Lillooet TSA
Timber Supply Review 3
Mountain Pine Beetle Impact Assessment

Addendum to the
Lillooet TSR3 Analysis Report
(March 31, 2005)

March 3, 2008

Prepared For:
B.C. Ministry of Forests and Range
Forest Analysis and Inventory Branch
Victoria, BC

Submitted by:
Forsite
Box 2079, 330-42nd Street SW
Salmon Arm, B.C V1E 4R1
(250)832-3366

Table of Contents

1. Introduction

In 2005, the Lillooet Timber Supply Area's Timber Supply Review #3 Analysis Report[i] was released. This report included both a Current Practice and LRMP Base Case, and provided information on future harvest levels for these scenarios, along with several critical issue analyses. However, the potential impacts of the current Mountain Pine Beetle (MPB) epidemic were not explored. This report has been prepared to provide insight into the potential timber supply impacts that could result from this MPB epidemic.

2. Pine Distribution

The Lillooet TSA contains approximately 17.6 million m³ of Lodgepole pine (Pl) volume, of which 84% (14.8 million m³) exists in Pl-leading stands (Table 1). Within non Pl leading stands, Douglas-fir stands contain the most Pl volume (9%), while spruce stands contain the next largest amount (5%) of Pl volume.

Table 1. Distribution of lodgepole pine volume (m³) by Leading Species and Pl Percent (%)

	Percent Lodgepole Pine										
Leading Species	**91-100**	**81-90**	**71-80**	**61-70**	**51-60**	**41-50**	**31-40**	**21-30**	**11-20**	**0-10**	**Total**
Balsam	0	0	0	0	0	8,098	66,264	97,981	97,745	66,523	**336,611**
Cedar	0	0	0	0	0	0	0	0	0	0	**0**
Decid.	0	0	0	0	0	0	0	221	25	987	**1,234**
Douglas-fir	0	0	0	0	0	62,077	495,565	388,002	364,208	252,371	**1,562,223**
Hemlock	0	0	0	0	0	0	0	0	0	0	**0**
Lodgepole Pine	6,667,285	2,854,767	2,108,789	1,317,218	1,394,743	320,580	133,271	3,068	0	0	**14,799,720**
Spruce	0	0	0	0	0	16,526	241,793	335,788	187,478	98,985	**880,569**
Other	0	0	0	0	0	645	4,698	12,790	2,260	2,935	**23,327**
Total	**6,667,285**	**2,854,767**	**2,108,789**	**1,317,218**	**1,394,743**	**407,282**	**936,892**	**825,060**	**649,456**	**418,866**	**17,580,357**

3. MPB Mortality

MoFR Research Branch modeling work (BCMPB)[ii] has predicted that ~80% of all pine volume in the Lillooet TSA will die, and yearly volume killed by MPB will peak in 2009 at 2.95 million m³ killed/yr (Figure 1). Figure 2 shows that by 2012, the vast majority (90%) of pine volume that is expected to die will be dead[iii] and the full extent of the mortality will occur by 2020.

As the current inventory of Pl in the TSR3 dataset is lower than that found the BCMPB project (TSR3 ~17.5 million, BCMPB ~19 million >60yrs old) the 80% kill rate has been used to determine the volume killed in TSR3. Assuming 80% of all Pl in the TSR3 dataset dies, this translates into 14.1 million m³. This is expected to occur over the next 12 years but the vast majority occurs in the next 5 years so the full mortality will be implemented in the 1st decade during modeling. These assumption forms the basis of all the MPB scenarios shown in this report.

---

[i] Lillooet TSR3 Analysis Report, March 31, 2005, Forsite Consultants Ltd. (http://www.for.gov.bc.ca/hts/tsa/tsa15/tsr3/15ts05ar.pdf)

[ii] Provincial-Level Projection of the Current Mountain Pine Beetle Outbreak: An Overview of the Model (BCMPB v4) and Results of Year 5 of the Project.

[iii] BCMPB reporting shows a total of 19.4 million m³ Pl volume in the Lillooet TSA. Lillooet TSR3 resultant show 17.4 million m³ of Pl volume. Mortality was implemented using the percentage killed (80%), not the absolute volume.

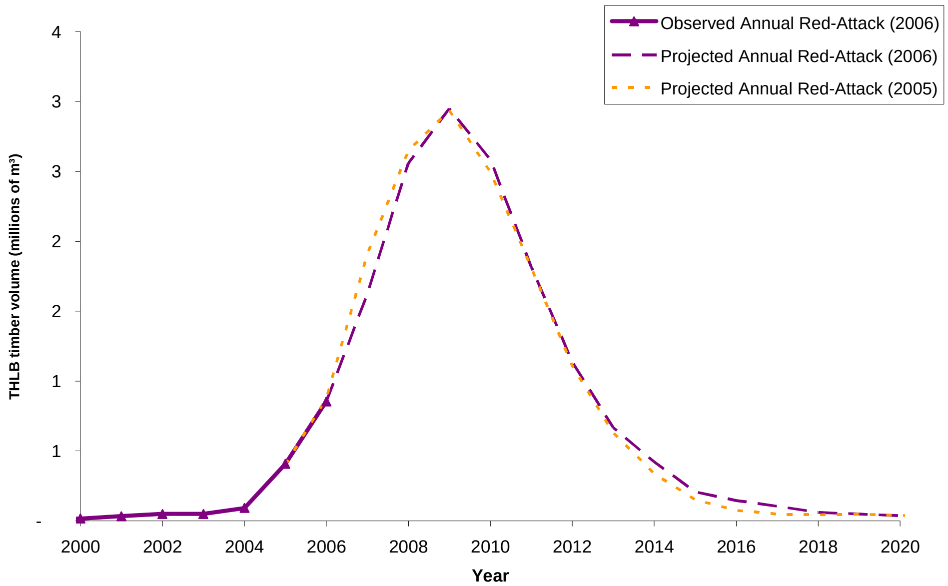

Figure 1. Yearly Pl volume killed by the MPB in the Lillooet TSA (BCMPBv4, 2007).

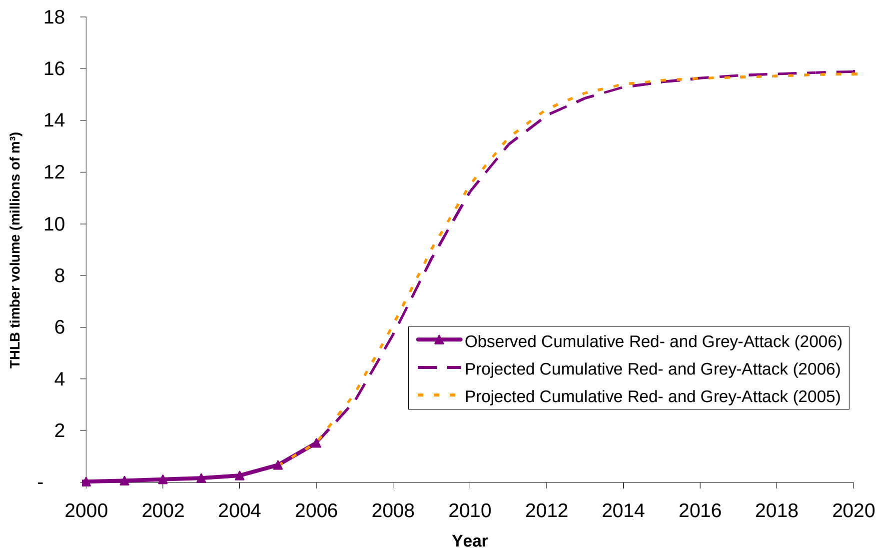

Figure 2. Cumulative Pl Volume killed by the MPB in the Lillooet TSA (BCMPB v4, 2007)

4. Scenario Overview

In total, three different scenarios were modeled and analysed and are briefly described below. Further details can be found in Section 5.

Base Case + MPB Mortality

The TSR3 Current Practice scenario assumptions are used while assumptions for MPB mortality (described in section 5) are also implemented. Pine stand mortality is implemented at the end of the first decade and salvage logging is allowed to occur in the first decade as driven by the relative oldest first harvest priority. Pl stands were removed from Visual Quality Objectives polygons for the first 30 years to allow flexibility in harvesting within these visual areas. All other assumptions are consistent with the Current Practice Base Case.

Pl Salvage

This scenario explores the potential impact of focusing harvesting efforts toward salvage of Pl leadings stands in the first decade. The only change made from the Base Case + MPB scenario was to implement a harvest priority on Pl leading stands in the first period.

No Harvest in Pl leading Stands

Because very little harvest of Pl leading stands is currently occurring in the TSA due to economic challenges, this scenario explores a worst case scenario where harvest is perpetually excluded from Pl leading stands. Assumptions remain the same as the Base Case + MPB scenario except Pl leading stands were made ineligible for harvest.

5. MPB Modeling Approach / Methodology

This section details the modeling approach used for the scenarios mentioned in Section 4. Unless otherwise stated, all assumptions for the “Pl Salvage” and “No Harvest in Pl-leading stands” scenario remained the same as the Base Case + MPB scenario assumptions.

5.1. Base Case + MPB Scenario

5.1.1 Baseline

Modeling used the Current Practice Base Case assumptions documented in the TSR3 Analysis Report appendix. No updates to the inventory were completed so that results are comparable with the results published in the TSR3 Analysis Report (Forsite - March 31, 2005).

This scenario assumes that the 14.1 million m^3 will be lost in the next 10 yrs and very little of the Pl mortality will be salvage harvested. This is consistent with current performance in the TSA as pine makes up very little of the harvest profile. No uplift was considered as the TSA is chronically undercut and very little harvesting is happening in Pl stands.

5.1.2 Mortality in Mature Stands (>60 years)

As discussed above, 14.1 million m^3 was depleted out of the inventory at the end of the first period. This was done by selecting the highest % Pl stands (>60yrs) until an area representing 14.1 million m^3 (all species) was identified. These stands were then set to age zero (volume removed). Because of the way this was implemented, there was ~1.3 million m^3 of non-Pl volume depleted from the inventory. This however, was cancelled out by the fact that there was still ~1.3 million m^3 of Pl in the rest of landbase that was not depleted. In reality, the pine mortality will be more dispersed (spatially and temporally) than what was modeled here.

Dead unsalvaged stands were given a regen delay of 10 yrs and a concurrent 10 year addition to the MHA and were set to regenerate on their original VDYP curves.

5.1.3 Mortality in Young Stands (<60 years)

In order to reflect MPB mortality in young pine stands, additional area was killed in pine leading stands <60 yrs old. The percent of pine killed in younger age classes was estimated based Lorraine Maclauchlan's recent work[iv] (% of population with attack) and professional judgment about the ultimate extent of the attack in these stands. These assumptions should be considered very 'rough'. In total, an area of 969 ha of young Pl stands was killed at the end of the first decade. These stands had their ages set to 0.

Table 2. Mortality applied to stands <60 years.

Age Class	Pl Leading Area (ha)	% of Stands With Attack	Extent of Mortality	% Pine Mortality	Total Area Impacted
<20	17,624	0	0	**0%**	-
20-29	2,727	30%	50%	**15%**	409
30-39	336	62%	50%	**31%**	104
40-49	423	83%	50%	**41%**	173
50-59	602	93%	50%	**47%**	283
Total	**21,711**				**969**

Impacted young stands were given a 20 year regen delay (less opportunity for natural regeneration) and a concurrent 20 year addition to the MHA.

5.1.4 Cover Constraints

Pine leading stands were removed from VQO constraint areas for a period of 30 years because licensees are typically given flexibility around VQOs when impacted by MPB. All other constraints remained in place (CWS, wildlife habitat). Dead OGMAs will not be replaced (very little area in Pl leading stands).

5.2. Pl Salvage Scenario

In order to mimic Pl salvage efforts, Pl leading stands were prioritized for harvest in the first period. A relative oldest first priority determined which Pl stands were harvested and the model exhausted opportunities to log all Pl stands before moving to other stand types (1st period only). This priority did not persist past the first period because it was implemented using a fixed schedule (hardwired) of logging/mortality for Pl stands based on other model runs.

5.3. No Harvest in Pl-Leading Stands

A 'No-Harvest' constraint was added to all Pl-leading AUs for this scenario. This allowed Pl-leading stands to contribute to forest cover requirements but prevented all Pl-leading stands from being harvested for the entire planning horizon.

[iv] MacLauchlan, L., 2006. Determining susceptibility of young pine plantations to the mountain pine beetle *Dendroctonus ponerosae*, and manipulating future stands to mitigate losses. Forest Investment Account (FIA project Y0610003) – Forest Science Program. Ministry of Forests and Range.

6. Results

6.1. Base Case + MPB

6.1.1 Harvest Flow

As a result of implementing the MPB mortality assumptions described above, the mid-term harvest level drops from 635,900 m³/yr down to 413,900 m³/yr starting in the second period. This is down 34.9% from the TSR3 current practice scenario (Figure 3). This harvest level continues until the 10th decade, at which point it falls down to the same Long-term harvest flow as the TSR3 current practice base case (379,920 m³/yr). This occurs because 32% of the current growing stock disappears at the end of the first decade, and is no longer available to support harvest levels until managed stands begin to come online in 60-70 years from now. The remaining mature growing stock must be metered out more slowly.

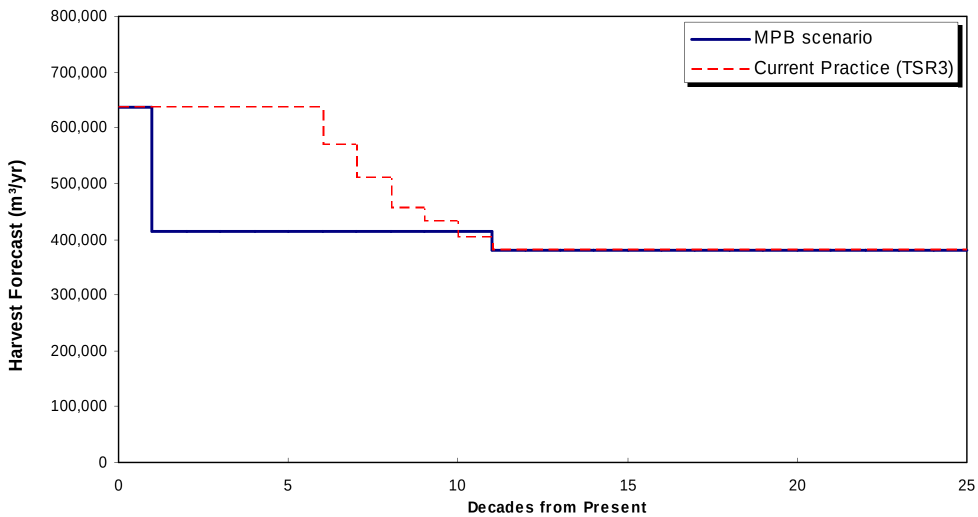

Figure 3. Mountain Pine Beetle Base scenario - Harvest Flow

6.1.2 Growing Stock

The resulting change in total growing stock on the THLB over time with MPB mortality assumptions is shown in Figure 4. Growing stock drops sharply in the second period as a result of the MPB mortality. In total, 15.5[v] million m³ of Pl leading stands are killed in the first period. Combined with the harvest that occurred during this decade, the net change in growing stock is 19.9 Million m³. By the 10th decade, the growing stock recovers to the same level as the current practice (TSR3) scenario as a result of the reduced harvest rate in earlier periods.

[v] As mentioned previously, an equivalent area representing 14.1 million m³ was selected from the inventory to implement mortality against. A discrepancy of 1.4 million m³ results from utilizing modeling yield curves as opposed to inventory volumes in the model as well as the fact that the mortality event occurs 5 years into the planning horizon so there is an additional 5 years worth of growth tacked on to the selected area.

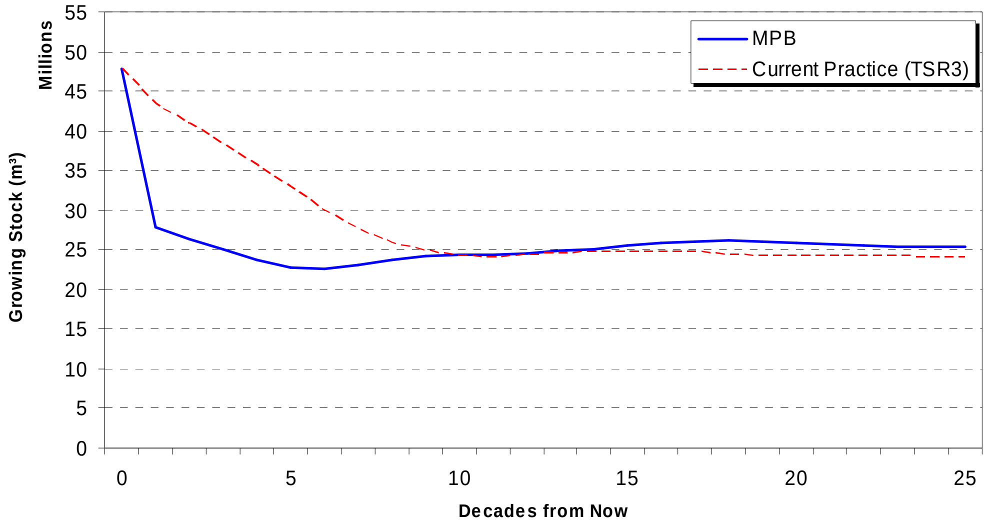

Figure 4. Growing Stock on the THLB - MPB scenario

6.1.3 Harvest Attributes

The contribution of species groups to the harvest profile is shown in Figure 5. The large volume of harvest in MPB impacted stands beginning in the 9th decade is important to note as it shows how much the harvest flow depends on these stands 90-110 years from today. This scenarios captures ~850,000 m³ of Pl volume in the first period (14% of 1st period harvest volume).

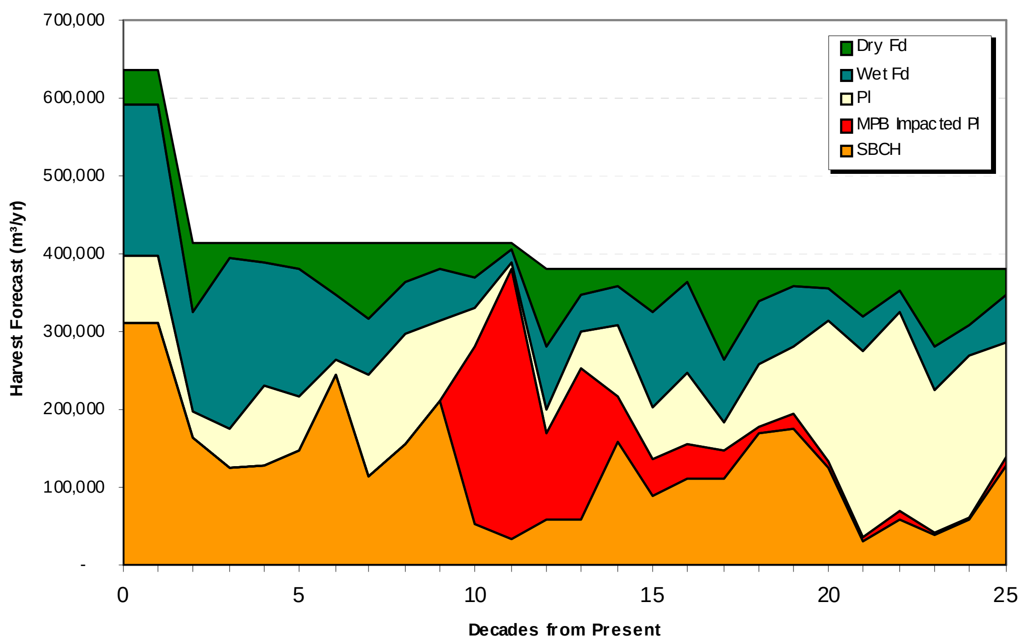

Figure 5. Contribution of species groups to the MPB Base scenario

6.1.4 Age Class Distribution

A time-series showing the age-class distribution of the TSA's forest is shown in Figure 6. The relatively large amount of area in the 50 year age class five decades from now is the result of the MPB mortality assumptions implemented in the first decade. By the15th decade, the majority of this Pl volume has been harvested and the associated area is more or less evenly distributed in the younger age classes.

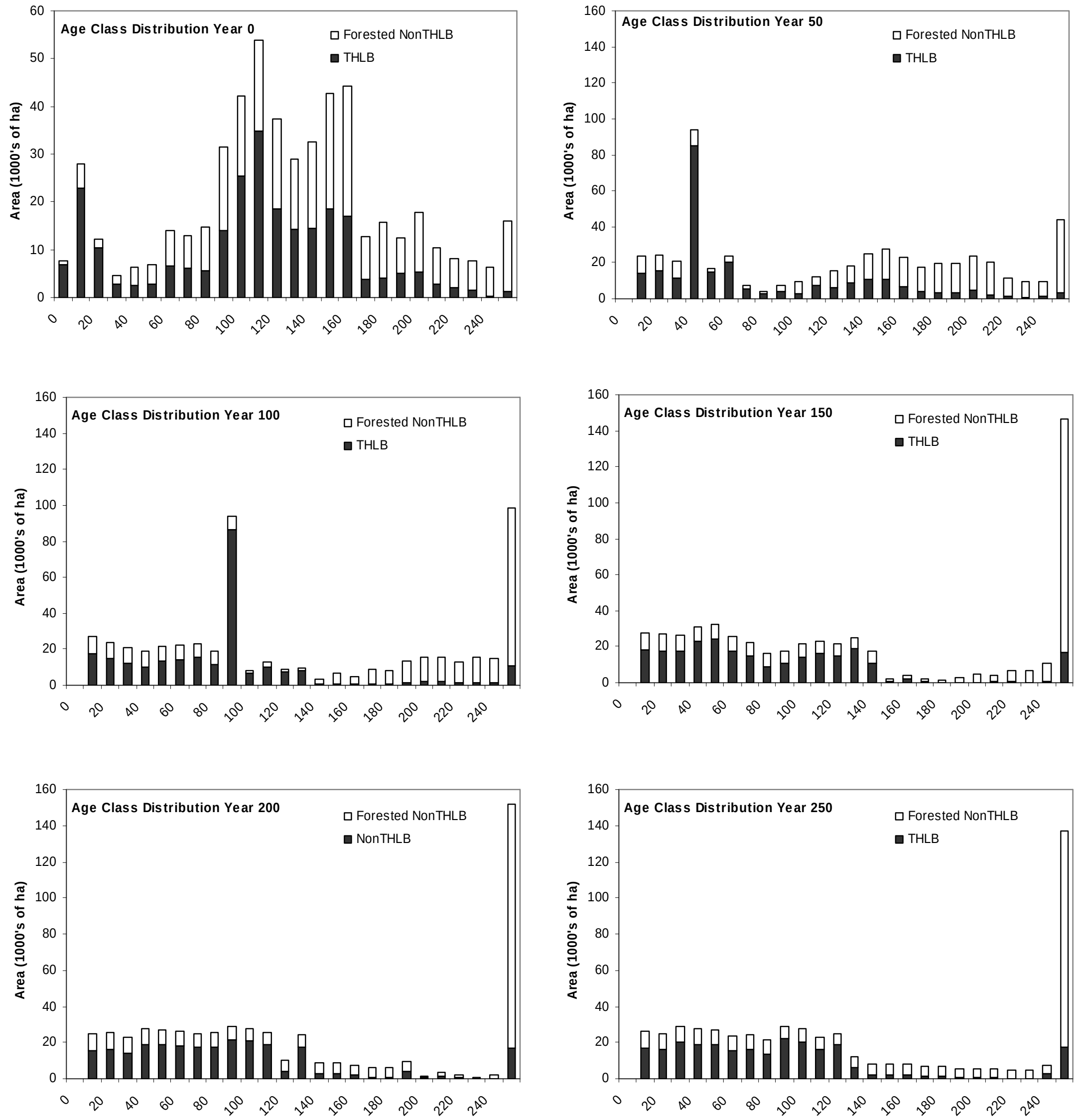

Figure 6. Age class composition snapshots at 0, 50, 100, 150, 200, 250 years from now.

6.2. Pl Salvage Scenario

When Pl stands are prioritized for harvest in the first period, approximately 2.33 million m³ of volume that would have otherwise been lost to MPB mortality is captured and an additional 2.01 million m³ of Pl leading stand volume not originally scheduled for succession was also harvested. This totals to a first period Pl-leading harvest volume of 4.34 million m³. This resulted in an increase in the mid-term harvest level by 10.9% or 45,000 m³/yr (Figure 7). The long-term harvest level was unaffected.

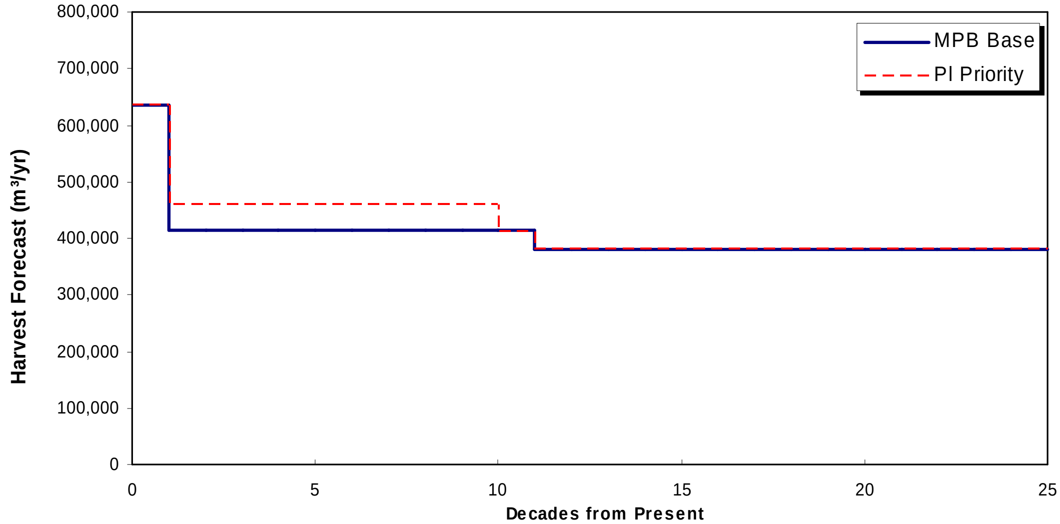

Figure 7. Harvest flow comparison - Pl priority vs. MPB base

Figure 8 shows the growing stock for this scenario relative to the Base Case + MPB scenario. The immediate drop in growing stock (decade 1) is less under this scenario because, even with higher harvest levels, the capture of Pl volume that would have otherwise been lost to MPB reduces the need to harvest green timber. Thus, the volume that would have been lost anyways is used to meet the harvest volume goal and therefore leaves green stands (growing stock) on the land base.

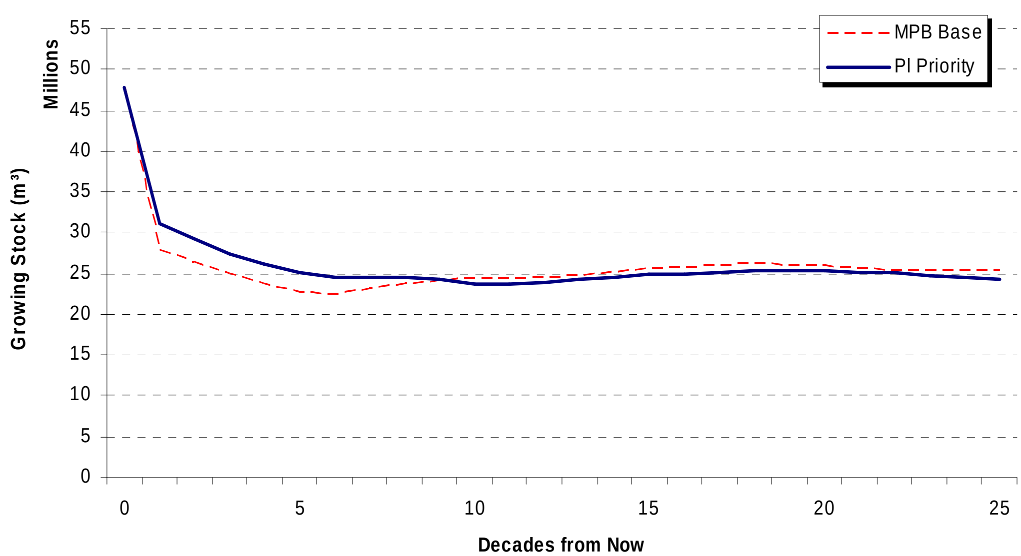

Figure 8. Growing Stock (m³) on the THLB - Pl Priority vs. MPB Base Scenario

Figure 9 shows that the first period harvest is now dominated (67%) by the harvest of Pl leading stands. Constraints served to limit the model from harvesting nothing but Pl stands.

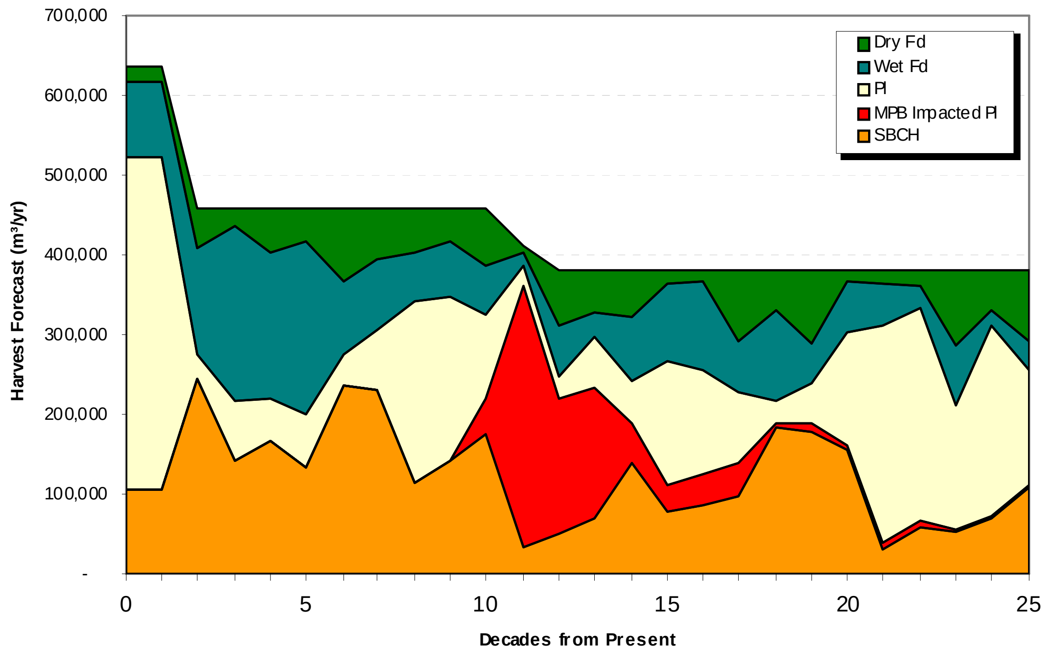

Figure 9. Contribution of species groups to the Pl Priority Scenario

6.3. No Harvest in Pl-leading

The harvest flow resulting from perpetually excluding harvest from Pl leading stands is shown in Figure 10. The initial harvest level was dropped to 442,400 m³/yr in order to provide for an orderly (max 10%) decline to the long term harvest level. It did not make sense to show a significant drop in period two if no salvage efforts were occurring in Pl stands. This new initial harvest level represents a decrease of 30% (193,400 m³) from the current AAC. The harvest levels drops in 10% increments for the first 4 decades to a mid-term harvest of 294,000 m³/yr which lasts for 4 decades. The harvest then drops to a LTHL of 218,900 m³/yr in the 10th decade, which is ~42% below the Base Case + MPB scenario. This correlates closely with the proportion of Pl leading stands on the THLB (39%).

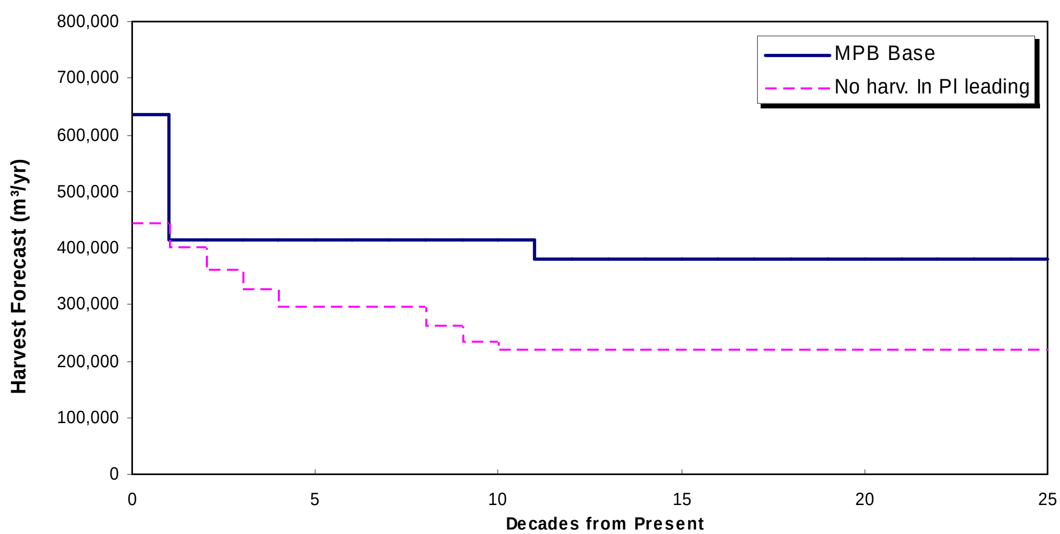

Figure 10. Harvest flow comparison - No Harvest in Pl leading vs. MPB Base

The contribution of species groups to the harvest flow is depicted in Figure 11. As prescribed, Pl is absent from the harvest profile.

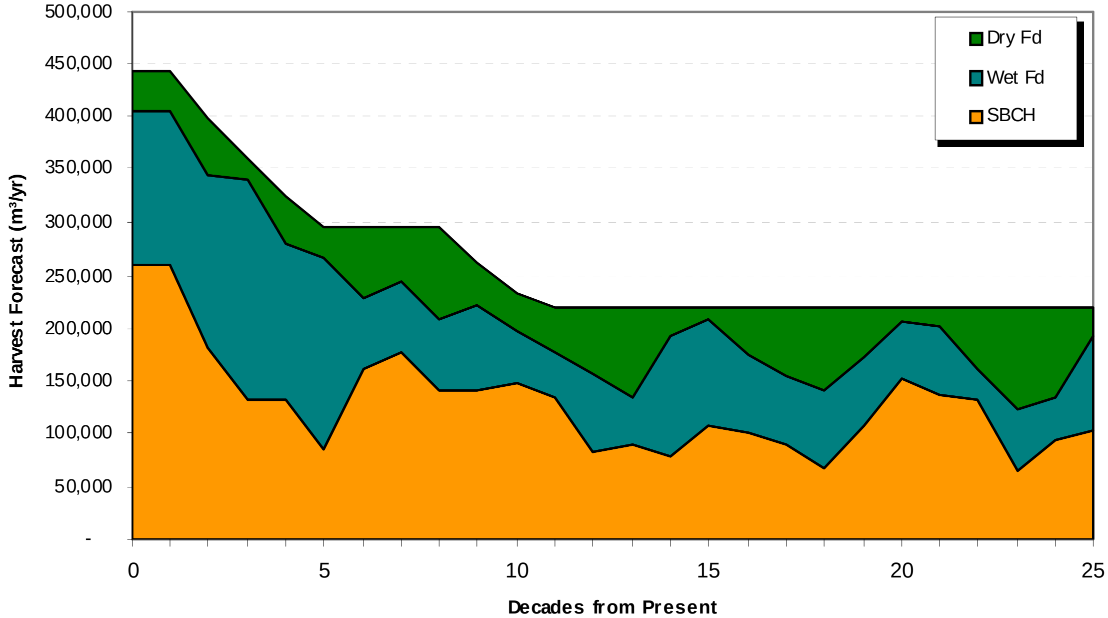

Figure 11. Contribution of species groups to the No Harvest in Pl-leading scenario

7. Discussion / Conclusion

The three scenarios presented here span a wide spectrum of future timber supply outcomes as they relate to MPB mortality and impacts. Based on the mortality projections provided by the province's BCMPB model, all scenarios indicate there will be a significant reduction in timber supply in the short term (Figure 12). The three scenarios can be characterized as follows:

- **Optimistic**: If the TSA is able to make the salvage of Pl stands economically viable, and roughly 2/3rds of the AAC is directed toward salvage, the falldown occurs in 10 yrs to a level 28% below the current AAC.
- **'Middle of the Road'**: If the TSA can dedicate 14% of the AAC in the next decade toward Pl salvage and find a way to access Pl stands in the future, the falldown occurs in 10 yrs to a level 34% below the current AAC.
- **Pessimistic**: If the harvest of Pl stands in the TSA proves to be perpetually uneconomic, 39% of the landbase and growing stock become unavailable and results in an immediate drop in the harvest level to 442,400 m^3/yr (30% below current AAC). The long term harvest level drops to 218,900 m^3/yr and is ~42% below the TSR3 Base Case level.

The Pl Salvage scenario shows that significant improvements can be realized in the short and midterm if an aggressive salvage effort is implemented.

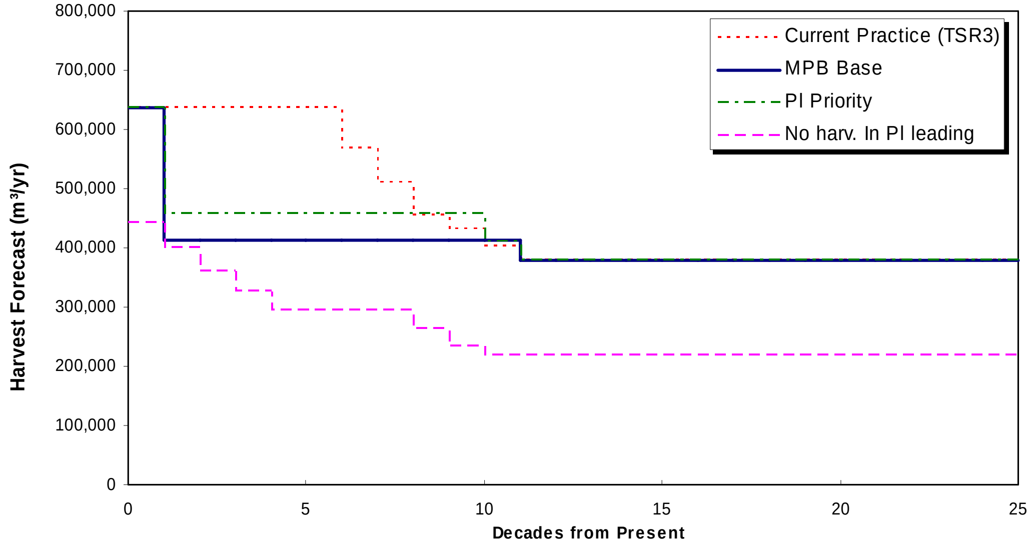

Figure 12. Harvest flow scenario comparison