	200	1,000
Totals	11,600	25,692	25,250	27,800	28,844	119,186

Proposed Budget (\$)

Activity	Year 1 (ha)	Year 2 (ha)	Year 3 (ha)	Year 4 (ha)	Year 5 (ha)	Totals (ha)
Studies/Surveys	385,000	\$ -	\$ -	\$ -	\$ -	\$ 385,000
Fertilize	\$ 600,000	\$ 4,700,000	\$ 4,700,000	\$ 4,700,000	\$ 5,337,600	\$20,037,600
Spacing/Thinning (timber)	\$ 125,000	\$ 1,350,000	\$ 1,350,000	\$ 1,950,000	\$ 1,950,000	\$ 6,725,000
Spacing/Thinning (habitat)	\$ 30,000	\$ 300,000	\$ 300,000	\$ 300,000	\$ -	\$ 930,000
Planting (timber)	\$ 1,900,000	\$ 2,038,000	\$ 1,300,000	\$ 1,300,000	\$ 1,300,000	\$ 7,838,000
Planting (habitat)	\$ 20,000	\$ 240,000	\$ 175,000	\$ 1,260,000	\$ 1,260,000	\$ 2,955,000
Pruning	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Rehab underperforming & PFT stands	-	\$ 170,000	\$ 170,000	\$ 170,000	\$ 170,000	\$ 680,000
Address Backlog (NSR and Impeded)	\$ 6,510,000	\$ 6,510,000	\$ 6,510,000	\$ 6,510,000	\$ 6,510,000	\$32,550,000
Rehab Roads/Landings	-	\$ 1,500,000	\$ 1,500,000	\$ 1,500,000	\$ 1,500,000	\$ 6,000,000
Treat for Invasives	\$ -	\$ 200,000	\$ 200,000	\$ 200,000	\$ 200,000	\$ 800,000
Under burning	\$ 10,000	\$ 10,000	\$ 10,000	\$ 10,000	\$ 10,000	\$ 50,000
Totals	\$ 9,580,000	\$ 17,018,000	\$ 16,215,000	\$ 17,900,000	\$ 18,237,600	\$ 78,950,600

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	1,283	-	-	-	-	1,283
Fertilize	100	1,175	1,175	1,175	1,329	4,954
Spacing/Thinning (timber)	-	7,628	7,628	11,018	11,018	37,290
Spacing/Thinning (habitat)	170	1,700	1,700	1,700	-	5,270
Planting (timber)	3,100	3,284	2,300	2,300	2,300	13,284
Planting (habitat)	100	200	500	3,600	3,600	8,000
Pruning	-	-	-	-	-	-
Rehab underperforming & PFT stands	-	450	450	450	450	1,800
Address Backlog (NSR and Impeded)	18,660	18,660	18,660	18,660	18,660	93,300
Rehab Roads/Landings	-	300.00	300.00	300.00	300.00	1,200.00
Treat for Invasives	2,000	2,000	2,000	2,000	2,000	10,000
Underburning	40	40	40	40	40	200
Totals	25,453	35,437	34,753	41,243	39,697	176,582

In addition to the above strategies/investments, a retention strategy plan was 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,

assess fertilization / armillaria / response relationships). Ongoing survey and layout costs associated with specific strategies are included in the strategy costs.

8.2.1 Expected Outcomes (Idealized Funding Level)

If \$78.9 million was invested over a 5-year period, the following outcomes could be expected:

Estimated Timber Supply Outcomes

- 181,400 m³ made available at the front end of the trough
 - o Realized from late rotation fertilization (mostly Fd/Lw stands)
- 2,974,700 m³ made available in the middle of the trough
 - o Realized from young stands fertilization, treatment of impeded stands, and thinning of drybelt Fd stands.
- 765,000 m³ made available in the back end of the trough
 - o Realized mainly through planting of sites with no obligations and treatment of NSR/impeded stands, but also from spacing of repressed PI (OK fire), rehabilitation of roads, and a small amount from rehabilitation of under performing plantations.

Timber Quality Outcomes

- Potentially higher output of logs suitable for production of MSR grade lumber.

Habitat Supply Outcomes

- Enhance old forest stand structure on 12,550 ha of drybelt Fd stands (thinned/spaced), with 1,000 ha of this also under-burned.
- Speed hydrologic recovery and mitigate stream temperatures by regeneration of 4,100 ha of impacted stands with a habitat focus, and regeneration of 4,892 ha of impacted stands with a timber focus.
- Maintain wildlife and recreation values by removal of 1200 ha of roads/landings from the land base.
- Protect native plants through removal of invasive/noxious weed species from 10,000 ha.

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 be significantly reduced (Figure 13). This forecast is highly speculative and there is no guarantee that enough suitable treatment areas could be found. It should be noted that simply allowing more flexibility in the minimum harvest age could result in at least as great an improvement to timber supply at no investment cost.

If this level of funding was continued for 20 years (\$315.6 million total) and similar benefits were achieved throughout, the depth of the midterm trough could be reduced by 50%. Very large volumes are necessary to make improvements to the trough because of its duration. Again, it should be noted that implementing flexibility around minimum harvest ages in the midterm trough would cost nothing and greatly improve the midterm timber supply.

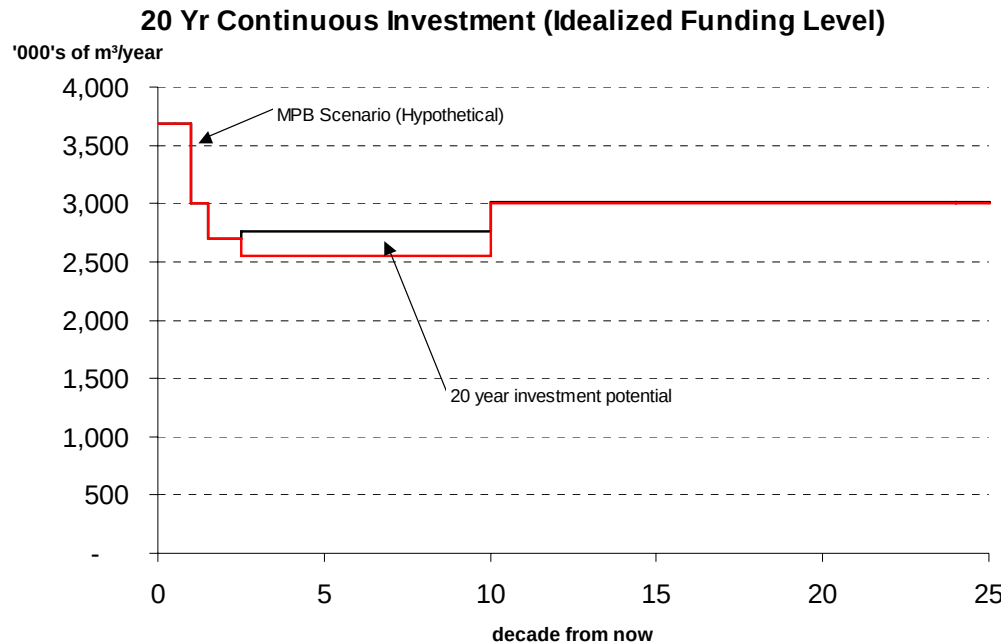


Figure 13. 20 yr continuous investment (idealized funding level)

8.3 Silviculture Strategy Program (Historical Funding Level)

This section describes a silviculture program constrained to approximately 25 million dollars over five years in terms of the area treated, annual 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	1,000	2,550	2,750	2,250	2,150	10,700
Spacing/Thinning (timber)	500	-	1,000	1,000	1,000	3,500
Spacing/Thinning (habitat)	250	500	500	250	250	1,750
Planting (timber)	1,200	1,292	800	800	800	4,892
Planting (habitat)	-	200	250	1,350	1,350	3,150
Pruning	-	-	-	-	-	-
Rehab underperforming & PFT stands	100	100	100	75	75	450
Address Backlog (NSR and Impeded)	1,800	500	600	500	500	3,900
Rehab Roads/Landings	-	100	100	50	50	300
Treat for Invasives	-	2,000	2,000	2,000	2,000	8,000
Under burning	200	200	200	200	200	1,000
Totals	5,050	7,442	8,300	8,475	8,375	37,642

Proposed Budget (\$)

Activity	Year 1 (ha)	Year 2 (ha)	Year 3 (ha)	Year 4 (ha)	Year 5 (ha)	Totals (ha)
Studies/Surveys	325,000	\$ -	\$ -	\$ -	\$ -	\$ 325,000
Fertilize	\$ 600,000	\$ 1,020,000	\$ 1,100,000	\$ 900,000	\$ 880,000	\$ 4,500,000
Spacing/Thinning (timber)	\$ 300,000	\$ -	\$ 600,000	\$ 600,000	\$ 600,000	\$ 2,100,000
Spacing/Thinning (habitat)	\$ 150,000	\$ 300,000	\$ 300,000	\$ 150,000	\$ 150,000	\$ 1,050,000
Planting (timber)	\$ 1,900,000	\$ 2,038,000	\$ 1,300,000	\$ 1,300,000	\$ 1,300,000	\$ 7,838,000
Planting (habitat)	\$ -	\$ 240,000	\$ 175,000	\$ 945,000	\$ 945,000	\$ 2,305,000
Pruning	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Rehab underperforming & PFT stands	\$ 10,000	\$ 170,000	\$ 170,000	\$ 127,500	\$ 127,500	\$ 605,000
Address Backlog (NSR and Impeded)	\$ 1,740,000	\$ 570,000	\$ 660,000	\$ 570,000	\$ 570,000	\$ 4,110,000
Rehab Roads/Landings	-	500,000	500,000	250,000	250,000	1,500,000
Treat for Invasives	\$ -	\$ 200,000	\$ 200,000	\$ 200,000	\$ 200,000	\$ 800,000
Under burning	\$ 10,000	\$ 10,000	\$ 10,000	\$ 10,000	\$ 10,000	\$ 50,000
Totals	\$ 5,035,000	\$ 5,048,000	\$ 5,015,000	\$ 5,052,500	\$ 5,032,500	\$ 25,183,000

Job Outcomes

Activity	Year 1 (ha)	Year 2 (ha)	Year 3 (ha)	Year 4 (ha)	Year 5 (ha)	Totals (ha)
Studies/Surveys	325,000	\$ -	\$ -	\$ -	\$ -	\$ 325,000
Fertilize	\$ 600,000	\$ 1,020,000	\$ 1,100,000	\$ 900,000	\$ 880,000	\$ 4,500,000
Spacing/Thinning (timber)	\$ 300,000	\$ -	\$ 600,000	\$ 600,000	\$ 600,000	\$ 2,100,000
Spacing/Thinning (habitat)	\$ 150,000	\$ 300,000	\$ 300,000	\$ 150,000	\$ 150,000	\$ 1,050,000
Planting (timber)	\$ 1,900,000	\$ 2,038,000	\$ 1,300,000	\$ 1,300,000	\$ 1,300,000	\$ 7,838,000
Planting (habitat)	\$ -	\$ 240,000	\$ 175,000	\$ 945,000	\$ 945,000	\$ 2,305,000
Pruning	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Rehab underperforming & PFT stands	\$ 10,000	\$ 170,000	\$ 170,000	\$ 127,500	\$ 127,500	\$ 605,000
Address Backlog (NSR and Impeded)	\$ 1,740,000	\$ 570,000	\$ 660,000	\$ 570,000	\$ 570,000	\$ 4,110,000
Rehab Roads/Landings	-	500,000	500,000	250,000	250,000	1,500,000
Treat for Invasives	\$ -	\$ 200,000	\$ 200,000	\$ 200,000	\$ 200,000	\$ 800,000
Under burning	\$ 10,000	\$ 10,000	\$ 10,000	\$ 10,000	\$ 10,000	\$ 50,000
Totals	\$ 5,035,000	\$ 5,048,000	\$ 5,015,000	\$ 5,052,500	\$ 5,032,500	\$ 25,183,000

In addition to the above strategies/investments, a retention strategy/plan was 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 \$25 million was invested over a 5-year period, the following outcomes could be expected:

Estimated Timber Supply Outcomes

- 167,700 m³ made available at the front end of the trough
 - o Realized from late rotation fertilization (mostly Fd/Lw stands)
- 370,000 m³ made available in the middle of the trough
 - o Realized from young stands fertilization and treatment of impeded stands.
- 983,800 m³ made available in the back end of the trough
 - o Realized mainly through planting of sites with no obligations and treatment of NSR/impeded stands, but also from spacing of repressed PI (Ok Fire), rehabilitation of roads, and a small amount from rehabilitation of under performing plantations.

Timber Quality Outcomes

- Potentially higher output of logs suitable for production of MSR grade lumber.

Habitat Supply Outcomes

- Enhance old forest stand structure on 5,250 ha of drybelt Fd stands (thinned/spaced), with 1,000 ha of this also under-burned.
- Speed hydrologic recovery and mitigate stream temperatures by of 3,150 ha of impacted stands with a habitat focus, and regeneration of 4,892 ha of impacted stands with a timber focus.
- Maintain wildlife and recreation values by removal of 300 ha of roads/landings from the land base.
- Protect native plants through removal of invasive/noxious weed of invasive/noxious weed species from 8,000 ha.

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 be reduced by ~17% (Figure 14). This forecast is highly speculative and there is no guarantee that enough suitable treatment areas could be found.

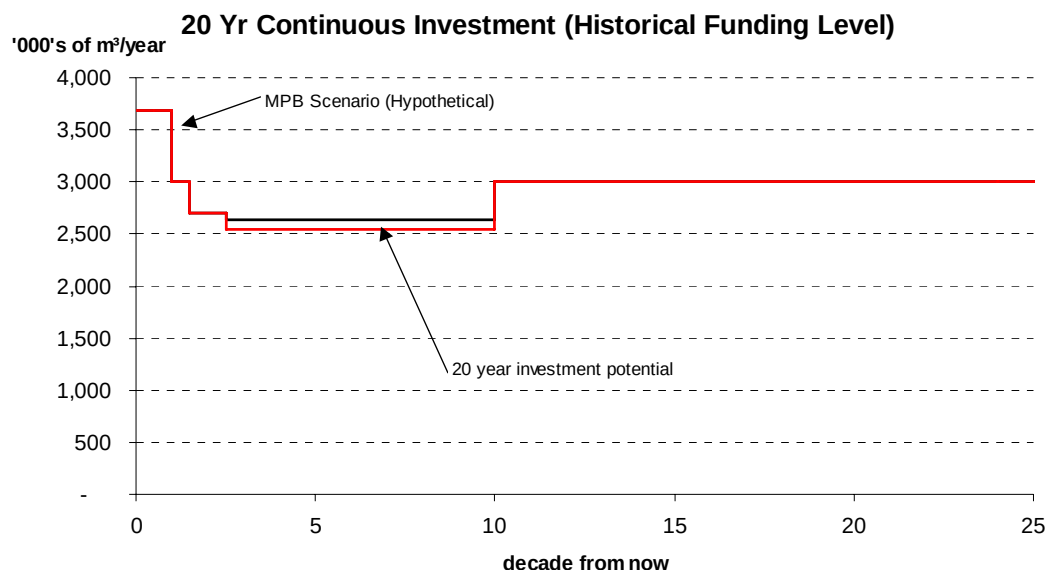


Figure 14. 20 yr continuous investment (historical funding level)

If this level of funding was continued for 20 years (\$100 million total) and similar benefits were achieved throughout, the depth of the midterm trough could be reduced by ~20%. Very large volumes are necessary to make improvements to the trough because of its duration. Again, it should be noted that implementing flexibility around minimum harvest ages in the midterm trough would cost nothing and greatly improve the midterm timber supply.

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. Retention planning is required to identify areas where salvage will not occur and to provide guidance around increased retention at the watershed, landscape stand level and guide incremental silviculture to these areas as needed. It can also benefit midterm timber supply by retaining areas with mixed pine overstory and/or advanced regeneration.
2. 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.
3. Inventory for locations of species of conservation concern so that management, including incremental silviculture activities, can better address these species.
4. Develop a forest health strategy that looks beyond MPB in order to protect growing volume that will be critical in the midterm trough.
5. Develop an access management plan to limit the amount of open road within the TSA.
6. Develop a seed strategy that identifies seed inventories (natural stand and orchard), seed gaps and seed mitigation strategies over the short and long term.
7. Increased production of non-traditional seed suitable for planting to increase species diversity (i.e. cottonwood)
8. Better understand the link between fertilization application and impacts/losses from root disease.
9. Clean up data in results - (i.e. NSR and Impeded stands already underway) - other issues may exist.
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.

10.0 References

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Appendix A: Abbreviations

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