6. Preferred Forest Management Scenarios

6.1 Background

The W11 and W13 PFMSs represent the culmination of a lengthy, iterative process in which forest management objectives were carefully balanced and then evaluated to ensure their operational feasibility. Both FMUs were modelled as separate Sustained Yield Units (SYU) resulting in separate PFMSs for each FMU. The W11 PFMS was W11_P12004. The W13 PFMS was W13_P12009.

The PFMSs are 200-year spatially explicit plans, with the first 20-years of harvesting activity, consisting as two 10-year sequences for each PFMS, represented as a SHS. The PFMSs are socially, biologically, and economically feasible plans which will direct Millar Western's and the quota holders' operations for the next 10 years

The PFMSs represents the scenario that best protects the Values and meets the objectives established for the DFMP. In both FMUs numerous scenarios were evaluated, to determine how well each scenario met DFMP objectives and their associated targets. Since initial targets could not all be achieved from the landbase, trade-offs had to be made.

Although there are some operational considerations within the VOITs there were additional operational assessments completed on the SHS that were meant to ensure that the sequences were economically feasible (*e.g.*, block shape and arrangement). .

In this section, a brief description of each PFMS is presented which highlights the Goals that were used to control the forecasting model. The ability of the PFMSs to achieve these goals is summarized.

Detailed descriptions of the PFMSs forecasts for each of the indicators output by the forecast model are presented in this section. Selected indicators derived by the IAGs after the PFMSs were developed are also included.

The tables in this section that contain volumes by species strata represent the volume for the area of the stratum not the individual species volumes. For example, a PL stratum stand may be composed of pine, white spruce, and black spruce trees. The volumes do not include structural retention reductions, which will be accounted for at the block level.

6.2 Forest Management Approach and Objectives

Forest management direction was derived from Millar Western's forest management approach (*Chapter 1*). Specific components of the approach are to:

- Undertake sustainable forest management by maintaining and enhancing the long-term health of forest ecosystems while providing ecological, social, and cultural opportunities for the benefit of present and future generations while striving to satisfy the fibre needs of the manufacturing facilities;
- Apply CSA-Z809 sustainable forest management standards and framework in plan development and implementation; and
- Address immediate threat and long-term forest susceptibility from the current mountain pine beetle infestation.

Applying the CSA framework of Values, Objectives, Indicators and Targets to Millar Western's forest management approach, provided direction for the PFMS selection process. Forest management criteria, values and objectives in the VOIT format that were applied in the forecasting and development of the PFMSs are summarized in Table 21.

Table 21. Criteria, values and objectives addressed in forecasting.

Criteria, Values and Objectives in Forecasting
Criterion: 1. Conservation of Biological Diversity
Value 1.1.1. Landscape scale biodiversity
1.1.1.1. Maintain biodiversity by retaining the full range of cover types and seral stages.
1.1.1.2. Maintain biodiversity by avoiding landscape fragmentation.
1.1.1.3. Maintain biodiversity by minimizing access.
1.1.1.6. Retain ecological values and functions associated with riparian zones.
Value 1.1.2. Local/stand scale biodiversity
1.1.2.1. Retain stand level structure.
Value 1.2.1. Viable populations of identified plant and animal species
1.2.1.1. Maintain habitat for identified indicator species.
Criterion: 2. Maintenance of Forest Ecosystem Condition & Productivity
Value 2.1.1. Reforested harvest areas
2.1.1.1. Operator specific regenerated strata distribution
Value 2.1.2. Maintenance of forest landbase
2.1.2.3. Reduce the susceptibility of forest stands to mountain pine beetle.
2.1.2.4. Alter the current pine age structure of the forest to reduce long-term MPB susceptibility.
Criterion: 3. Conservation of Soil and Water Resources
Value 3.2.1. Water quantity
3.2.1.1. Limit impact of timber harvesting on water yield.
Criterion: 4. Forest Ecosystem Contributions to Global Ecological Cycles
Value 4.1.1. Understanding of carbon balance on DFA
4.1.1.1. Produce a carbon budget for DFA.
Criterion: 5. Multiple Benefits to Society
Value 5.1.1. Sustainable timber supplies
5.1.1.1. Establish appropriate AACs.
Value 5.1.2. Maintain non-timber supplies.
5.1.2.3. Minimize visual impact of harvesting activities along defined corridors.
Value 5.2.1. Risk to communities and landscape values from wildfire is low
5.2.1.1. To reduce wildfire threat potential by reducing fire behaviour, fire occurrence, threats to values at risk and enhancing fire suppression capability.
Value 5.2.3. Forest Productivity
5.2.3.1. Maintain Long Run Sustained Yield Average
Value 5.3.1. Competitive resource businesses
5.3.1.1. Maintain a sustainable, perpetual, economical supply of timber for wood products.

Each of the objectives in Table 21 influenced the PFMS development. The objectives not listed in Table 21 were addressed in other components of the DFMP. The indicators for each objective are presented in the PFMS section of this chapter. Additional maps such as habitat values at selected timer periods and the full set of DFMP VOITs are described *Appendix XXIII – Commitments*.

Most of the objectives in Table 21 had specific indicators incorporated into the forecasting model to aid in decision making during PFMS development. However, a few objectives (*e.g.*, **VOIT 36 – Existence of carbon budget analysis on the Preferred Forest Management Strategy of the 2007-2016 DFMP (4.1.1.1)***)* did not directly influence the PFMS but required indicators to be generated in the forecasting.

6.3 Forecasting Goals

All of the indicators associated with the objectives listed in Table 21 were tracked or generated in the forecasting models. In some cases the levels of these indicators met initial targets under the forecasting scenarios, making it unnecessary to set goals within the model. Presence or absence of goals within the model didn't indicate the importance of the related indicator; it's based on model requirements.

In many cases, it was necessary to constrain an indicator to attain a desired outcome. This was accomplished by setting a goal for the indicator within the forecasting model. This section describes the goals or constraints that were active in the forecasting model, and the ability of the PFMSs to achieve these goals. This section is not meant to describe the all of the results of the PFMSs, which are provided in Section 6.4.

Goals set within the forecasting model were in the form of maximum and/or minimum values for each indicator. When both maximum and minimum goals were active at the same level it is referred to as an absolute goal. In the following charts, absolute goals are shown in green, minimum goals in red and maximum goals in blue. The thickness of the line representing the goals relates to the weighting of the goal. Thicker lines have higher weighting, generally indicating more effort was required to achieve the goal. When the absolute goal and result line are superimposed, as is the case with the harvest goals, it means the goal was achieved.

Forecasting is not as simple as setting goals and then running the model to generate results. While this is technically true, the process undertaken to establish the PFMS goals is far more complex. The goals observed in this section were the result of a lengthy iterative process that began with analysis of specific indicators or in some cases, professional judgment to determine what a desirable goal would be for that indicator. These values were often used as a starting point in the Patchworks forecasting. In some cases, initial values for the Patchwork goals were determined from the corresponding Woodstock model.

Section 7 Management Issues and Decisions describes some of the analysis that was undertaken to establish initial goals. Section 7 also describes how goals and weights were modified until a desirable balance between indicators was achieved, resulting the selection of the PFMSs.

6.3.1 W11 PFMS Goals

There were 11 goals active in the W11 PFMS, reflecting five general forest management indicators: harvest level and timing, growing stock, Opening Patches, Oldgrowthness area, and Oldgrowthness patches.

The minimum, maximum or absolute values plotted for each goal are the input(s) set in the Patchworks forecasting model. The black line is the result value. Patchworks may have 'achieved' a goal while not producing the exact values as the goal. More detail about the exact value achieved can be found in Section 6.4 Detailed Results.

Harvest

There were three active goals relating to harvesting in W11. The first goal related to deciduous harvest, the second goal related to coniferous harvest and the final goal related to early wood deciduous harvest.

The deciduous harvest goal was comprised of two components (Figure 24); an even flow harvest level; and 840,000m^3 of carryover volume harvested from 2007 to 2026.

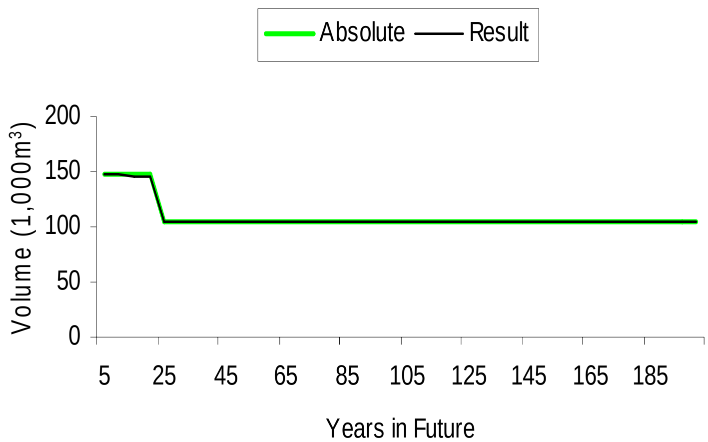


Figure 24. Deciduous harvest goal and result from the W11 PFMS.

Figure 24 shows the resulting harvest level is in line with the goal demonstrating that the model achieved the desired deciduous harvest level. While the carryover is being harvested the harvest level is significantly higher than the remainder of the planning horizon.

The coniferous harvest goal was derived from the combination of three components: 1) a surge cut from 2007-2016 which was approved during the 2002 PFMP development, 2) a dropdown to an even flow level from 2017-2206, and 3) 26,708m^3 of carryover for the 2006-2010 quadrants. As the first modeling period is from 2007-2011, only four years of the carryover (21,367m^3) were included in the forecasting.

As illustrated in Figure 25, the coniferous harvest level was achieved over the entire planning horizon.

Figure 25. Coniferous harvest goal and results from the W11 PFMS.

The final goal associated with harvest was to ensure that one third of the deciduous harvest was from early-wood areas from 2007 to 2016 (for a definition see section 5.18). Millar Western currently has agreements with the Fort Assiniboine Deciduous Loggers Committee to provide one third of their AAC harvest in early wood accessible areas. Adequate volumes are not available in early wood areas to meet this goal for the full planning horizon, therefore the goal for the PFMS was to ensure 33% of the deciduous harvest volume for the first 10 years was from early-wood areas. This goal was set for the total deciduous harvest volume even though the commitment to contractors was that only 33% of the AAC, excluding carryover, would come from these areas (Figure 26). Note that the goal was set for only the first five years of the planning horizon, and as the compartment sequence addressed the required early wood volumes for the next 20 years no goal was required during that period. Earlier analysis had demonstrated that it was impossible to maintain the early wood goal beyond 25 years and so the goal was not continued longer into the planning horizon.

Figure 26. Early wood harvest goal and results from the W11 PFMS.

Figure 26 shows large fluctuations in the percent of deciduous harvest volume from early wood areas. The result line shows that the first period is below the 33% required and the second period is slightly higher than 33%. When the early wood harvest was compared to the even flow harvest component, excluding carryover, early wood harvest made up over 33% of the deciduous harvest.

All W11 harvest goals were met in all periods with the exception of the early wood harvest, which met the operational targets but not the strategic modeled goal.

Growing Stock

Goals were established to maintain minimum coniferous and deciduous operable growing stock on the landbase. The Planning Standard requires the operable growing stock on the landbase to be stable for the final 50 years of the planning horizon. The non-declining yield levels of coniferous and deciduous operable growing stock achieved from the Woodstock scenario mimicking the PFMS were used as minimum growing stock levels for the entire length of the planning horizon. These goals ensure that the harvest level from the landbase is sustainable beyond the end of the planning horizon. The deciduous and coniferous operable growing stock levels are shown in Figure 27 and Figure 28 respecitvely.

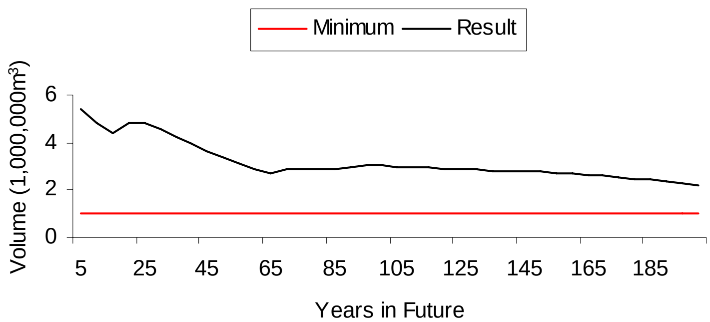


Figure 27. Deciduous operable growing stock goal and results from the W11 PFMS.

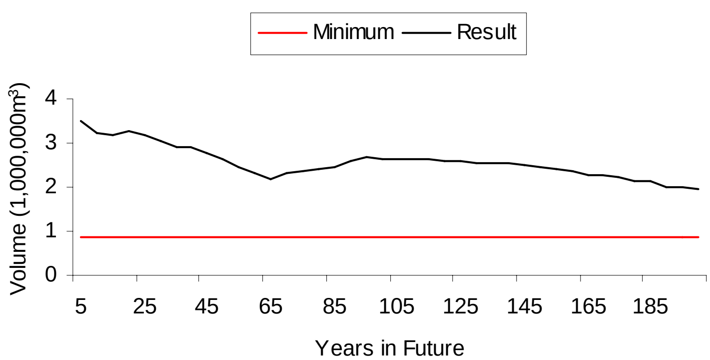


Figure 28. Coniferous operable growing stock goal and results from the W11 PFMS.

The operable coniferous and deciduous growing stock levels are higher than the minimums derived from the Woodstock results for all periods of the planning horizon. There is a decline in the growing stock throughout the final quarter of the planning horizon, but this is largely a result of the end of planning horizon effect. The manner in which Patchworks behaves with growing stock constraints makes it very difficult to create a true non-declining yield of operable growing stock.

Opening Patch

There were four Opening Patch goals within the PFMS model: three created a desired distribution of patch sizes; and one ensured operational feasibility. The first goal, incorporated for operational feasibility, attempted to eliminate the smallest patches (< 4 ha) by setting a goal of no patches of this size class (Figure 29). Respectively Figure 30, 31 and 32 present the goals for the 4-100 ha, 100-1000 ha and 1000 ha + Opening Patches in the model. The patch sizes goals were 76%, 19% and 5%, of the total patch area respectively, and were allowed to vary by +/-2.5% to allow some flexibility in the model.

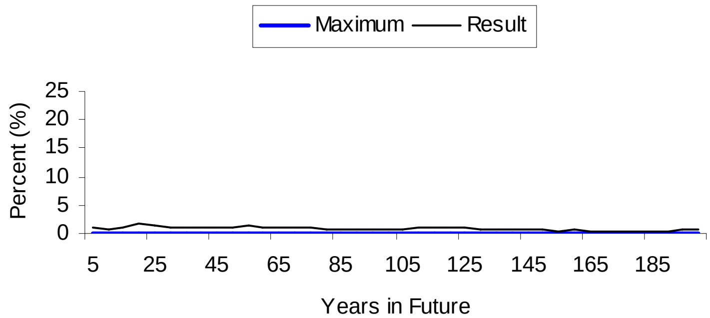


Figure 29. 0-4 ha Patch size goal and results from the W11 PFMS.

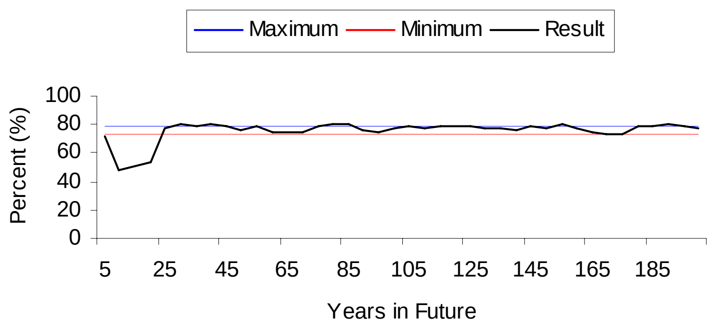


Figure 30. 4-100 ha Patch size goal and results from the W11 PFMS.

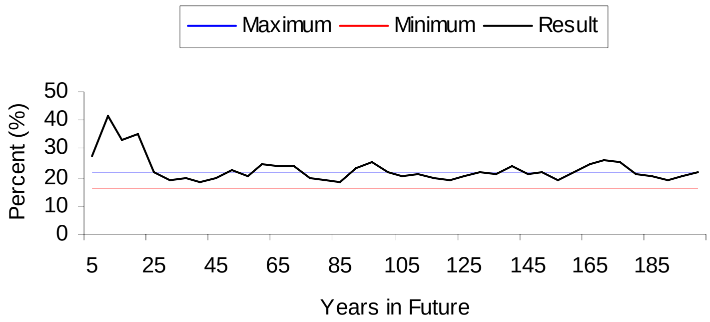


Figure 31. 100-1000 ha Patch size goal and results from the W11 PFMS.

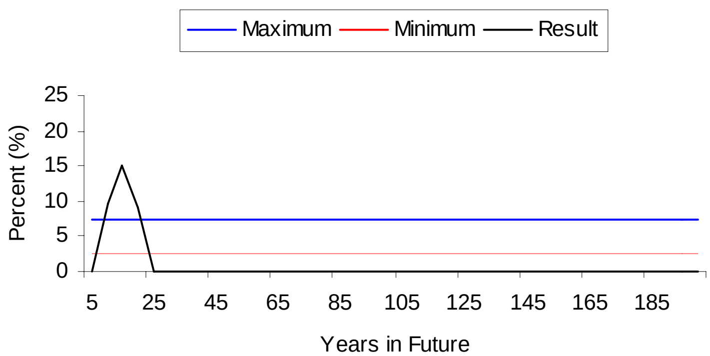


Figure 32. 1000+ ha Patch size goal and results from the W11 PFMS.

Figure 29 shows that there are very few 0-4 ha openings on the landbase throughout the planning horizon. There are fewer 4-100 ha opening patch sizes than desired in the early portions of the planning horizon and correspondingly more 100-1000 and 1000+ ha patches on the landbase in the early periods. Later in the planning horizon all patch size goals are closer to being achieved than in the early periods, except for the 1000+ha patches which are not present after approximately 25 years. One of the reasons for this increased opening patch size early in the planning horizon is that Millar Western has targeted removal of second pass volume from compartments to reduce forest fragmentation.

Opening Patch size goals were not met initially, however after 25 to 30 years, the goals are close to the desired levels.

Oldgrowthness Area

Based on the work of Dr. Doyon, Oldgrowthness area was used in the model to ensure adequate Old growth characteristic were represented on the landbase. Oldgrowthness is meant to measure Old growth characteristics on the landbase rather than the traditional binary old growth measure. Through previous analysis it was decided that 10% of the landbase area should be represented in Oldgrowthness area (Figure 33).

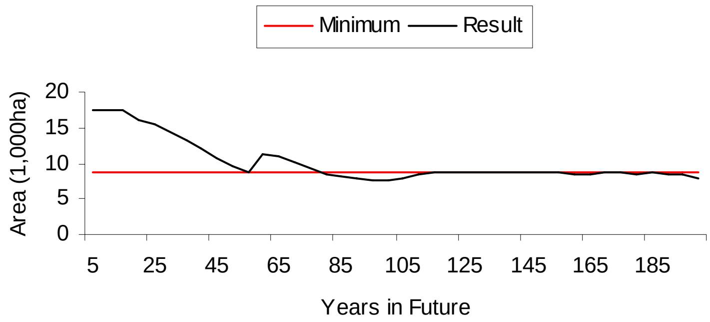


Figure 33. Oldgrowthness area goal and results from the W11 PFMS.

In the early periods of the planning horizon the Oldgrowthness area goal is exceeded. Later in the planning horizon the Oldgrowthness area drops slightly below the goal minimum, but returns to the minimum for the remainder of the planning horizon. There is additionally a slight drop in the Oldgrowthness area that is associated with the end of planning horizon effect.

Oldgrowthness Patch

There are two problems associated with maintenance of Oldgrowthness patches: it is difficult to create Oldgrowthness patches in the model as it takes a long period of time for Oldgrowthness area to exist; and if the young landbase is fragmented into small patches it becomes difficult to aggregate Oldgrowthness area into large patches.

To address this, in addition to the goal placed on the amount of Oldgrowthness area, a goal was placed on the model that required 75% of the Oldgrowthness area to be in patches greater than 120 ha in size (Figure 34). This included patches both on the managed and unmanaged landbases. This size was a proxy used to approximate the 100 ha interior old patches defined in the Planning Standard.

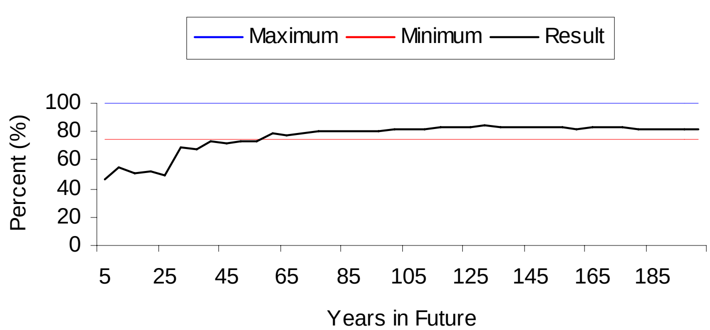


Figure 34. Oldgrowthness patch goal and results from the W11 PFMS.

Initially the Oldgrowthness area on the landbase is not arranged in patches greater than 120 ha in size. For the first quarter of the planning horizon the percent of the Oldgrowthness patches greater than 120 ha increases and then it stays fairly stable throughout the remainder of the planning horizon, with approximately 80% of the Oldgrowthness area in patches in greater than 120 ha.

Goal Summary

Eleven goals were actively incorporated in the W11 PFMS. Although some trade-offs between these goals had to be made, the goals were balanced in the PFMS to achieve them to the best of the forest's ability. There were periods of time when some of the goals fell below the desired level.

6.3.2 W13 PFMS Goals

There were 20 goals active in the W13 PFMS, reflecting eight forest indicators including harvest level, post-harvest stand conversion, Opening Patches, Oldgrowthness area, Oldgrowthness patches, growing stock, MPB susceptibility and mixedwood retention.

The minimum, maximum or absolute values plotted for each goal are the input(s) set in the Patchworks forecasting model. The black line is the result value. Patchworks may have 'achieved' a goal while not producing the exact values of the goal. More detail about the exact value achieved can be found in the Results section (6.4.2).

Harvest

There were three specific goals relating to harvesting in W13. The first goal related to the coniferous harvest, the second goal related to deciduous harvest, and the final goal related to Weyerhaeuser's deciduous harvest.

The coniferous harvest goal included a surge cut to address MPB with a subsequent drop down to an even flow level (Figure 35).

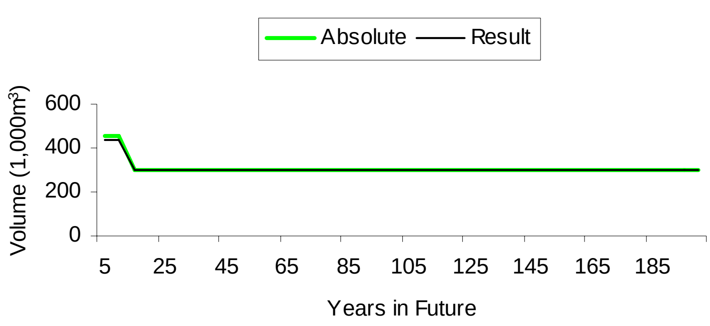


Figure 35. Coniferous harvest goal and results from the W13 PFMS.

Figure 35 shows that, other than the slight underachievement in the first 10 years, the goal is met throughout the planning horizon. The underachievement in the first 10 years is due to the review and removal of non-merchantable black spruce from the first 10 years of the SHS. This was completed as per discussions with the government regarding black spruce operability (Section 7.27).

The deciduous harvest goal included a 10-year surge cut followed by a drop down to an even flow harvest volume for the remainder of the planning horizon (Figure 36). The surge cut of deciduous volume was required to allow for the increase in incidental harvest volume from the coniferous surge. The coniferous stands scheduled in the SHS included too much incidental deciduous volume to maintain an even flow deciduous harvest while maintaining Weyerhaeuser's quota volume.

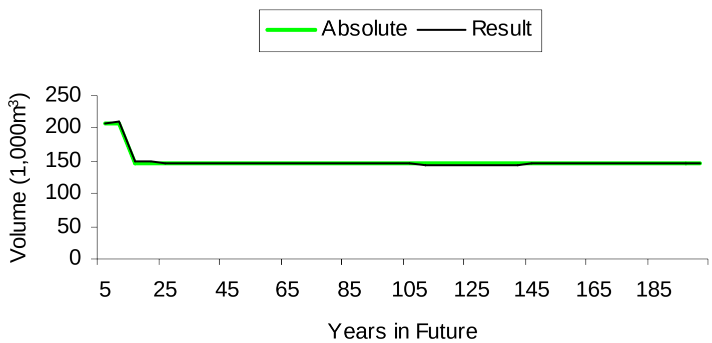


Figure 36. Deciduous harvest goal and result from the W13 PFMS.

Figure 36 shows the resulting deciduous harvest level is achieved in all periods of the planning horizon.

The final goal associated with the harvest was on the deciduous volume harvested from the five compartments within which Weyerhaeuser wishes to harvest their quota volume (Whitecourt Mountain, Robison, Paddle River, Hardluck Creek, and Groat Creek) (Figure 37). This goal was specific to pure deciduous stands, although Weyerhaeuser only harvests B, C, and D density stands. In the SHS review process all A density stands were removed from the sequence, therefore the stands in the first decade represent only the B, C, and D density stands.

Figure 37. Weyerhaeuser deciduous harvest goal and results from the W13 PFMS.

Figure 37 shows large fluctuations in the volume harvested from the five Weyerhaeuser compartments of interest. For the first 10 years there is adequate volume from the compartments of interest to meet this goal, however, these compartments are unable to sustain this harvest level into perpetuity.

All of the W13 harvest goals were met in the PFMS. These goal levels were balanced with the other indicators to ensure that all of the goals were met based on the trade-off analyses completed.

Post Harvest Stand Conversion

Millar Western uses stand conversion to increase the long term coniferous harvest within W13. Stand conversion is a derivative of the crop plan conversions that were incorporated in the previous DFMP. Operationally the decision on which strata shall be converted and which stands to convert will be made on stand by stand bases as not all stands are suitable for conversion and other operational and ecological factors unavailable to the model must be considered. Species strata targets will be used to direct operations, not the specific polygons converted in the modeling. A goal was incorporated into the model to limit the amount of area treated by the conversion action. The goal was set to a maximum of 50% of stands converted, by area (Figure 38). The result produced was arbitrarily high as pure coniferous stands were eligible for the conversion action as defined here and thus show as conversion along with the true conversion to conifer. The choice between normal harvest and conversion on coniferous sites did not affect the outcome therefore Patchworks used the treatment arbitrarily. The corrected output, with coniferous conversion excluded can be seen in the W13 results section. The figure below shows the Patchworks results including the arbitrary coniferous conversion.

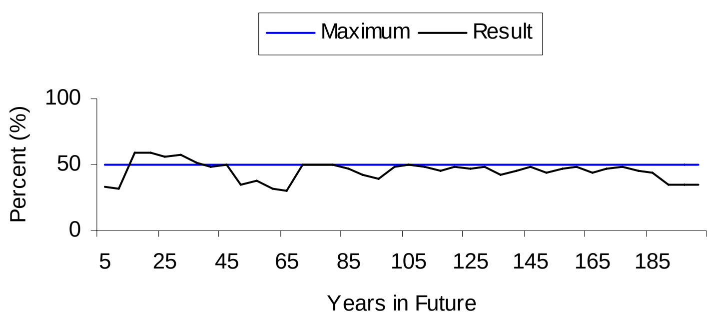


Figure 38. Post harvest stand conversion target from the W13 PFMS.

This figure shows that in the first 10 years the amount of conversion is lower than the maximum. The subsequent 20 years the level of conversion is above the target level, after which the target is achieved for the remainder of the planning horizon.

Opening Patch

There were five Opening Patch goals within the PFMS model for W13. Three were used to create a distribution of patch sizes, one ensured operational feasibility and one ensured quota holder commitments could be met. The first goal, limiting patches < 4 ha (Figure 39), was used to ensure operational feasibility and the goal was set to 0 to reduce the amount of very small opening patches. Figure 40, 41 and 42 present the goals for the 4-100 ha, 100-1000 ha and 1000 ha + Opening patches. These goals were 76%, 19% and 5% respectively and allowed a deviation of +/-2.5% for flexibility in the model. The final patch size goal was in Weyerhaeuser harvest area of interest to ensure the Opening Patches were less than 100 ha (Figure 43). This related to Weyerhaeuser's previous agreement with residents of Whitecourt Mountain, not to harvest large blocks in this area. This agreement has expired but the target remained in the PFMS model.

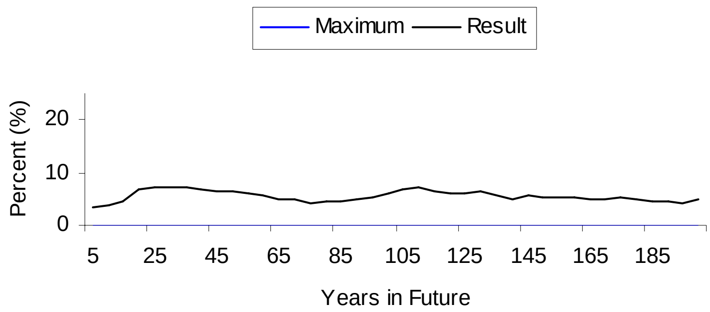


Figure 39. 0-4 ha Patch size goal and results from the W13 PFMS.

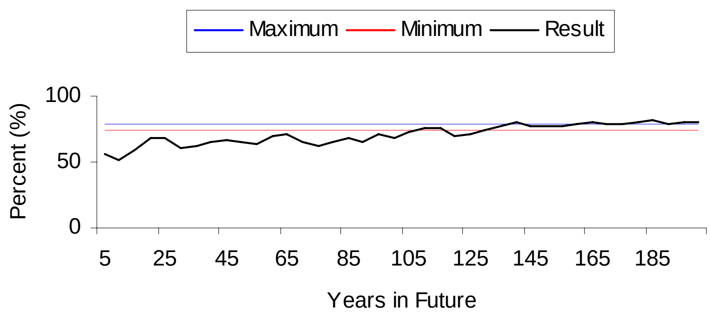


Figure 40. 4-100 ha Patch size goal and results from the W13 PFMS.

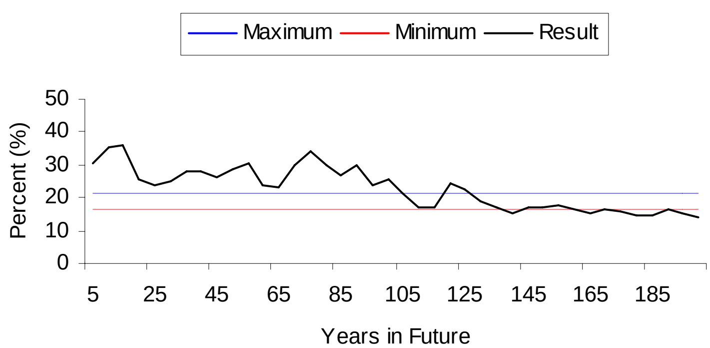


Figure 41. 100-1000 ha Patch size goal and results from the W13 PFMS.

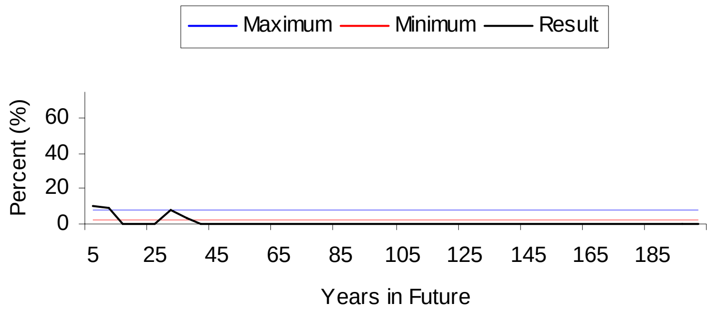


Figure 42. 1000+ ha Patch size goal and results from the W13 PFMS.

Figure 43. Weyerhaeuser patch size goal and results from the W13 PFMS.

Figure 39 shows that very few 0-4 ha openings are created on the landbase. There are fewer 4-100 ha Opening Patches than desired in the early portions of the planning horizon and correspondingly more 100-1000 ha patches on the landbase in the early periods than desired. In the early portion of the planning horizon the 1000+ ha patch goal is met but it is not sustained throughout the planning horizon. Some Weyerhaeuser blocks are greater than the desired 100 ha in the PFMS. Later in the planning horizon all patch size goals are closer to being achieved than in the early periods, except for the 1000+ha patches which are not present after approximately 25 years. One of the reasons for this increased Opening Patch size early in the planning horizon is that Millar Western has targeted removal of second pass volume from compartments to reduce forest fragmentation.

Oldgrowthness Area

Based on the work of Dr. Doyon, Oldgrowthness area was desired in the model to ensure adequate old area is represented on the landbase. Oldgrowthness is meant to measure Old growth characteristics on the landbase. Through previous analysis it was decided that 10% of the landbase within W13 should be represented as Oldgrowthness area (Figure 44). After a review of a draft PFMS it was decided by Dr. Doyon that there should also be targets placed on the amount of Oldgrowthness area from D and DC cover group stands to ensure representation of Oldgrowthness across different cover groups. Therefore a minimum goal was set for the D and DC cover groups (Figure 45 and Figure 46).

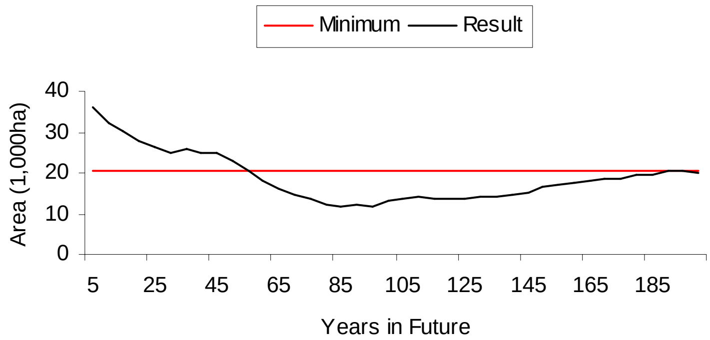


Figure 44. Oldgrowthness area goal and results from the W13 PFMS.

Figure 45. Oldgrowthness area goal and result in the D cover group from the W13 PFMS.

Figure 46. Oldgrowthness area goal and result in the DC cover group from the W13 PFMS.

In the early periods of the planning horizon the Oldgrowthness area goals are exceeded. Later in the planning horizon the managed Oldgrowthness area drops below the minimum goal, but returns to the minimum towards the end of the planning horizon. The D and DC cover group Oldgrowthness targets were met for the entire planning horizon.

Oldgrowthness Patch

There are two challenges associated with Oldgrowthness patches: it is difficult to create Oldgrowthness patches in the model as it takes a long period of time for Oldgrowthness area to exist; and if the young landbase is fragmented with small patches, it becomes difficult to aggregate Oldgrowthness area into large patches.

To address this, a goal requiring 75% of the Oldgrowthness area to be in patches greater than 120 ha in size was incorporated into the PFMS model (Figure 47). This included patches both on the managed and unmanaged landbases. This 120 ha patch size was a proxy used to approximate the 100 ha interior old patches as defined by the Planning Standard.

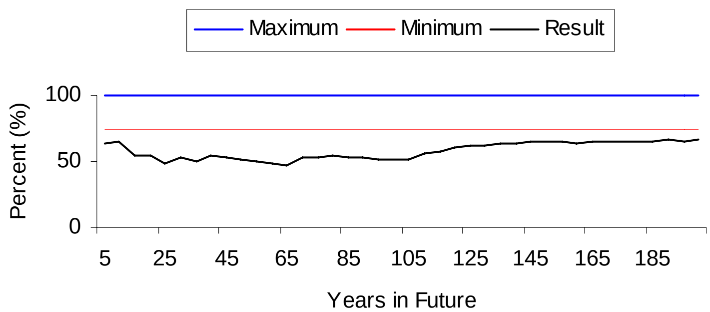


Figure 47. Oldgrowthness patch goal and results from the W13 PFMS.

Oldgrowthness patches initially decreases slightly and then increases as the PFMS is implemented. However, Oldgrowthness patches are consistently below the 75% modeling goal that was set.

Growing Stock

Goals were assigned for the minimum coniferous and deciduous operable growing stock on the landbase. The Planning Standard requires the operable growing stock on the landbase to be stable for the final 50 years of the planning horizon. The non-declining yield levels of coniferous and deciduous operable growing stock achieved from the Woodstock scenario mimicking the PFMS were used as minimum growing stock levels for the entire planning horizon. These goals ensure that the harvest level from the landbase is sustainable beyond the end of the planning horizon. The deciduous operable growing stock is shown in Figure 48 and the coniferous operable growing stock in Figure 49.

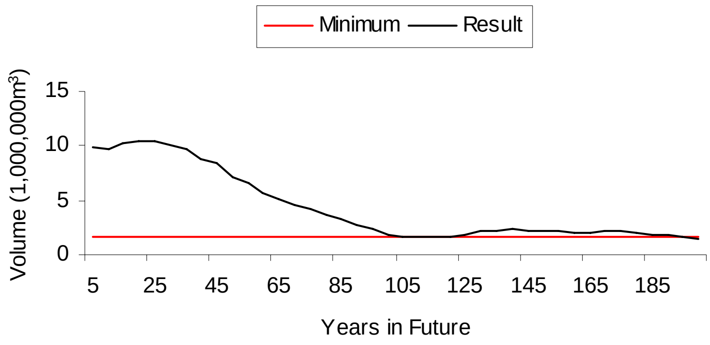


Figure 48. Deciduous operable growing stock goal and results from the W13 PFMS.

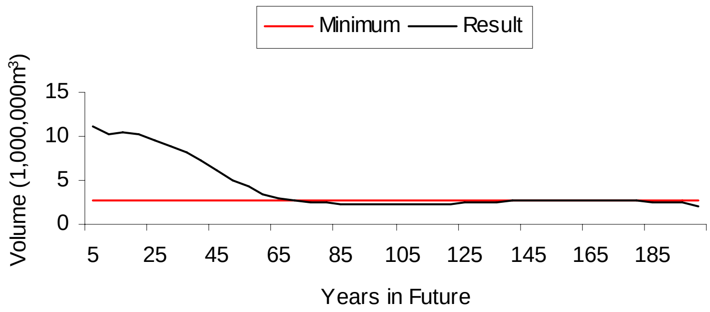


Figure 49. Coniferous operable growing stock goal and results from the W13 PFMS.

Both the coniferous and deciduous growing stock levels are high in the early portions of the planning horizon then drop to a stable level for the last two thirds of the planning horizon.

Mountain Pine Beetle

MPB is a very important forest management concern in W13 and Millar Western has chosen to actively incorporate MPB susceptibility into the PFMS development process. The W13 PFMS contained a goal for reducing the MPB susceptible area based on a dynamic modeling approach developed by Millar Western for MPB risk prediction (Section 5.12). The goal was to remove 50% of the susceptible stands within 10 years and 75% of the susceptible stands within 20 years (Figure 50).

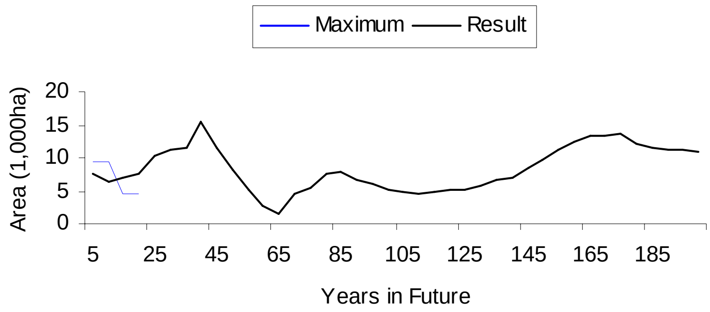


Figure 50. Mountain pine beetle susceptibility goal and results from the W13 PFMS.

The MPB goal is not achieved in the first portion of the planning horizon, although when compared to forecast scenarios which do not incorporate an active MPB goal, there is a significant reduction in the MPB ranking on the landbase. This result demonstrates that even with a surge cut, the MPB susceptibility of this forest increases for the first 45 years of the planning horizon. The reason for this increase is the large area of younger pine in the Windfall burn area established from the fires in the 1950's that will become old enough to achieve a significant increase in the forests susceptibility to MPB but not yet merchantable. This dynamic is not present in the ASRD ranking which is based on the current forest condition and does not age. If however, the ASRD ranking was determined on the forest aged 45 years into the future, a higher ranking would be expected.

Mixedwood Retention

Retention of mixedwood stands in W13 was identified as important in the previous DFMP and Millar Western is ensuring this continues in the 2007-2016 DFMP. Since the model has the ability to convert mixedwood stands to pure coniferous stands it was necessary to establish goals to retain the mixedwood stands. Goal were set for each of the four mixedwood species strata (AP, AS, PA and SA) to ensure that at least 50% of the managed area by species strata would exist at the end of the planning horizon (Figure 51, Figure 52, Figure 53, and Figure 54).

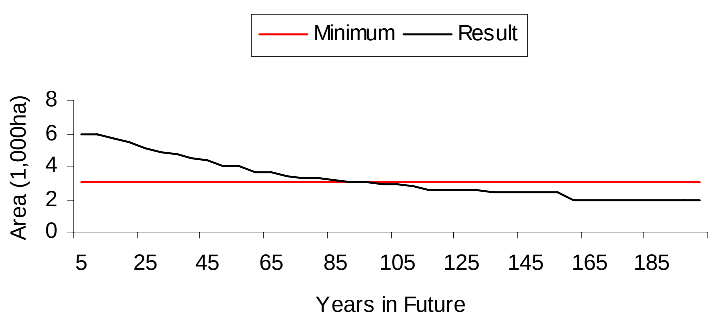


Figure 51. AP mixedwood goal and results from the W13 PFMS.

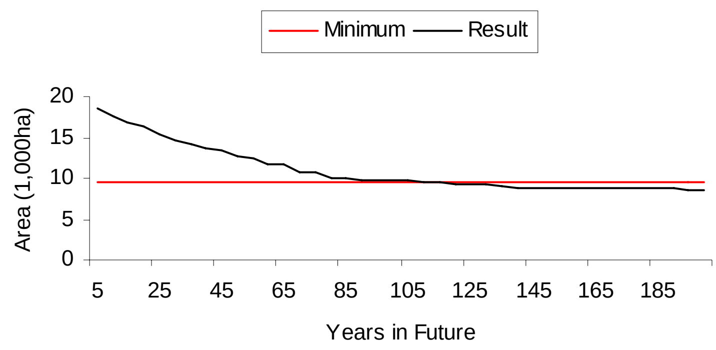


Figure 52. AS mixedwood goal and results from the W13 PFMS.

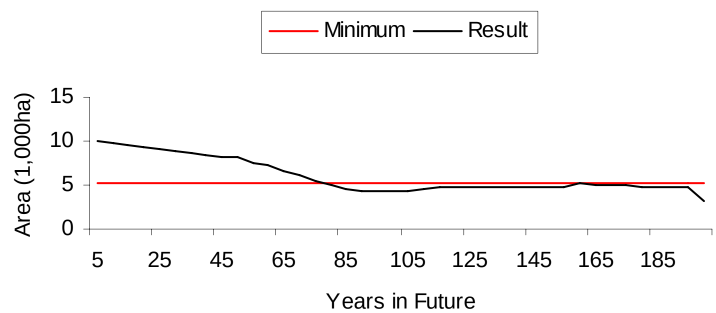


Figure 53. PA mixedwood goal and results from the W13 PFMS.

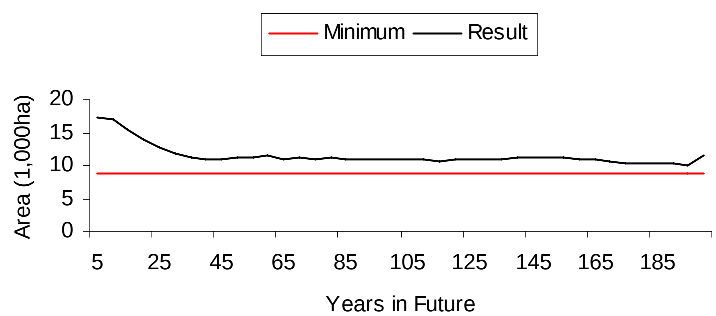


Figure 54. SA mixedwood goal and results from the W13 PFMS.

Generally, the area of each mixedwood species strata decreased throughout the planning horizon, and approaching the minimum level set by the model.

Goal Summary

Twenty goals were actively incorporated into the W13 PFMS. Overall, the PMFS balanced these different goals to the best ability of the forest based on the direction from the plan development team. Unlike W11, there were numerous tradeoffs made in W13 which caused desired levels of some indicators to deviate from the modeling goals. The largest of these tradeoffs was the inclusion of a surge cut to reduce MPB susceptibility, which caused decreases to many of the inventory indicators on the landbase such as Oldgrowthness area. The conifer surge cut also forced an accompanying surge cut of deciduous harvest, and lowered the long term coniferous and deciduous levels. Both Millar Western and the other DFMP stakeholders considered this an acceptable tradeoff and it was retained in the PFMS.

6.4 Detailed Results

This section presents the detailed results from the W11 and W13 PFMSs. As previously discussed, more indicators were tracked and reported than those that were actively constrained in the model. This section details all the indicators of interest for each the PFMSs.

The PFMSs results are presented in three subsections: the first relates to harvest activities; the second to inventory indicators and the final to hydrologically related indicators.

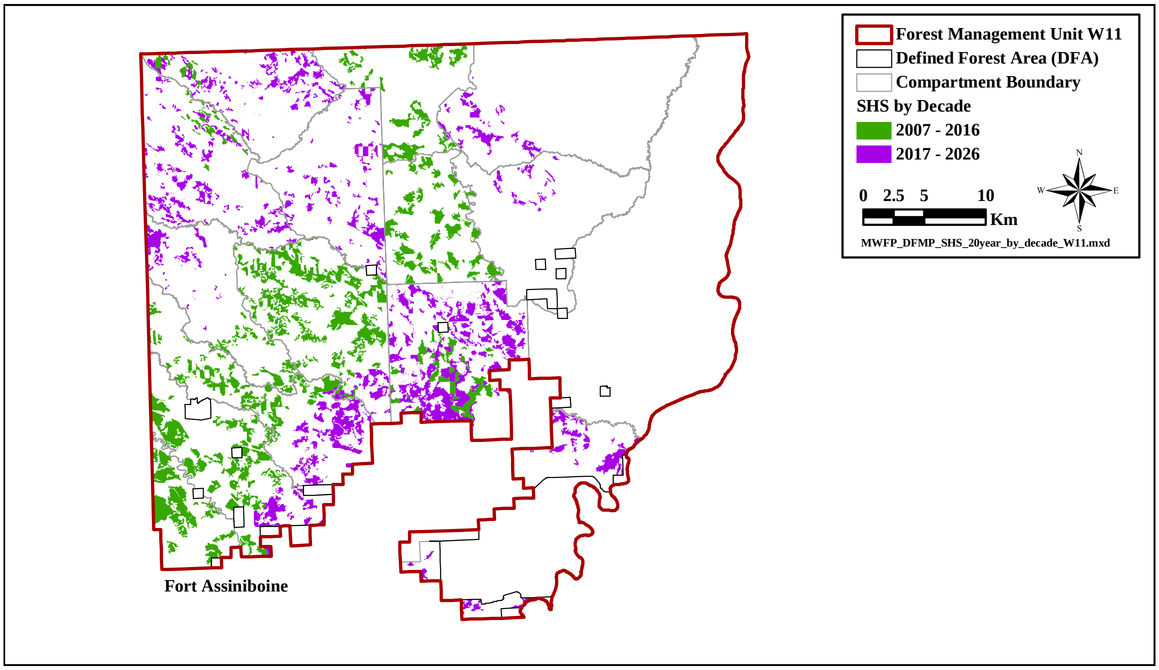
6.4.1 W11 Detailed Results

Millar Western only has rights to deciduous timber in W11; all coniferous volume is allocated to other forest companies. Beginning with the development of PFMP, Millar Western and the W11 quota holders have been moving forward in the joint management of this FMU. Although it has been a learning process for all, the integration has been improving through time.

There is an excess of mature and over mature timber volume in the FMU; with a large percentage only accessible in the winter. There is an existing approved coniferous surge cut carried over from the PFMP included in the PFMS. While there is pine in this unit, it is scattered or too young to be merchantable at this time. If MPB is established in the FMU, level 1 and 3 responses will be pursued and depending upon the level of infestation, the sequence may have to be revised. The management philosophy is basic by sound forest management where the current species harvests are maintained through time.

Harvest Indicators

There were four main sets of harvest indicators tracked through time in this planning process: volume harvested; area harvested; average harvest age; and the piece size distribution of the harvest. The forecasts for these different harvest indicators are shown separately below. The W11 SHS can be seen in Map 14.



Map 14. W11 SHS by decade from the PFMS.

Volume

The harvest level changed through time in the PFMS (Table 22). The harvest levels shown represent the periodic average harvest levels for the periods shown. The initial coniferous harvest level is associated with a surge cut approved in the PFMP. As indicated in Figure 55, during the even flow periods of the planning horizon the harvest fluctuates slightly. Not included in these volumes, is a 1% volume reduction for structure retention that will be applied during layout and harvesting operations.

Table 22. Harvest levels achieved from the W11 PFMS.

Years	Conifer Harvest (m^3/yr @ 15/10)	Deciduous Harvest (m^3/yr @ 15/10)
Harvest Level		
2007-2016	94,893	106,049
2017-2026	55,702	104,479
2027-2206	55,755	104,677
Carryover		
2007-2010	5,342	
2007-2026		42,000

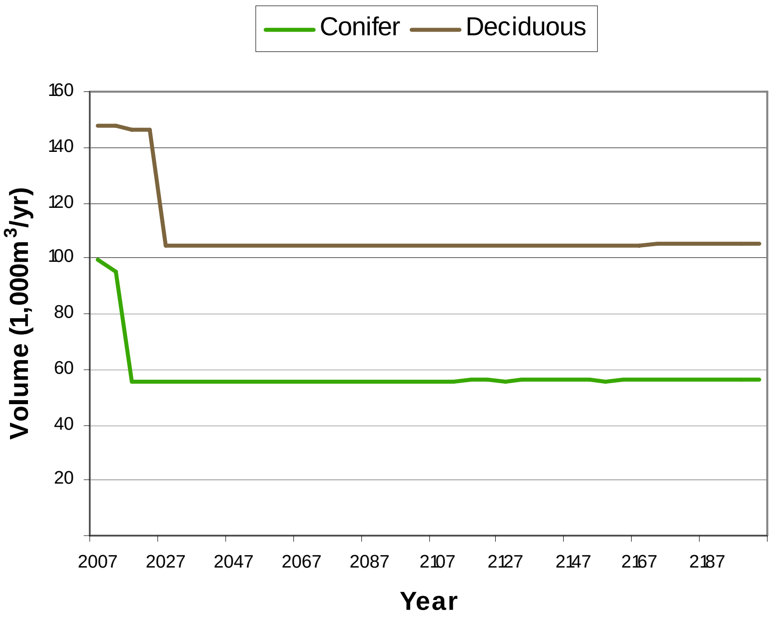


Figure 55. Total harvest level from the W11 PFMS.

There is carryover of deciduous and coniferous volume included in the PFMS comprised of 26,708 m^3 (OK Lumber Ltd.) of coniferous carryover from 2006-2010, and 840,000m^3 (Millar Western) deciduous carryover from 2007-2026. OK Lumber indicated they wished to harvest their approved carry over volume equally distributed over the quadrant i.e. 5,341m^3/year. As the first DFMP period is from 2007-2011 only 4 years of the coniferous carryover was included in the first DFMP period (21,367m^3). The 840,000m^3 of deciduous carryover is allocated over the next 20 years, a total of 42,000m^3 annually. After the carryover and surge cuts are completed the harvest levels are even flow for the remainder of the planning horizon. The difference from the minimum to the maximum coniferous harvest level in the even flow period is 0.8%; the deciduous percent difference from the minimum to the maximum is 0.5%. Therefore both harvests meet the 5% allowable fluctuations for an even flow harvest level allowed in the Planning Standard.

The early-wood deciduous harvest is shown in Figure 56. The average early-wood volume harvested in the first 10 years is 37,886m^3/yr. The average deciduous harvest, excluding carryover, from this same period is 106,049m^3/yr. Therefore, in the first 10 years, the ratio of early-wood to total deciduous harvest (excluding carryover) is 35.7%, meeting the minimum objective of 33% of the deciduous harvest from early-wood areas.

Both the coniferous and deciduous harvest volumes (Figure 48 and Figure 49) are sourced from a range of species strata types. Note the large amount of conifer incidental volume sourced from pure hardwood species strata (AW). The harvest volumes, including carryover, by species strata from the SHS can be seen in Table 23.

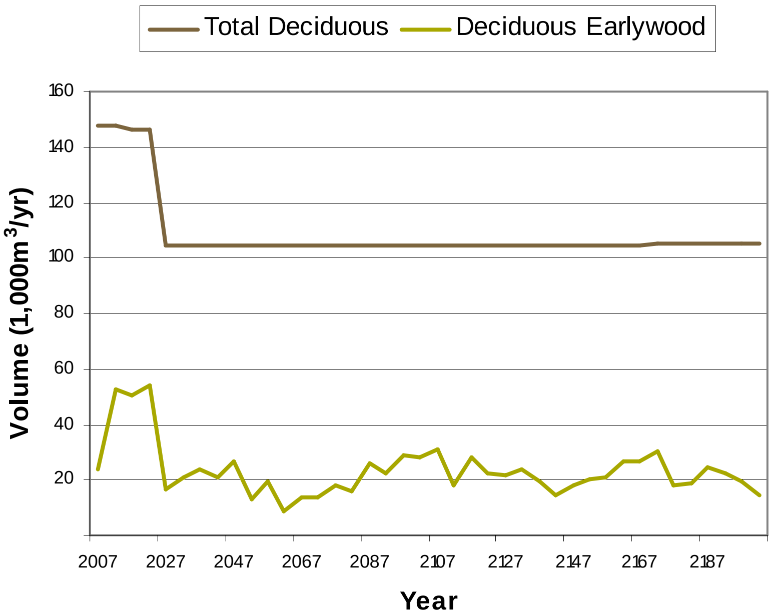


Figure 56. Early-wood harvest from the W11 PFMS.

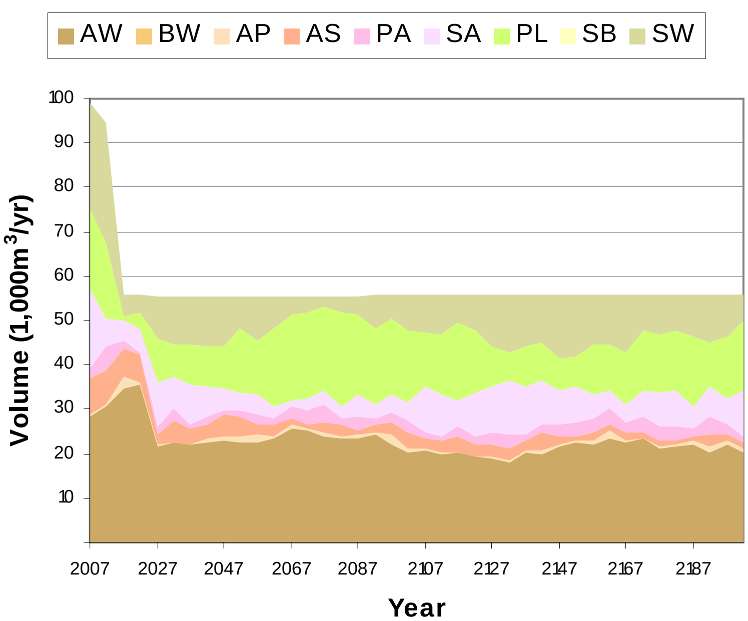


Figure 57. Coniferous harvest volume by species strata from the W11 PFMS.

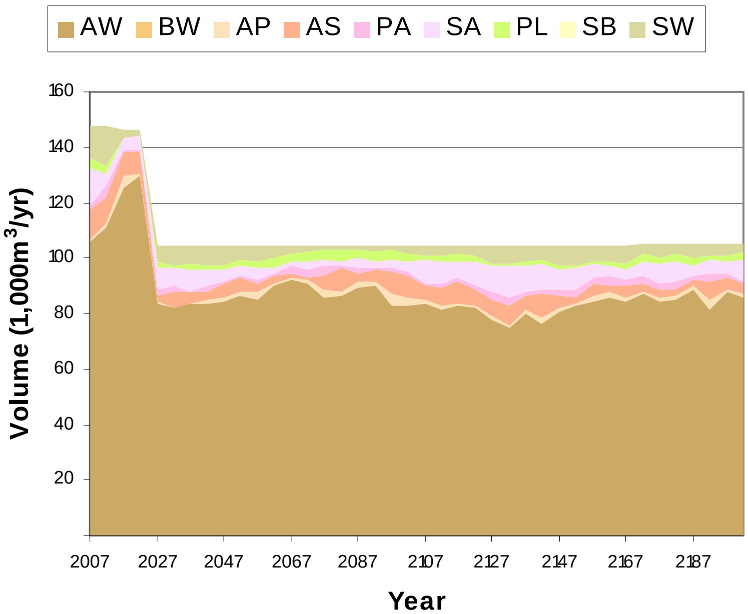


Figure 58. Deciduous harvest volume by species strata from the W11 PFMS.

Table 23. Harvest volume by decade and species strata from W11 PFMS.

Species Strata	2007-2016 Harvest Volume (m^3/yr) Coniferous	Deciduous	2017-2026 Harvest Volume (m^3/yr) Coniferous	Deciduous
AW	29,322	108,360	35,010	127,744
BW	-	-	-	-
AP	820	1,149	1,609	2,158
AS	7,551	10,006	6,358	8,433
PA	4,041	3,031	1,121	874
SA	12,035	9,022	5,140	4,362
PL	17,554	3,143	2,152	221
SB	-	-	-	-
SW	25,707	13,338	4,312	2,687
TOTAL	97,030	148,049	55,702	146,479

There are areas outside of Millar Western's FMA that are within FMU W11 that Millar Western does not currently have rights to harvest (see Section 7.28). Table 24 shows the annual harvest volume by company and licence within W11.

Table 24. Harvest volume from the FMA, and non-FMA area by company from the W11 PFMS.

Company Name	Disposition Number / FMA Ref.	FMA/ FMU/ Grazing	Deciduous AAC (%)	Deciduous AAC (m3/yr)	Coniferous AAC (%)	Coniferous AAC (m3/yr)
W11						
MWFP	FMA970034	FMA		103,520		
OK Lumber	CTQ110005	FMU			21.05	19,975
Fort Assiniboine Lumber	CTQ110004	FMU			6.26	5,940
Spruceland Millworks Inc.	CTQ110006	FMU			72.70	68,987
MWFP (Requested)*		Grazing	100.00	2,529		
Total				106,049		94,903
FMA						
Area Residents	[8(2)(d)]	IN	1000**			

* July 18, 2006 letter to D.A. Sklar, re: DTA's for unallocated deciduous volume
** conifer/deciduous(birch) Not accounted in calculations
Represent basis for calculations

Area Harvested and Regenerated

The area harvested in the PFMS is highest at the beginning of the planning horizon, subsequently dropping off and then steadily increasing (Figure 59). The initial high harvest area is attributable to the coniferous surge cut and coniferous and deciduous carryover volumes. The subsequent increase in harvest area is related to the decrease in average harvest age. No stand conversion after harvesting was permitted in W11 and the results show that no area was converted (note the black line at the bottom of the chart). Table 25 shows that the SHS follows the landbase profile.

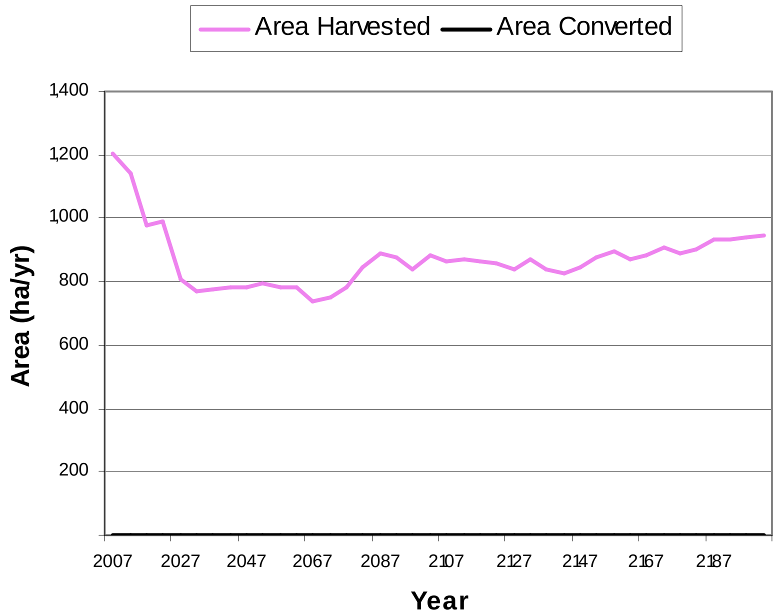


Figure 59. Area harvested and converted in the W11 PFMS.

Table 25. Landbase areas compared to the first 10 years of the SHS.

Yield Strata	Landbase Gross	Managed	Operable	10 yr SHS
AW	38%	61%	58%	57%
BW	0%	0%	0%	0%
AP	1%	2%	1%	1%
AS	4%	6%	7%	8%
PA	2%	2%	2%	2%
SA	4%	6%	7%	7%
LT	17%	0%	0%	0%
PL	9%	13%	11%	10%
SB	18%	0%	0%	0%
SW	7%	11%	14%	15%

The Alberta government included a conifer incidental replacement strategy condition in the 2004 PFMP approval. The quota holders and Millar Western do not support the conifer incidental replacement strategy and propose to follow the regeneration strategy from the PFMS. Refer to Section 7.20 for more information.

Figure 60 shows the area harvested by species strata on the landbase. The majority of the harvest occurs in deciduous stands. All harvested areas are regenerated back to themselves in this scenario. The area harvested and regenerated by operator is summarized in Table 26. The SHS by species strata for W11 is provided, by decade, in Map 15 and Map 16.

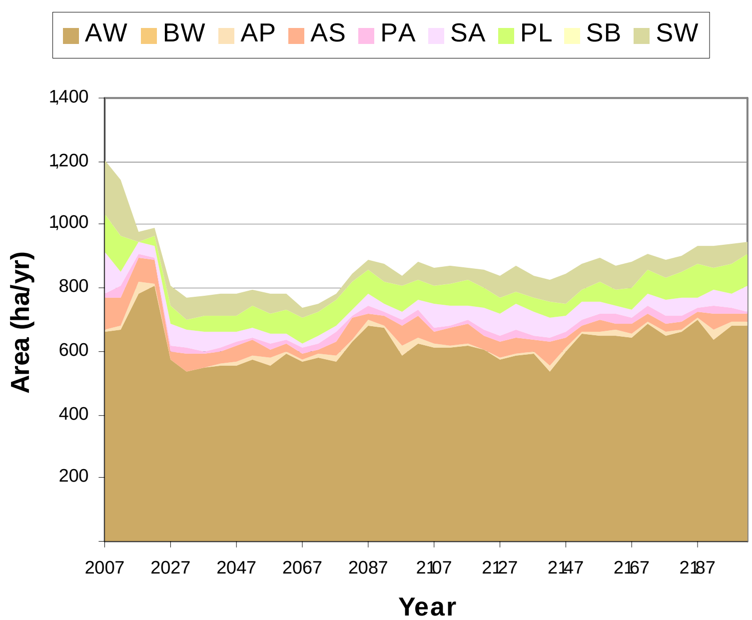
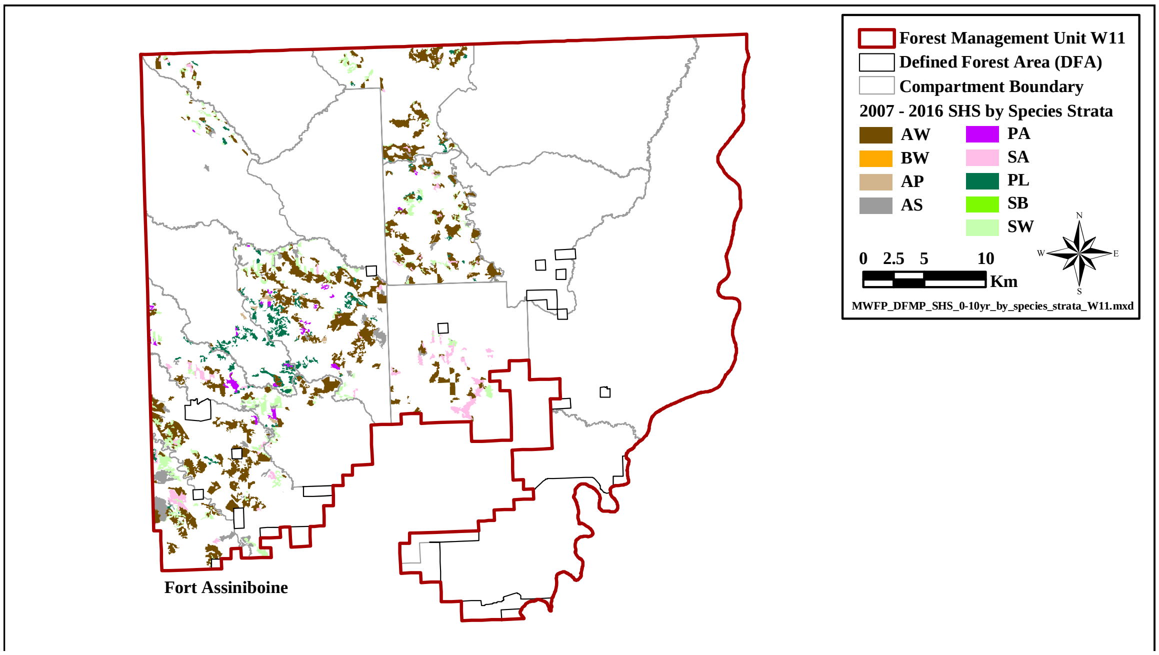


Figure 60. Area harvested by species strata from the W11 PFMS.

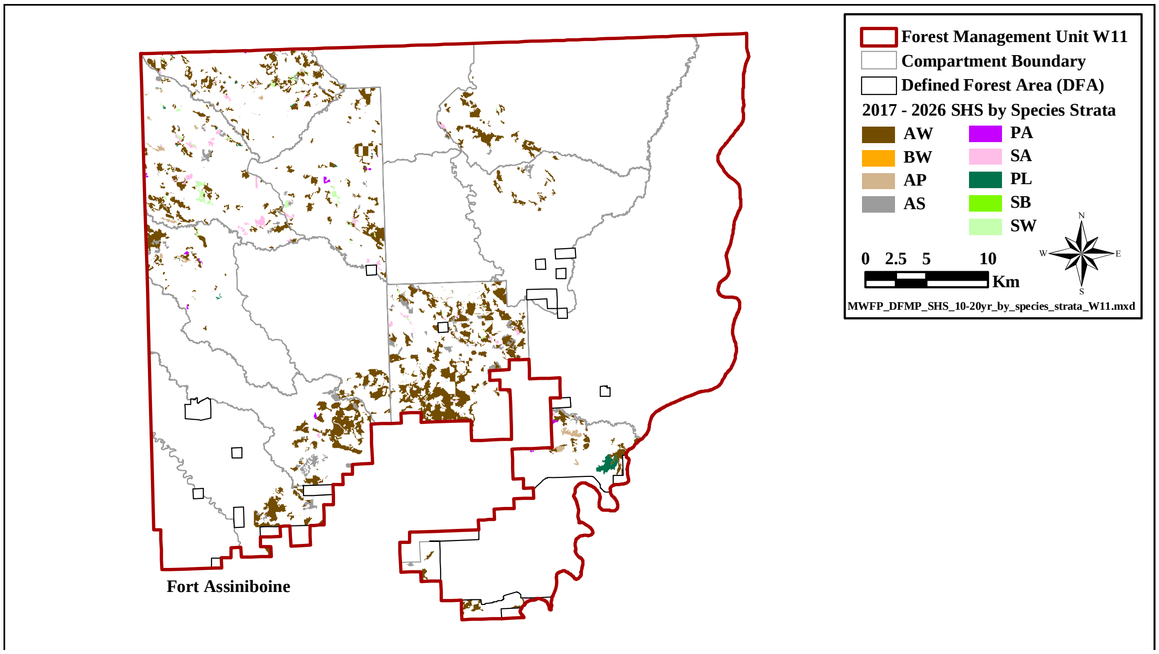
Table 26. 2007-2016 area harvested and regenerated by operator and species strata from the W11 PFMS.

Regenerated Strata	Company Specific Regeneration Targets								Total	
	OK Lumber		Spruceland		Ft. Assiniboine		Millar Western			
	(ha)	(%)	(ha)	(%)	(ha)	(%)	(ha)	(%)	(ha)	(%)
AW	-	0%	-	0%	-	0%	6,640	100%	6,640	57%
AP	22	2%	77	2%	7	2%	-	0%	106	1%
AS	197	18%	682	18%	59	18%	-	0%	938	8%
PA	61	6%	209	6%	18	6%	-	0%	288	2%
SA	182	17%	629	17%	54	17%	-	0%	865	7%
PL	240	22%	830	22%	71	22%	-	0%	1,142	10%
SW	367	34%	1,267	34%	109	34%	-	0%	1,743	15%
Total	1,070	100%	3,694	100%	318	100%	6,640	100%	11,722	100%

The regeneration targets in this table are determined using the "back-to-itself" strategy. Although the regenerated strata totals and the individual operator totals are accurate, the proportion that each operator will harvest (and regenerate) will differ once the DFMP has been implemented.



Map 15. 2007-2016 W11 SHS by species strata.



Map 16. 2017-2026 W11 SHS by species strata.

Average harvest age

The average harvest age of all strata increases early in the planning horizon (Figure 61). There is a subsequent drop in harvest age approximately 50 years in the planning horizon for the deciduous strata while the pine strata stays fairly high for the majority of the planning horizon. The spruce and conifer dominated mixedwood strata decrease after approximately 80 years.

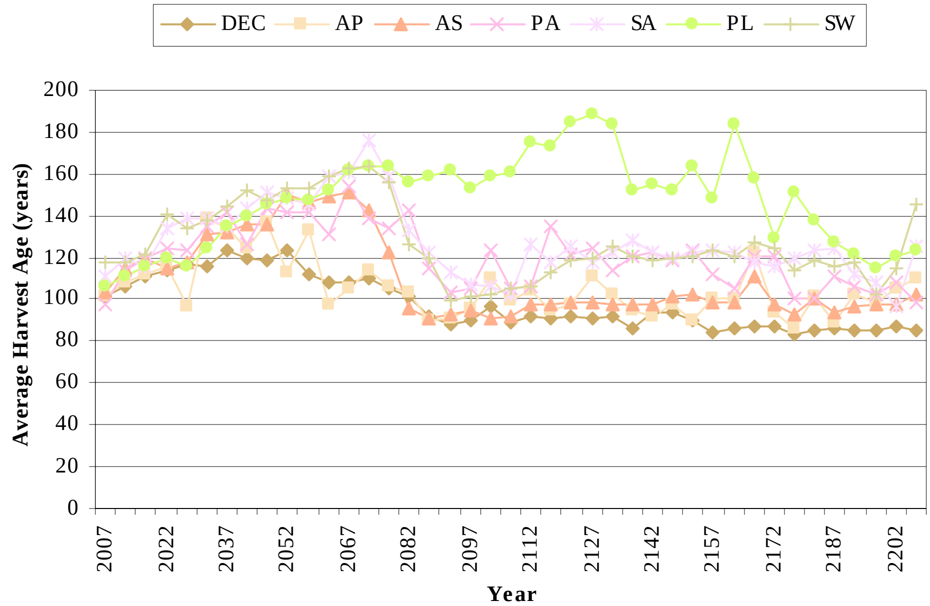


Figure 61. Average harvest age from the W11 PFMS.

Piece size

Addressing piece size ensures that the profile of wood harvested from the landbase stays constant, so that the infrastructure set up to process the volume is suitable. Typically a large increase in piece size could require changes to facilities. The average coniferous and deciduous piece sizes harvested by species strata can be seen in Figure 62 and Figure 63 respectively. Piece size remains fairly constant during and beyond the SHS, with a slight increase in deciduous piece size. Note that the conifer volume curves are comprised of all merchantable conifer species and the deciduous volume cures comprises all merchantable deciduous species.

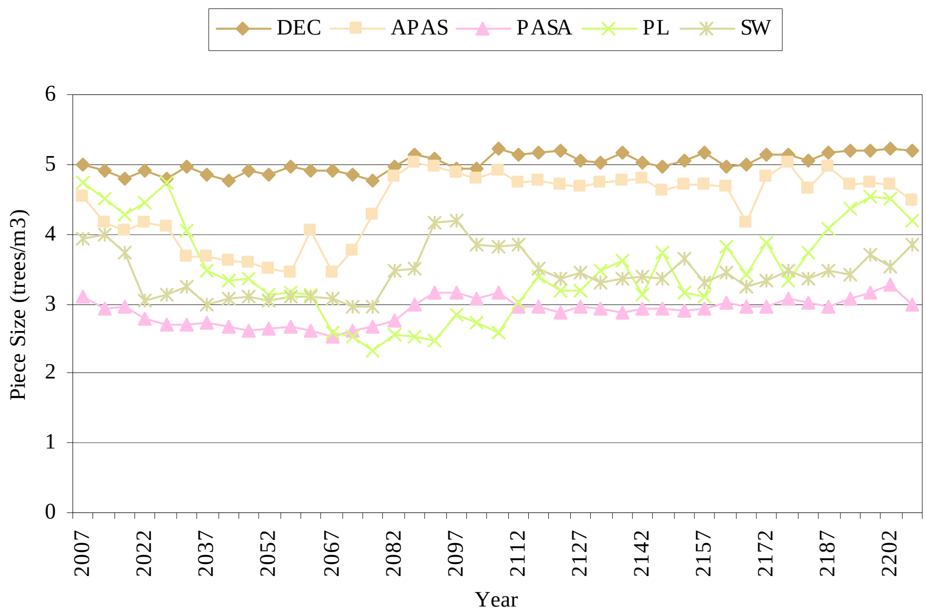


Figure 62. Coniferous piece sizes from the W11 PFMS.

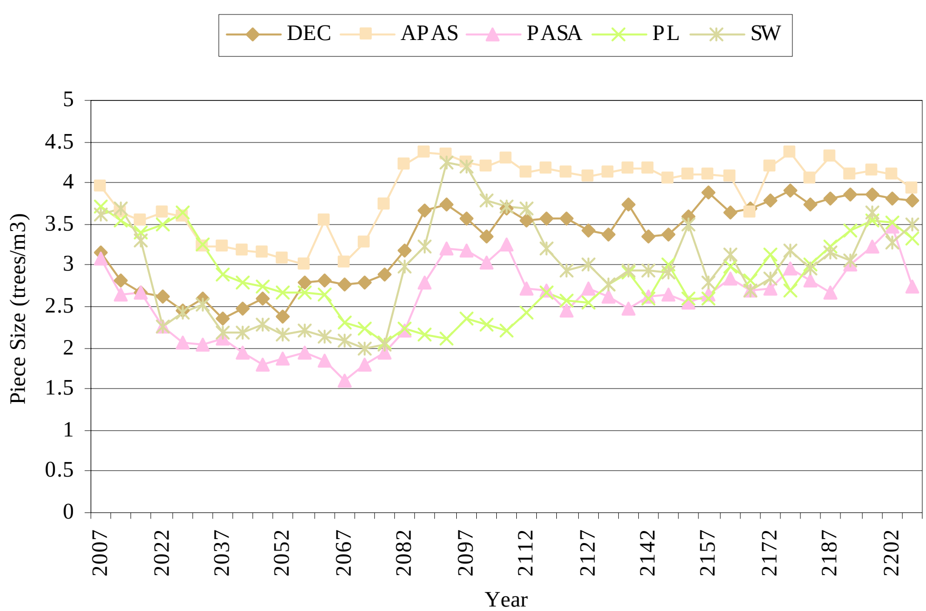


Figure 63. Deciduous piece sizes from the W11 PFMS.

Inventory Indicators

There were a number of indicators relating to inventory that were tracked in the PFMS. These included growing stock, MPB susceptible area, species strata area, age class, Oldgrowthness area, old growth, patches, and BAP indicators.

Growing Stock

Growing stock represents the volume of timber on the landbase. Three representations of growing stock were considered in the forecasting for the DFMP: forested growing stock; managed growing stock; and operable growing stock.

Forested growing stock, also known as total growing stock, includes all volume on the landbase within forested stands that have merchantable species components during their lifespan. The forested growing stock is calculated by using the managed landbase yield curves and the gross landbase area, which may result in an overestimate of volume in some non-merchantable stands. Larch stands are subjectively deleted so they are not represented on the managed landbase, had no yield curves and are therefore excluded from the forested growing stock calculations. Managed growing stock represents the volume on the managed landbase while operable growing stock represents the volume that is on the managed landbase and within stands older than the minimum harvest age in the period of interest.

Figure 64 shows all of the growing stock levels broken down by coniferous and deciduous volumes. Growing stock levels decrease over the first third of the planning horizon, after which they stabilize with a slight decrease through the remainder of the planning horizon.

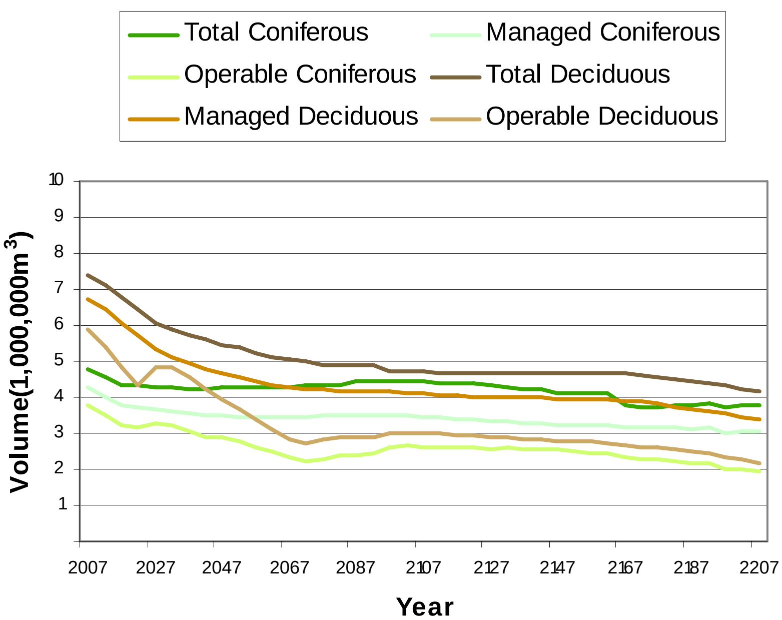


Figure 64. Growing stock by type from the W11 PFMS.

Mountain Pine Beetle

MPB risk reduction was not a primary driver in the W11 PFMS. However, the forecasted area of pine, by ASRD MBP ranking for the entire planning period is illustrated in Figure 65. It shows a decrease in the amount of Rank 2 pine on the landbase through time, even though there was no goal set to encourage the W11 model to remove the susceptible pine. The initial steep reduction in susceptible area is associated with the coniferous surge cut. Note that the changes in ASRD MPB ranking through time was derived by updating the ranking to account for harvested stands only; stand growth is not incorporated. There are no Rank 1 or Rank 3 stands in W11.

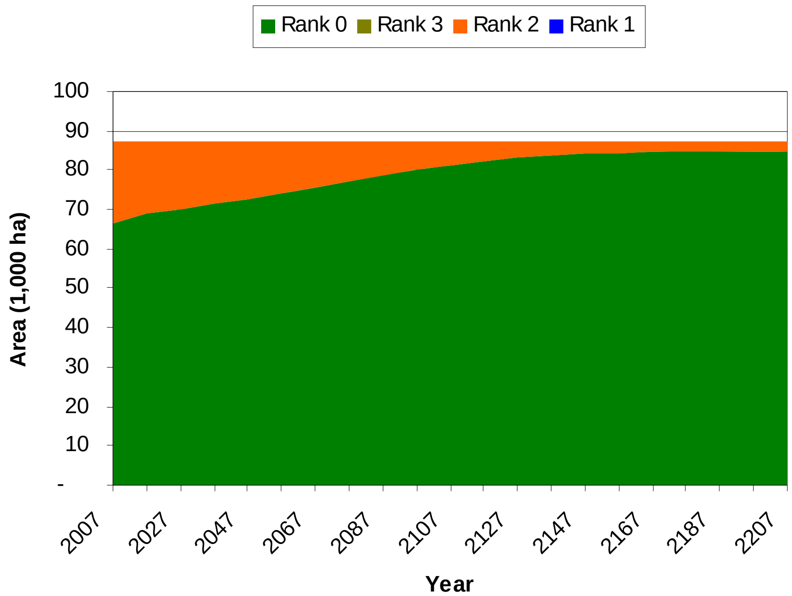


Figure 65. Area by ASRD MPB rank on the landbase from the W11 PFMS.

ASRD mountain pine beetle ranking and the percent reduction from the 2007 condition for the next 100 years is illustrated in Table 27. Note that in 20 years, a 17% reduction in the amount of Rank 2 stands is achieved. This does not meet the guideline of a 75% reduction over 20 years in the MPB Interpretive Bulletin, however given the scattered nature of the mature pine and prevalence unmerchantable Rank 2 stands, little can be done to reduce achieve the guideline at this time.

Table 27. W11 ASRD mountain pine beetle rank 1 & 2 areas from 2007

	Rank 1		Rank 2		Rank 1+ Rank 2	
Year	**Area (ha)**	**Reduction (%)**	**Area (ha)**	**Reduction (%)**	**Area (ha)**	**Reduction (%)**
2007	0	baseline	21,006	baseline	21,006	baseline
2017	0	0	18,502	12%	18,502	12%
2027	0	0	17,359	17%	17,359	17%
2037	0	0	15,981	24%	15,981	24%
2047	0	0	14,613	30%	14,613	30%
2057	0	0	13,232	37%	13,232	37%
2067	0	0	11,707	44%	11,707	44%
2077	0	0	10,265	51%	10,265	51%
2087	0	0	8,765	58%	8,765	58%
2097	0	0	7,342	65%	7,342	65%
2107	0	0	6,195	71%	6,195	71%

Species Strata Area

The species strata distribution on the gross and managed landbase stayed fairly constant through the planning horizon, Figure 66 and Figure 67 respectively. Changes to the landbase distribution are associated with succession occurring on the landbase.

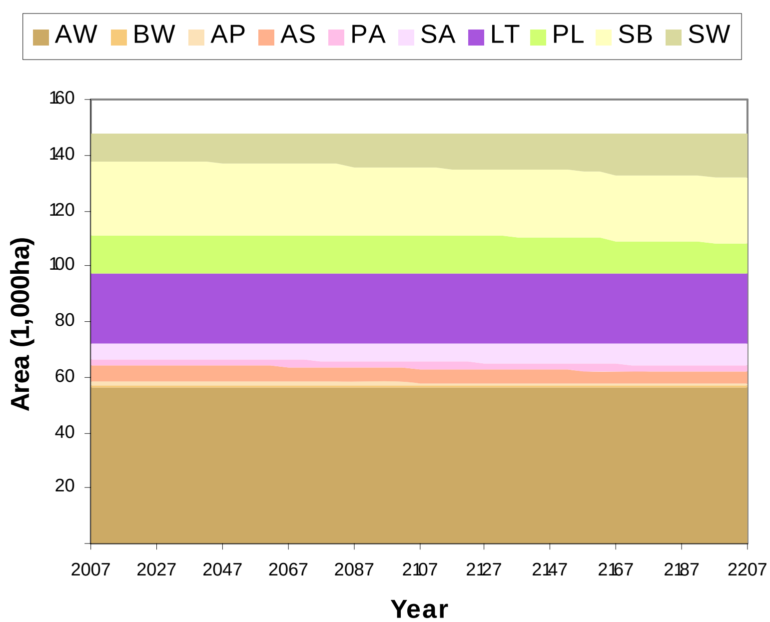


Figure 66. Area by species strata on the gross landbase from the W11 PFMS.

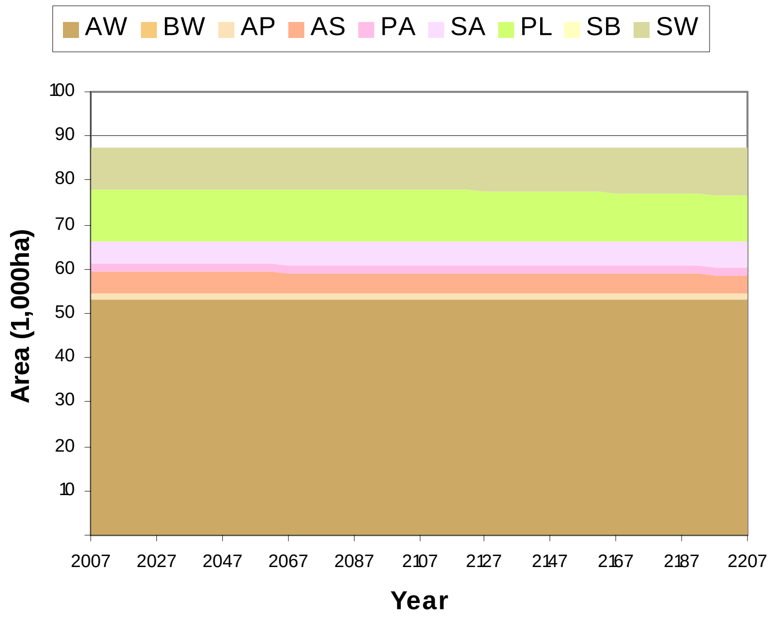


Figure 67. Area by species strata on the managed landbase from the W11 PFMS.

Age Class

Figure 68 shows the age class distribution of the managed landbase through time. The age class distribution decreases in the first third of the planning horizon, then stabilizes maintaining area within the older age classes throughout the planning horizon.

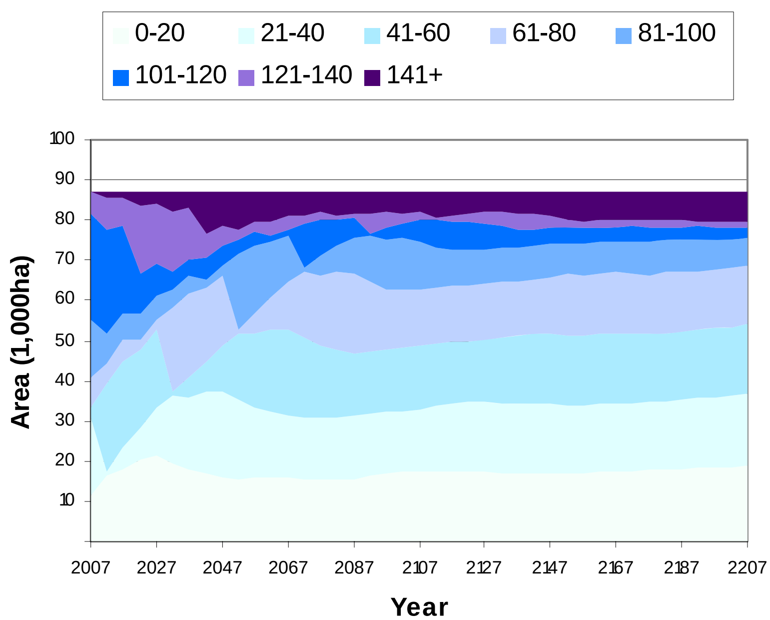


Figure 68. Area by age class on the managed landbase from the W11 PFMS.

Oldgrowthness Area

Oldgrowthness was used to ensure old forest area was maintained on the landbase. The gross and managed Oldgrowthness area, over the planning horizon, can be seen in Figure 69. The gross landbase Oldgrowthness area increased for the first three quarters of the planning horizon, and then stabilized. The managed landbase Oldgrowthness area decreases in the first quarter of the planning horizon and then stabilized. As indicated in Figure 70 the majority of the Oldgrowthness area is from the C (coniferous) cover group. The managed landbase distribution is also dominated by the C cover group, although there is a larger representation of the other cover groups (Figure 71).

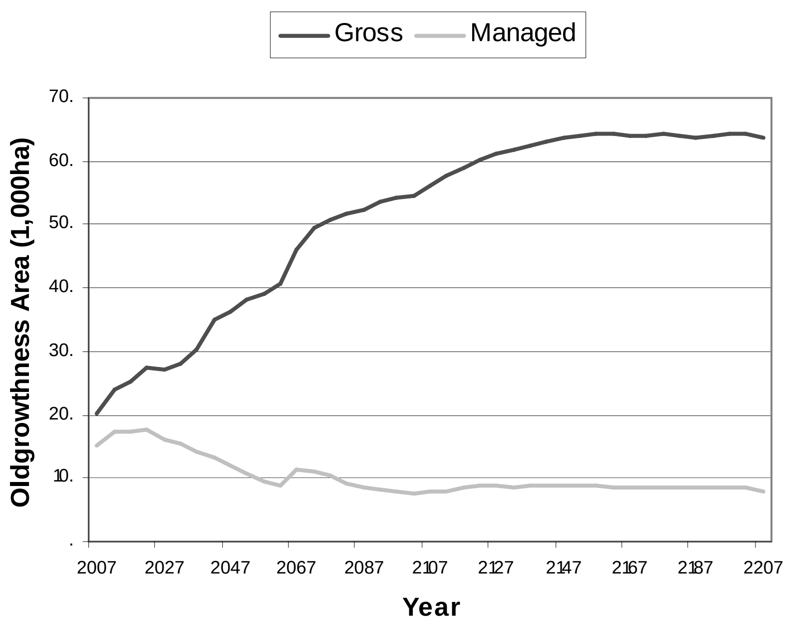


Figure 69. Oldgrowthness area on the landbase from the W11 PFMS.

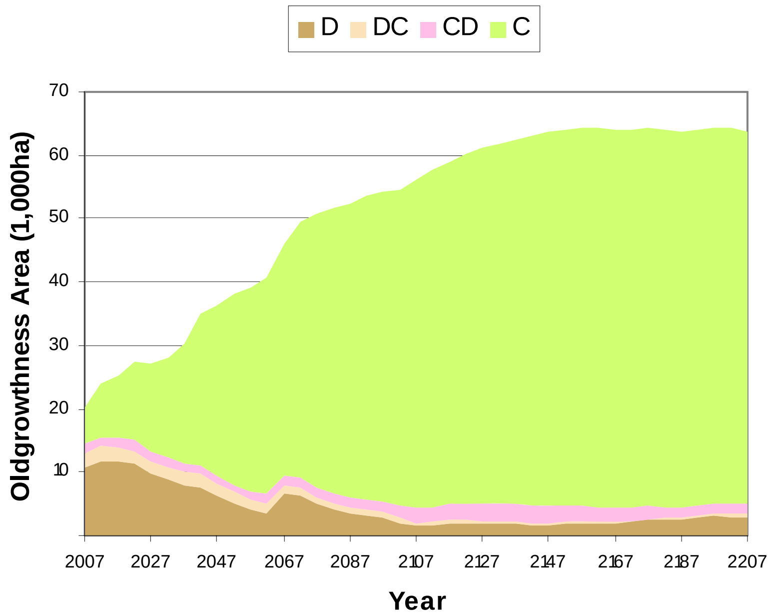


Figure 70. Oldgrowthness area on the gross landbase from the W11 PFMS.

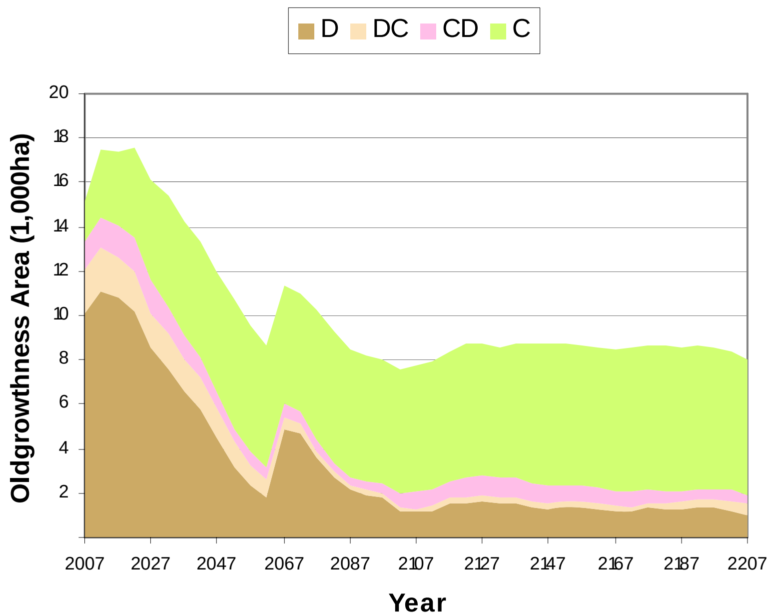


Figure 71. Oldgrowthness area on the managed landbase from the W11 PFMS.

Old Forest

The combined area of Mature and Old forest, on the gross landbase, stays fairly constant throughout the planning horizon (Figure 72), although there is a transition from Mature to Old as the planning horizon progresses. Within the managed landbase, there is a decrease in the combined area of Old and Mature forest during the planning horizon (Figure 73). The area of

Old increases early in the planning horizon and stays fairly constant for the remainder of the planning horizon resulting in an overall increase in Old growth.

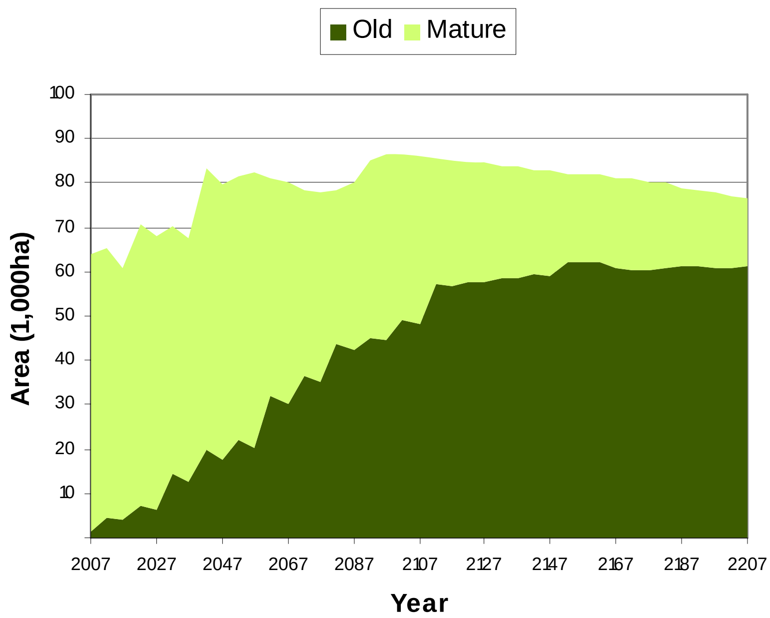


Figure 72. Area of mature and old on the gross landbase from the W11 PFMS.

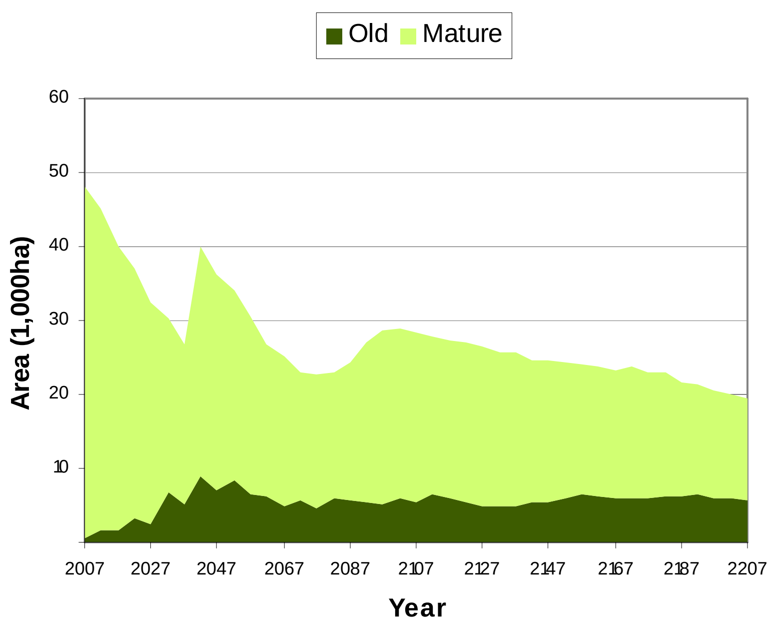


Figure 73. Area of mature and old on the managed landbase from the W11 PFMS.

On the gross landbase the majority of the old forest is comprised of the LT and SB species strata (Figure 74); both of these strata were not eligible for treatments and had long lifespans. In the managed landbase, old forest was initially comprised primarily of the AW species strata. Over the planning horizon the composition changed and PL and SW become the dominant species strata (Figure 75). Old SW forest was identified by the Alberta government as a key wildlife habitat that should be monitored. Map 17, Map 18, and Map 19 show the Old SW area in 2007, 2017, and 2057 respectively. Though there is very little old SW forest in 2007 the amount increases in the first 50 years of the planning horizon.

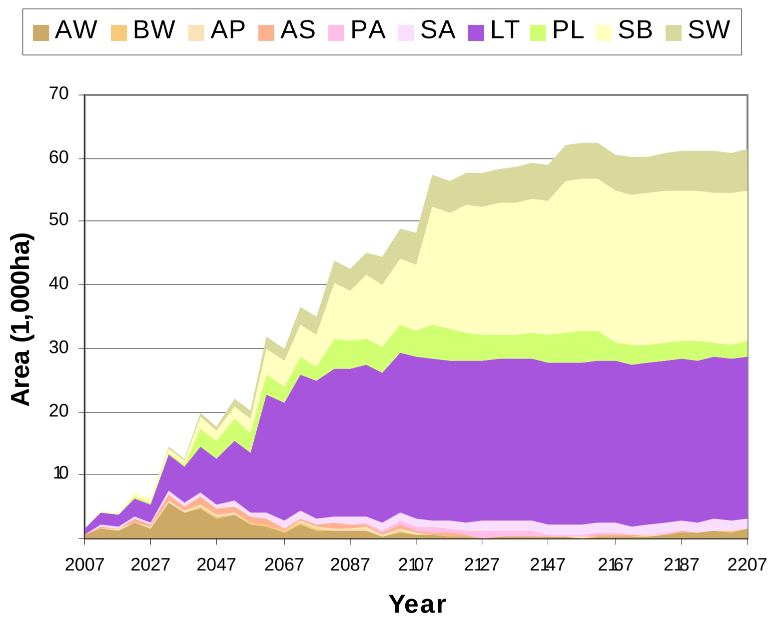


Figure 74. Gross old area by species strata from the W11 PFMS.

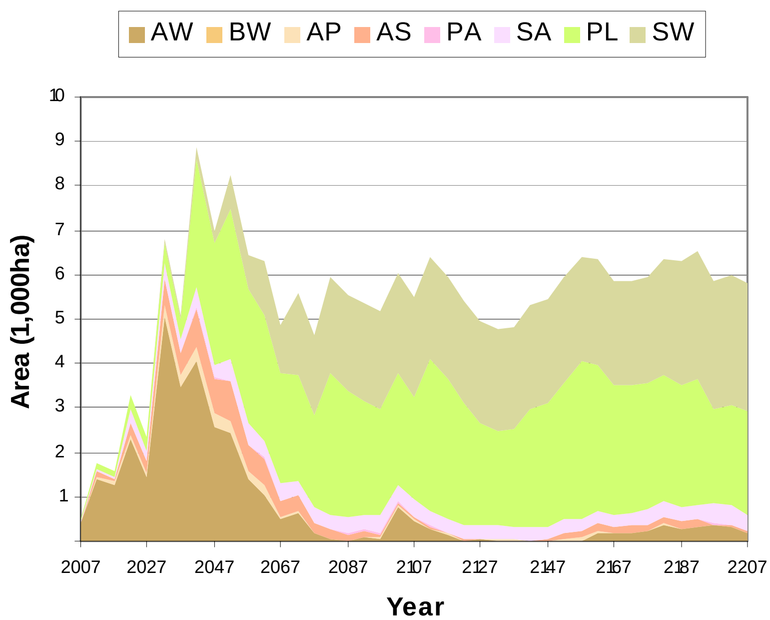
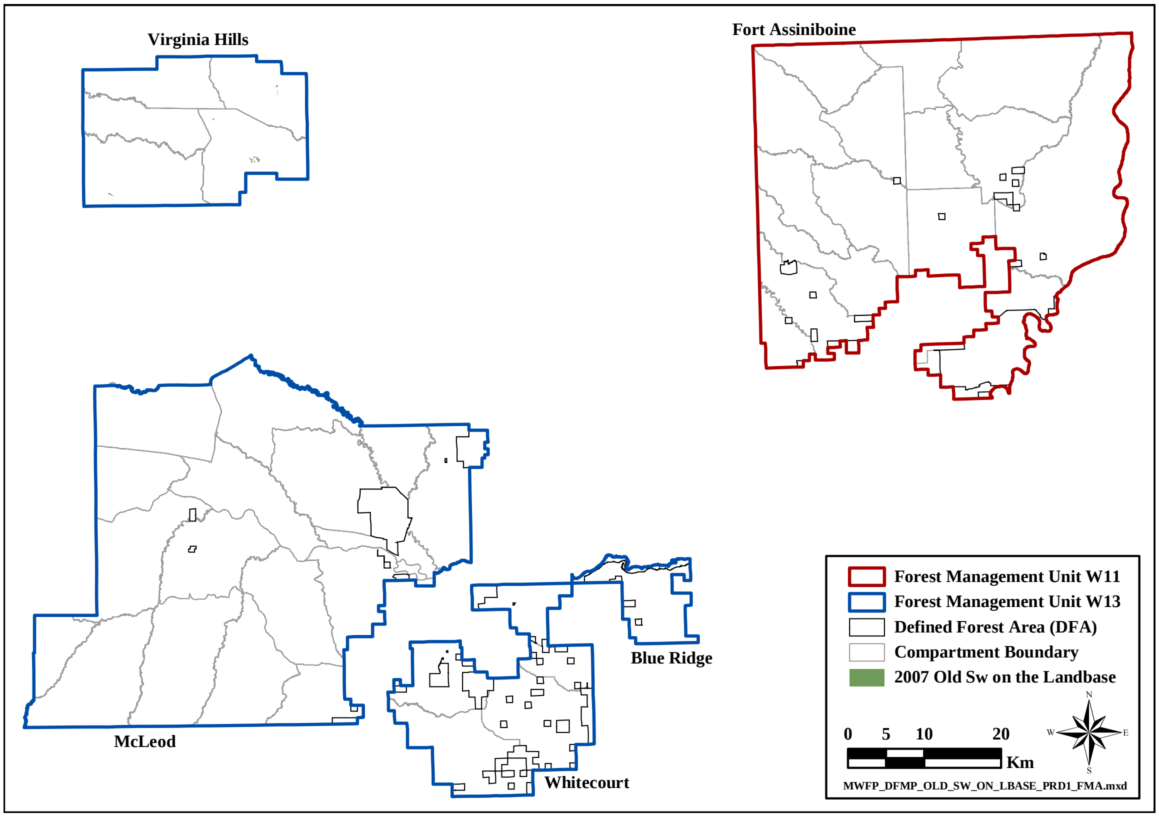
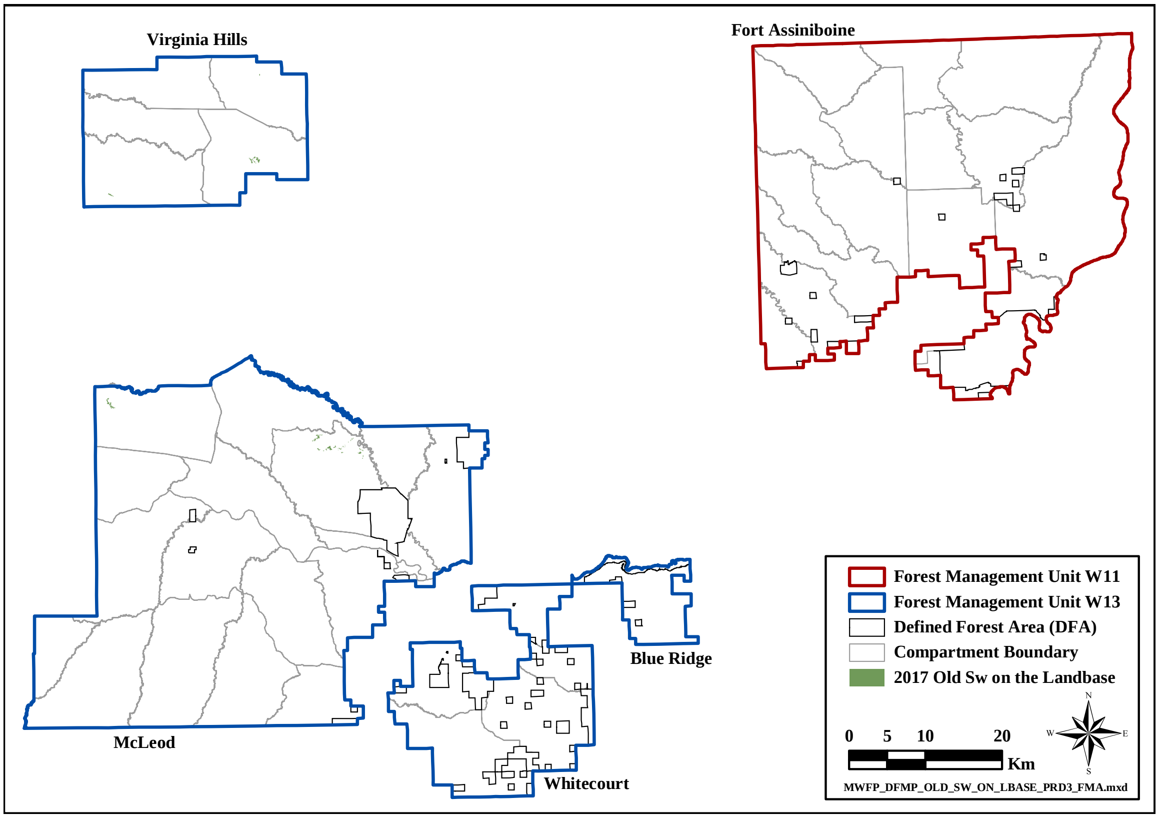


Figure 75. Managed old area by species strata from the W11 PFMS.

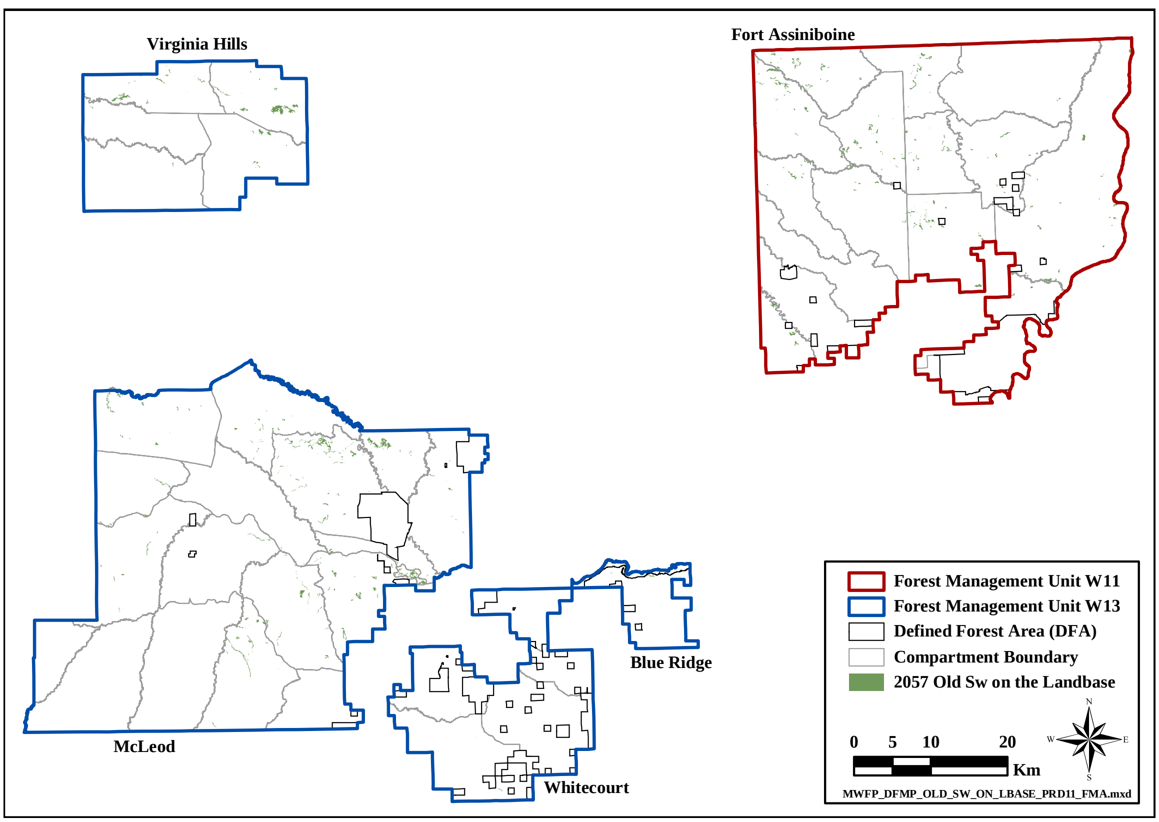


Map 17. Old growth SW on the landbase in 2007 on the gross landbase from the PFMSs.

Note that there is very little old growth SW on the landbase today and that significant amounts do not begin to appear for 50 years. This demonstrates that the PFMSs are achieved their long term goal.



Map 18. Old growth SW on the landbase in 2017 on the gross landbase from the PFMSs.



Map 19. Old growth SW on the landbase in 2057 on the gross landbase from the PFMSs.

Patches

The patch size distribution of the Oldgrowthness on the gross landbase is provided in Figure 76. Over the planning horizon, the proportion of Oldgrowthness patches greater than 500 ha in size increases dramatically.

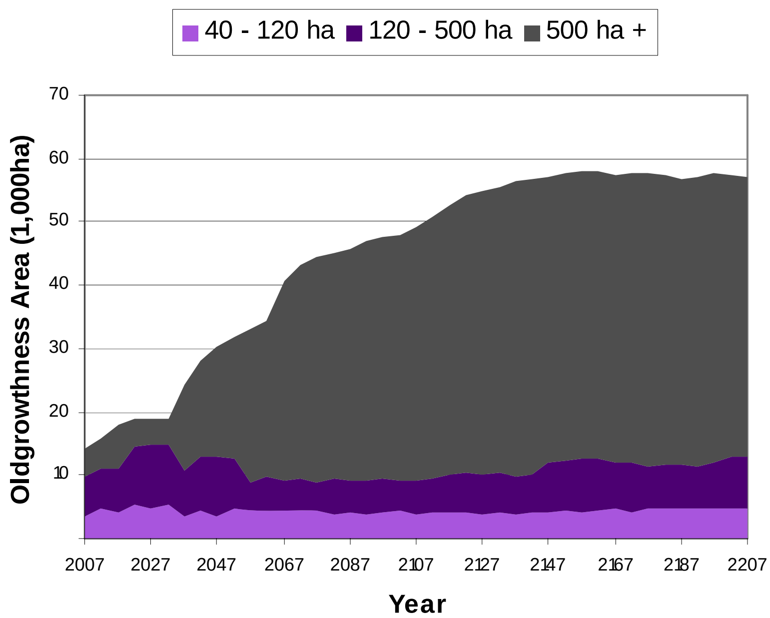


Figure 76. Oldgrowthness patch size on the gross landbase from the W11 PFMS.

Figure 77 shows the distribution of opening patches on the gross landbase. The majority are smaller than 250 ha.

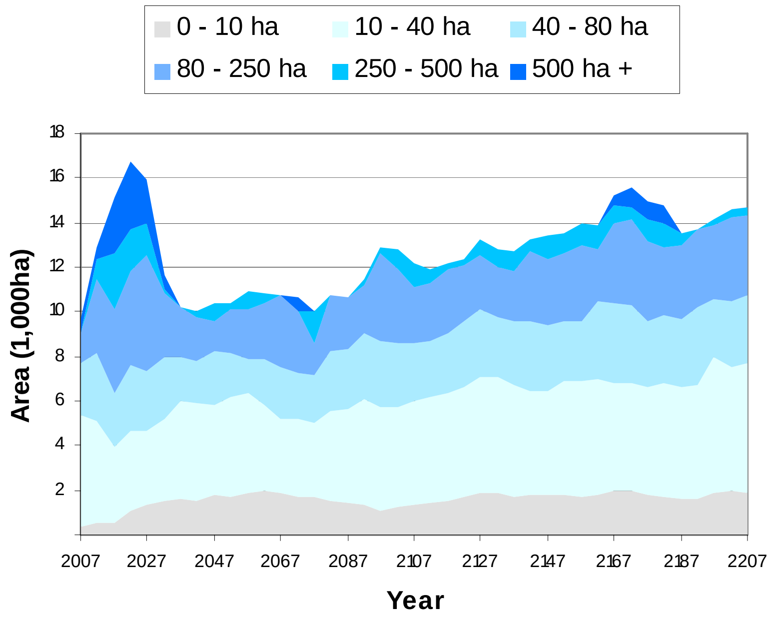


Figure 77. Opening patch sizes on the gross landbase from the W11 PFMS.

Biodiversity Assessment Project (BAP)

Numerous BAP indicators that were included in the forecasting model. These indicators were developed by IQAFF for inclusion in forecasting (*Appendix XII – BAP SHE Yield Curve Documentation*).

BAP species proportions on the gross and managed landbase can be seen in Figure 78 and Figure 79, respectively. These represent the proportion of tree species and not the proportion of strata on the landbase. In both landbases there are slight fluctuations in the species representation.

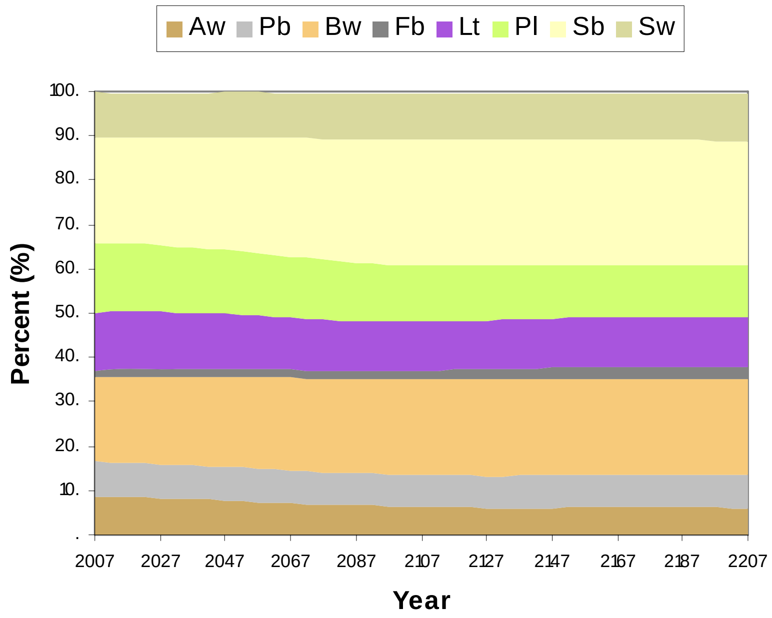


Figure 78. BAP species proportions on the gross landbase from the W11 PFMS.

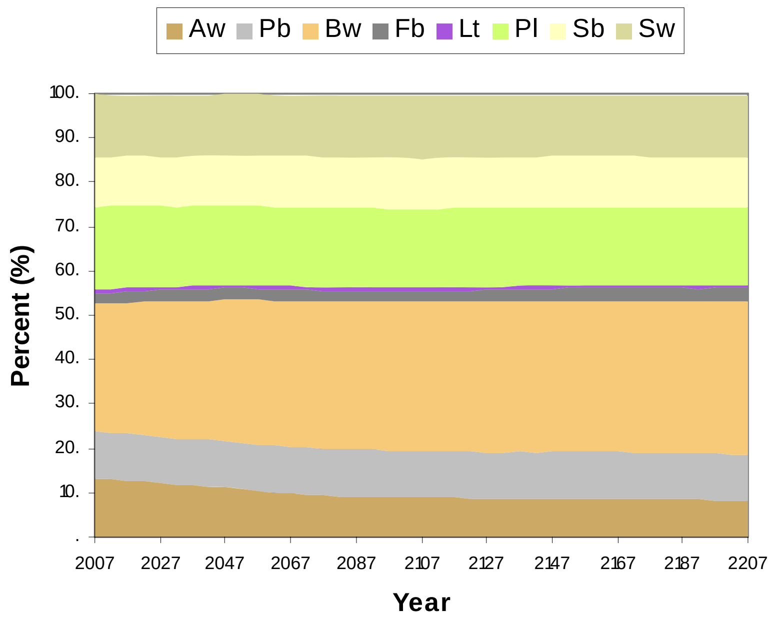


Figure 79. BAP species proportions on the managed landbase from the W11 PFMS.

Down woody debris (DWD) is an important habitat factor for many species. There is an initial decrease in DWD and then it subsequently stabilizes (Figure 80).

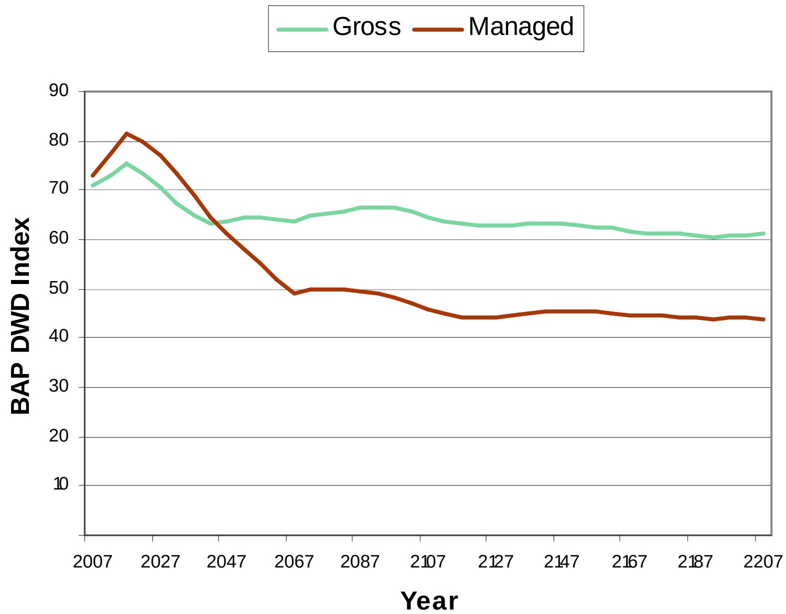


Figure 80. BAP DWD index on the landbase from the W11 PFMS.

There are many BAP special habitat element (SHE) indictors such as the previously described downed woody debris and the next one, snag density, which were incorporated into forecasting. Numerous other BAP indicators were not incorporated into forecasting but form part of the suite of indicators that are influenced by natural and anthropogenic forces. This section simply describes the changes over time for the forecasted indicators under the PFMS. *Appendix X – Biodiversity Assessment of the PFMS* describes the impacts of the changes from a biodiversity perspective. Millar Western has various programs to address the predicted changes in SHE values from operational ground rules to generic establishment regimes and numerous VOITs and company commitments which are detailed *Appendix XXIII – Commitments*.

Snag density has also been identified as a key coarse filter indicator. On the gross landbase the 20+cm coniferous snags increased throughout the planning horizon, while the deciduous snags of all sizes decreased. Large (40+cm) coniferous snags stayed fairly constant (Figure 81). On the managed landbase all snag types decreased over the planning horizon (Figure 82). The BAP IAG rated snag density as either low or no risk in the long term in W11 (*Appendix X – Biodiversity Analysis of the PFMS*).

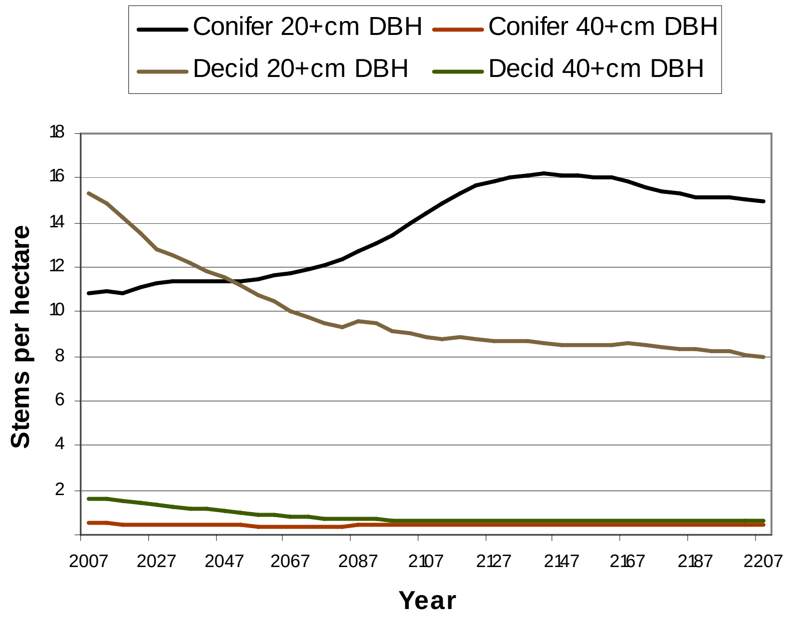


Figure 81. BAP snag density on the gross landbase from the W11 PFMS.

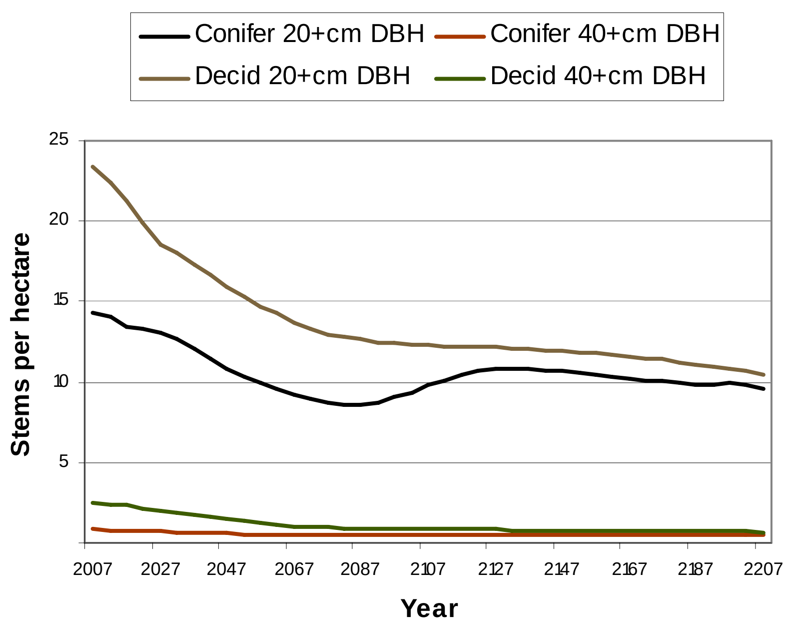


Figure 82. BAP snag density on the managed landbase from the W11 PFMS.

On both the managed and gross landbase, coniferous and deciduous sapling densities increased over the planning horizon (Figure 83 and Figure 84).

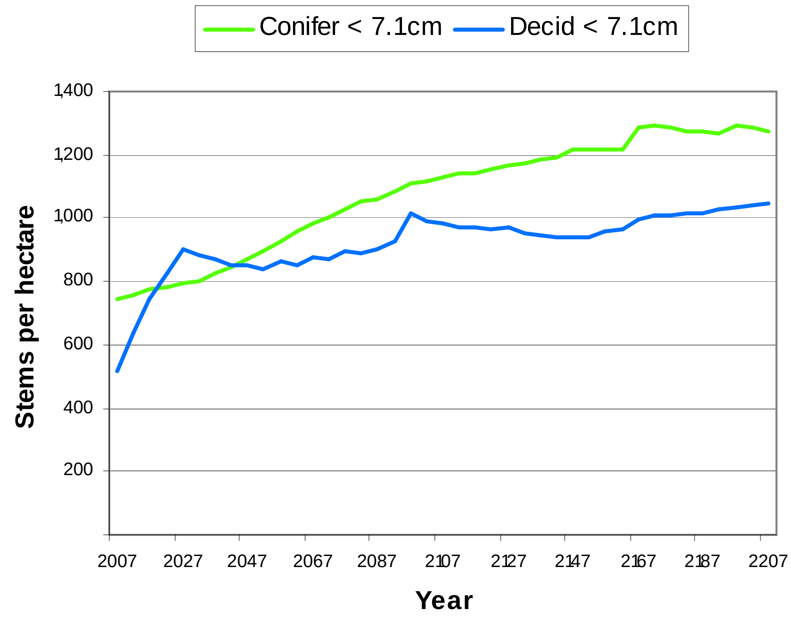


Figure 83. BAP sapling density on the gross landbase from the W11 PFMS.

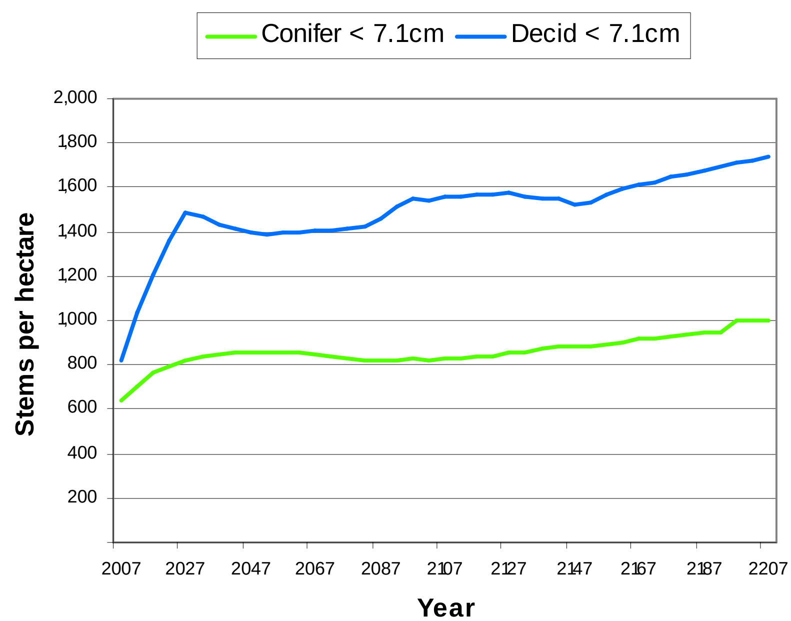


Figure 84. BAP sapling density on the managed landbase from the W11 PFMS.

The free to manoeuvre flying space (FMFS) indicators, on both the gross and managed landbase, stay fairly constant throughout the planning horizon (Figure 85 and Figure 86).

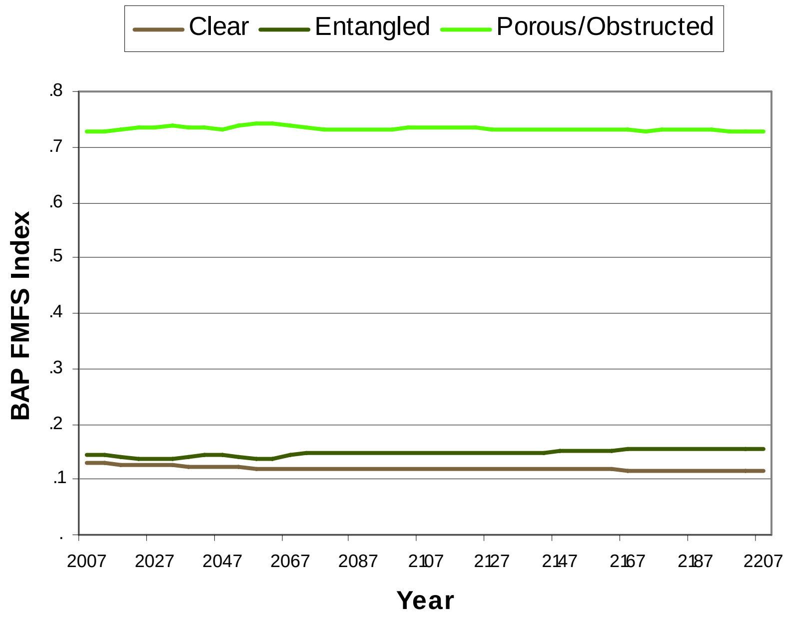


Figure 85. BAP FMFS index on the gross landbase from the W11 PFMS.

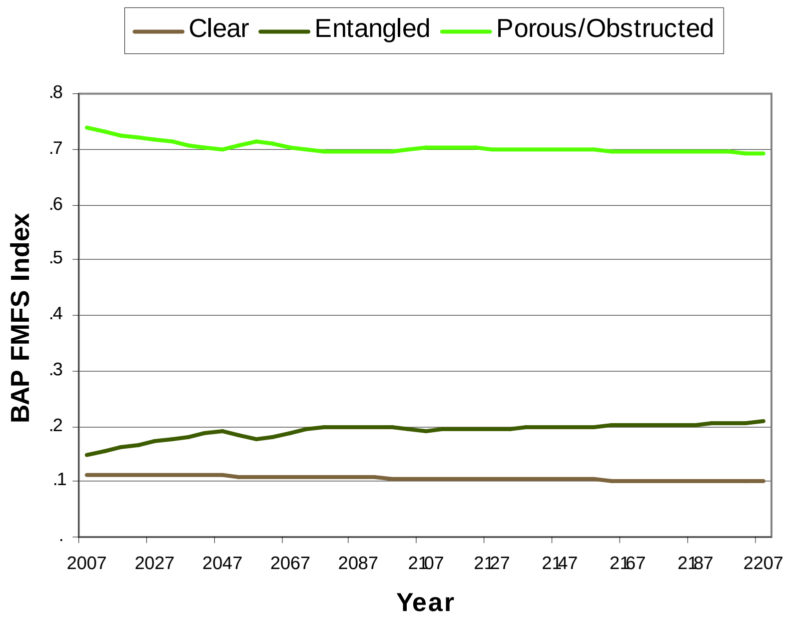


Figure 86. BAP FMFS index on the managed landbase from the W11 PFMS.

Four other BAP indicators that were tracked on the gross and managed landbase were mean DBH; basal area; herb cover; and shrub cover, all shown in Figure 87 and Figure 88. The mean DBH decreased slightly throughout the planning horizon on both the gross and managed landbase. The basal area on both the gross and managed landbase also decreased throughout the planning horizon. Both the herb and shrub cover, on both the gross and managed landbase, increased over the planning horizon.

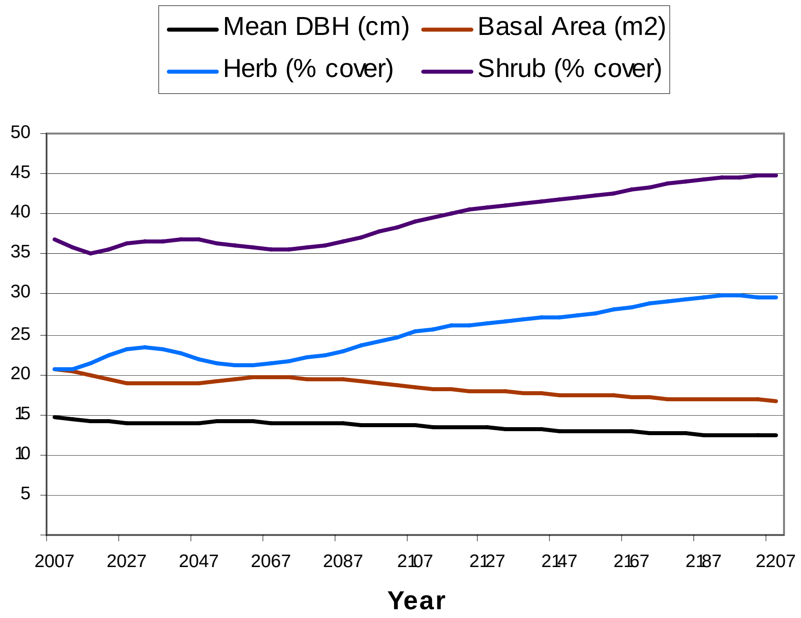


Figure 87. Other BAP indicators on the gross landbase from the W11 PFMS.

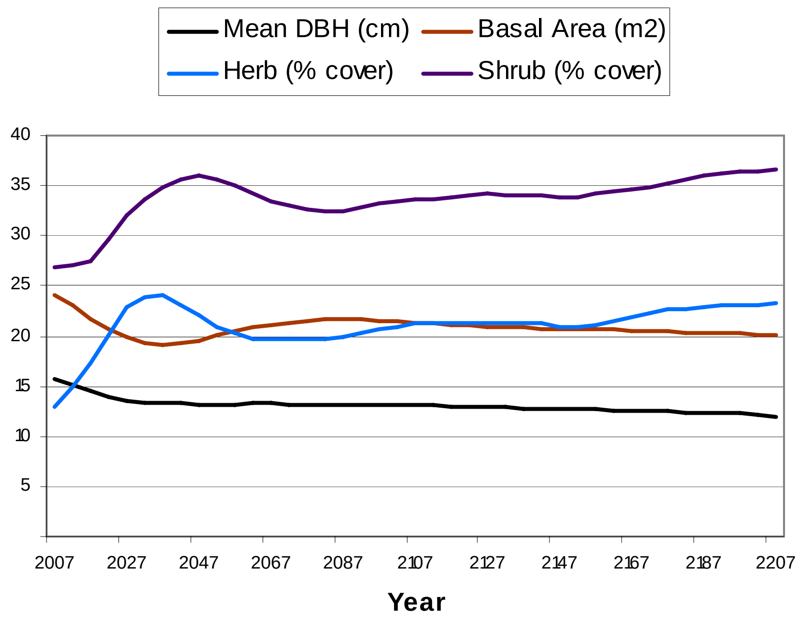


Figure 88. Other BAP indicators on the managed landbase from the W11 PFMS.

Watershed Summary

Analysis to determine the impact of harvesting on water runoff was undertaken according to the protocols described earlier. The goals were as follows:

- Over the 200-year planning horizon, a maximum 15% increase in average RC above baseline condition due to harvesting on eligible third order watersheds.

- Over the 200-year planning horizon, a maximum of 5% of the first order watersheds are permitted a >50% increase in average annual RC above baseline condition. This applied only to first order watersheds with at least 50% of their area within the DFA.

The largest increases in RC above baseline values for all functional third order watersheds in W11 was a 25% increase for watershed 1023, and a 16% increase for watershed 1019, which account for only 2% and 12%, respectively, of the DFA area (Figure 89). All other watershed increases were below the 15% management target.

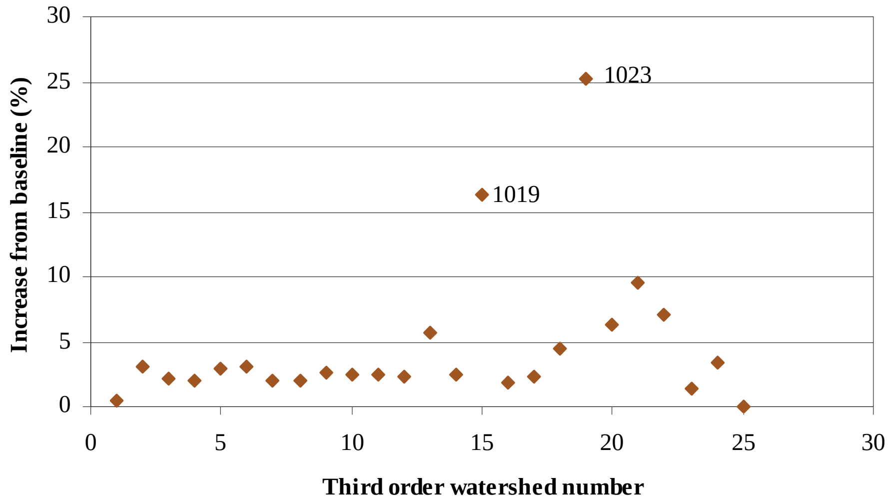


Figure 89. Maximum percent increase in RC above baseline for all 3rd order watersheds in W11.

The increase in RC above baseline conditions for third order watersheds that have at least 50% of their area within the DFA is presented in Table 28. The table identifies the four watersheds that have at least 90% of their area within the DFA and to which the management goal of a maximum 15% RC increase was applied.

Table 28. Increase in RC above baseline conditions for selected 3rd order watersheds in W11.

FUNCORD3	%area in DFA	%area_in_ DFA>90%	Area (ha)	Runoff Coefficient Min	Max	Change	%increase
1013	100%	Yes	18,213	0.4806	0.4927	0.0121	3%
1007	100%	Yes	16,722	0.4852	0.4948	0.0096	2%
1011	100%	Yes	10,469	0.4836	0.4963	0.0127	3%
1016	100%	Yes	8,043	0.3470	0.3668	0.0198	6%
1020	80%	No	7,233	0.4596	0.4683	0.0087	2%
1002	80%	No	12,770	0.4751	0.4895	0.0144	3%
1010	79%	No	8,779	0.4803	0.4902	0.0099	2%
1018	76%	No	10,094	0.4875	0.4995	0.0120	2%
1022	68%	No	5,652	0.4756	0.4970	0.0214	5%
1003	66%	No	11,011	0.4813	0.4917	0.0104	2%
1021	65%	No	10,292	0.4774	0.4887	0.0113	2%
1014	62%	No	7,068	0.4825	0.4941	0.0116	2%
1024	57%	No	7,596	0.3228	0.3432	0.0204	6%
1005	53%	No	8,569	0.4794	0.4930	0.0137	3%
1001	51%	No	7,906	0.4269	0.4287	0.0018	0%
Average (for watersheds with >90% within DFA)			13,362	0.4491	0.4627	0.0135	3%

The largest increase of the third order watersheds with at least 50% of their area within the DFA was 6% in watersheds 1016 and 1024. The average increase of these watersheds was only 3%. This is well within the 15% increase threshold recommended by FORWARD. Third order watersheds 1016 and 1024 are not adjacent to each other, which further mitigated the impact. Changes in RC over the planning horizon were very subtle and are presented in Figure 90 for the four watersheds subject to management goals.

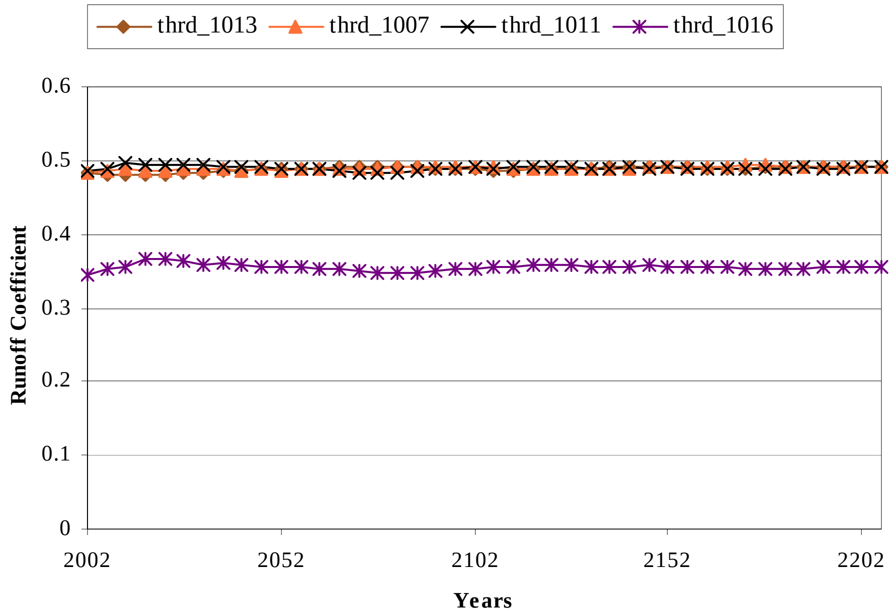


Figure 90. Change in RC for W11 3rd order watersheds with at least 90% of their area within the DFA.

First order watersheds are smaller than third order watersheds and subsequently are impacted more by harvesting. Because of this, the permissible increase in RC was higher than that allowed for third order watersheds (*i.e.*, 50%). Maximum percent increase in RC for W11 first order watersheds with at least 50% of their area within the DFA are presented in Figure 91.

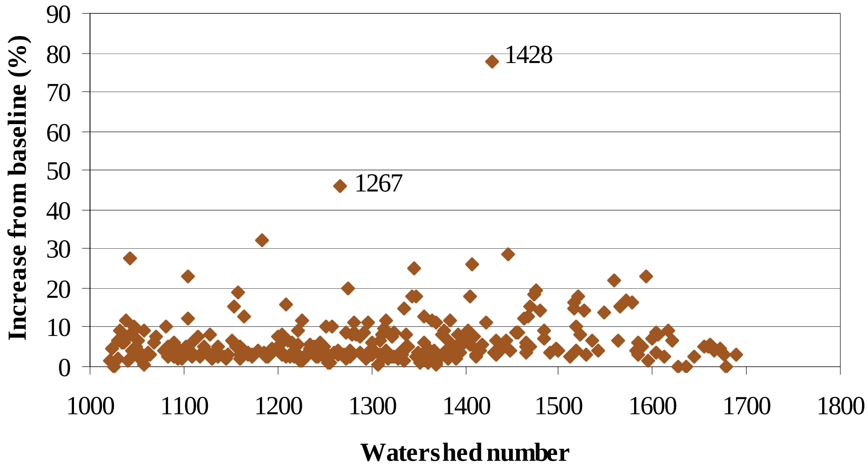


Figure 91. Percent increase in RC above baseline condition for W11 1st order watersheds with at least 50% of their area within the DFA.

There are 377 first order watersheds in W11 of which 303 have at least 50% of their area within the DFA. Only one first order watershed, number 1428, which is within third order watershed 1022, had an increase in RC above 50% (Map 27), which equates to 0.33% of the watersheds. This is well within the 5% maximum management variance, which permitted a maximum of 15 watersheds to exceed the 50% RC increase.

Table 29 presents the changes in first order watershed RCs for the 10 watersheds with the greatest percent increase. The FORWARD IAG recommended that, in addition to the 50% increase target for 95% of the watersheds, none of the first order watersheds had more than 100% increase in RC. The largest increase from the PFMS was 78% and the average increase for all eligible first order watersheds was 7%. As a result, the management goal for first order watersheds was achieved by PFMS.

Table 29. Percent increase in RC above baseline for W11 1st order watersheds with at least 50% of their area within the DFA.

FUNCORD1	%area in DFA	%area_in_ DFA>50%	Area (ha)	Runoff Coefficient Min	Max	Change	%increase
1428	100%	YES	268	0.0817	0.1451	0.0634	78%
1267	100%	YES	301	0.0936	0.1368	0.0432	46%
1183	100%	YES	686	0.1303	0.1726	0.0423	32%
1446	100%	YES	284	0.1602	0.2059	0.0457	29%
1042	85%	YES	169	0.1701	0.2175	0.0474	28%
1407	69%	YES	212	0.1082	0.1365	0.0283	26%
1346	100%	YES	871	0.1245	0.1555	0.0310	25%
1594	100%	YES	433	0.1491	0.1838	0.0347	23%
1105	100%	YES	962	0.1989	0.2446	0.0457	23%
1558	100%	YES	295	0.1838	0.2245	0.0407	22%
Average (for watersheds with >50% in DFA)			522	0.4198	0.4419	0.0221	7%

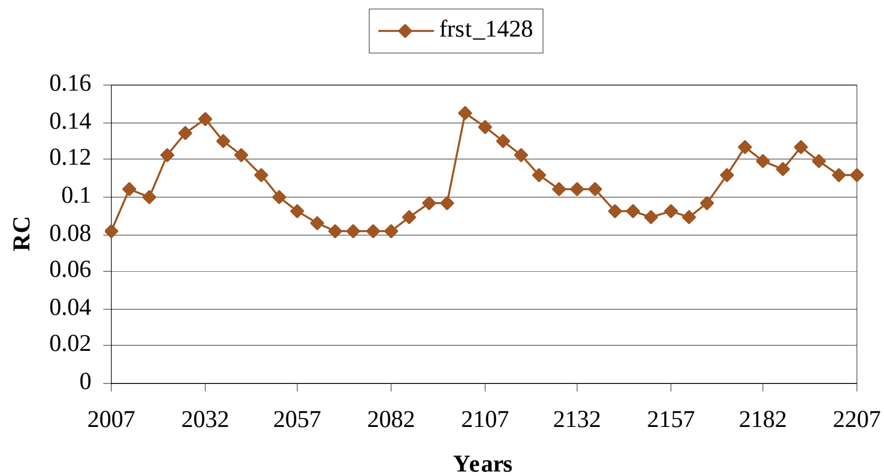


Figure 92. Change in RC for 1st order watershed #1428.

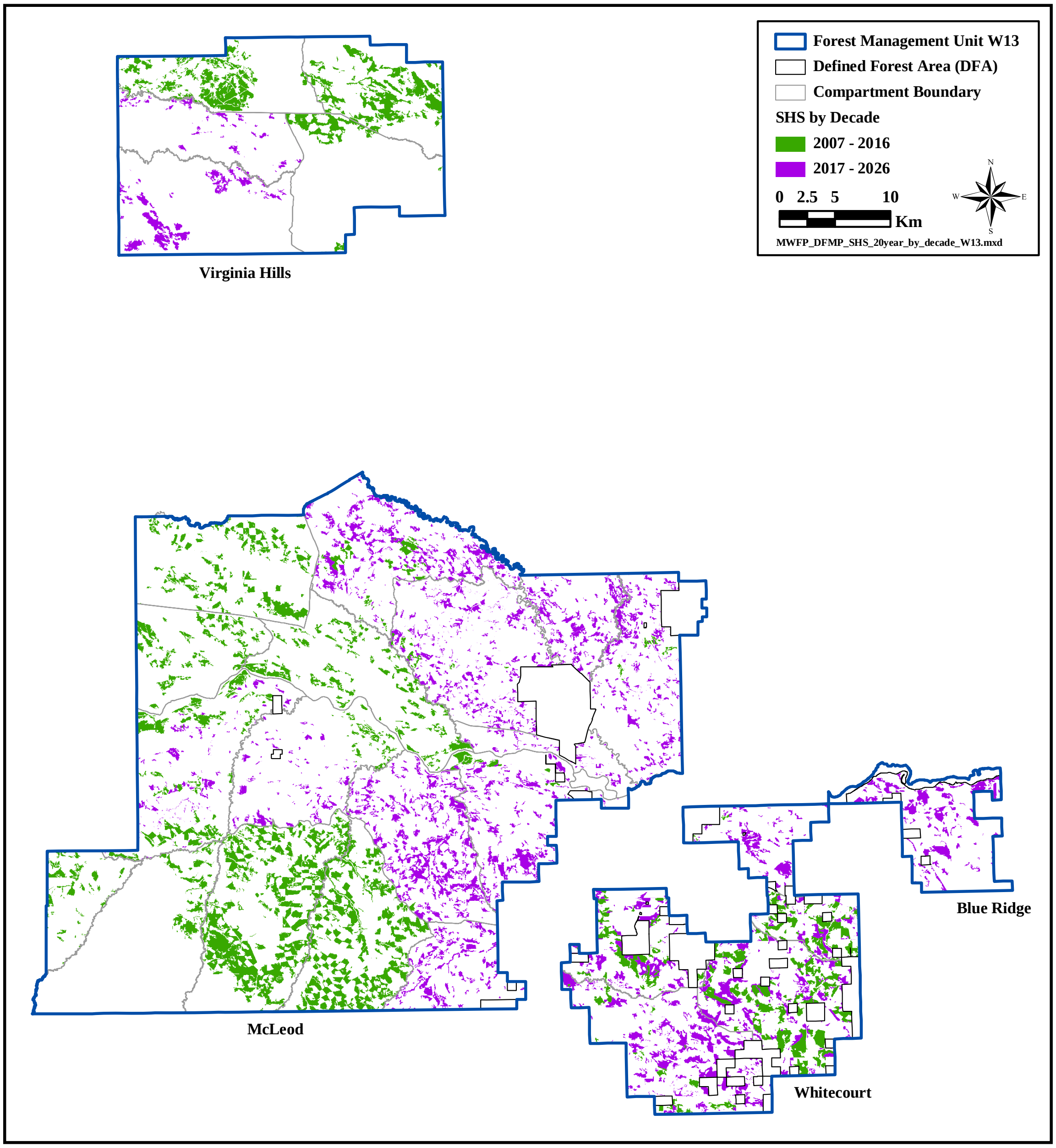
The change throughout the planning horizon in runoff coefficient for first order watershed 1428 is presented in Figure 92. The peak increases in RC were predicted to occur in 30 years and again 70 years later. The sharp increase in RC following harvesting in the year 2102 with a gradual recovery is clearly evident. The step increase and gradual recovery sequences represent multiple harvest entries into the watershed and the different recovery rates between tree species.

6.4.2 W13 Detailed Results

Millar Western manages W13 with the input from the quota holders and other stakeholders. Currently, a major concern in W13 is the MPB epidemic threatening Alberta. To ensure a continuous and viable supply of pine from the FMU, Millar Western will initiate measures to mitigate the risk of a MPB invasion and its impacts. This risk mitigation was a key issue in the PFMS selection.

Harvest Indicators

Four main sets of harvest indicators were tracked through time in this planning process: volume harvested; area harvested; average harvest age; and the piece size distribution of the harvest. The forecasts for these different harvest indicators are shown separately below. The W13 SHS is presented in Map 20.



Map 20. W13 SHS from the PFMS.

Volume

The harvest level for W13 included a MPB surge cut for both coniferous and deciduous harvest followed by a drop down to an even-flow level (Table 30 and Figure 93). Not included in these volumes, is a 1% volume reduction for structure retention that will be applied during layout and harvesting operations. The coniferous surge cut is 435,844m^3/yr for 10 years and the deciduous surge cut is 209,412m^3/yr for the first 10 years of the DFMP. The deciduous surge cut was not originally intended to be a component of the DFMP. However, due to the large amount of incidental volume from the coniferous and mixedwood stands, it was not possible to harvest the coniferous surge cut without exceeding the maximum deciduous even-flow level while maintaining Weyerhaeuser's volume commitment in the Whitecourt area. Outside of the Weyerhaeuser deciduous harvest, there is very little pure deciduous harvest scheduled in the first 10 years of the SHS. The pure deciduous harvest that is present is to ensure the block shapes are operationally feasible for harvest.

Early indication was that no carryover volumes would be required in the W13 PFMS and so it was developed without carryover. However, late in the planning process unexpected carryover volumes of 48,789 m^3 of coniferous and 6,347 m^3 of deciduous were determined by Millar Western and applied for. Carryover volumes were determined too late to be incorporated into the SHS and PFMS, and due the small amount of volume under consideration, would not be expected to have noticeable negative effects on the PFMS and thus it was deemed not critical to incorporate these carryover volumes into the PFMS.

Table 30. Harvest volume by period from the W13 PFMS.

Years	Conifer Harvest (m^3/yr @ 15/10)	Deciduous Harvest (m^3/yr @ 15/10)
2007-2016	435,844	209,412
2017-2206	295,849	145,807

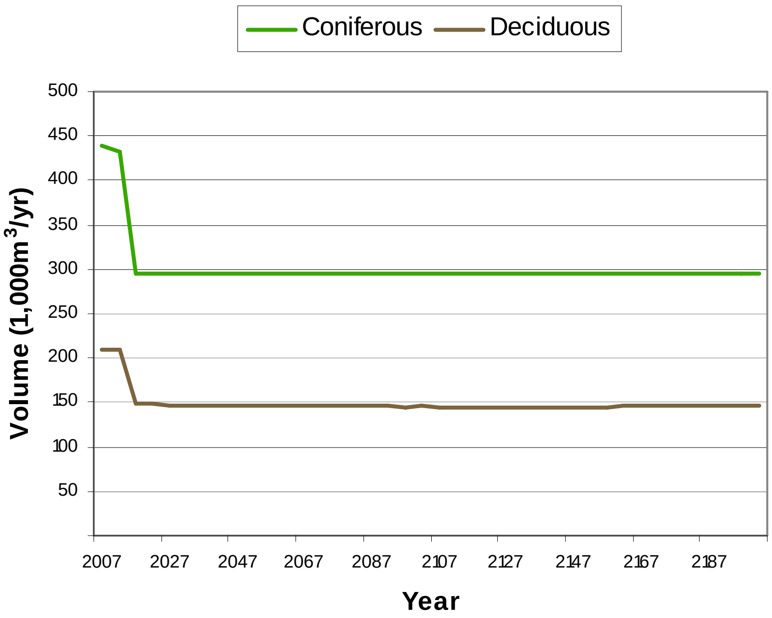


Figure 93. Total harvest level from the W13 PFMS.

As previously explained, the conifer surge cut level was derived to address MPB risk and to balance the pine spruce harvest ratio to maintain merchantability of the harvested timber. The assumption is that MPB will continue to invade W13 at an increasing rate. A higher surge cut may be required if the MPB infestation is worse or faster than expected.

The highest percent of the coniferous harvest is from the PL species strata (Figure 94). There are other species strata being harvested in the PFMS, to ensure the SHS is operationally feasible. The deciduous harvest volume was sourced from all of the species strata (Figure 95). As noted earlier, a large amount of the deciduous volume came from the harvest of coniferous and mixedwood stands on the landbase. The birch volume harvested from each species strata can be seen in Figure 96. Table 31 shows the volume harvested by species strata in the SHS.

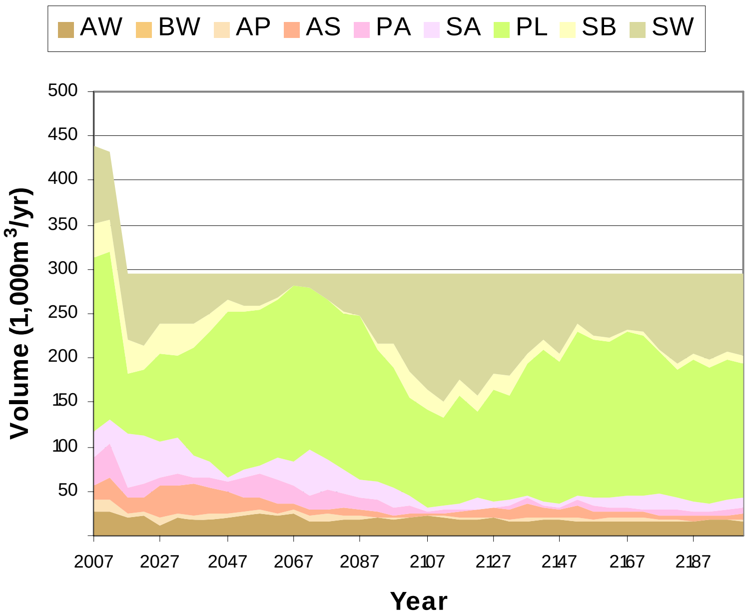


Figure 94. Coniferous Harvest Volume by Species Strata from the W13 PFMS.

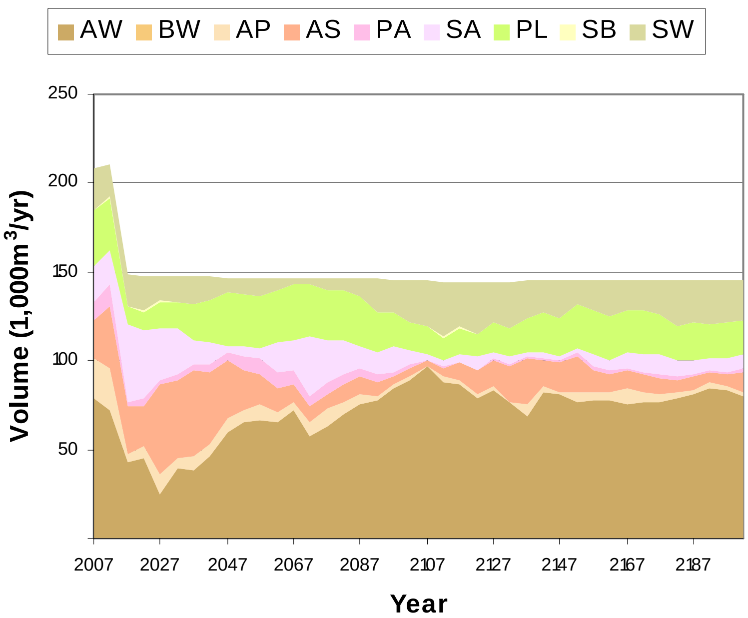


Figure 95. Deciduous harvest volume by species strata from the W13 PFMS.

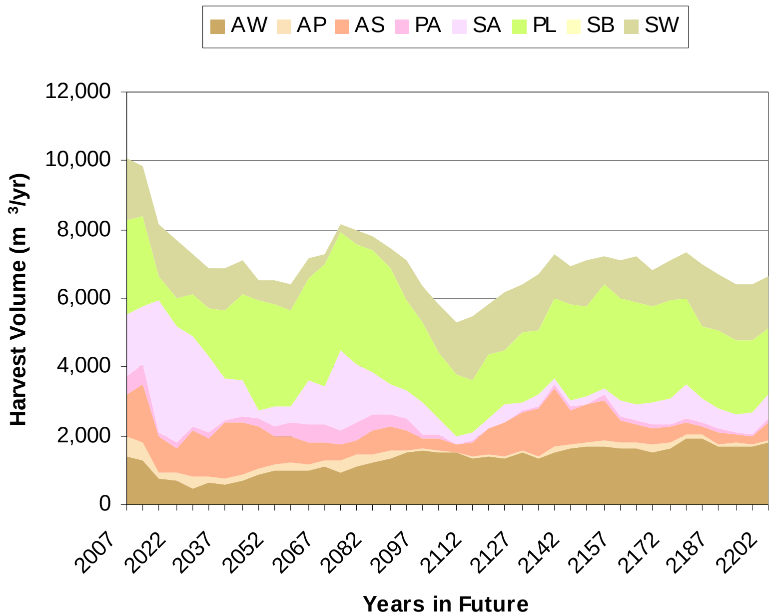


Figure 96. Birch volume harvested from each species strata from the W13 PFMS

Table 31. Volume harvested in first 20 years by species strata from the W13 PFMS.

Species Strata	2007-2016 Harvest Volume (m^3/yr) Coniferous	Deciduous	2017-2026 Harvest Volume (m^3/yr) Coniferous	Deciduous
AW	27,218	75,636	20,940	43,778
BW	-	-	-	-
AP	13,561	22,830	4,986	5,889
AS	20,118	28,001	17,376	24,526
PA	35,272	11,007	12,658	3,692
SA	27,669	20,142	57,657	40,540
PL	192,463	30,412	71,007	10,562
SB	37,181	552	31,938	560
SW	82,362	20,832	79,005	18,745
TOTAL	435,844	209,412	295,567	148,292

There are areas outside of Millar Western's FMA that are within FMU W13 that Millar Western does not currently have rights to harvest (see Section 7.28). The percent volume outside the FMA was calculated by assuming that the FMU based quotas harvest their volume within the FMA and outside the FMA proportionately. Therefore, the requested MWFP DTA does not account for the full volume outside of the FMA. Table 32 shows the annual harvest volume by company and licence within W13.

Table 32. Harvest volume from the FMA, and Non-FMA area from the W13 PFMS.

Company Name	Disposition Number / FMA Ref.	FMA/ FMU/ Grazing	Deciduous AAC (%)	Deciduous AAC (m3/yr)	Incidental Deciduous (%)	Incidental Deciduous (m3/yr)	Coniferous AAC (%)	Coniferous AAC (m3/yr)
W13								
MTU	[8(2)(e)(i)]	FMA						30,000
MTU*	[8(2)(e)(ii)]	FMA			100	861		
Weyerhaeuser	DTAW130001	FMU		45,000				
MWFP (QUOTA)	CTQW130002	FMU					4.42	19,264
MWFP (FMA)	FMA970034	FMA		157,099				376,925
MWFP	CTQW130001	Grazing					100	9,655
Unallocated		Grazing	100	6,452				
Sub Total				208,551		861		
Total				209,412				435,844
FMA								
Area Residents	[8(2)(d)]	IN				1000**		

* within Whitecourt and Blue Ridge subunits

** conifer/deciduous(birch) Not accounted in calculations

Represent basis for calculations

Area Harvested and Regenerated

The area harvested varies throughout the planning horizon (Figure 97). It is at the highest level early in the planning horizon because of the coniferous and deciduous surge cuts. The area harvested generally decreases for the remainder of the planning horizon except for a period around 60 years where area harvested increases. This second increase represents a pinch point in the timber supply; the harvest level is constant but the area harvested increases, due to a lack of operable sized timber.

In the W13 PFMS, stand conversion between species strata was permitted immediately after harvesting. Figure 97 shows only part of the conversion occurring, where deciduous or mixedwood stand types are converted to pure coniferous types, as this was of interest to the plan development team. Stand conversion between pure conifer types was also permitted but is not shown in this figure. The total amount of all area converted by species strata for the first 10 years can be seen in the regeneration targets. In the PFMS, conversion is spatially modeled, but these spatial representations are made by the model without the block-level information that affects specific site selections for conversion. Operational consideration will be used to select what stands are converted and what they will be converted to. Regenerated species strata targets are derived from the distribution of all regenerated stands during the 2007-2016 period of the PFMS, including all conversion, and were used to determine the regeneration targets for implementation (refer to **Appendix XXIII – VOIT 21 – Forestry Operator specific regenerated strata distribution percentage by subunit (2.1.1.1C)**). This approach provides the operational flexibility required by operations and commits the silviculturalist to meet the regeneration targets of the PFMS.

The partial harvesting that occurs in the model is not shown in these figures. The first 10 years of the SHS compared to the gross, managed, and operable land can be seen in Table 33. When the SHS is compared to the operable landbase there is significantly more area harvested in the pine dominated strata. This shows that this SHS is biased towards harvesting more pine than the other species early in the planning horizon, reducing the MPB susceptible pine.

Not shown in these figures is the partial harvesting that occurs in the model. There are 231 ha of partial harvesting that occurs in the model in the first 10 years, all of which is in the Athabasca Flats area (Map 21).

Figure 98 shows the harvest area by species strata from the W13 PFMS.

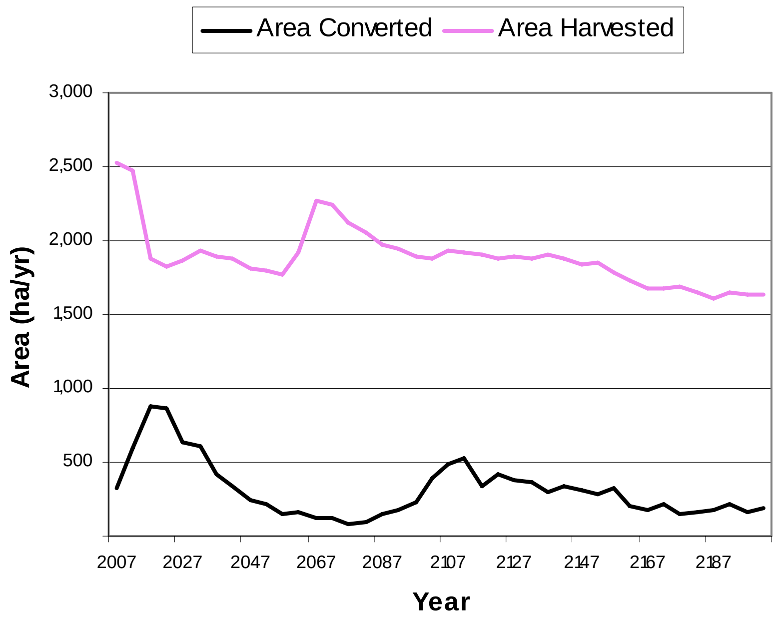
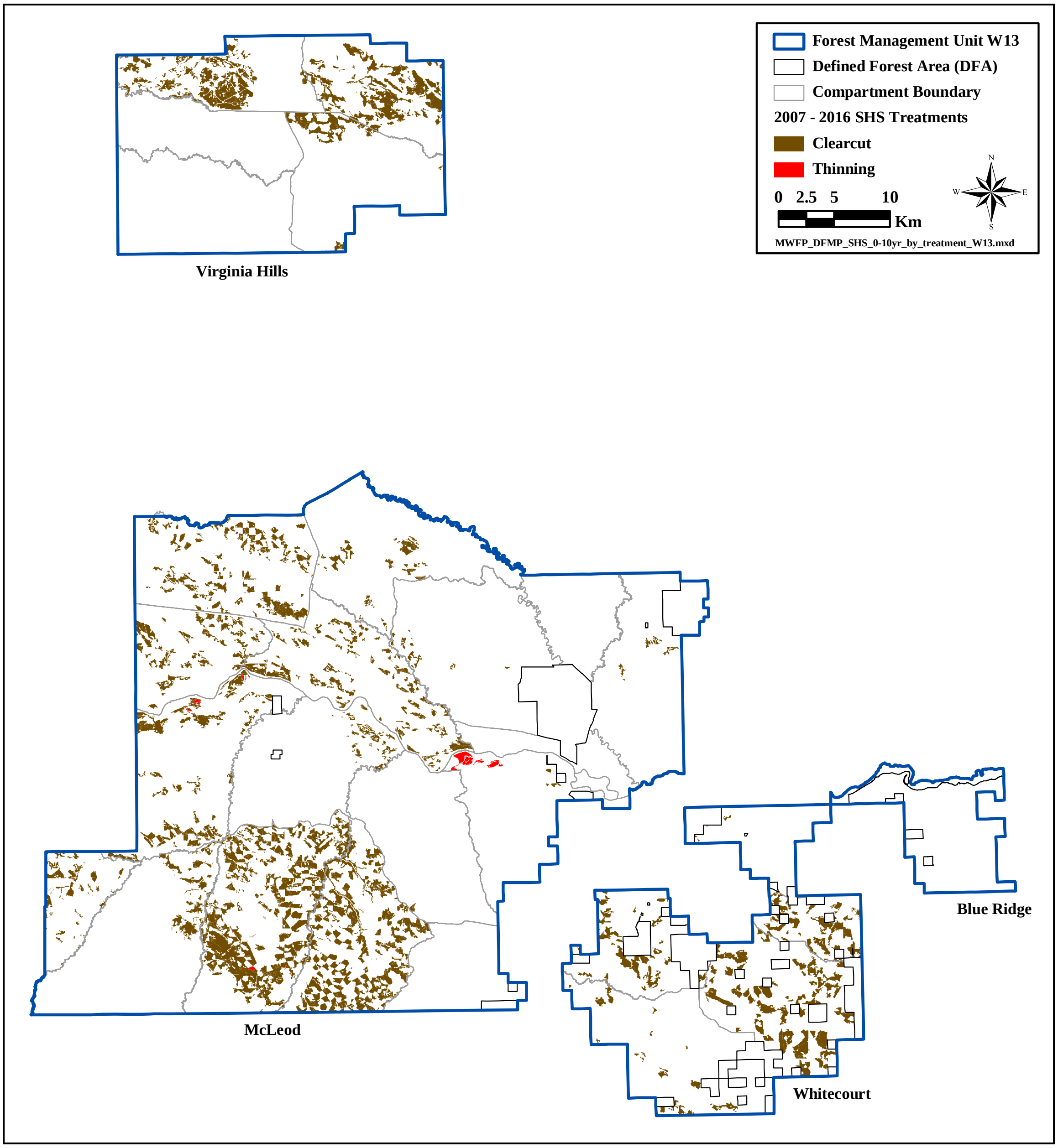


Figure 97. Area harvested and converted in the W13 PFMS

Table 33. Landbase areas compared to the first 10 years of the SHS.

Yield Strata	Landbase Gross	Managed	Operable	10 yr SHS
AW	25%	28%	30%	22%
BW	0%	1%	0%	0%
AP	2%	3%	3%	4%
AS	8%	9%	14%	7%
PA	4%	5%	5%	7%
SA	7%	9%	10%	8%
LT	2%	0%	0%	0%
PL	26%	32%	21%	32%
SB	16%	5%	6%	8%
SW	8%	8%	11%	12%



Map 21. Harvest treatments in the first decade from the W13 PFMS.

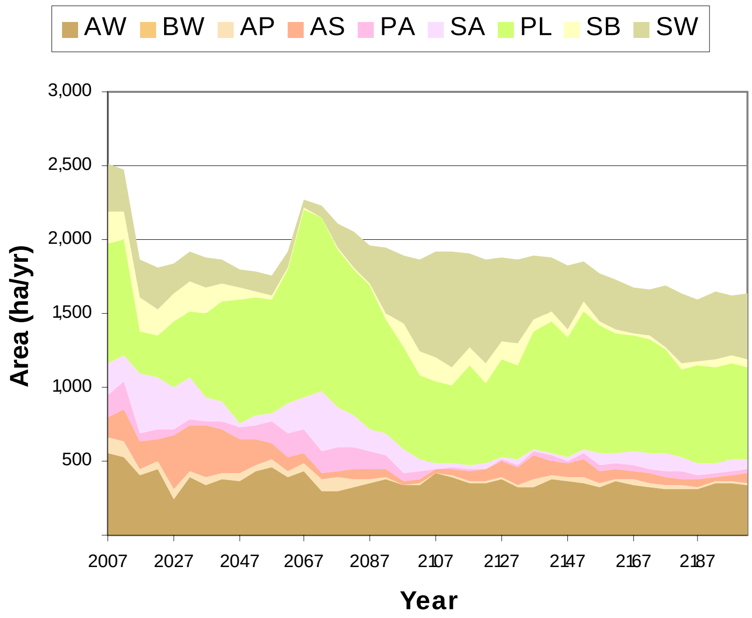
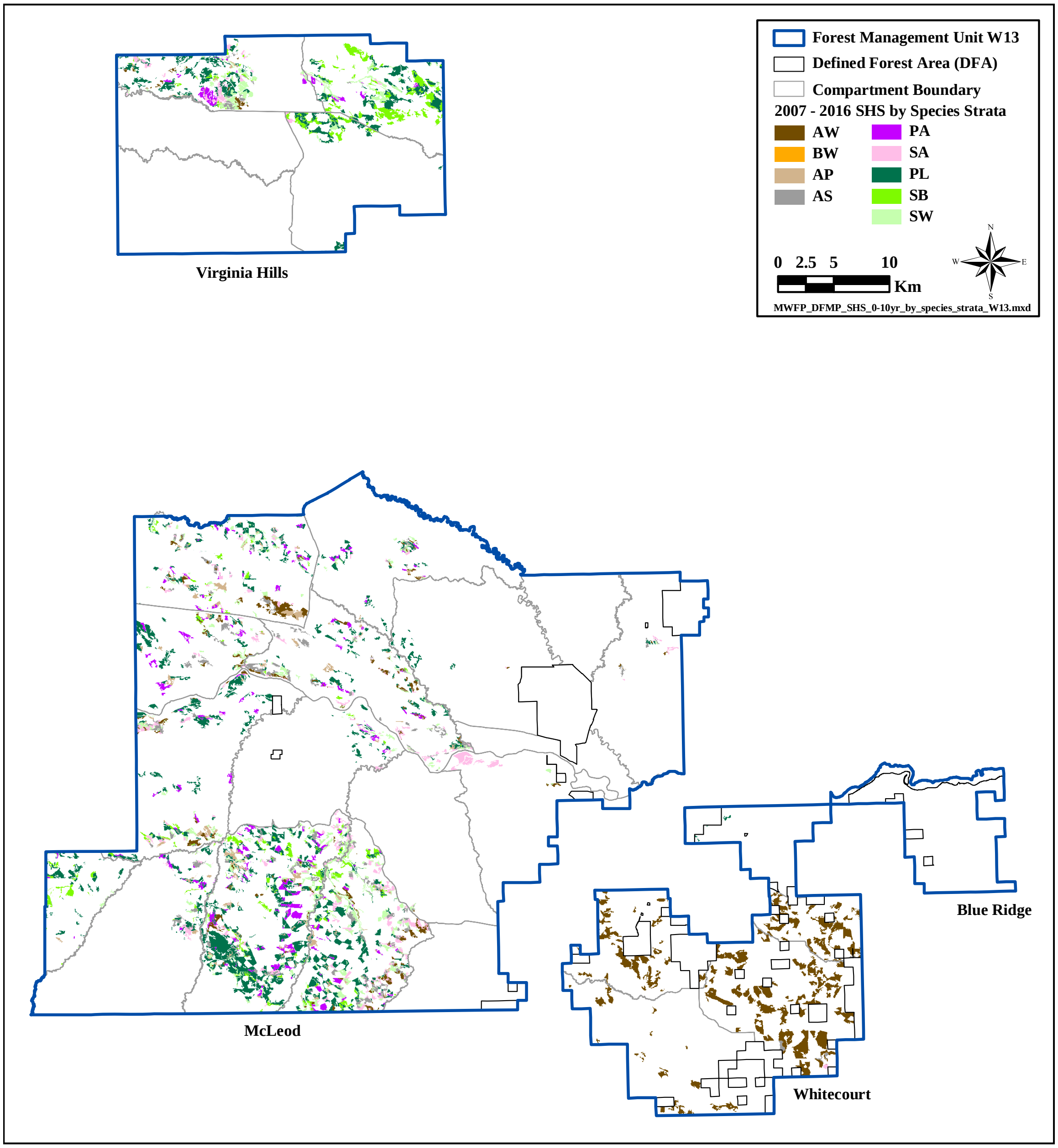
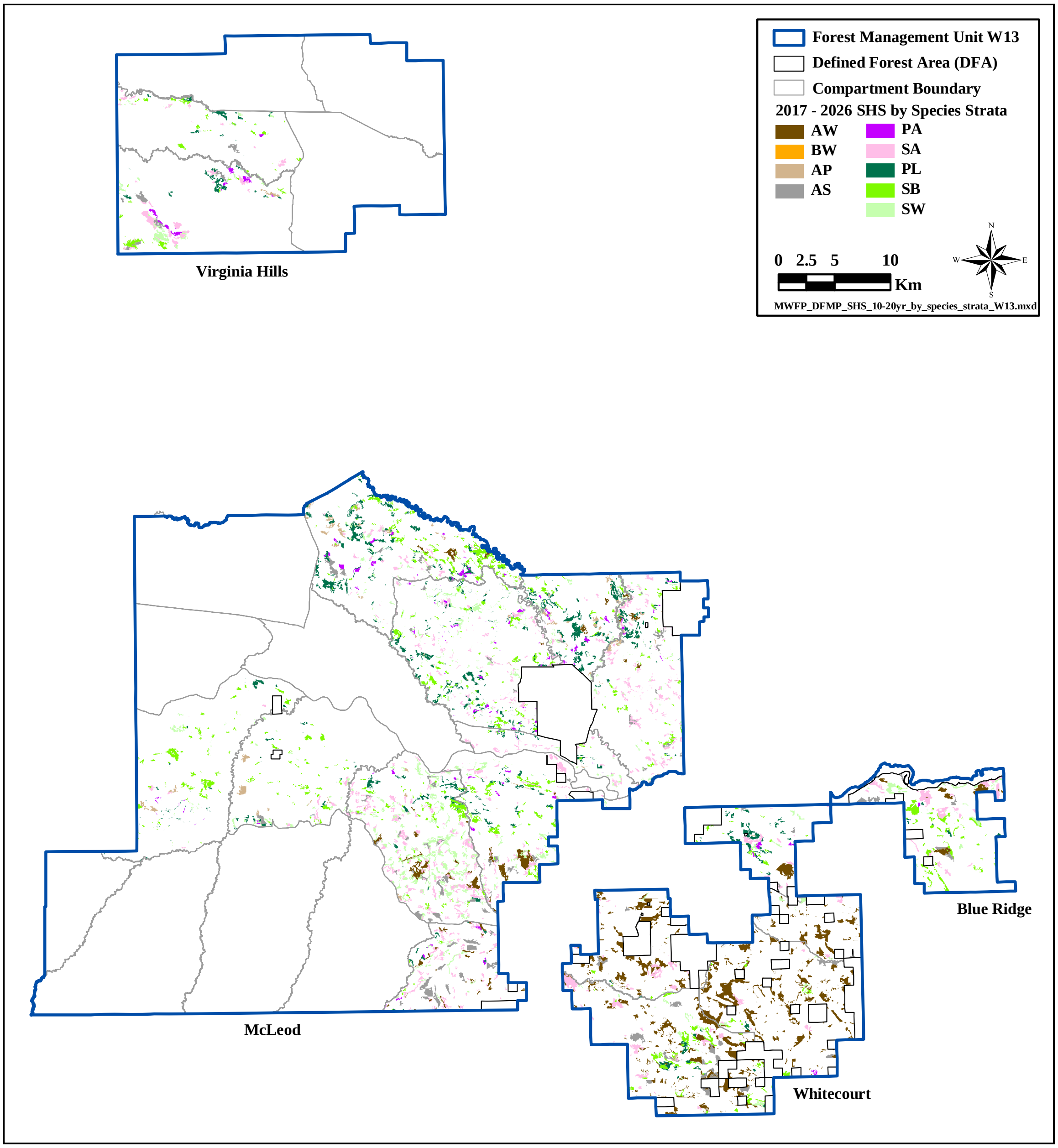


Figure 98. Area harvested by species strata from the W13 PFMS

The SHS by species strata for W13 are presented in Map 22 and Map 23 by decade.



Map 22. 2007-2016 W13 SHS by species strata



Map 23. 2017-2026 W13 SHS by species strata

The area harvested and regenerated by strata from the PFMS can be seen in Table 34. Note the impacts of conversion on the percent distribution of the yield strata that are regenerated; AW decreases by 5%, as does AS. The yield strata with the largest increase is SW, which increases from 12% to 25% of the regenerated area. While these changes appear quite large the impact on the overall forest is much smaller due to the relatively small percent of the managed and gross landbase represented by this 10 years of harvest.

Table 34. Area harvested and regenerated by strata from the W13 PFMS.

Strata	Harvested area		Regenerated area	
AW	5,394	22%	4,236	17%
AP	1,066	4%	1,019	4%
AS	1,721	7%	186	1%
PA	1,754	7%	1,302	5%
SA	1,954	8%	1,267	5%
PL	8,028	32%	8,526	34%
SB	2,085	8%	2,085	8%
SW	2,949	12%	6,329	25%
Total	24,951		24,951	

The harvest and regeneration targets by operator in the first 10 years of the planning horizon can be seen in Table 35 and Table 36. These targets were derived by assignments of strata to operators and not from the assignment of specific stands to each operator. The stand assignment process will initially be undertaken by the DFA harvest committee in the first year of SHS implementation and will be refined as required to meet operational needs. The assigned stands will be used to adjust each operator's harvest and regeneration targets. Refer to Chapter 6 for more information on the process.

Table 35. Area harvested by operator from the W13 PFMS.

Harvest	Company Specific Harvest Targets (ha)			
Strata	MTU*	Weyerhaeuser**	Millar Western	Total
AW	-	4,236	1,158	5,394
AP	78	-	988	1,066
AS	126	-	1,595	1,721
PA	129	-	1,625	1,754
SA	143	-	1,811	1,954
PL	589	-	7,438	8,028
SB	153	-	1,932	2,085
SW	216	-	2,733	2,949
Total	1,435	4,236	19,280	24,951

*Based on the average coniferous volume harvest from non AW stands in first decade and proportional harvest from conifer landbase

** Based on area from AW stands with B, C, or D, density in Weyerhaeuser compartments of interest in first decade

Table 36. Area regenerated by operator and species strata from the first decade of the W13 PFMS.

Regenerated Strata	Company Specific Regeneration Targets						Total	
	MTU		Weyerhaeuser		Millar Western			
	(ha)	(%)	(ha)	(%)	(ha)	(%)	(ha)	(%)
AW	-	0%	4,236	100%	-	0%	4,236	17%
AP	71	5%	-	0%	949	5%	1,019	4%
AS	13	1%	-	0%	173	1%	186	1%
PA	90	6%	-	0%	1,212	6%	1,302	5%
SA	88	6%	-	0%	1,180	6%	1,267	5%
PL	591	41%	-	0%	7,935	39%	8,526	34%
SB	144	10%	-	0%	1,941	10%	2,085	8%
SW	439	31%	-	0%	5,890	29%	6,329	25%
Total	1,435	100%	4,236	100%	20,245	100%	24,951	100%

Average Harvest Age

The average harvest age of all species increases for the first 15 years for all strata (Figure 99). The non-pine strata continue to increase for the first quarter of the planning horizon before they decrease, associated with second rotation volume being harvested, and then steadily increase throughout the remainder of the planning horizon. Generally the pine based strata decrease earlier in the planning horizon associated with the increase in pine percentage harvested on the landbase.

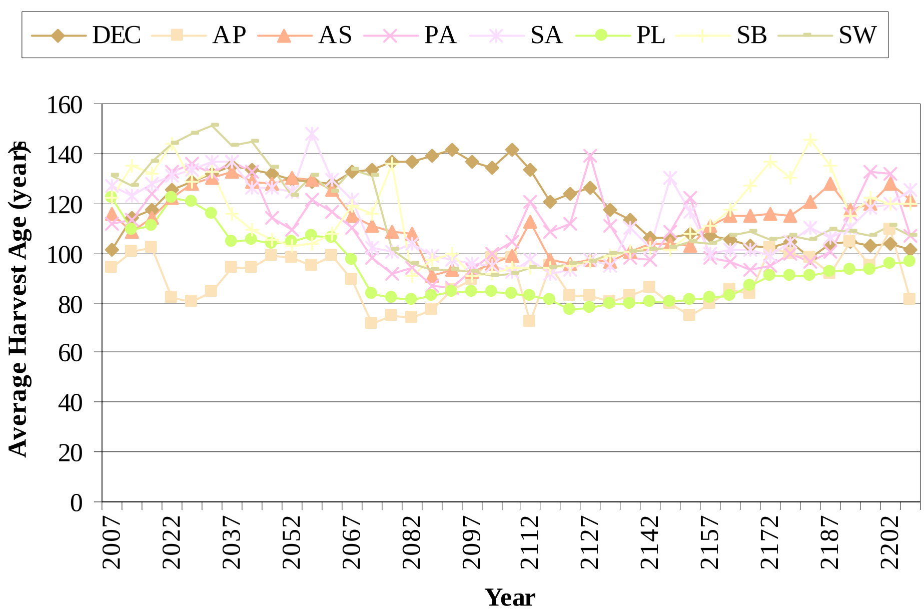


Figure 99. Average harvest age from the W13 PFMS.

Piece size

Piece size is important indicator for ensuring the wood profile harvested from the landbase stays constant. Both the coniferous and deciduous piece size curves for each species strata fluctuate throughout the planning horizon (Figure 100 and Figure 101 respectively). Note that the conifer volume curves are comprised of all merchantable conifer species and the deciduous volume cures comprises all merchantable deciduous species.

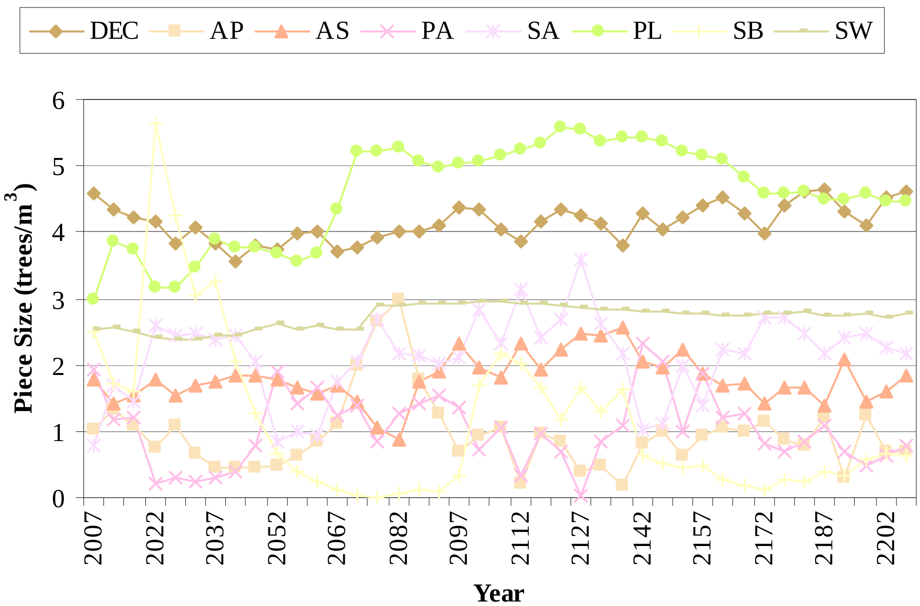


Figure 100. Coniferous harvest pieces size by species strata from the W13 PFMS.

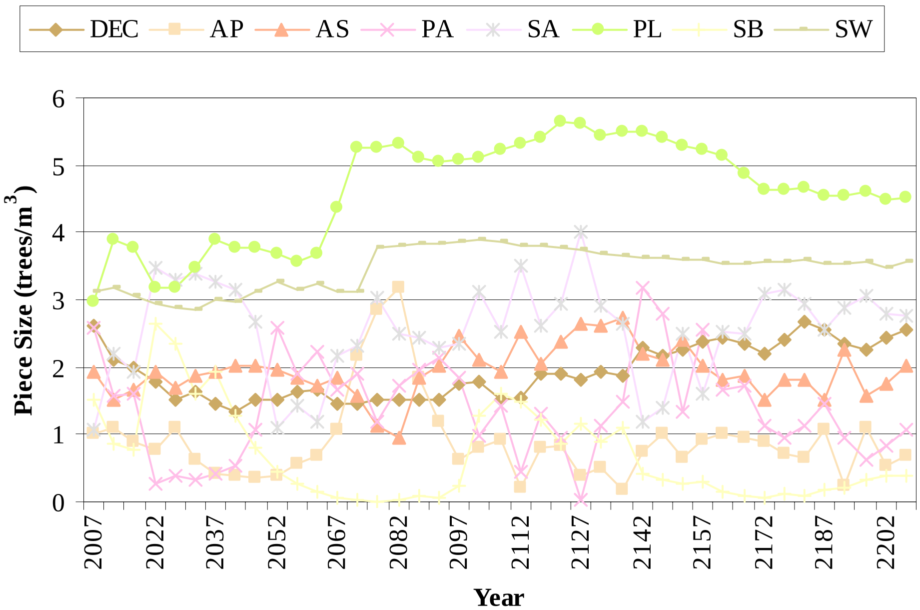


Figure 101. Deciduous harvest pieces size by species strata from the W13 PFMS.

Inventory Indicators

A number of indicators relating to landbase inventory that were tracked for the PFMS. These included but are not limited to growing stock, MPB susceptible area, age class, old growth, and free to maneuver flying space.

Growing stock

Growing stock represents the volume of timber on the landbase. Three representations of growing stock are addressed: forested growing stock; managed growing stock; and operable growing stock (see Section 6.4.1).

Figure 102 shows all of the growing stock levels through time from the W13 PFMS. The total and managed coniferous growing stock levels decrease for the first half of the planning horizon, after which they increase for the remainder of the planning horizon to end at higher levels than at the start. The operable coniferous growing stock level decreases for the first 75 years of the planning horizon after which time it stays constant for the remainder of the planning horizon. All of the deciduous growing stock levels decrease over the first half of the planning horizon after which time they stabilize.

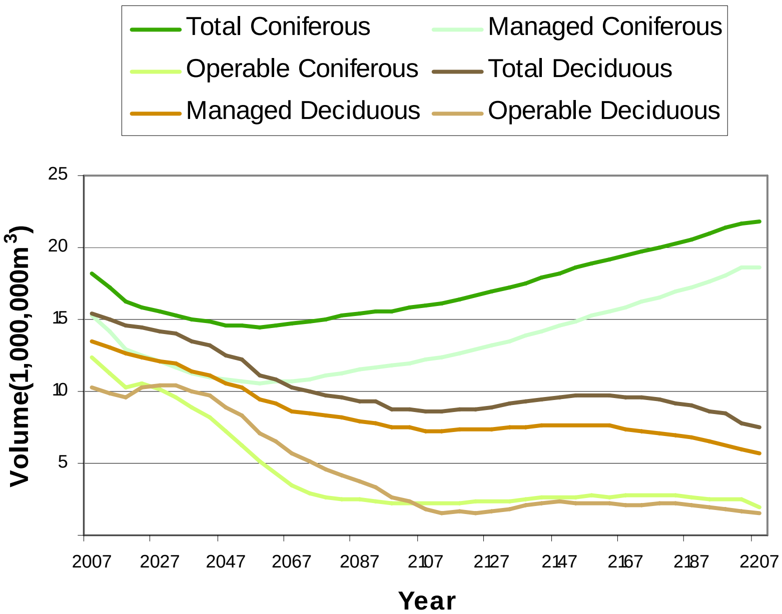


Figure 102. Growing stock by type from the W13 PFMS

Mountain Pine Beetle

The area of pine stands within ASRD Rank 1 and Rank 2 MPB categories decreases rapidly for the first 10 years of the planning horizon (Figure 103). This initial reduction is a result of the MPB coniferous surge cut included in the PFMS. Subsequently, the area with high ASRD rankings continues to decrease for the remainder of the planning horizon, but at a slower rate.

Table 37 presents the MPB ranking results for the first 100 years in tabular format and includes the percent reduction from the 2007 baseline condition. Currently, there are 85,000 ha of Rank 1 and Rank 2 stands in W13 and much of this is in stands that are currently too young for harvest. Map 5 on page 57 shows the current ASRD MPB rank distribution. The SHS achieves an 18% reduction in Rank 1 and Rank 2 stands over the first 10 years and a 25% reduction over the first 20 years.

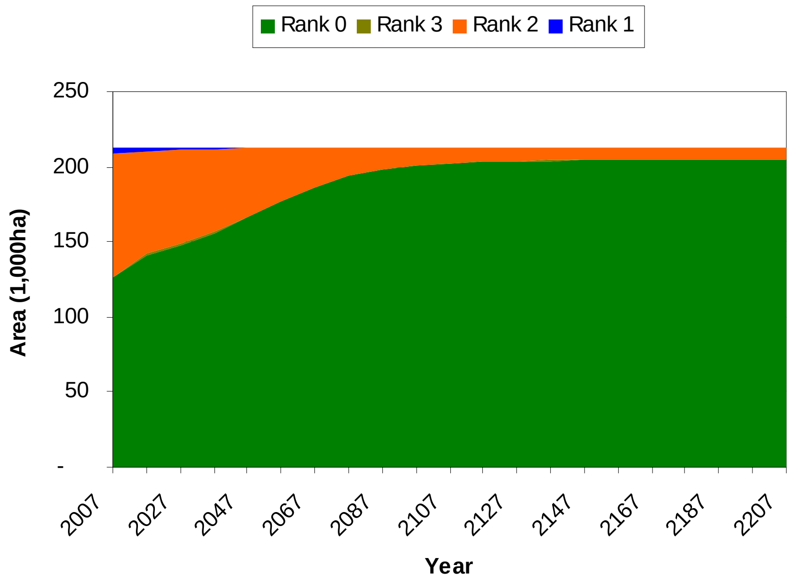
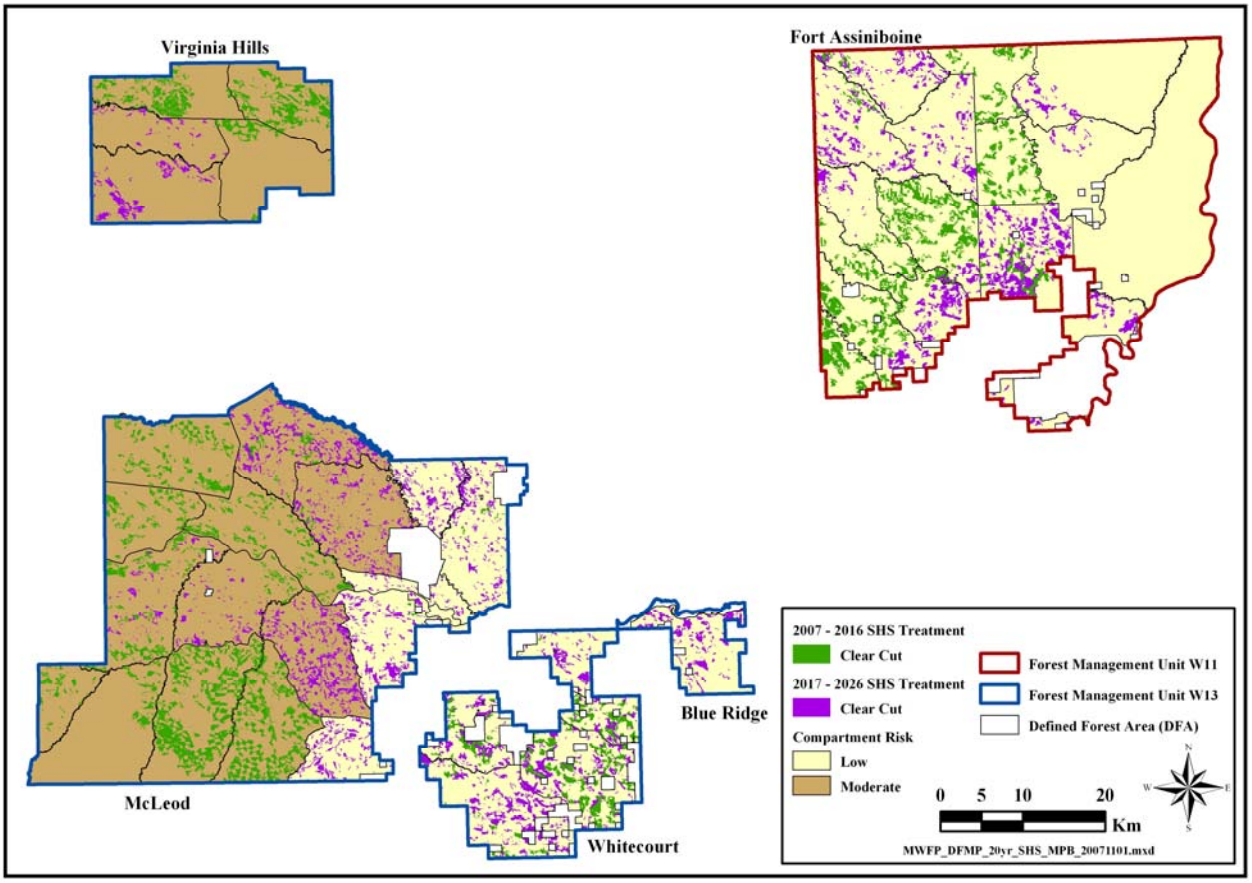


Figure 103. Area by ASRD MPB Rank on the land base from the W13 PFMS

Table 37. W13 ASRD MPB Rank 1 & 2 area and percent reduction

	Rank 1		Rank 2		Rank 1+ Rank 2	
Year	**Area (ha)**	**Reduction (%)**	**Area (ha)**	**Reduction (%)**	**Area (ha)**	**Reduction (%)**
2007	3,376	baseline	82,184	baseline	85,560	baseline
2017	1,859	45%	68,224	17%	70,083	18%
2027	1,428	58%	62,479	24%	63,907	25%
2037	626	81%	54,801	33%	55,427	35%
2047	293	91%	45,684	44%	45,976	46%
2057	179	95%	34,900	58%	35,079	59%
2067	119	96%	25,619	69%	25,737	70%
2077	92	97%	18,455	78%	18,546	78%
2087	88	97%	13,692	83%	13,780	84%
2097	88	97%	11,093	87%	11,181	87%
2107	84	98%	9,595	88%	9,679	89%

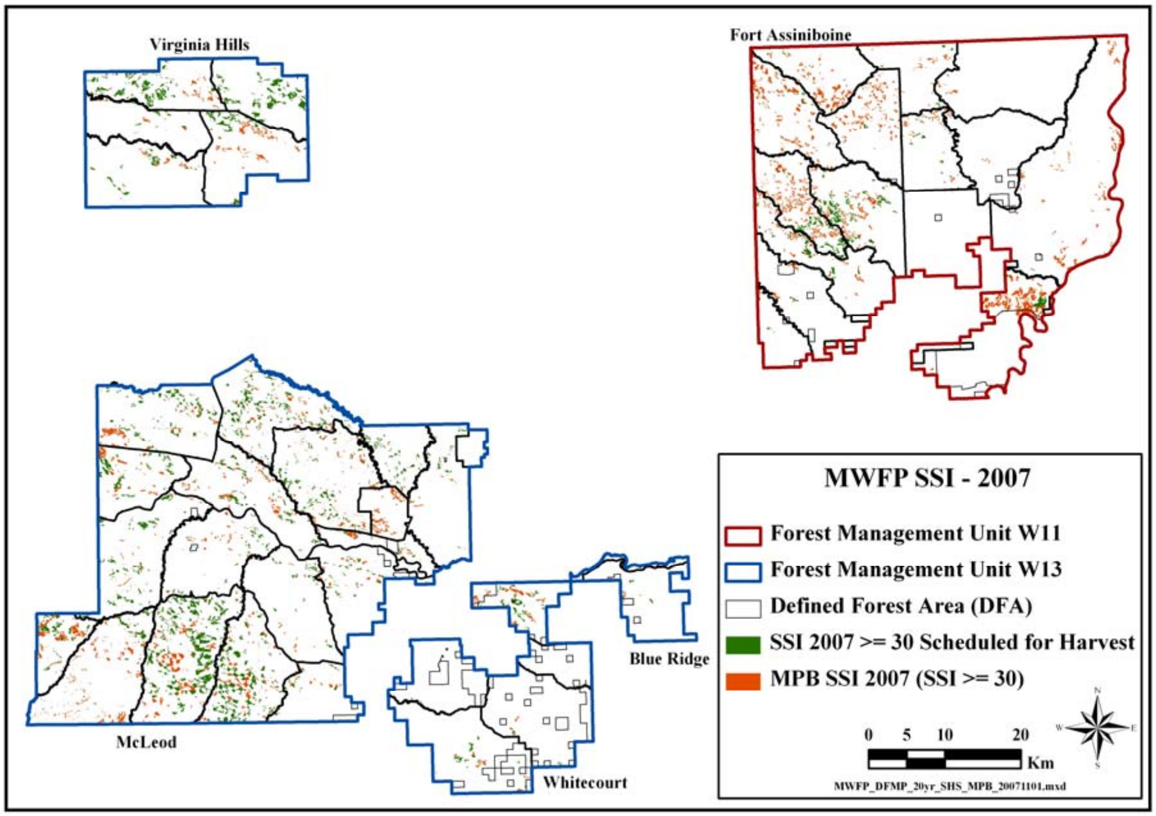
In W13, the SHS targeted pine stands in the compartments identified as medium risk, especially in the first 10 years (Map 24). There are large areas of Rank 2 pine in the Windfall burn (southeast portion of W13) that are currently too young for harvesting and thus no stands are included within SHS in the Windfall burn area. Scheduled harvesting in the Whitecourt compartments (predominantly deciduous compartments) is required to meet deciduous volume commitments for Weyerhaeuser.



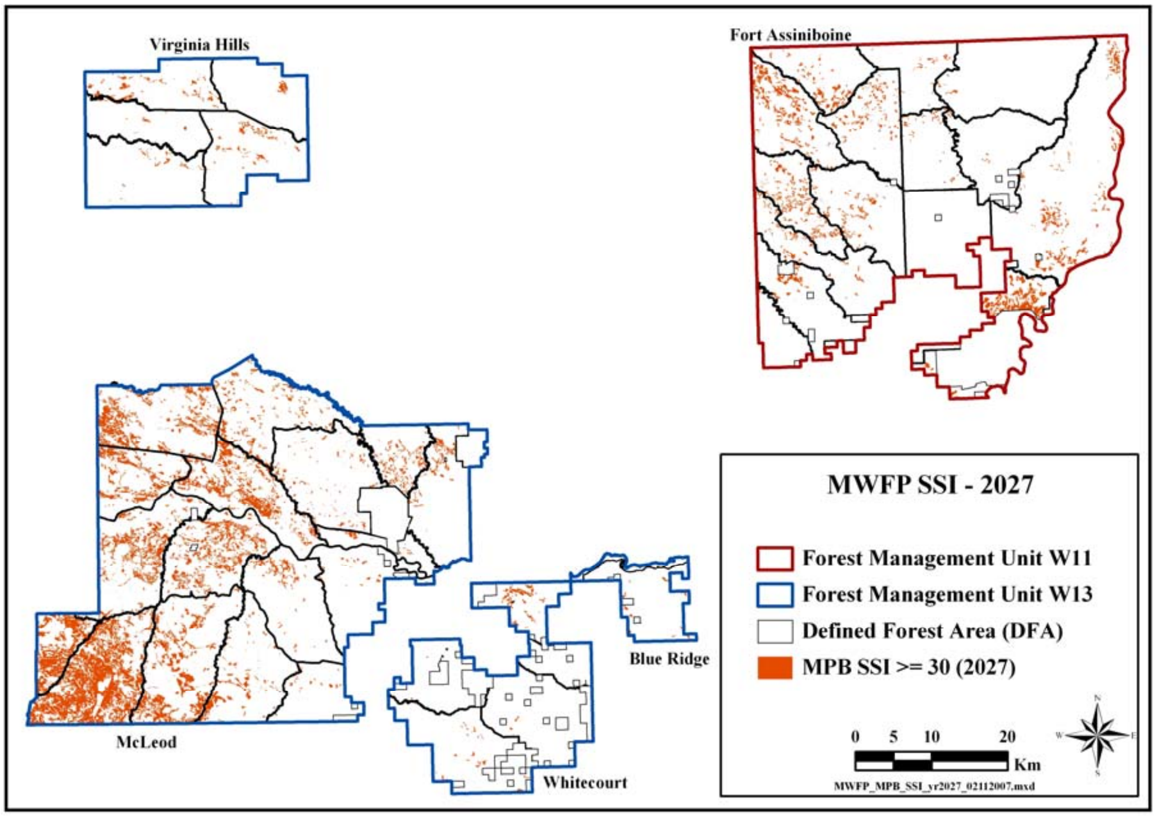
Map 24. MPB compartment risk and the SHS for the DFA

ASRD MPB rankings presented here do not account for forest growth so updating the ranking in the future will produce larger values. To account for growth the Millar Western dynamic SSI ranking was developed. This dynamic index and the success in the addressing MPB risk are shown in the next 2 maps. Using a threshold value of 30, Millar Western high MPB susceptibility are divided into stands that are sequenced in the SHS and stands that are not sequenced (Map 25). Most of the highly susceptible stands are sequenced in W13. The second map shows that due to aging, a large amount of area becomes highly susceptible in 20 years that is not highly susceptible today (Map 26). The second map more closely resembles the ASRD MPB ranking map (Map 5 on page 57). The difference between the ASRD ranking and Millar Western's is largely one of operability and the difference of using yield strata to rank stands compared to pine content.

It is questionable if all of the pine stands in the Windfall burn area will become merchantable in 20 years due to the high densities in much of that area. If a large MPB infestation occurs in the Windfall burn earlier than expected, harvest activities may have to be modified to address the large amount of susceptible pine area as shown in Map 26. Depending upon the amount of merchantable area when an infestation occurs, a surge cut might be required to promptly address the infestation. The decision to harvest or not within the Windfall burn area will be based on merchantability criteria at the time of infestation.



Map 25. SHS and MWFP high MPB SSI in 2007



Map 26. MWFP high MPB SSI in 2027

Species Strata Area

The area of gross and managed landbase of each species strata changes throughout the planning horizon (Figure 104 and Figure 105, respectively). Species strata distribution changes for two reasons: firstly succession can cause species strata to change; and secondly there are management actions which allow conversion from mixedwood or deciduous types to pure coniferous types. The change to the species strata distribution on the managed landbase is almost exclusively from conversion, while changes on the unmanaged landbase are exclusively successional.

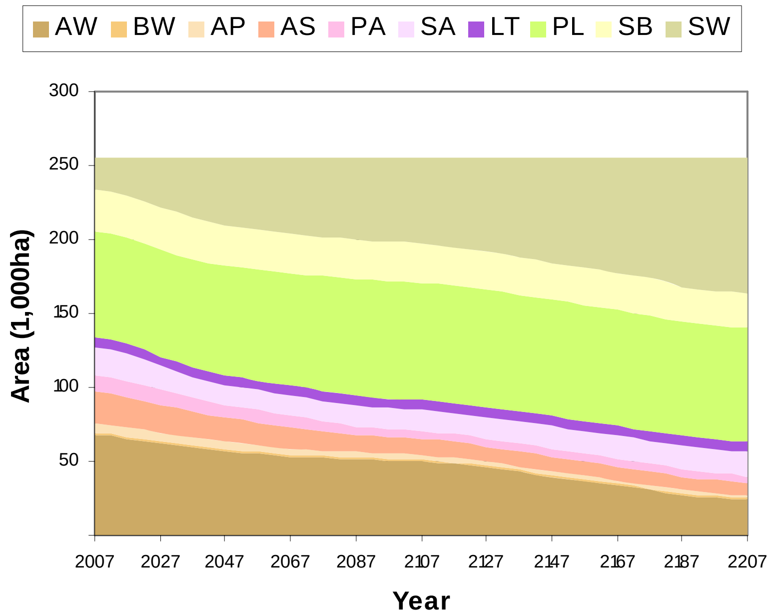


Figure 104. Area by species strata on the gross landbase from the W13 PFMS.

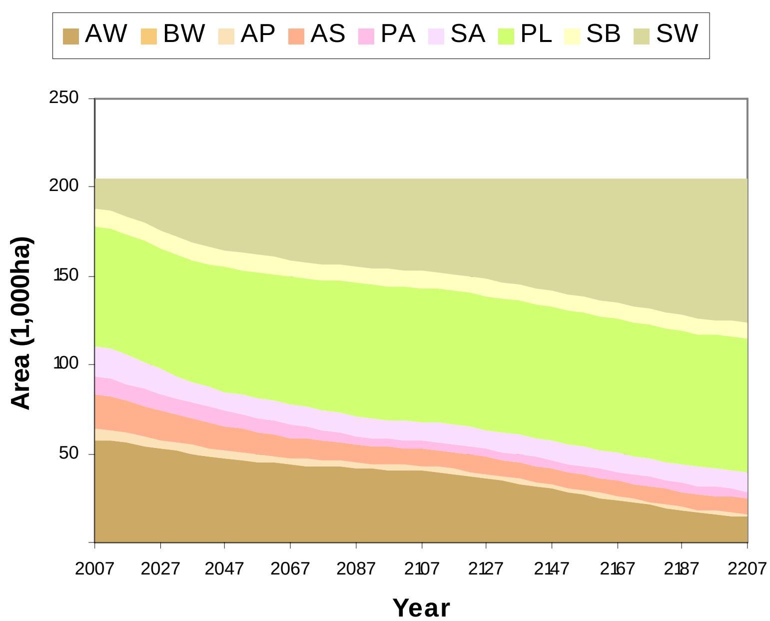


Figure 105. Area by species strata on the managed landbase from the W13 PFMS.

Age Class

The age class structure of the managed landbase stays fairly constant through out the planning horizon (Figure 106). Although there is a slight increase in the young age class structure early in the planning horizon, it approximates starting levels towards the end of the horizon.

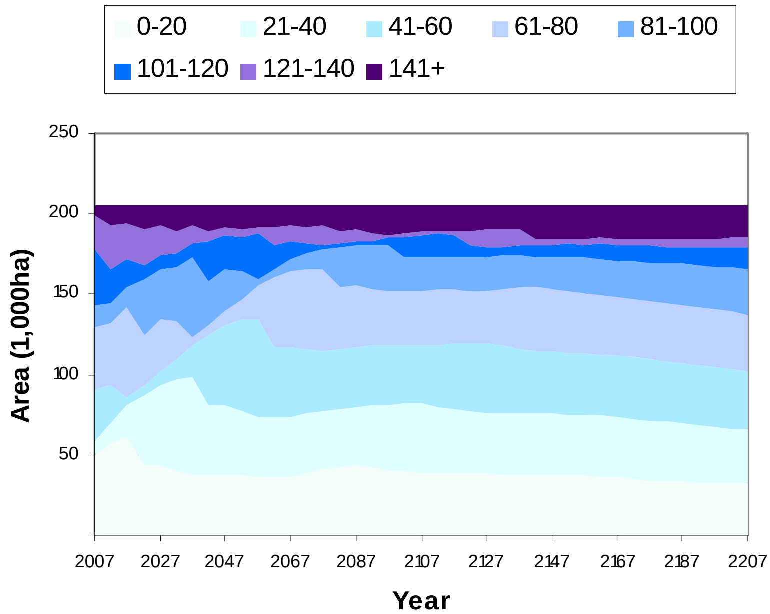


Figure 106. Area by age class on the managed landbase from the W13 PFMS

Oldgrowthness Area

Oldgrowthness was the measure used to constrain the old forest component on the landbase. Figure 107 shows the gross and managed Oldgrowthness area. In both the managed and gross landbases, Oldgrowthness area decreases over the first half of the planning horizon before increasing. On the gross landbase, Figure 108 shows that the majority of the Oldgrowthness area is from the C and CD broad cover groups. On the managed landbase, the area in C and CD broad cover groups is lowest during forecast pinch-point which occurs at the middle of the planning horizon (Figure 109).

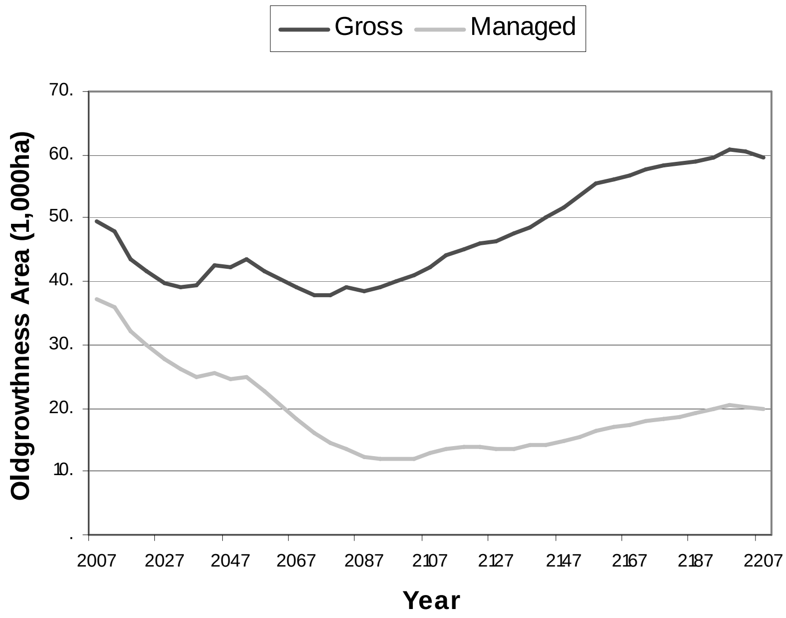


Figure 107. Oldgrowthness area on the landbase from the W13 PFMS.

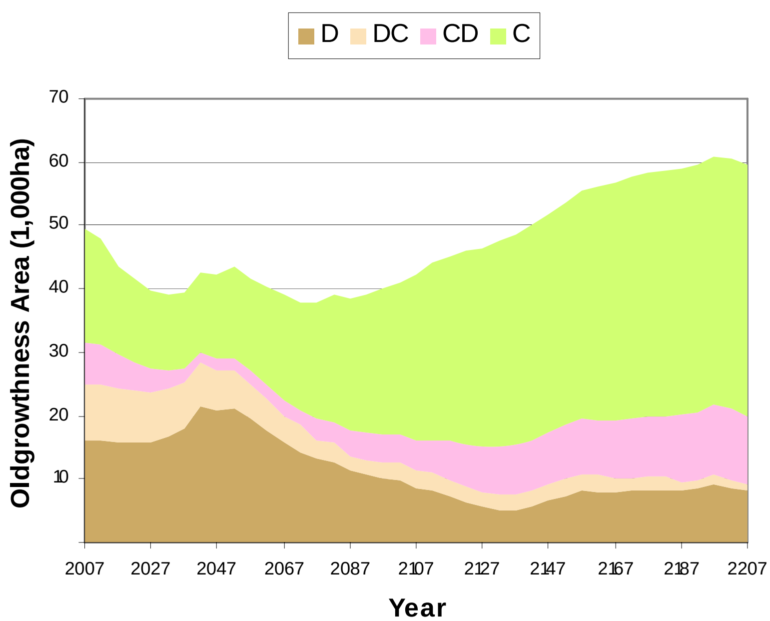


Figure 108. Oldgrowthness area on the gross landbase from the W13 PFMS.

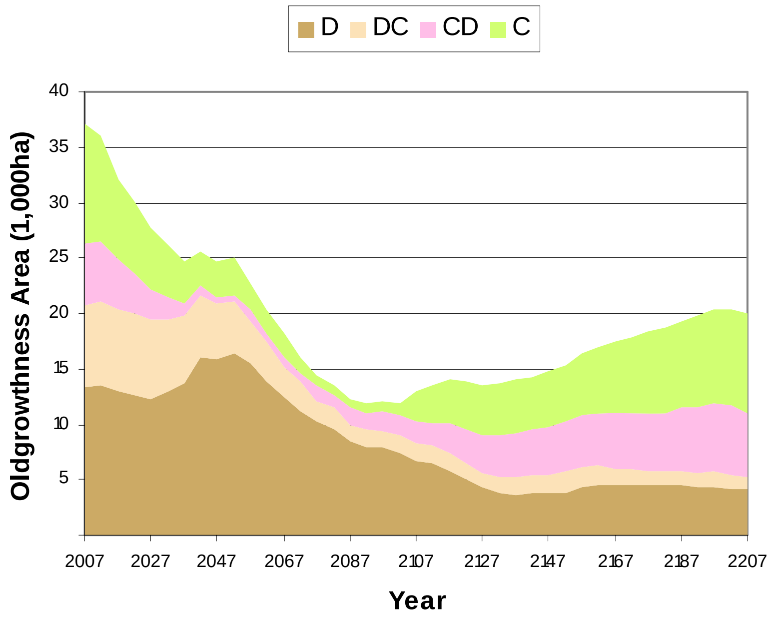


Figure 109. Oldgrowthness area on the managed landbase from the W13 PFMS.

Old Growth

The area of Mature plus Old growth on the gross and managed landbase is the highest at the start of the planning horizon. It initially decreases before rebounding towards the end of the planning horizon (Figure 110 and Figure 111). The area of old growth on the gross landbase increases throughout the planning horizon, while on the managed landbase it remains fairly constant.

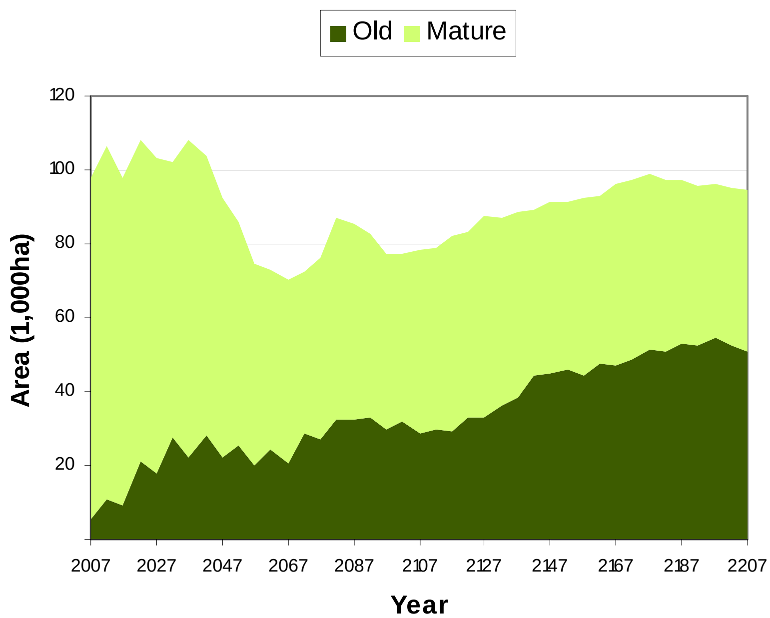


Figure 110. Area of mature and old on the gross landbase from the W13 PFMS

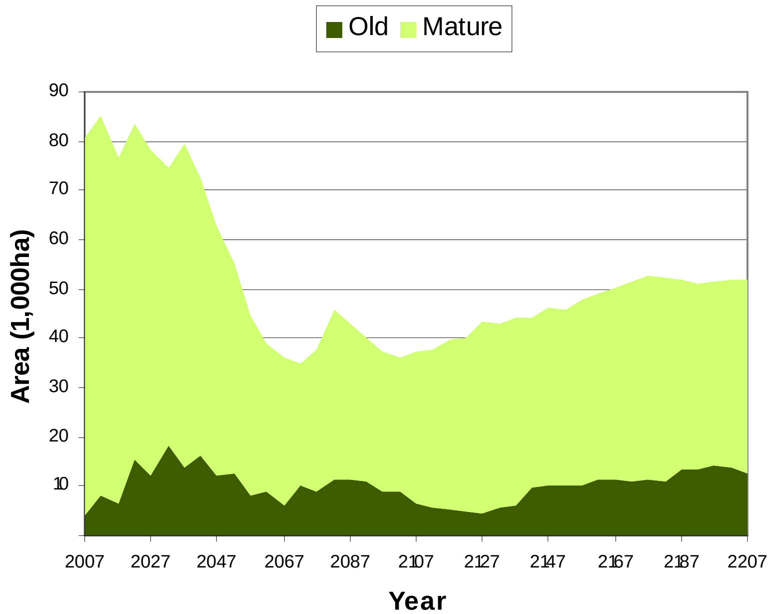


Figure 111. Area of mature and old on the managed landbase from the W13 PFMS.

The old forest area on the gross landbase is comprised of a variety of species strata throughout the planning horizon (Figure 112). As the planning horizon progresses there is a larger representation of coniferous species strata in the old forest. Initially on the managed landbase, the majority of the old growth area is from the deciduous species strata (Figure 113). Towards the end of the planning horizon the representation of coniferous species strata increased. Old SW forest was identified by the Alberta government as a key wildlife habitat that should be monitored, Map 17, Map 18, and Map 19 show the old forest area in 2007, 2017, and 2057 respectively (in W11 Detailed results section). Note that currently there is very little SW area on either the gross or managed landbase but that SW area becomes more prevalent through time on both landbases.

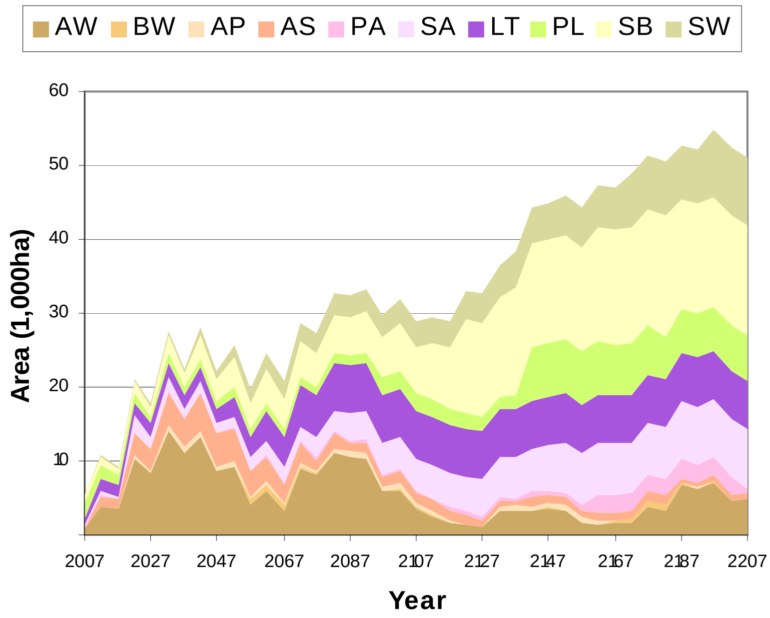


Figure 112. Gross old area by species strata from the W13 PFMS.

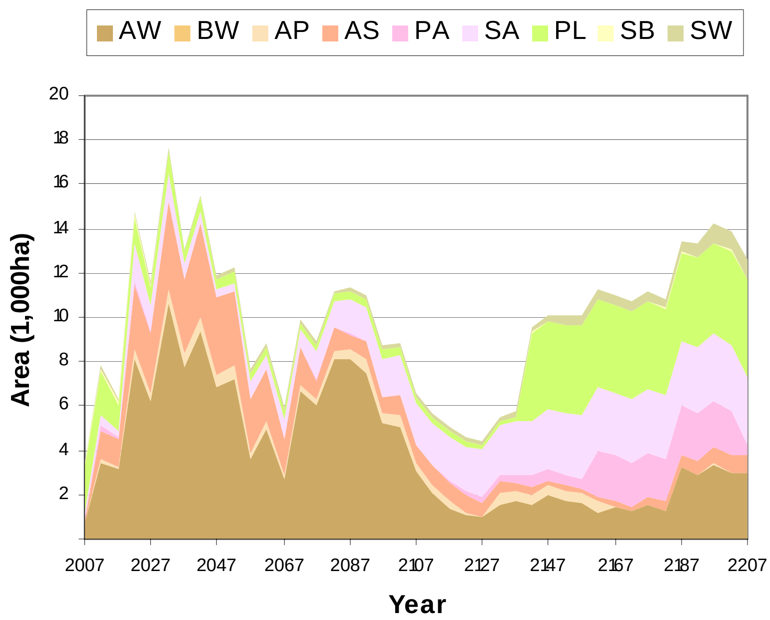


Figure 113. Managed old area by species strata from the W13 PFMS.

Patches

The Oldgrowthness patch size distribution on the gross landbase was fairly constant through time, with an increase in the area within patches 500 ha or greater in the last half the planning horizon (Figure 114).

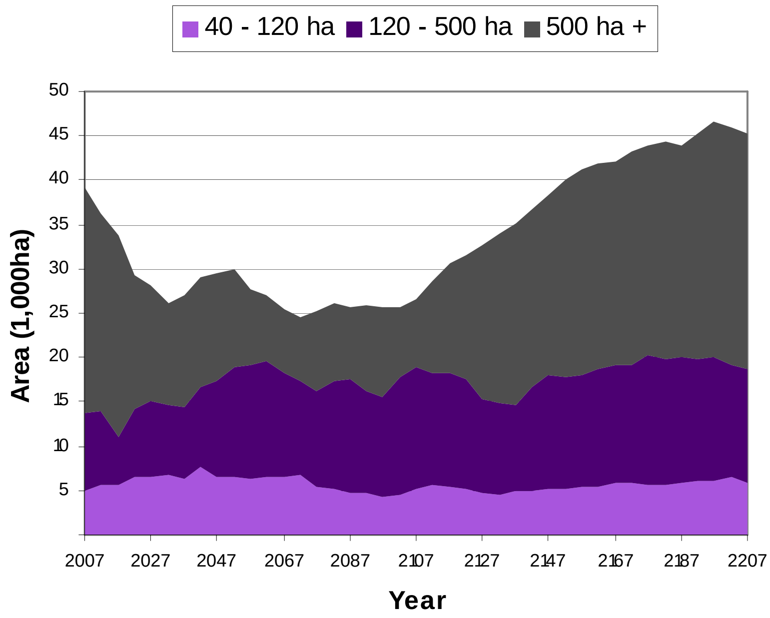


Figure 114. Oldgrowthness patch size on the gross landbase from the W13 PFMS

Early in the planning horizon there were a number of 500+ ha opening patches on the landbase (Figure 115). The number of these patches decreased through time and the opening patch distribution then stayed fairly constant for the remainder of the planning horizon.

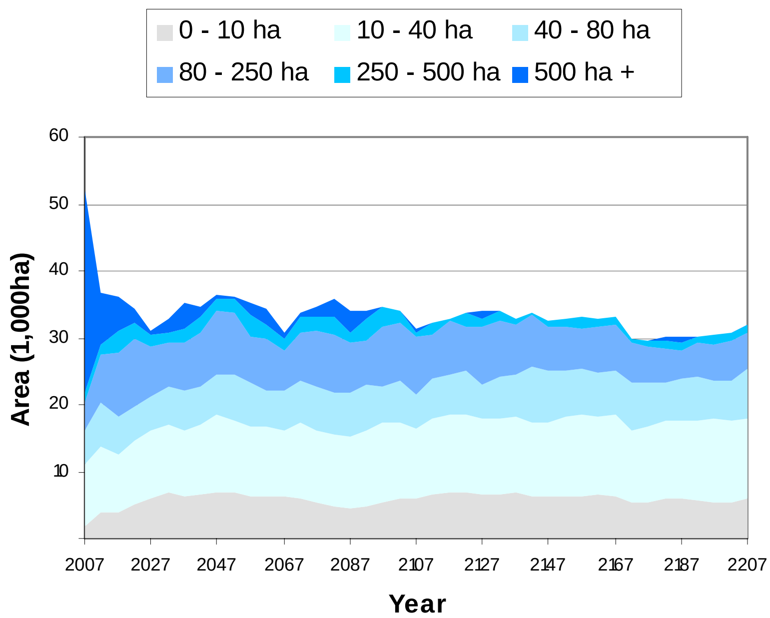


Figure 115. Opening patch sizes on the gross landbase from the W13 PFMS

Biodiversity Assessment Project (BAP)

Numerous BAP indicators were included in the forecasting model. These indicators were developed by IQAFF for inclusion in forecasting (*Appendix XII – BAP SHE Yield Curve Documentation*).

BAP tree species proportion on the gross (Figure 100) and managed (Figure 101) landbase is similar to the stand level species representation on the landbase. Generally, there is an increase in the coniferous species on the landbase through time, with a decrease in the other tree species.

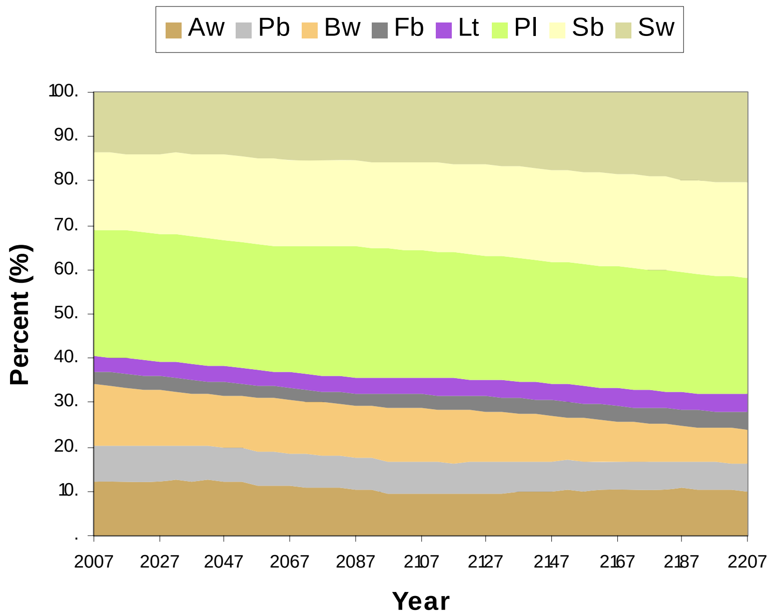


Figure 116. BAP species proportions on the gross landbase from the W13 PFMS

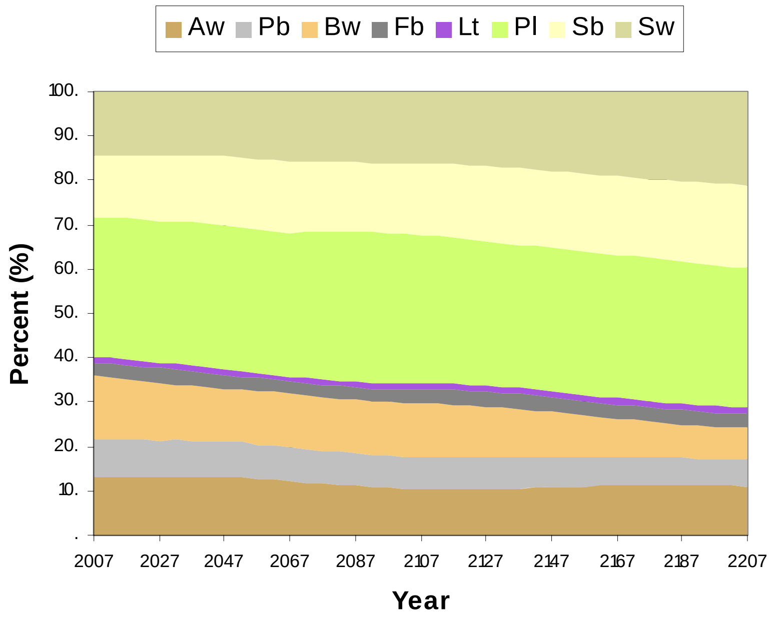


Figure 117. BAP species proportions on the managed landbase from the W13 PFMS

The BAP DWD index on the gross and managed landbase decreases over the first third of the planning horizon after which time it became relatively stabile but continue to decrease slightly (Figure 118).

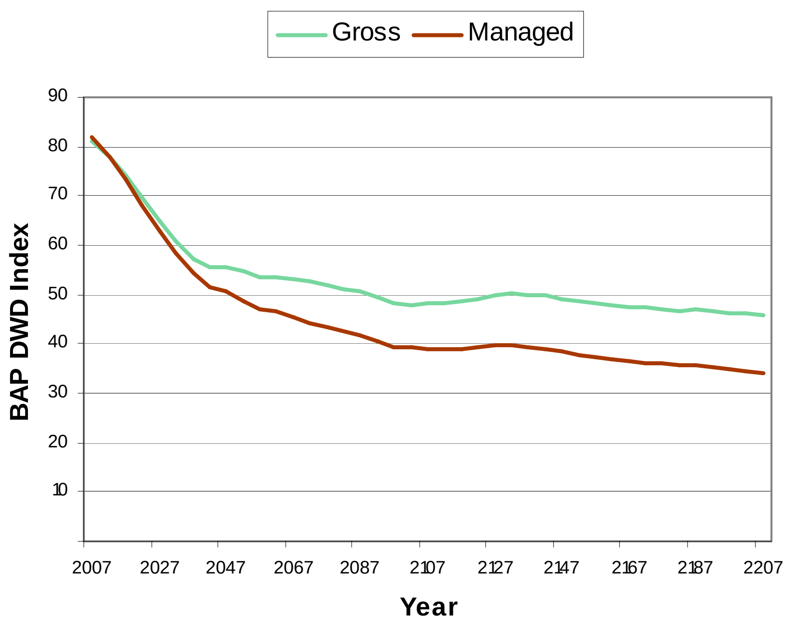


Figure 118. BAP DWD index on the landbase from the W13 PFMS

There are many BAP special habitat element (SHE) indictors such as the previously described downed woody debris and the next one, snag density, which were incorporated into forecasting. Numerous other BAP indicators were not incorporated into forecasting but form part of the suite of indicators that are influenced by natural and anthropogenic forces. This section simply describes the changes over time for the forecasted indicators under the PFMS. *Appendix X – Biodiversity Assessment of the PFMS* describes the impacts of the changes from a biodiversity perspective. Millar Western has various programs to address the predicted changes in SHE values from operational ground rules to generic establishment regimes and numerous VOITs and company commitments which are detailed *Appendix XXIII – Commitments*.

The BAP snag density indicators for the gross (Figure 119) and managed (Figure 120) landbase follow similar trends. For both the gross and managed landbase, the 20+ cm coniferous and deciduous snags decrease over the first third of the planning horizon, after which the 20+ cm coniferous snags increase for the remainder of the planning horizon, while the deciduous snags stay fairly constant. The coniferous and deciduous 40+ cm snags on the gross and managed landbase decrease slightly over the planning horizon but are fairly constant. In their risk assessment, (*refer to Appendix 10 – Biodiversity Analysis of the PFMS*), the BAP IAG rated snag density as either low risk or no risk in the long term in W13. The decline in snag density was not considered large enough to warrant setting a goal in the forecasting.

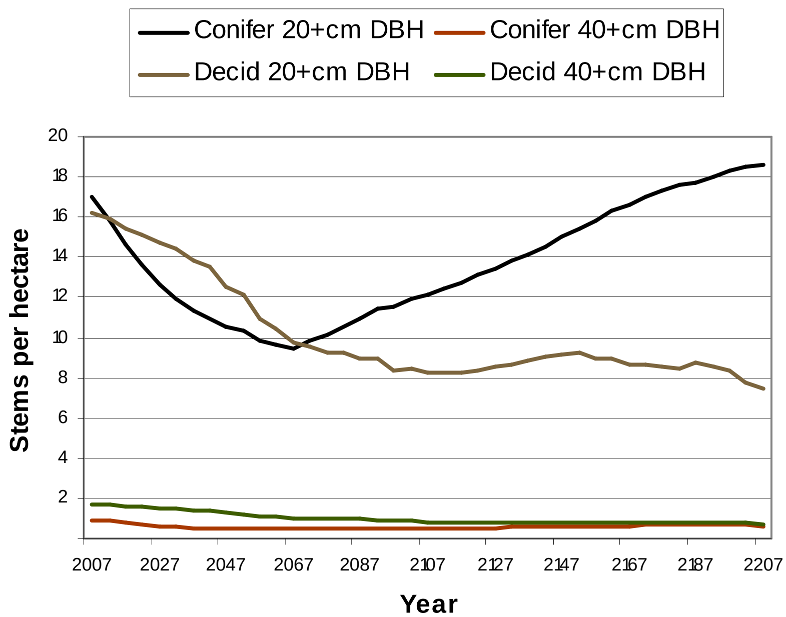


Figure 119. BAP Snag density on the gross landbase from the W13 PFMS

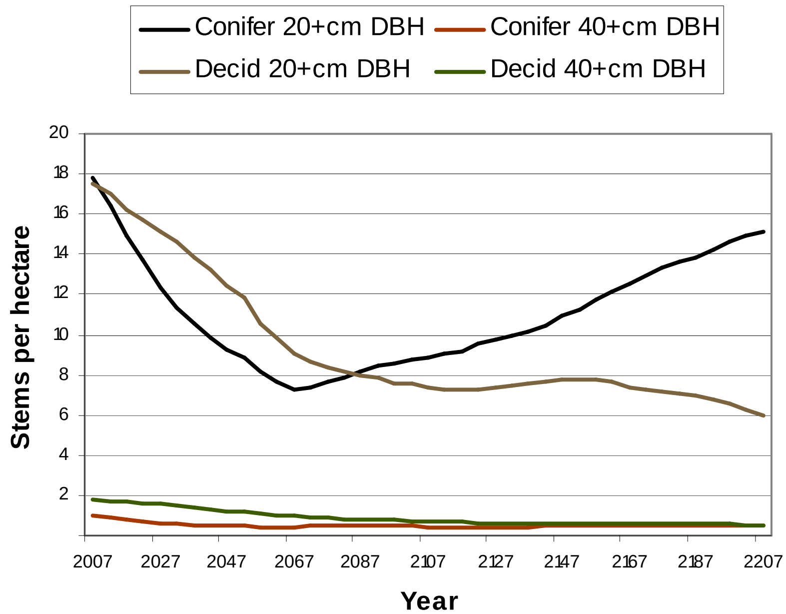


Figure 120. BAP snag density on the managed landbase from the W13 PFMS

The decline in snag density is primarily attributable to the loss of snags from the Virginia Hills fire and the harvesting of older age classes to address the risk from MPB. BAP assumed that there was no snag retention following harvesting unless variable retention was modeled and in these PFMSs variable retention was not incorporated. The PFMS includes a green tree retention strategy that will mitigate the reduction in snags from the levels predicted here.

BAP sapling density stays fairly constant in both the gross (Figure 121) and managed (Figure 122) landbase. The coniferous <7.1 cm sapling density increases on both the managed and gross landbase, while the deciduous <7.1 cm sapling density decreases.

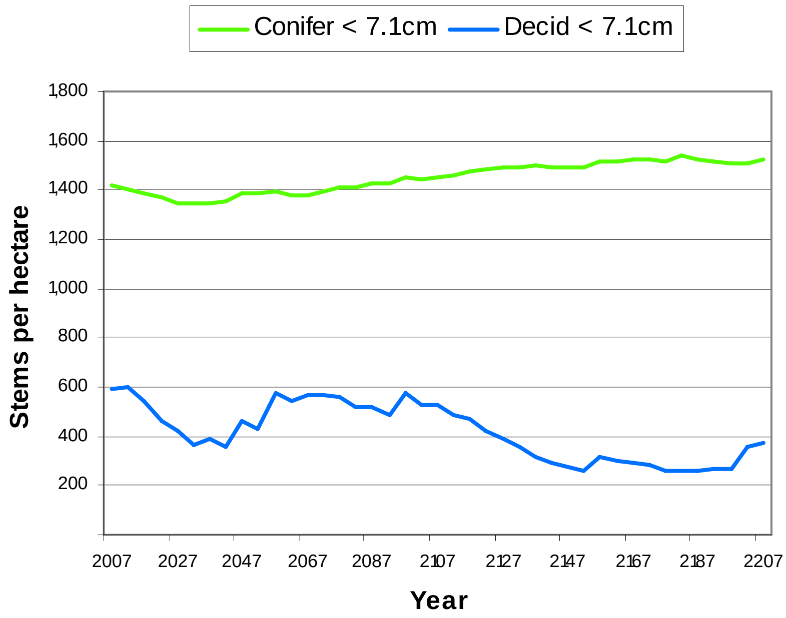


Figure 121. BAP sapling density on the gross landbase from the W13 PFMS

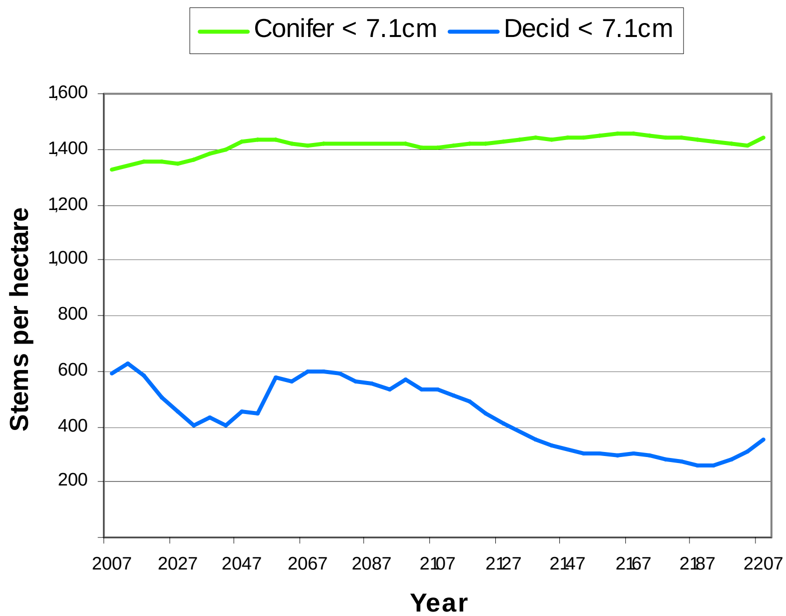


Figure 122. BAP sapling density on the managed landbase from the W13 PFMS

On both the managed (Figure 123) and gross (Figure 124) landbase the free to manoeuvre flying space (FMFS) index indictors remain fairly constant throughout the planning period.

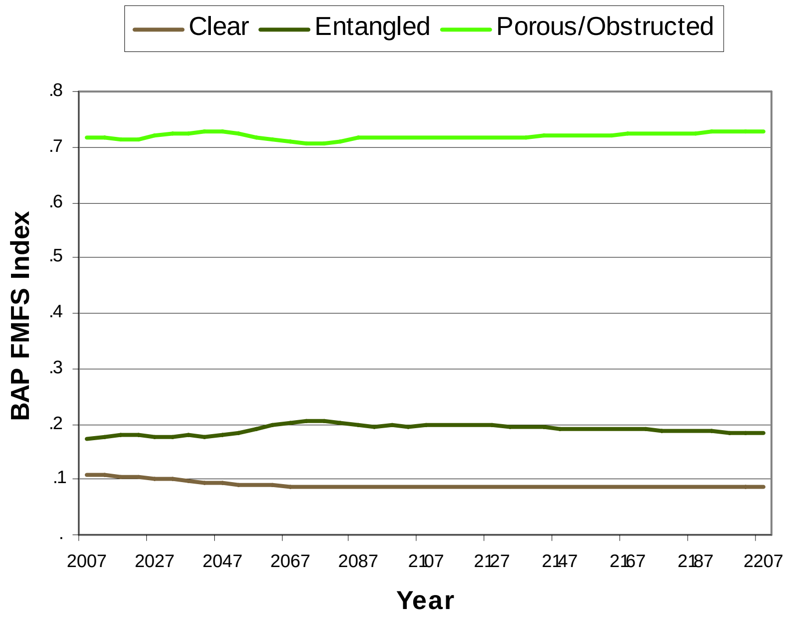


Figure 123. BAP FMFS index on the gross landbase from the W13 PFMS

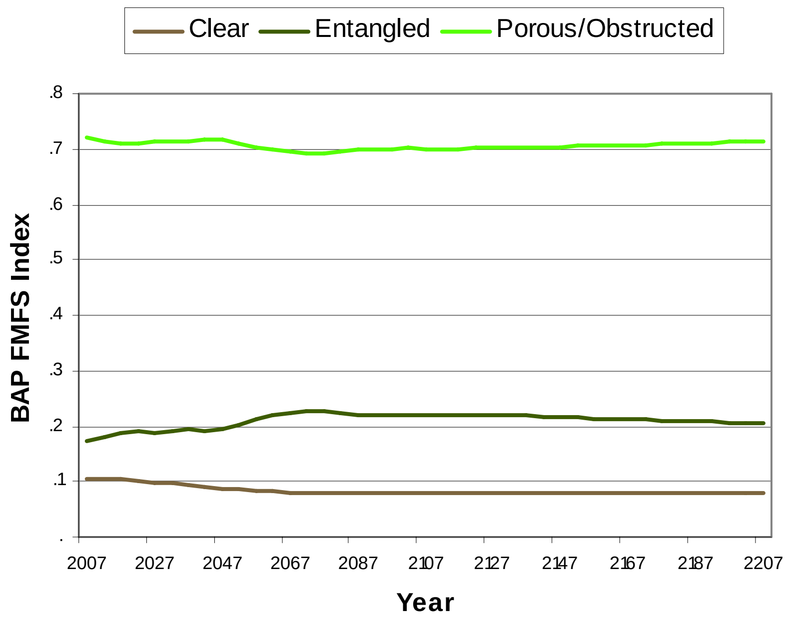


Figure 124. BAP FMFS index on the managed landbase from the W13 PFMS

On both the managed (Figure 125) and gross (Figure 126) landbase the mean DBH decreases slightly early in the planning horizon after which time it stabilizes. The basal area indicator follows a similar trend but gradually increases through time. Both the herb and shrub covers also decrease through time.

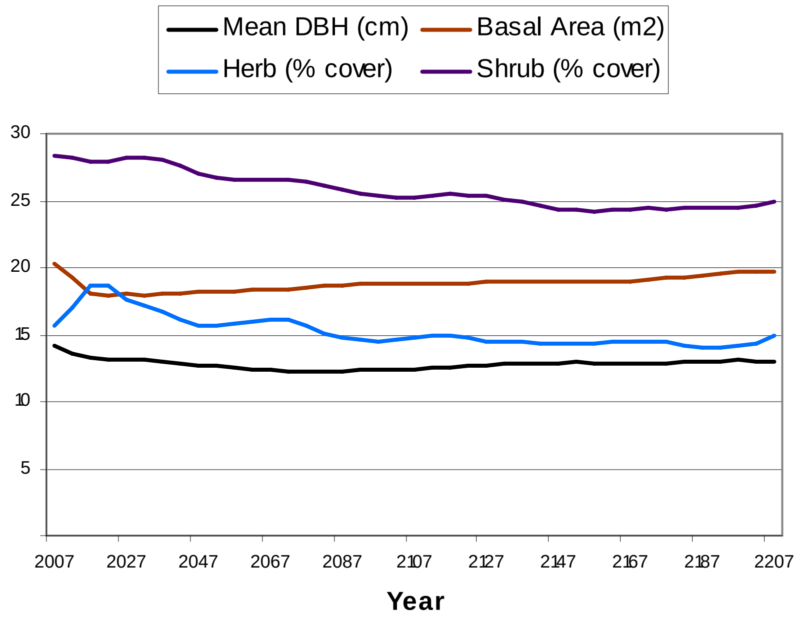


Figure 125. Other BAP indicators on the gross landbase from the W13 PFMS

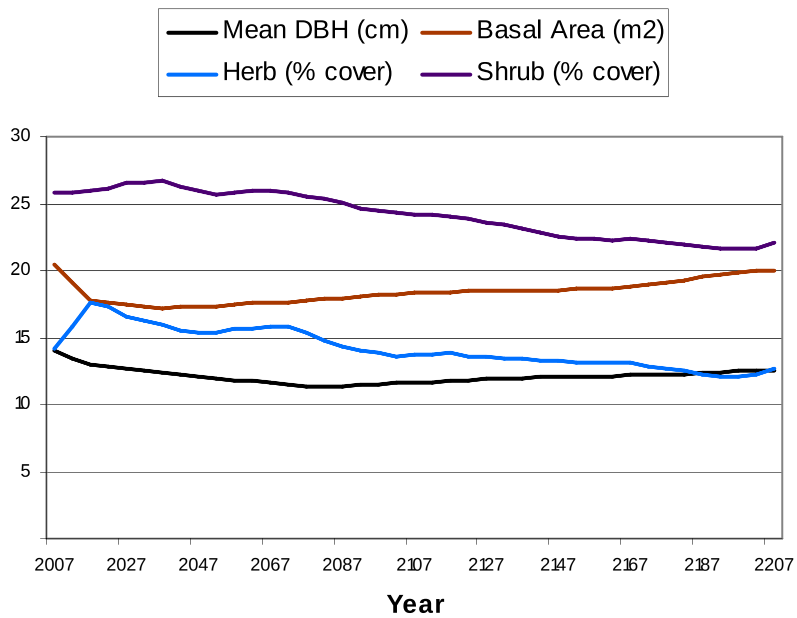


Figure 126. Other BAP indicators on the managed landbase from the W13 PFMS

Watershed Indicators

The watershed management targets for W13 were the same as those in W11:

- Over the 200-year planning horizon, a maximum 15% increase in average RC above baseline condition due to harvesting on eligible third order watersheds.
- Over the 200-year planning horizon, less than 5% of the functional first order watersheds were permitted a >50% increase in average annual RC above baseline condition. This applied only to first order watersheds at least 50% of their area within the DFA.

Figure 127 illustrates the percent increase in RC above baseline conditions for all W13 third order watersheds. Note that the X-axis is not the watershed number but an arbitrary number from 1 to 41. W13 watershed numbers are comprised of 41 watersheds that have a mixture of watershed names both below 40 and above 1,000, which would make the chart difficult to read if the watershed number was used on the x-axis.

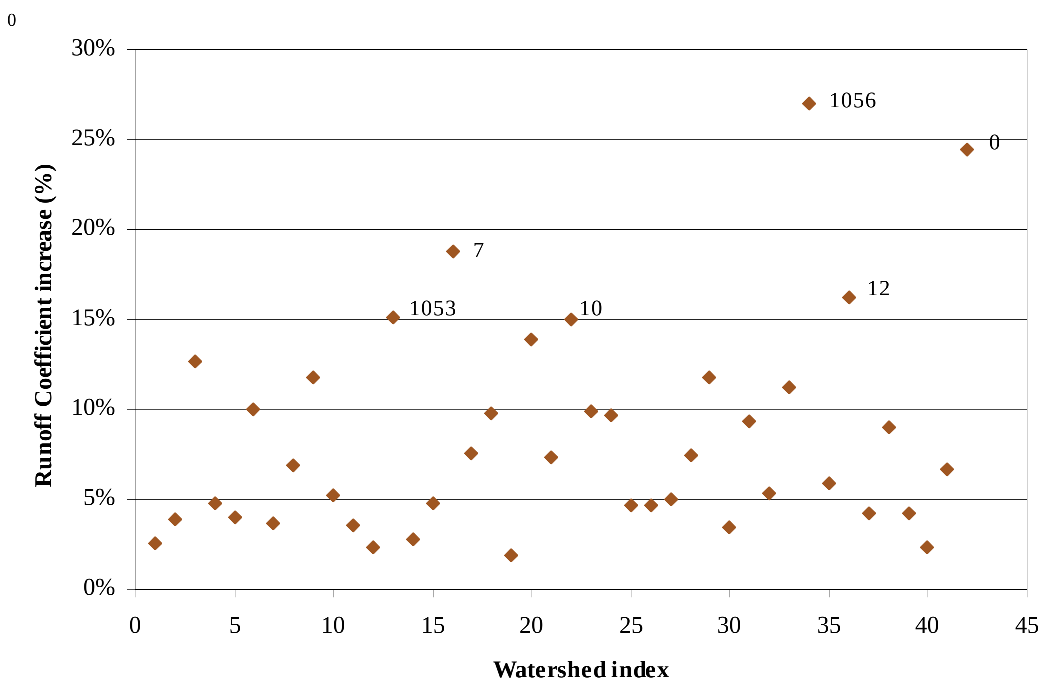


Figure 127. RC increase (%) for all W13 3rd order watersheds.

The RC increase in six of the 41 third order watersheds exceeded the 15% threshold (see Figure 111). However, all these watersheds have less than 90% of their area within the DFA and are thus not subject to the management target. Watershed number 1056 had the largest increase, at 27%, but it has only 23% of its area within the DFA. The other 77% of the watershed would provide some buffering but conditions and activities on that portion of the watershed are unknown.

The Alberta government requested that all third order watersheds be reported and that management targets be identified, regardless of the portion inside or outside the DFA. It was only possible to report on the portion of the watershed within the DFA as forestry activities outside the DFA are beyond Millar Western's authority. The FORWARD IAG investigated methods of reporting forestry activities and the impacts on the portions outside the DFA but none were satisfactory and some, including the use of averages, may provide incorrect trends. Millar Western and the FORWARD IAG felt that the targets provided are appropriate until a broader Alberta-wide reporting mechanism, such as the Firesmart reporting based on Alberta government data, is developed for watersheds.

Table 38 presents the increase in RC for the 12 W13 third order watersheds that have at least 90% of their area within the DFA and are thus subject to the management target.

Table 38. Increase in RC above baseline conditions for W13 3rd order watersheds 90% within the DFA.

Third Order		Area in DFA			Runoff Coefficient			
FUNCORD3	name	Percent	>90% in DFA?	Area (ha)	Min	Max	Increase	% Increase
26	thrd_26	100%	Yes	5,149	0.3780	0.3875	0.0095	3%
25	thrd_25	100%	Yes	16,009	0.3739	0.3883	0.0144	4%
31	thrd_31	100%	Yes	5,881	0.1546	0.1742	0.0196	13%
28	thrd_28	100%	Yes	4,904	0.3546	0.3715	0.0169	5%
29	thrd_29	100%	Yes	5,786	0.4211	0.4380	0.0169	4%
6	thrd_6	100%	Yes	5,475	0.3262	0.3589	0.0327	10%
23	thrd_23	100%	Yes	8,527	0.4049	0.4196	0.0147	4%
1058	thrd_1058	99%	Yes	6,924	0.2466	0.2635	0.0169	7%
8	thrd_8	99%	Yes	7,085	0.4212	0.4706	0.0494	12%
1055	thrd_1055	99%	Yes	7,701	0.2720	0.2863	0.0143	5%
1049	thrd_1049	97%	Yes	13,587	0.3314	0.3433	0.0119	4%
21	Chickadee	95%	Yes	14,841	0.3412	0.3491	0.0080	2%
Average				8,489	0.3355	0.3542	0.0188	6%

The largest increase was 13% on third order watershed number 31, which was below the 15% target. The average increase for all 12 third order watersheds was 6%. As a result, the third order water quantity target is achieved by the PFMS. Changes in runoff coefficient over the planning horizon were very subtle and are presented in Figure 128 for the 12 watersheds subject to management targets.

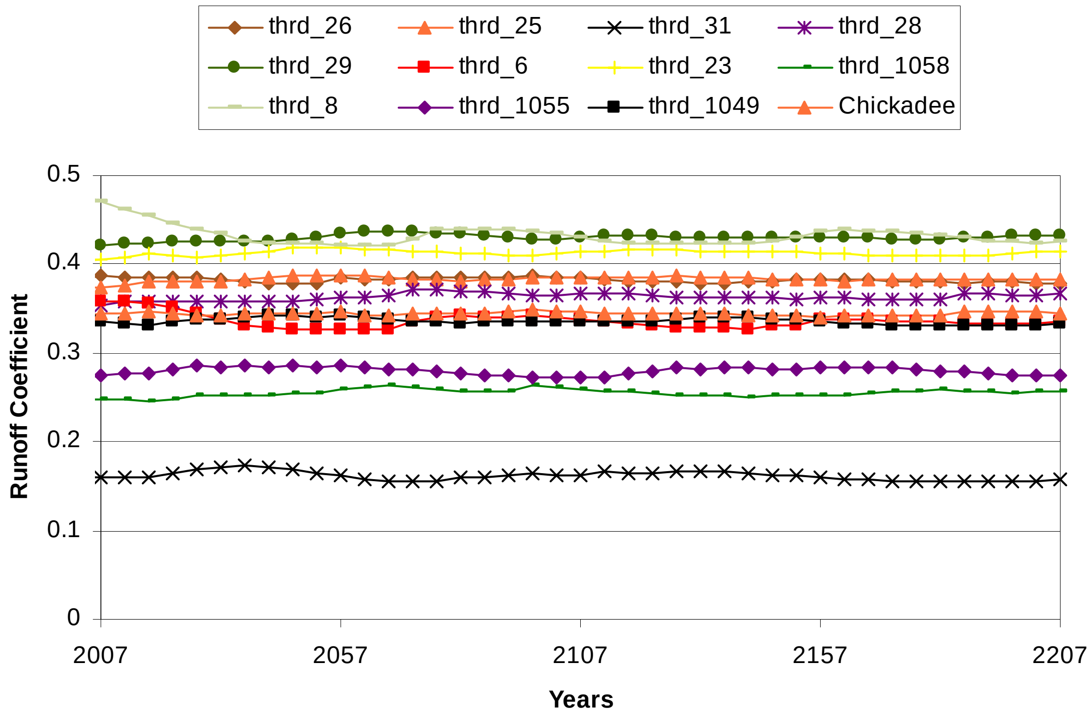


Figure 128. Change in RCs for W13 3rd order watersheds with at least 90% of their area within the DFA.

The highest RC value observed over the planning horizon was in watershed 8 at the start of the simulation. These high values were due to the 1998 Virginia Hills fire and demonstrate the scale of watershed impacts related to natural disturbances, which can have impacts that exceed those related to harvesting. The fluctuation over the planning horizon in RC at the third order level that is attributable to harvesting is very small even with the incorporation of a surge cut to address MPB risk.

Figure 113 illustrates the maximum percent increase in RC for W13 first order watersheds with at least 50% of their area within the DFA. Note that the x-axis is not the watershed number but a numerical assignment from 1 to 538. This was necessary for display purposes to address the large range and clumping in the watershed numbers within W13. The ten first order watersheds with the highest increases have been labelled for reference.

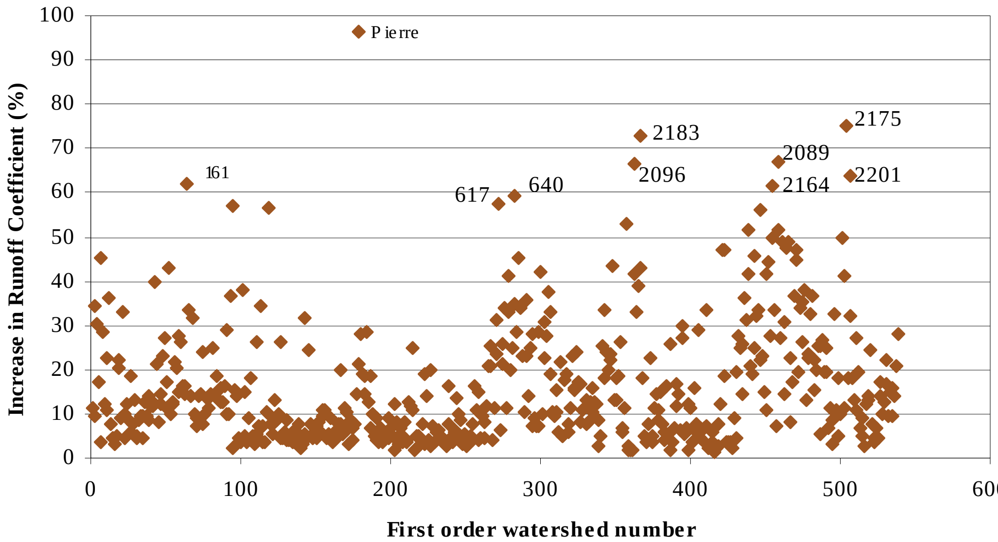


Figure 129. Percent increase in RC above baseline condition for W13 1st order watersheds with at least 50% of their area within the DFA.

There are 622 first order watersheds in W13 of which 538 have at least 50% of their area within the DFA. The 5% management variance permits a maximum of 27 of the 538 watersheds to exceed the 50% RC increase. Sixteen watersheds exceeded the 50% RC threshold (3%), which is within the 5% management variance.

Table 39 lists the changes in first order watershed RC for the 16 watersheds that exceeded the 50% increase threshold. The FORWARD IAG recommended that none of the first order watersheds have more than 100% increase in RC. The largest observed increase was 97% and the average increase for all eligible first order watersheds that exceeded 50% increase was 63%. As a result, the goal for first order watersheds was achieved by PFMS.

Table 39. Changes in RC above baseline for W13 1st order watersheds with at least 50% of their area within the DFA.

	Watershed Order		Area in DFA		Runoff Coefficient			
Observation	First	Third	%	Ha	Minimum	Maximum	Increase	% increase
1	Pierre	24	100%	258	0.0730	0.1435	0.0705	97%
2	2175	1056	72%	263	0.0763	0.1335	0.0572	75%
3	2183	1001	100%	87	0.0805	0.1391	0.0586	73%
4	2089	1053	100%	531	0.0742	0.1237	0.0496	67%
5	2096	1001	81%	163	0.0573	0.0954	0.0382	67%
6	2201	1056	51%	162	0.0703	0.1151	0.0448	64%
7	161	7	100%	832	0.1160	0.1880	0.0720	62%
8	2164	1052	100%	371	0.0861	0.1390	0.0529	61%
9	640	30	100%	714	0.0743	0.1182	0.0439	59%
10	617	30	100%	275	0.0989	0.1559	0.0570	58%
11	209	10	65%	166	0.1262	0.1980	0.0718	57%
12	435	21	100%	398	0.1094	0.1711	0.0617	56%
13	2108	1052	60%	171	0.0846	0.1322	0.0476	56%
14	2100	1001	52%	340	0.0861	0.1317	0.0457	53%
15	2087	1053	100%	278	0.1017	0.1544	0.0527	52%
16	2088	1052	75%	210	0.1070	0.1621	0.0551	52%
Average					0.0889	0.1438	0.0549	63%

The change in RC for the 16 functional first order watersheds exceeding the 50% increase is presented in Figure 130. Compared to Figure 112, there was considerable variation in the first order watersheds RC values, due to their smaller size.

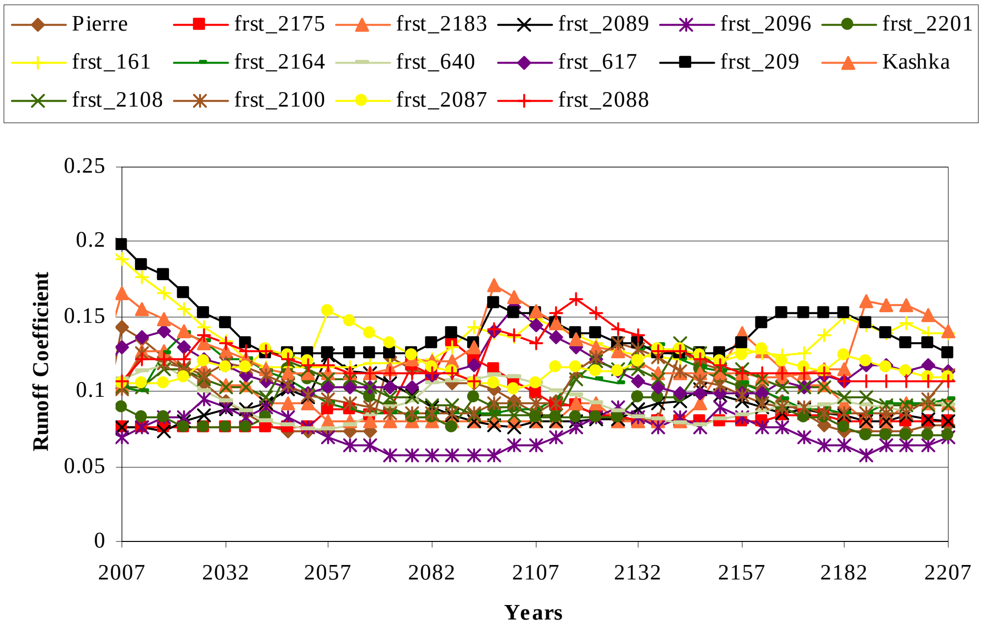
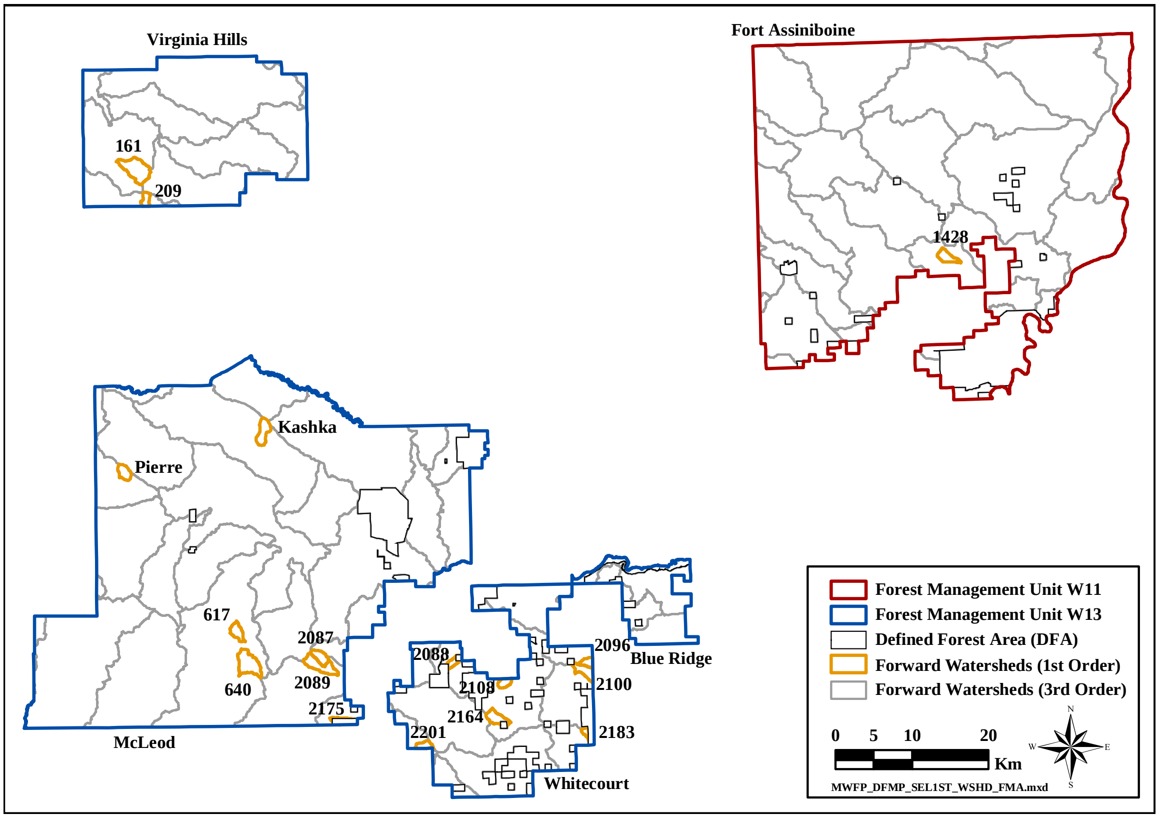


Figure 130. Change in RC for 16 W13 1st order watersheds

The highest RC values were present in watersheds 161 and 209, both of which were burned in the 1998 Virginia Hills fire. These watersheds are not associated with the greatest percent change because their baselines were also higher due to factors such as slope, soil, and wetland percent. Watersheds Kashka and Pierre are FORWARD research watersheds, where the maximum area possible within each watershed was harvested in winter 2003-2004 (58% and 84% of watershed area harvested, respectively) to determine the impacts upon hydrology. Pierre has the highest percent increase in runoff coefficient due to its high maximum and low baseline condition.

Map 27 shows the location of the first order watersheds with a greater than 50% increase in RC and that have at least 50% of their area within the DFA. The watersheds are spread throughout the DFA and are not concentrated within a few third order watersheds. It would not be desirable to have these first order watersheds concentrated with a single area. The highest density of the first order watersheds with the most change in runoff is in the Whitecourt Mountain area, which has the greatest topographic relief.



Map 27. First order watersheds at least 50% within DFA and a 50% increase in RC.

7. Management Issues and Decisions

7.1 Background

There were many decisions that needed to be made throughout the forecasting process to create the desired PFMSs. These decisions covered a wide range of topics, including harvest levels, minimum old growth area, and patch sizes. Many of these issues were related. Decisions were made throughout the process of the PFMSs creation, sometimes with incomplete information. During the development of the DFMP, the process for distribution of background material for decision-making was fine-tuned. The TSA IAG facilitated for the distribution, explanation and discussion of issues. Initially results from analyses were presented to this group and explanations and discussion occurred in this forum. As this process extended in time, and issues were re-visited or not considered for extended periods of time, tracking these issues became a concern. Therefore to allow easier tracking of issues and related decision, The Forestry Corp. produced and distributed issue documents that explained the background, analysis, results, and discussions around these issues. These documents tracked the decision process and the summarized the information that was available at the time of the decisions. Due to DFMP development timelines and early assumptions about the final outcomes of the plan, much of the information presented did not include exactly the same assumptions and inputs as the PFMSs used. Therefore, the absolute results presented to the TSA IAG relating to many of these issues are not directly comparable to the PFMS. However, the scenario testing and trade-off analysis conducted by the TSA IAG to arrive at the PFMS are still relevant, despite some changes to assumptions and inputs.

The forecasting scenario names are descriptive. The first portion of the name is the unit in which the scenario was completed and is followed by a W or P which refer to whether the run was completed in Woodstock or Patchworks. The next 1 or 2 numbers refer to the landbase round the run was completed with, and the last numbers refer to the scenario number. For example, run W11_W11010 was completed on FMU W11 using Woodstock on the Round 11 landbase and is run number 10.

7.2 Variable Retention

Variable Retention is a silviculture approach to harvesting which retains some of the existing trees into the post-harvest stand. The Alberta government requires variable retention to be included in the VOITs. The optimal level and distribution of variable retention for the Millar Western DFA was extensively discussed by the IAGs in the planning process.

The BAP IAG wished to incorporate the ability of the forecasting model to use variable retention levels within the forecasting model to allow the increase of biological indicators through structure retention when required. Dr. Doyon originally proposed incorporating four levels of variable retention into the forecasting model. These levels were 0%, 15% and 30%. Each of these retention levels would produce different levels of the SHE's post harvest, requiring a large number of post-harvest relationships (*i.e.* curves). It was not possible to include all of these actions into the forecasting model and create a model able to make the required decisions. Modeling actions for both the 0% and minimum variable retention amount were included in the model. These actions were derived because existing blocks are harvested with no variable retention, as retention was already included within in the block boundaries, and new harvest was completed with the minimum required variable retention. As there was uncertainty in the amount of retention that would occur at the outcome of the planning process, variable retention was not implemented in the Forecasting model and is to be addressed at the operational level (refer to **VOIT 11 – Percent of FMU AAC residual structure (living and dead), within a harvest area, representative of the status (living/dead), size and species distribution of the overstorey trees by operating compartment (1.1.2.1A))**. The result of retaining 1% merchantable structure retention in the field but not incorporating it in the 0% variable retention assumed in the SHE curve development, is that BAP slightly underpredicts the amount of retention.

7.3 SHE's/BAP curves

There were numerous SHE curves and biologically related curves included in the forecasting model. These curves are described in *Appendix XII – BAP SHE Yield Curve Documentation*. These curves represent only a subset of the total set of SHEs that were analyzed in the DFMP development. The selection of these was based on the key indicators from the 1997 – 2006 DFMP for W13. Previous work with the SHEs allowed us to bring key SHEs of interest into the forecasting model early to monitor, and if necessary activate goals when required.

7.4 Objective Function

Woodstock models based on linear programming contain objective functions to solve subject to numerous constraints. Typically in forestry, timber based objectives are included in the objective function. Changing the timber objectives used in the model permit various management issues to be addressed and can have large impacts upon the results. Three basic maximize timber volume objectives were considered; first, maximizing the total coniferous plus deciduous harvest from the landbase,; second, maximizing the coniferous harvest; and third maximizing the deciduous harvest. In W11 there are quota holders with rights to either the coniferous or deciduous volume from the landbase, whereas in W13 there is only a fixed deciduous commitment of 45,000m^3 to Weyerhaeuser, an MTU program and Millar Western who harvests both conifer and deciduous.

Three scenarios for each FMU were analyzed to determine the maximum possible even-flow harvest levels. The objectives function and scenario numbers can be seen in Table 40. Even-flow harvest for conifer volume and for deciduous volume was the only constraint in these scenarios.

Table 40. Modelling objective and Run Number by FMU.

Run Name	W11 Run Number	W13 Run Number
Max total harvest	W11_W11010	W13_W11010
Max conifer harvest	W11_W11011	W13_W11011
Max decid harvest	W11_W11012	W13_W11012

7.4.1 Results

The maximum harvest level possible is shown in Table 41 and Table 42 for FMU’s W11 and W13, respectively.

In both FMU’s changing the modeling objective caused the volume type optimized to attain the highest levels of any of the scenarios analyzed. All of the W13 scenarios had more volume than needed to meet the deciduous commitments required.

Table 41. Objective function percent change in harvest levels for FMU W11.

TSA Scenario		Difference from Reference (%)		
Number	Name	Conifer	Decid	Total
W11_W11010	Max total harvest		- Reference -	
W11_W11011	Max conifer harvest	104%	91%	96%
W11_W11012	Max decid harvest	94%	102%	99%

Table 42. Objective function percent change in harvest levels for FMU W13.

TSA Scenario		Difference from Reference (%)		
Number	**Name**	**Conifer**	**Decid**	**Total**
W13_W11010	Max total harvest		- Reference -	
W13_W11011	Max conifer harvest	101%	95%	99%
W13_W11012	Max decid harvest	95%	101%	98%

7.4.2 Discussion

The maximum harvest volumes were consistent with expected results for both FMU's. In W11 the differences associated with moving from a total objective to coniferous or deciduous objectives may affect the non optimized harvest level more than is desired. In W13 there is lower total harvest level when a coniferous volume objective is modeled. However, if there is a desire for conversion of deciduous and mixedwood stands to conifer then it may be beneficial to have a coniferous volume objective for the forest.

As Millar Western only has rights to harvest the deciduous volume in W11 and there are other quota holders with rights to the coniferous volume, a decision was made to maximize total harvest. In W13 where there is only limited deciduous volume commitments, and Millar Western has rights to harvest all species, the objective function will be the maximization of coniferous harvest volume.

Patchworks does not use an objective function; only Woodstock does. Therefore when a maximize coniferous or total objective function is discussed the results from relevant Woodstock scenarios were used to set the initial goal levels for modeling.

In Patchworks, goals are entered and the analyst modifies the weighting and goals to obtain the best solution. There is no maximize or minimize capacity in Patchworks. In order to find effective starting goals for Patchworks, a Woodstock formulation of the Patchworks model was first run. Therefore, while the PFMSs modeled in Patchworks did not have a timber based objective function, the result of the Woodstock timber based objective function was used as the starting point for the PFMSs.

7.5 Growing Stock

7.5.1 Background

Ending growing stock constraints are meant to ensure that forecasting models do not liquidate all remaining growing stock in the final few periods of the planning horizon, ensuring there is volume to harvest in perpetuity. There are many forms of ending growing stock constraints that can be used; the Alberta government requires a stable yield of operable growing stock over the last quarter of the planning horizon. Operable growing stock refers to volume on the managed landbase that is eligible for harvest in the period of interest.

The effect of adding a non-declining operable growing stock constraint was tested on different objective functions. The scenario listings are provided in Table 43.

Table 43. Scenarios used to analyze the effect of the non-declining growing stock constraint.

Run Name	W11 Run Number		W13 Run Number	
	No GS	With GS	No GS	With GS
Max total harvest	W11_W11013	W11_W11020	W13_W11010	W13_W11020
Max conifer harvest	W11_W11014	W11_W11021	W13_W11011	W13_W11021
Max decid harvest	W11_W11015	W11_W11022	W13_W11012	W13_W11022

7.5.2 Results

The effect of including an ending growing stock constraint, based on a variety of objective functions are summarized in Table 44 and Table 45 for W11 and W13, respectively.

Table 44. Percent change to the harvest level, coniferous, deciduous, and total, from adding an ending growing stock constraint based on different objective functions in W11.

	Percent Change		
Objective	Conifer	Decid	Total
Max total harvest	-2%	-3%	-3%
Max conifer harvest	-2%	-6%	-4%
Max decid harvest	-5%	-3%	-3%

Table 45. Percent change to the harvest level, coniferous, deciduous, and total, from adding an ending growing stock constraint based on different objective functions in W13.

	Percent Change		
Objective	Conifer	Decid	Total
Max total harvest	-2%	-1%	-2%
Max conifer harvest	-2%	-2%	-2%
Max decid harvest	-2%	-1%	-1%

The changes to the harvest level associated with adding an ending growing stock constraint are small. As expected, the maximum change to the coniferous harvest level from the constraint is when the maximize deciduous harvest level objective is active. The deciduous harvest level is affected the most when a maximize coniferous harvest objective is active. Adding a non-declining growing stock constraint in W13 resulted in approximately a 2% change in harvest in all cases.

7.5.3 Discussion

Overall there was a small impact related to the addition of a non-declining operable growing stock constraint. The effect of this constraint was further reduced when other constraints, specifically those that increase the amount of volume remaining on the landbase such as the old growth, are added to the model. A stable operable ending growing stock constraint was included in subsequent forecasts.

7.6 Yield Curves

The yield curves used in the modeling process can have a large impact on the forecasting results. Many methods for fitting yield curves were evaluated during the DFMP development process, but only the site-specific curve analysis which was ultimately utilized in the DFMP is addressed in this section. The yield curve issues addressed the development of fully stocked regeneration curves, including the pine site index curves which were derived from the Foothills Growth and Yield Association's study results.

7.6.1 Fully Stocked Regeneration

The Alberta government's current regeneration standards require companies to regenerate their blocks to a fully stocked level and to ensure they remain fully stocked until they reach free-to-grow. Fully stocked regenerated stand condition representing managed stands are assumed in the 2007-2016 DFMP forecasting. The effects of assuming fully stocked stand condition represent managed stand yields, is addressed in this section.

As there had not been a decision made on the W11 objective function at the time this analysis was undertaken, three objective functions were investigated for W11.

Results

Table 46 and Table 47 show the percent change to the coniferous, deciduous, and total harvest levels assuming fully stocked regeneration. In W11, the maximum change is 7% in the scenarios maximizing conifer harvest, while the total change is 4% under the other 2 objective functions. In W13, there is a 2% increase in coniferous harvest when fully stocked is assumed, while the total harvest is decreased by 2%.

Table 46. The percent change to the coniferous, deciduous and total harvest levels for W11 when fully stocked regeneration is assumed.

	Harvest Volume (m³/yr at 15/10)		
Objective	Conifer	Decid	Total
Max total harvest	106%	103%	104%
Max conifer harvest	104%	109%	107%
Max decid harvest	106%	103%	104%

Table 47. The percent change to the coniferous, deciduous and total harvest levels for W13 when fully stocked regeneration is assumed.

	Harvest Volume (m3/yr)		
Objective	Conifer	Decid	Total
Max Coniferous Harvest	102%	91%	98%

Discussion

Overall increase in harvest level attained by assuming fully stocked regeneration is modest. In W13 the decrease in deciduous harvest was driven by the decrease in incidental deciduous volume associated with the fully stocked curves. Since Millar Western regenerates all stands to a fully stocked state, fully stocked curves were included to more accurately represent what will exist on the landbase in the future.

7.6.2 Pine Site Index Yield Increase

Numerous Western Canadian studies demonstrate that there is an increase in the pine growth in regenerating stands versus natural stands. Of direct interest to this DFMP is research from the Foothills Model Forest that indicates there is an increase in site index in regenerating pine stands. The results of this research was applied to the Millar Western yield curves in W13.

Results and Discussion

For ease of modeling, an average site index increase was applied consistently across all pine stands, regardless of site differences.

Table 48 shows the effect of including the Pl site index bump curves. Their inclusion increased the coniferous harvest level by 5% while decreasing the deciduous harvest level by approximately 1%.

Table 48. Harvest levels with and without the Pine SI increase.

		Percent Change in Harvest Level		
Scenario	**Description**	**Conifer**	**Decid**	**Total**
W13_W11202	Without Pl SI increase		-- Baseline --	
W13_W11237	With Pl SI increase	105%	99%	103%

The Pl site index increase observed across western Canada in regenerating pine stands is expected to hold true in W13. The increase in growth is effectively equal to all sites growing at approximately a good site quality level, which is what was included in this case. The PL SI increase curves were included in the forecasting as they are believed to more accurately represent future growth.

Tree Improvement Yield Curves

Millar Western investigated for DFMP inclusion the tree improvement programs for the three coniferous species that they plant in W13, white spruce, black spruce, and lodgepole pine. Percent increase and deployment schedules were developed for each of these species.

Millar Western has already invested in a white spruce tree improvement program. First gains were estimated at 2% associated with the orchard seed they are receiving. Predictions for future increases from continued rouging investment are expected to be 4%.

Millar Western has the option of investing in a black spruce seed orchard in which they would be able to receive a 2% increase in growth from their black spruce seeding. They also have the option of rouging or establishing a second orchard to achieve a further 2% increase (to 4%) in the future.

Millar Western also has the option to join a lodgepole pine seed orchard that would produce a 3% gain to growth, with future options to increase this to a 6%.

All of the above gains are realized through increases in height growth that improved seed would provide Millar Western. A cost matrix and a suite of scenarios were developed to show the incremental and cumulative effects of implementing tree improvement programs.

Results

The baseline scenario had no tree improvement included and was the reference for comparison of all scenarios in this analysis. The addition of any level of tree improvement provided an increase in the harvest level (Table 49). The Level 2 program for all species provided a higher return than the increase provided by the level 1. The cumulative run, with all level 2 tree improvement treatments did not provide a cumulative increase effect; there was only a marginal increase over the individual treatments. Overall the gain associated with tree improvement were not large.

Table 49. Effect of different levels of tree improvement.

		Harvest level Change (%)		
Scenario	**Name**	**Conifer**	**Decid**	**Total**
W13_W9001	No Tree Improvement		-- Baseline --	
W13_W9002	Sw Level 1	100.2%	100.5%	100.3%
W13_W9003	Sw Level 2	100.3%	100.5%	100.4%
W13_W9004	Pl Level 1	100.4%	101.2%	100.7%
W13_W9005	Pl Level 2	100.6%	102.0%	101.0%
W13_W9006	Sb Level 1	100.1%	100.3%	100.2%
W13_W9007	Sb Level 2	100.1%	100.4%	100.2%
W13_W9008	All Tree Improvement Level 2	100.8%	102.1%	101.2%

Discussion

In addition to the harvest level results that were shown here, an economic analysis was completed on each level, and combination of treatments. The results were provided to Millar

Western for internal use. This analysis did not include the factors such as reduced cost associated with seed collection.

Subsequent to this issue being examined by the TSA IAG, the Alberta government released new requirements for inclusion of tree improvement in a DFMP. Due to the late timing of these requirements, and the small increases realized, no tree improvement was applied in the forecasting, though Millar Western is still maintaining their white spruce program.

At the present time, Millar Western will not pursue an AAC gain from the current white spruce rouging program. Millar Western is also reviewing the economic justification for the Company to participate in tree improvement programs in light of the small AAC gains that can be realized according to new Alberta government rules.

7.7 Stand Conversion

7.7.1 Background

Millar Western's 1997-2006 DFMP used white spruce, black spruce and lodgepole pine crop plans as an enhanced forest management activity. Included in the crop plans regime was the ability to convert mixedwood and deciduous stands into pure coniferous stands. During the current DFMP planning process crop plans were not implemented, but the option to convert mixedwood and deciduous sites to pure coniferous stands was assessed as a forest management option to maintain the coniferous harvest level.

7.7.2 Results and Discussion

Allowing conversion causes an increase in the coniferous harvest level of approximately 12,000m^3/yr and a decrease of approximately 20,000 m^3/yr to the deciduous harvest level.

Including conversion increased the amount of white spruce and lodgepole pine on the landbase. The old growth levels did not vary between the scenarios as in both cases the level was at the minimum constrained level. The growing stock level differed between these two scenarios. The scenarios without conversion had a higher deciduous growing stock level, while the conversion scenarios had a slightly higher coniferous growing stock level. The coniferous growing stock increase was not large considering the size of the increase in the coniferous harvest level and the increased coniferous area harvested. This means that most of the increase in the coniferous volume went to support the higher harvest level, rather than building growing stock . Including conversion did increase the amount of area on the coniferous landbase throughout the planning horizon. This in turn, increased the amount of the old coniferous cover type area on the landbase.

7.7.3 Decision

Given company capabilities and future plans, Millar Western included conversion in W13 but not in W11. If stands are regenerated under the company's intensive management establishment strategy, higher yield response in the 2017-2027 DFMP is anticipated.

7.8 Succession

7.8.1 Background

Forecasting requires succession rules to be defined and included in the model. These transitions can have a large effect on the forecasting, therefore it is important that these rules be biologically realistic. In Millar Western's DFMP development process, initial succession rule sets were based on the previous DFMP for W13. Subsequently, a full set of transitions were defined by a group of foresters and biologists (Table 50). This is a complex set of transitions resulting in stands changing to multiple species at multiple time steps in some cases. This set of transitions are believed to be realistic, but were too complex to be modeled. As Patchworks is not able to effectively deal with multiple transitions of a stand type and unable to split spatial polygons, multiple transitions are difficult. Although there are methods available to implement such transition rule sets, the added complexity was not worth the effort added to the model.

A simplified set of transitions were subsequently defined which could be modeled without adding a large amount of overhead to the model (Table 51). This simplification was completed with BAP IAG input to ensure they were biologically appropriate.

After the simplified rule set was defined, an additional step was needed before they could be implemented in the forecast model. For all BAP strata that underwent a gap phase succession, the yield curves associated with the BAP strata were truncated to the succession age and the lifespan was set to very high age. This way, once a stand reached the succession age, the stand age would continue increasing but the attributes of the stand would remain constant.

The option for fluctuations to occur post lifespan was considered, however, the additional modeling requirements outweighed potential benefits and the decision was made not to pursue this option. Finally, the ages post and pre-transition assumptions were examined to ensure the transitions aligned with and would work properly with other indicators. For instance, would a specific transition cause unintended results in fire modeling?

Table 50. Full transitions decided early on in the forecasting process.

Pre-Succession Strata[1]						Succession		Post-succession Strata		
Broad Cover Group	Species Strata	BAP Strata	TPR	FMU	Min. Age (yrs) for Old Seral Stage[2]	Age	Mechanism	BAP Specific Strata	Age (yrs)	Percent
D	AW	AW	G,M,F,U	W9/W11	100	150	Stand Breakup	AW	40	50
								AW_SWSB	40	50
				W5		150	Stand Breakup	AW	10	100
		PB	G,M,F,U	all	110	150	Stand Breakup	PB	10	100
	BW	BW	G,M,F,U	all	90	110	Stand Breakup	BW	10	100
DC	AP	AW_PL	G,M,F,U	all	115	160	Fire	AW_PL	0	50
								AW_PL	160	50
						180	Succession	PL_AWPB	180	100
	AS	AW_SWSB	G,M,F,U	all	120	160	Fire	AW_SWSB	0	20
								AW_SWSB	160	80
						180	Succession	SW_AW	160	100
		PB_CON	G,M,F,U	all	125	160	Fire	PB_CON	0	20
								PB_CON	160	80
						180	Succession	SW_PB	160	100
		BW_CON	G,M,F,U	all	90	90	Fire	BW_CON	0	20
								BW_CON	90	80
						110	Succession	SW	90	100
CD		PL_AWPB	G,M,F,U	all	115	160	Fire	PL_AWPB	0	20
								PL	0	50
								PL_AWPB	160	30
						200	Succession	PL	200	100
		PL_BW	G,M,F,U	all	90	110	Succession	PL	110	100
		SB_DEC	G,M,F,U	all	140	160	Fire	SB	0	70
								SB_DEC	160	30
						180	Succession	SB	160	100
		SW_AW	G,M,F,U	all	125	160	Fire	SW_AW	0	10
								SW_AW	160	90
						180	Succession	SW	180	60
								SW_AW	150	40
		SW_PB	G,M,F,U	all	130	160	Fire	SW_PB	0	10
								SW_PB	160	90
						180	Succession	SW	180	60
								SW_PB	150	40
		SW_BW	G,M,F,U	all	90	110	Succession	SW	110	100
C		LT	G,M,F,U	all	150	190	Fire	LT	0	40
								SB	0	40
								LT	190	20
						210	Succession	SB	180	100
		PL	G,M,F,U	all	120	220	Fire	PL	0	90
							Succession	SW	60	10
		SB	F,U	all	160	200	Fire	SB	0	10
								SB	200	90
						250	Succession	SB	180	80
								LT	0	20
			G,M	all		180	Fire	SB	0	50
							Succession	SB	160	30
								PL	180	10
								SW	160	10
		SW	G,M,F,U	all	150	210	Fire	SW	0	10
							Succession	SW	180	90

Pre-succession strata that remain unchanged after succession are greyed out.

[1] All disturbance origins are included

[2] Ages in red were modified October 13, 2005 during a succession pathway brainstorming session.

[3] Ages in red were modified after the October 13, 2005 brainstorming session as the original age (180 years) forced a second immediate transition in the future type.

Table 51. Final simplified transitions used in the forecasting.

Broad Cover Group	Pre-succession Strata: Species Strata	Pre-succession Strata: BAP Strata	Pre-succession Strata: FMU	Succession: Age (yrs)	Succession: Mechanism	Post-succession Strata: BAP Strata	Post-succession Strata: Density	Post-succession Strata: Age (yrs)
D	AW	AW	W9/W11	150	Stand Breakup	AW	CD	0
			W5	150	Stand Breakup	AW*	CD	0
		PB	all	150	Stand Breakup	PB	CD	0
	BW	BW	all	110	Stand Breakup	BW	CD	0
DC	AP	AW_PL	all	160	Succession	PL_DEC	AB	140
	AS	AW_SWSB	all	180	Succession	SWSB_DEC	AB	160
		PB_CON	all	180	Succession	SWSB_DEC	AB	160
CD	PA	PL_DEC	all	200	Stand Breakup	SWSB_DEC	CD	0
	SA	SWSB_DEC	all	180	Gap Phase	SWSB_DEC	n/c	n/c
C	LT	LT	all	210	Gap Phase	LT	n/c	n/c
	PL	PL	all	220	Stand Breakup	SW	CD	0
	SB	SB_UP	all	180	Succession	SW	AB	160
		SB_LOW	all	250	Gap Phase	SB_LOW	n/c	n/c
	SW	SW	all	210	Gap Phase	SW	n/c	n/c

* W5N Aspen stands (AW W/BR) regenerate back to the W9 Aspen curve (AW MC/VH)

n/c = no change

7.8.2 Results and Discussion

When no succession was permitted, the coniferous harvest level increased by approximately 8,000m^3/yr and the deciduous harvest level decreased by approximately 500m^3/yr over levels attained with the simplified set (lifespan set to 405 years for all BAP strata). The differences between the succession rule sets were not quantified. Overall the succession rules did not have a large effect on the early portions of the planning horizon, but slightly changed the later periods.

The simplified transition rules in Table 51 were used in the PFMSs as they were felt to accurately represent the transitions in the forest, while not incorporating unnecessary overhead in the forecast model.

7.9 DFA Silviculture Committee

Millar Western formed the DFA Silviculture Committee in order to clarify the connection between the objectives related timber supply, biodiversity, and water quality that are identified in the DFMP, and the silviculture practices the Company employs. The Alberta Government requires a SHS to identify blocks planned for harvest in the next 20 years. Millar Western considers a Spatial Silviculture Sequence (SSS) a similar tool for operations, making the link between regeneration standards and yield more effective. The DFMP does not include the SSS on a block-by-block level at this time.

The DFA Silviculture Committee investigated silviculture modeling with forecasting runs to assist in developing operational linkages to the strategic planning. Edasite was identified as the linkage to assign silviculture treatments to landbase stands. Edasite was a simplified ecosite call for each stand. When the ecosite coverage was created and assigned to the landbase, several ecosites were available to be assigned to each stand. In W11 the ecosite options were listed in order of likelihood so that the edasite was assigned to the first ecosite in the list. In W13, the assignment was more complex, as the ecosites present in each polygon were listed in alphabetical order. The dominant ecosite was selected to determine the edasite for each polygon. This allowed for one silviculture regime to be assigned to each stand. Each stand was assigned a label that includes the Natural subregion (ecoregion), Edasite, ecosite phase (edatype), the silviculture treatment regime, the regenerated species, silviculture intensity and site class.

The DFA Silviculture Committee used edasite classification and current species type to determine the Generic Establishment Regime (GER). The GER indicates the silvicutural activities by species strata and silviculture intensity. Stock types used in each location for planting, financial implications of each activity and projected percent cover of non-treed vegetation types, 10 years post harvest (vegetation community assembly transitions as described in *Appendix IX – Silviculture Generic Establishment Regimes (GER)*) have all been incorporated into the plan. Overall this plan will guide the silviculture forester, allowing them to make better choices to meet DFMP objectives and maintain a sustainable forest.

The GER intensity has three levels; extensive, managed and conversion with crop plans. Crop plans were originally included as a possible management option early on in the DFMP development process but were not included in the PFMSs.

Extensive regeneration intensity is reserved mainly for aspen dominated stands in all Ecoregions where the outcome desired is an aspen forest. These are the least silviculturaly intensive GERs, as they are leave for natural (LFN), with no mechanical or chemical site preparation, seeding or planning.

Managed stands typically incorporate mechanical or chemical site preparation, seeding or planting, and tending activities. The conversion action was similar to the managed action but instead of a stand returning to a similar species composition, it was regenerated to white spruce or pine. In some cases this may require more intensive silviculture to ensure the conversion.

Crop plan treatments represent a higher intensity establishment for silviculture operations and were planned for medium to rich nutrient and mesic to hygric moisture regimes. Crop plans have mechanical interventions occurring later in the stand life including precommercial thinning if required, and a commercial thinning. Crop plan treatments are not present in the PFMSs.

The SSS will enable better linkages across forestry operation and result in more predictable and manageable silviculture programs. It will enable MWFP to link habitat, timber, and water quality objectives more closely with silviculture practices. Overall, the SSS will be a tool that supports the Company’s commitment to sustainable forest management.

7.10 Hydrology

7.10.1 Background

Hydrology was addressed in the DFMP by the FORWARD IAG. The primary forecasting indicator derived by the FORWARD IAG for use in the development of PFMSs were Runoff Coefficients (RC). There were numerous versions of the RC and water modeling approaches analyzed throughout the development of the DFMP. The primary issues investigated for application in the trade off analysis were:

- Appropriate variable to represent hydrological condition,
- Impacts of wetlands,
- Peak versus average flow,
- Establishment of baseline conditions,
- Influence of conifer and deciduous forests on runoff ,
- Influence of slope on runoff,
- Influence of aspect on runoff, and
- Watershed area outside the DFA.

Details on these and other issues are provided in *Appendix XIV – FORWARD Contributions*, with the RC and wetland inputs for forecasting discussed in Section 5.17 and the results by FMU in Sections 6.4.1and 6.4.2. This section provides some background and summaries of some of the development issues.

7.10.2 Discussion

For forecast modeling, the FORWAD IAG selected RC to represent relative change in watershed streamflow. RC is the ratio of runoff to precipitation for a watershed and thus allows elegant comparisons among years and among areas with differing absolute runoff or precipitation. RC values were first developed using SWAT model simulations, then verified and adjusted against measured results in the FORWARD watersheds. Model derived RC values were initially fitted to measured values for first order watersheds. Results derived from first order summations were then investigated for a fit with results measured in third order watershed.

Early on, the FORWARD IAG identified wetlands as having a large influence on water runoff. The intent was to incorporate wetland impacts directly into the RC determination for each watershed. This was achieved through the application of a wetland modifier function based on the percent of wetland within each first order watershed which was applied to the watershed RC values. The results were two-fold. First, RC values for first order watersheds increased as the percent wetland increased up to a maximum value of 30% wetland. Secondly, the application of the wetland function made the calculation too complex for the Patchworks model and thus the wetland modifier was applied to the model outputs. This meant that absolute RCs were not available for use as goals within Patchworks and had to be determined after the model was run. However, a mathematical representation of RC was available for model reporting as only constants were excluded from the Patchworks model. Future versions of the forecasting model will overcome this limitation.

Both peak flow (storm event) RCs and average annual RCs were derived by the FORWARD IAG. The difference between the two was relatively small. Event values were approximately 14% larger than average annual values but the patterns are similar because storm events drive streamflow patterns on the Boreal Plain. Thus, only the peak flow values representing rainstorm events were used in the trade off analysis.

Determination of percent change requires the establishment of a baseline from which to predict change. The FORWAD IAG spent considerable time determining the baseline. Establishing the current condition as the baseline would ignore the impact of previous disturbances, while establishing a fully forested condition as the baseline would ignore the impacts from other non-forestry disturbance mechanisms (*e.g***.** oil & gas, natural fires, blow down etc.). Given the limited information available, it was decided that for this DFMP, baseline conditions would be the lowest observed RC over the planning horizon. In most cases this was the fully forested condition or very close to a fully forested baseline condition.

Selecting a baseline condition from which to establish change becomes even more complicated when stand conversion is included. Different stand types (*e.g.* coniferous or deciduous dominated) behave differently in terms of interception, retention and runoff, resulting in different RC values for the same land area. Due to lower interception and retention, fully forested deciduous stands have lower RC values than coniferous stands, and because clearcut conditions are similar for either stand type, the change from the fully forested condition to the clearcut condition is less for deciduous stands. This produces a situation where the harvesting impact, in terms of increased runoff, is greater for coniferous stands than deciduous stands. A forest manager seeking to minimize the harvesting impact within a watershed would convert coniferous stands to deciduous. Under these conditions, setting a baseline would require decisions as to what stand type should be present on the site to represent the baseline condition. The FORWARD and TSA IAGs determined that depending on the selected stand type, it would be possible to meet water targets by converting stands to reduce the amount of future change in RC while maintaining the same harvesting practices and disturbance levels. This was not the intent of the water management targets for the 2007-2016 DFMP and therefore raises the question of establishing water budgets for forestlands as water management objectives, instead of using changes in runoff. While water budgets for forested lands may be a desirable long term objective to strive towards, it is beyond the scope of the current DFMP and would need the co-operative efforts of all operators within the watershed. Thus RC differences between stand types and any impacts due to stand conversion were ignored in the development of the 2007-2016 DFMP by removing stand type as a factor in RC development.

Runoff coefficients were initially developed by the FORWARD IAG for each broad cover group. However, there was no suitable literature, nor field based data set, to support the creation of conifer and deciduous species specific runoff coefficients. Simulated conifer stands had runoff coefficients consistent with the data collected from the field sites, thus they were used for this DFMP. Further data may be collected to evaluate potential separation of runoff coefficients by species over the coming years. For the 2007-2016 DFMP, the runoff coefficients used were the same for all treed sites within each soil and slope class.

Slope impacts were included in the modeling as the area weighted average slope value in the FORWARD watershed coverage as determined by GISmo Solutions Inc., for each of the small atomic polygons that make up a watershed. These values were applied to the net landbase polygons and RC lookup values were developed for each slope class.

Based on model output, the number of landscape parameters was reduced to eliminate those that did not make a substantial or detectable difference to runoff. Soil type and slope were maintained whereas aspect was removed.

Predicting water impact and applying forest management controls on partial watersheds is an issue common to all cases where administrative boundaries are not aligned with watershed boundaries. The issue of watershed boundaries is outside the scope of individual FMA holders, but deserves attention. In the meantime, FORWARD recommended that first order watersheds with at least 50% of their area within the DFA be considered for management targets and the rest be ignored. This assumption represents 94% of the DFA and thus 94% of the DFA area was subject to first order watershed targets. Thirty-four percent of the land within the DFA has third order watersheds with at least 90% of their area within the DFA, and were subject to third order management targets as recommended by the FORWARD IAG.

RCs were determined under various harvesting patterns as part of the FORWARD IAG's research effort but are not documented in the 2007-2016 DFMP.

The FORWARD IAG's analysis showed that the fluctuation in third order runoff coefficients throughout the planning horizon was small. This demonstrates that for this forest, harvesting has minimal impacts on runoff at the third order level. This holds true even with the surge cut that was incorporated to address MPB risk. As expected, larger fluctuations from harvesting activities were observed at the first order but the impacts on water runoff from harvesting can be managed. Overall forestry's impact on water runoff was not serious.

7.11 Surge Cut

7.11.1 Background

The Planning Standard allows for surge cuts under specific situations. W11 has an existing surge cut that was approved in the Preliminary Forest Management Plan to mitigate an immediate drop down in harvest levels associated with the new timber supply analysis. In W13 a surge cut is proposed in the 2007-2016 DFMP to address the prevalence of older age pine forest; where a surge will decrease possible losses to insect and disease outbreaks. Given the MPB threat to Millar's FMA, a surge cut would also allow a reduction in pine age class and the risk associated with a MPB infestation. Albertans have recognized the risks posed by a MPB outbreak, largely from the lessons learned from British Columbia's current infestation. Therefore, the Alberta government, companies, and the public are being proactive to ensure the devastation experienced in British Columbia is avoided. In many cases, management options include a pine surge cut to reduce the pine age class of the forest, thereby reducing the amount of large diameter pine trees that are required for successful large scale mountain pine beetle reproduction. Other management options include removal of individual infected trees by the Alberta government at the front line of the infestation and the removal of infected stands by industry.

To explore MPB risk reduction scenarios, a range of surge cuts and their effect on the post step down even flow harvest level and other indicators were examined.

7.11.2 Results

The existing approved coniferous surge cut in W11 will be incorporated in this DFMP. Table 52 shows the surge level is 33% above the even flow level for the first 10 years and is subsequently 2% below the even flow level after the surge cut.

Table 52. Even flow harvest level and conifer surge cut scenarios from W11 along with the percentage changes from the even flow scenario.

	Harvest Volume (m^3/yr at 15/10)				Percent Difference from Even Flow		
Scenario	**Years**	**Conifer**	**Decid**	**Total**	**Conifer**	**Decid**	**Total**
Even Flow Scenario							
W11_W11020	2007-2206	71,440	113,519	184,960			
Surge Scenario							
W11_W11023	2007-2016	95,000	113,369	208,369	133%	100%	113%
	2017-2206	69,970	113,369	183,339	98%	100%	99%

In W13, there is a desire to increase the coniferous harvest level to mitigate risk due to MPB loss. Based on a coniferous surge cut of 470,000m^3 that is 30% higher than the even flow level, there would be a 3% drop down in harvest post-surge from the even flow level (Table 53). The W13 scenario included Oldgrowthness, non-declining growing stock and mixedwood retention constraints.

Table 53. Even flow harvest level and conifer surge cut scenarios from W13 along with the percentage changes from the even flow scenario.

	Harvest Volume (m^3/yr at 15/10)				Percent Difference from Even Flow		
Scenario	**Years**	**Conifer**	**Decid**	**Total**	**Conifer**	**Decid**	**Total**
Even Flow Scenario							
W13_W12a010	2007-2206	360,316	157,375	517,692			
Surge Scenario							
W13_W12a017	2007-2016	470,000	159,436	629,436	130%	101%	122%
	2017-2206	348,691	159,436	508,128	97%	101%	98%

7.11.3 Discussion

In both FMUs there is very little effect, in terms of post surge harvest level, given the model formulation used, of including coniferous surge cuts. In W11, the harvest level was approved in the PFMP although it does not meet all of the current Planning Standard rules for a surge cut (*i.e.*, the surge must not be greater than 25% above the even flow harvest level, and 10% lower than the even flow harvest level). In W13, the surge cut meets the drop down criterion but is above the 25% upper boundary.

Both surge cuts have been included in the PFMSs forecasting. The W11 surge cut was reviewed previously and approved by the government in the PFMP. The W13 surge cut was assessed by the Alberta government and was acceptable at the level suggested to mitigate the MPB threat on the landbase.

7.12 Carryover

7.12.1 Background

The Alberta government may approve carryover when a company does not harvest their full volume from the previous quadrant. The effect of adding carryover to the model is addressed in this section. In the Millar Western 2007-2016 DFMP, there is coniferous and deciduous carryover available in W11. No carryover was modeled in W13.

Early in the planning process Millar Western expected 960,000m^3 of deciduous carryover in W11 but as the process continued, this was revised to 840,000m^3. The coniferous carryover is 26,708m^3 from 2006-2010. Therefore only 4 years (26,708*4/5= 21,366) of this coniferous carryover are included in the DFMP planning period.

7.12.2 Results

Adding the deciduous carryover to the harvest level increases the even flow coniferous cut and decreases the even flow deciduous cut compared to no surge cut (Table 54). With a surge cut, the post surge coniferous even flow harvest level increases and the deciduous even flow harvest level decreases when carryover is added. When 840,000m^3 of carryover volume is included, the average 200-year coniferous and total harvest level over the planning horizon is higher than when no carryover is included, but the deciduous harvest level is lower. The trends are the same but higher when 960,000m^3 of carryover is included. Under the surge cut condition, the coniferous, deciduous and the total 200-year average harvest levels are higher when carryover is included.

Table 54. Harvest levels from selected runs given different levels of deciduous carryover in W11.

Run Number	Carryover (m^3) Conifer	Carryover (m^3) Decid		Even Flow Harvest (m^3/yr) Conifer	Even Flow Harvest (m^3/yr) Decid	Even Flow Harvest (m^3/yr) Total	Average Harvest Level including Carryover (m^3/yr) Conifer	Average Harvest Level including Carryover (m^3/yr) Decid	Average Harvest Level including Carryover (m^3/yr) Total
W11_W11020	0	0	2007-2206	71,440	113,519	184,960	71,440	113,519	184,960
W11_W11034	0	840,000	2007-2206	72,294	110,947	183,241	76,494	110,947	187,441
W11_W11024	0	960,000	2007-2206	72,353	110,478	182,831	77,153	110,478	187,631
W11_W11023	-	0	2007-2016	95,000	113,369	208,369	71,222	113,369	184,590
			2017-2206	69,970	113,369	183,339			
W11_W11027	-	960,000	2007-2016	95,000	110,716	205,716	72,252	115,516	187,768
			2017-2206	71,055	110,716	181,771			

Adding the coniferous carryover (see Table 55), when the deciduous carryover is already included, had very little effect on the harvest levels. With either level of deciduous carryover, adding the coniferous carryover caused a slight decrease in the even flow coniferous harvest and a slight increase in the deciduous harvest. When the harvest levels are averaged (including the carryover) there is a slight increase in all harvest levels from adding the carryover. When the deciduous and coniferous carryovers are included with the coniferous surge cut, the post surge even flow harvest level is slightly higher than without the carryover (W11_W11023 from Table 54).

Table 55. Harvest levels from selected runs given different levels of coniferous carryover in W11.

Run Number	Carryover (m^3) Conifer	Carryover (m^3) Decid		Even Flow Harvest (m^3/yr) Conifer	Even Flow Harvest (m^3/yr) Decid	Even Flow Harvest (m^3/yr) Total	Average Harvest Level including Carryover (m^3/yr) Conifer	Average Harvest Level including Carryover (m^3/yr) Decid	Average Harvest Level including Carryover (m^3/yr) Total
W11_W11034	0	840,000	2007-2206	72,294	110,947	183,241	72,294	115,147	187,441
W11_W11035	26,708	840,000	2007-2206	72,196	110,960	183,156	72,329	115,160	187,490
W11_W11024	0	960,000	2007-2206	72,353	110,478	182,831	72,353	115,278	187,631
W11_W11025	26,708	960,000	2007-2206	72,224	110,530	182,754	72,358	115,330	187,688
W11_W11028	26,708	960,000	2007-2016	95,000	110,721	205,721	72,239	115,521	187,760
			2017-2206	70,900	110,721	181,621			

7.12.3 Discussion

Overall there is very little effect on adding the carryover, either coniferous or deciduous, on the even flow harvest levels. In all cases, the average total harvest level including carryover is higher than without carryover. Carryover was included in the W111 PFMS, but not in the W13 PFMS.

7.13 Old Growth

7.13.1 Background

Old growth is a concept that is often discussed relating to forests. Though the concept is often agreed upon, the definition of old growth is often difficult. This section presents six measures that have, or are proposed for use in Alberta, that were considered for use in the DFMP. The measures considered were:

- BAP: Climax Old Seral Stage ages provided by Dr. Frédérik Doyon for the 2007-2016 DFMP based on TSP and PSP plot data and professional judgment "Climax old" was based on structural characteristics of the stand

- 1997 DFMP: Overmature Seral Stage from the 1997-2006 DFMP (Chapter 3) adapted for BAP strata in the 2007-2016 DFMP

- ASRD: Early and Late Old Growth Seral Stages table of ages provided by ASRD adapted for BAP strata in the 2007-2016 DFMP

- ASRD: 40 Years above maximun MAI from Footnote 3, Annex 4 Performance Standards (VOITs), Alberta Forest Management Planning Standard - Version 3 Calculated for natural stand yield curves

- BRL: Older Forest from Blue Ridge Lumber's 2004 DFMP adapted for BAP strata in the 2007-2016 DFMP

- BAP: Oldgrowthness curves provided by Dr. Frédérik Doyon for the 2007-2016 DFMP

Criteria related to each of these measures are shown in Table 56. The basis for classification of each measure differs, along with differences in the ages that define each stage.

Table 56. Old growth definitions analyzed.

Ages (in years) of Old Growth

BAP Stratum	Mod.	BAP Climax Old Seral Stage	1997 DFMP Over-mature Seral Stage	SRD Natural Subregion	SRD Early and Late Old Growth Seral Stages	SRD FMU	SRD Crown Closure Class	SRD 40 Years Above Max. MAI[1]	BRL Older Forest
AW		> 130	> 100	BM	> 120	W11	AB	> 90	> 100
				LF	> 130	W11	CD	> 130	
				UF	> 140	W13		> 120	
PB		> 140	> 110	BM	> 130	W11	AB	> 90	> 100
				LF, UF	> 140	W11	CD	> 130	
						W13		> 120	
BW		> 100	> 90	BM	> 120			> 130	> 100
				LF	> 130				
				UF	> 140				
AW_PL		> 130	> 115	BM, LF	> 140	W11		> 110	> 100
				UF	> 150	W13		> 140	
AW_SWSB		> 140	> 120	BM	> 140	W11		> 110	> 100
				LF, UF	> 150	W13		> 130	
PB_CON		> 150	> 125	BM	> 140	W11		> 110	> 100
				LF, UF	> 150	W13		> 130	
PL_DEC		> 160	> 115	BM	> 150	W11		> 140	> 100
				LF	> 140	W13		> 160	
				UF	> 160				
SWSB_DEC		> 150	> 125	BM, LF	> 150	W11		> 140	> 100
				UF	> 160	W13		> 120	
LT		> 130	> 150	BM	> 180			> 130	> 140
				LF, UF	> 200				
PL		> 140	> 120	BM	> 140	W11	AB	> 150	> 100
				LF, UF	> 160	W11	CD	> 180	
						W13		> 160	
SB	LOW[2]	> 180	> 160	BM	> 180			> 130	> 140
	UP[3]	> 160		LF, UF	> 200				
SW		> 170	> 150	BM	> 160	W11	AB	> 140	> 120
				LF	> 180	W11	CD	> 110	
				UF	> 200	W13		> 160	

[1] Max. MAI was calculated using the following volumes by broad cover group:
Decid volume for D (AW, PB, BW)
Total volume for DC and CD (AW_PL, AW_SWSB, PB_CON, PL_DEC, SWSB_DEC)
Conifer volume for C (PL, SB, SW)

[2] Lowland black spruce is defined by AVI moisture regime of "wet" for the defining layer

[3] Upland black spruce is defined by AVI moisture regime of "not wet" for the defining layer

The percent of old growth for each definition for the managed and gross landbases (landbase 11) in FMUs W11 and W13 are summarized in Table 57. The measure used to evaluate the old growth area on the landbase affect the amount of area on the landbase in the old growth state.

Table 57. Percent area of old growth in 2004 under different definitions

FMU	Landbase	BAP Climax Old Seral Stage	1997 DFMP Over-mature Seral Stage	SRD Early and Late Old Growth Seral Stages	SRD 40 Years Above Max. MAI	BRL Older Forest	BAP Old Growthness
W11	Managed	1%	20%	2%	10%	34%	20%
	Gross DFA	1%	13%	1%	9%	24%	15%
W13	Managed	2%	17%	1%	8%	29%	20%
	Gross DFA	2%	15%	1%	9%	26%	21%

(Percent Area of Old Growth)

7.13.2 Outcome

Oldgrowthness curves were selected as the old growth indicator used to control the forecasting model. Oldgrowthness was selected because:

- It was the preferred method of the biodiversity expert, Dr. Frédérik Doyon of IQAFF, working on this DFMP;
- 15-20% of the classified landbase is Old, which was consistent with expectations of stakeholders.

All BAP seral stages including the climax old seral stage were reported on in all forecast model runs.

7.14 OldGrowthness Level

7.14.1 Background

The PFMSs reported two different 'Old' measures; Oldgrowthness and BAP climax old growth, although only Oldgrowthness was actively used in the forecast modeling.

Oldgrowthness levels within the DFA were constrained for the second half of the planning horizon.

7.14.2 Results

A series of runs were created to evaluate the effect of various Oldgrowthness constraints upon timber supply. Initially a reference run was completed with no Oldgrowthness constraint; subsequently the amount of Oldgrowthness was increased by 2.5% per run, up to a maximum of 20% (Table 58).

Table 58. Scenario listing for Oldgrowthness impacts.

Run Name	W11 Run Number	W13 Run Number	Minimum Amount of Oldgrowthness	Effective Period
Reference Scenario	W11_W11028	W13_W12a050	-	-
Oldgrowthness >= 2.5%	W11_W11070	W13_W12a051	2.5	100-200
Oldgrowthness >= 5%	W11_W11071	W13_W12a052	5	100-200
Oldgrowthness >= 7.5%	W11_W11072	W13_W12a053	7.5	100-200
Oldgrowthness >= 10%	W11_W11073	W13_W12a054	10	100-200
Oldgrowthness >= 12.5%	W11_W11074	W13_W12a055	12.5	100-200
Oldgrowthness >= 15%	W11_W11075	W13_W12a056	15	100-200
Oldgrowthness >= 17.5%	W11_W11076	W13_W12a057	17.5	100-200
Oldgrowthness >= 20%	W11_W11077	W13_W12a058	20	100-200

7.14.3 Results

Results of the different scenarios are compared for each FMU. The scenarios had numerous constraints in addition to the Oldgrowthness constraint, including: evenflow harvest levels in all W13 scenarios; a coniferous surge cut and evenflow deciduous cut in W11 with deciduous and coniferous carryover included; planned blocks were forced; non-declining yield of growing stock; crop plan areas thinned at least once; and, ensuring 50% of the mixedwood area by species strata remained at the end of the period.

Figure 131 shows the conifer harvest level from each scenario. In both FMUs, increasing the amount of desired Oldgrowthness from the landbase causes a decrease in the coniferous harvest level achievable from the forest. The same trend can be seen in the deciduous harvest level; as the Oldgrowthness increases the harvest level decreases (Figure 132).

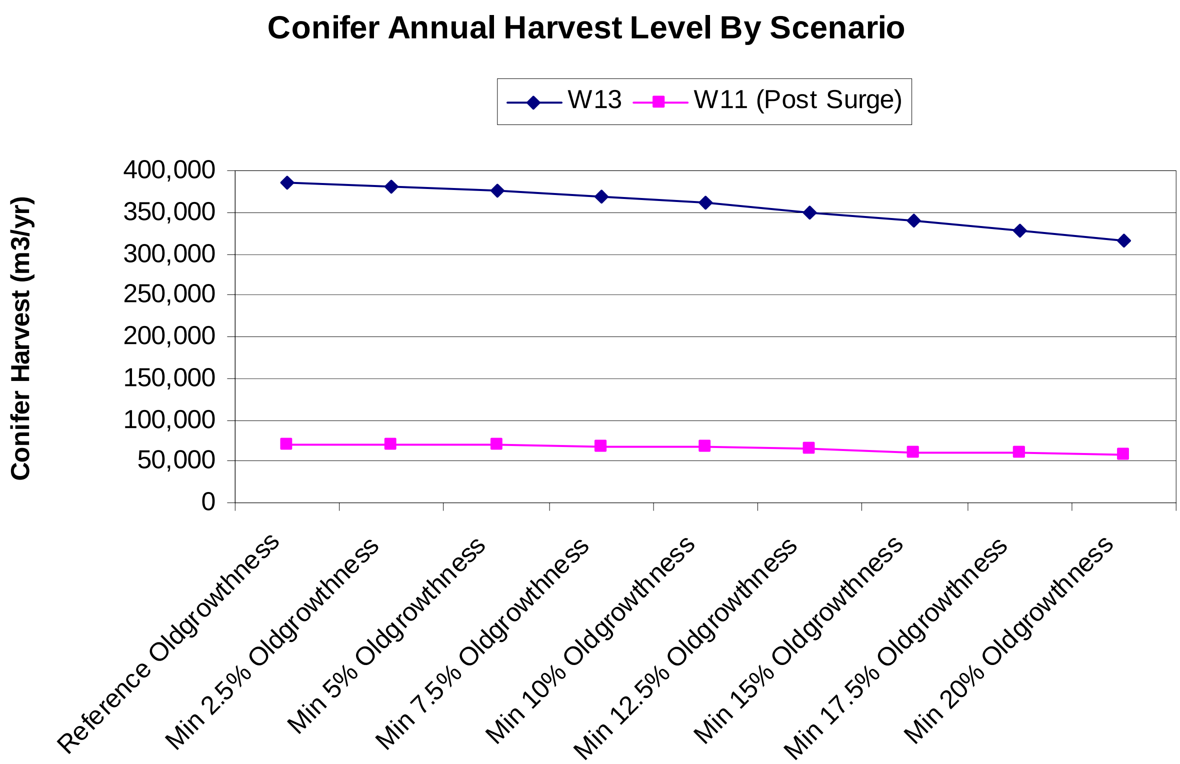


Figure 131. Conifer harvest level by % Oldgrowthness.

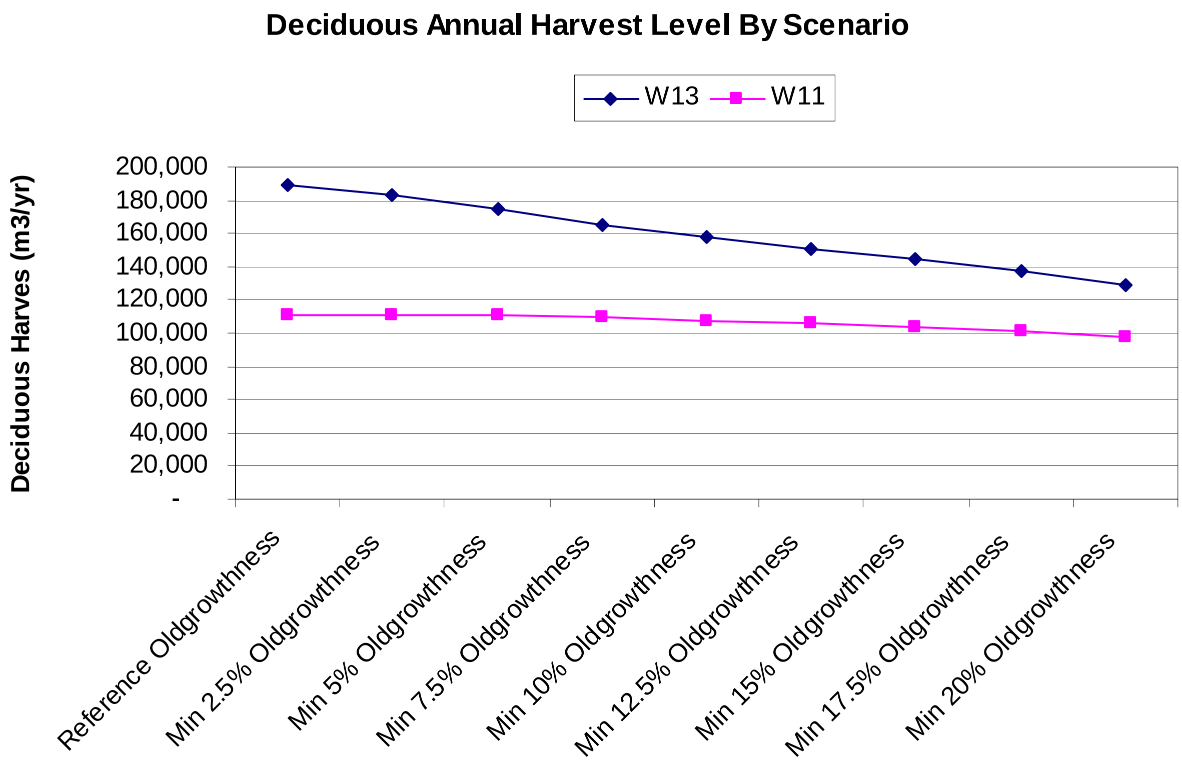


Figure 132. Deciduous harvest level by % Oldgrowthness.

The operable conifer and deciduous growing stock at the end of the planning horizon increase as the Oldgrowthness increases (Figure 133 and Figure 134), which is related to the decreasing harvest level associated with more Oldgrowthness.

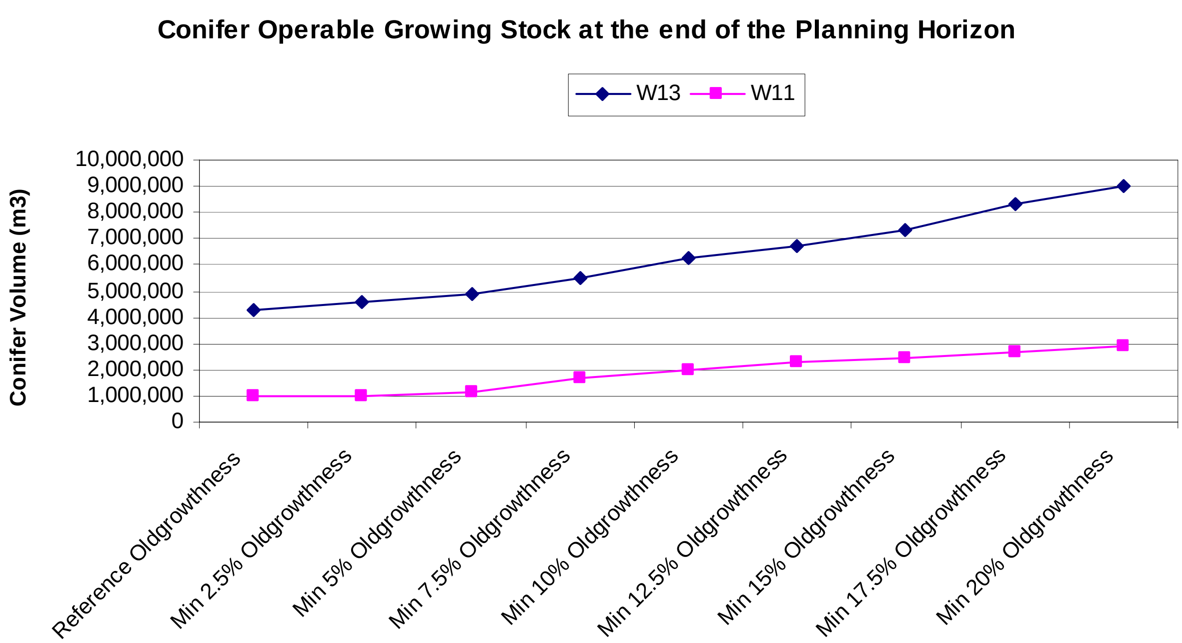


Figure 133. Coniferous operable growing stock at the end of the planning horizon.

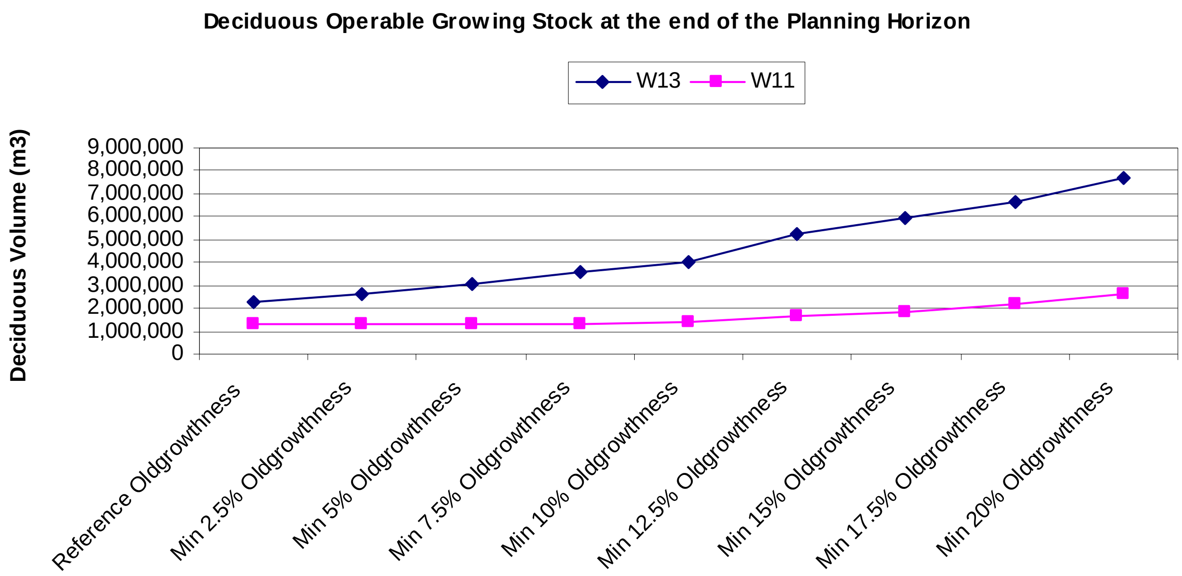


Figure 134. Deciduous operable growing stock at the end of the planning horizon.

The Oldgrowthness on the landbase largely comes from coniferous dominated species strata in all of the scenarios. In all scenarios analyzed increasing the Oldgrowthness on the landbase caused many of the other BAP indicators to increase as well. These other indicators included coarse woody debris, snags, DBH, and basal area. There was a reverse effect on the average shrub and herb cover which decreased as the Oldgrowthness increased.

7.14.4 Discussion

The relationship between Oldgrowthness and harvest level is simple and logical. As the level of Oldgrowthness increases on the landbase there is a decrease in the achievable harvest. In W13 there is a larger effect on the conifer harvest level than the deciduous harvest level. This is due to the objective function being the maximization of the coniferous harvest level from W13. In W11 the coniferous and deciduous harvest levels react more similarly because the objective is the maximization of the total harvest volume.

There is also a relationship between BAP indicators and Oldgrowthness on the landbase. As the amount of Oldgrowthness on the landbase increases there was a related increase in many of the indicators that are typically associated with 'Old' stands such as coarse woody debris and snags. There was, however, a decrease in area for BAP indicators which are associated with young stands such as the herb and shrub cover.

Based on this analysis and recommendations by IQAFF, a 10% Oldgrowthness goal was established for the managed landbase in both FMU's.

7.15 Patch Targets

7.15.1 Background

Patchworks is able to consider harvest level, and other indicators throughout the length of the planning horizon, ensuring that the harvest pattern does not isolate timber in the future. Recently, it has also become increasingly desirable to create large contiguous old forest patches to reduce forest fragmentation. Spatial planning is essential to meet these long term spatial and aspatial timber supply requirements.

Patch size goals were incorporated in the forecast model at two periods in stand development corresponding to the two periods when there are VOIT requirements on patch size targets. These are Opening patches, which are measured as any stands in the first two seral stages on the forest, and old forest patches.

In both W11 and W13, goals were incorporated for the following four opening patch sizes: 0-4 ha, 4-100 ha, 100-1000 ha and 10000+ ha. The goals were 0%, 76%, 19%, and 5% respectively. Goals were allowed to vary by +/-2.5%, except for the 0-4 ha goal. This 0-4 ha goal of 0% of area in this class was included to increase operational feasibility of the PFMSs. For W13, there was an additional quota holder constraint that patch sizes could not be more than 100 ha in size in the Weyerhaeuser compartments of interest. Millar Western developed these patch targets using historical regional forest fire data. Dr. Dave Andison[3], reviewed these targets and indicated that even larger patches might be biologically appropriate although he recognized the social sensitivity associated with very large a patch sizes.

The second patch target analyzed focused on old forest patches. Many species require large old forest patches on the landbase. A goal was therefore set to create large old forest patches wherever possible. A 120 ha patch target was included in the model to aggregate old forest patches. The modeling landbase did not include seismic lines nor other narrow linear features. Therefore these features did not create breaks in the old forest patches. This was not a concern because linear features need to be greater than 8 meters wide to create patch breaks in the model. The target was that a minimum of 75% of the Oldgrowthness area on the landbase should be in Patches greater than 120 ha in size. This target was recommended by Dr. Doyon for the DFMP. These old patches were used by Millar Western as a proxy for the 100 ha old forest patches defined in the Planning Standard.

All patch targets were addressed on the gross landbase. Biological values associated with both opening patches and old forest patches are the same, regardless of whether the area is part of the gross or managed landbase.

There was a negligible effect of adding patch targets to the model, as the model is able to effectively rearrange harvest to include these controls without changing the harvest profile to a

[3] Dr. David W. Andison, Bandaloop Landscape-Ecosystem Services, 3426 Main Avenue, Belcarra, British Columbia, V3H 4R3. 604-939-0830 andison@bandaloop.ca

large degree. The historical problem with the inclusion of such targets was the inability of planning tools to incorporate such goals not the binding nature of these constraints.

7.16 Species of Special Concern

The MPB Interpretive Bulletin and the Planning Standard require that species of special concern be addressed in DFMP development. Millar Western addressed species of special concern through BAP and Operating Ground Rules. One species identified by the Alberta government as a species of special concern and not addressed by BAP is grizzly bear. Major issues in addressing grizzly bear habitat and ultimately population levels are road development and road access. Millar Western and the other forestry operators are only one of the industries that develop, maintain and use roads in the DFA and no single industry has control over access. Partly for this reason, BAP did not include grizzly bear in its species (refer to *Appendix XIII – BAP Report #2 – The Species Selection Procedure* for more information). The Alberta government is currently developing a grizzly bear recovery plan and when operational guidelines are provided, Millar Western will incorporate them.

7.17 Compartment Sequence Control

Access control units in Patchworks are used to restrict or allow harvest in certain areas in given time periods. This allows the harvest in a period of time to be aggregated together to increase the operational feasibility of a scenario and for harvest to be restricted from areas during specific time periods. The compartment sequence can have a large impact on the final Spatial Harvest Sequence and significant effort was made to ensure the compartment sequence was appropriate and feasable.

The original base compartment sequence for this DFMP was the Compartment sequence that was implemented in the last DFMP and PFMP for W13 and W11 respectively.

Initially the compartment sequence was based on Millar Westerns operating compartments. It became apparent that these compartments were too large to allow access control to be feasibly set. Compartments were then further broken down into sub compartments based on breaks in natural features, age class structures, and/or species strata distributions. This allowed, for example, the burn areas within the Virginia Hills compartments to be separated from the unburned areas.

Subsequent to this initial compartment sequence, Dr. Doyon of IQAFF completed a biological analysis of the landbase to prioritize compartments that should be left in the short term for biological value (*Appendix XI – Biodiversity Based Compartment Prioritization*). This sequence and the existing planned activities in W11 were not well aligned. Since there were previous agreements with disposition holders and significant efforts made to plan activities in W11, the

W11 compartment sequence was not modified to include the recommendations. In W13 there were numerous compartment sequences analyzed in various scenarios. Some of these compartment sequences were better aligned with BAP's suggestions than others. In the W13 PFMS many of the BAP IAG sequencing suggestions were incorporated into the compartment sequence such as postponing harvesting to meet biodiversity objectives.

7.18 Planned Blocks

Across the FMA there were numerous planned blocks from all operators on the landbase including, Millar Western, Weyerhaeuser, OK Lumber, and the MTU. These operators have all expended effort to plan some of their future harvest on the landbase. Therefore these blocks were incorporated into the forecasting, even if their inclusion caused a slight negative effect on the harvest level.

It could be assumed that the planned blocks were not the optimal forecast model choices; therefore there would be a reduction in the objective function with the inclusion of the planned blocks. This reduction was not explicitly examined, but was combined with the effects of adding a compartment sequence.

7.19 Crop plans

7.19.1 Background

Crop plans are enhanced forest management (EFM) treatments which Millar Western developed at the request of the Alberta government for use in their 1997-2006 DFMP. Bob Day[4] from Lakehead University assisted Millar Western staff in crop plan development over a period of approximately three years. The crop plan treatment involved site preparation, planting, vegetation control, pre-commercial thinning, and commercial thinning in most cases. This treatment was also used to convert sites from deciduous or mixedwood to coniferous (white spruce or lodgepole pine). Millar Western identified their intent to use crop plans in the approved Terms of Reference for the 2007-2016 DFMP.

Yield curves, including crop plan yield curves were submitted to the Alberta government on June 28, 2006. In spite of previous approval in the1997 DFMP, and approval of the Terms of Reference for the 2007-2016 DFMP, the Alberta government did not approve the crop plans for the current DFMP.

[4] Professor Emeriti, Lakehead University, Thunder Bay, Ontario.

7.19.2 Results

The proposed crop plan yields indicated an increase of approximately 50,000m^3/yr without allowing stand conversions. When conversion was allowed in addition to the crop plans, there was an additional increase of approximately 25,000m^3/yr. .

7.19.3 Discussion

Crop plans had been a pivotal part of Millar Western's management strategy going into the 2007-2016 DFMP planning process. Much of the forecasting undertaken in the 2007-2016 DFMP included crop plans, and discussion occurred throughout the DFMP process for their inclusion. Only upon formal submission of yield curves and crop plans to the Alberta government was any issue raised upon the use of crop plans. The Alberta government rational for not accepting the crop plans was insufficient data to support the assumptions. As a result, Millar Western voluntary removed the crop plans from the 2007-2016 DFMP. Much of the work completed on the management plan had to be reassessed and revised, as a pivotal part of the management approach had been removed. Millar Western maintained stand conversion in this management plan, and will pursue the re-inclusion of intensive forest management treatments in subsequent plans. Millar Western will collect data to support higher volume managed stand yields in the next DFMP. Refer to *Appendix XXIII - Company Commitment 9.*

7.20 W11 Incidental Coniferous Replacement

Millar Western completed a PFMP for W11 in 2004 when FMU W11 was added to their FMA. Sustainability of the timber resource is dependant upon the regenerating volumes meeting the sum total of the assumptions of the managed stand yield curves. The Alberta government recognizes this and has identified the maintenance of incidental volumes as an issue. The Alberta government's premise of the PFMP timber supply, is that without the incidental coniferous volume being actively replaced in deciduous stands, the coniferous AAC will not be sustainable. The final PFMP approval letter stated the following regarding the Coniferous Volume Replacement:

> "Millar Western shall monitor and report area of pure deciduous stands harvested annually. Coniferous volumes from pure deciduous stands will be replaced by converting pure deciduous stands to pure coniferous stands according to the following formula:
>
> > [Yield curve estimate of incidental coniferous volume per ha in pure deciduous stands at 80 years] / [Yield curve estimate of coniferous volume per ha in pure coniferous stands at 80 years] = [ha of pure deciduous stands to be converted per ha cut] or, 1 ha reforested to pure coniferous for every 2.2ha of pure deciduous strata harvested."

> Millar Western and the embedded operators shall develop an incidental replacement strategy for coniferous volumes acceptable to the Executive Director, Forest Management Branch, for inclusion in the DFMP due in 2006."

Millar Western and the W11 quota holders have been cooperating in meeting the coniferous volume replacement approval condition. The amount of deciduous area converted is reported in *Chapter 4 – Previous FMPs and Significant Events* and work was undertaken by the TSA IAG to address the requirement to develop a new incidental volume replacement strategy.

Incidental conifer and the development of a conifer replacement strategy is problematic in W11. The root cause of the problem is the poor quality of the classification in the W11 forest inventory, especially in the older stands. Much of the area classified as pure stands are actually mixedwood stands. This produced a pure deciduous yield curve with a large amount of conifer incidental volume and this incidental volume supports a large part of the W11 conifer timber supply. The problem is more complex in that much of the younger pure deciduous stands really are pure deciduous and they have no conifer understorey. When these stands are harvested after the next 20 years, they will not produce the same level of incidental volume as the current stands do. A new forest inventory and volume sampling program is required to address this but it will not be available for a number of years.

Related to this are the W11 deciduous regenerated yield curves used in the forecasting to predict timber supply. The deciduous regenerated yield curves were constructed from the standing timber yield curves and thus they contain the same levels of incidental volume as the standing timber yield curves. However, under provincial regeneration standards, the amount of conifer regeneration required to meet the incidental volumes predicted in the deciduous yield curve would prohibit the stand from passing deciduous regeneration standards. To quantify the impact of different growth assumptions and regenerated yield curve assumptions the TSA IAG undertook a timber supply analysis, which is described below.

7.20.1 Results

In the W11 PFMP, the Alberta government directed the current conifer incidental volume replacement strategy of converting a portion of all deciduous stands to pure conifer. The formula resulted in 1 ha of coniferous area being regenerated for every 2.2 ha of deciduous area harvested. Millar Western and the quota holders do not support this approach but if mandated by the Alberta government, the revised calculations based on the 2007-2016 DFMP yield curves can be seen in Table 59. The replacement rate drops to establishing one hectare of spruce for each 4.22 hectares of deciduous harvested.

Table 59. W11 incidental coniferous replacement strategy.

Yield Curve	Volume (m^3/yr @ 80 yrs)	Area (ha)	Replacement Rate
Natural Aw_AB	6.7	8,626	
Natural Aw_CD	37.3	47,940	
Natural Aw*	32.6		
Managed Sw	137.8		4.22

* Area Weighted Average

New deciduous curves were created by removing the coniferous volume from the managed curves and making the deciduous component of the curve consistent with 95% of the total volume that was associated with the base managed curve. When harvesting the PFMP, or DFMP depending on the scenario, conversion rates were forced on the model. Table 60 shows the effect of implementing this strategy on the post surge harvest level.

Table 60. Effect of modelling the incidental conifer replacement strategy on the post coniferous surge harvest level.

		Post Surge Harvest level Change (%)		
Scenario	Name	Conifer	Decid	Total
W11_W9001	No Incidental Replacement	-- Baseline --		
W11_W9002	PFMP Incidental Replacement	-34.3%	-4.9%	-15.8%
W11_W9003	DFMP Incidental Replacement	-36.5%	5.0%	-10.4%

7.20.2 Discussion

The different classification of stands during this landbase process changed the calculated conversion rates significantly. Implementing the incidental replacement strategy does not accomplish what was originally intended, as it actually results in a significant reduction in the coniferous harvest, when regenerated deciduous timber yield curves reflect the current provincial regeneration standards. In addition the conversion erodes the deciduous landbase through time and will eventually reduce the deciduous harvest. A new forest inventory and yield curves constructed to meet regeneration standards would provide a better forecast, but this information is not available at this time.

Millar Western and the quota holders could not agree on a new incidental conifer replacement strategy but both parties do not support and have no intention of continuing the current conifer incidental replacement strategy into the 2007-2016 DFMP. Additionally, the Alberta government's conifer incidental replacement strategy was not incorporated into the PFMS as this will erode the deciduous landbase.

7.21 Carbon reporting

Millar Western completed a carbon accounting exercise for their PFMSs. This was completed by IQAFF using CBM-CFS2, which is a tool created by the Canadian Forestry Service for tracking carbon flow in the forest. The CBM-CFS2 model was released during the later stages of the management plan development process and there were numerous issues surrounding correct loading of data into the model. Therefore The Forestry Corp. in conjunction with IQAFF and CFS had to alter the forecasting model and outputs to ensure the CBM-CFS2 model behaved correctly. The major step undertaken was a reduction in the number of themes. The CBM-CFS2 model was only capable of handling 10 themes in their Woodstock to CBM translation tool. Additionally the CFB model was unable to deal with some of the transition syntax situations that were valid in Woodstock. More detail relating to the carbon modeling is provided in *Appendix XV – Carbon Accounting for the DFA.*

7.22 Minimum Harvest Age

Prior to the start of the Millar Western DFMP an analysis was done to assess minimum harvest ages and quantify the effects of varying the minimum harvest ages of different species. This analysis provided a starting place for the DFMP minimum harvest ages. Though there was subsequent analysis completed after the SHS reviews occurred, these initial minimum harvest ages provided a good base for the forecasting.

7.22.1 Pine

Background

Minimum harvest ages can dramatically affect timber supply. Typically when minimum harvest age is increased the harvest level will decrease. As the minimum harvest age is decreased the larger the probability that small, not yet merchantable stands are selected for harvest. A balance in the model must be made to set realistic minimum harvest ages.

In reviewing the Millar Western SHS it was noticed that there was a significant amount of area of < 15 meter tall pine being queued for harvest. Millar Western has found questionable merchantability of pine trees less than and equal to 15 m. After analyzing the SHS and landbase it was determined that the majority of the ‘short’ wood was coming from medium pine sites.

There is a strong relationship between the height and age class of the merchantable pine in W13 in all Timber Productivity Ratings (TPR). Figure 135 shows the area of each age class (coloured portion of columns) by 1 meter height class and TPR category. For example, 15 meter good site pine is almost completely comprised of stands 65 years of age, whereas about half of the 14 meter good site pine is 65 years of age. Therefore a possible solution to the large amount of ‘short’ pine harvested in the SHS could be to increase the minimum harvest age of the medium and fair pine sites. Four scenarios were run to test the effect of increasing the minimum harvest age of medium and fair pine sites. The four scenarios were created by varying the minimum harvest age and harvest flow constraint (Table 61).

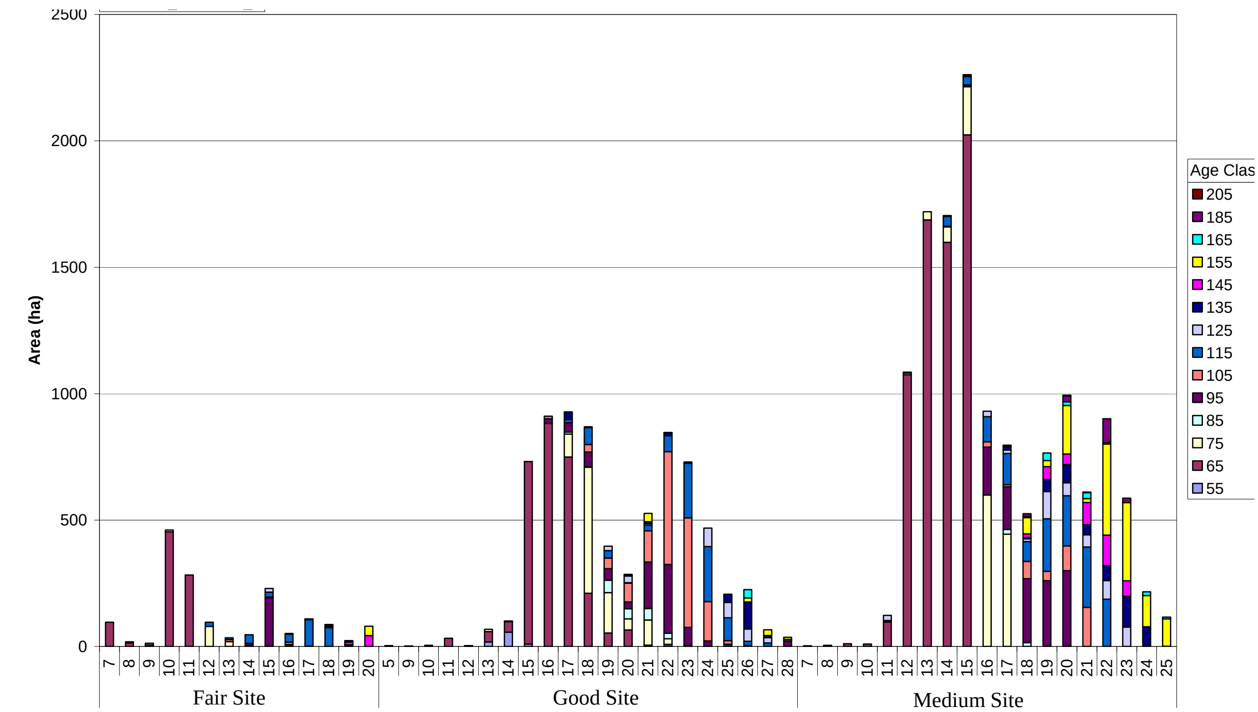


Figure 135. Area by age class plotted by height and TPR of the merchantable Pl stands in W13.

Table 61. Pl Minimum harvest age scenarios by flow constraint and harvest age.

	Harvest Flow Constraint	
Minimum Harvest Age	**Even Flow**	**Conifer Surge Cut**
Baseline	Even Flow Reference Scenario W13_W12a010	Surge Cut Reference Scenario W13_W12a017
+10 yrs M Pine +5 yrs F Pine	Even Flow Increased Pl Harvest Age W13_W12a015	Surge Cut Increased Pl Harvest Age W13_W12a016

Results

The forecasting scenarios had numerous constraints modeled in all scenarios, including an even flow or coniferous surge harvest level with an even flow deciduous harvest level. The other constraints on the model included: forcing all planned blocks; non-declining yield of growing stock; ensuring all crop plans are thinned at least once; ensuring 50% of the mixedwood area; by species strata, remained at the end of the year; and a minimum of 10% of the landbase being Oldgrowthness.

The coniferous harvest level from each scenario can be seen in Figure 136. The coniferous harvest level was not dependant on the minimum harvest age of medium and fair pine. The deciduous harvest level was also not affected by the pine minimum harvest age (Figure 137).

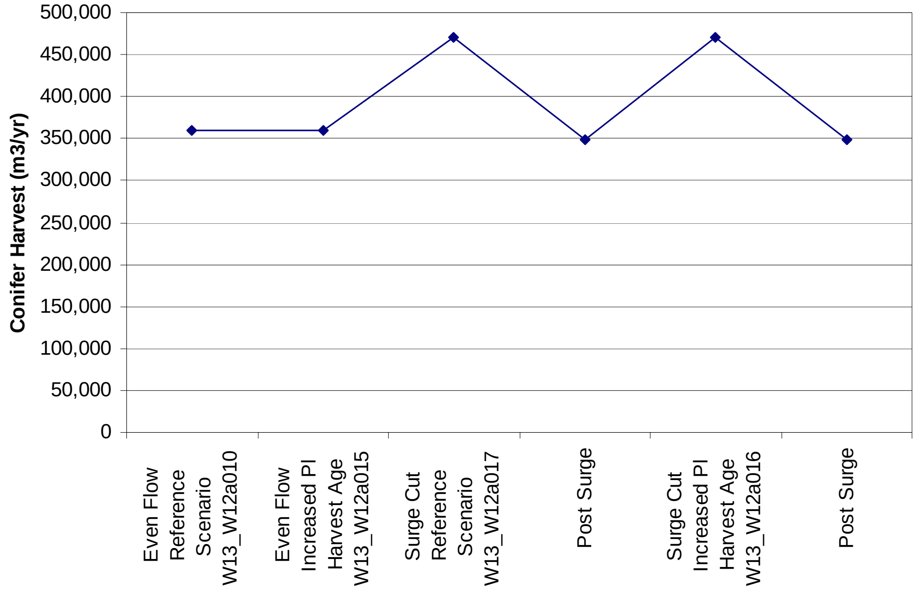


Figure 136. Coniferous harvest level by scenario.

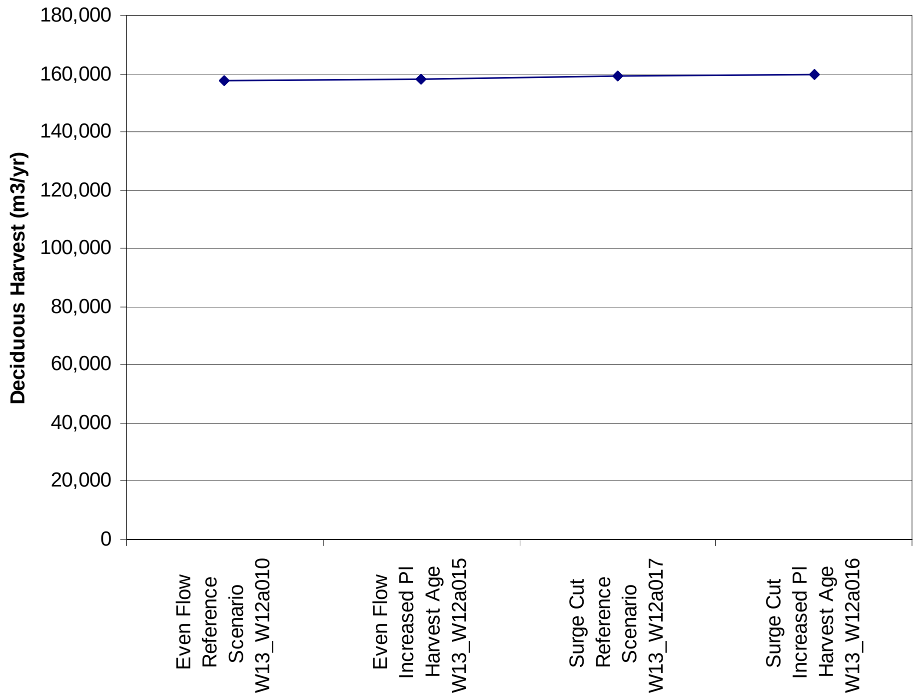


Figure 137. Deciduous harvest level by scenario.

The growing stock at the end of the planning horizon and old growth indicators showed no significant changes between comparable runs.

Discussion

Increasing the minimum harvest age of fair and medium pine sites is an option to reduce the amount of 'short' (<= 15 m) pine that is harvested during the SHS. Because of the relationship between the stand age and height; increasing the minimum harvest age of the medium and fair pine should reduce the amount of 'short' pine being harvested in the SHS.

Increasing the minimum harvest age of pine in the aspatial scenarios analyzed shows there was little effect on the harvest level achievable from the landbase. There was also very little effect on the ending growing stock or old forest area.

The reason there is no effect on ending growing stock, or Oldgrowthness area, when changing the minimum harvest age of pine in these scenarios is because the Woodstock model is harvesting the old pine first, and is deferring the younger pine until the next period. Patchworks has typically harvested more of this young pine than Woodstock, based on the amount of 'short' pine seen in the first decade of the SHS. Therefore, there may be an effect when increasing the minimum harvest age of pine in Patchworks, although it is assumed to be minimal.

A decision was made to increase the minimum harvest age of medium pine sites by 10 years and fair pine sites by 5 years.

The results of the analysis presented here were applied to both natural and managed stands, although all the analytical work was undertaken on data from natural stands. Managed stands with their better spacing are expected to produce merchantable volumes earlier, and thus the minimum harvest age is conservative for managed stands.

7.22.2 Black Spruce

Background

Within W13, the operability of black spruce has been an issue, as has the identification of long-term operability through the attributes available on the landbase. Many of the attributes investigated by Millar Western that could be used to classify the black spruce (Sb) were shown to be unreliable.

Millar Western proposed two methods of dealing with the black spruce on the landbase (Annex II). Both methods included the classification of all black spruce stands classified in the SHS to one of three categories, Operable (currently operable), Deferred (will be operable in the Future), or Non-Productive (never operable). After classifying the black spruce stands into one of these categories there would be a percent reduction (area or volume) applied to the black spruce portion of the AAC.

Millar Western's proposed handling of marginal black spruce was acceptable to the Alberta government under two conditions. Firstly, that the area reduction method be applied to all black spruce stands outside the SHS that were not field checked and secondly, that the proposed 'Deferred' category from the SHS review not be used. Deferred black spruce stands must be deleted from the landbase (Annex II).

Since it is not appropriate to delete or harvest the black spruce that is not yet merchantable, but will be in the future, there was discussion of increasing the minimum harvest age to reduce the amount of 'deferred' black spruce. Five scenarios were run to show the effect on the harvest level from increasing the minimum harvest age of black spruce. These scenarios started with Millar Western initial minimum harvest age for black spruce and then increased the ages by five year increments (Table 62).

Table 62. SB minimum harvest age by run name and number

	TPR		
Run Name (Number)	**G**	**M**	**F**
Reference Scenario (W13_W12a010)	86	91	-
Sb +5 years(W13_W12a011)	91	96	-
Sb +10 years(W13_W12a012)	96	101	-
Sb +15 years(W13_W12a013)	101	106	-
Sb +20 years(W13_W12a014)	106	111	-

An assumption made when increasing the minimum harvest age of black spruce to reduce the area in the 'Deferred' category is that the height of the trees is correlated to the age of the trees. This assumption may be true, generally, for upland black spruce sites; but generally when all black spruce sites on the managed landbase are analyzed this trend does not hold true. Figure 138 shows the height of the black spruce on the managed landbase in W13 based on the age of the trees. The bars represent the amount of area in each height class and the colours the amount of area within each age class. For example, height class 15 meters is over 95% comprised of stands over 85 years and the 10 meter height class is comprised of over 95% of stands 85 years of age and under. However, between 14 and 20 meters, about half of the stands are comprised of stands over 125 years of age. The conclusion was that older black spruce stands are not necessarily taller than younger stands.

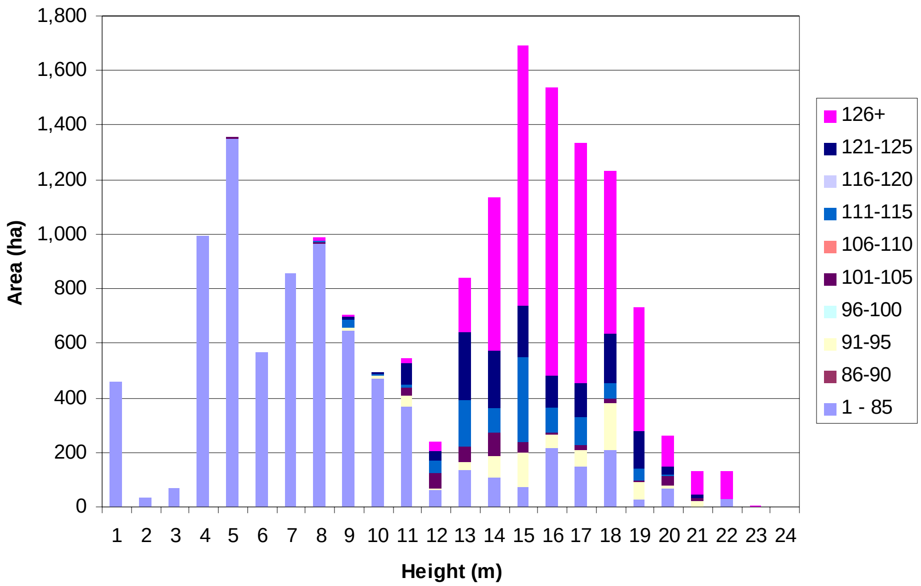


Figure 138. Area by height of the managed SB stands in W13 based on Age

Results

The forecasting scenarios for black spruce included numerous constraints such as an evenflow harvest level in all scenarios; forcing all planned blocks; non-declining yield of growing stock; ensuring all crop plans are thinned at least once; ensuring 50% of the mixedwood area, by species strata, remained at the end of the year; and a minimum of 10% of the landbase being Oldgrowthness.

Figure 139 shows the conifer harvest level derived from each scenario. Increasing the black spruce minimum harvest age resulted in a small decrease in the conifer harvest level. The deciduous harvest level showed very little change (Figure 140). Figure 139 presents the operable conifer growing stock at the end of the planning horizon. These levels change in the scenarios due to the changing operability ages and amount of black spruce harvested from the scenario. There was a decrease in average annual area harvested by scenario as the minimum harvest age increased, from 165 ha/yr in the reference scenarios to 110 ha/yr in the +20yrs scenario.

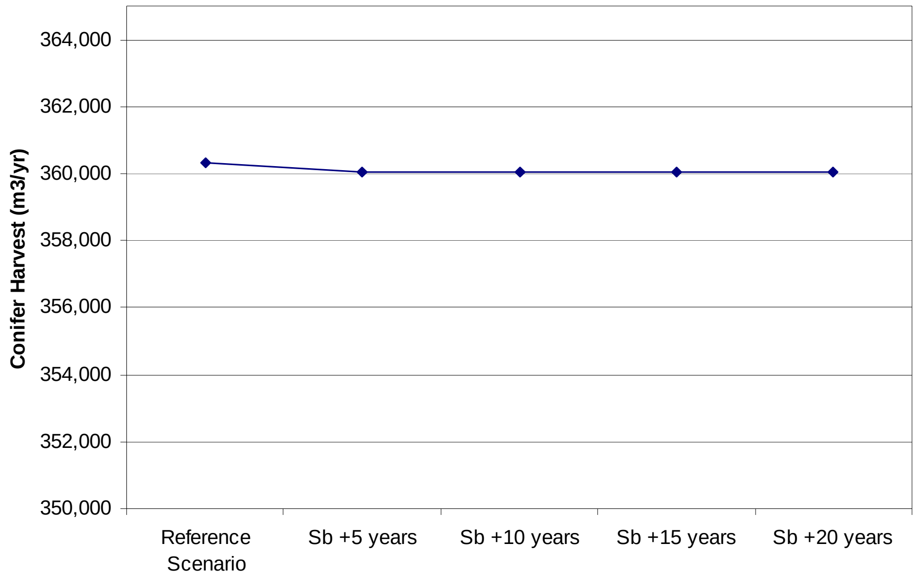


Figure 139. Conifer harvest level by scenario.

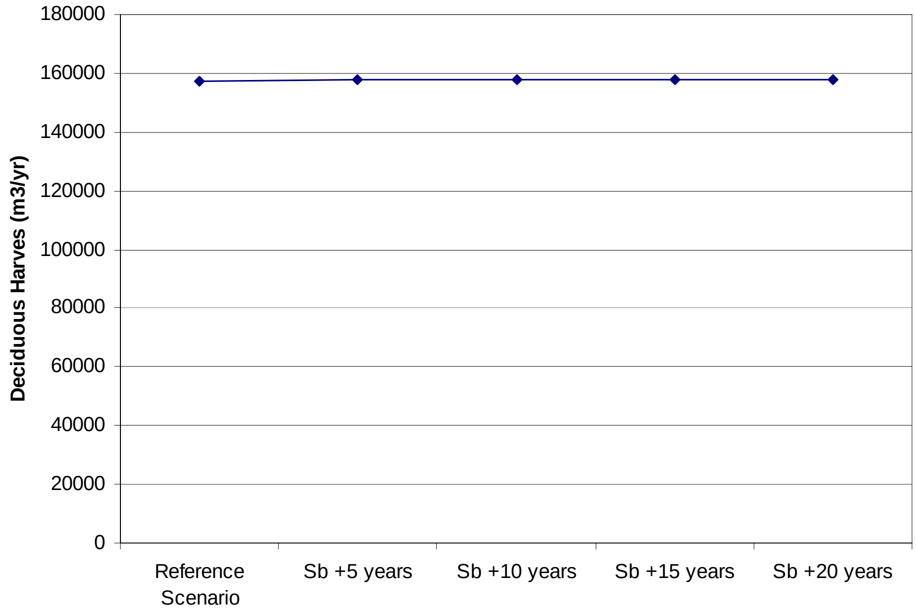


Figure 140. Deciduous harvest level by scenario.

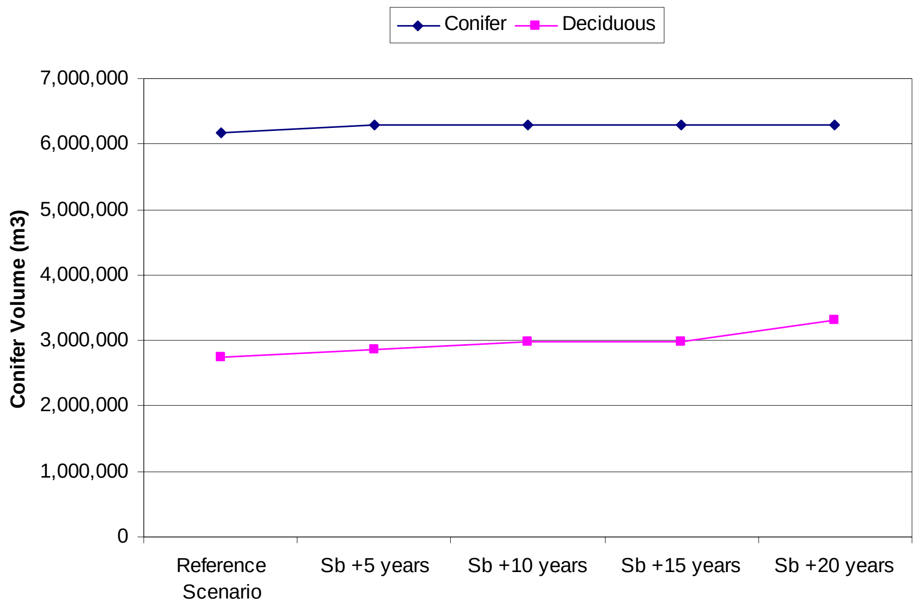


Figure 141. Coniferous operable growing stock at the end of the planning horizon.

Increasing the minimum harvest age of black spruce causes the coniferous harvest level to decrease,. The deciduous harvest level stays fairly constant in all of the scenarios as the model is optimizing coniferous harvest volume and there is very little incidental deciduous volume in black spruce sites. There is an increase in the average harvest age of black spruce over the planning horizon (Table 63), although this does not necessarily relate to an increase in average height harvested from the forest.

Table 63. Average harvest age in years by decade and over the planning horizon.

	Decade 1	Decade 2	Planning Horizon
Reference Scenario	143	115	101
Sb +5 years	146	119	107
Sb +10 years	147	124	113
Sb +15 years	147	124	111
Sb +20 years	154	134	121

Discussion

Overall, there is no evidence to suggest that increasing the minimum harvest age of black spruce will achieve the goal of reducing the amount of 'Deferred' black spruce harvested in the SHS. As indicated in Figure 138, the correlation between height and age is not strong. Some very young black spruce is tall enough to be harvested while some very old black spruce is not tall enough for harvest. The height of black spruce is more closely related to site than to age.

A more appropriate method of assessing the black spruce could be researched for the next DFMP but it is not available for this forecasting. If the decision was made to increase the minimum harvest age this would cause a double reduction in the black spruce harvest proportion. This double counting would involve a reduction in harvest associated with increasing the minimum harvest age and secondly from field reviewing sites and decreasing the cut due to non-operable black spruce site percent; which would not likely change due to the increased minimum harvest age. Also Millar Western would still be forced to assess the black spruce sites on the landbase and reduce their harvest level based on the percent of the sites that are ‘Non Operable’. Example calculations are shown in Table 64. Note that these numbers are examples and are not based on the forecasting analysis.

Table 64. Example Calculation showing how increasing the Sb minimum harvest age would cause a double reduction in the Sb harvest proportion.

With Minimum Harvest Age Increase			Without Minimum Harvest Age Increase		
Baseline harvest Level	10000	m3 / yr	Baseline harvest Level	10000	m3 / yr
With Minimum Harvest Age Increase	9000	m3 / yr			
Percent Reduction (45%)	4950	m3 / yr	Percent Reduction (45%)	5500	m3 / yr
Final Sb Harvest Level	**4950**	**m3 / yr**	**Final Sb Harvest Level**	**5500**	**m3 / yr**

Because there was no evidence to support increasing the minimum harvest age of black spruce in an effort to increase the amount of questionable black spruce sequenced, the minimum harvest ages were not changed.

7.23 Long Run Sustained Yield Average (LRSYA)

7.23.1 Background

The Long Run Sustained Yield Average (LRSYA) is the theoretical maximum harvest level that can be harvested indefinitely. Long Run Sustained Yield Average values presented here are based on the natural origin curves and managed landbase areas, as the majority of the landbase is currently of natural origin. Additionally the maximum Mean Annual Increment (MAI) was determined based on the objective function that was used in the FMU. This means that, as the W11 model’s objective function was the maximization of the total volume harvest, the MAIs are based on the age at which the total MAI is maximized.

7.23.2 Results

The MAIs in Table 65 represent the coniferous and deciduous MAIs when the total MAI is at its maximum. The areas are broken down by yield strata. The table shows the contribution of each yield strata to the total LRSYA. Again these values represent the maximum harvest if each stand was managed to maximize the MAIs of the stand. This assumption would ignore other forest Values and objectives and would not be consistent with any other decisions made regarding the PFMS. Table 66 presents the same information for W13.

Table 65. W11 LRSYA based on natural curves.

Species		MAI			Harvest Level (m^3/yr)	
Strata	Density	Conifer	Decid	Area (ha)	Conifer	Decid
AWPB	AB	0.04	1.71	8,186	327	13,998
	CD	0.47	1.73	45,272	21,278	78,321
AP	ABCD	0.73	1.26	1,510	1,103	1,903
AS	ABCD	0.73	1.26	4,913	3,587	6,191
PA	ABCD	1.46	0.83	1,573	2,297	1,306
SA	ABCD	1.46	0.83	5,075	7,410	4,212
PL	AB	1.04	0.12	3,593	3,737	431
	CD	1.66	0.35	8,031	13,331	2,811
SW	AB	0.84	0.30	2,864	2,405	859
	CD	1.53	0.79	6,641	10,160	5,246
Total				87,658	65,635	115,277

Table 66. W13 LRSYA based on natural curves.

Species		MAI			Harvest Level (m^3/yr)	
Strata	TPR	Conifer	Decid	Area (ha)	Conifer	Decid
AWPB *	G	0.61	4.12	6,113	3,735	25,160
	M	0.50	2.19	41,290	20,837	90,401
	F	0.41	1.42	10,471	4,345	14,865
BW	All	1.03	1.22	1,106	1,139	1,349
AP	G	1.59	2.79	1,051	1,671	2,933
	M	1.36	1.89	4,073	5,539	7,698
	F	1.14	0.98	923	1,052	905
AS	G	1.32	1.59	2,124	2,798	3,379
	M	1.24	1.42	13,190	16,291	18,788
	F	1.18	1.30	3,829	4,518	4,976
PA	G	2.35	0.61	3,791	8,893	2,319
	M	1.59	0.58	5,564	8,833	3,250
	F	0.61	0.55	1,007	610	552
SA	G	2.14	0.91	3,811	8,160	3,456
	M	1.57	0.79	12,467	19,580	9,848
	F	1.14	0.73	1,440	1,642	1,044
PL	G	2.88	0.51	18,717	53,931	9,560
	M	2.20	0.35	41,825	91,931	14,710
	F	1.34	0.16	6,157	8,256	971
SB	G	2.45	0.02	3,866	9,458	74
	M	1.36	0.02	11,787	15,978	240
	F	0.80	0.02	1,156	921	20
SW	G	2.50	1.05	3,313	8,270	3,474
	M	2.13	0.51	12,039	25,619	6,155
	F	1.71	0.07	1,507	2,569	108
Total				212,615	326,577	226,235

* Represents the area wieghted MAI between W5 and W9 curves

These results are compared to the PFMSs and other selected runs in section 7.30.

7.24 Mountain Pine Beetle (MPB)

MPB is a native forest pest in Western Canada and has typically existed at endemic levels. There have been historical MPB outbreaks, but none have been at the magnitude of the current outbreak in British Columbia and Alberta. There is debate regarding the cause of the current outbreak including effective forest protection which has caused an over mature forest and global warming, causing warmer winters, that have reduced winter mortality of MPB.

Since the current rate of MPB spread is unprecedented, it is difficult to predict its behaviour. Through the past number of years, during the development of 2007-2016 DFMP, there has been a change in the Alberta government's approach to the management of MPB. When Millar Western initially explored the possibility of pursuing a MPB scenario it was positively but cautiously received from the Alberta government. About this time, the first MPB stand susceptibility prediction models were being distributed in Alberta. This first model predicted that very little area within W13 was susceptible to MPB attack. This model under went a number of minor changes in the subsequent months, increasing the susceptible area on Millar Western's landbase. The Alberta government's models only predicted the amount of area that was susceptible to MPB attack for current forested conditions (*i.e*. they are static models) and did not account for stand growth. From a long term forest management perspective, if MPB is in Alberta to stay, which it arguably is, it would be advantageous to dynamically model MPB susceptibility and include it as an indicator in the forecasting models. To permit MPB susceptibility to be addressed directly in the forecasting models along with indicators for other values, Millar Western created dynamic MPB susceptibility curves, which show changes in stand susceptibility through time. This method closely mimicked the area of susceptible pine at the start date, based on the Alberta government's model, but accounted for dynamic changes to susceptibility through time. During the modeling process Millar Western used their dynamic MPB susceptibility to favour pine stand allocation in W13 as part of their MPB strategy. The Alberta government MPB ranking was used for reporting and field knowledge in the SHS review and compartment sequencing.

In Sept 2006 the Alberta government released the Mountain Pine Beetle Interpretive Bulletin describing the steps to develop and approve MPB forest management plans. W13 meets the requirements of this bulletin with the exception of the MPB Outbreak scenario which will be provided in a separate annex to the plan.

The W13 compartment sequencing addressed the MPB compartment risk and the surge cut reduced the area of rank 1 and rank 2 stands by 25% over 20 years (Table 67). Refer to page 153 for more information. A larger reduction in rank 1 and 2 stands would require an increased harvest level and would force the harvest of non-merchantable stands. Given the current state of the MPB and the other values and objectives to be addressed Millar Western had proposed a more modest increase in harvest level. If however, the MPB infestation should be worse than anticipated or arrive faster then an increase in harvest level may be required.

Table 67. W13 ASRD MPB Rank 1 & 2 areas and percentage reduction from PFMS.

	Rank 1		Rank 2		Rank 1+ Rank 2	
Year	Area (ha)	Reduction (%)	Area (ha)	Reduction (%)	Area (ha)	Reduction (%)
2007	3,376	baseline	82,184	baseline	85,560	baseline
2017	1,859	45%	68,224	17%	70,083	18%
2027	1,428	58%	62,479	24%	63,907	25%
2037	626	81%	54,801	33%	55,427	35%
2047	293	91%	45,684	44%	45,976	46%
2057	179	95%	34,900	58%	35,079	59%
2067	119	96%	25,619	69%	25,737	70%
2077	92	97%	18,455	78%	18,546	78%
2087	88	97%	13,692	83%	13,780	84%
2097	88	97%	11,093	87%	11,181	87%
2107	84	98%	9,595	88%	9,679	89%

7.25 SHS Review

7.25.1 Background

The current Planning Standard requires companies to follow the SHS developed during their DFMP. Beyond a 20% deviation, companies must justify the reasons for deviating from the sequence.

There was great effort put into ensuring the sequences that were produced by Patchworks were socially, economically, and biologically operable with the 20% deviation allowed. Many different data sources were included in the process. Data sets include variability and error, which can affect the reliability of the sequences. Additionally there are other considerations that affect the feasibility of implementation which are too difficult to include in the forecasting modeling. Some of these considerations include the economics of road construction across unidentified features, block shapes, and local variations. In another example, the model cannot, as the information is not provided, tell the difference between two good site 70 year old pine sites, even though one may be more merchantable than the other. A SHS review allows factors such as these to be addressed.

The operational feasibility review process was completed at different scales and intensities depending on knowledge of the areas under review. For some compartments the block shapes were simply reviewed on the orthophoto’s to check the feasibility of the sequence. In other areas it was necessary to field check the sequence. Two full reviews were completed in W13 and one full review was completed in W11, though other smaller scale reviews were also completed. The first review was in August 2005 and the second review was in the fall of 2006. These two full reviews will be discussed separately below.

August 10, 2005 review and sequence

The first sequence that was sent for full review was created on August 10, 2005. This sequence was thought at the time to be the starting point for a final SHS (Run40001). This run was provided to the interested groups for review. There were two major sets of findings that from this review and they are explained by the two groups who extensively reviewed the sequence, Millar Western and IQAFF.

Millar Western field reviewed the majority of this SHS. There were a number of findings but arguably the 2 most important were regarding the compartment sequence and black spruce. These two issues were somewhat related.

Millar Western found that a significant area of the black spruce that was reviewed was not yet merchantable, or was of concern for regeneration. The data from their review, in terms of which stands were accepted and rejected, was analyzed to try to make a rule set which would allow the SB on the landbase to be subjected evaluated, where non-merchantable stands could be removed easily. It was found that the only indicator that was somewhat accurate as to the merchantability of the sites was the moisture regime. Though this allowed a group of the black spruce that was consistently merchantable to be identified, it did not allow the remaining site, which were still split between merchantable and non-merchantable to be identified. The learning's from this analysis drove the BAP SB strata to be broken into upland and lowland.

Somewhat related to this it was found in the review that the compartment sequence forced on the model did not produce the optimal sequence. It was decided after this review was completed, along with the increase in the MPB priority in sequencing that it would be possible to incorporate the suggestions of the BAP IAG compartment sequence (*Appendix XI – Biodiversity Based Compartment Prioritization)*, to reduce the MPB risk, and incorporate the learnings from this review to create a more favourable sequence.

As stated the BAP IAG reviewed the preliminary MPB sequence and provided a summary of their findings in *Appendix X – Biodiversity Analysis of the PFMS.* This review was used to help further guide the PFMSs sequence. Additional targets on Oldgrowthness levels of D and DC broad cover groups were added.

Summary

Overall the review of the August 2005 sequence provided feedback that was used to improve the harvest sequencing from the model in W13. There were also additional targets added to the model to address the concerns of the BAP IAG group before the final sequence was completed. This review was invaluable to the process.

Fall 2006 Review

The second review was started on the sequence W11_P12002 for W11 and W13_P12003 for W13. Updated information was fed back into the models and they were then rerun to balance any changes that were made in the field review. The number of times this was completed varied by FMU.

The W11 field review mainly involved ensuring that the blocks sequenced were operational feasible shapes and areas. The final sequence did not differ in any great manner from the initial reviewed version. All parties interested in this sequence, the Alberta government, and quota holders, were involved with this review.

In W13 the field review varied in intensity by area. In some areas the review was simply the review of block shapes to ensure feasibility. In some areas the sequence was modified for biological reasons. After meetings with fish and wildlife branch representatives there was a significant amount of area surrounding water buffers that were deferred for biological reasons. In some areas the review was modified to include stands that had MPB populations within them, and adjacent high risk stands. Probably the most complex portion of this review related to the handling of pine around the minimum harvest age. This minimum harvest age of pine is described in section 7.22, and occurred during this review.

In numerous stages of this review the work that had been completed on the review was loaded into the model and Patchworks was allowed to rebalance the un-reviewed portions of the sequence. The final step in this review occurred after all areas of the sequence had been reviewed and related to the black spruce net down. This process is described in section 7.25 of the review.

Groups Involved

This sequence was reviewed with stakeholders interested or affected by the sequence. These interested parties included quota holders, the Alberta government (forestry and fish and wildlife), and trappers. All of these groups were given the information they required to review the sequence.

For the forestry operators in the FMA they received shapefiles of SHS and other merchantable area on the landbase, results packages, and 1:15,000 maps of all compartments. The Alberta government was provided with the same information, and an individual review of the sequence was completed with Fish and Wildlife department. The trappers in the FMA all received maps of their trapline areas with the planned harvest shown for the SHS and were provided tables describing the impact upon the forest within their trapelines. Information from the forestry operators and trappers was assembled by Millar Western and used to finalize the SHS.

7.26 Black Spruce Thinning

7.26.1 Background

Black spruce operability has been an issue throughout the development of the DFMP. Numerous discussions have occurred regarding management of black spruce, including the option of thinning some or all of the black spruce stands. The effects of thinning at different scales was assessed in terms of its affect on the harvest level. Thinning and clearcutting were compared to a no black spruce harvest scenario to evaluate the effect of different treatments. Additionally a 50% clearcut, 50% thinning scenario was evaluated.

Multiple possible thinning harvest regimes for black spruce were considered. Only the final sets of thinning treatments were forecasted in scenarios. The selected treatment was based on a single thinning of stands with volume recovery occurring post thinning.

7.26.2 Results

The baseline scenario allowed no treatment on black spruce stands. The next scenario analysed allowed clearcutting of all black spruce stands which increased the coniferous harvest level by 11.4% while decreasing the deciduous harvest level by 6.2%. When only thinning was allowed on all black spruce stands the coniferous harvest level increased by 4.2% when compared to the no treatment run, while the deciduous harvest level decreased by 3.7%. The final scenario allowed half of the stands to be clearcut while half had to be thinned. This scenario resulted in an increase of 6.8% in coniferous harvest and decrease of 3.7% in deciduous harvest when compared to the no harvest scenario.

Table 68. Harvest level effect of different Sb treatment regimes.

		Harvest level Change (%)		
Scenario	**Name**	**Conifer**	**Decid**	**Total**
W13_W9013	No Sb Treatment	-- Baseline --		
W13_W9010	Clearcutting Sb	11.4%	-6.2%	5.6%
W13_W9011	Thinning Sb	4.2%	-2.3%	2.1%
W13_W9012	50% thinning and 50% clearcutting	6.8%	-3.7%	3.5%

7.26.3 Discussion

The largest impact on the harvest level occurred when the black spruce areas were eligible for clearcutting, with a smaller positive effect associated with allowing thinning only. The thinning approach would allow better regeneration of the sites as the trees remaining on the site would reduce the post harvest water table increase, which is often an issue in regenerating black spruce stands. When the half and half treatment was examined, the majority of the increase that occurs is due to the clearcutting portion of this scenario.

Due to the small volume benefits associated with allowing thinning of black spruce stands, compared with high implementation cost, Millar Western elected to remove additional black spruce stands from the sequence and apply only the clearcut treatment on the remaining stands.

7.27 Black Spruce Net Down

7.27.1 Backgound

Black spruce operability was a topic of discussion throughout the planning process in W13. In W11 the quota holders, who have rights to harvest all coniferous volume in W11, subjectively deleted all black spruce stands. Typically black spruce stands have often proved to be borderline operable in many cases, both in terms of harvest volume and regeneration.

In W13 the situation is different and a different approach was applied. Alhough there are many stands that are operable and valuable, the DFA harvest planning committee and TSA IAG could not identify an attribute set that would accurately classify the black spruce on the landbase.

The process that was agreed upon by Millar Western and the Alberta government for the handling of black spruce on the landbase involved a review of the SHS scheduled black spruce stands (refer to Annex II for proposal and final response). Millar Western agreed to assess all of the black spruce stands in the first 10 years of the SHS and remove all non-operable stands from the landbase. The percent of the stands that were deleted from the SHS would then be calculated and this percent was applied to all black spruce polygons on the landbase that were not in the first 10 years of the SHS. This step reduces the managed landbase, and was completed after a final SHS was developed.

Once the SHS review was completed, Millar Western developed a set of rules that were to be used to identify the non operable stands within the sequence. Though it was not possible to develop a rule set that worked on the entire landbase, this rule set was able to classify a subset. This rule set developed incorporated site visits and examination of orthophotos.

7.27.2 Results

The final rule set used to net down the black spruce is shown in Figure 142.

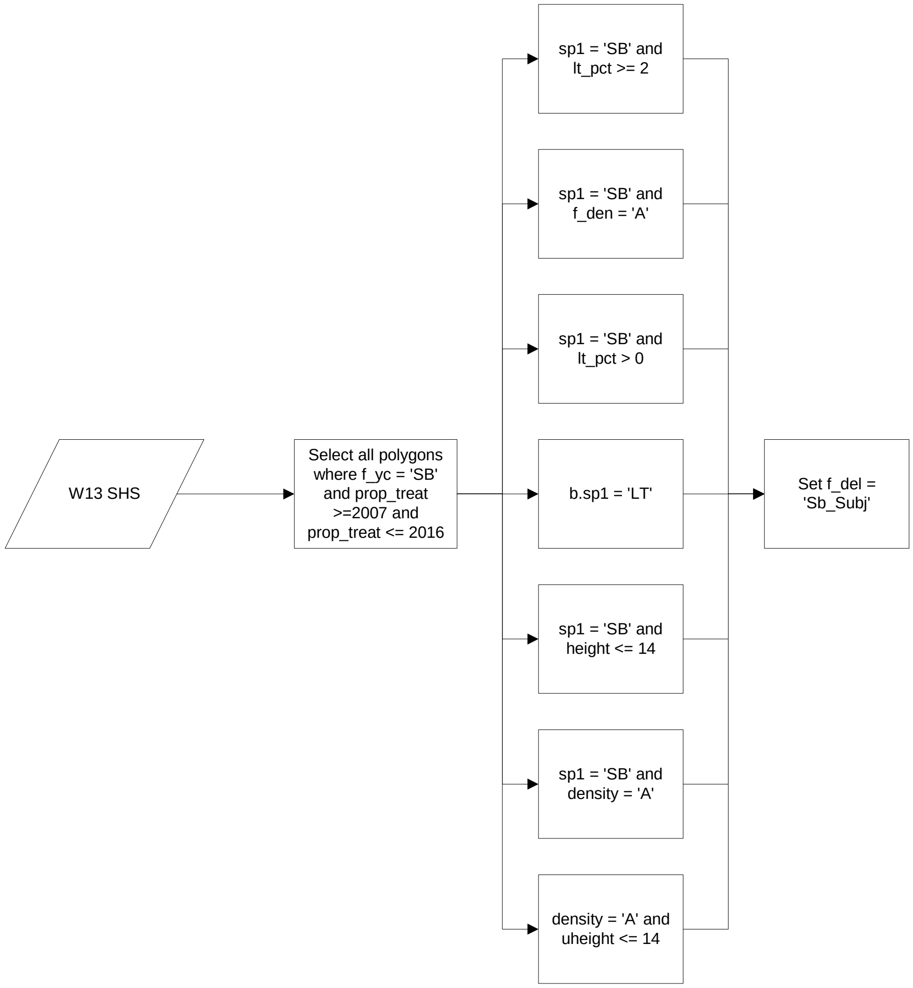


Figure 142. Process used to select the subset of the SHS to delete

The SHS including the black spruce stands to be excluded, contained 25,891 ha of scheduled area in the first 10 years. Of this 3,233 ha was classified in the black spruce species strata (SB). The process discussed above deleted 1,155 ha of this 3,233 ha or 35.7% of the SB in the first 10 years of the SHS. All of these polygons were given a final deletion code ("SB_SHS" in the f_del field) in the final landbase.

Subsequently a 35.7% reduction in area was applied to all black spruce classified polygons that were not in the first 10 years of the SHS. The SHS was locked into the model and the model was allowed to balance the effects of the proportional black spruce reduction in the remainder of the planning horizon.

7.28 Inside/Outside FMA Harvest

7.28.1 Background

Millar Western does not currently have authority to harvest deciduous timber outside of the FMA but within FMU W11 or W13. Millar Western requested that DTAs be issued for both W11 and W13 and at the same time proposed an approach for calculating the harvest level within the FMU that is outside of the FMA (Communication, J. Russell to D.A. Sklar, July 18, 2006, refer to Annex II). The approach involved calculating the sustainable harvest levels from the FMUs and corresponding FMA areas and extrapolating the non-FMA areas from this information. This approach for calculating the FMU and FMA harvest levels was agreed to by the Alberta government.

The runs used to compare the FMU versus FMA harvest levels were completed in Woodstock. The runs contained the non-spatial constraints included in the PFMS, but did not include the surge cuts. The 8 steps identified in the letter were:

1. Model non-spatial sustainable AAC for TSA Area, including FMA area and Grazing Dispositions. (TSA_AAC_NS).
   - Woodstock non-spatial TSA tool.
2. Model non-spatial sustainable AAC for FMA Area. (FMA_AAC_NS).
   - Woodstock non-spatial TSA tool.
3. Calculate non-spatial sustainable AAC for Grazing Disposition Area. (Grazing_Disposition_AAC_NS).
   - Grazing_Disposition_AAC_NS = TSA_AAC_NS – FMA_AAC_NS
4. Calculate proportion of FMA Area sustainable AAC within TSA Area sustainable AAC. (FMA_%AAC_NS)
   - FMA_%AAC_NS = FMA_AAC_NS / TSA_AAC_NS
5. Calculate proportion of Grazing Disposition Area sustainable AAC within TSA Area Sustainable AAC. (Grazing_Disposition_%AAC_NS)
   - Grazing_Disposition _%AAC_NS = Grazing_Disposition _AAC_NS / TSA_AAC_NS
6. Model spatial sustainable AAC for TSA Area. (TSA_AAC_S)
   - PatchWorks spatial TSA tool.
7. Calculate spatial sustainable AAC for FMA Area. (FMA_AAC_S)
   - FMA_AAC_S = TSA_AAC_S * FMA_%AAC_NS
8. Calculate spatial sustainable AAC for Grazing Disposition Area. (Grazing_Disposition _AAC_S)
   - Grazing_Disposition _AAC_S = TSA_AAC_S * Grazing_Disposition _%AAC_NS

7.28.2 Results

Table 69 shows the FMA harvest levels for both FMUs under the reference letter number 1, and the FMA harvest levels under number 2. The grazing disposition harvest level was the FMU harvest minus the FMA harvest level. The percent allocations in numbers 4 and 5 were calculated by dividing numbers 2 and 3 respectively by the FMU harvest level. Number 6 shows the PFMSs harvest levels. This was used with numbers 4 and 5 respectively to calculate the inside / outside harvest levels in 7 and 8.

Table 69. Inside/outside FMA harvest calculations.

DTA Letter Reference*	FMU	Description	Deciduous	Coniferous
1	W11	TSA_AAC_NS	112,001	64,166
	W13	TSA_AAC_NS	157,627	348,509
2	W11	FMA_AAC_NS	109,330	63,052
	W13	FMA_AAC_NS	151,442	340,432
3	W11	Grazing_disposition_AAC_NS	2,671	1,114
	W13	Grazing_disposition_AAC_NS	6,186	8,077
4	W11	FMA_%AAC_NS	98%	98%
	W13	FMA_%AAC_NS	96%	98%
5	W11	Grazing_Disposition_%AAC_NS	2%	2%
	W13	Grazing_Disposition_%AAC_NS	4%	2%
6	W11	Patchworks spatial TSA	148,049	97,030
	W13	Patchworks spatial TSA	209,412	435,844
7	W11	FMA_AAC_S	144,518	95,345
	W13	FMA_AAC_S	201,194	425,743
8	W11	Grazing_Disposition_AAC_S	3,531	1,685
	W13	Grazing_Disposition_AAC_S	8,218	10,101

* July 18, 2006 letter to D.A. Sklar, re: DTA's for unallocated deciduous volume

7.28.3 Discussion

The volume outside of the FMA area in W11 would all be associated with the Millar Western requested DTA. The W13 volume outside of the FMA would be accounted for between the Weyerhaeuser harvest that occurs outside of the FMA and Millar Westerns harvest outside of the FMA.

7.29 Annual Update Procedure

7.29.1 Background

The current planning process in Alberta requires companies develop a DFMP every 10 years; including a classified landbase, and yield curves for use in forecasting. The forecasting calculates the recommended sustainable harvest level associated with the PFMS, which requires approval from the government. This harvest level is effective until the next DFMP, or forecasting revision. A new forecast could be required for a number of different reasons including a:

1. change of more than 2.5% to the managed landbase, or
2. change to the forest management strategy by the company, or companies operating on the area.

Referring to point 1 above, the primary influences that would result in a greater than 2.5% change to the DFA has, historically, been land withdrawals associated with oil and gas development and or major forest fires. The area that would need to be affected in the DFMP planning period to cause a recalculation can be seen in Table 61. Landbase loss concerns that were dealt with during the DFMP development were restricted to the influence of land withdrawals from the DFA, as there is currently no government policy around the cumulative affects of land withdrawals on the DFA forest landbase.

Table 70. Maximum landbase loss permitted before a required AAC recalculation.

FMU (ha)	
W11	W13
2,184	5,310

As referenced in the classified landbase, the oil and gas industry, via land withdrawals, have a significant impact on the amount of land available for timber production. FMA holders, however, are not required to account for these removals through TSA updates unless they meet one of the above conditions for large removals. In Millar Western's case literally tens of thousands of hectares associated oil and gas exploration and production have substantially suppressed the long term harvest levels.

When oil and gas dispositions are issued by the Alberta government, the land is removed from Millar Western's FMA/DFA and the disposition holder then has rights to the timber and land that is covered by the disposition. Currently, Millar Western charges and collects timber damage assessment monies for the value of this timber, reforestation costs (depreciated silviculture costs of reforestation), and annual allowable cut loss. These timber damage assessment values are calculated each year as negotiated through the Joint Management Committee (JMC) and are used in the timber damage assessment (TDA) tables. FMA holders use these values to invoice (timber damage assessment) the disposition holder as permitted through the FMA. It is important to note that JMC does not prescribe or negotiate any of the methodology or process used to calculate volumes originating from their dispositions/ land withdrawals. JMC is only in place as a voluntary body to negotiate the methodology to calculate timber damage compensation and the interpretation of the master withdrawal agreement.

The Alberta government requires all merchantable timber to be salvaged by the disposition holder and directs Millar Western to acquire all the timber cut by oil and gas companies, although they do not oblige the oil and gas disposition holders to direct the timber resource to any forest company. Historically, ASRD has calculated and prescribed a single volume/ha value for coniferous and deciduous species for Millar Western to use when calculating volume depletion from each land withdrawal. ASRD has required Millar Western use this ‘theoretical’ volume calculation to drain the current allowable cut each year via timber production audits and quarterly timber returns. It is believed by ASRD that this process encourages industrial salvage purchasing by FMA holders although the FMA’s have no control or ability to accurately forecast or track the potential for salvage volumes. It is important to note that through Millar Western tracking and analysis, it was concluded that that only 50% of the coniferous volume drain from the AAC was in fact realized across their mill’s weigh scales.

The current the Alberta government process for tracking and charging industrial salvage is problematic. There is no statute that requires forest companies to apply volume that has been generated by a non-forest company via a land withdrawal other than the requirement for payment of timber dues (see Section 31 (1) of the FMA Agreement). The volume actually produced by way of a land withdrawal is no longer in the DFA/FMA, therefore, is not linked to the landbase previously assumed. Through subsequent new classified landbases (and DFMP’s) these withdrawals are spatially accounted for and hence a reduction in future harvest levels will be accounted for. These land withdrawals are assumed to be permanent depletion and therefore do not re-enter the managed and operable landbase the way a cutblock does.

The requirement to charge all volume generated by way of a land withdrawal is not consistent with the timber supply assumptions currently in place. In essence FMA holders charge volume as if it was a cutblock that was assumed to be regenerating after a period of time. If all volume generated from a disposition was to be utilized one would have to divide the utilized volume by the number of years the area is to be removed from the operable landbase and use that as the basis for an AAC drain.

As an alternative to the above approach, Millar Western is proposing updating their timber supply more frequently to account for the losses associated with third-party land withdrawals. The industrial salvage volume would be available to the open market and, in view of the softwood lumber agreement, complement a competitive approach to acquiring the timber. If Millar Western or the other forest operators were to buy that timber from the other disposition holders, it would be a transaction outside of their harvest agreements, and not chargeable.

Based on the Planning Standard the classified landbase effective date must be within two years of the effective date of the DFMP. In the case of the 2007-2016 DFMP the effective date of the landbase is three years preceding the implementation date of the 2007-2016 DFMP due to the length of the planning process. Therefore, oil and gas activities on the DFA as accounted for in the DFMP landbase are three years behind from the implementation date of the DFMP.

To determine the effect of annual disposition activity, two years of data were collected, the 2004/05 timber year and the 2005/06 timber years, so that the effect of these other dispositions on the harvest level through a recalculation of the landbase could be quantified. The two years of data acquired were incorporated into the final Patchworks landbase using a polygon area reduction. Table 2 shows the amount of area affected for the two sample years. This data does not include seismic lines, only other oil and gas dispositions.

Table 71. Area affected by Oil and Gas activity annually.

	FMU (ha)	
Year	W11	W13
04/05	71	114
05/06	72	330
Average	71	222

Once the landbase was updated for the two years of dispositions it was possible to create two aspatial areas files that could be used in Woodstock. These different area files were loaded into aspatial Woodstock models, which contained constraints similar to the PFMSs, excluding spatial constraints.

7.29.2 Results and Discussion

Three runs were compared aspatially to test the effect of updating the landbase for all oil and gas activity and recalculating the harvest level. The harvest levels achieved from the different runs can be seen in Table 3. There is little effect on the harvest level of removing the area affected from oil and gas dispositions (excluding seismic lines).

Table 72. Achieved harvest levels from different scenarios.

	W13 (m^3/yr)					W11 (m^3/yr)				
		Harvest Level		Change from Baseline			Harvest Level		Change from Baseline	
Scenario	Year	Conifer	Decid			Year	Conifer	Decid		
Baseline	2007-2016	454,000	296,000	-	-	2007-2016	95,000	151,976	-	-
	2017-2206	331,724	148,938	-	-	2017-2026	63,239	151,976	-	-
						2027-2206	63,239	109,976	-	-
04/05	2007-2016	454,000	296,000	(0)	0	2007-2016	95,000	151,877	(0)	(99)
	2017-2206	331,544	148,811	(180)	(128)	2017-2026	63,193	151,877	(46)	(99)
						2027-2206	63,193	109,877	(46)	(99)
05/06	2007-2016	454,000	296,000	(0)	(0)	2007-2016	95,000	151,769	0	(108)
	2017-2206	331,012	148,517	(532)	(293)	2017-2026	63,149	151,769	(44)	(108)
						2027-2206	63,149	109,769	(44)	(108)

Although there is only a small annual effect, this effect would accumulate annually until a new TSA or DFMP is required. Table 73 and Table 74 show a theoretical harvest level through time, assuming the same average disturbance occurred for the next 10 years. The maximum change possible before a recalculation is necessary is also shown in these tables.

Table 73. Theoretical decrease and maximum decreases from annual update method in W11.

Update year	Harvest year	Harvest Level (m^3/yr) Conifer	Harvest Level (m^3/yr) Decid	Theoretical Annual Change [1] (m^3/yr) Conifer	Theoretical Annual Change [1] (m^3/yr) Decid	Cummulative Annual Change (m^3/yr) Conifer	Cummulative Annual Change (m^3/yr) Decid
2007	2007-2016	95,000	151,976				
	2017-2026	63,239	151,976				
	2027-2206	63,239	109,976				
2008	2007-2016	95,000	151,976	(0)	(104)	(0)	(104)
	2017-2026	63,194	151,872	(45)	(104)	(45)	(104)
	2027-2206	63,194	109,872	(45)	(104)	(45)	(104)
2009	2007-2016	95,000	151,976	(0)	(104)	(0)	(207)
	2017-2026	63,149	151,769	(45)	(104)	(90)	(207)
	2027-2206	63,149	109,769	(45)	(104)	(90)	(207)
2010	2007-2016	95,000	151,976	(0)	(104)	(0)	(311)
	2017-2026	63,104	151,665	(45)	(104)	(135)	(311)
	2027-2206	63,104	109,665	(45)	(104)	(135)	(311)
2011	2007-2016	95,000	151,976	(0)	(104)	(0)	(414)
	2017-2026	63,059	151,562	(45)	(104)	(180)	(414)
	2027-2206	63,059	109,562	(45)	(104)	(180)	(414)
2012	2007-2016	95,000	151,976	(0)	(104)	(0)	(518)
	2017-2026	63,014	151,458	(45)	(104)	(225)	(518)
	2027-2206	63,014	109,458	(45)	(104)	(225)	(518)
2013	2007-2016	95,000	151,976	(0)	(104)	(0)	(621)
	2017-2026	62,969	151,355	(45)	(104)	(270)	(621)
	2027-2206	62,969	109,355	(45)	(104)	(270)	(621)
2014	2007-2016	95,000	151,976	(0)	(104)	(0)	(725)
	2017-2026	62,924	151,251	(45)	(104)	(315)	(725)
	2027-2206	62,924	109,251	(45)	(104)	(315)	(725)
2015	2007-2016	95,000	151,976	(0)	(104)	(0)	(829)
	2017-2026	62,879	151,147	(45)	(104)	(359)	(829)
	2027-2206	62,879	109,147	(45)	(104)	(359)	(828)
2016	2007-2016	95,000	151,976	(0)	(104)	(0)	(932)
	2017-2026	62,834	151,044	(45)	(104)	(404)	(932)
	2027-2206	62,834	109,044	(45)	(104)	(404)	(932)
Max change[2]	2007-2016	92,625	148,177	(2,375)	(3,799)		
	2017-2026	61,658	148,177	(1,581)	(3,799)		
	2027-2206	61,658	107,227	(1,581)	(2,749)		

1 - Average of the years calculated above

2 - Assuming the 2.5% change trigger

Though forecasting models were not created for each of these periods it can be assumed these numbers are approximately equal. This is because the oil and gas activity is likely to affect a representative section of the landbase. Therefore the model results will be reduced by the same proportion in harvest as in area.

Table 74. Table 5. Theoretical decrease and maximum decreases from annual update method in W13.

Update year	Harvest year	Harvest Level (m^3/yr)		Theoretical Annual Change [1] (m^3/yr)		Cummulative Annual Change	
		Conifer	Decid	Conifer	Decid	Conifer	Decid
2007	2007-2016	454,000	296,000				
	2017-2206	331,724	148,938				
2008	2007-2016	454,000	296,000				
	2017-2206	331,368	148,728	(356)	(210)	(356)	(210)
2009	2007-2016	454,000	296,000				
	2017-2206	331,012	148,517	(356)	(210)	(712)	(421)
2010	2007-2016	454,000	296,000				
	2017-2206	330,656	148,307	(356)	(210)	(1,068)	(631)
2011	2007-2016	454,000	296,000				
	2017-2206	330,300	148,097	(356)	(210)	(1,424)	(842)
2012	2007-2016	454,000	296,000				
	2017-2206	329,944	147,886	(356)	(210)	(1,780)	(1,052)
2013	2007-2016	454,000	296,000				
	2017-2206	329,588	147,676	(356)	(210)	(2,136)	(1,262)
2014	2007-2016	454,000	296,000				
	2017-2206	329,232	147,465	(356)	(210)	(2,492)	(1,473)
2015	2007-2016	454,000	296,000				
	2017-2206	328,876	147,255	(356)	(210)	(2,848)	(1,683)
2016	2007-2016	454,000	296,000				
	2017-2206	328,520	147,045	(356)	(210)	(3,204)	(1,894)
Max change[2]	2007-2016	442,650	288,600	(11,350)	(7,400)		
	2017-2206	323,431	145,215	(8,293)	(3,723)		

1 - Average of the years calculated above
2 - Assuming the 2.5% change trigger

Issues with implementing this methodology would relate to which updates are incorporated. Ideally Millar Western would only update one year of oil and gas updates annually.

This process was completed with Woodstock, because it produces the mathematically optimally forecast, permitting better direct comparisons. This process was first undertaken using Patchworks but it is not an efficient platform to measure such small changes as it uses heuristic goal programming and small changes in inputs make small changes in the deviations from the numerous goals. Determining if slight deviations between 2 scenarios are significant is largely judgmental.

7.30 Government Requested Sensitivities

7.30.1 Background

The Planning Standard in section 5.6.iii reserves the right to request forecast scenarios be completed if the Alberta government has concerns about the yield projections used in the analysis. The Alberta government requested that a series of scenarios be completed to test the effect of the yield curves and other factors regarding the PFMSs, such as surge cuts and carryover.

Table 75 and Table 76 present the scenarios[5] completed and the constraint differences between them. These sets of scenarios allow all of the necessary effects associated with yield curves, surge cuts, and carryover to be isolated.

Table 75. Model Constraints for W11 by scenario.

Constraint	PFMS	Evenflow	No Carryover	Even Flow/BTI	20 Year PFMS/
Coniferous surge cut	x		x		x
Coniferous carryover	x	x			x
Deciduous carryover	x	x			x
Compartment sequencing	x	x	x	x	x
Planned blocks	x	x	x	x	x
Ending operable growing stock constraint	x	x	x	x	x
Minimum old forest constraint	x	x	x	x	x
Patch size distribution targets	x	x	x	x	x
Managed yields	x	x	x		

Table 76. Model constraints for W13 by scenario.

Constraint	PFMS	Evenflow	Even Flow/BTI	Worst-case
Coniferous surge cut	x			x
Meets quota commitments	x	x	x	x
Compartment sequencing	x	x	x	x
Planned blocks	x	x	x	x
Ending operable growing stock constraint	x	x	x	x
Minimum old forest constraint	x	x	x	x
Patch size distribution targets	x	x	x	x
Managed yields	x	x		
Conversion	x	x		

[5] BTI stands for back-to-itself post harvest transitions were no conversion is permitted between strata after harvesting and the same standing timber yield curves are used for regenerated yields.

7.30.2 Results and Discussion

W11

Table 77 presents the coniferous and deciduous harvest levels for the first 10 years of the SHS and the average volumes for the remainder of the planning horizon for W11. Carryover has been removed and shown in separate columns. The evenflow scenario was used as a baseline for all scenarios. The LRSYA harvest using natural curves is also included in this table.

The conifer surge cut was more than 25% above the evenflow harvest level. This surge level was approved in the PFMP for inclusion in the DFMP to mitigate the reduction of the landbase combining effect that was seen in the PFMP. Including the surge cut does not cause a drop down greater than the 10% permitted in the Planning Standard. In the back-to-itself (BTI) scenario, the harvest level was higher than the scenarios that included the managed curves. This was because there was no regeneration lag included in the natural curves and they were used as managed curves in the model, plus there was a higher level of incidental volume in the natural curves when compared to the managed curves. When carryover is removed from the scenarios it can be seen that there is little affect.

Table 77. W11 Average harvest volumes by scenario.

			Average volume (m^3/yr)			Percent Change		
Scenario	**Harvest Type**	**Year**	**Conifer**	**Decid**	**Total**	**Conifer**	**Decid**	**Total**
PFMS	Primary	2007-2016	94,359	106,049	200,408	53%	1%	21%
		2017-2206	55,752	104,667	160,419	-10%	0%	-4%
	Carryover	2007-2010	5,342					
		2007-2026		42,000				
Evenflow	Primary	2007-2016	61,725	104,580	166,304	-- Baseline --		
		2017-2206	62,086	104,625	166,711			
	Carryover	2007-2010	5,342					
		2007-2026		42,000				
No Carryover	Primary	2007-2016	96,401	108,860	205,261	56%	4%	23%
		2017-2206	55,741	108,644	164,384	-10%	4%	-1%
	Carryover	2007-2016						
		2017-2026						
Evenflow/BTI	Primary	2007-2016	66,544	113,226	179,770	8%	8%	8%
		2017-2206	66,764	112,986	179,750	8%	8%	8%
	Carryover	2007-2010						
		2007-2026						
20 Year PFMS/ Evenflow/ BTI	Primary	2007-2016	94,358	106,047	200,405	53%	1%	21%
		2017-2206	55,953	104,866	160,818	-9%	0%	-3%
	Carryover	2007-2010	5,342					
		2007-2026		42,000				

Examining the other indicators on the forest showed that there were no other unexpected results associated with these scenarios. When carryover was included there was a large amount of incidental coniferous volume harvested when compared to scenarios with no carryover. This was expected due to the high incidental volumes in W11 yield curves.

Age class of the regenerated forest was related to the age class structure of the current forest, with a greater effect on long term harvest than short term harvest level. The higher the long term harvest level, the lower the amount of old forest, while the short term levels had little effect on old forest. This same trend was observed regarding oldgrowthness .

W13

Table 78 presents the coniferous and deciduous harvest levels for the first 10 years of the SHS and the average volumes for the remainder of the planning horizon for W13.

Table 78. W13 Average harvest volumes by scenario.

			Average volume (m^3/yr)			Percent Change		
Scenario	**Harvest Type**	**Year**	**Conifer**	**Decid**	**Total**	**Conifer**	**Decid**	**Total**
PFMS	Primary	2007-2016	435,844	209,412	645,256	30%	24%	28%
		2017-2206	295,849	145,807	441,657	-12%	-7%	-10%
Evenflow	Primary	2007-2016	335,679	168,872	504,551		-- Baseline --	
		2017-2206	336,874	156,325	493,200			
Evenflow/BTI	Primary	2007-2016	298,642	202,182	500,823	-11%	20%	-1%
		2017-2206	298,639	202,438	501,077	-11%	29%	2%
20 Year PFMS/ Evenflow/ BTI	Primary	2007-2016	435,844	209,412	645,256	30%	24%	28%
		2017-2206	280,812	170,766	451,578	-17%	9%	-8%
LRSYA	Primary	2007-2016	329,296	226,235	555,531	98%	134%	110%
		2017-2206	329,296	226,235	555,531	98%	145%	113%

The surge cut harvest is 30% higher than the even flow level, and the drop down is 12% below the even flow harvest level. This surge cut will reduce the MPB susceptibility of the forest by removing older aged pine stands.

The 20-year PFMS/Evenflow/BTI scenario, represents 20 years of the PFMS then the application of very conservative regenerated yield assumptions (current timber yields and no transitions between strata after harvesting) for the remainder of the planning horizon. This results in a post drop down harvest level that is 5% below the PFMS for conifer and 2% above the PFMS for deciduous with the over all harvest level being 2% above the PFMS and 8% below the baseline.

Examining the other indicators on the forest showed no other unexpected results associated with these scenarios. When carryover was included there was a large amount of incidental coniferous volume harvested when compared to scenarios with no carryover, but this was anticipated due to the high incidental volumes in W13 yield curves.

Similar to W11, the age class of the W13 regenerated forest was related to the age class structure of the current forest, with a greater effect on long term harvest level versus short term harvest level. The higher the long term harvest level, the lower the amount of old forest remaining on the landbase, while the short term harvest level did not impact old forest levels to the same degree.

7.30.3 Summary

The PFMSs that Millar Western and the quota holders propose to implement over the next 10 years include coniferous surge cuts in both FMUs and in W13 there is also a small deciduous surge cut. In FMU W11 carryover volume is included in both the coniferous and deciduous harvest levels, while W13 had no carryover modeled. Considering other values, the small negative effects of these surge cuts were deemed acceptable.

Overall the largest change in harvest levels from the previous timber supply determination occurs in W13. The forecasting and timber supply assumptions in W13 changed significantly throughout plan development, especially the yield curve assumptions and the emergence of the MPB strategy. The W13 surge cut was developed to mitigate the impact of the MPB infestation, but if the infestation is worse than expected, harvest levels may have to be increased.

8. Conclusion

Millar Western has been harvesting in the Whitecourt area since 1922 and will continue harvesting for many years into the future. The company lead the development the 2007-2016 DFMP which will direct forest management activities from May 1, 2007 until April 30, 2016 over their Forest Management Agreement area encompassing FMUs W13 and W11. This chapter described the process used to develop the W11 and the W13 PFMSs with their associated recommended harvest levels and Spatial Harvest Sequences.

Building upon the previous timber supply analysis in the 1997 DFMP, Millar Western set out on an ambitious direction for improvement by embracing CSA's value, objective, indicator and target process, increasing the scope and number of values forecasted and directly considered within the trade-off process. Millar Western and the plan development team were ultimately successful with this new direction and it permitted the company to more effectively balance the competing values thus producing more comprehensive Preferred Forest Management Scenarios. A few of the many successes achieved are:

- Success in integrating a wide ranging group of disciplines into an effective multi-disciplinary planning team to address critical management issues;
- Success in expanding the number and scope of Values, represented as Indictors directly considered in the trade-off process used in developing the Preferred Forest Management Scenario;
- Success in using more indicators representing a greater range of Values as drivers in the development of the Preferred Forest Management Scenario;
- Success in achieving a significant reduction in mountain pine beetle risk to the forest while balancing the conflicting values of biodiversity maintenance and increases in water runoff;
- Success in involving a wide range of harvesting operators in the development of an effective Spatial Harvest Sequence;

All of these successes were achieved during a period of rapid change in the industry's competitiveness, unprecedented threat from MPB and the rollout of new government planning standards during plan development.

The resulting PFMSs represents balanced social, biological and economic factors as derived through the trade-off analysis. This included operational considerations and economically feasible block design in the creation of the Spatial Harvest Sequence associated with each Preferred Forest Management Scenario. Two Preferred Forest Management Scenarios were created, one for each of W13 and W11. The PFMSs included a 10-year surge cut of coniferous harvest in both W13 and W11. In W13 this surge cut was developed to mitigate the risk associated with a large scale MPB epidemic and to align the pine age class distribution with the Alberta government's healthy pine forest strategy (ASRD (2)). The W11 coniferous surge cut was carried over from the existing W11 Annual Allowable Cut which was approved until 2016 as part of the 2004 Preliminary Forest Management Plan (Table 79).

Table 79. Recommended AAC's from the PFMSs.

Company Name	Disposition Number / FMA Ref.	FMA/ FMU/ Grazing	Deciduous AAC (%)	Deciduous AAC (m3/yr)	Incidental Deciduous (%)	Incidental Deciduous (m3/yr)	Coniferous AAC (%)	Coniferous AAC (m3/yr)
W13								
MTU	[8(2)(e)(i)]	FMA						30,000
MTU*	[8(2)(e)(ii)]	FMA			100	861		
Weyerhaeuser	DTAW130001	FMU		45,000				
MWFP (QUOTA)	CTQW130002	FMU					4.42	19,264
MWFP (FMA)	FMA970034	FMA		157,099				376,925
MWFP	CTQW130001	Grazing					100.00	9,655
MWFP (Requested)**		Grazing	100.00	6,452				
Sub Total				208,551		861		
Total				209,412				435,844
W11								
MWFP	FMA970034	FMA		103,520				
OK Lumber	CTQ110005	FMU					21.05	19,975
Fort Assiniboine Lumber	CTQ110004	FMU					6.26	5,940
Spruceland Millworks Inc.	CTQ110006	FMU					72.70	68,987
MWFP (Requested)**		Grazing	100.00	2,529				
Total				106,049				94,903
FMA								
Area Residents	[8(2)(d)]	IN				1000***		

* within Whitecourt and Blue Ridge subunits
** July 18, 2006 letter to D.A. Sklar, re: DTA's for unallocated deciduous volume
*** conifer/deciduous(birch) Not accounted in calculations
Represent basis for calculations

The commitments and rules for implementation of the Preferred Forest Management Scenarios and the associated Spatial Harvest Sequence are described in *Chapter 6 – Sustainable Forest Management Strategy* and in detail in *Appendix XXIII – Commitments*.

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10. Annexes

Annex I SHS Maps

There are 3 SHS maps; one for FMU W11 and two for FMU W13. Digital copies of the maps have also been provided, along with SHS shapefiles (on enclosed CD).

Annex II Letters

Black Spruce Operability

This Annex contains 2 letters concerning black spruce operability and how it is to be addressed in the forecasting, timber supply and sequencing.

The first letter (draft version) was written on June 11, 2006 by Millar Western and described their proposed approach and provides 2 options for the Alberta government to consider.

The second letter is a result of clarifying the black spruce issue. The Alberta government's reply was written on August 2, 2006 and it described the acceptable approach to back spruce in the timber supply and forecasting.

New DTAs and FMU-FMA AAC Determination

Millar Western requested new DTAs to address incidental volume operability concerns along with proposing an approach to determine the FMU and FMA AAC levels in a letter to the Alberta government dated July 18, 2006.

MILLAR WESTERN FOREST PRODUCTS LTD.

Tel: 780.486.8200 Fax: 780.486.8284

June 11, 2006

Stephen Wills
Forest Management Planning Forester
Sustainable Resource Development
8th floor, Great West Life Building
9920 – 108 Street
Edmonton, Alberta
T5K 2M4

Dear Steve;

Overview and Background

Black spruce operability is problematic in harvest sequence development due to the variable nature of black spruce stands and the inability of AVI attributes to clearly distinguish operability. Millar Western and the TSA IAG have discussed this issue and Millar Western proposes the following approach be applied in the 2007-2016 DFMP. FMU W11 is straightforward with respect to black spruce as all Sb stands were subjectively deleted during the landbase netdown and thus this approach applies only to W13.

- This approach applies to the black spruce strata as defined and assigned in the W13 netdown landbase and subsequently used in the timber supply and SHS determination
- Millar Western developed black spruce subjective deletions that were applied to the black spruce strata to produce the managed black spruce strata. This was intended to define the population of productive stands, *i.e.* those that could be harvested now and/or in the future.
- During the fall and early winter of 2005 Millar Western field checked black spruce stands in the August 2005 SHS and assigned categories of currently operable, non-operable and deferral to all stands.
- Field checked results of August 2005 SHS show that:
    - 45% of the Sb strata is harvestable today (operable)
    - 30% of the Sb strata is not harvestable today but will be in the future (deferred)
    - 25% of the Sb strata will never be harvestable (non-productive)

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- Mostowich's subjective deletions rules were not very effective in identifying non-operable stands
- BAP's upland modifier which is based on the moisture regime from AVI was effective in identifying operable and productive stands but the lowland modifier was about 1/3 effective in identifying non-productive stands

Black Spruce TSA and SHS Process

The 3 steps that will be used to determine the black spruce AAC and SHS are presented below. 2 options to update the AAC to reflect the field verification process are presented:

1. Initial Sb sequence and AAC determination
    a. Use managed landbase definition in the TSA model, model controls and operational adjustments to SHS based on orthophotos, maps and patterns to determine the AAC and develop an initial SHS
2. Refine operable Sb stands for the SHS
    a. Field check initial SHS using helicopter and photos to assign all Sb stands in SHS to one of the following categories (note that Operable + Deferred = Productive):
        i. Operable – stand operable now
        ii. Deferred – stand operable in the future
        iii. Non-productive – stand will never be operable
    b. Update initial SHS to reflect only the operable Sb stands (drop the deferred and non-productive stands from the SHS)
    c. Do not add additional stands to the SHS to make up for the stands dropped
3. Update Sb AAC – Volume Adjustment (Option "A" or go to step 4)
    a. From the entire population of Sb stands in the SHS, determine the percent of the Sb stands that are productive (operable + deferred) based on the field survey (productive Sb%)
    b. Determine the portion of the AAC from the Sb strata based on the 200 year average conifer harvest volume from the Sb strata
    c. Multiply the inverse of the productive Sb% to the AAC from the Sb strata to obtain an Sb AAC adjustment (m^3/yr)
    d. Reduce the total AAC by the AAC adjustment
    e. Do not rerun AAC after adjustment.

f. Retain only the operable stands in the SHS.

4. Update Sb AAC – Area Adjustment (Option "B")

a. From the entire population of Sb stands in the SHS, determine the percent of the Sb stands that are productive (operable + deferred) based on the field survey (productive Sb%)

b. Update the landbase file by removing the field identified non-operable Sb stands from the managed landbase and by coding the field identified productive stands to remain part of the managed landbase (applies only to the SHS)

c. Update the landbase file to lock out the identified deferred Sb stands from harvest for at least 20 years

d. Update the landbase file by multiply the area of all managed Sb strata polygons outside the SHS (the population of stands that were not field checked) by the productive Sb% to obtain a field adjusted managed area

e. Using the updated SHS locked into the model, rerun the PFMS to obtain a new AAC and harvest sequence. No changes are made to the SHS in this step.

Either option A or B must be selected for application in the DFMP. Millar Western recommends Option B, the Area Adjustment. This will provide the tightest linkage between the TSA, AAC and the forecasted forests. A separate black spruce AAC will be not identified in the DFMP. Control of harvest by strata will be accomplished through SHS variance controls.

Supplementary Information

Black Spruce Strata Definition

A generalized rule description for black spruce strata assigned is:

- Coniferous broad cover group (>79% conifer) and
- Black spruce is the leading conifer species
- Overstory layer assignment if crown closure is B,C or D density or else assignment based on understory layer
- Composite crown closure weighted layer was developed if overstory is >14 m and understory height is within 2/3 of the overstory height for 2 valid layers

Refer to Landbase netdown documentation for the precise rules used.

Black Spruce Subjective Deletions

The black spruce strata subjective deletions were applied in the landbase file only to the Sb strata. The following black spruce stand types were deleted:

- FMU W11 all black spruce

- W13 AVI complex or horizontal stands
- W13 single story A density overstory stands
- W13 fair TPR and at least 80% black spruce and/or larch

Refer to Landbase netdown documentation for precise rules.

Please feel free to contact me if you have any questions regarding our proposed approach.

Yours truly,

Jonathan Russell
Chief Forester

Cc Ray Hilts
Ted Gooding

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Ted

Alberta
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Forestry Division
Forest Management Branch

8th Floor 9920 - 108 Street
Edmonton, Alberta
Canada T5K 2M4

Telephone (780) 427-8474
Fax (780) 427-0084

August 2, 2006

Ref: 06301 – F02 – 04

Mr. Jonathan Russell
Millar Western Forest Products Ltd.
16640 - 111 Avenue
Edmonton, Alberta
T5M 2S5

Dear Mr Russell:

I am in receipt of two letters dated July 18, 2006. One of the letters deals with the Black Spruce landbase modelling approach; the other letter deals with Alternative Regeneration Standard development timelines.

In regards to the Black Spruce modelling approach, it is acceptable to use field reconnaissance of the first 10 years of stands rather than 20 years of stands from the most current draft harvest sequence to assess Black Spruce stand merchantability for inclusion in the net landbase. In addition, the information previously obtained from the last draft harvest sequence field reconnaissance for Black Spruce merchantability should be used as well.

In regards to the Regeneration Standards, as stated in your letter, Millar and the embedded operators will continue to use the current SRD Regeneration Survey Manual standards in assessing reforestation (including crop plan areas) until Millar completes development of Alternative Regeneration Standards (ARS) for the FMA area. It should be noted however that in accordance with *Interpretive Bulletin: Alternative Regeneration Standards*, dated November 28, 2005 (http://www.srd.gov.ab.ca/forests/fmd/manuals/), deferrals of allowable cut adjustments can not be granted without submission of a Letter of Intent (LoI) to formally commence the ARS development process and request the deferral. For more information on the ARS process or any questions regarding the interpretive bulletin, please contact Mr. Scott Milligan, Operations Section Manager, at (780) 422-0672.

Trusting this provides the necessary clarity.

Regards,

Stephen Wills
Forest Management Planning Forester

cc: Daryl Price, Senior Manager, Resource Analysis section
Scott Milligan, Senior Manager, Operation section
Brian Wallach, Woodlands Forest Area

MILLAR WESTERN FOREST PRODUCTS LTD.

Tel: 780.486.8200 Fax: 780.486.8284

July 18, 2006

D. (Doug) A. Sklar
Executive Director
Forest Management Branch
Sustainable Resource Development
7th floor, Great West Life Building
9920 – 108 Street
Edmonton, Alberta
T5K 2M4

Dear Doug;

The intent of this letter is as follows:

- Request that Sustainable Resource Development (SRD) issue Deciduous Timber Allocations (DTA) to Millar Western Forest Products Ltd. (MWFP) to cover deciduous timber harvest operations within the grazing dispositions within Forest Management Units (FMU) W11 and W13 and
- Request SRD's approval of MWFP's proposed approach for calculating the sustainable annual allowable cut (AAC) volume for the areas in the grazing dispositions within W11 and W13.

MWFP currently doesn't have the authority to harvest deciduous timber within FMU W11 and W13 grazing leases. At this time, MWFP is formally requesting that SRD issue DTA's for the W11 and W13 grazing leases concurrent with the approval of MWFP's 2007 – 2016 Detailed Forest Management Plan (DFMP); planned submission timing: November 2006.

As part of the Timber Supply Analysis (TSA) section of the 2007 – 2016 DFMP, MWFP will include sustainable AAC figures for the W11 and W13 grazing dispositions. Based on direction provided by SRD during the January 18, 2006 TSA Impact Assessment Group meeting, our proposed approach for calculating these figures is as follows (refer to W11 and W13 FMA and Grazing Disposition Map):

1. Model non-spatial sustainable AAC for TSA Area, including FMA area and Grazing Dispositions. (TSA_AAC_NS).
   - Woodstock non-spatial TSA tool.
2. Model non-spatial sustainable AAC for FMA Area. (FMA_AAC_NS).
   - Woodstock non-spatial TSA tool.
3. Calculate non-spatial sustainable AAC for Grazing Disposition Area.

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(Grazing_Disposition_AAC_NS).
- Grazing_Disposition_AAC_NS = TSA_AAC_NS – FMA_AAC_NS

4. Calculate proportion of FMA Area sustainable AAC within TSA Area sustainable AAC. (FMA_%AAC_NS)
   - FMA_%AAC_NS = FMA_AAC_NS / TSA_AAC_NS
5. Calculate proportion of Grazing Disposition Area sustainable AAC within TSA Area Sustainable AAC. (Grazing_Disposition_%AAC_NS)
   - Grazing_Disposition _%AAC_NS = Grazing_Disposition _AAC_NS / TSA_AAC_NS
6. Model spatial sustainable AAC for TSA Area. (TSA_AAC_S)
   - PatchWorks spatial TSA tool.
7. Calculate spatial sustainable AAC for FMA Area. (FMA_AAC_S)
   - FMA_AAC_S = TSA_AAC_S * FMA_%AAC_NS
8. Calculate spatial sustainable AAC for Grazing Disposition Area. (Grazing_Disposition _AAC_S)
   - Grazing_Disposition _AAC_S = TSA_AAC_S * Grazing_Disposition _%AAC_NS

For W13, the above calculations and apportioning of volume are done on the understanding that either Millar Western or Weyerhaeuser can harvest and or obtain the DTA chargeable fibre and will apply it against their respective DTA's. Any shortfall, over the quadrant period, within Millar Western's DTA will be made up with fibre from the general FMA area to ensure that the entire AAC is harvested and that the DTA (grazing disposition) volume is always obtained. This, in essence, is a paper exercise as the volume calculated is the total Millar Western DTA volume, which may be accessed by Weyerhaeuser or Millar Western dependant upon harvest scheduling. The calculation does not reflect the realities of the specific DTA area, and indeed cannot due to the size and distribution of the landbase for this specific calculation. For W11 the same logic applies except for the fact that only Millar Western will be accessing the volume.

In addition, the volumes actually applied to the DTA may or may not come from the specific DTA area due to the Spatial Harvest Sequence being established in a manner different from the AAC determination. In reality the total TSA_AAC_NS does reflect the actual proper calculation and the apportioning of volumes is done to satisfy the requirements surrounding the issuance and administration of FMA's and Dispositions.

Please feel free to contact me if you have any questions regarding our request for DTA's in the grazing leases of W11 and W13 or our proposed approach for determining the associated sustainable AAC's for these areas.

Yours truly,

P.c.c. Jonathan Russell
Chief Forester

Cc Ray Hilts
Ted Gooding

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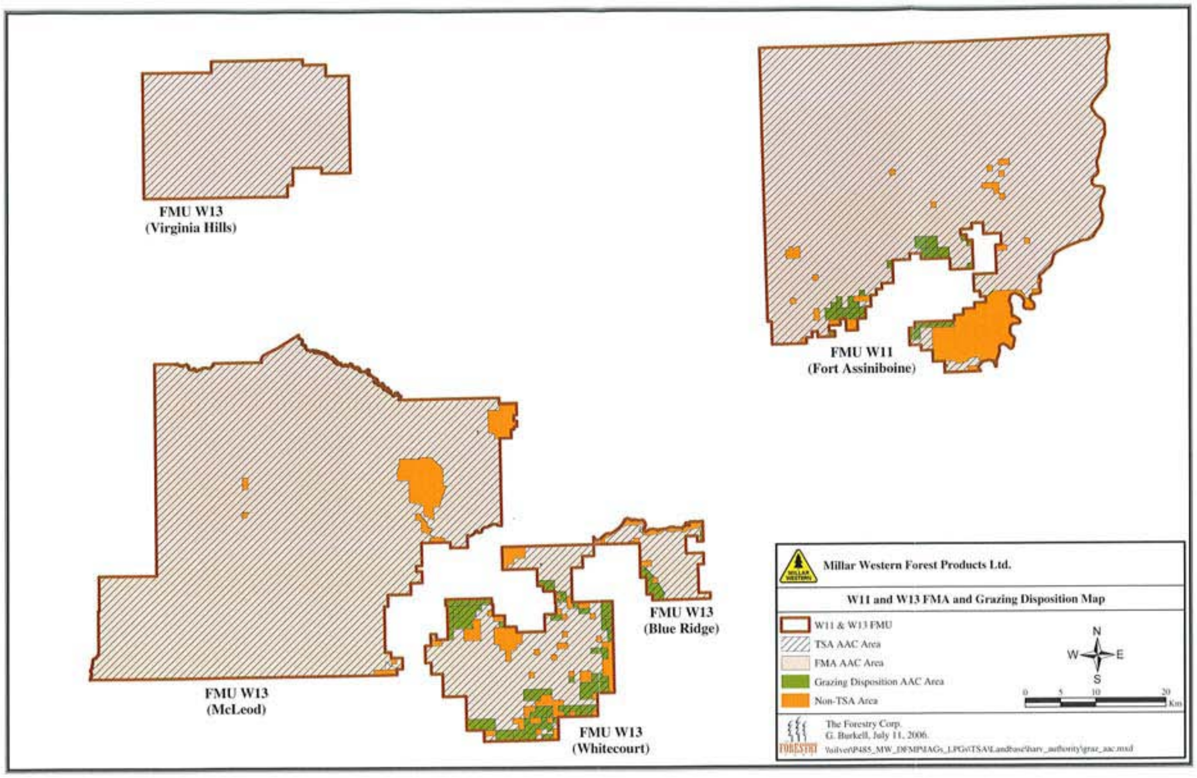
FMU W13
(Virginia Hills)
FMU W11
(Fort Assiniboine)
FMU W13
(Blue Ridge)
FMU W13
(McLeod)
FMU W13
(Whitecourt)
Millar Western Forest Products Ltd.
W11 and W13 FMA and Grazing Disposition Map
W11 & W13 FMU
TSA AAC Area
FMA AAC Area
Grazing Disposition AAC Area
Non-TSA Area
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Km
The Forestry Corp.
G. Burkell, July 11, 2006.

Annex III Planning Standard Table 5.12

These tables comprise Table 5.12 in the Planning Standard on pages 55 and 56.

Historical Allocation											
Company Name	**Disposition Number**	**Landbase Management Type**	**Effective Date of AAC**	**Deciduous AAC (%)**	**Deciduous AAC (m3/yr)**	**Incidental Deciduous (%)**	**Incidental Deciduous (m3/yr)**	**Coniferous AAC (%)**	**Coniferous AAC (m3/yr)**	**Incidental Coniferous (%)**	**Incidental Coniferous (m3/yr)**
W13											
MTU	[8(2)(e)(i)]	FMA	2000						30,000		
MTU*	[8(2)(e)(ii)]	FMA	2000			100	~1000				
Weyerhaeuser	DTAW130001	FMU	2000		45,000						
Mostowich	CTQW130002	FMU	2000					4.42	15,388		
MWFP (FMA)	FMA970034 & CTQW130001	FMU	2000		145,797				302,746		
Total					191,797		~1000		348,134		
W11											
MWFP	FMA970034	FMA	2003		106,049						
OK Lumber	CTQ110005	FMU	2003					21.05	19,975		
Fort Assiniboine Lumber	CTQ110004	FMU	2003					6.26	5,940		
Spruceland Millworks Inc.	CTQ110006	FMU	2003					72.70	68,987		
Total									94,893		
FMA											
Area Residents	[8(2)(d)]							1000***			

*** conifer/deciduous(birch) Not accounted in calculations

Proposed Allocation								
Company Name	**Disposition Number / FMA Ref.**	**FMA/ FMU/ Grazing**	**Deciduous AAC (%)**	**Deciduous AAC (m3/yr)**	**Incidental Deciduous (%)**	**Incidental Deciduous (m3/yr)**	**Coniferous AAC (%)**	**Coniferous AAC (m3/yr)**
W13								
MTU	[8(2)(e)(i)]	FMA						30,000
MTU*	[8(2)(e)(ii)]	FMA			100	861		
Weyerhaeuser	DTAW130001	FMU		45,000				
MWFP (QUOTA)	CTQW130002	FMU					4.42	19,264
MWFP (FMA)	FMA970034	FMA		157,099				376,925
MWFP	CTQW130001	Grazing					100.00	9,655
MWFP (Requested)**		Grazing	100.00	6,452				
Subtotal				208,551		861		435,844
Total				209,412				435,844
W11								
MWFP	FMA970034	FMA		103,520				
OK Lumber	CTQ110005	FMU					21.05	19,975
Fort Assiniboine Lumber	CTQ110004	FMU					6.26	5,940
Spruceland Millworks Inc.	CTQ110006	FMU					72.70	68,987
MWFP (Requested)**		Grazing	100.00	2,529				
Total				106,049				94,903
FMA								
Area Residents	[8(2)(d)]	IN				1000***		

* within Whitecourt and Blueridge subunits
** July 18, 2006 letter to D.A. Sklar, re: DTA's for unallocated deciduous volume
*** conifer/deciduous(birch) Not accounted in calculations
Represent basis for calculations

Utilization														
Utilization used to determine Harvest Level in PFMS					Operational Utilization						Marginal Dues Utilization			
Disposition Number	Top Diameter (cm)	Butt Diameter (cm)	Minimum Length (m)	Stump Height	Top Diameter (cm)	Butt Diameter (cm)	Minimum Length (m)	Stump Height (cm)	Deciduous AAC (m3) based on operational utilization	Coniferous AAC (m3) based on operational utilization	Top Diameter (cm)	Butt Diameter (cm)	Minimum Length (m)	Stump Height (cm)
W11	10	15	4.88	30	10	15	4.88	30	106,049	94,903	10	15	4.88	30
W13														
Sw	10	15	4.88	30	10	15	4.88	30	208,551	435,844	10	15	4.88	30
Non-Sw	10	15	4.88	20	10	15	4.88	20	208,551	435,844	10	15	4.88	20

Production							
Disposition Number	Cut Control Period	Proposed Periodic Cut Control AAC (m3)	Previous Quadrant Date	Previous Quadrant Production (m3)	Quadrant Coniferous Under Production (m3)	Quadrant Deciduous Under Production (m3)	Quadrant AAC (m3)
FMA9700034 - W13 Conifer	5/1/2006 - 6/30/2010	1,884,624.61	5/1/2001 - 6/30/2006	1,752,356	48,789		1,933,413.61
FMA9700034 - W13 Deciduous	5/1/2006 - 6/30/2010	785,495.39	5/1/2001 - 6/30/2006	298,943		840,043	995,506.14
FMA9700034 - W11 Deciduous	5/1/2006 - 6/30/2010	517,599.97	5/1/2001 - 6/30/2006	719,675		6,347	523,946.97
CTQW130001	5/1/2006 - 6/30/2010	48,273.87	5/1/2001 - 6/30/2006	9,120	0		48,273.87

Chargeability									
Disposition Number	Deciduous Species Used in AAC	Coniferous Species Used in AAC	Species Not Chargeable to AAC	Rights to Species Not Chargable to AAC	Structure Retention (%)	Structure Retention (%) Accounted for in AAC	Net Landbase Variations (net landbase not included in AAC, by covertype or by species)	Net Landbase Variation: Rights to Timber	Industrial Salvage Accounted for in AAC
DTAW13000	Aw & Pb		N/A		1%	0	0	0	N/A
CTQW130002		Fb, Pl, Sb, S	N/A		1%	0	0	0	N/A
FMA970034	Aw & Pb	Fb, Pl, Sb, S	N/A		1%	0	0	0	N/A
CTQW130001		Fb, Pl, Sb, S	N/A		1%	0	0	0	N/A
FMA970034	Aw & Pb	Fb, Pl, Sb, S	N/A		1%	0	0	0	N/A
CTQ110005		Fb, Pl, Sb, S	N/A		1%	0	0	0	N/A
CTQ110004		Fb, Pl, Sb, S	N/A		1%	0	0	0	N/A
CTQ110006		Fb, Pl, Sb, S	N/A		1%	0	0	0	N/A

Fiber Assignment Agreements				
Assignment Type (e.g. FMA, DTA, VSA, CTQ)	**Directed to (Company Name)**	**Disposition Number**	**Species (Coniferous or Deciduous)**	**Volume (m3)**
20-year Volume Supply Agreement - under FMA clause 35(1)(2)	Weyerhaeuser		Deciduous	30,000 m^3/yr
W13 MTU program - FMA clause 8(2)(e)(i)	W13 MTU program		Coniferous	30,000 m^3/yr
W13 MTU program - FMA clause 8(2)(e)(ii)	W13 MTU program		Incidental deciduous	100% from volume supply area 1
Local timber permits - FMA clause 8(2)(d)	-		Birch	1,000 m^3/yr

Note: DTA and CTQ are not included.

Annex IV PFMSs Goal Weightings

Target Account	Target Weighting Minimum	Target Weighting Maximum
W11 PFMS		
feature.FMPArea.Account.managed.Seral.7OldGrowthness	1,000	1
feature.FMPVol.Account.managed.VolType.NetMerch.Conif	1	1
feature.FMPVol.Account.managed.VolType.NetMerch.Decid	1	1
patch.Interior.7Oldgrowthness.120+.size	1	1
patch.Seral.12.Rest.0_4.size	1	100
patch.Seral.12.Rest.1000_100000.size	1	1
patch.Seral.12.Rest.100_1000.size	1	1
patch.Seral.12.Rest.4_100.size	1	1
product.FMPVol.Account.managed.VolType.Conif	10	100
product.FMPVol.Account.managed.VolType.Decid	10	100
product.FMPVol.Account.managed.VolType.Early_Late_Ratio.Decid	1	1
W13 PFMS		
feature.FMPArea.Account.managed.MPB.hazard	1	1,000
feature.FMPArea.Account.managed.Seral.7OldGrowthness	10,000	1
feature.FMPArea.Account.managed.Seral.CG.D.7OldGrowthness	1	1
feature.FMPArea.Account.managed.Seral.CG.DC.7OldGrowthness	1	1
feature.FMPArea.Account.managed.YS.2AP	10	1
feature.FMPArea.Account.managed.YS.2AS	17,650	2
feature.FMPArea.Account.managed.YS.3PA	100	1
feature.FMPArea.Account.managed.YS.3SA	10	1
feature.FMPVol.Account.managed.VolType.NetMerch.Conif	1	1
feature.FMPVol.Account.managed.VolType.NetMerch.Decid	1	1
patch.Interior.6OldGrowthness.120+.size	100	1
patch.Seral.12.Rest.0_4.size	1	1,000
patch.Seral.12.Rest.1000_100000.size	1	1
patch.Seral.12.Rest.100_1000.size	1	1
patch.Seral.12.Rest.4_100.size	1	1
patch.Seral.12.WEY.0_100.size	10	100
product.FMPVol.Account.managed.VolType.Conif	10,000	10,000
product.FMPVol.Account.managed.VolType.Decid	100	1,000
product.FMPVol.managed.WEY.VolType.Decid.YC.1AW	100	1
product.Treated.Conv.Ratio	1,000	100

Annex V Digital Data

Digital data including the models and detailed outputs from the forecasting and FireSmart are only included in the copies of this document used for technical review and are not available for public review.

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