

**ADDENDUM
TO THE
“WOOD SUPPLY REPORT FOR
FOREST MANAGEMENT LICENCE AREA #1”**

Forestry Branch

Manitoba Conservation

August 2006

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This document is addendum to the “Wood Supply Report for Forest Management Licence Area #1” that examines the wood supply under a total volume harvest scenario.

This addendum will: 1) document the total volume scenario and its results of the Woodstock and Stanley runs at strategic and tactical levels respectively, 2) establish AAC’s for tamarack and ash.

1 RESULTS AND DISCUSSION UNDER TOTAL VOLUME SCENARIO

This section presents the results of the wood supply analysis under total harvest volume scenario using Manitoba Conservation’s (MC) log length timber utilization standard for the Forest Management Licence Area (FMLA) #1.

The total harvest volume scenario identifies all merchantable softwood and hardwood strata types for the calculation of wood supply. Yields, treatment and vegetation response files were revised and forest management objectives were amended to correspond to the total harvest volume scenario strategy.

Under this scenario, new yields for MC’s log length utilization were developed, specifically for NSPF as this stratum is now fully available from the harvestable land base (only 20% of the area was used in the softwood operation). Even flow softwood and hardwood harvest levels were determined under the model objectives to maximize the total harvest level. The caribou habitat constraint was maintained and the non-declining softwood operable growing stock constraint was applied in the last 50 years of the planning horizon. The strata were assigned the same treatment and response transitions, as in the softwood only scenario with the exception of the NSPF stratum. This stratum transitioned to 40% NSPF, 40% HWD and 20% MSPF after harvest.

1.1 Strategic Level Results

The strategic level harvest forecasts, for the FMLA, present both softwood and hardwood volume under a total harvest volume scenario. The model results, presented in Table 1 of this report, shows the non-spatial theoretical maximum sustainable wood supply (TMSY) achieved under Manitoba Conservation’s “log-length” utilization standard and even-flow policy over the 200 year planning horizon. Under total harvest volume scenario both softwood and hardwood stands are considered available for harvest. Softwood volume includes the incidental volume from pure hardwood and hardwood leading strata, while the hardwood volume includes incidental volume from pure softwood and softwood leading mixed strata. Under the total harvest volume scenario, the softwood TMSY available for harvest is 368,539 m³/yr and hardwood TMSY available for harvest is 134,706 m³/yr. This integrated harvest operation results in a 5% increase in softwood TMSY over the softwood only “Base Case”.

Over the 200 year planning horizon, the sum of minimum or maximum softwood and hardwood growing stock will not equal the corresponding total growing stock. This phenomenon exists because softwood and hardwood total growing stock does not occur at the same time.

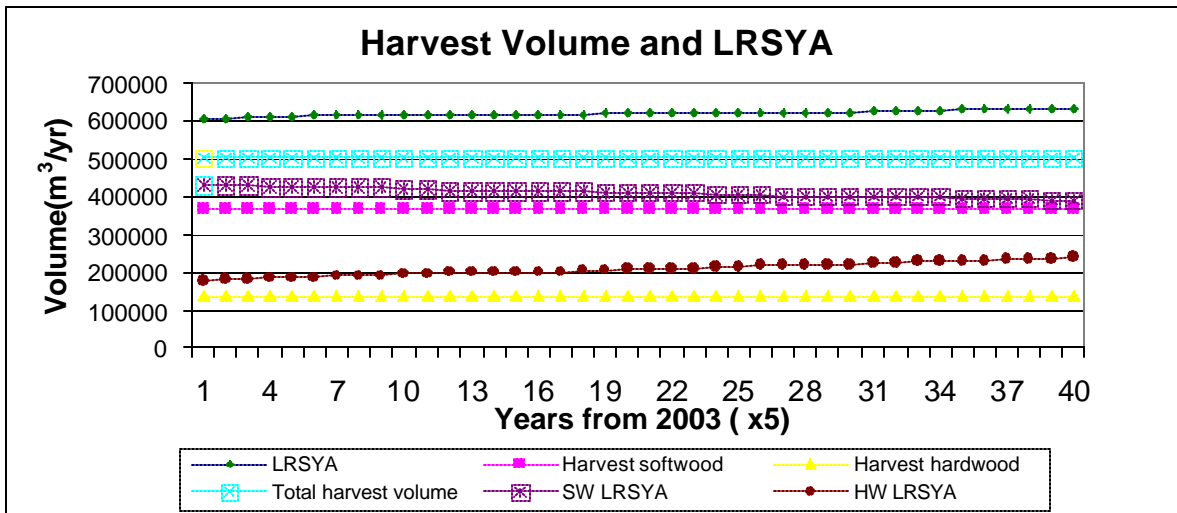
Table 1. Summary of Strategic Wood Supply Results for the FMLA #1 under a Total Volume Scenario

	Theoretical Wood Supply				
	Over 200 years			Year 1-100	Year 101-200
	Minimum	Maximum	Average	Average	Average
Harvest Softwood (m ³ /yr)	368,539	368,539	368,539	368,539	368,539
Harvest Hardwood (m ³ /yr)	134,706	134,706	134,706	134,706	134,706
Total Harvest volume (m ³ /yr)	503,245	503,245	503,245	503,245	503,245
Total LRSYA (m ³ /yr)	606,278	630,402	620,649	615,561	625,737
SW merchantable growing stock (000's m ³)	17,007	23,299	20,122	21,880	18,364
HW merchantable growing stock (000's m ³)	8,223	12,765	10,275	10,275	11,573
Total merchantable growing stock (000's m ³)	27,608	33,280	31,045	32,154	29,936
SW merchantable operable stock (000's m ³)	2,777	12,839	5,775	7,799	3,751
HW merchantable operable stock (000's m ³)	725	4,329	2,911	2,144	3,678
Total merchantable operable stock (000's m ³)	5,604	15,277	8,686	9,942	7,429

The Long Run Sustained Yield Average (LRSYA) is the theoretical average harvest level that the forest (on the harvestable land base) can support over the long term and it is an important indicator of sustainability in the evaluation of harvest levels. It is calculated by multiplying the mean annual increment of a yield strata at minimum harvest age by the harvestable area of that strata. A graphical illustration of the sustainable harvest levels in the FMLA is presented in Figure 1.

Under total harvest volume scenario the total LRSYA is about 20% above the total TMSY. Due to the even flow harvest policy and the treatment and response pathways, the softwood LRSYA slowly declines across the planning horizon, and the hardwood LRSYA increases through time. This indicates that the hardwood land base is increasing in area resulting in an increase in hardwood productivity. The overall total volume LRSYA is relatively steady across the planning horizon.

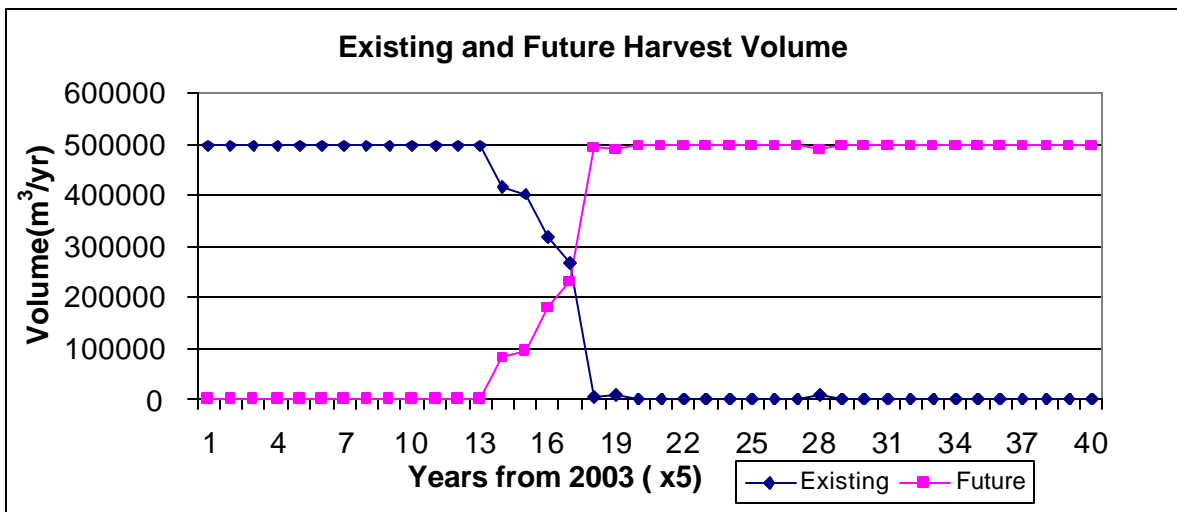
Figure 1



1.1.1 Second Growth Transitional Trends

Figure 2 illustrates transitional trends to second growth forests resulting from total harvest volume scenario and accompanying silviculture programs. The trends illustrate the timing of transition from existing natural stands to second growth stands (previously depleted and regenerating). Harvesting at maximum sustainable levels will result in harvesting operations moving into second growth stands in 70 years, completing the transition into the new forest at 100 years.

Figure 2

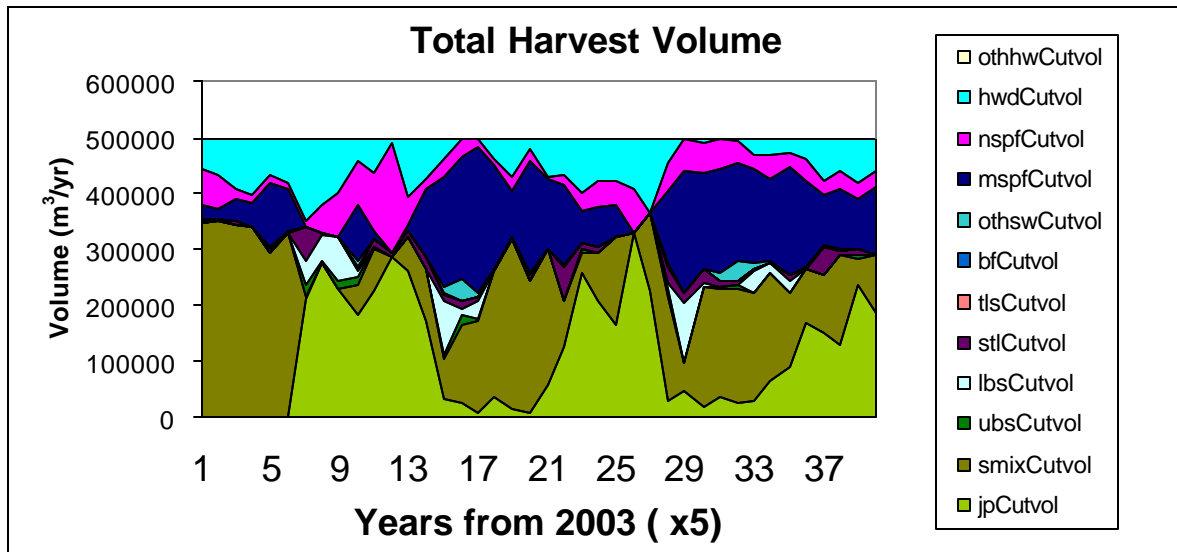


1.1.2 Harvest Volume by Strata

Figure 3 illustrates volume harvested by forest strata types. The strata contribution to harvested volumes varies over time and is a dynamic

process that takes into account forest age class distribution, strata size and productivity, minimum harvest age, death and the effects of transition pathways for depleted hectares. In the FMLA under the total harvest volume scenario JP, SMIX and MSPF strata make up about 80% of the total harvested volume, while the HW stratum accounts for about 10% of total harvested volume. The graph demonstrates that the total harvested volume by strata type is cyclical and is not always equal in proportion. In order to achieve the TMSY volume the harvest strata should be followed accordingly.

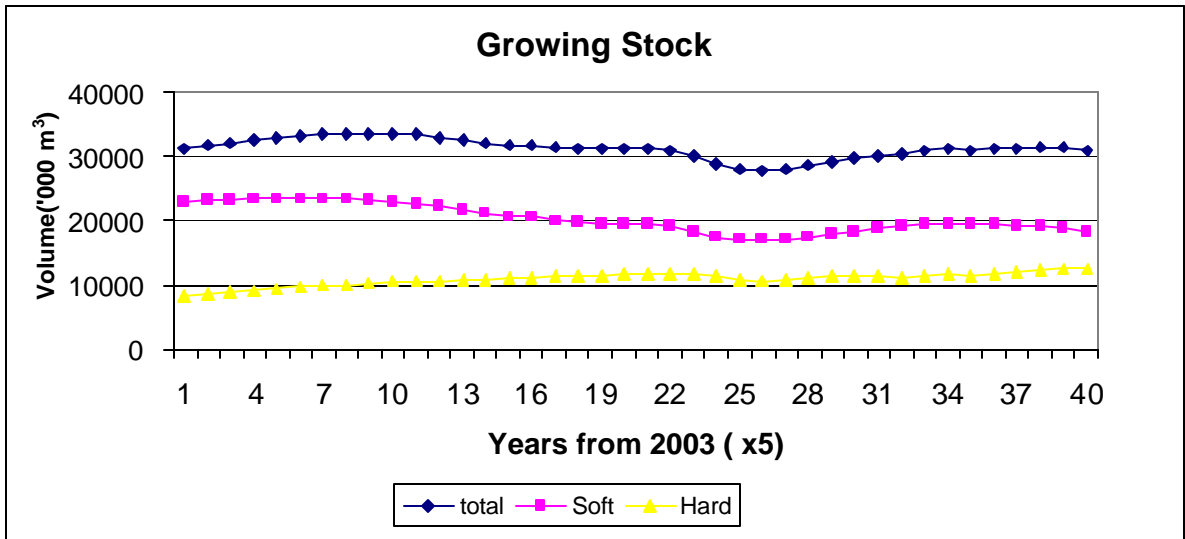
Figure 3



1.1.3 Total Growing Stock

Figure 4 shows a projection of total growing stock in cubic meters on all forested lands within the FMLA over 200 years. The graph shows that the present level of total growing stock on the FMLA is approximately 31 million cubic meters of which 23 million are softwoods and 8 million are hardwoods. The level of total growing stock increases to 33 million in period 9, then gradually declines to 28 million by period 26, and back to 31 million by the end of the planning horizon. The gradual increase and decline in growing stock over planning horizon is largely due to changing age class structure reflecting the associated changes in forest productivity. The total harvest volume scenario moderates the fluctuation in the growing stock in comparison to the softwood only harvest scenario.

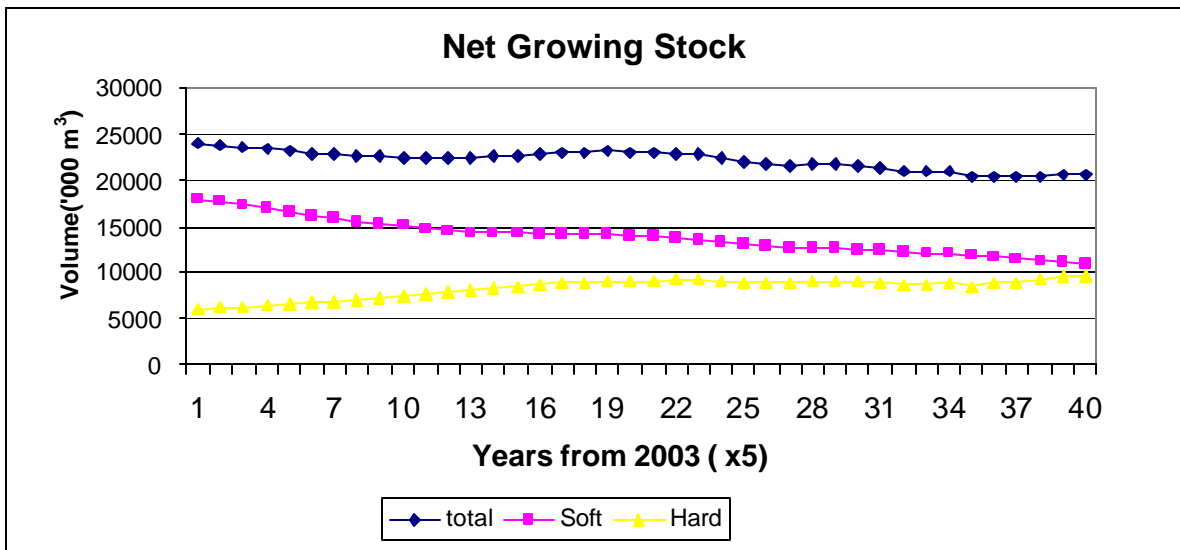
Figure 4



1.1.4 Net Growing Stock

Figure 5 shows a projection of the net growing stock on the harvestable land base. As in the softwood only harvest scenario softwood net growing stock on the harvestable land base declines at a steady rate over time. The hardwood rate of increase over “Base Case” is not as dramatic. The rate of increase is influenced by the incremental hardwood harvest and corresponding increase in hardwood growing stock.

Figure 5



1.1.5 Operable Growing Stock

Figure 6 depicts the operable growing stock (OGS). Under total volume scenario, the OGS graph accounts for both softwood and

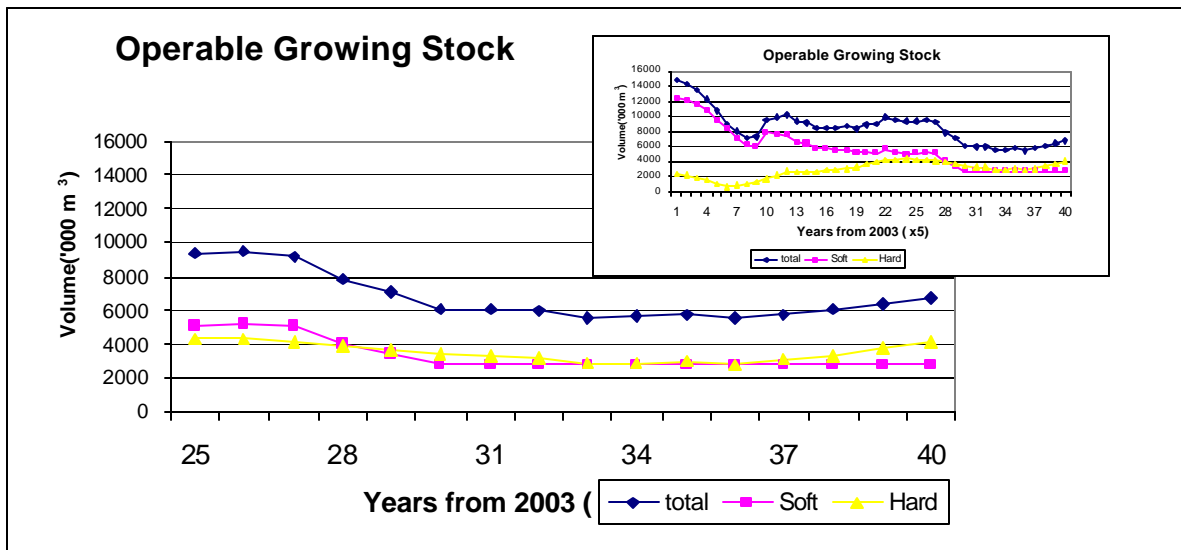
hardwood volumes within the operability window from the harvestable land base.

The softwood OGS at the beginning of the planning horizon is approximately 12.5 million cubic meters which declines to 2.7 million by year 150 and maintained at that level until the end of the planning horizon; the hardwood OGS generally increased from 2.3 million to 4.1 million at the end.

The management objective for maximizing total harvest volume with even flow softwood and hardwood volume while maintaining woodland caribou habitat in the Owl Lake area drive the OGS up and down over the 200 years. The low level of OGS usually is the threshold for the even flow harvest volume determination. In order to prevent OGS from declining at the end of planning horizon softwood OGS was constrained for the last 50 years of planning horizon in the Woodstock model. The softwood OGS is maintained above 2.7 million m³ which will provide some flexibility in the event of an unplanned events (fire, land base withdrawals, etc) in the future.

The increases and declines in OGS also coincide with harvest cycles on the harvestable land base and effects on productivity due to the treatment and response pathways. The slight increase in operable growing stock in period 9 reflects the mass maturing of areas burned in the 1980's. The trends in OGS of a total harvest volume scenario are not significantly different from the "Base Case" softwood only scenario.

Figure 6



1.1.6 Area Harvested by Strata Type

Figures 7 and 8 show the total area harvested from the harvestable forest land base. Since total volume scenario considers all merchantable forest stands, the total harvested increase when compared to the softwood only scenario. The total harvest area varies from minimum of 4,447 ha to maximum of 5,780 ha, with an average of 5,020 ha over 200 years. Overall the total harvest area remains relatively stable across the planning horizon. JP, SMIX and MSPF strata account for majority harvest area, while NSPF and HW strata contributed for the rest over 200 years. However individual strata types see peaks and valleys over periods when harvesting is very low or does not take place at all.

Figure 7

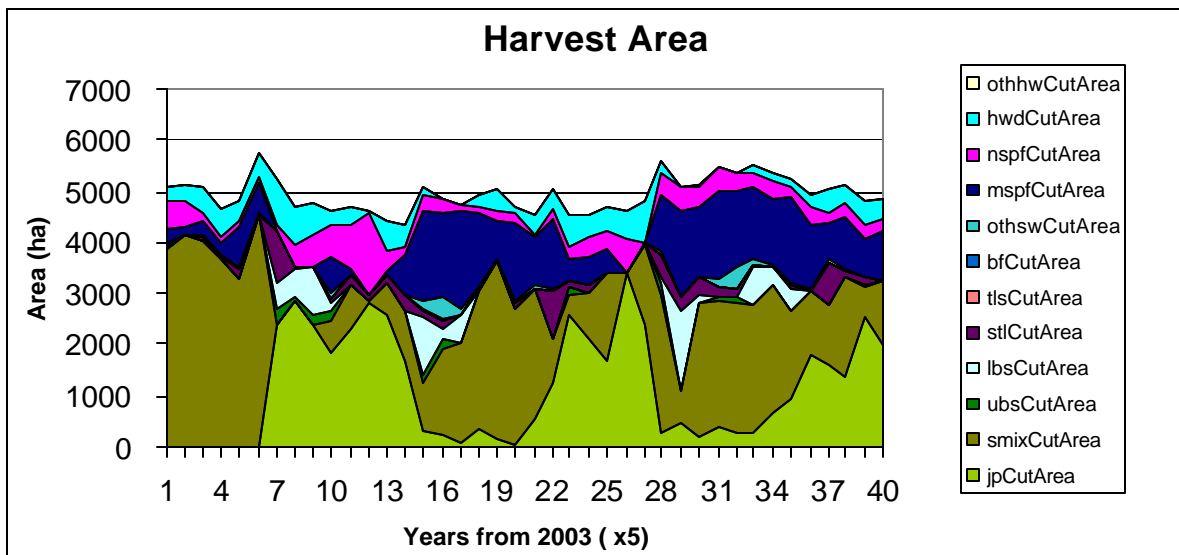
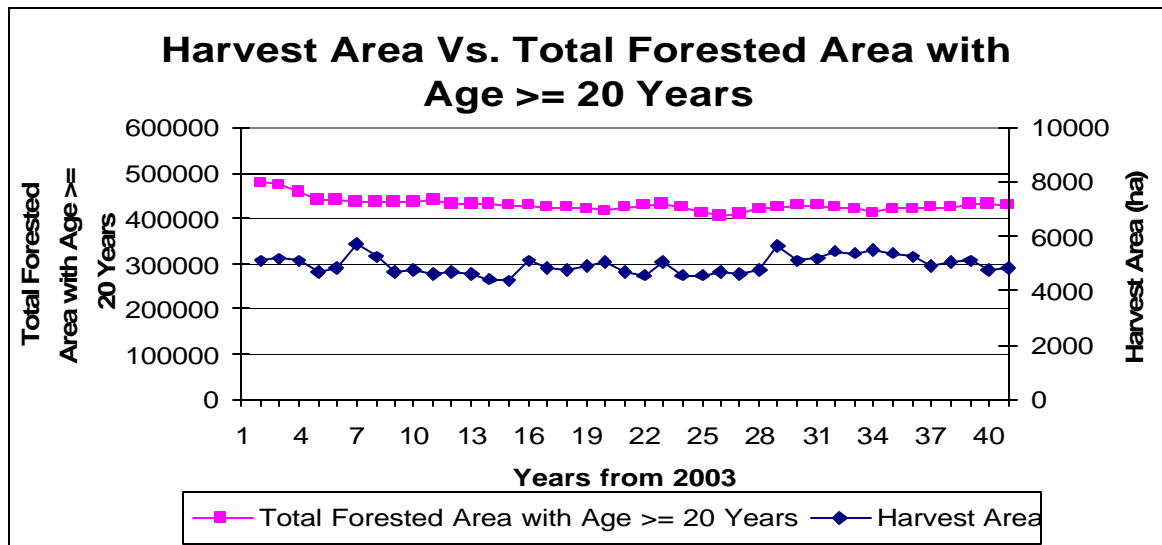


Figure 8

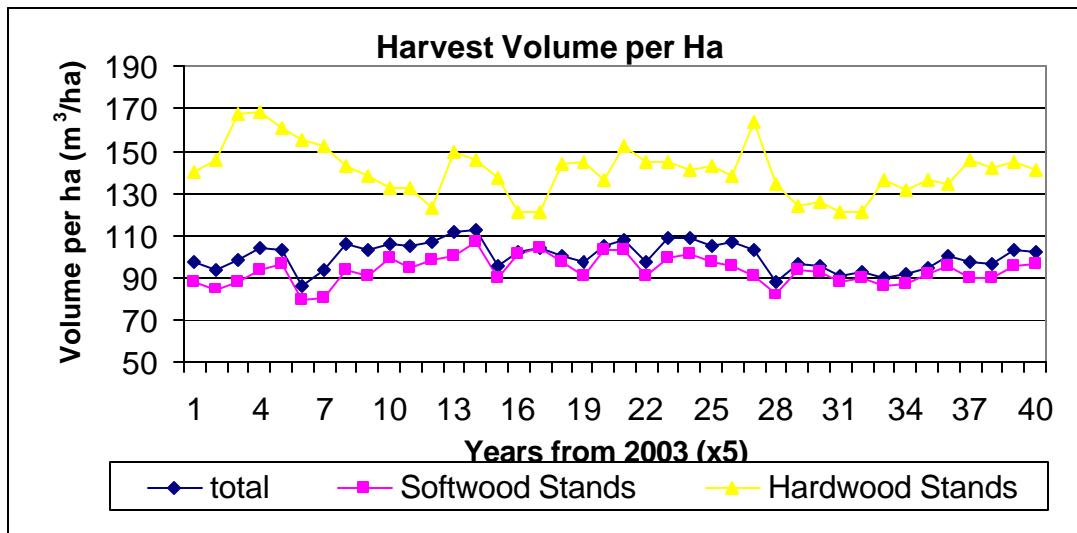


1.1.7 Mean Annual Volume Harvested

Figure 9 illustrates the mean volume per hectare harvested over time. The mean volume per hectare is the total harvest volume divided by total harvest area at each planning period and is one of the important indicators in evaluating feasibility of operations.

Over the 200 year planning horizon the total harvest volume per hectare is $101 \text{ m}^3/\text{ha}$ on average with a low of $87 \text{ m}^3/\text{ha}$ at period 6 and a high of $113 \text{ m}^3/\text{ha}$ at period 14. From the strata perspective, the area weighted softwood stands average approximately $90 \text{ m}^3/\text{ha}$, and area weighted hardwood stands average approximately $140 \text{ m}^3/\text{ha}$ across the planning horizon. The incidental volumes from softwood and hardwood stands greatly influence the total harvest volume per ha. Although the mean total harvest volume per hectare fluctuates over time, there are no significant changes in mean volume per hectare throughout the planning horizon. The variability is minimized through the even flow harvest policy and corresponding harvest area under the total volume scenario.

Figure 9



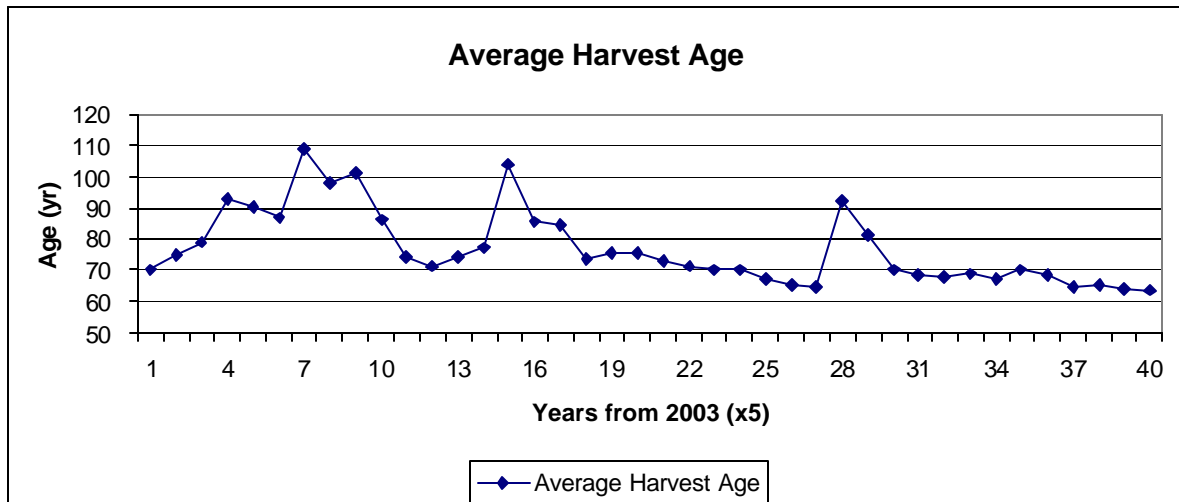
1.1.8 Average Harvest Age

Figure 10 illustrates the strata-area weighted average harvest age by period over the 200 year planning period. The graph illustrates that the strata are harvested within an acceptable range in age which is very similar to the softwood scenario.

Over the 200 years the average harvest age is 77 years, with maximum of 109 years at the period 7 and minimum of 64 years at the end. The significant jumps in average harvest age in period 7, 15 and 28 follows

the completion of harvesting in the JP strata and subsequent moves into the aging BS, SMIX and MSPF strata where the majority of harvesting occurs at an age well above the average harvest age of the JP strata. Generally speaking, the area-weighted harvest age stays around 70 years and indicates the decline in piece size at the end of planning periods.

Figure 10



1.1.9 Age Class Distribution

Figure 11 presents the area distribution over age classes of all strata across the FMLA. The graph illustrates the current and future age class distribution on the total productive forest area and on the harvestable (after net down) land base.

Under the total harvest volume scenario and in the absence of natural disturbances (fires), the age class distribution on the harvestable forest land base becomes more evenly distributed through time, reflecting the impact dynamics of harvesting, management policies and constraints such as even-flow and wildlife habitat maintenance. A percentage of area in older age classes is maintained, in part, to satisfy the caribou constraint within the model.

The influence of large fires is clearly illustrated within the age class structure overtime. There have been two major fire events one in the early 1980's and another in 1930's. The influence of these events on wood supply is illustrated in the harvest area and harvest volume summaries.

Figure 11

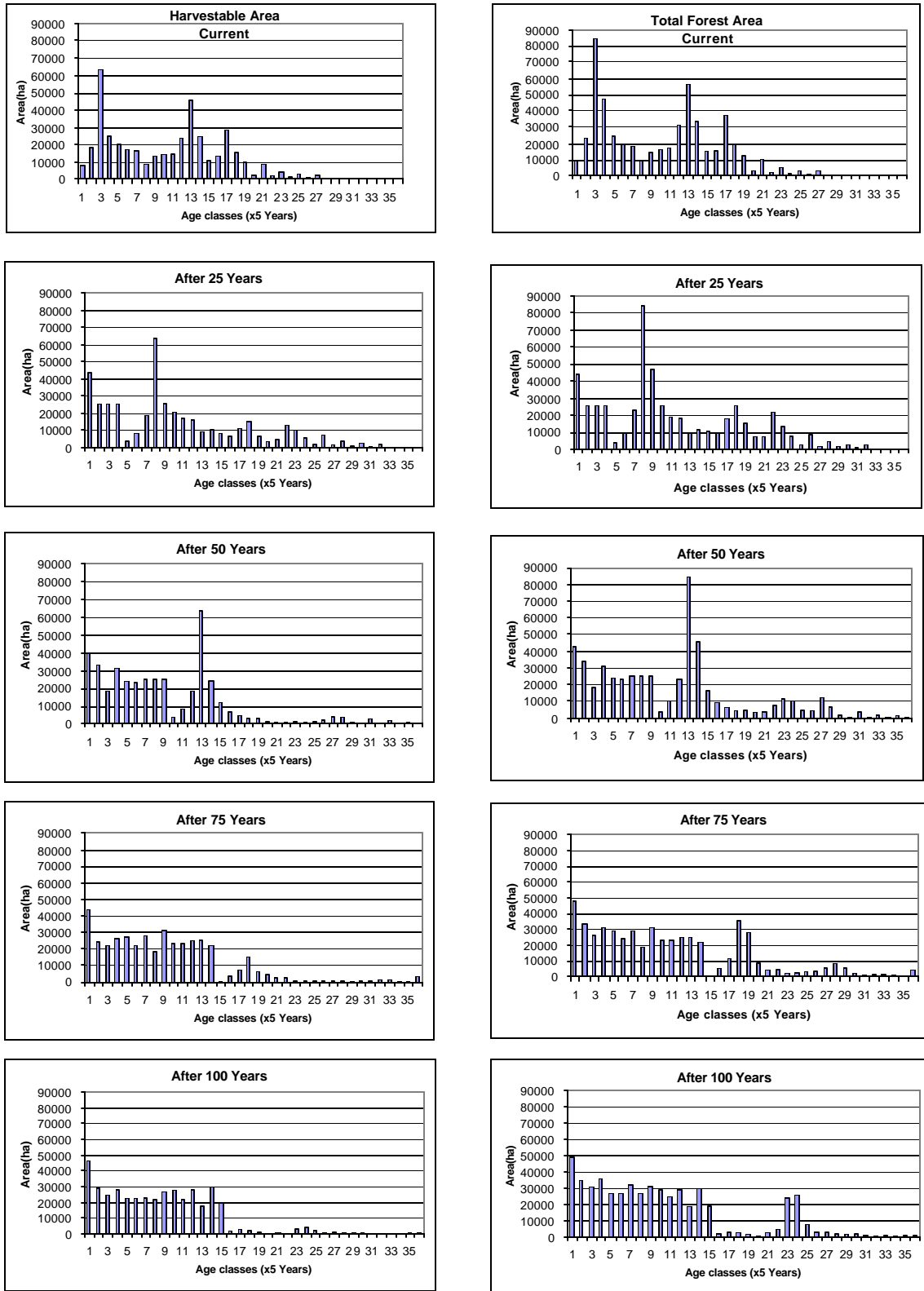
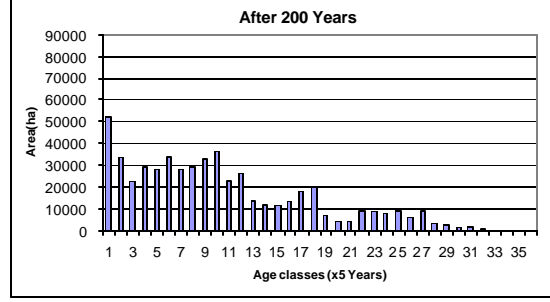
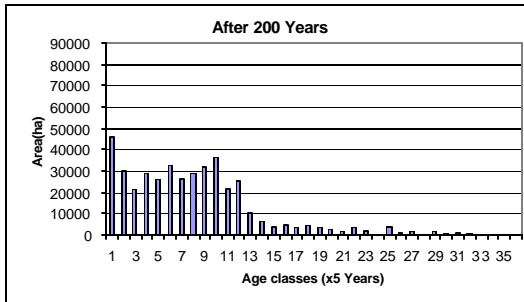
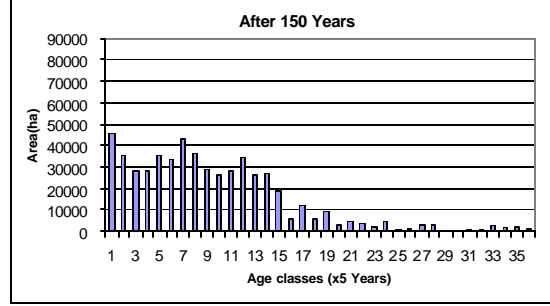
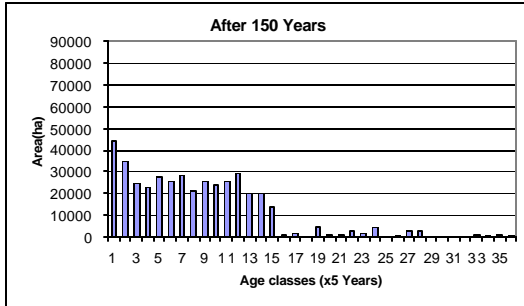
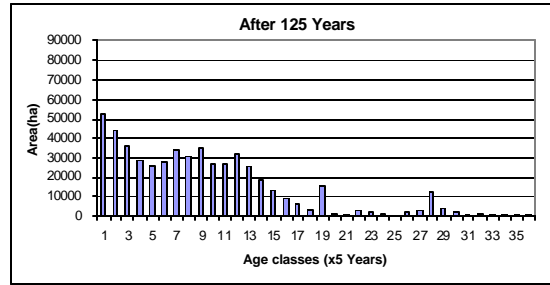
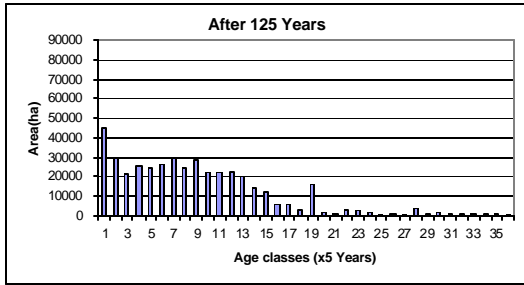


Fig. 11 (continued)



1.1.10 Mortality

Figure 12 tracks mortality occurring through time on the total forest land base. Figure 13 tracks mortality by strata type on harvestable (open) forest land. Since hardwood and hardwood leading mixed wood stands are now scheduled for harvest, the vast majority of mortality occurs in buffer and closed zones rather than hardwood leading stand types that were not harvested under the softwood only scenario.

Figure 12

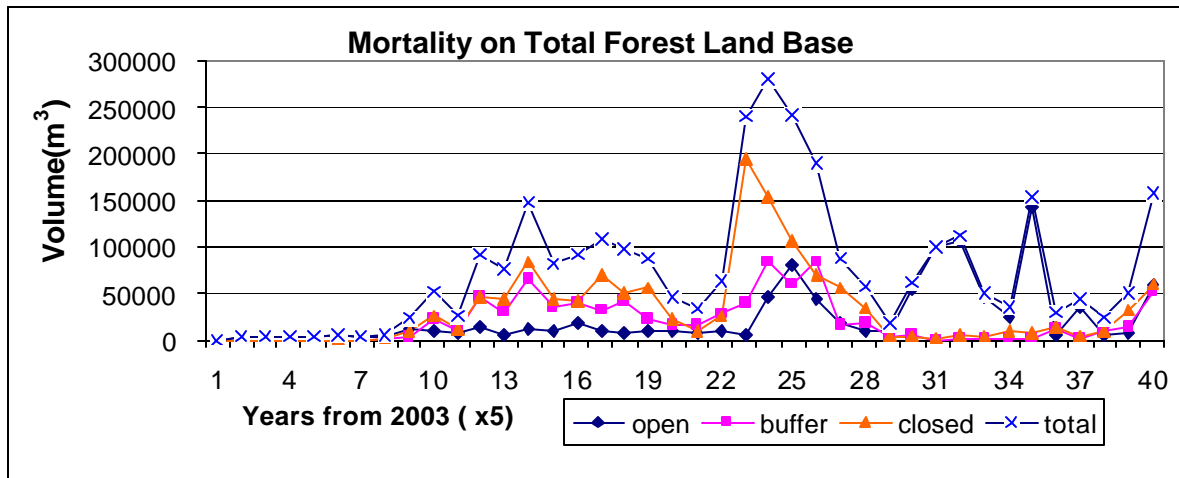
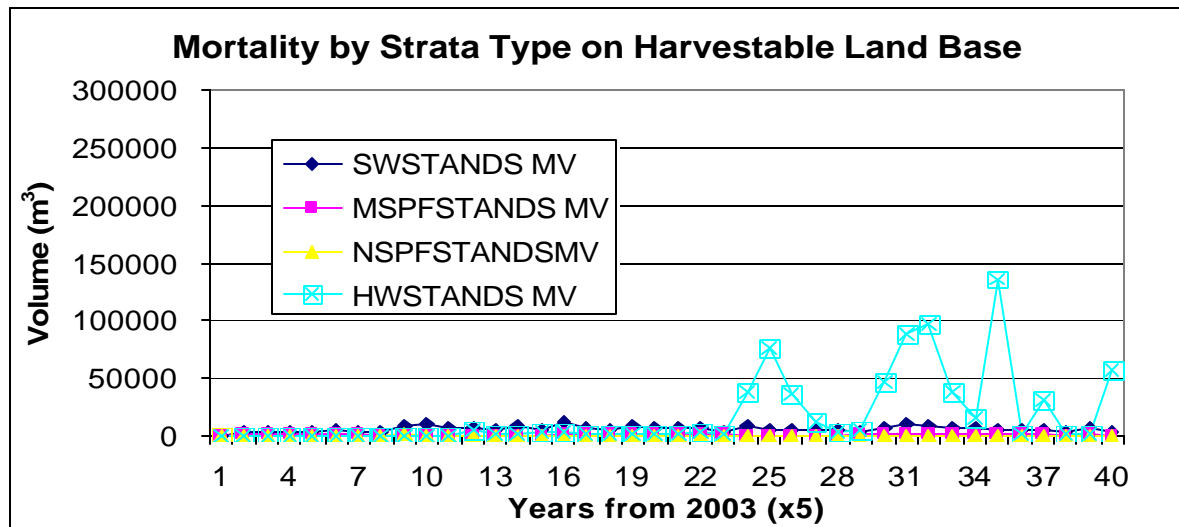


Figure 13



The hardwood OGS (Fig. 6) shows the pinch point for even flow at the beginning of planning horizon and thus constrains the hardwood harvest level over the 200 year planning period. The hardwood treatment and response pathways and the even flow harvest requirement result in accumulated mature hardwood volume and

subsequent mortality after 120 years. The hardwood mortality could be minimized in the future through AAC re-calculation and/or by short term increases to AAC.

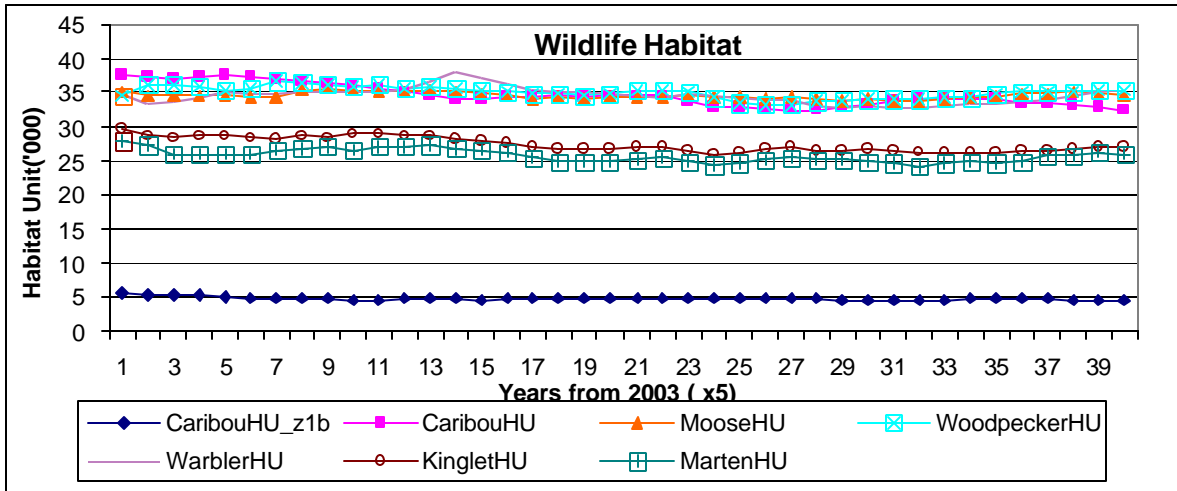
Under total volume scenario the overall level of mortality in the open zone is reduced significantly and postponed till the end of planning horizon compared to the “Base Case” of softwood operation.

1.1.11 Habitat Suitability Indices

Figure 14 in Appendix V illustrates the caribou, moose and other selected wildlife species habitat suitability indices that result from this total volume operation scenario.

This graphic demonstrates the trend in habitat availability under the harvest the total volume scenario. Note that the caribou habitat suitability indices (HSI) are separated between high value habitat zone (1B) and the FML area. All levels of habitat are maintained within reasonable levels with only minor fluctuations across the planning horizon.

Figure 14



1.2 Tactical Level Results

Stanley software was used to determine the optimal wood supply solution by incorporating government spatial constraints such as greenup delays, maximum cutover size into the analysis. The tactical level analysis also applied a global reduction for wildlife tree retention. Areas, within harvestable stands are left standing to serve as cover for wildlife and to provide movement corridors. The Company estimates that 2% of softwood

volume and 5% of hardwood volume from the harvestable forest land is left as residual cover for this purpose.

The optimal solution achieved 99% of the softwood TMSY, and 98% of hardwood TMSY produced by the “Woodstock” harvest schedule in the first 25 years. A total of 500 iterations were simulated to analyze the harvest blocks distribute. Table 2 presents the results of the simulation exercise and the impact of global spatial reductions on the “Woodstock” TMSY.

Table 2. Net Harvest Level after Stanley Simulation Scenario (0-25 Years) and Wildlife Tree Retention

Source	Softwood Volume (m ³ /yr)	Hardwood Volume (m ³ /yr)	Total (m ³ /yr)
Woodstock TMSY	368,539	134,706	503,245
Stanley Reduction (softwood 1%, hardwood 2%)	3,685	2,694	
Wildlife Tree Reduction (softwood 2%, hardwood 5%)	7,371	6,735	
Net Total	357,483	125,277	482,760

The ‘net’ softwood TMSY is 357,483 m³/yr, and ‘net’ hardwood TMSY 125,277 m³/yr has been determined for the next 25 year period. The cut-block statistics in Table 3 shows that almost 30% of the area scheduled for harvest in the first 25 years are from blocks less than or equal to 10 hectares in size; indicating that the harvest operation is highly fragmented.

Table 3. Harvest Block Size Statistics (0-25 years)

Block Size Category (hectares)	Number of blocks (% of total)	Total area (% of total)
<= 10	15,144 (83.3%)	34,733 (27.8%)
10.1 – 20	1,527 (8.4%)	21,309 (17.1%)
20.1 – 30	571 (3.1%)	13,905 (11.1%)
30.1 – 50	489 (2.7%)	19,107 (15.3%)
50.1 – 100	356 (2.0%)	24,324 (19.5%)
100.1 – 150	68 (0.4%)	8,153 (6.5%)
150.1 – 200	15 (0.1%)	2,446 (2.0%)
200.1 – 250	4 (0.0%)	840 (0.7%)
Total	18,183	124,817

Presently, Tembec harvest operations are more consolidated than the spatially fragmented blocks of the Stanley simulation. There are sound reasons for consolidating harvest operations from both an economic perspective and a wildlife perspective. However, there is a cost for these benefits and that cost

is volume. Unless timber harvesting operations can confine harvesting into strata types and age classes that very closely follow the strata types and ages scheduled for harvest by “Woodstock” there must be an adjustment to harvest levels.

1.3 Conclusion and Comparison to the “Base Case” of Softwood Operation

The “Base Case” report¹ documents in detail the wood supply for the current forest management practice on FMLA (softwood only scenario). This addendum documents the analysis for a total volume scenario on the FMLA.

Total volume scenario considers not only the softwood leading stands but also all mixedwood and hardwood leading stands. The net softwood TMSY includes the incidental softwood volume from the hardwood leading strata, and net hardwood TMSY includes hardwood volume from softwood leading strata. This requires integration of softwood and hardwood forest management, planning, harvesting, and renewal in order to achieve the total TMSY.

Table 4 summaries the model difference between the softwood only and total volume scenarios. There exists difference in harvest rules, treatment and vegetation response after harvest, and yields resulting from harvest hardwood leading strata and NSPF.

The key resource indicators for the total volume scenario exhibit similar trends to the softwood only scenario (woodland caribou habitat maintenance, the mean harvest volume per hectare, average harvest age, and age class distribution over the harvestable and total land base).

Introducing a total volume harvest scenario that utilizes both hardwood and softwood species, increases softwood volumes by an additional 17,502 m³/yr of softwood, and hardwood by 105,438 m³/yr at the tactical level. This potential increase in the harvest level of softwood is primarily due to capturing all softwood trees within the newly eligible hardwood working groups. Under the total volume harvest scenario, softwood LRSYA is maintained above the harvest level and hardwood LRSYA is increased at the end of planning horizon because of the projected transition after harvest. The total OGS increased significantly at the last 50 years while comparing to the softwood only scenario. In addition, the volume lost due to mortality, especially hardwood stands, is reduced significantly due to total volume harvest of softwood and hardwood species.

¹ Wood Supply Report for Forest Management Licence Area #1(MC, June 2006)

Table 4. Comparison to the “Base Case” of Softwood Operation¹

Model Setup	Softwood Only Operation (“Base Case”)	Total Volume Scenario
Strategic Level		
Area File	NSPF1 (20% of NSPF)	100% of NSPF
Action	Harvest on Softwood, MSPF, and NSPF1 stands	Harvest on Softwood, MSPF, and NSPF and hardwood stands
Treatment and Response	NSPF1(Table 9 in the report ¹)	NSPF(see section 1 in this report)
Yields	MC Log-length	MC Log-length
Optimization	Maximize and even flow softwood only	Maximize total volume and even flow both softwood and hardwood
Tactical Level		
Shapefile	No NSPF1	NSPF included
‘Net’ TMSY		
Softwood	339,981	357,483
Hardwood	19,839	125,277
Total	359,820	482,760

¹ Wood Supply Report for Forest Management Licence Area #1(MC, June 2006)

The total harvest volume scenario not only changes the harvest strata profile but also increases the average total harvest area by 17% when compared to the softwood only scenario. For example, JP and SMIX harvest volume and area (Fig. 3 and 7) changed significantly from the softwood only scenario (Fig.3 and 7, Appendix V). Under the total harvest volume scenario the harvest pattern is in about 65-year harvest cycles for SMIX and JP stands while MSPF and hardwood stands show substantial increase in harvest area and volume when compared to softwood only operation. The harvest sequence for individual strata varies significantly over 200 years from softwood only scenario to total volume scenario.

The increased softwood volume under a total harvest scenario has silvicultural implications. The hardwood development type has been assigned a treatment and response pathway that cycles back to 100% hardwood and the same yield curve. It is not likely that predominantly hardwood stands, once harvested, will yield similar softwood volumes at the second rotation. Harvesting mixed-wood strata would also present considerable softwood renewal challenges.

Under a total harvest volume scenario its ‘net’ softwood TMSY is 357,483 m³/yr, and ‘net’ hardwood TMSY 125,277 m³/yr. The harvest level is tied closely to the harvest sequence, harvest system, post harvest silviculture program and forest management objectives.

The Branch evaluated a number of different utilization levels under a total volume scenario. Table 5 presents the results of this exercise and indicates harvest level changes by different utilization standards at strategic level. The detail utilization standards can be found in the report (MC, June 2006).

Table 5. Impacts of Changes in Tree Utilization Levels at Strategic Level

Utilization level	Total Volume Operation (TMSY)	
	Softwood (m ³ /yr)	Hardwood (m ³ /yr)
MC Log-Length	368,539	134,706
MC Tree-Length	391,132	142,533
Tembec (1)	380,797	135,738
Tembec (2)	390,234	140,433
Tembec (3)	393,200	140,423

2 AAC'S FOR TAMARACK AND ASH IN TOTAL VOLUME SCENARIO

Under the total harvest volume scenario determining individual AAC's for tamarack (TL) and ash required the inclusion of tamarack and ash volume in the total softwood and hardwood volumes. New yield curves were developed and the AAC was calculated at the strategic level. The volume difference was analysed and assigned as tamarack and ash AAC's as per Table 6.

Table 6. Tamarack and ash AAC under Total Volume Scenario

	TMSY Softwood (m³/yr)	TMSY Hardwood (m³/yr)
Strategic level	407,926	135,800
Tactical level: Net TMSY ¹ (including TL and ASH)	395,689	126,294
Net TMSY ² (excluding TL and ASH)	357,483	125,277
TL AAC	38,206	---
ASH AAC	---	1,017

¹ Deduction percentage (see Table 2) applied to strategic level for its 'Net' TMSY

² See Table 4 for detail

Tamarack and ash contribute 38,206 m³/yr and 1,017 m³/yr respectively to the net TMSY. Tamarack harvest level is derived primarily from TLS and STL strata, however SMIX and JP strata types also contribute incidental tamarack volume to the total volume. This increase in tamarack and ash is possible should the tamarack and ash be managed and utilized effectively by the industry.