Weyerhaeuser Grande Prairie
2011 – 2021 DFMP

Forest Management Plan and Timber Supply Forecasting Report

FMA #6900016

Prepared for:

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TECO Natural Resource Group Limited

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Executive Summary

The 2011 – 2021 Detailed Forest Management Plan (DFMP) has been developed for the Weyerhaeuser Grande Prairie Forest Management Agreement Area # 6900016. It includes areas outside the FMA such as some grazing and other dispositions that have direct affect on the Defined Forest Area (DFA). The plan's main area is comprised of Forest Management Unit (FMU) G16.

Weyerhaeuser Grande Prairie DFMP covers a total Defined Forest Area (DFA) of 1,142,924ha located between the 54th and 56th parallels in west central Alberta (Figure 3-1). The DFA is comprised of a Forest Management Agreement (FMA# 6900016) area of 1,117,070ha and an additional 25,854ha of non-FMA area. The FMA is divided into two disjointed spatial locations, the smaller "Saddle Hills" area to the north of the city of Grande Prairie and the larger main portion to the south of the city.

The DFMP utilizes a comprehensive and detailed land and vegetation inventory (Alberta Vegetation Inventory) updated in 2005. The Weyerhaeuser DFA contains seven subregions with two (lower and upper foothills) making up 70% of the area. Subalpine and central mixed wood make up a further 25%.

The effective date of this timber supply analysis is May 1st, 2009. May 1st is the beginning of the timber operating and production tracking year. The term of this plan is from July 11, 2011 to April 1, 2021 or until replaced with another plan.

A team of Weyerhaeuser resource managers participated in the development of this plan, including other members of the Planning Development Team:

Organization	Representatives
SRD Smoky Forest Area	Mark Feser, Area Forester
	Craig Johnson, Senior Fisheries Biologist
	Dave Stepnisky, Senior Wildlife Biologist
SRD Edmonton	Tim Boult, Lead, Forest Planning and Performance Monitoring
Tolko	Ian Whitby
Ainsworth	Dave Beck, Divisional Forester
Weyerhaeuser	Greg Behuniak, Timber Supply Analyst
	Wendy Crosina, Management Forester
	Rob Harder, Forest Planning Manager

Communication with the public through Public Advisory Group(s) (initially a joint Weyerhaeuser/Ainsworth group, followed by both companies facilitating their respective groups) occurred through the development of the plan.

Ainsworth received approval in the 2007 MPB Plan for an accelerated deciduous cut for 20 years; this forest management plan incorporated the same assumptions.

This DFMP also addresses Weyerhaeuser and Ainsworth deciduous land base and strata imbalance issues. The process adapted by both companies to address this issue is detailed in Section 2.7 of Land Base Updates document.

Proposed Weyerhaeuser Grande Prairie PFMS AAC's by operators are summarized in the table below.

Operators	2009-2018		2019-2028		Notes
	Dec	Con	Dec	Con	
Weyerhaeuser: Coniferous	-	2,269,478	-	1,305,315	Primary 33,000 m^3/yr Dec allocated in Volume Supply Zone 1
Deciduous	148,000	-	148,000	-	Includes incidental deciduous 10,000 m^3/yr opportunity for rural use
Unallocated	51,000	-	51,000	-	Unallocated deciduous AAC
Tolko[1]	80,000	-	80,000	-	Must take incidental as identified by operator and zone in Table 11-5 prior to cutting.
ASRD CTP	-	8,634	-	8,634	
Ainsworth LC	1,199,041	-	1,217,625	-	Ainsworth receives remaining of the FMA deciduous cut
FMA Total	1,478,041	2,278,112	1,496,625	1,313,949	

1 – Tolko's carry over volume of 161,170 m^3 has been added to Period 1

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1 Introduction

The mountain pine beetle (MPB) has been present in the Weyerhaeuser Grande Prairie FMA area for over five years. Its in-flights from British Columbia in 2006 and then again in 2009 resulted in severe infestation levels in the Saddle Hills area of the FMA. Healthy overwinter survival rates resulted in an expanding population to the level that by the fall of 2010 one was hard pressed to find a living unaffected mature pine larger than pole size in the Saddle Hills. The MPB infestation has largely affected the conifer management strategies not only in Saddle Hills but also across entire FMA area forming the basis for the new forest management plan.

This document details public participation plan and the timber supply forecasting component of the 2011 – 2021 Weyerhaeuser Grande Prairie DFMP. It solidifies the selection of the Preferred Forest Management Strategy (PFMS), including accelerated pine harvest, to control MPB, and accelerated deciduous cut to capture stand senescence. The preferred scenario indicates current and future output levels associated with meeting all management goals identified by Weyerhaeuser and stakeholders. Analysis outputs include measures and indicators of a wide variety of forest resource values.

Final estimates of long-term sustainable harvest levels are the result of data collection and processing, stakeholder meetings, and public consultation meetings, tempered by Weyerhaeuser's corporate philosophy, values, and objectives. The timber supply modeling process employs all of this information to determine the allowable harvest levels, the various impacts on competing values, and the future forest conditions.

2 Public Participation Plan

2.1 Background

A public advisory group (PAG) was formed in November of 2000 specifically to provide input into the development of local Values, Goals, Indicators and Objectives (CSA Z809-96 nomenclature). Initial participants were selected by Weyerhaeuser on the basis of recommendations from Weyerhaeuser's Forest Management Advisory Group in Grande Cache and Environmental Advisory Committee (EAC) in Grande Prairie. In addition, Weyerhaeuser invited various Aboriginal groups from the Grande Prairie and Grande Cache areas to become members of the PAG, or to provide input in an alternative manner of their choosing. Advertisements soliciting for people interested in serving on the PAG were put in the Grande Prairie and Grande Cache newspapers.

Weyerhaeuser maintained two public advisory groups (PAG and EAC) in Grande Prairie until 2010 when all Weyerhaeuser timberlands in Canada certified to the SFI (2010-2014) standard, and subsequently dropped CSA Z809. Weyerhaeuser combined the two advisory groups in early 2010, inviting all PAG members to join the EAC. The Terms of Reference of the EAC were revised in March 2010. Although this is not a joint group with Ainsworth, Ainsworth and Tolko have been invited to meetings when public input is sought on the DFMP.

Between December 8, 2008 and February 23, 2011 twelve PAG/EAC meetings took place. Notes regarding meeting objectives, actions, and outcomes have been compiled by Weyerhaeuser. On December 8, 2010 special DFMP meeting took place. This meeting was brought together by Weyerhaeuser to review preliminary DFMP outcomes and obtain land base and TSA feedback from group at large.

2.2 Public Advisory Group Membership

Membership of the public advisory team is designed to reflect all those with interest in this DFA and mill facilities in Grande Prairie. The public advisory group has been striving to have representation from each of the groups listed in Table 2-1.

Table 2-1 Members of Public Advisory Group

County of Grande Prairie	Grande Prairie and Area Forest Education Society	Oil and Gas
MD of Greenview #16	Aquatera	Local business
Alberta Environment	Peace Wapiti School Board	Harvest contractors
Alberta Sustainable Resource Development	County of Saddle Hills	Environmental groups
Circle of Aboriginal Students at GPRC	Alberta Trappers Association	Metis Local 1990
Aseniwuche Winewak Nation (AWN)		

Participation in this process by Aboriginal members has not impacted any existing or future treaty rights or any other rights or freedoms that pertain to Aboriginal people.

2.3 Objective

The following are objectives for public participation plan:

1. Ensure effective ongoing communication on company operating strategies between key stakeholders, including government. Issues will be addressed through consultation.
2. Weyerhaeuser to receive input and feedback from the community on company operations including:
   a. Environmental performance of the plant – all aspects;
   b. Forestry planning and operations – all aspects;
   c. Environmental monitoring – all aspects;
   d. All socio-economic impacts; and
   e. Any health impacts.
3. Assist Weyerhaeuser to operate more effectively by sharing information of interest to the community.
4. The committee will provide input, feedback and/or advice to both government and the company, as appropriate.

2.4 Role

Special Interest Groups Representative: Provide input and advice on Weyerhaeuser's Grande Prairie operations. Seek opportunities to resolve or address all issues. Support effective communication between all stakeholder representatives.

Alberta Government Agencies: Advising EAC on government policy and provide access to technical information. This role will be dynamic and will change with the issues being worked. Seek opportunities to resolve or address issues. Support effective communication between all stakeholder representatives and improve public understanding.

Weyerhaeuser Grande Prairie Operations: Will initiate the consultative committee. Provide access to data and resources where reasonable. Seek opportunities to resolve or address all issues. Support effective communication between all stakeholder representatives and improve public understanding.

Members at Large: From time to time, members of the community may become known to the committee who, through association with the community at large, may approach the EAC for membership. The committee will vote to accept or deny membership to the committee for any proposed member at large.

2.5 Decision Making Method

Public advisory process will work as follows:

1. Meetings must be called by the Chairperson/Alternate Chairperson and cancelled by the Chairperson/Alternate Chairperson (i.e., weather, attendance).
2. Application to make presentations shall be made through the Chairperson and approved by the committee.
3. Quorum for decisions on all matters of the committee, other than financial matters or organizational changes, shall be 50% of members in attendance at the meeting. Quorum for decisions on financial matters and organizational changes shall be 50% of the total EAC membership plus one.
4. It is generally understood that each stakeholder representative has one vote, Weyerhaeuser has one vote and each member at large has one vote.

2.6 Stakeholders

The stakeholders list is provided in Appendix 2; it was used to notify stakeholders that have taken an interest in forest management on the Weyerhaeuser FMA and DFMP process. The Company provided them with information as requested. In addition, all stakeholders got further opportunities to discuss the DFMP process at our annual open houses held each fall.

2.7 First Nations Consultation

Alberta SRD has advised Weyerhaeuser that consultation with Aseniwuche Winewak Nation (AWN) and Horse Lake First Nation (HLFN) is required for this DFMP.

Weyerhaeuser views the relationship with these Aboriginal People as an on-going process based and recognition and respect. We recognize that the long-term goal of proactively building mutual beneficial relationships will be achieved over time, not solely through the DFMP process.

Weyerhaeuser's policy is to work proactively with each of its businesses to build mutually beneficial relationships with Aboriginal peoples in the company's areas of operation. Our relationship building is based on the principles that seek to:

1. Acknowledge Aboriginal cultures, heritages and traditions, respect Aboriginal rights and status and understand Aboriginal points of view.
2. Engage in regular, ongoing communication to foster continuing, improving and successful relationships between Weyerhaeuser and Aboriginal groups and leaders.
3. Work with proven Aboriginal leaders and encourage the development of ongoing, capable Aboriginal leadership.
4. Enhance the value of resources through fair, equitable and mutually beneficial relationships.
5. Generate realistic expectations that recognize the rights of stakeholders and assist where possible with treaty settlement negotiations.
6. Recognize that both minor and major goals will be achieved over time and that there will be successes and learning's along the way.

Summaries of consultation with each Aboriginal People have been compiled separately. These summaries were forwarded to the respective parties and SRD under a separate cover.

2.7.1 Education

Weyerhaeuser views education as two fold. The company has clearly heard from both Aboriginal groups that education is important both to their young people and those in the work force. Weyerhaeuser attended the career fair in Edmonton (NAAF Career Fair) and also the Spirit Seekers Conference at the Grande Prairie Regional College (GPRC) to encourage students to continue pursue their career aspirations. Over the course of preparing the DFMP, Weyerhaeuser staff has taken the time to educate the Aboriginal Consultations Managers in the provincial planning processes to enable a more informed dialogue.

Secondly, for this dialogue to work both ways, Weyerhaeuser conducted aboriginal awareness training to leadership in 2010. We continue to learn from our dialogue and field visits about what's important to First Nations and avoid impacting their critical sites.

In addition to Weyerhaeuser, the public advisory group has benefited greatly from the participation and insights from representatives from AWN.

2.7.2 Capacity Building

Weyerhaeuser has participated in the GPRC Aboriginal Industrial Workers Employment Program that helps prepare young adult aboriginal people for the industrial workplace. We participate in the practicum part of the program to gain access to an aboriginal applicant pool to select potential new hires, and to increase our profile in the aboriginal community as an inclusive employer.

3 Current Status of the FMA Area

3.1 Setting

The defined forest area (DFA) described by timber supply forecasting document covers nearly 1,143,000 hectares, including the Weyerhaeuser Grande Prairie FMA and surrounding some non-FMA areas. Weyerhaeuser Grande Prairie FMA comprises one Forest Management Unit (FMU) G16. Figure 3-1 shows the FMA area in a provincial context.

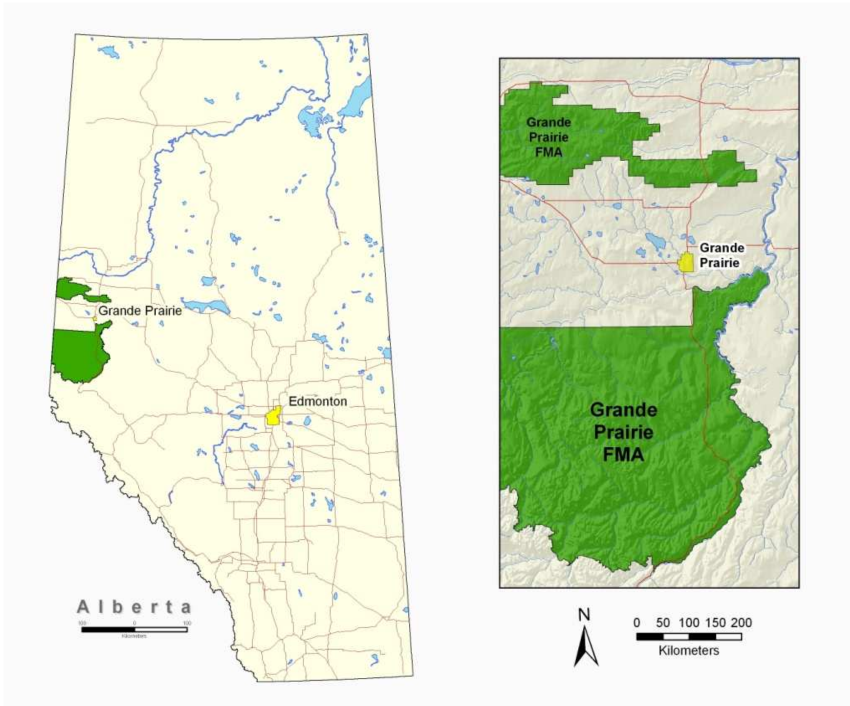


Figure 3-1 Weyerhaeuser Grande Prairie FMA Location Map

3.2 Overall Timber Supply Strategy

3.2.1 Timber Supply Forecasting Overview

Final estimates of long-term sustainable harvest levels are the result of data collection, data processing, stakeholder meetings, and public consultation meetings, tempered by Weyerhaeuser's corporate philosophy, values, and objectives. The timber supply modeling process employs all of this information to determine the allowable harvest level, the various impacts on competing values, and the future forest condition.

Figure 3-2 provides and overview of Timber Supply Forecasting Process.

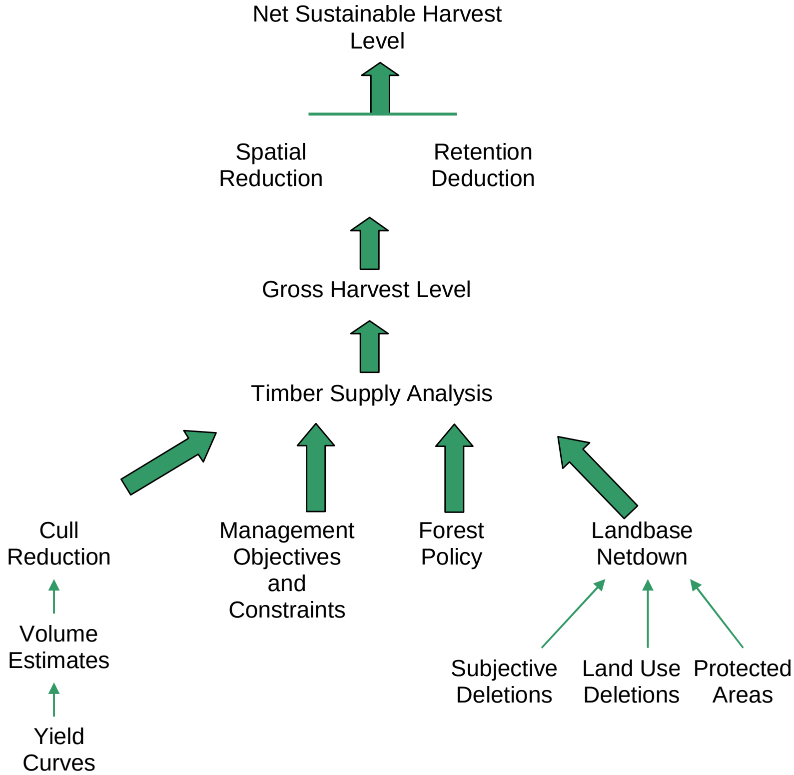


Figure 3-2 Overview of Timber Supply Forecasting Process

3.2.2 Effective Date

The effective date of this timber supply analysis is May 1st, 2009. May 1st is the beginning of the timber operating and production tracking year. The start date is defined as the point in time that best reflects the forest attributes at the beginning of the TSA model. Therefore, every reasonable attempt was made to have all input data sets consistent with this date.

3.3 Forest Inventory

The Weyerhaeuser Grande Prairie analysis area was described using the Alberta Vegetation Inventory (AVI). The AVI provides continuous geo-spatial coverage for all the Forest Management Units included in this analysis. The inventory was supplied by GreenLink Forestry Inc.

The AVI for the Weyerhaeuser Grande Prairie FMA area was initiated in 1997 and was completed in 2004. The inventory updates were completed over a seven-year period; the final product was standardized to AVI version 2.1 specifications. The Forest Management Division of Alberta Sustainable Resource Development audited the inventory and advised Weyerhaeuser that the inventory met the standards for an AVI as stated in the audit report of August 22, 2005.

3.4 Growing Stock

Growing stock is the amount of standing merchantable volume within the net harvestable land base. This definition is further refined by the operable growing stock which is portion of the growing stock that is currently harvestable as defined by the operability limits. The amount of operable growing stock at the beginning of the planning horizon is summarized in Table 3-1.

Table 3-1 FMA 2009 Net Land Base Operable Growing Stock

Growing Stock	Coniferous volume (m^3)	Percent of total coniferous volume	Deciduous volume (m^3)	Percent of total deciduous volume	Total volume (m^3)	Percent of total volume
Primary	88,160,258	97	43,092,636	70	131,252,894	86
Incidental	2,852,686	3	18,703,336	30	21,556,022	14
Total	91,012,944	100	61,795,972	100	152,808,916	100

3.5 Defining the Net Harvestable Land Base

Many polygons could potentially be assigned to several deletion types. Therefore, a deletion hierarchy was ranked from “harder” to “softer” deletions. The “harder” deletions identified areas which can confidently be removed from the net land base because of productivity or land use criteria. “Softer” deletions such as subjective deletions are also excluded from the net harvestable land base. This method facilitated understanding of how much forested land is ultimately deleted under various criteria. Refer to Appendix 3 and Appendix 4 for further details regarding the types of features excluded and the process used to define the net harvestable land base including land base updates since its early submission in 2010.

A hierarchy of non-operable land base deletion rules was identified and applied to a composite land base resulting in the forested productive land base. The deletion hierarchy and net areas identified by deletion category are provided in Table 3-2. An expanded version of this table is located in Appendix 4 (Table 5). This table summarizes the classification of the FMA area and timber harvesting land base by forest management units. The current timber harvesting land base is approximately 75% (862,141 ha) of the total FMA area. The majority of forest land excluded from the timber harvesting land base is either economically inoperable, environmentally sensitive, or both.

Table 3-2 DFA Area Land Base Assignments

Land Base Assignment Category	Total Area* (ha)	FMA %
1. Dispositions and Other Area Removals	50,245	4.4
2. Non-Forested Area Reductions	54,027	4.7
3. Water Buffers and Seismic Lines	76,047	6.7
4. Operability Restrictions and Subjective Deletions	100,468	8.8
5. Net Harvestable	862,141	75.4
CX – Pure Coniferous	502,789	44.0
CD – Conifer Leading Mixedwood	45,851	4.0
DC – Deciduous Leading Mixedwood	88,289	7.7
DX – Pure Deciduous	220,716	19.3
Composite YC	4,496	0.4
Grand Total	1,142,929	100.0

* Table includes areas outside the FMA but part of the TSA and PFMS reporting.

3.6 Comparison of the 2007 MPB Plan and 2011 DFMP

Many significant changes have occurred in the FMA area over the last 12 years. The three main changes include the FMA area changes (removal of Grande Cache E08), inventory updates (Phase 3 inventory was replaced with AVI), and new AVI based yield curves were applied with several changes in assumptions, the most significant of which is that there is now an assumption of an “uplift” in site productivity between natural and regenerated stands as opposed to the 1999 submission. As a result, the associated primary harvest levels from the current revised TSA and the previous management strategy (1999 DFMP) cannot be directly compared. The enhanced silviculture regeneration option was considered in the 1999, but not included in the final 1999 DFMP. This plan includes deployment of the enhanced silviculture strategy.

Even though there are differences between 1999 and 2011 DFMPs, this document follows structure and results provided in the 2004 – 2014 Mountain Pine Beetle Plan submitted in October 2007. Table 11-6 compares PFMS AAC and operable growing stock between 2007 MPB Plan and 2011 DFMP. These were considered as key indicators comparing different management strategies. Complete 2011 DFMP PFMS results are summarized in Section 11.4.

Table 3-3 Comparison of AAC and Operable Growing Stock Between 2007 MPB Plan and 2011 DFMP

Description	2007 MPB AAC	2011 PFMS AAC
Primary Conifer AAC - pd 1	1,643,361	2,246,574
Primary Conifer AAC - pd 2	1,741,412	2,252,278
Primary Conifer AAC - pd 3	1,741,412	1,250,281
Primary Conifer AAC - pd 4	1,485,238	1,280,599
Primary Conifer AAC - pd 5 - 10 Avg	1,485,238	1,271,538
Primary Conifer AAC - pd 11 - 40 Avg	1,503,383	1,364,798
Primary Conifer AAC - pd 1 - 40 Avg	1,515,608	1,390,072
Primary Decid AAC - pd 1	748,282	1,199,358
Primary Decid AAC - pd 2	1,167,155	1,167,114
Primary Decid AAC - pd 3	1,167,155	1,131,590
Primary Decid AAC - pd 4	1,167,155	1,131,827
Primary Decid AAC - pd 5 - 10 Avg	775,733	577,463
Primary Decid AAC - pd 11 - 40 Avg	681,923	588,666
Primary Decid AAC - pd 1 - 40 Avg	734,046	643,866
Incidental Conifer AAC - pd 1	55,635	86,893
Incidental Conifer AAC - pd 2	142,659	87,306
Incidental Conifer AAC - pd 3	114,127	81,593
Incidental Conifer AAC - pd 4	54,610	82,808
Incidental Conifer AAC - pd 5 - 10 Avg	54,610	39,526
Incidental Conifer AAC - pd 11 - 40 Avg	48,487	46,072
Incidental Conifer AAC - pd 1 - 40 Avg	53,732	48,948
Incidental Decid AAC - pd 1	128,848	305,569
Incidental Decid AAC - pd 2	147,343	375,465
Incidental Decid AAC - pd 3	147,343	424,586
Incidental Decid AAC - pd 4	147,343	397,822
Incidental Decid AAC - pd 5 - 10 Avg	223,510	246,214
Incidental Decid AAC - pd 11 - 40 Avg	213,422	227,010
Incidental Decid AAC - pd 1 - 40 Avg	207,865	244,775
Primary Conifer OGS - Start	91,816,590	81,599,760
Primary Conifer OGS - End	44,538,989	46,779,633
Primary Decid OGS - Start	43,228,592	39,142,712
Primary Decid OGS - End	5,899,580	11,096,126
Incidental Conifer OGS - Start	3,186,350	1,558,967
Incidental Conifer OGS - End	415,755	817,725
Incidental Decid OGS - Start	19,148,251	12,517,748
Incidental Decid OGS - End	4,125,963	4,720,818

3.7 Age Class Distribution

Figure 3-3 shows the current age composition by broad cover groups of the net land base in the FMA area (refer to Appendix 4 Section 4.2). The age class distribution of forested areas excluded from the timber harvesting land base can affect timber supply. In order to provide a suitable area for habitat and other non-timber values, some portions of the forest area are excluded from harvesting. Habitat and non-timber attributes are also addressed by maintaining certain age ranges and patch size distributions across the landscape.

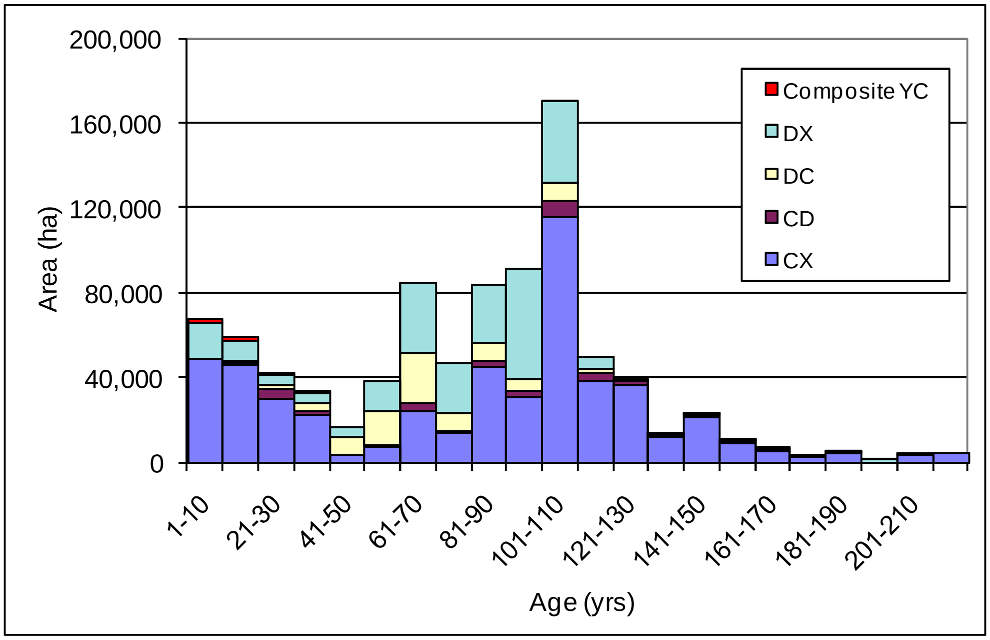


Figure 3-3 Weyerhaeuser Grande Prairie FMA age class distribution of net harvestable forest land base organized by broad cover groups

4 Yield Curves

4.1 Yield Curve Development

FMA PSP data are assigned to 23 yield groups based on attributes that allow spatial linkage to the AVI. Stratification rules were based on those used in the 1999 DFMP analysis, but were revised for compatibility with the new AVI. Assignments to yield groups are based on the overstory and/or understory stratum (primary management cover type and crown closure class).

Yield relationships were derived for each yield group from the PSP data using a two-stage modeling approach. First, individual plot gross merchantable volume was modeled with top height. Then, stand growth was related to site productivity by modeling stand top height to AVI stand age. Finally, volume-age tables were generated by yield group and Natural Subregion by calculating the average site index, or site index seed, by leading species group and Natural Subregion, and combining the volume-height and height-age models.

4.2 Area Weighted Yield Curves

The Yield curves developed in 2007 for the MPB Plan were considered good but required minor changes to the yield stratification. Yield curve validation involved a comparison of the area-weighted yield tables to the average of last measurement PSP volumes by age class averages. As in 2007, area-weighted yield tables were calculated by broad cover group and by yield group. Total, conifer, and deciduous area-weighted yield tables for the CD, DC and DX broad cover groups fall within the 95 percent confidence intervals of the 25-year age class average PSP volumes where there is sufficient plot representation. Total, conifer, and deciduous area-weighted yield tables for the CX broad cover group fall within most of the 95 percent confidence intervals of the 25-year age class average PSP volumes where there is sufficient plot representation. Variance from the 95 percent confidence intervals at later stand ages in the yield validation process is related to the area-weighted effect of yield groups with large area representation and low plot representation at later stand ages.

Appendix IV of Appendix 5 provides additional details on the calculated area-weighted yield tables. The following three figures (Figure 4-1, Figure 4-2, and Figure 4-3) show the total, pure conifer, and pure deciduous area-weighted yield curves, respectively.

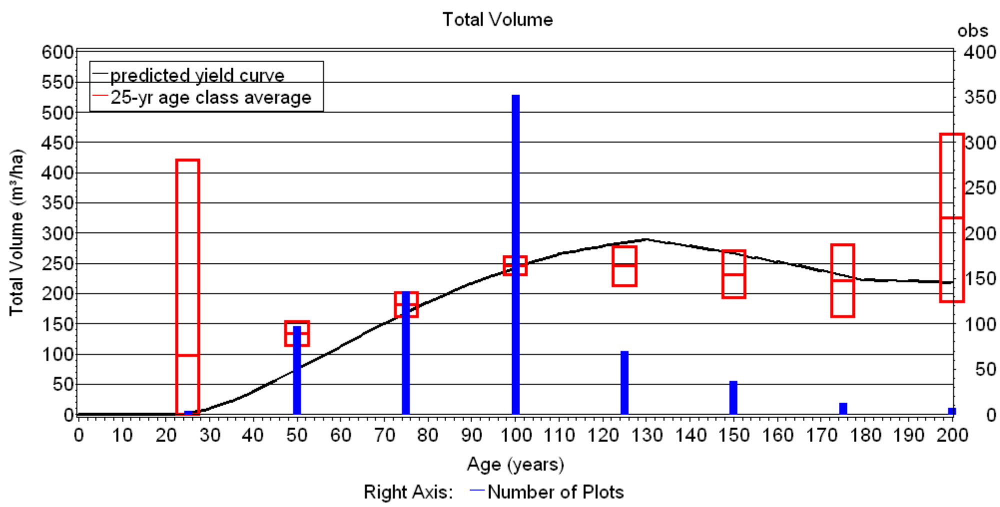


Figure 4-1 Total Volume Area Weighted Yield Curves for the FMA area

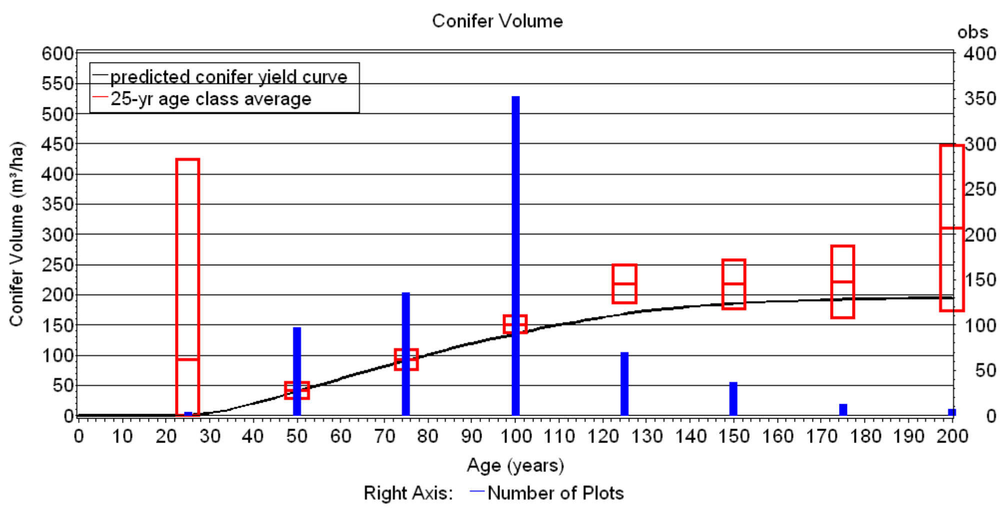


Figure 4-2 Coniferous Volume Area Weighted Yield Curves for CX Broad Cover Groups in the FMA area

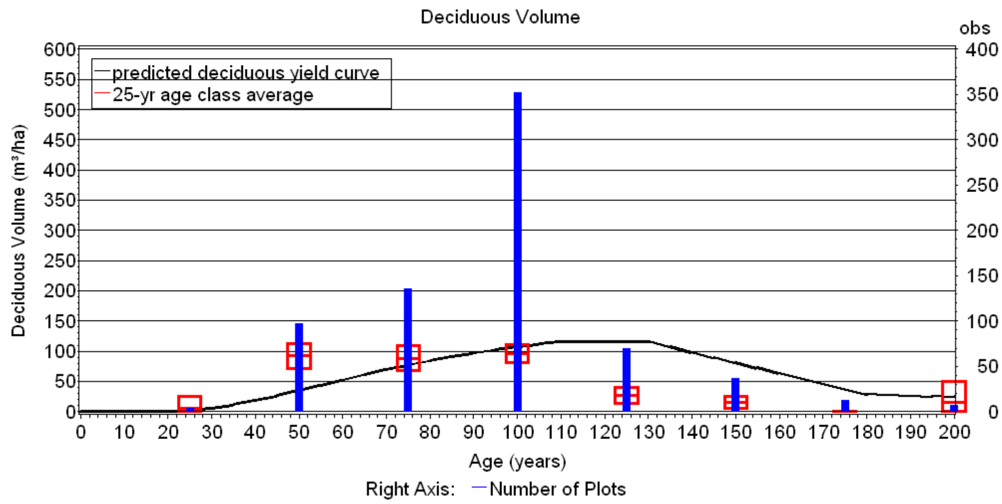


Figure 4-3 Deciduous Volume Area Weighted Yield Curves for DX Broad Cover Groups in the FMA area

4.3 Linking the Yield Groups to the Land Base

Each stand eligible for forest management activities is assigned a yield group based on broad cover group, Natural Subregion, site quality, crown closure, percentage coniferous composition, and the overstory or understory AVI call used for the primary management stratum. During the process of defining the net harvestable land base, each forested stand is assigned to a yield stratum using the exact same definitions used to stratify the plot data. The land base netdown process was also applied to the plot data such that the final yield groups actually model the net harvestable land base. This ensures that the estimated volumes are appropriately assigned to delineated stands of the same composition. In the timber supply model, each yield group is given a unique label. This unique label is also assigned to each stand in the land base definition process, and is carried forward into the model. Appendix 5 Section 3.4 summarizes yield group assignments.

4.4 Utilization Standards

For this forest management plan, conifer volume was compiled to a 15/10 utilization standard. Deciduous volume was compiled to a 15/10 utilization standard for plots located in pure conifer (CX), and mixedwood (CD and DC) broad cover groups, and to a 15/11 utilization standard for plots located in the pure deciduous (DX) broad cover group. Both conifer and deciduous compilations assumed a 15 cm stump height.

However, Ainsworth holds a Deciduous Timber Allocation (DTA) overlapping Weyerhaeuser's FMA and the deciduous cut associated with the DTA is from pure and mixedwood stands. Weyerhaeuser was asked to develop an alternative utilization yield table for pure deciduous stands with deciduous volume compiled to 15/11 utilization standard. An additional analysis of pure deciduous stand volume differences between 15/11 and 15/10 was completed; Appendix 5 Section 3.8 and 3.9 summarize these results.

5 Forecasting Model

Timber supply review analyses are based on optimized resource allocation. Remsoft Spatial Planning System (RSPS) was employed, and this integrated package includes Woodstock™, Spatial Woodstock™, and Stanley™ modules. MOSEK software was used as the linear program (LP) solver.

5.1 Remsoft Spatial Planning System

Remsoft products are designed to support integrated, spatial forest management planning and are accepted tools for timber supply analyses in Alberta. Woodstock™, Spatial Woodstock™, and Stanley™ – are collectively referred to as the core of Remsoft Spatial Planning System (RSPS) (Figure 5-1). This system is widely used in North America and elsewhere, and provides the ability to consider timber and non-timber resources (Remsoft 2005).

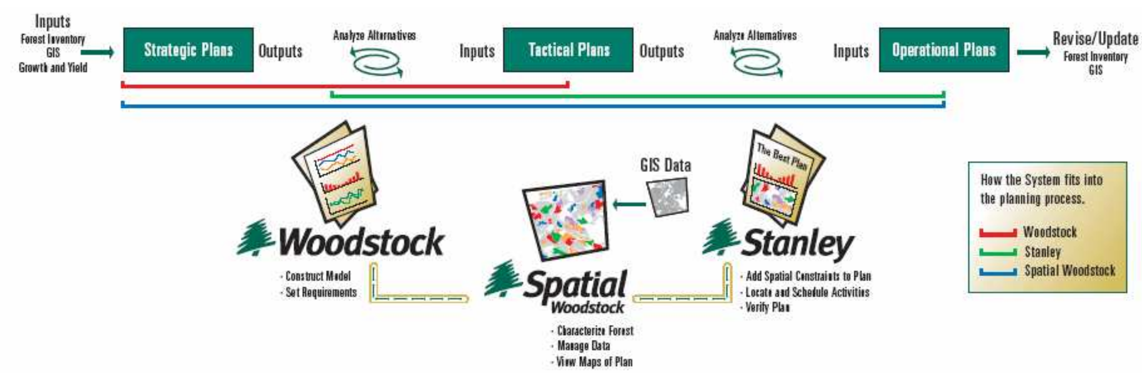


Figure 5-1 Overview of Remsoft Spatial Planning System (Remsoft 2005)

Woodstock™ is the RSPS aspatial model that is used for strategic-level planning and is designed to address forest management planning questions using LP algorithms. It is a user-defined model that is commonly used to estimate expected harvest volumes over time and to assess trade-offs from other values and objectives. Woodstock™ also allows the user to define a wide variety of expected output levels such as growing stock volumes, harvested areas, age class distributions, and many others.

The second module is Spatial Woodstock™. Spatial Woodstock™ provides a spatial connection between Woodstock™ and Stanley™. Spatial Woodstock™ is used to create the area files (land base to be modeled) and to generate time-specific spatial characteristics of the land base. Recently, however, the Woodstock™ and Spatial Woodstock™ products have been merged into a common platform often referred to as Woodstock™.

The last module utilized through the RSPS is Stanley™. Stanley™ is a stand-level planning tool that is used to define both where and when the timber volumes projected with Woodstock™ will be harvested. Unlike Woodstock™, Stanley™ is a simulation-based spatial activity allocation model. Stanley™ incorporates the planned blocks created by the company's harvest planning team, as well as the Woodstock™ schedule, and spatially allocates the schedule subject to minimum, maximum, and target opening sizes, adjacency, green-up and other spatial constraints.

5.2 MOSEK

MOSEK is company that specializes in creating advanced software for solution of mathematical optimization problems. It focuses on solving linear, quadratic, and nonlinear convex optimization problems to help users make decisions. Their customer base consists of financial institutions and companies, universities, and software vendors, among others. MOSEK is a commercial partner of Remsoft.

The MOSEK optimization software is designed to solve the following large-scale mathematical optimization problems:

1. Linear problems (integer constrained variables may also be included);
2. Conic quadratic problems;
3. Quadratic and quadratically constrained problems (integer constrained variables may also be included); and
4. General convex nonlinear problems.

The technical highlights of MOSEK are:

1. For continuous problems MOSEK implements the simplex and interior-point based algorithms;
2. For mixed integer problems MOSEK implements a “branch and bound and cut” algorithm; and
3. The MOSEK interior-point optimizer is capable of exploiting multiple processors.

5.3 Software Solutions

Table 5-1 summarizes Remsoft and MOSEK software versions used for this project.

Table 5-1 Versions of the Various Models used in Forecasting

Model	Version
Spatial Woodstock™	2010.5.1
Stanley™	2010.5.1
MOSEK	5.0

6 Uncertainties, Assumptions, and Background Data

It is impossible to model all natural processes in boreal forests. However, to create realistic models, it is possible to make certain key assumptions about natural forest processes. Many of these assumptions deal with the complexities of forest succession, stand-modifying disturbances and forest growth rates. These are difficult to predict accurately (especially the timing, extent and severity of stand modifying events).

6.1 Succession Dynamics

As the planning horizon for the Woodstock™ model exceeds the lifespan of most tree species in the FMA area, Woodstock™ requires rules by which complex changes over time in stand species composition and density can be modeled. This requires two main assumptions about how Woodstock™ will “grow” these stands from their present state to the end of their lifespan. The first assumption for stand dynamics is straightforward: stands are assumed to retain the same species composition until death / senescence. The second assumption is that as a stand dies or is harvested, it regenerates back to that same species composition and structure as it develops over time. The exception is deciduous leading mixedwood (DC) stands; they regenerate as CD stands (refer to stand transitions in Section 9.1.7).

Regenerating stands grow at a rate defined by empirical yield curves that are based on data collected from natural forest stands (no silvicultural intervention) and from modified stands where genetically improved stock has been planted. Realistic transition models are important because they reflect succession trends that affect yields over the entire planning horizon. Transition models that use stand conversion rules or modified yield curves are only as reliable as the underlying data. Weyerhaeuser’s permanent sample plot program and other research initiatives such as long term studies for mixedwood management and regenerated lodgepole pine through partnerships with the Western Boreal Growth and Yield Association, Mixedwood Management Association and the Foothills Growth and Yield Association provide ongoing increased of knowledge of stand succession dynamics; it is periodically used to adjust transition rules and yield curves. Yield curve development is detailed in Appendix 5 Section 2.

Significant challenges from stand succession dynamics were presented in the Saddle Hills area. The mountain pine beetle has been present in the FMA area for over five years. In flights of mountain pine beetle from British Columbia occurred in 2006 and 2009. Aerial survey results conducted in the fall of 2010 by Alberta SRD indicated a total of 43,435 red tree locations on the FMA, with a total of 1.038 million red trees. Over 1 million of these red trees were located in the Saddle Hills and the north half of the “main block”. Recent history suggest beetle populations in these areas show moderate to high success in over wintering and have annual red to green rations above 1. The MPB infestation has largely affected the conifer management strategies not only in Saddle Hills but also across entire FMA area forming the basis for the new forest management plan.

To address this situation, Alberta SRD has suggested (July 7, 2010) two main approaches to deal with this situation. First, pure pine stands (≥ 60% pine content) that have been severely affected by MPB and are older than 60 years assume entire stand mortality and removal for the net land base. This change is summarized in more details in the land base updates document Appendix 4 Section 3.4. Alternatively, stands with < 60% pine content and older than 60 years of age assumed pine volume reduction; stands maintained their age but their volume was reduced by the amount of pine content. This process is summarized in Section 9.1.6.1.

6.2 Natural Disturbance

Some natural disturbance patterns are indirectly represented in Weyerhaeuser’s yield curves through permanent sample plots (PSPs). The PSPs are located at points on a systematic grid, allowing stands affected by natural disturbance to be sampled proportional to the extent of the natural disturbance on the land base (the exception would be catastrophic events). There have been numerous natural disturbance events captured in the PSP database including windstorms, insect and disease outbreaks, and fires that have a significant impact on yield estimates.

One major assumption within the TSA is that current volume losses due to the incidence of fire, insect and disease outbreaks are representative of future volume losses. Because the timing, location, intensity and extent of natural disturbances are typically unpredictable, it is difficult to apply an accurate average deduction over the planning horizon. As well, natural disturbances do not result in total timber losses and some of the volume is often salvageable. A large scale change (>= 2.5%) in the harvestable land base may trigger a re-calculation of the AAC. Recently burned stands that have not regenerated have been excluded from the harvestable land base until new inventory, update or survey programs can verify that they are satisfactorily restocked. Those stands that are not sufficiently stocked represent an aspatial deduction on the land base (e.g., fires).

6.3 Long Run Sustainable Yield

Long Run Sustainable Yield Calculation (LRSY) is an estimate of the yield attainable once a regulated forest state has been achieved and all stands are harvested at the point of a stand's maximum net-volume production (Mean Annual Increment (MAI) – culminating rotation age). The LRSY provides the theoretical maximum of the AAC that forests can sustain.

The LRSY is an aggregate product of the net contributing area and maximum MAI for each stand. In case of accurate land base and yield information and reasonable assumptions of the stand harvest and succession, the LRSY model could provide a realistic estimate of the maximum sustainable AAC. Moreover, if natural stands are planned to be replaced with more productive stands, their respective LRSY is expected to increase over time to reach new equilibrium at a higher harvest levels. However, if the long term AAC is constrained to remain constant over the planning horizon and harvested stands are replaced with more productive ones, the LRSY could increase over and above the long term AAC.

The cull adjusted comparison between conifer and deciduous LRSY for the analysis area is summarized in Figure 6-1. The figure shows the project volumes over 200 planning horizon from the FMA net contributing area.

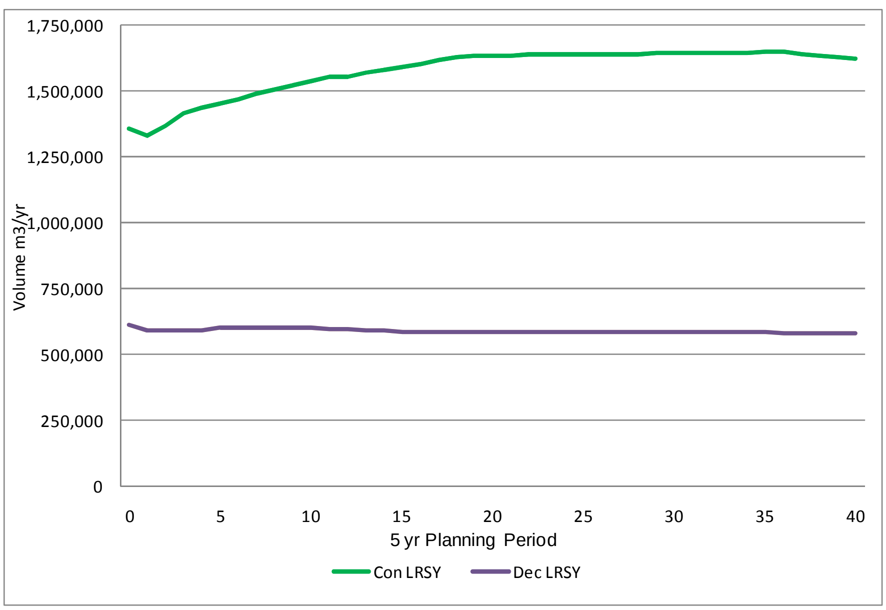


Figure 6-1 FMA-Based Long Run Sustainable Yield (Cull Adjusted)

In 2011, conifer LRSY is estimated to be 1,356,472 m3/yr and deciduous LRSY 613,398 m3/yr. While deciduous LRSY is projected to remain essentially constant throughout the TSA planning horizon, conifer LRSY is projected generally to increase. The exception is the projected reduction in conifer LRSY in 10 years (end of second planning period); that reduction is attributed to the anticipated loss of pine volume due to MPB infestation. However, this loss is offset by increasing LRSY over remainder of the planning horizon as managed stands (including enhanced silviculture options) are projected to replace natural stand yields.

6.4 Block Volume Deductions

Two types of block volume deductions were applied for chosen timber supply review: cull and stand retention. Cull reduction parameters were estimated during yield table preparation and are documented in detail in Appendix 5 Section 2.8. Table 6-1 shows the quantitative overview of the cull reduction factors by Natural Subregion.

Table 6-1 Aspatial Post-Modeling Harvest Level Cull Reductions

Natural Subregion Group	Cull Reduction %		
	Coniferous	Deciduous YG 1-17	Deciduous YG 18-21
Central / Dry Mixedwood	1.86	5.7	4.3
Lower Foothills	1.86	5.7	4.3
Upper Foothills	1.59	5.7	4.3
Montane / Subalpine / Alpine	3.49	5.7	4.3

In 2007, Weyerhaeuser reviewed in-block retention practices over eight-year period between 1999 and 2006. Following the review, the company decided to set a 2.5% merchantable coniferous volume retention target for the entire FMA area.

No additional volume reduction has been applied for larch and black spruce volume. Their retention was analyzed as miscellaneous conifer deletion during the netdown process and is detailed in Appendix 10. As such, a subjective deletion procedure was applied to the land base for Black spruce and larch as follows:

1. Black spruce: where black spruce and larch are greater than or equal to 80% of stand's composition.
2. Larch: where greater than or equal to 20% of stand's composition.

There was a 3% merchantable volume reduction for deciduous harvests.

There was no additional deduction for temporary roads and landings. Weyerhaeuser's permanent sample plot program (PSP), using a random grid for plot locations, takes into account temporary roads and landings. Yield curves therefore reflect road reduction volumes.

6.5 Regeneration Lag

Regeneration lag is the time (number of growing seasons, expressed in years) following harvest required for a new stand to initiate tree growth as compared to the natural yield curve. The regeneration lag is equivalent to the time a harvested area is not satisfactorily stocked with regenerating merchantable trees. The regeneration lag assumed in the TSA is based on the timing of historical reforestation activities and the regeneration survey status. Appendix 8 discusses the regeneration lag determination in more detail.

The harvest projection output is recorded in five-year time periods; regeneration lag calculations used a proportional adjustment to determine regenerated area. For example, a calculated regeneration lag value for CD is 1.9 years; it has 38 percent (1.9 yrs / 5 yr period) of the area (ha) delayed for one five-year period; the other 62 percent of the area is modeled as having no regeneration delay. Table 6-2 shows the regeneration lags used in this plan that form the basis for the regenerating stand transition rules (Section 9.1.7.2) used in the TSA models.

Table 6-2 Stand Regeneration Lags

Broad Cover Groups	Regeneration Lag (Years)	5-year period conversion percentage of stands with a 5-year regeneration lag (Column 2) / 5	5-year period conversion percentage of stands with no regeneration lag (100% - (*Column 3*))
Column 1	Column 2	Column 3	Column 4
CX	2.5	50%	50%
CD	1.9	38%	62%
DC	1.7	34%	66%
DX	1.7	34%	66%

7 Forest Management Strategies

7.1 Woodland Caribou Management Strategy

7.1.1 Background and Description

Woodland caribou are currently listed as a '*Threatened*' species under the Alberta Wildlife Act and the federal Species at Risk Act. In 2005, consistent with federal and provincial legislation, Alberta developed a Provincial Recovery Plan and established the Alberta Caribou Committee (ACC) to implement it. In 2008, the ACC, through its West Central Caribou Landscape Planning Team developed a more detailed West Central Recovery Plan. The recovery plan outlined several options and made various recommendations to the Governance Board of the ACC. The Governance Board adopted a great majority of that report, but submitted additional recommendations to the Deputy Minister of SRD. The recommendations are now under Government consideration. Under the federal Species at Risk process, a National Recovery Strategy for the Boreal woodland caribou has been completed. The Plan will be soon posted for public review. In addition, the federal scientific review committee is developing a process for identifying critical habitat.

Woodland caribou are strongly associated with large tracts of mature to old coniferous stands. In Alberta, two woodland caribou ecotypes are identified – 'mountain' and 'boreal', based on whether they are migratory or not. The migratory mountain ecotype of woodland caribou winters in large contiguous pine-spruce forests along the eastern slopes, but summers on high elevations sub-alpine and alpine ranges in Western Alberta and British Columbia.

Approximately 33% of the Weyerhaeuser Grande Prairie FMA (370,000 ha) provides winter habitat for three herds of mountain woodland caribou, the Red Rock Prairie Creek herd (approximately 300 animals), the Narraway herd (approximately 100 animals) and the animals in the Lingrell/Calahoo Caribou Range (numbers unknown). Outside the National Parks, the Weyerhaeuser GP FMA provides winter range to most of the mountain woodland caribou in Alberta.

Since the 1980s, Weyerhaeuser has been a leader in the work to integrate caribou habitat needs into forest management planning. In part of this work, the Company has maintained a long term caribou collaring and monitoring program in all caribou ranges within the FMA. The Company has worked to maintain a minimum number of caribou collars in ranges on the FMA and has used the collected data to inform and develop caribou plans. Weyerhaeuser has supplemented this monitoring program by supporting a significant amount of caribou research undertaken by institutions such as the University of Alberta and the ACC. Weyerhaeuser's current approach is still based on maintaining a dialogue with all stakeholders, and continuing to work closely with Alberta Government biologists, academics and environmental organizations to address respective interests and concerns. This is supplemented by a commitment to long term monitoring and research.

The Weyerhaeuser caribou management strategy includes a focus on maintaining large contiguous patches of habitat for caribou and retaining a larger amount of older forest than would be normally left (late rotation). These objectives are used in combination with the Company's 'In-Block Retention Strategy' that aims to leave standing timber in harvest blocks for ecological and biodiversity reasons. This management strategy was part of the Detailed Forest Management Plan approved by the Alberta Government in 1999. In 2007, the Weyerhaeuser GP Mountain Pine Beetle Action Plan made a determined effort to minimize the impact of beetle control operations on caribou habitat.

In developing the caribou strategies for the 2011 DFMP, the caribou sub-committee recommended changes to caribou zone boundaries. The agreement included:

1. The outside boundary of Caribou Management Zone (CMZ) was modified based on available GPS data from collared animals.
2. Three caribou ranges within the CMZ: Lingrell (including Lingrell and Calahoo), Narraway and Red Rock (including Red Rock and Prairie Creek) versus the previously used high, medium and low zones in the 2007 MPB Plan.
3. Identification of important areas for caribou within the new ranges. These areas will be called: Lingrell A, Narraway A and Red Rock A. It was agreed that Lingrell A is different from Narraway and Red Rock A and could have different management strategies applied to them.
4. The area outside the A zones and within the CMZ outside boundary will be called B zones. Each of the A zones will have an associated B zone; Lingrell B, Narraway B and Red Rock B. The Narraway and Wapiti Rivers will be used to separate the B zones.

7.1.2 Caribou Management Zones - Short Term Strategy

Weyerhaeuser submitted a revised management plan in 2007 (Weyerhaeuser GP Mountain Pine Beetle Action Plan) that attempted to address caribou needs and included a spatial harvest sequence (SHS) that was scheduled to last until 2019. The 2007 SHS indicated minimal harvest activity within areas designated as "High" caribou habitat (as defined by Fish & Wildlife biologists in 2006 and shown in maps in the 2007 MPB plan). Although Weyerhaeuser will continue with the SHS outlined in the 2007 MPB Plan, some of these planned stands have been by-passed for areas thought to be more susceptible to MPB. As result, the company believes it is moving through the SHS faster than scheduled and were forced to schedule stands for harvest outside the existing SHS before 2019. Some of these newly scheduled areas will fall within the three caribou management zones.

The mountain pine beetle is still the dominant forest management consideration on the FMA and the company must continue to harvest highly susceptible pine stands in order to reduce losses to the insect. Generally speaking, the priority stands for harvesting are located at lower elevations, closer to Grande Prairie and are outside areas that have been rated as more important to caribou by SRD.

In addition, the 2007 Plan was guided by principles recommended in the West Central Recovery Plan such as:

1. Focuses on avoiding intact areas determined to be important to caribou at this time;
2. Takes place mainly in areas that have been fragmented by previous harvesting and energy sector activity; and
3. In areas of little or no harvest, activity is concentrated in large openings to minimize habitat fragmentation and to provide for future caribou habitat.

The company believed the appropriate strategy for the Lingrell CMZ is to aggressively manage the area to reduce pine beetle risk / losses and to set the area up as an area for future caribou habitat. Factors leading to this direction included:

1. From an MPB viewpoint:
    a. Larger than 12,000 hectares of pine stands with an SSI CF of 30 or greater;
    b. High densities of red trees in annual surveys despite level 1 control efforts;
    c. Surveys indicate a moderate to high success rate in MPB over-wintering survival in the area; and
    d. Estimates that pine in the area could become largely unmarketable within the next 5 years.

2. From a caribou viewpoint:
    a. Available GPS data indicates that this is not currently an area used by caribou; and
    b. The area has already been heavily impacted by energy sector development and past forest harvesting; the West Central Landscape Plan did not rank this area high in intactness.

7.1.3 Caribou Management Zones - Long Term Strategy

Weyerhaeuser worked with ASRD Fish & Wildlife biologists, ASRD Forest Management Branch and other key stakeholders to develop a long term caribou management strategy for inclusion in the 2011 Forest Management Plan. Two fundamental uncertainties need to be kept in mind when planning for future forest conditions with respect to caribou habitat:

1. There is a high level of uncertainty around how the mountain pine beetle situation will unfold and what the forest will actually look like in the future.
2. It is unknown to what extent MPB killed areas will be utilized in the long term by caribou as habitat.

In light of these and other uncertainties, the proposed plans are more "direction statements" based on what we know (assume) today and will need to be re visited as better information becomes available.

Main components of this caribou plan include:

1. Range Delineation
   Assumptions built into the land base net down are:

    a. There are 3 individual caribou ranges identified within the Grande Prairie FMA – Red Rock, Narraway and Lingrell; and
    b. Within each range, there are two zones, named A and B. Based on current telemetry and habitat data, there is recognition that within each range, zone A currently has a higher degree of caribou use than zone B. The area and boundaries associated with A and B could change over time as caribou use changes. It's also important to note that the relative importance of zone A areas are not the same. For example based on current GPS data points (usage), field observations, and level of habitat intactness, it is clear that zone A in the Lingrell range is not as important for caribou today as the Red Rock zone A.

2. Habitat Planning
   Planning for caribou habitat within an FMA can be seen as trying to integrate two needs with conflicting requirements:

2.1. Caribou habitat requirements

i. Minimize early seral stage forests to minimize habitat conditions favorable to primary prey species such as moose and deer. An increase in these species is thought to result in an increase in wolves, which then prey on caribou as an alternate species. Weyerhaeuser has traditionally used 30 years as a definition of early seral stage which is consistent with the West Central Landscape Recovery Plan.
ii. There is a need to maintain habitat greater than 30 years in large contiguous areas.
iii. There is a need for a significant level of habitat over time that is greater than 80 years in large contiguous areas.
iv. Must minimize access and lineal disturbance as these are believed to provide access pathways for wolves and increase predator efficiency.

2.2 Timber management / forest health requirements

i. Must manage to an optimum rotation age to maximize timber production; typically 90 – 120 years; and
ii. Create a balance between the ecological need for over-mature forest and the risks associated with too much over-mature such as fire, insect and disease loss and wood quality issues associated with older stands.

The position that the Company is putting forth is to continue with limiting early seral stage (30 years and younger) in each range to 20% of or less of the productive conifer area (i.e., the 20/30 rule). This equates to an average of 0.67% of the land base in caribou zone being available for harvest each year (150 year rotation). The exception to this will be the Lingrell CMZ. Because the Lingrell area will have an increased level of harvesting in the first ten years of the plan, the amount of early seral stage forest after the first ten years of the plan will be greater than 20%. This will mean that re-entry into the Lingrell range is not expected within the first four periods, and will not be scheduled for harvest again until the amount of early seral stage forest is below 20%.

The impact of this constraint, to the AAC has been previously modeled and is estimated to be about 120,000 m^3 /year. From an age class structure viewpoint, limiting the annual average harvest to 0.67% of the net land base will theoretically result (after 150 years) in a forest that will have about 47% of its productive area in stands greater than 80 years of age (assuming no catastrophic losses to MPB, fire or other events).

SRD requested Weyerhaeuser to complete a sensitivity run using the 11/30 rule to look at the impacts on caribou / harvest relative to a more constrained landscape compared with the preferred scenario. An unconstrained caribou scenario was also completed. Refer to Section 10.3 to review the relative impacts of each scenario.

3. Sequencing

A number of key criterions were taken into account when considering selection of harvest areas within caribou management zones:

1. Caribou usage based on telemetry collar info and current GPS data points
2. A review of currently fragmented areas
3. A review of identified intact areas
4. The estimate of MPB susceptibility /risk
5. Existing access
6. Age class distribution of the forested areas
7. Information available on current practices and strategies for caribou in British Columbia to account for cross-jurisdictional concerns for the Narraway and Lingrell ranges.

In part of the long term caribou management strategy in the Red Rock and Narraway ranges, the Company identified requirement to have limited harvests in A zones to prevent a long term “halo effect”. The halo effect was the result of heavy harvesting all around the perimeter of A zones with little or no harvesting within these zones. It has been suggested that the halo effect may have a detrimental impact on caribou over the long term. Limited harvests within the A zones were also determined as an important tool to address the long term age class issues within these zones. The forest age class distribution would be on track to be significantly skewed to an over-mature age class and, therefore, susceptible to the negative consequences associated with that scenario. In part of the discussion between SRD and Weyerhaeuser, a selected number of blocks were identified in Area A to ensure limited harvests. Avoiding automated Stanley™ selection of blocks, the blocks were manually selected to ensure intactness of habitats on the landscape.

Table 7-1 describes the agreed to hectares to be harvested in caribou zones by period beyond the 2007 MPB sequence. These hectares are assumed to be the correct as they are field verified numbers as opposed to the Woodstock outputs which were the result of a point-poly overlay process to bring in these hardwired blocks. Any operational changes will be confirmed with SRD and balance to these hectares.

4. Table 7-1 Agreed Harvest Activities in the CMZ

Caribou Management Zone (CMZ)	Area (ha)	Time Period
Lingrell	4,798	2009-2029
Narraway	969	2019-2029
Red Rock	3,343	2019-2029

In the short term, a ratio of about 1:2 will be used to schedule harvests in the zones A and B (i.e., after the MPB SHS is completed). Beyond the 4th period (20 years), spatial harvest sequencing in 2011 DFMP will not be constrained by A or B zones.

4. Operational considerations

Harvest area size and arrangement on the landscape
The intent of all harvesting in caribou ranges will be to create large contiguous patches of forest with the same approximate age class. In areas with a previous harvesting history of traditional size blocks and a two or three pass system, this means removing all or most of the remaining leave blocks. In some area it will be desirable to leave some reserve blocks as patches of late seral stage retention. In areas where there has been no history of harvesting, the company will utilize large block designs (up to 1,000 hectares). The density of these blocks on the landscape (i.e., how many big blocks in a given geographic area) will be determined on a case by case basis.

Access / Season of operations
The majority of the primary access routes to the locations identified in the proposed harvest areas within caribou management zones already exist. Access from primary access roads into the harvest blocks will utilize existing roads where possible. Roads constructed for the purpose of the Company’s operations will be temporary in nature and constructed under AOP approval versus LOC and will be reclaimed after silviculture operations are complete. Adequate temporary summer access may still be required to ensure early start of harvest / haul operations during an operating season and to allow for silviculture access. Reliable temporary access allows operations to “get in and get out” of an operating area in the least number of years.

Silviculture considerations
The company will work to maintain or increase the amount of area reforested to pure conifer types currently present within caribou ranges. Areas reforested to mixed wood or pure deciduous

types will remain the same or decrease. This will ensure that reforestation practices are not shifting the land base to yield groups that provide more favorable habitat for secondary prey species such as deer and moose.

In order to successfully implement the plan in its entirety, and as outlined above, the Company has made two key assumptions:

a) The rate of spread of mountain pine beetle infestation on the FMA does not increase significantly and survival rates of MPB in the Red Rock / Prairie Creek and Narraway CMZ areas remain low with the Lingrell range being the exception, where MPB survival rates are already high.
b) Direction from an approved West Central Caribou Recovery plan and a subsequent range implementation plans centers on minimizing and mitigating disturbance in the short term (next ten years) within areas that are relatively intact and continue to be important to caribou.

7.2 Grizzly Bear Management

The grizzly bear (*Ursus arctos*) is listed as 'threatened' under the Alberta Wildlife Act and as a species of 'special concern' by COSEWIC (Committee on the Status of Endangered Wildlife in Canada). A provincial recovery plan for the grizzly bear was approved in 2008. The plan refers to 'habitat and 'mortality risk' maps developed by the Foothills Research Institute Grizzly Bear Research Program (FRIGRP) as a way to evaluate impacts of different activities on grizzly bear habitat. Based on Resource Selection Functions models DFA maps were developed that describe areas of high habitat value for grizzly bears, areas of low mortality risk and areas considered to be safe harbors. These maps and associated data are intended to provide operational tools to adjust harvest designs and road density and alignment.

Over the past twelve years, the FRIGRP has made significant advances in improving our understanding of how grizzly bears use forested landscapes within their range in Alberta. Some of this information has been used by Alberta SRD to delineate new grizzly bear management zones including core and secondary habitats along the eastern slopes. Weyerhaeuser has been a significant supporter of this research since the inception of the program.

The grizzly bear research has helped to identify their population units within the province, which are further subdivided into Grizzly Bear Watershed Units (GBWU). These watershed units were loosely based on major watersheds with size approximately 700 km^2, simulating the size of an adult female grizzly bear home range. Each GBWU was divided into core or secondary habitat. Habitat value was determined through a combination of current landscape condition, GPS location data from collared grizzly bears, and expressed through a Resource Selection Function (RSF). Other factors, such as mortality risk and safe harbor measures were also included and were driven by Open Route Density. The core areas were considered to be of higher habitat value while secondary areas – a lower value to bears.

The Weyerhaeuser Grande Prairie FMA area contributes a significant area of both core and secondary habitat. Approximately 45% of the southern portion of the FMA area has been designated as core and 32% of the area has been considered secondary habitat (Figure 7-1).

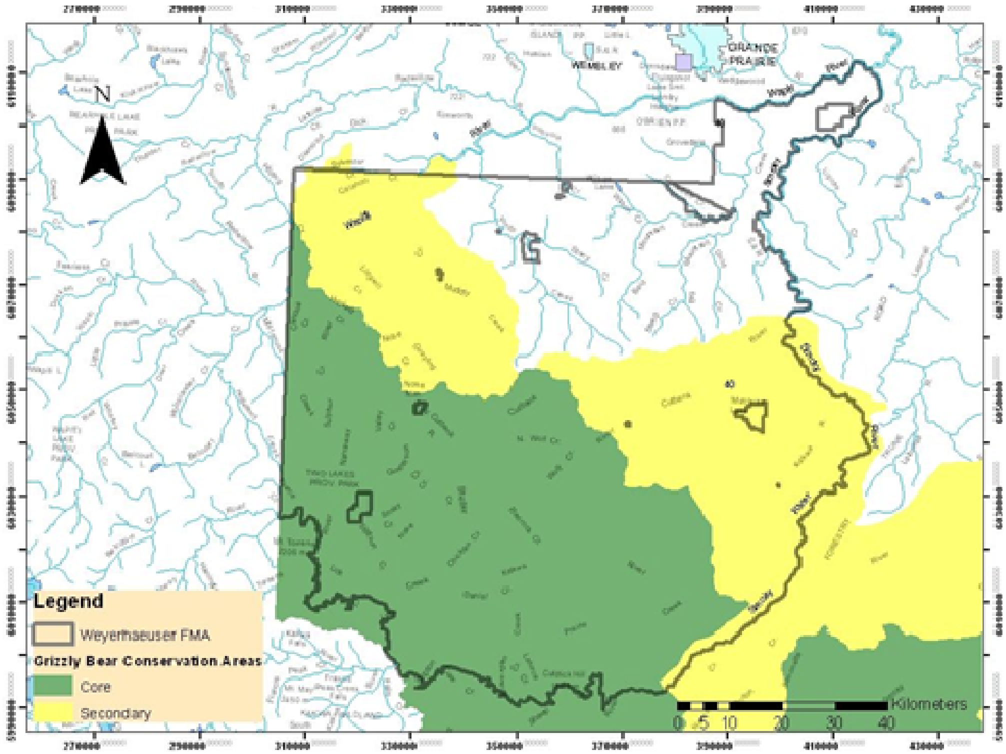


Figure 7-1 Grizzly Bear Core and Secondary Areas in the FMA Area

In order to determine the key areas for grizzly bear management within the FMA area, Alberta SRD provided results of current forest conditions including grizzly bear habitat use. Proposed anthropogenic developments were also added to allow the assessment of future forest conditions and habitat use. Based on the application of the FRIGRP model, ASRD provided output on the following four key variables:

1. Resource Selection Function

   RSF measures presence and amount of grizzly bear habitat including probability of grizzly bear presence on the landscape. To validate RSF maps, FRIGRP research showed a strong correlation between high RSF values and current grizzly bear distribution. The SRD objectives were to maintain or increase maximum RSF values in core areas and to increase maximum RSF values in secondary areas.

2. Mortality Risk

   Mortality risk represents areas with increased probability of human caused grizzly bear mortality. The mortality risk was calculated based on open access and available habitat; it was developed in conjunction with open route density. The objectives were to maintain or reduce mortality risk where possible.

3. Safe Harbor

   Safe harbor is a combination of good habitat and low grizzly bear mortality risk. Bears are attracted to the safe harbors by increased food resources and lower risk of human related mortality. Within the grizzly bear range, management objectives were to either maintain or increase safe harbor quantity.

4. Open Route Density

   Open Route Density was defined as the total length of all open routes divided by the area of each GBWU. Research has shown a strong correlation between grizzly bear mortality rates and human use / access. Regulating human access within grizzly bear zones could reduce the risk of human caused bear mortality. The Grizzly Bear Recovery Plan recommended using Open Route Density to measure human use / access. The target for Open Route Density in core grizzly bear areas was set to 0.6 km/km^2 and 1.2 km/km^2 in secondary areas.

To ensure the continued existence of a viable population of grizzly bears on the Weyerhaeuser Grande Prairie FMA, it is of critical importance to reduce the overall amount of permanent access in prime grizzly bear habitat so to minimize bear mortality risk. To mitigate the situation, Weyerhaeuser and Alberta SRD Fish and Wildlife staff have identified mitigation strategies that, over time, could reduce potential negative impacts to grizzly bear habitat. These strategies were based on the assumption that no new permanent roads will be built by Weyerhaeuser over the term of the planned scenarios. Suggested strategies included:

1. Any AOP constructed non-permanent roads will be reclaimed as quickly as possible. The company commits to developing an acceptable step-wise approach to facilitate prompt reclamation of AOP roads in grizzly bear zones.
2. Areas with lower Safe Harbor values and/or approaching threshold road densities can be used as a basis for focusing joint industry discussions aimed at seeking opportunities for road management and scoping road reclamation options. Examples of potential areas might include G10 where mortality risk appears to be increasing and the Safe Harbor value decreasing over time.
3. Areas associated with larger negative changes in Safe Harbor and overlap with other values (e.g., ungulate management zones) could be used to focus AOP road discussions. One suggested strategy included a 'mini-road plan' that could be developed to ensure access control measures for the life of the AOP roads in the area.
4. Areas that currently show lower Safe Harbor values and high RSF values could be considered for some level of timing restrictions.

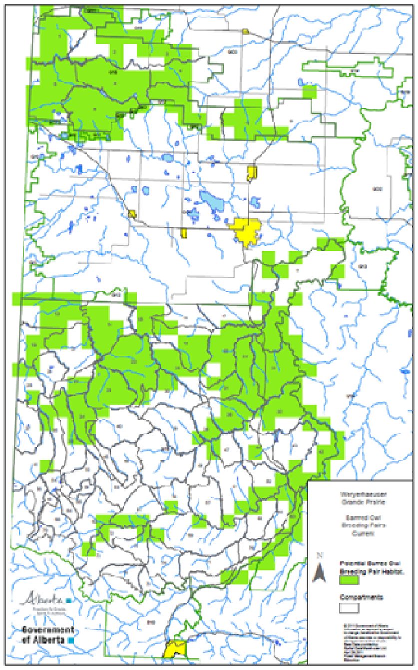
Above mentioned are suggested strategies only; Weyerhaeuser will continue to work with ASRD in good faith to address concerns related to grizzly bear and other wildlife management plans. It should be noted that due to the structure of the current planning process, company’s consideration can only be given to forest harvesting impacts on grizzly bear habitat. There are other issues including education, other industrial activities and human use restrictions that Weyerhaeuser has little or no control over and cannot be addressed in this plan.

7.3 Barred Owl Management

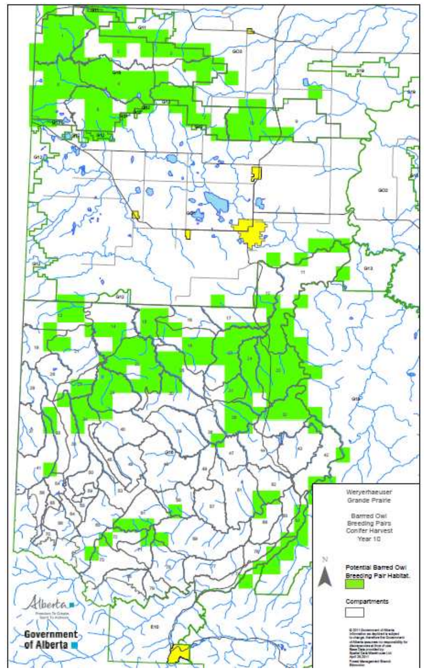
The Barred Owl (*Strix varia*) is considered a ‘sensitive’ species in Alberta. These owls are relatively rare in the province; they are interior forest species requiring large blocks of mature dense woodland. Barred Owls have clumped breeding distributions because they nest in cavities of old, large diameter *Populus sp*. trees, and select old and/or mature mixedwood forests to fulfill life requisites. As such, Barred Owls were identified as indicators of old mixedwood forests across the western boreal forests.

In part of Weyerhaeuser’s commitment to maintain biodiversity in its operating areas, owls are monitored across the FMA area using a standardized nocturnal owl survey protocol. These surveys were initiated in 2007 and are conducted every three years. Surveys have shown that Barred Owls are relatively common in the Grande Prairie FMA compared to other large-owl species such as Great Horned Owl, Gray Gray Owl and Long-eared Owl. In 2007, 27 Barred Owls were detected; there were 48 of them identified in 2010 surveys.

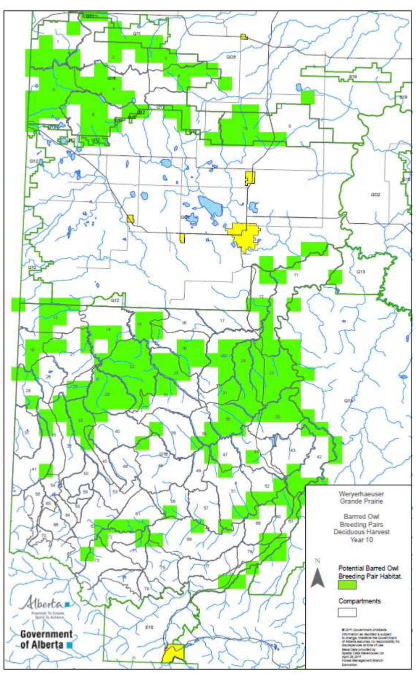
In addition to on-going long-term monitoring, Weyerhaeuser supports evaluation of the efficacy of existing models for predicting the availability of Barred Owl habitats in northwestern Alberta and the ability of these habitat models to predict demographic success within Barred Owl territories. In support of the SRD directive that identifies Barred Owls as a coarse filter indicator species, Weyerhaeuser participated in the development of a habitat model that was specific to the Grande Prairie region. The model provided a series of outputs, including a territory map outlining potential Barred Owl breeding pair habitat at the current time, and at year 10 of the SHS (Figure 7-2). The outputs provide a snapshot of areas within the FMA area with sufficient habitat to support a breeding pair of Barred Owls.



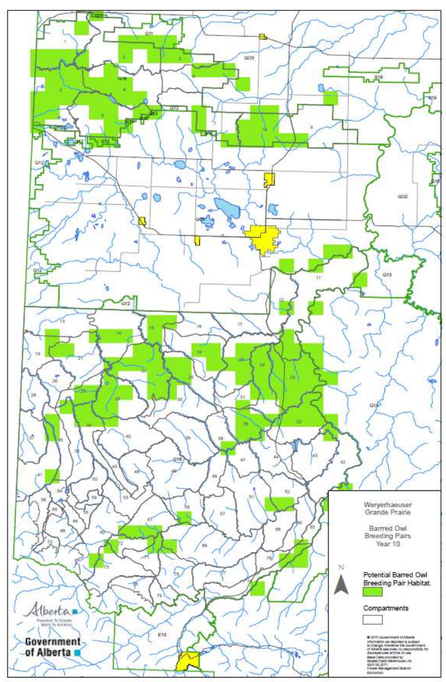
Barred Owl Breeding Pairs Current



Barred Owl Breeding Pairs Conifer Harvest - Year 10



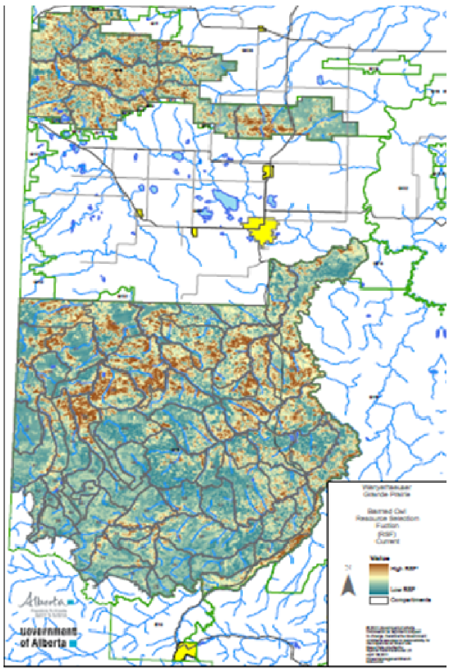
Barred Owl Breeding Pairs Deciduous Harvest - Year 10



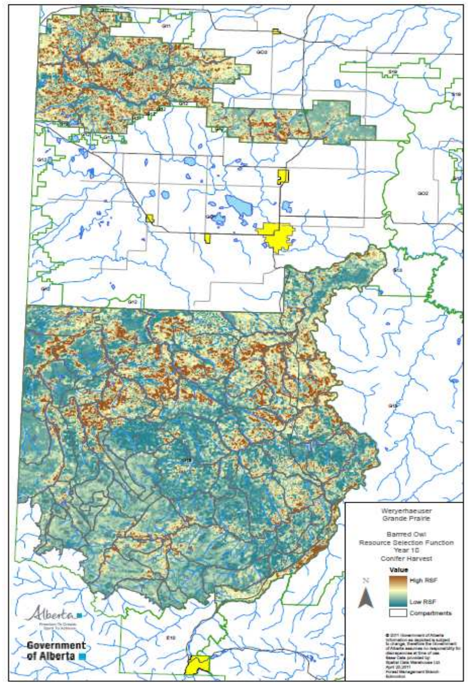
Barred Owl Breeding Pairs Combined Harvest - Year 10

Figure 7-2 Barred Owl Current Breeding Pairs and Conifer and Deciduous 10 Year Harvest Predictions

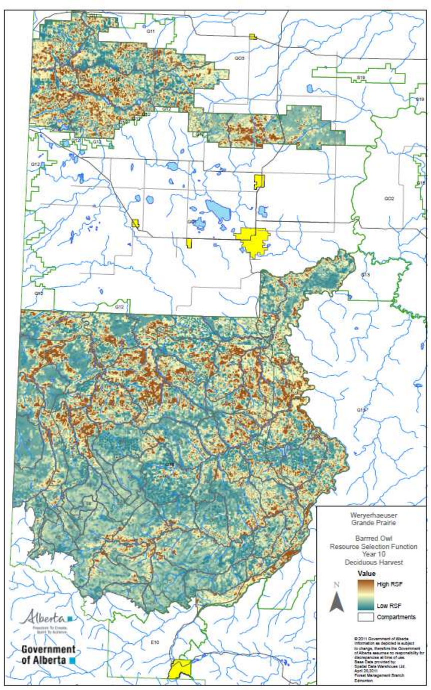
A second output of the habitat model was a Resource Selection Function (RSF) map. Figure 7-3 shows current and 10 year Barred Owl RSF estimates. These RSF maps give an indication of quality of habitat available. The combination of these two metrics provides an early indication of what the impact of forest harvesting may be on Barred Owl populations on the Weyerhaeuser FMA.



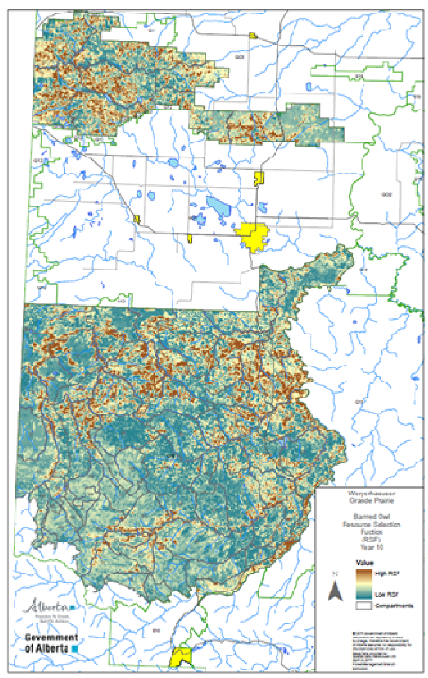
Barred Owl RSF Current



Barred Owl RSF Conifer Harvest - Year 10



Barred Owl RSF Deciduous Harvest - Year 10



Barred Owl RSF Combined Harvest - Year 10

Figure 7-3 Current and 10 Year Predicted Barred Owl RSFs

Even though provided outputs suggest rather limited SHS impact over the first ten years, it was important to discuss potential mitigation opportunities. Weyerhaeuser has engaged Alberta SRD Fish & Wildlife staff in discussions regarding modeled outputs including some suggested mitigation strategies that could be employed over the life of the plan. Suggested strategies will be employed on key areas identified using the outputs and in consultation with SRD staff. These mitigation strategies included, but were not limited to:

1. Work towards increasing amounts of old and very old seral stages retained on the FMA;
2. Where possible, design harvest areas to increase or decrease the amount of forest edge;
3. Retain visual and protective buffers around key habitats identified during harvest design;
4. Incorporate structure retention in areas with high Barred Owl habitat value. Retain additional structure (including snags and coarse woody material) adjacent to key habitats where appropriate;
5. Discuss location of roads during harvest design and look for opportunities to avoid areas of highly sensitive habitat; and
6. Continue surveys and monitor long-term presence/absence of Barred Owls within the FMA area.

There is also an ongoing commitment from Weyerhaeuser to gather information on Barred Owl and other focal species on the FMA. Weyerhaeuser will participate in a continual improvement process that includes ongoing discussions and consultation with Alberta SRD Fish & Wildlife staff to ensure company practices continue to meet biodiversity needs on the operating area.

7.4 Fisheries Management

The Bull trout *(Salvelinus confluentus)* is a freshwater salmonid found within the Rocky Mountain and Foothills Natural Regions and portions of the Peace River basin in the Boreal Forest Natural Region of Alberta. It has significant importance in fisheries management in the FMA area; they are currently listed as a '*Species of Special Concern*' under the Alberta Wildlife Act. Bull trout are typically associated with clear water in large cold rivers, small rocky streams, and lakes in Alberta. Optimal Bull trout habitat is determined by water temperature regulation (i.e., shading), nutrient input (i.e., detritus and invertebrates), cover (i.e., coarse woody debris), and water quality (i.e., sediment loads). In Alberta, stream conditions preferred by trout are typically associated with mature/old forests.

Bull trout can be found in two major spawning beds on the Weyerhaeuser FMA, Lynx Creek and Copton Creek. The Company does have planned harvest to the north of these areas and typically does not operate in the vicinity of these spawning beds and is further guided by operating ground rules that are specific to Bull trout and their habitat. Weyerhaeuser is currently involved in two projects that have direct relevance to Bull trout. One is a research project at the Forest Research Institute (FRI) that is studying the effects of Mountain Pine Beetle (MPB) on the hydrology of impacted watersheds and their ability to recover. This Weyerhaeuser supported research project will provide a better understanding of what these impacts might be on Bull trout in affected areas. Another project with relevance to Bull trout is the continued development of a 'Fish Sustainability Index' by ASRD Fish & Wildlife biologists. Weyerhaeuser will continue to support the development of this tool and work with Fish & Wildlife biologists to incorporate results and best management practices into planning and harvesting activities throughout the life of the plan.

7.5 Enhanced Silviculture Regeneration

Enhanced silviculture regeneration is an option provided in developing the preferred scenario. Areas selected for enhanced silviculture following harvest will be planted with enhanced white spruce or lodgepole pine stock (Section 7.8). No silviculture treatments are currently planned in cutblocks older than 14 years.

Weyerhaeuser Grande Prairie is involved in the HuAllan Seed Orchard Co-op (HASOC) and has a small inventory of B1 (800 – 1200 m) and B2 (1200 – 1600 m) lodgepole pine, and a large inventory G1 white spruce material.

Deployment of improved lodgepole pine is currently constrained by seed orchard production. Weyerhaeuser will continue to deploy the available improved pine seed within the approved seed zones, as the seed becomes available.

Weyerhaeuser will continue to deploy improved white spruce stock on suitable sites within the approved seed zone, but the number of improved spruce planted annual is not expected to increase significantly over the next ten years, since the cut will be strongly pine dominated.

The TSA includes a separate yield curves for stands planted with improved stock, and assumptions about the number of hectares per year that will be planted with improves stock. The supply of improved pine seed is expected to be sufficient to meet those assumptions.

Weyerhaeuser's enhanced silviculture regeneration strategy targets were as follows:

1. The area treated with enhanced silviculture must be <= 3,000 hectares for pine, and <= 7,262 hectares for spruce, in period 1;
2. The area treated with enhanced silviculture must be <= 5,000 hectares for pine, and <= 14,881 hectares for spruce, for period 2 onward;
3. Enhanced stands only established outside CMZs for TSA modeling. However, maybe deployed in CMZ in the future;
4. Enhanced stands must remain as enhanced stands across the planning horizon; and
5. No stands that have been managed under an enhanced silviculture option may break-up naturally during the planning horizon; they will be harvested.

7.6 Mountain Pine Beetle and Conifer Accelerated Harvest

Mountain pine beetle (*Dendroctonus ponderosae*) (MPB) has possessed the biggest threat to the forest inventory over the last few years. 2009 in flight from British Columbia resulted in infestation levels (in stands scheduled for harvest) averaging about 10% in the north half of the south FMA, and 2% or less in the south half. Overwinter survival rates in the north half of the FMA indicated an expanding population while on the south half the trend was towards a stable or declining population. Red to green tree survey results in September 2010 indicated that in the northern portion, Zone 1, of the FMA area (Figure 7-4) an average ratio of 2 green attack trees for every red attack tree. In the southern portion of the FMA area (Zone 2) the average ratio is 1.5. Aerial mapping of the infestation is underway, with results expected in middle of October 2011.

Weyerhaeuser believes in forest management approach that results in long term healthy forests both from regeneration and a wildlife habitat perspective. Harvest strategies for 2010 /2011 were focused in the northern portion of the FMA area. A strategy of leaving red trees standing in the block to the extent this is possible is being employed. Estimated levels of MPB killed volume in the delivered wood flow (both red and green attack) are in the range of 20 -25%.

Weyerhaeuser also believes the accelerated harvest of approximately 2.2 million m^3/yr until 2019 will help to capture the volume from infested pine stands that, unless harvested within 10 years, would be killed off by the mountain pine beetle and require removal from the active land base.

However, there are certain uncertainties regarding this prediction:

1. No one really knows for sure what will happen with MPB population spread in the FMA area;
2. The MPB is at the edge of its historical range;
3. MPB to date has exceeded expectations of spread; and
4. MPB survival, green-to-red surveys indicate populations are doing fine in north half of FMA.

Weyerhaeuser's pine stand mortality assumptions could be too drastic if:

1. A cold weather event(s) takes place causing beetle mortality by either killing existing population or slowing down its rate of spread; or
2. Weyerhaeuser is able to use killed wood for a longer period of time (i.e., capitalize on extended shelf life);

Weyerhaeuser's pine stand mortality assumptions could be too conservative if:

1. Additional MPB fly over events occur;
2. Pine trees less than 60 years of age are attacked;
3. Higher mortality occurs in mature pine at the south end of the FMA; or
4. Weyerhaeuser is unable to use all the pine in stands that are killed off and stands don't get regenerated.

In response to these assumptions, Weyerhaeuser has adapted ten year coniferous accelerated harvests (almost 40% over current LRSY) to manage the current and future MPB infestation risks. The PFMS strategy was built that incorporated current projections of MPB spread and balancing existing and future harvest levels in highly sensitive Caribou Management Zones.

Weyerhaeuser accelerated coniferous harvests are based on combined AAC levels from three zones representing MPB infestation spread within the FMA area. Each zone reflects current knowledge and assumptions and the current MPB infestation levels, potential merchantable volume loss, and estimated MPB future spread over time. Currently MPB infestation has been the worst in Zone 1; this zone represents the highest probability of harvestable volume loss in the FMA area. As such, it has received the highest level of management intensity relative to other zones. Zone 3, on the other hand, represents area where MPB threat has been defined to be the lowest or even non-existent due to its ecological conditions and high elevations. Therefore, Zone 3 has received the lowest level of management intensity. The probability of merchantable volume loss in Zone 2 has been identified to be between Zones 1 and 3.

Weyerhaeuser's MPB management has been derived based on recently modified SSI CF rather than SSI. Total area in MPB Zone 1 with pine content < 60% and age 60 yrs 561,696 ha. Area distribution between SSI and SSI CF are provided in table. More details on differences between SSI CF and SSI are provided in Section 9.1.3.10

Table 7-2 MPB SSI and SSI CF Area Comparison

Sum of area		SSI CF			Grand Total
		< 31	> 31	NA	
SSI	<31	70,653			70,653
SSI	>31	5,987	60,033		66,020
SSI	NA			425,023	425,023
Grand Total		76,640	60,033	425,023	561,696

Figure 7-4 summarizes three MPB management zones at the FMA level.

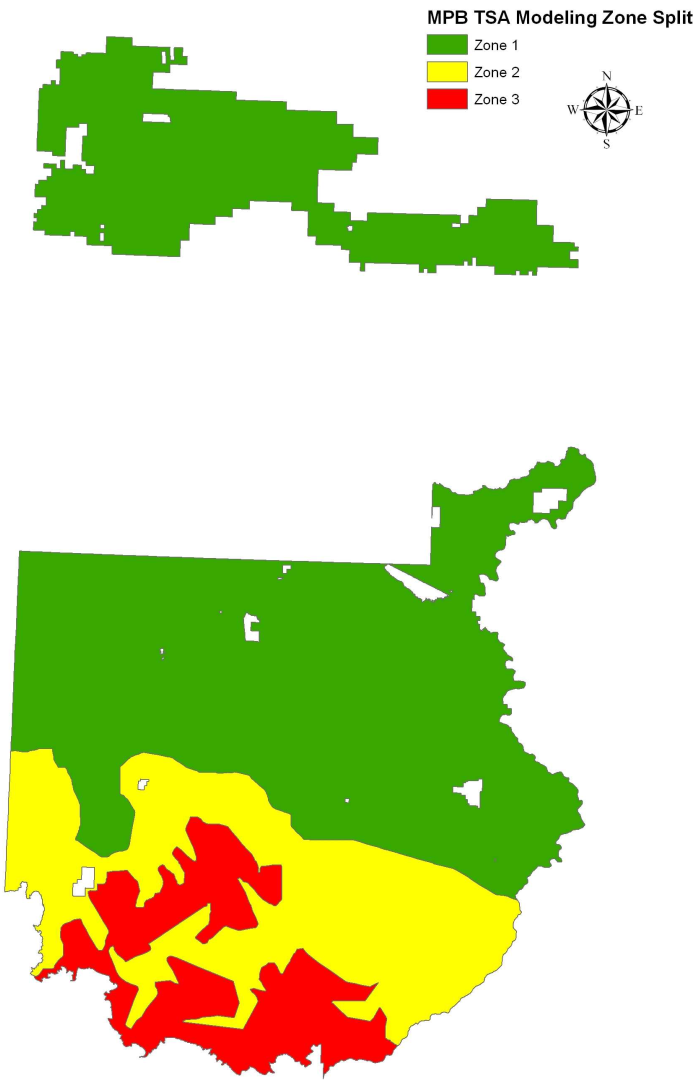


Figure 7-4 Weyerhaeuser GP FMA Area Split into Three MPB Spread Zones for TSA Modeling Purposes

The following are detailed MPB and merchantable timber management considerations for each zone.

Zone 1 is approximately 755,600 ha (66%) of entire land base had targeted conifer AAC of approximately 1.73 million m^3/yr. There is a subtle difference in MPB Zone 1 for some susceptible pine stands in the Saddle Hills. The Saddle Hills area represents susceptible pine stands that have been affected by the MPB and are currently of no value to Weyerhaeuser facilities or others in the surrounding area. In Zone 1 it was assumed all pine stands with ≥ 60% content that has an SSI CF > 0 and area ≥ 60 years of age will be impacted by MPB within the first ten years. These stands will be "killed off" and the land removed from the productive land base if not harvested within the first ten years using the following assumptions:

1. For stands that are > 60% pine content and > 60 years old and SSI_CF > 31, assume entire stand mortality and removal from the active / productive land base (if will not contribute to the TSA). This represents 1,717 hectares.
2. Fore stands that are < 60% pine content and > years old:
    a. Stand maintains some age and yield curve classification. It remains in the active land base and contributes to the TSA provided the stand is harvested consistent with how it is

modeled (if the TSA harvest the stand in a particular period, the company shall commit to harvesting that stand within that period). This represents 1,848 hectares.

b. Conifer yield is reduced proportionate to the pine portion of the conifer component within AVI.

Zone 2 assumed a similar set of assumptions as in Zone 1. However, the assumptions were applied to stands that have an SSI CF ≥ 31. In stands with an SSI CF <31, assume 50% stand's pine content would be dead after ten years and unavailable for harvest. Approximately 257,900 ha (23%) of entire land base were assigned to Zone 2 with targeted conifer AAC of approximately 489,000 m^3/yr.

In Zone 3 it was assumed the beetle would exist at very low levels, as most of the land base is in Subalpine NSR and high value caribou zone. No reductions to forecasted yields were made. Approximately 129,500 ha (11%) of entire land base were assigned to Zone 3 with targeted conifer AAC of only 3,000 m^3/yr.

7.7 Deciduous Accelerated Harvest

As is the case across much of Alberta, the deciduous age class distribution in Grande Prairie region is skewed towards older age classes. The long history of fire suppression and the relative recent history of harvesting deciduous species in Alberta have resulted in 57% of the deciduous stands being greater than 80 years old. Figure 7-5 summarizes age class structure for deciduous stands. A consequence of the current age class distribution is that there is approximately 42 million m^3 of operable deciduous wood on the land base while under a more regulated age class distribution we would expect about 10 million m^3 to be present. As the current deciduous stands age further, one would expect much of this "extra" volume to be lost, as decline in deciduous species typically occurs much faster than with conifer. In a paper by Pothier, Raulier and Riopel the authors conclude that "In even-aged stands composed of pioneer species, such as trembling aspen (*Populus tremuloides* Michx.), synchronous tree senescence can cause an important and rapid drop in merchantable volume, known as stand breakup."

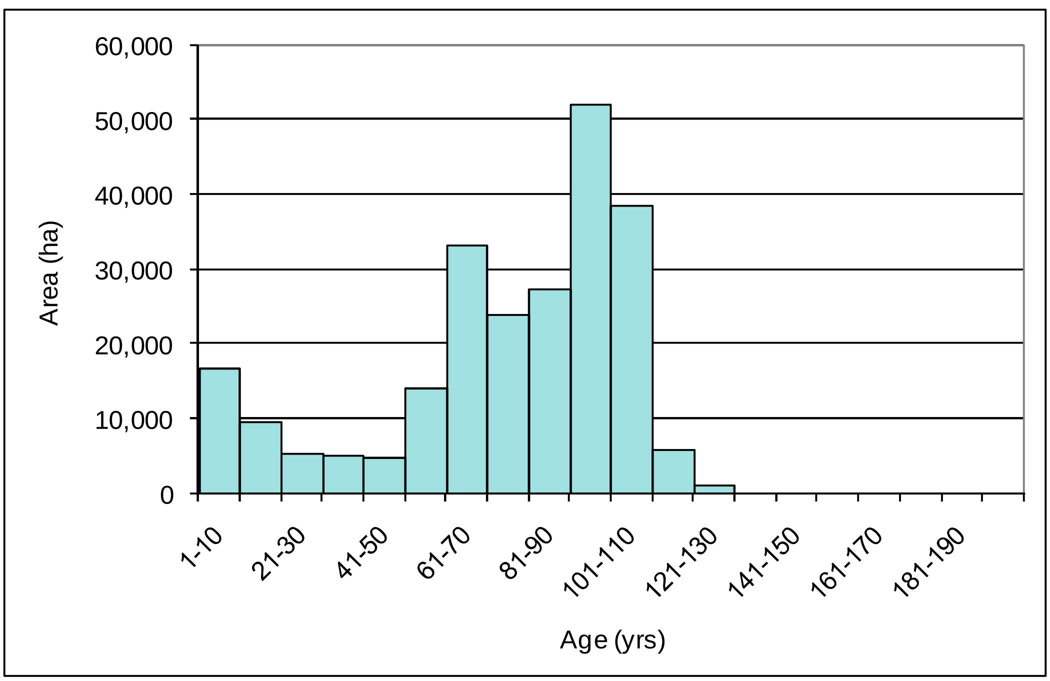


Figure 7-5 Current Pure Deciduous Stand Age Class Distribution

A moderately accelerated harvest is proposed to help deal with the expected downfall in volume and imbalance in age class. The primary deciduous harvest has been modeled at 1,167,155 m^3/yr for periods 1-4 (20 years), or about 31% above the long term AAC. As indicated in Section 11.7.1, during the surge cut, most of the pure deciduous accelerated harvests are targeting older age classes; this management approach helps balancing disproportionate age class distribution. At the end of the accelerated harvest, there will be a small (2.5%) reduction in the pure portion of the deciduous annual allowable cut.

7.8 Reforestation Strategies

7.8.1 Natural Subregions

Weyerhaeuser reforestation strategies are largely based on natural subregions. Landscape Assessment documents natural subregions within the DFA (Section 2.5) including characterization of climate (mean annual temperature and precipitation in Section 3.4) and characteristic stand types or succession patterns. Since natural subregions are fairly large and encompass a wide range of site conditions, Weyerhaeuser's silviculture prescription process is focused on an ecosite based prescription matrix. After identifying the natural sub-region and ecosite phases, site specific variables are described and used in decision making. This approach allowed the Company to identify the limiting factors to tree growth and to ameliorate site conditions through appropriate silviculture prescriptions.

7.8.2 Tree Species to be Reforested

Lodgepole pine and white spruce make up the majority of the FMA's conifer cut, and are the main species to be reforested on the landscape. Lodgepole pine and white spruce reforestation will be achieved through planting of seedlings. Leave for natural regeneration techniques will also be used, particularly for lodgepole pine, trembling aspen and balsam poplar.

7.8.3 Seed Zones and Seed Supply

Weyerhaeuser complies with natural subregion based seed zone management. Seed zone and seed supply is species dependent and is summarized it Table 7-3.

Table 7-3 FMA Seed Supply Assessment by Seed Zones

Seed Zones	Inventory (kg)	Number Of Seedlings That Could Be Planted With Current Inventory	Area That Could Be Planted With Current Inventory (ha)	Approximate Area To Be Cut In This Seed Zone In Next 10 Years (ha)	Seeds Required For Next 10 Years (kg)	Required Seed Collection For Next 10 Years (kg)
Lodgepole Pine (PL)						
B1(Stream2)	21.6	3,176,471	2,269	n/a	n/a	n/a
B2(Stream2)	4	588,235	420	n/a	n/a	n/a
CM3.4	3.1	455,882	326	4,500	43	40
DM 1.2	-	-	-	1	0.01	0.01
DM1.3	35	5,147,059	3,676	1,900	18	-
LF1.2	40.6	5,970,588	4,265	2,200	21	-
LF1.4	175.5	25,808,824	18,435	33,000	314	139
M 2.1	-	-	-	145	1.4	1
SA1.1	25.5	3,750,000	2,679	1,600	15	-
SA2.1	-	-	-	110	1.0	1
UF1.3	147.7	21,720,588	15,515	26,000	248	100
Grand Total	453	66,617,647	47,584	69,456	661	281
White Spruce (SW)						
CM3.4	126.8	33,564,706	23,975	1,400	7	-
DM1.3	-	-	-	800	4	4
G1(Stream2)	216.3	57,255,882	40,897	n/a	n/a	n/a
LF1.2	334	88,411,765	63,151	2,500	13	-
LF1.4	479.9	127,032,353	90,737	7,000	37	-
M2.1	-	-	-	17	0.1	0.1
SA1.1	3.5	926,471	662	200	1	-
SA2.1	8.2	2,170,588	1,550	0	0	-
UF1.3	32.9	8,708,824	6,221	4,200	22	-
Grand Total	1201.6	318,070,588	227,193	16,117	85	4
Black Spruce (SB)						
CM3.4	0.63	222,353	159	400	1.4	0.7
DM1.3	-	-	-	170	0.6	0.6
G3(Stream2)	0.653	230,471	165	-	-	-
LF1.2	-	-	-	310	1.1	1.1
LF1.4	-	-	-	3,300	11.2	11.2
M2.1	-	-	-	-	-	-
SA1.1	-	-	-	11	0.04	0.04
SA2.1	-	-	-	-	-	-
UF1.3	-	-	-	900	3.1	3.1
Grand Total	1.283	452,824	323	5,091	17.3	16.7

Notes for Table Table 7-3:
- Seed inventory data is current as of April 30, 2010
- Number of hectares that could be planted is based on 1,400/ha and 1.7 seeds per cavity

Weyerhaeuser current plans are to collect pine seed annually in conjunction with harvesting, with a 5 year goal of increasing the inventory to more than 20 years worth of pine seed. Spruce seed may be collected in priority areas during the next mast year. This plan will result in collection of enough seed to meet Weyerhaeuser's conifer planting requirements. Seed zone variances may be applied operationally, if needed.

7.8.4 Genetically Improved Material

Weyerhaeuser Grande Prairie is involved in the HuAllan Seed Orchard Co-op (HASOC); it has a small inventory of B1 (800-1200m) and B2 (1200-1600m) lodgepole pine, and a large inventory G1 white spruce genetically improved material. However, a deployment of improved lodgepole pine is currently constrained by seed orchard production. Weyerhaeuser will continue to deploy the available improved pine seed within the approved seed zones, as the seed becomes available.

Weyerhaeuser will also continue to deploy improved white spruce stock on suitable sites within the approved seed zone. However, the number of improved spruce planted annually is not expected to increase significantly over the next ten years, since the cut will be strongly pine dominated.

The TSA includes separate yield curves for stands planted with improved stock, and assumptions about the number of hectares per year that will be planted with improved stock. The supply of improved pine seed is expected to be sufficient to meet those assumptions.

Historical deployment (number of seedlings planted) of improved HASOC stock on Weyerhaeuser Grande Prairie FMA is summarized in Table 7-4.

Table 7-4 Number of Seedlings Planted of Improved HASOC Stock

Year	Pine	White Spruce
1998	744,120	
1999	1,064,666	
2000		
2001		
2002		
2003		
2004		
2005		
2006	1,314,679	479,565
2007	850,936	826,705
2008	2,824,800	963,831
2009	1,200,150	878,550
2010	2,151,540	1,508,125
Grand Total	10,150,891	4,656,776

7.8.5 Incidental Timber Volume Replacement Strategy

Weyerhaeuser will maintain incidental deciduous volume on the conifer land base by protecting some of the deciduous component in regenerating stands when conducting stand tending. As part of its silviculture survey program, Weyerhaeuser will continue to track the MAI results to support this strategy.

The following two strategies will be deployed:

The decision to stand tend a block will be based on the competition assessment flowchart shown in Figure 7-6. Not all blocks will require stand tending.
For blocks declared to a conifer stratum, the standard operating procedure is to carry out stand tending on up to 90% of the net harvested area of the block. Untreated areas will typically be located along the block edges and creek buffers.

Ainsworth and Tolko's strategy for maintaining conifer on the deciduous land base is based on natural recruitment and protection of existing conifer. The companies are committed to developing a protocol to determine whether this strategy reflects what incidental conifer is actually regenerating. The protocol will be signed off by all companies by the end of 2011, with data being collected in the 2012 and 2013 field seasons. This data will be used in the subsequent timber supply analysis.

7.8.6 Forest Stand Transition Assumptions

Weyerhaeuser's general intent is to balance the regenerating stand structure to the original stand structure assessed in the forest inventory. Similar to 2007 MPB plan, DC to CD transition strategy remains unchanged; it is described in Section 9.1.7.

The exception is yield stratum – WEYG03 – Px/Hwd. It is to regenerate a lodgepole pine leading conifer dominated mixedwood at C/D densities. Pine is a relatively shade intolerant species, so there is an increased risk of poor seedling survival and growth under a deciduous canopy. In order to reduce the risk of poor conifer crop establishment, some or all of the openings in this stratum may be planted with a mixture of pine and spruce, since white spruce is likely to have better growth and survival under a deciduous canopy.

This is a low risk strategy, since it maintains a conifer dominated mixedwood and improves the likelihood of establishing an adequate conifer understory. This stratum is expected to comprise approximately 5% of the total area cut in the next 10 years.

7.8.7 Current Decision Process for Operational Silviculture Prescriptions

Operational Silviculture Prescriptions and Competition Assessment / Stand Tending decision making processes are provided in Figure 7-6 and Figure 7-7. The decision processes for silviculture prescriptions are continually monitored and changes made to improve results.

7.8.8 Understory Management Strategies

Deciduous stands with > 250 conifer stems/ha will be managed for conifer land base with no deciduous overstory removal prior to final harvest. When deciduous stands with < 250 conifer stems/ha are harvested, understory avoidance will be carried out as per the Operating Ground Rules. After these stands are harvested, they will be reforested to a D standard.

7.8.9 Reforestation of Roads and Landings

The goal of reforesting roads and landings is to regenerate the area to an equivalent level of productivity and similar species proportions as the adjacent regenerating stand.

Roads and landings will be reclaimed by rolling back topsoil and slash, and may be treated with the same site preparation method that was used on the majority of the cutblock (if applicable). These areas will be planted with conifer (1,400 stems/ha). Deciduous operators may opt to plant roads and landings with poplar.

If stand tending is required, it will be carried out in conjunction with tending on the associated cutblock.

Figure 7-6 summarizes operational silviculture prescriptions. Competition Assessment and Stand Tending is summarized in Figure 7-7.

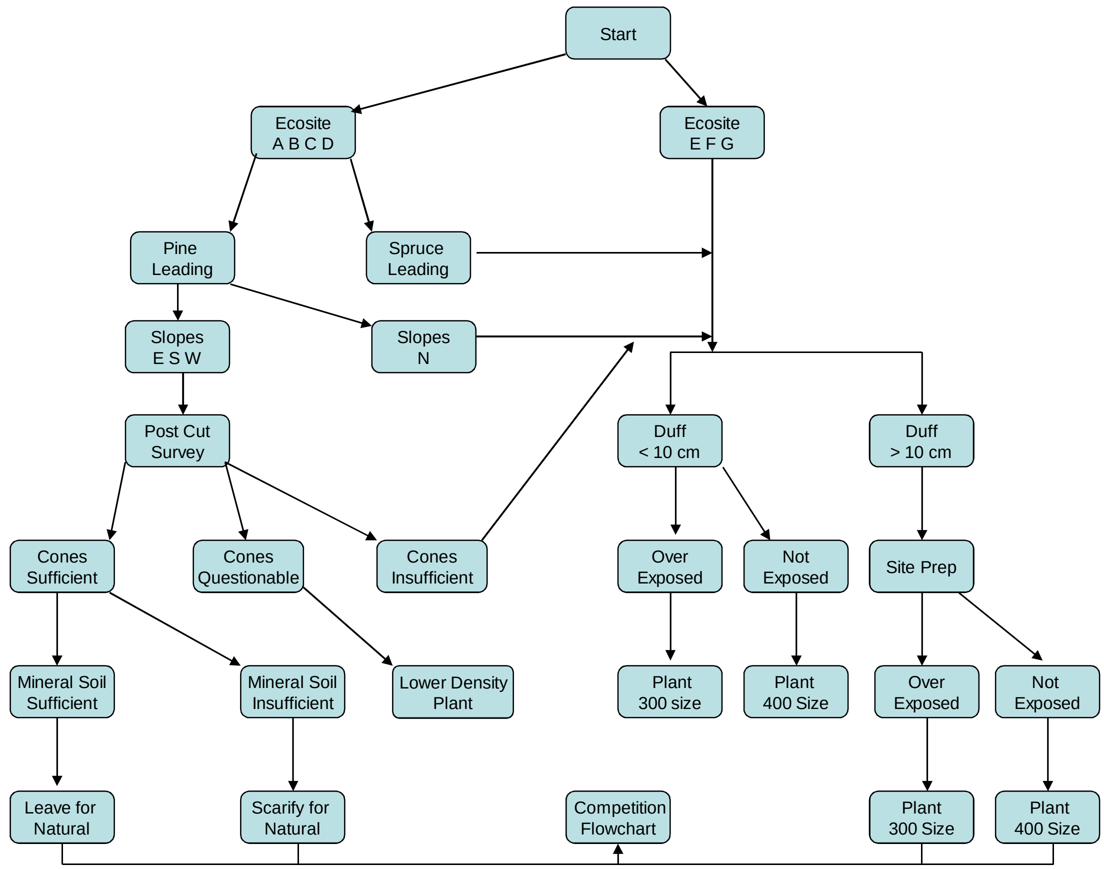


Figure 7-6 Flow Chart for Operational Silviculture Prescriptions

Notes:
Post-cut surveys and scarification / site preparation are done in the first summer after harvest
Planting is done in the first or second summer after harvest
'Over Exposed' refers to exposed ridges or other sites that are more prone to wind damage or desiccation from Chinooks. Smaller seedlings are planted on these sites to minimize seedling damage.

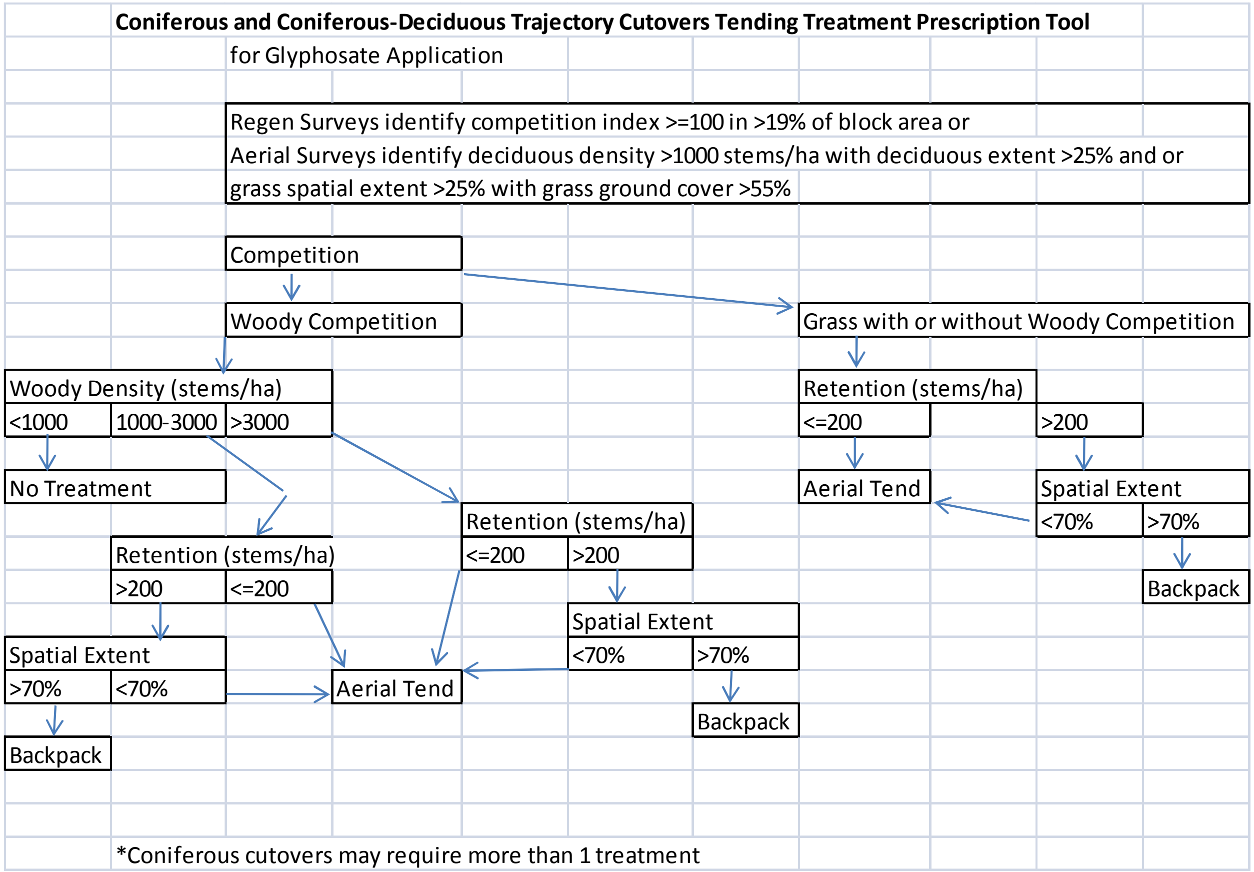


Figure 7-7 Flow Chart for Competition Assessment and Stand Tending

Notes to Figure 7-7:

In order to improve treatment efficacy, backpack application is the preferred treatment on blocks with a high level of retention (>200 stems/ha) and on blocks with retention spread across >70% of the block area.

8 General Description of the Modeling Process

Once interim approval was received from Alberta Sustainable Resource Development (ASRD) for both the net harvestable land base and the growth and yield forecasts, land base data were prepared for subsequent timber supply analyses. Preblocks and themes were added so that planner-defined harvest blocks and previously harvested areas are appropriately sequenced with the correct period and harvest action.

Woodstock™ was used to create an area file and LP schedule (of all the planned blocks). The modeling approach used in this analysis followed the pathway shown in Figure 8-1 and is outlined in this section.

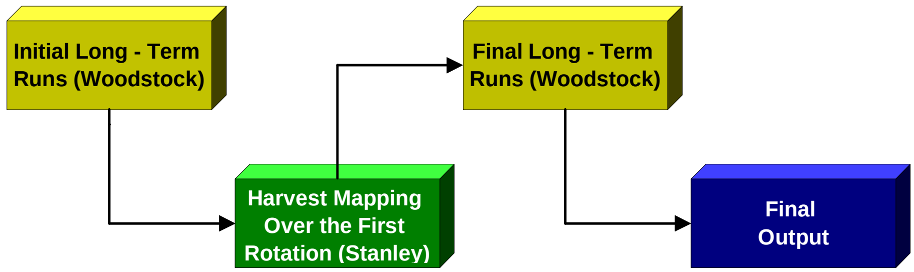


Figure 8-1 Overview of the Modeling Approach

8.1 Initial Woodstock™ Runs

The Woodstock™ model is designed to achieve the maximum harvest volume within the objectives for operability and sustainability of both timber and non-timber resources. Yield relationships are applied to specific forest types (or yield strata) over a specified planning horizon. Harvest activities are applied to the forest based on specified objectives and parameters such as minimum harvest age, and minimum merchantable volume. Woodstock™ creates a matrix of the LP formulation (the collection of the objective and constraints, in consideration of the land base, yield curves, and other management protocols). MOSEK solver was then used to solve the matrix, returning an optimized harvest schedule to Woodstock™. Lastly, Woodstock™ interprets the LP model's solution over the planning horizon. A list of outputs and indicators included in the analysis is presented in Table 8-1.

Table 8-1 Outputs / Indicators Modeled in Woodstock™

Indicators / Outputs
Total Net Growing Stock
Operable Net Growing Stock
Age Class Structure
Volume Harvested
Average Harvest Age
Average Harvested Volume per Hectare
Seral Stage Area Distribution
Area Harvested
Piece Size (qDBH)
Mortality
Enhanced Forest Management
Area of Natural Sub Region
Surge Cut Constraints
MPB Indicators
Caribou Management Zone Indicators

Section 9.1 summarizes all Woodstock™ models developed for this DFMP.

8.2 Stanley™ Spatial Harvest Allocation

Stanley™ allocates the Woodstock™ solution to individual stands, creating the spatial harvest sequence (SHS). The SHS ensures forest / landscape pattern constraints are met over the first 70 years (14 harvest periods) of the planning horizon. Primary hardwood and softwood harvest objectives (softwood from conifer land base and hardwood from deciduous land base) were blocked simultaneously using Stanley™. Spatial harvest scheduling was applied in a stepwise approach:

1. All existing conifer and deciduous harvest blocks prior to May 1, 2009 were identified. They were pre-blocked to ensure that green up delays in these blocks were considered for subsequent blocks.
2. Previously planned blocks from Ainsworth and Weyerhaeuser were incorporated as pre-blocks into the harvest schedule. The majority of these were allocated into periods 1 and 2 however, a smaller number were scheduled into periods 3 and 4.
3. The coniferous and deciduous land bases were blocked simultaneously, with the objective of maximizing the spatial allocation of the primary conifer and primary deciduous harvest levels.

Stanley™ allocates the Woodstock™ schedule to specific polygons on the land base subject to spatial modeling parameters (refer to Section 9.2 for a summary of the modeling protocols). Stanley™ takes into consideration all of the pre-blocks created by the planning team and creates additional blocks in order to achieve the aspatial volumes generated in Woodstock™. After a number of iterations, when a spatially optimal solution is reached (or it is reasonable close), the model is stopped and the spatial harvest sequence is written to a shapefile (a storage format for storing geometric location and associated attribute information). Maps of the areas scheduled for the 20 year SHS are generated with ArcMap™. The SHS is repeatedly assessed and refined by the operations planning staff of Weyerhaeuser and the other timber operators to create a harvest design to be used operationally. The final map of the SHS is located in Appendix 14.

8.3 Final Runs (SHS Woodstock™ Playback)

As a last step, the preferred SHS produced by Stanley™ was incorporated into the long-term Woodstock™ run, providing a direct linkage between the operationally feasible SHS and long-term sustainability. The harvest schedule in periods 15 to 40 was re-optimized to account for adjustments made by Stanley™ in the first 14 periods of harvest and to incorporate these into the long-term harvest schedule. All modeling outputs displayed herein were based on this harvest schedule unless otherwise specified.

To ensure that additional blocks were not sequenced in the first tactical portion of the planning horizon, the objective is set to minimize volume and/or excluding actions. For the remainder of the planning horizon, the objective was returned to the original setting. If required, minor adjustments to the Woodstock™ optimization section were made.

Once the final outputs are calculated, the aspatial reduction factors (in-block and other retention) are subtracted from the estimated harvest volumes to produce the proposed sustainable harvest volumes for the FMA area.

9 Model Structure and Variable Summary

Weyerhaeuser Grande Prairie timber supply analysis was completed using Remsoft Spatial Planning System's Woodstock™ and Stanley™ models. The overview of the modeling structure is listed in Table 9-1.

Table 9-1 Overview of the Forest Model Structure

Basic Forest Modeling Principles		Description	Woodstock™/Stanley™ Structure (input files: []=WK, {}=STAN)
Land base Description		Netdown/Stratification	[AREAS], [LANDSCAPE]
Development Patterns		m^3/ha	[YIELDS]
Treatments	Types	Harvesting Activity	[ACTIONS]
	Eligibility	Operability Windows	[ACTIONS], [LIFESPANS]
	Responses	Succession	[TRANSITIONS]
Resource Indicators		Growing Stock	[OUTPUTS] ,[REPORTS], [GRAPHICS]
Model Control		Planning Horizon	[CONTROL], [GRPAHICS], [OPTIMIZATION]
Integration of Existing Plans		Cut Blocks/5 yr Plan	{SHAPEFILE}, [LPSCHEDULE], {PARAMETERS}, {AREAS}
Spatial Constraints		Block size/Green Up	

9.1 Woodstock™

A wide variety of input parameters and management assumptions must be identified prior to modeling harvest schedules with Woodstock™. These were specified in order to reflect both the biological processes of the forest, as well as the current realities of operational forest management practices. A detailed description of input parameters and management assumptions are provided below.

9.1.1 Basic Parameters

The timber supply review was based on 200 year planning horizon using 40 five year periods.

9.1.2 Lifespan Section

The lifespan identifies the maximum age of a development type before it was assumed to die or it is replaced by another development type (Remsoft, 1999).

Depending on forest types, the model was based on three different lifespans:

1. Coniferous broad cover groups [Theme4 = ‘CX’, ‘CD’, ‘DC’]: All coniferous broad cover group stands were assumed to have a lifespan of 300 years.
2. Deciduous broad cover groups [Theme4 = ‘’DX’]: All deciduous broad cover group stands were assumed to have a lifespan of 200 years.

Regeneration lags described in Section 6.5 were modeled using post-disturbance regenerating forest cover [Theme8 = ‘RRST’, ’RENH’]: All regenerating forest cover types with regeneration lag were assumed to have a lifespan of one period (5 years). Following the regeneration delay, these stands were assigned back to normal yield trajectories as defined by broad cover groups (refer to Section 9.1.7.2).

9.1.3 Landscape Section

The landscape section defines the strata variables (called Themes) used in the TSA. There were eleven Themes identified as detailed below.

9.1.3.1 Theme1 – Natural Subregion

Six Natural Subregions, as defined by actual land base classification, were aggregated for TSA modeling based on the provincial data sets.

A Alpine
LF Lower Foothills
SA Subalpine and Montane
UF Upper Foothills
CM Central Mixedwood
MIX Dry Mixedwood

*AGGREGATE ENH - Enhanced regeneration (*AGGREGATE refers to Woodstock syntax)
LF SA UF CM MIX

9.1.3.2 Theme2 – Mountain Pine Beetle Working Areas

Theme2 indicates working areas concerning mountain pine beetle.

East MPB Zone 1 and SRD-defined eastern portion of Saddle Hills
West MPB Zone 1 and SRD-defined western portion of Saddle Hills
Cent MPB Zone 1 and SRD-defined central portion of Saddle Hills
Zone1S MPB Zone 1 outside of Saddle Hills
Zone 2 MPB Zone 2
Zone 3 MPB Zone 3
X All other area (default)

*AGGREGATE Zone1 - MPB Zone 1 (*AGGREGATE refers to Woodstock syntax)
East West Cent Zone1S

*AGGREGATE Saddle -Saddle Hills
East West Cent

9.1.3.3 Theme3 – Natural Subregion Used for Yield Curve Modeling

Due to a shortage of PSP data and small NSR areas in the FMA, some Natural Subregions defined in Theme 1 were combined for yield curve modeling. Refer to the yield curve document (Appendix 5). The following aggregated NSR classes were used:

ALP Alpine (SA, A, M)
MIX Mixedwood (CMW/CM, DMW/MIX)
LF Lower Foothills
UF Upper Foothills

9.1.3.4 Theme4 – Broad Cover Group

Five broad cover groups were identified in the Land Base Assignment document and used in the TSA as follows:

CD Coniferous Mixedwood

CX Pure Coniferous
DC Deciduous Mixedwood
DX Pure Deciduous
CM Area weighted yield curves

*AGGREGATE CON - for green-up modeling
CD CX DC CM

*AGGREGATE MIX
CD DC

*AGGREGATE DDC – used to identify D/DC cover groups within grazing areas
DX DC

9.1.3.5 Theme5 – Yield Strata

The yield curves were developed as described in the Developing Yield Forecasts document (Appendix 5). Yield curve number, broad cover group, and yield curve's compositions are provided next:

1 CX PL A&B
2 CX PL C
3 CX PL D
4 CX FB A&B
5 CX FB C&D
6 CX LT A&B
7 CX LT C&D
8 CX PL-SS all Good
9 CX SW-PL all Good
10 CX PL-SW A&B Fair
11 CX PL-SW C&D Fair
12 CX MXS all Fair
13 CD PL mixedwood all
14 CD SW mixedwood A&B
15 CD SW mixedwood C&D
16 DC mixedwood A&B
17 DC mixedwood C&D
18 DX A
19 DX B
20 DX C
21 DX D
40 DU Deciduous understory stands
50 CM Area-Weighted Composite
98 BGC = XX; Dens = X or yield Strata is blank

9.1.3.6 Theme6 – Grazing

Harvesting activities on grazing dispositions in Weyerhaeuser Grande Prairie FMA's grazing areas were limited to deciduous operators. Identification of these grazing areas were defined in the Land Base Assignment document (Weyerhaeuser 2006):

No grazing (0)
Grazing (1)

9.1.3.7 Theme7 – Land Base Classification

Based on productivity and FMA boundaries, the forested land base was divided into three groups:

Non-productive (2)
Productive FMA (3)
Productive Non-FMA (grazing) (4)

*AGGREGATE prod – productive forest
3 4

9.1.3.8 Theme8 – Regeneration Status Types

Stand regeneration status identifies stand growth and productivity potential and stand regeneration delay. Five regeneration types were identified:

NAT	Natural stands
ENH	Partial genetic gain
RRST	Regeneration delay
RENH	Regeneration delay - ENH
MGD	Managed stands

*AGGREGATE FTG – Free-To-Grow stands
NAT ENH MGD

*AGGREGATE REGEN – Regeneration delay
RRST RENH

*AGGREGATE ENHANCED – Stands with enhanced genetic potential
ENH RENH

9.1.3.9 Theme9 – Caribou Management Zones

Caribou Management Zones (CMZ) were derived based on geographical location:

LNG	Lingrell / Calahoo
LNG_AA	Lingrell / Calahoo management priority area
NW	Narraway
NW_AA	Narraway management priority area
RR	Red Rock
RR_AA	Red Rock management priority area
N	Non-CMZ

*AGGREGATE ALL_CMZ
LNG LNG_AA NW NW_AA RR RR_AA

9.1.3.10 Theme10 – MPB Susceptibility Rating

MPB susceptibility rating was based on climate factor (CF), pine stand susceptibility rating (SSI), pine component (percent). Each category was described using codes provided below. A combination of these four groups yields unique MPB susceptibility rating. The percent pine component was calculated based on total coniferous content in a stand. Table 9-2 summarized MPB susceptibility rating system for Woodstock™ Theme 10 (five character code).

Table 9-2 MPB Susceptibility Rating

Climate Factor Rating (CF)	Pine Component Rating (SSI)	SSICF Classification (CF * SSI = SSICF)	Percent Pine in Conifer and AVI	Percent Pine in Conifer
A = 1.0	A = 81-100	L = 0-30	1-9 = 10-90% of conifer	1-9 = 10-90% of conifer
B = 0.8	B = 51-80	M = 31-50	X = 100% of conifer	X = 100% of conifer (pure pine stand)
C = 0.5	C = 31-50	H = 51-100	D = 60+% pine content in AVI	
D = 0.2 E = 0.1	D = 0-30			

The 'Percent Pine' value is preceded by the letter "D" for stands with >= 60% overall pine content. Any stand without a pine component receives a "ZZ" (non-pine) rating. All stands, once harvested, transition to ZZ susceptibility.

Finally, as a fifth character, a new MPB theme updates were added to show pine as percent of conifer for stands with >= 60% pine.

Aggregates were established for this theme on the basis of management strategy, as follows:

*AGGREGATE Z1Pine - >= 60% pine, SSICF > 0 for MPB Zone 1
***D*
*AGGREGATE Z1Red# - < 60% pine, SSICF > 0, #% conifer volume reduction
***# (where # represents pine percent of conifer values from 1 to 9 and X (100%))

*AGGREGATE Z2Pine - >= 60% pine, SSICF >= 31 for MPB Zone 2
**MD* or **HD*
*AGGREGATE Z2Red# - < 60% pine, SSICF >= 31, #% conifer volume reduction
***# (where # represents pine percent of conifer values from 1 to 9 and X (100%))
*AGGREGATE Z2BRed# - < 60% pine, SSICF < 31, #% conifer volume reduction * 50%
***# (where # represents pine percent of conifer values from 1 to 9 and X (100%))

9.1.3.11 Theme 11 – NSR Reductions

All openings with an NSR condition resulting from a performance survey had yields adjusted according to the stocking percentage class indicated below.

0 – Stands with < 50% stocking (removed from productive land base)
60 – Stands with 50-65% stocking
70 – Stands with 65-75% stocking
80 – Stands with 75-85% stocking
90 – Stands with 85-95% stocking
100 – Stands with > 95% stocking or fully stocked

9.1.4 Actions and Operability Section

The action section applies activities / treatments the forest. There were six actions used:

1. EnhSilv1 – Harvesting of coniferous stands followed by stand regeneration with enhanced stock for the first 3 periods.
2. DecCC – Harvesting of pure deciduous stands and mixedwood stands.
3. EnhSilv2 – Harvesting of coniferous stands followed by stand regeneration with enhanced stock after period 3.
4. ConCC1 – Harvesting of coniferous stands for the first 3 periods.
5. ConCC2 – Harvesting of coniferous stands after period 3.
6. MPBKill – Death of stands meeting specific criteria for MPB management.

Minimum harvest volume per hectare and age were used to define an “operability window” when a stratum was eligible for harvest. Lower operability limits are defined for each land base type based on various components such as tree growth, volume, product sizes, Weyerhaeuser harvesting practices and systems.

The minimum requirements for the land base groups to be harvested by Weyerhaeuser are as follows:

1. Enhanced silviculture option for coniferous dominated stands (Theme1 = ENH and) Theme4 = CON, outside of the grazing area) and at least 47.5 m^3/ha
2. Deciduous (Theme4 = DX, Theme4 = CD and Theme5 = 40 in areas managed for grazing) and stand age should be older than 12 periods (60 years)
3. Coniferous dominated stands (Theme4 = CON, outside of the grazing area) and stand should have at least 47.5 m^3/ha

There were no upper operability limits for timber harvest eligibility in the timber supply model.

9.1.5 LP Schedule

Planned operational blocks (preblocks) are included in the model using LP Schedule in Woodstock™. The LP schedule lists the area of development type classes to treat with specific actions in specific planning periods. To create the LP schedule file with Woodstock™, the shapefile must include attributes identifying the preblocks. There are two sources for pre-planned operations blocks: Weyerhaeuser and Ainsworth. Both company plans were merged into a single file and used in Woodstock™ and Stanley™.

Pre-planned operation blocks are identified in the database by four fields: [PREBLOCK], [BLOCK], [CUT_PERIOD], and [ACTION]. Details on field values are summarized in the data dictionary in Appendix 4 Section 8.2.

9.1.6 Yields Section

The development of cull adjusted yield curves is described in detail in Weyerhaeuser Grande Prairie FMA Yield Table document (Appendix 5) The yields section provides output data from the yield projection technical reports into the TSA model.

Volumes for each yield curve were determined by Theme3 (Natural Subregion used for yield curve modeling), Theme5 – yield curve number, and Theme8 – Regeneration Status Type.

The following data are provided within the yield section:

1. CONYLD – Coniferous volume (m^3/ha);
2. CONQDBH – Estimated coniferous tree mean quadratic diameter of the stand;
3. DECYLD – Deciduous volume (m^3/ha); and
4. DECQDBH – Estimated deciduous tree mean quadratic diameter of the stand.

For seral stage targets, additional values were added to the yield curve section as follows:

1. Late: Late 80+ years old;
2. VLate: Very Late 120+ years old; and
3. OM: Over Mature 140+ years old

These seral stage brakes combined with NSR classification provided means for VOITs reporting.

9.1.6.1 Mountain Pine Beetle volume reduction factors

Pine volume adjustment factors were included to model reduced pine content due to mountain pine beetle mortality. In MPB Zone 1, stands with >= 60% pine and SSICF > 0 were given a 100% conifer volume reduction starting in period 3 to reflect full mortality of the stand. In MPB Zone 1, stands with < 60% pine and SSICF > 0 had their conifer volumes reduced proportionate to the percentage of pine using the following equation:

Adjustment factor (%) = 100 – (11.5884 + 0.6637 * pine% of conifer)

Thus, for example, a stand with 10% pine of conifer would have its conifer volume adjusted to 82% of normal.

In MPB Zone 2, stands with >= 60% pine and SSICF >= 31 were given a 100% conifer volume reduction starting in period 3 to reflect full mortality of the stand. In MPB Zone 2, stands with < 60% pine and SSICF >= 31 had their conifer volumes reduced proportionate to the percentage of pine using the following equation:

Adjustment factor (%) = 100 – (11.5884 + 0.6637 * pine% of conifer)

Stands in MPB Zone 2 with SSICF < 31, regardless of pine content, had their conifer volumes reduced by 50% of the standard adjustment factor, using the following formula:

Adjustment factor (%) = 100 – ((11.5884 + 0.6637 * pine% of conifer) * 50%)

Exception to this is the Saddle Hills area (see Section 7.6).

9.1.6.2 Not Sufficiently Regenerating stand volume reduction factors

An adjustment factor to yields was also applied to not sufficiently regenerating stands. Therefore, stands with 70% stocking, for example, had their yields adjusted to 70% of full yield.

9.1.7 Transitions Section

The stand transition rules were not changed from 2004 timber supply model. There were two different types of transitions, those that occur after death and those that occur after harvesting. Regenerating stand age after transition was reset to zero.

9.1.7.1 "_Death" Transitions

Stands that are not harvested are subject to mortality. If they are on the non-forested land base they are removed through death / senescence and are assumed for the purposes of modeling to return to the natural stratum and are assigned an age of zero. That includes non-harvestable forested stands (e.g. buffers) following break-up.

Regeneration delayed stands harvested post 1990 (Theme8 = RRST) return to regenerating stands (Theme8 = RST).

All _death transitions reduce MPB susceptibility rating to zero (i.e., to the same rating as stands without pine component (Theme10 = ZZ)).

9.1.7.2 Harvesting Transitions

EnhSilv1, DecCC, EnhSilv2, ConCC1, and ConCC2 represent harvesting actions and were subject to regeneration delays (see Section 6.5).

All harvesting transitions reduced MPB susceptibility rating to zero (i.e., to the same rating as stands without pine component (Theme10 = ZZ).

In addition, under the EnhSilv1, EnhSilv2, ConCC1 and ConCC2 actions, the mixedwood stand and pure coniferous stand transitions were different:

1. DC and CD mixedwood stands with yield strata 16 or 17 (Theme5 = 16 or 17) regenerate to C-density CD broad cover group stands as described by yield stratum 15 (Theme4 = CD and Theme5 = 15).
2. All harvested deciduous leading mixedwood stands and switch stands outside grazing areas (Theme4 = DC and Theme5 = 40 and Theme6 = 0) also regenerate to C-density CD broad cover group stand as described by yield stratum 15 (Theme4 = CD and Theme5 = 15). Note that in the net land base determination process, some stand understory calls were used in place of overstory calls. For these stands, referred to as "switch stands", stand classification was based on AVI understory information (refer to Land Base Assignment document Appendix 3 Section 3.5.3).
3. All harvested pure coniferous stands (Theme4 = CON and Theme5 = YC_C) and coniferous leading mixedwood stands (Theme4 = CON and Theme5 = YC_MX) regenerate back to themselves.
4. All composite yield curve stands (Theme4 = CM and Theme5 = 50) regenerate as CD broad cover group and yield curve 13 (Theme4 = CD and Theme5 = 13).
5. Enhanced SW transitions (Yield Curves 4, 5, 9, 12, 14, and 15) transition to Yield Curve 5.

Under DecCC action the following transitions took place:

1. All harvested deciduous leading mixedwood stands and switch stands in grazing areas (Theme4 = DC and Theme6 = 1) regenerate to C-density of CD broad cover group stands as described by yield stratum 15 (Theme4 = CD and Theme5 = 15). Note the identical transition between ConCC and DecCC actions.
2. Finally, all harvested pure deciduous stands (Theme4 = DX and Theme5 = YC_D) regenerate to C-density pure deciduous stands (Theme4 = DX and Theme5 = 20).

9.1.7.3 MPB Kill transitions

The FMA was divided into MPB management zones. Within Zone 1, encompassing northern portions of the FMA, stands with >= 60%, and SSICF value > 0 and age >= 60 years are assumed to die in period 2 unless they are harvested in periods 1 or 2. If these stands undergo the MPB Kill action, they are removed from the productive land base (THEME7 = 2) and have their MPB susceptibility reset to 0 (THEME10 = ZZ).

9.1.8 Optimize Section

The optimize section is where the objective function and linear programming right-hand side (constraints) were brought together to obtain the optimal solution.

Within the Weyerhaeuser Grande Prairie FMA area there were several operators each with assigned coniferous and/or deciduous volumes. The timber supply objective is to maximize the sum of coniferous and deciduous primary harvest volumes [TOTVOL] over the next 200 years.

Constraints are rules sets, representing management objectives, which are applied to the objective of maximizing harvest volume. Constraints were used to model sustainability, assign where volume was to be removed, and to incorporate controls for maintaining ecological diversity.

No seral stage constraints were modeled. Instead, seral stage area percent is calculated by natural subregion, leading species group and three age classes. They are reported and described in more detail in Section 11.7.5.

9.1.8.1 Volume Flow Constraints

Volume flow constraints were incorporated into the model to ensure that the level of forest management is sustainable over time.

Primary conifer volume was constrained to be even flow for the first two periods. This allows for a surge harvest to better manage for mountain pine beetle. A goal-programmed constraint was added requesting the surge cut primary conifer harvest volume to be >= 2,223,166 m3/yr which was derived from a series of interim analyses around MPB management.

Harvest flow constraints were also implemented for primary conifer harvest by MPB zone in the first two periods. The Zone 1 primary conifer harvest was constrained to be even flow and <= 1,731,343 m3/yr for the first two periods. MPB Zone 2 and 3 had primary conifer harvest volume constraints of 488,970 and 2,853 m3/yr, respectively, but were not constrained to be even flow. These harvest levels were determined from interim timber supply runs.

Following the surge cut, primary conifer harvest was constrained to be even flow from period three onwards. An additional constraint was added (goal-programmed) to limit harvest of primary conifer in the first 5 periods to stands >= 70 years of age.

Primary deciduous harvest was constrained to be <= 1,167,155 m3/yr (the current deciduous AAC) in periods 2 to 4. The period 1 primary deciduous harvest was constrained to be 161,170 m3 higher than the period 2 primary deciduous harvest volume to account for Tolko carryover volume. Primary deciduous harvest was constrained to provide even flow volume from period 5 onwards. An additional constraint was added (goal-programmed) to limit harvest of primary deciduous in the first 2 periods to stands >= 80 years of age.

Incidental conifer volume was constrained to have no more than 20% flow variation in periods 1-4 and 5 onwards, to reflect the flow constraints for primary deciduous volume. Incidental deciduous volume was constrained to have no more than 20% flow variation across the entire planning horizon.

A constraint limiting harvest in the first 70 years of the timber supply to existing stands (stands that have not undergone a modeled transition) were included as a way to improve the spatial allocation.

9.1.8.2 Saddle Hills Deciduous Volume Constraints

At least 80,000 m^3 of deciduous volume per year is required from volume supply area 2 (VSA 2); this volume will be utilized by Tolko. An additional 51,000 m3/yr is required as “unallocated volume”. Period 1 Saddle Hills volume was constrained to include the additional 161,170 m3 of Tolko carryover volume.

9.1.8.3 Non-Declining Operable Growing Stock Constraints

To provide some support to long term sustainability, the primary operable growing stock for both the coniferous [Ocongs] and deciduous [Odecgs] volume was constrained not to decrease over the last 50 years (10 periods) of the planning horizon.

9.1.8.4 Mountain Pine Beetle Constraints

Rather than attempting to achieve a certain percentage reduction in MPB susceptible stands, the focus has been put on managing the harvest levels within MPB Zones. Within Zone 1, encompassing northern portions of the FMA, stands with >= 60% pine, and SSICF value >= 0 and age >= 60 years will die (via the MPB Kill action) in period 2 unless they are harvested in periods 1 or 2. Within Zone 2, stands with >= 60%, and SSICF value >= 31 and age >= 60 years will undergo the MPB Kill action in period 2 unless they are harvested in periods 1 or 2. Additional constraints were added (goal-programmed) to limit the area of stands undergoing the MPB death action, thus forcing the model to harvest these stands rather than let them die.

9.1.8.5 Caribou Zone Constraints

Managing for MPB also takes caribou habitat into account. Caribou habitat constraints have been put in place after the coniferous surge-cut. Levels are set using the 20/30 rule, where no more than 20 percent of area can be less than or equal to 30 years of age. This constraint is applied to each of the Narraway, Lingrell and Red Rock CMZs from period 5 onwards. No harvest was permitted within any CMZ in the first 20 years except for preblocks.

9.1.8.6 Enhanced Silviculture

Maximum areas that could be regenerated with enhanced stock are provided in Appendix 9. A maximum of 5,000 ha and 14,881 ha are available to be established in each period for pine and spruce, respectively. In addition, enhanced regeneration areas were not permitted to die.

9.1.9 Output Section

A wide variety of outputs were generated for use as constraints or for reporting purposes. The following tables describe the key outputs used in the model formulation. Remaining outputs are described directly in the output section of the model.

9.1.9.1 Harvested Volumes

Output	Description
convol	Primary coniferous harvest
convol5	Annual primary coniferous harvest
idecvol	Incidental deciduous harvest
idecvol5	Annual incidental deciduous harvest
decvol	Primary Deciduous harvest
decvol5	Annual primary deciduous harvest
iconvol	Incidental coniferous harvest
iconvol5	Annual incidental coniferous harvest
totvol	Total Primary volume harvested
totivol	Total Incidental volume harvested
ttotvol	Total volume harvested
Dec_saddle	Primary deciduous harvest from Saddle Hills
Convolz	Annual primary conifer harvest by MPB Zone
Con70	Harvested primary conifer volume from stands < 70 years of age
Dec80	Harvested primary deciduous volume from stands < 80 yes of age

9.1.9.2 Growing Stock

Output	Description
Tdecgs	Total deciduous growing stock
Tcongs	Total coniferous growing stock
ODecGS	Operable deciduous growing stock (manual)
OConGS	Operable coniferous growing stock (manual)

9.1.9.3 Caribou Management Zone Outputs

Output	Description
HCMZ_area	Harvested area within Caribou Management Zones.
LNG_area	Total area within the Lingrell CMZ
LNG30_area	Total area within the Lingrell CMZ that is <= 30 years of age
RRC_area	Total area within the Red Rock CMZ
RRC30_area	Total area within the Red Rock CMZ that is <= 30 years of age
NRW_area	Total area within the Narraway CMZ
NRW30_area	Total area within the Narraway CMZ that is <= 30 years of age

9.1.9.4 Mountain Pine Beetle Areas

Output	Description
Mpb1op	Harvest operable zone 1 MPB stand area (pine >= 60%, ssicf > 0, age >= 60 yrs)
Mpb1hrv	Harvested zone 1 MPB stand area
Mpb1kill	Zone 1 MPB stand area that undergoes the 'mpbkill' action
Mpb2op	Harvest operable zone 2 MPB stand area (pine >= 60%, ssicf >= 31, age >= 60 yrs)
Mpb2hrv	Harvested zone 2 MPB stand area
Mpb2kill	Zone 2 MPB stand area that undergoes the 'mpbkill' action

9.1.9.5 Enhanced Forest Management Areas

Output	Description
Enh_est_pl	Established pine enhanced regeneration area
Enh_est_sw	Established spruce enhanced regeneration area
Enh_darea	Enhanced regeneration area that undergoes the 'death' action
Enh_concc	Enhanced regeneration area that undergo 'concc' actions

9.1.9.6 Piece Size

Output	Description
Con_conqdbh	Quadratic mean diameter of harvested conifer stands
Dec_decqdbh	Quadratic mean diameter of harvested deciduous stands
Con_ps	Piece size (average qDBH) of harvested conifer stands
Enh_concc	Piece size (average qDBH) of harvested deciduous stands

9.1.9.7 Harvest Summaries

Output	Description
CAvgVolPerHa	Average conifer volume/ha harvested
DAvgVolPerHa	Average deciduous volume/ha harvested

9.1.9.8 Natural Subregion and Species Summaries

Output	Description
A_MIX_AT	Total aspen species group area in central mixedwood subregion
A_MIX_PL	Total pine species group area in central mixedwood subregion
A_MIX_SB	Total Black spruce species group area in central mixedwood subregion
A_MIX_SW	Total white spruce species group area in central mixedwood subregion
A_LF_PL	Total pine species group area in lower foothills subregion
A_LF_SB	Total Black spruce species group area in lower foothills subregion
A_LF_SW	Total white spruce species group area in lower foothills subregion
A_SA_PL	Total pine species group area in sub-alpine subregion
A_SA_SB	Total Black spruce species group area in sub-alpine subregion
A_SA_SW	Total white spruce species group area in sub-alpine subregion
A_UF_PL	Total pine species group area in upper foothills subregion
A_UF_SB	Total Black spruce species group area in upper foothills subregion
A_UF_SW	Total white spruce species group area in upper foothills subregion

9.1.9.9 Seral Stage Outputs

Output	Description
<NSR>_<SPE_GR>_<AGE>	Area by natural subregion (NSR = MIX (central mixedwood), LF (lower foothills), UF (upper foothills), SA (sub-alpine)), species group (SPE_GR = AT (aspen), PL (pine), SB (Black spruce), SW (white spruce)) and age (80 = late seral stage (> 80 years of age, 120 = very late seral stage (> 120 years of age, 140 = overmature seral stage (> 140 years of age)

9.2 Stanley™

RSPS Stanley™ assigns actions to polygons, subject to spatial rule sets, in an attempt to match the optimal aspatial output values from Woodstock™. The resulting spatial harvest sequence (SHS) is a key output of the timber supply analysis process as it incorporates the strategic objectives necessary to achieve the desired future forest into operational planning.

The Stanley™ parameters are outlined in the following table and described in more detail in the following sections.

Table 9-3 Summary of Input Parameters and Assumptions Required for 70-Year Spatial Planning

Parameter / Criteria	Periods 1 & 2	Period 3-14
Green-up Delays	None for EnhSilv1 and ConCC1 10 years (1 period) for DecCC	15 years (2 periods) for EnhSilv2 and ConCC2 10 years (1 period) for DecCC
Minimum Block Size	5 ha	5 ha
Maximum Opening Size	None	None
Target Block Size	100 ha	360 ha
Adjacency Distance	55 m	55 m
Proximal Distance	21 m for DecCC, else 0 m	21 m
Timing Deviations	2 periods (10 years)	2 periods (10 years)
Spatial Flow Tolerance	3%	5%
Objectives (Weight)	ConVol (1) DecVol (5)	ConVol (5) DecVol (1)
Allow multi-period openings	Yes	Yes

9.2.1 Spatial Planning Horizon

Stanley™ was used to block harvest activities (i.e., spatially allocate actions to polygons) for the first 14 periods (70 years) from the effective date.

Stanley™ modeling was split into two distinct steps. During the first step, periods 1-2 were allocated first to ensure mountain pine beetle and harvest volume objectives could be achieved without interference from future blocks. Subsequently, periods 3-14 were allocated during the second step.

9.2.2 Maximum Timing Deviation

The maximum timing deviation sets the maximum number of periods that harvest scheduling can deviate from the aspatial timings. The Stanley™ modeling process attempts to assign treatments to polygons such that deviations from the optimal timings outlined in the strategic schedule are minimized. However, it may be necessary to advance or delay activities to facilitate block allocation. A higher setting allows for greater flexibility in the allocation process at the expense of a greater divergence from the goals and objectives reconciled in the strategic schedule (Remsoft, 1999).

A maximum deviation of two periods was used during spatial planning horizon to ensure that operational objectives set up in Woodstock™ were not compromised by Stanley™. Since Stanley was used to allocate periods 1 and 2 separately from the rest of the spatial planning horizon, the effect of the two period deviation allowance was to permit Stanley™ to switch blocks between periods 1 and 2 only. In this way, the SHS was able to maintain the associated objectives of the first two periods: mountain pine beetle and harvest flows (including surge cut, carryover, and flow constraints).

9.2.3 Objectives, Spatial Flow Tolerance and Weighting

Stanley™ uses the Woodstock™ outputs as objectives for blocking. Stanley™ assigns actions to polygons in the timing and amount specified in the Woodstock™ schedule, within the allowable deviations and parameters, to closely match the Woodstock™ outputs. Two objectives were chosen for Stanley™: primary conifer and primary deciduous volumes.

Stanley™ objectives were weighted to establish their relative importance. The relative weighting was used to aid coniferous and deciduous harvest allocations in Periods 1 and 2 and then in Periods 3 through 14. In part MPB strategy during Periods 1 and 2, deciduous harvests were harder to achieve due to accelerated coniferous harvests. During this period, to help in achieving better deciduous harvest allocation, deciduous harvests were weighted more than coniferous harvests. Following surge coniferous surge cut, it became more difficult to achieve coniferous harvests. In Periods 3 through 14 the weights were switched favoring coniferous harvests.

Periodic weights were also used; they helped to prioritize periods within a single objective (e.g., coniferous harvests). Objective weightings and periodic weightings for Stanley™ were chosen "on the fly" to produce an SHS that did not unfairly prejudice Stanley™ in favor of either conifer or deciduous primary volume, but placed more emphasis on the early periods where key objectives were being met.

Similar to even-flow constraint formulation in Woodstock™, a deviation of 3% was allowed for primary volumes in periods 1 and 2, and 5% from period 3 onwards (percentage is determined as the difference between the maximum and the minimum value).

9.2.4 Adjacency Distance

Adjacency describes the ways that polygons are spatially related to other polygons in the forest. Within the Stanley™ environment, adjacent polygons can be, and are, combined to form harvest blocks. This adjacency value dictates the maximum distance between polygons that Stanley™ would be allowed to group into a harvest block. The adjacency distance assigned for the constraint was 55 meters. The distance selected allows polygons to be grouped into blocks that are separated by relatively narrow non-eligible features such as seismic lines, trails or other narrow linear features, but prevents the grouping of polygons separated by landscape features that would, in reality, prohibit the harvest of the group as a single unit. In past analyses, the percentage harvest achieved was relatively insensitive to modifications to adjacency distances, as many non-eligible features are too narrow to be captured as individual polygons within the inventory. As a result, these features do not often act as block boundaries, whereas a 55 meter separation would usually denote a watercourse or a large right-of-way that would preclude these polygons from being grouped.

9.2.5 Minimum Block Size

Minimum block size is a constraint within the Stanley™ modeling environment that sets the minimum acceptable harvest block size created using the adjacency distance. Single-polygon or composite-polygon blocks that are smaller than the minimum are identified as impossible area and become isolated stands.

The minimum block size can have significant effects on the spatial harvest levels; the larger the minimum block size, the greater the negative impact on the spatial harvest level. Five hectares was selected as the minimum block size for this analysis.

9.2.6 Maximum Opening Size

An opening is defined as a group of harvest blocks within the proximal distance of one another that are in green-up. The maximum opening size parameter defines the upper limit on the size of openings. There was no maximum openings size parameter used in the model.

9.2.7 Target Block Size

The target block size parameter establishes the desired block size. Various scenarios were analyzed and due to the fragmented nature of the land base it was very difficult to create average disturbance patches in the vicinity of the desired patch sizes. The target block size was eventually raised to 360 ha. This meant the model would attempt to aggregate polygons until the block was close to 360 ha in size. During the conifer surge cut, the target block size was reduced to 100 ha.

9.2.8 Proximal Distance

Spatial blocking within the Stanley™ environment requires a value to represent the proximal distance (zero to some arbitrary maximum) within which Stanley™ would be allowed to place harvest blocks that have not achieved green-up. In this case, proximity represents how close each created opening can be to another (either existing, planned or both). Proximal distance defines the minimum distance that a stand must be away from another stand in order that the two stands as part of separate blocks can be scheduled for harvest in the same period.

Once Stanley™ assigns a block to a harvest period; proximal stands will not be scheduled until the regenerating trees within the harvested area have achieved green-up. In the absence of a proximal distance, Stanley™ could place blocks as close together as the adjacent distance without causing a violation. However, under most management strategies this may be inappropriate; thus, by setting the proximal distance greater than or equal to the desired width of exclusion zones, Stanley™ will separate the proposed blocks by at least this amount within the green-up interval (Remsoft, 1999).

Results achieved in past analyses indicate that proposed harvest levels have been relatively insensitive to a changing proximal distance up to 60 meters, after which achievement of proposed aspatial harvest levels have decreased noticeably. Thus, in this analysis a proximal distance of 21 meters was selected. Two stands separated by a buffered small permanent stream (60 m width) would not be in violation of green-up.

The proximal distance for conifer harvests during the surge cut period was not applied.

9.2.9 Green-up Delays

Green-up delay is defined as the time it takes for a deciduous tree to reach 3 m and a coniferous tree to reach 2 m. Using stand development averages, the green-up length for pure coniferous stands is 15 years (2 periods) and for deciduous and mixedwood stands is 10 years (1 period).

No green-up delays were applied to conifer surge cuts.

9.2.10 Multi-Period Openings

The multi-period openings parameter determines whether or not Stanley™ can create openings that span more than one planning period. Blocks within an opening will be scheduled in the same planning period unless multi-period openings are allowed. Multi-period openings were permitted in the model.

10 Exploring TSA Trade-Offs and Sensitivities

10.1 Overview of Preliminary TSA and Sensitivity Models

The TSA modeling in the Weyerhaeuser Grande Prairie FMA area presented many challenges including requirements for conifer and deciduous fibre production, suitable woodland caribou habitat management, and, most recently, Mountain Pine Beetle infestation of epidemic proportions across the FMA area. Modeling Timber Supply Analysis (TSA) it was important to understand the interaction among modeling parameters and determine levels of their potential impact to the changes in short and long term forest resource supply. To aid the selection of the Preferred Forest Management Strategy (PFMS), a series of preliminary and sensitivity analyses were carried out to understand the impacts on TSA models. Details regarding both of these additional analyses are located in Section 10.3.

The following two types of analyses supported the PFMS selection of the 2011 DFMP:

1. Preliminary TSA analysis - TSA focus was on pine strategy, even-flow harvest and 20/30 rule in three caribou zones from period 5 onwards.

2. Four sensitivity analyses
    a. 11/30 CMZ: PFMS with 11/30 rule in 3 caribou zones starting period 1;
    b. No CMZ: PFMS without the limitation on the percentage of young forest within each CMZ;
    c. No MPB: PFMS without the MPB constraints and no yield adjustments; and
    d. Natural transitions: PFMS with all natural stand transition types; enhanced silviculture could still occur and stands will stay on enhanced trajectory.

The DC-to-DC transition sensitivity analysis has been completed on the 2007 MPB plan showing marginal improvement in total merchantable volume, mostly incidental deciduous. Although mentioned in the terms of reference, it was agreed by the Planning Development Team that the sensitivity analysis completed on the 2007 MPB plan (volume increase ratio) would be sufficient to meet the 2011 sensitivity request.

Ainsworth has prepared yield tables for pure deciduous stands summarized in alternate utilization yield tables in 2007 (J.S. Thrower 2007). This report included two deciduous utilization standards – 13/7 and 13/10. No direct sensitivity analysis has been carried out at this time; however, volume adjustment rations could be calculated using information provided in this document.

10.2 Preliminary TSA Analysis

This section summarizes preliminary TSA model; the PFMS was based on this model. The difference between preliminary TSA and PFMS is in CMZ targets and accelerated harvest modeling – preliminary TSA model was based on even flow harvest levels without any surge cuts. All constraints used in the preliminary TSA model could be summarized using the following groups:

1. Harvest flow restrictions;
2. Growing stock;
3. Caribou zones;
4. MPB;
5. Saddle Hills;
6. Enhance regeneration; and
7. Yield / net productive area adjustments.

All planned blocks were modeled. Table 10-1 summarizes preliminary TSA analysis constraints.

Table 10-1 Preliminary TSA Analysis Constraint Overview

Model Constraint Groups	Detailed Description
Harvest flow restrictions	Even flow primary conifer volume in periods 1-40 Minimize harvest of primary conifer volume under 70 years of age in first 5 periods Even flow primary deciduous volume in periods 1-40 Minimize harvest of primary deciduous volume under 80 years of age in first 2 periods Even flow (20%) incidental conifer volume in periods 1-40 Even flow (20%) incidental deciduous volume in periods 1-40
Growing stock	Non-declining operable primary deciduous growing stock from period 31 onwards (last quarter of planning horizon) Non-declining operable primary conifer growing stock from period 31 onwards (last quarter of planning horizon)
Caribou zones	20/30 rule in 3 caribou zones from period 5 onwards (goal-programmed)
MPB	MPB Zone 1: all stands >= 60% pine, SSICF > 0 and age >= 60 must be harvested by end of period 2 or be removed from productive land base MPB Zone 2: all stands >= 60% pine, SSICF > 31 and age >= 60 must be harvested by end of period 2 or be removed from productive land base
Saddle Hills	Minimum primary deciduous harvest of 131,000 m^3/yr from Saddle Hills (80,000 m^3/yr for Tolko + 51,000 m^3/yr unallocated) Minimum primary deciduous harvest of 816,170 m^3 from Saddle Hills in period 1 (80,000 m^3/yr for Tolko + 51,000 m^3/yr unallocated = 655,000 m^3/pd + 161,170 m^3 Tolko carry forward = 816,170 m^3)
Enhanced regeneration	Enhanced pine establishment <= 1,000 ha/yr (5,000 ha/period) Enhanced spruce establishment <= 2,976 ha/yr (14,881 ha/period) Enhanced regeneration stands not permitted to die Harvested enhanced regeneration stands must undergo enhanced regeneration again
Yield / net productive area reduction	MPB Zone 1: all stands < 60% pine, SSICF > 0 and age >= 60 get proportional conifer volume reduction MPB Zone 2: all stands < 60% pine, SSICF >= 31 and age >= 60 get proportional conifer volume reduction MPB Zone 2: all stands >= 0% pine, SSICF < 31 and age >= 60 get 50% of proportional conifer volume reduction Limit harvest of young primary coniferous stands (< 70 yrs old) in first 4 periods Limit harvest of young primary deciduous stands (< 80 yrs old) in first 2 periods

10.3 Sensitivity Analyses

Four sensitivity analyses (scenarios) were evaluated; they were based on the PFMS model with the following adjustments:

1. 11/30 CMZ
    a. Planned pre-blocks were turned off; and
    b. 11/30 rule in 3 CMZs from period 1 onwards.
2. No Caribou Management Zones
    a. Planned pre-blocks were turned off;
    b. Within each Caribou Management Zone no limitation on the percentage of young forest
3. No MPB
    a. Removed MPB constraints; and
    b. No yield adjustments.
4. Natural transitions
    a. All transitions were to natural stand types; and
    b. Enhanced silviculture can still occur and stands will stay on enhanced trajectory.

10.4 Preliminary TSA and Sensitivity Analysis Results

Table 10-2 provides TSA run overview. Results were summarized using primary and incidental volumes and growing stock at the start and at the end of the 200 year planning horizon; they do not include reductions for retention of 2.5% and 3.0% for coniferous and deciduous volume, respectively.

Table 10-2 Overview of PFMS, Preliminary TSA, and Sensitivity Analyses Results

Description	PFMS	Preliminary TSA	11/30 CMZ	No CMZ	No MPB	Natural Transitions
Primary Conifer AAC						
Period 1	2,246,574	1,372,677	2,223,166	2,278,873	2,223,166	2,318,747
Period 2	2,252,278	1,372,677	2,223,166	2,278,873	2,223,166	2,318,747
Period 3	1,250,281	1,372,677	1,174,235	1,518,947	1,544,879	1,313,098
Period 4	1,280,599	1,372,677	1,174,235	1,518,947	1,544,879	1,313,098
Period 5 - 10 (Average)	1,271,538	1,372,677	1,174,235	1,518,947	1,544,879	1,313,098
Period 11 - 40 (Average)	1,364,798	1,372,677	1,174,235	1,518,947	1,544,879	1,313,098
Period 1 - 40 (Average)	1,390,072	1,372,677	1,226,681	1,556,944	1,578,793	1,363,380
Primary Deciduous AAC						
Period 1	1,199,358	612,907	1,199,389	1,199,389	1,199,389	1,199,389
Period 2	1,167,114	612,907	1,167,155	1,167,155	1,167,155	1,167,155
Period 3	1,131,590	612,907	1,167,155	1,167,155	1,167,155	1,167,155
Period 4	1,131,827	612,907	1,167,155	1,167,155	1,167,155	1,167,155
Period 5 - 10 (Average)	577,463	612,907	594,186	606,603	600,297	606,383
Period 11 - 40 (Average)	588,666	612,907	594,186	606,603	600,297	606,383
Period 1 - 40 (Average)	643,866	612,907	652,289	663,464	657,788	663,266
Incidental Conifer AAC						
Period 1	86,893	47,907	96,714	96,607	91,326	90,452
Period 2	87,306	48,608	85,109	85,943	91,418	89,077
Period 3	81,593	49,279	89,824	89,687	91,838	88,621
Period 4	82,808	52,009	82,768	83,521	85,946	76,661
Period 5 - 10 (Average)	39,526	51,318	41,170	41,579	44,295	44,474
Period 11 - 40 (Average)	46,072	46,389	45,602	45,212	45,909	50,288
Period 1 - 40 (Average)	48,948	47,434	49,237	49,040	50,090	53,008
Incidental Deciduous AAC						
Period 1	305,569	190,741	279,533	305,831	297,598	284,271
Period 2	375,465	190,741	279,533	305,831	297,598	284,271
Period 3	424,586	238,426	279,533	305,831	297,598	284,271
Period 4	397,822	238,426	279,533	305,831	297,598	284,271
Period 5 - 10 (Average)	246,214	238,426	279,533	305,831	297,598	284,271
Period 11 - 40 (Average)	227,010	225,940	230,534	250,781	240,062	231,866
Period 1 - 40 (Average)	244,775	226,677	242,783	264,544	254,446	244,967
Operable Growing Stock						
Primary Conifer OGS - Start	81,599,760	86,008,516	81,807,171	81,484,557	81,800,576	81,291,928
Primary Conifer OGS - End	46,779,633	43,264,773	62,410,426	29,801,671	55,726,238	39,409,096
Primary Decid OGS - Start	39,142,712	42,064,850	39,255,441	39,255,405	39,197,163	39,198,252
Primary Decid OGS - End	11,096,126	12,154,963	11,926,355	11,810,221	11,797,719	12,043,544
Incidental Conifer OGS - Start	2,586,855	2,794,291	2,537,917	2,538,404	2,564,248	2,568,762
Incidental Conifer OGS - End	817,725	872,803	866,177	839,888	849,442	917,310
Incidental Decid OGS - Start	17,799,444	18,348,079	17,919,836	17,770,260	17,812,181	17,891,971
Incidental Decid OGS - End	4,720,818	4,041,463	3,595,497	2,688,150	4,250,494	4,322,260

11 Preferred Forest Management Strategy (PFMS)

11.1 Management Objectives

Following consultation with FMA quota holders and ASRD and a review of the preliminary and sensitivity analyses, a preferred scenario that best represented the collective goals and objectives was modeled to estimate sustainable harvest levels for the FMA. The PFMS objective was to maximize total primary volume harvested. The model was constructed to observe non-declining yields on the operable growing stock as a sustainability constraint. The selected model formulation ensures that harvests are not liquidating growing stock at the end of the planning horizon and timber volumes are present beyond the conclusion of the planning horizon.

The selected SHS provided a flexible, operationally based scenario that allows Weyerhaeuser and the embedded deciduous quota (DTA) holders to economically and sustainably harvest volume from the FMA area. A portion of the blocks in the 20 year SHS are pre-planned by the Weyerhaeuser planning team in Grande Prairie and most of the other timber operators (Tolko, Ainsworth LC, and ASRD) within the FMA area. This increases the expected congruency between the Spatial Harvest Sequence and the operational harvesting activities.

11.2 Model Constraints

This section summarizes PFMS constraints. The PFMS was based on the preliminary TSA model; the difference was based on modified CMZ constraints and added conifer and deciduous accelerated harvests. All constraints could be summarized using the following groups:

1. Harvest flow restrictions;
2. Growing stock;
3. Caribou zones;
4. Mountain Pine Beetle;
5. Saddle Hills;
6. Enhance regeneration; and
7. Yield / net productive area adjustments.

Table 11-1 summarizes PFMS constraints.

Table 11-1 PFMS Constraint Overview

Model Constraint Groups	Detailed Description
Harvest flow restrictions	Even flow primary conifer volume in periods 1-2 and 3-40 Primary conifer volume >= 1,797,828 m^3/yr in periods 1-2 (previous baseline harvest level) Primary conifer volume >= 2,223,166 m^3/yr in periods 1-2 (desired harvest level) Even flow primary conifer volume in MPB Zone 1 in periods 1-2 Primary conifer volume from MPB Zone 1 <= 1,731,343 m^3/yr in periods 1-2 Primary conifer volume from MPB Zone 2 <= 488,970 m^3/yr in periods 1-2 (goal) Primary conifer volume from MPB Zone 3 >= 2,853 m^3/yr in periods 1-2 Minimize harvest of primary conifer volume under 70 years of age in first 5 periods Even flow primary deciduous volume in periods 2-4 and 5-40 Primary deciduous volume in period 1 is 161,170 m3 higher than period 2 (Tolko carryover) Primary deciduous volume <= 1,167,155 m^3/yr in periods 2-4 (current deciduous AAC) Minimize harvest of primary deciduous volume under 80 years of age in first 2 periods Even flow (20%) incidental conifer volume in periods 1-4 and 5-40 Even flow (20%) incidental deciduous volume in periods 1-40
Growing stock	Non-declining operable primary deciduous growing stock from period 31 onwards (last quarter of planning horizon) Non-declining operable primary conifer growing stock from period 31 onwards (last quarter of planning horizon)
Caribou zones	No additional harvest inside CMZs in first 4 periods except for pre-blocks (goal-programmed) 20/30 rule in 3 caribou zones from period 5 onwards (goal-programmed)
Mountain Pine Beetle	MPB Zone 1: all stands >= 60% pine, SSICF > 0 and age >= 60 must be harvested by end of period 2 or be removed from productive land base MPB Zone 2: all stands >= 60% pine, SSICF > 31 and age >= 60 must be harvested by end of period 2 or be removed from productive land base
Saddle Hills	Minimum primary deciduous harvest of 131,000 m^3/yr from Saddle Hills (80,000 m^3/yr for Tolko + 51,000 m^3/yr unallocated) Minimum primary deciduous harvest of 816,170 m^3 from Saddle Hills in period 1 (80,000 m^3/yr for Tolko + 51,000 m^3/yr unallocated = 655,000 m^3/pd + 161,170 m^3 Tolko carry forward = 816,170 m^3)
Enhance regeneration	Enhanced pine establishment <= 1,000 ha/yr (5,000 ha/period) Enhanced spruce establishment <= 2,976 ha/yr (14,881 ha/period) Enhanced regeneration stands not permitted to die Harvested enhanced regeneration stands must undergo enhanced regeneration again
Yield / net productive area adjustments.	MPB Zone 1: all stands < 60% pine, SSICF > 0 and age >= 60 get proportional conifer volume reduction MPB Zone 2: all stands < 60% pine, SSICF >= 31 and age >= 60 get proportional conifer volume reduction MPB Zone 2: all stands >= 0% pine, SSICF < 31 and age >= 60 get 50% of proportional conifer volume reduction Limit harvest of young primary coniferous stands (< 70 yrs old) in first 4 periods Limit harvest of young primary deciduous stands (< 80 yrs old) in first 2 periods

11.3 PFMS Playback Adjustments

The completion of the PFMS playback required the following adjustments:

1. Inclusion of 14-period (70 year) Stanley™ generated LP Schedule;
2. Removal of volume fluctuation constraints for the first 14 periods;
3. Removal of any harvest level constraints for the first 14 periods;
4. Reassigning primary and incidental volume fluctuation, enhanced regeneration, MPB and CMZ constraints starting period 15;
5. Re-activated Tolko volume constraint starting period 15;
6. Goal programming of most inequality constraints; and
7. Excluding harvest actions for period 1 through 14.

11.4 PFMS Harvest Level (AAC)

11.4.1 Overview

The cull retention adjusted net volumes that the company has calculated as the proposed net sustainable harvest levels are provided in Table 11-2.

Table 11-2 Net Average Harvest Levels (AAC) for Weyerhaeuser Grande Prairie FMA

Harvest Volume AAC (m^3/yr)	2009 - 2018 Period 1..2	2019 - 2028 Period 3..4	2029+ Period 5..40
FMA Coniferous	2,278,112	1,313,949	1,359,379
Primary Coniferous	2,193,190	1,233,804	1,315,523
Incidental Coniferous	84,922	80,145	43,856
FMA Deciduous	1,478,041	1,496,625	792,499
Primary Deciduous	1,147,739	1,097,757	569,195
Incidental Deciduous	330,302	398,868	223,304
FMA Total	3,756,152	2,810,575	2,151,879

These volumes have been spatially allocated and obtained by averaging two adjacent planning periods following Woodstock spatial playback.

The PFMS represents Weyerhaeuser's best estimate on how the MPB infestation progress over the next ten years. However, there is growing uncertainty after 2019. Because of this, Weyerhaeuser is planning on submitting our next DFMP in 2018 for approval prior to April 2019 after a new AVI is completed and the status of the MPB is better known.

Weyerhaeuser believes that it would be more socially responsible to gradually step down the AAC following the MPB surge cut versus a large reduction.

As the primary focus of this plan was to deal with the MPB infestation and how it could impact other resource values, Weyerhaeuser did not build in any economic contingency plans. If, through the course of implementing this plan, economic times necessitate the need for augmenting piece size through the harvest of white spruce, Weyerhaeuser will initiate discussions with ASRD to explore options how this could be done in the context of the plan.

11.4.2 Periodic Allocations

Table 11-3 summarizes FMA coniferous and deciduous net AAC levels for the 200 year planning horizon (the tabulated net volumes are adjusted period-based averages). The net volumes have been reduced by 2.5% and 3.0% coniferous and deciduous volume retention, respectively.

Table 11-3 FMA Average Net Annual Harvest Volumes (AAC)

	Period	Coniferous			Deciduous		
		Primary	Incidental	Total	Primary	Incidental	Total
Spatially Allocated Volumes	1	2,190,410	84,720	2,275,130	1,163,377	296,402	1,459,779
	2	2,195,971	85,123	2,281,094	1,132,101	364,201	1,496,302
	3	1,219,024	79,553	1,298,577	1,097,642	411,848	1,509,490
	4	1,248,584	80,738	1,329,321	1,097,873	385,888	1,483,760
	5	1,239,351	40,606	1,279,957	572,074	169,925	741,999
	6	1,274,890	43,223	1,318,113	555,735	264,688	820,423
	7	1,218,015	34,402	1,252,417	555,384	199,123	754,508
	8	1,229,673	36,019	1,265,692	554,746	210,213	764,959
	9	1,217,330	38,814	1,256,144	568,191	330,825	899,016
	10	1,259,238	38,163	1,297,401	554,704	258,191	812,895
	11	1,215,334	40,663	1,255,997	554,635	270,759	825,394
	12	1,215,828	44,808	1,260,636	554,937	226,644	781,581
	13	1,219,542	35,340	1,254,882	561,755	299,040	860,794
	14	1,282,147	37,142	1,319,288	572,079	412,547	984,627
Aspatial Allocated (Woodstock) Volumes	15	1,345,672	53,269	1,398,942	572,568	175,583	748,152
	16	1,345,672	53,269	1,398,942	572,568	175,583	748,152
	17	1,345,672	44,484	1,390,157	572,568	175,583	748,152
	18	1,345,672	42,615	1,388,288	572,568	175,583	748,152
	19	1,345,672	42,615	1,388,288	572,568	201,847	774,416
	20	1,345,672	42,615	1,388,288	572,568	219,479	792,047
	21	1,345,672	42,615	1,388,288	572,568	219,479	792,047
	22	1,345,672	44,235	1,389,907	572,568	219,479	792,047
	23	1,345,672	46,953	1,392,626	572,568	219,479	792,047
	24	1,345,672	50,636	1,396,308	572,568	219,479	792,047
	25	1,345,672	53,269	1,398,942	572,568	219,479	792,047
	26	1,345,672	48,026	1,393,698	572,568	219,479	792,047
	27	1,345,672	53,269	1,398,942	572,568	219,479	792,047
	28	1,345,672	42,615	1,388,288	572,568	219,479	792,047
	29	1,345,672	53,269	1,398,942	572,568	219,479	792,047
	30	1,345,672	49,652	1,395,324	572,568	219,479	792,047
	31	1,345,672	42,698	1,388,370	572,568	219,479	792,047
	32	1,345,672	42,615	1,388,288	572,568	219,479	792,047
	33	1,345,672	42,615	1,388,288	572,568	176,100	748,669
	34	1,345,672	42,615	1,388,288	572,568	219,479	792,047
	35	1,345,672	42,615	1,388,288	572,568	219,479	792,047
	36	1,345,672	42,615	1,388,288	572,568	219,479	792,047
	37	1,345,672	42,615	1,388,288	572,568	190,505	763,074
	38	1,345,672	42,615	1,388,288	572,568	175,583	748,152
	39	1,345,672	42,615	1,388,288	572,568	219,479	792,047
	40	1,345,672	42,615	1,388,288	572,568	219,479	792,047

Figure 11-1 and Figure 11-2 show the pattern of net allocated coniferous and deciduous harvest flows over the planning horizon.

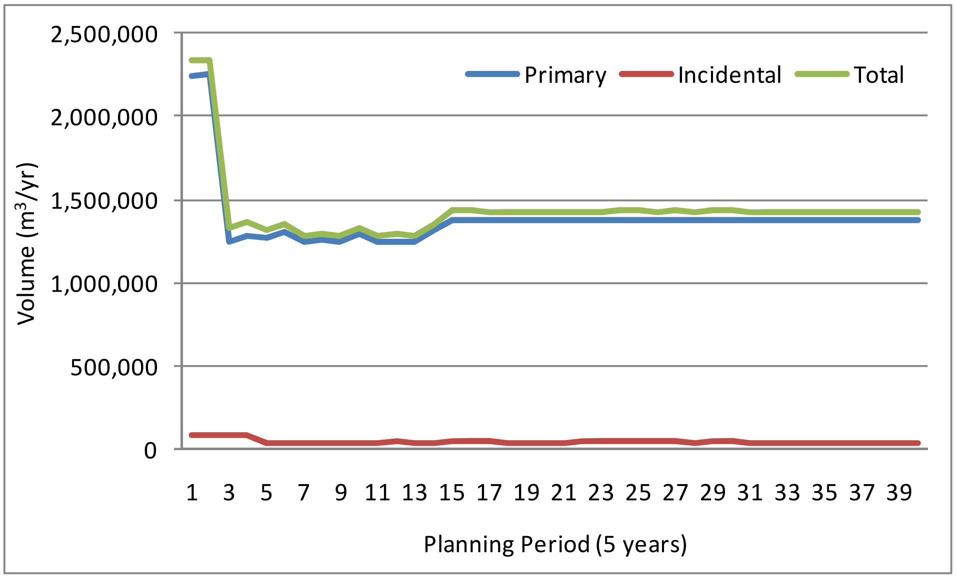


Figure 11-1 FMA Coniferous Annual Net Harvest Volume

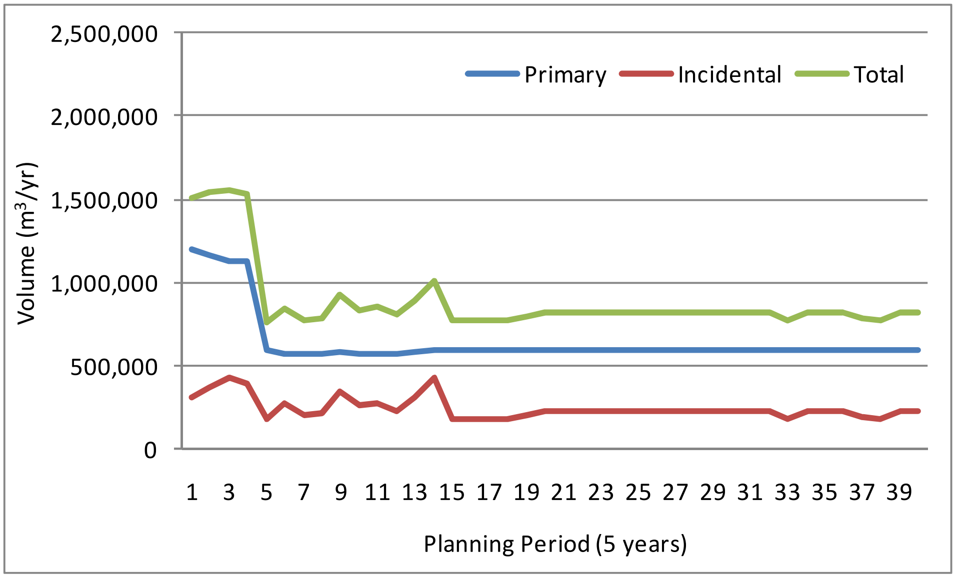


Figure 11-2 FMA Deciduous Annual Net Harvest Volume

11.5 Volume Allocation

11.5.1 Volume Allocation with the FMA

Table 11-4 summarizes Weyerhaeuser Grande Prairie FMA Net AAC allocation and distribution by operators.

Table 11-4 Weyerhaeuser Grande Prairie FMA Net AAC Allocation and Distribution by Operators

Operators	2009-2018		2019-2028		Notes
	Dec	Con	Dec	Con	
Weyerhaeuser: Coniferous	-	2,269,478	-	1,305,315	Primary 33,000 m^3/yr Dec allocated in Volume Supply Zone 1
Deciduous	148,000	-	148,000	-	Includes incidental deciduous 10,000 m^3/yr opportunity for rural use
Unallocated	51,000	-	51,000	-	Unallocated deciduous AAC
Tolko[1]	80,000	-	80,000	-	Must take incidental as identified by operator and zone in Table 11-5 prior to cutting.
ASRD CTP	-	8,634	-	8,634	
Ainsworth LC	1,199,041	-	1,217,625	-	Ainsworth receives remaining of the FMA deciduous cut
FMA Total	1,478,041	2,278,112	1,496,625	1,313,949	

1 – Tolko's carry over volume of 161,170 m3 has been added to Period 1

Ainsworth, Tolko and Weyerhaeuser agreed that the distribution of wood as depicted in the spatial harvest sequence (SHS) was adequate. Deciduous allocations in the Saddle Hills are based on the approved SHS within company respective license areas. SHS provides details on harvest schedule distribution by operators in the Saddle Hills.

All coniferous volume is allocated to Weyerhaeuser with exception of the community timber program (CTP). The CTP has 8,634 m^3/yr of coniferous volume allocation across the FMA area.

Majority of the deciduous AAC is allocated to Ainsworth. Tolko is allocated 80,000 m^3/yr deciduous volume in the Volume Supply Area 2 (Saddle Hills); 51,000 m^3/yr of deciduous volume remains unallocated. Weyerhaeuser has rights to 148,000 m^3/yr of deciduous harvests; 33,000 m^3/yr of this volume is allocated within Volume Supply Zone 1.

Effective May 1, 2009 through April 30, 2019, the rural use of timber opportunity is 10,000 m^3/yr; it is sourced from secondary (incidental) deciduous volume and is included in Weyerhaeuser total approved AAC.

11.5.2 Saddle Hills Allocation by Operator

Following the principles of this proposal, on average over the next ten years, SHS in Saddle Hills is projecting to produce 940,503 m^3/yr of net deciduous volume (859,978 m^3/yr and 80,525 m^3/yr from primary and incidental harvests, respectively). G16 Saddle Hills (Volume Area 2) spatial sequence by operator was proposed on February 16, 2011. Following guidance from this proposal, Table 11-5 summarizes deciduous operator AAC's in Saddle Hills by East, Central and West zones. Figure 11-3 provides spatial distribution of these harvests. All reported volumes are 'net'; they have been reduced by 2.5% and 3.0% coniferous (deciduous incidental volume) and deciduous (primary) stand retention, respectively. Figure 11-3 does not provide locations of Weyerhaeuser harvests.

Table 11-5 10 yr Average Net Deciduous AAC by Operators in Saddle Hills

Zone	Tolko			ASRD Unallocated			Ainsworth EC		
	Primary	Incidental	Total	Primary	Incidental	Total	Primary	Incidental	Total
East	14,991	2,013	17,003	7,954	1,068	9,022	123,675	16,604	140,279
Central	52,340	4,822	57,162	27,772	2,559	30,330	431,809	39,783	471,592
West	20,595	1,356	21,951	10,928	720	11,648	169,914	11,187	181,102
Total	87,926	8,191	96,117	46,654	4,346	51,000	725,398	67,575	792,973

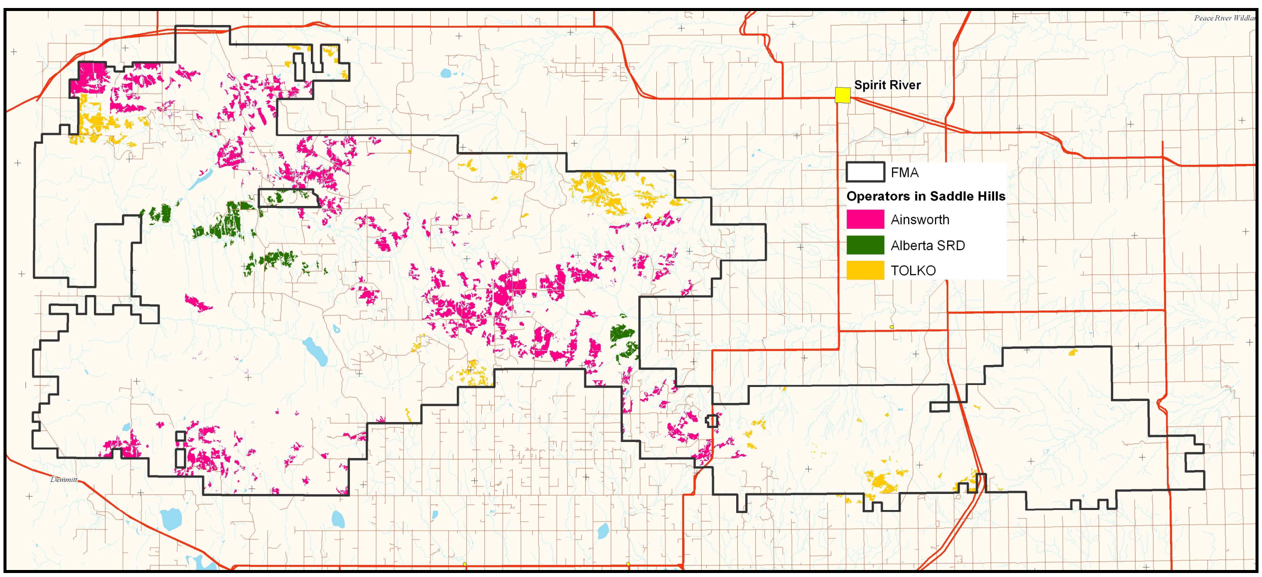


Figure 11-3 Distributiuon of Deciduous Cutblocks by Operators in Saddle Hills 2011 – 2021 (Alberta SRD Represent Unallocated Volumes)

11.6 Comparison of Harvest Levels between Current and Previous Management Plan

Many significant changes have occurred in the FMA area over the last 12 years. The three main changes include the FMA area changes (removal of Grande Cache E08), inventory updates (Phase 3 inventory was replaced with AVI), and new AVI based yield curves were applied with several changes in assumptions, the most significant of which is that there is now an assumption of an "uplift" in site productivity between natural and regenerated stands as opposed to the 1999 submission. As a result, the associated primary harvest levels from the current revised TSA and the previous management strategy (1999 DFMP) cannot be directly compared. The enhanced silviculture regeneration option was considered in the 1999, but not included in the final 1999 DFMP. This plan includes deployment of the enhanced silviculture strategy.

Even though there are differences between 1999 and 2011 DFMPs, this document follows structure and results provided in the 2004 – 2014 Mountain Pine Beetle Plan submitted in October 2007. Table 11-6 compares PFMS Net AAC and operable growing stock between 2007 MPB Plan and 2011 DFMP. These were considered as key indicators comparing different management strategies. AAC values have been reduced by 2.5% and 3.0% coniferous (deciduous incidental volume) and deciduous (primary) stand retention, respectively.

Table 11-6 Net AAC and Operable Growing Stock Comparison Between 2007 MPB Plan and 2011 DFMP

Description	2007 MPB AAC	2011 PFMS AAC
Primary Conifer AAC - pd 1	1,602,277	2,190,410
Primary Conifer AAC - pd 2	1,697,876	2,195,971
Primary Conifer AAC - pd 3	1,697,876	1,219,024
Primary Conifer AAC - pd 4	1,448,107	1,248,584
Primary Conifer AAC - pd 5 - 10 Avg	1,448,107	1,239,750
Primary Conifer AAC - pd 11 - 40 Avg	1,465,798	1,330,678
Primary Conifer AAC - pd 1 - 40 Avg	1,477,718	1,355,321
Primary Decid AAC - pd 1	725,834	1,163,377
Primary Decid AAC - pd 2	1,132,140	1,132,101
Primary Decid AAC - pd 3	1,132,140	1,097,642
Primary Decid AAC - pd 4	1,132,140	1,097,873
Primary Decid AAC - pd 5 - 10 Avg	752,461	560,139
Primary Decid AAC - pd 11 - 40 Avg	661,465	571,006
Primary Decid AAC - pd 1 - 40 Avg	712,024	624,550
Incidental Conifer AAC - pd 1	54,244	84,720
Incidental Conifer AAC - pd 2	139,093	85,123
Incidental Conifer AAC - pd 3	111,274	79,553
Incidental Conifer AAC - pd 4	53,245	80,738
Incidental Conifer AAC - pd 5 - 10 Avg	53,245	38,538
Incidental Conifer AAC - pd 11 - 40 Avg	47,275	44,920
Incidental Conifer AAC - pd 1 - 40 Avg	52,389	47,724
Incidental Decid AAC - pd 1	124,982	296,402
Incidental Decid AAC - pd 2	142,923	364,201
Incidental Decid AAC - pd 3	142,923	411,848
Incidental Decid AAC - pd 4	142,923	385,888
Incidental Decid AAC - pd 5 - 10 Avg	216,805	238,828
Incidental Decid AAC - pd 11 - 40 Avg	207,019	220,199
Incidental Decid AAC - pd 1 - 40 Avg	201,629	237,432
Primary Conifer OGS - Start	91,816,590	81,599,760
Primary Conifer OGS - End	44,538,989	46,779,633
Primary Decid OGS - Start	43,228,592	39,142,712
Primary Decid OGS - End	5,899,580	11,096,126
Incidental Conifer OGS - Start	3,186,350	2,586,855
Incidental Conifer OGS - End	415,755	817,725
Incidental Decid OGS - Start	19,148,251	17,799,444
Incidental Decid OGS - End	4,125,963	4,720,818

11.7 Indicators from the Preferred Forest Management Strategy

The preferred management strategy is designed to achieve the maximum harvest volume within the objectives for operability and sustainability of both timber and non-timber resources. For forest resource managers, it is prudent to understand the trade-offs and impacts that competing values, objectives, and goals present. This section provides an overview of various established indicators that are being tracked to assess the sustainability of the preferred scenario.

11.7.1 Average Volume per Hectare

Average harvest volumes are rather high and range between 150 to 238 m^3/ha for the coniferous and 177 to 296 m^3/ha for the deciduous dominant cover types. The volumes are generally declining especially coniferous volumes after period 33 (Figure 11-4).

Over the next 70 years, SHS is projecting rather low conifer and relatively high deciduous average harvest volumes. Following a surge cut, coniferous average volumes are projected be below 200 m^3/ha between periods 3 and 14; after 70 years volumes are projected to be around 210 m^3/ha. Deciduous harvests are projected to be above 275 m^3/ha for first 70 years. Following that, they are projected to drop and be fluctuating around 220 m^3/ha. Both coniferous and deciduous average harvest volumes are projected to decrease after period 32.

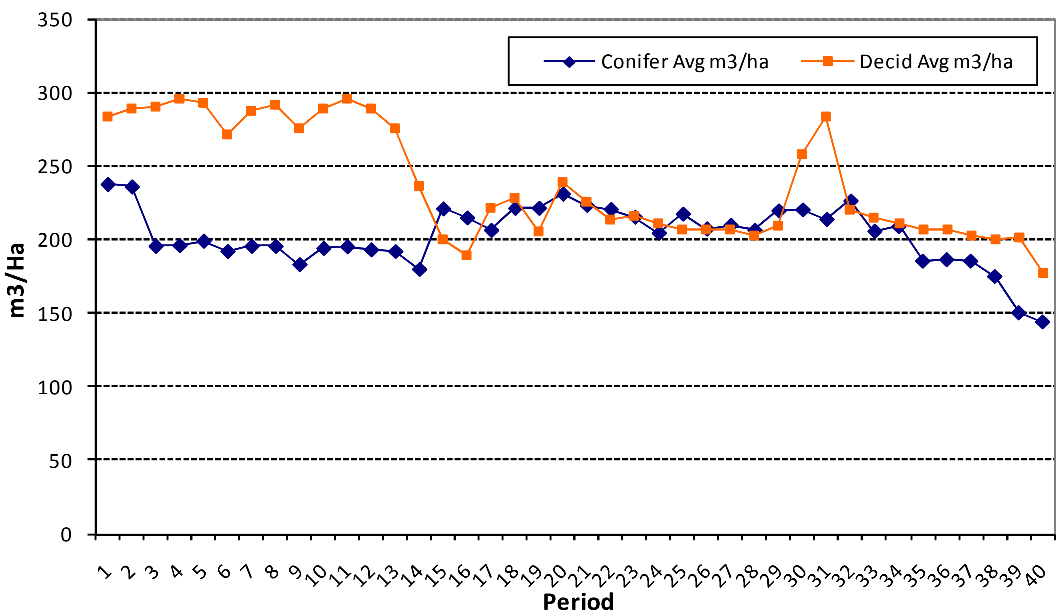


Figure 11-4 FMA Average Volume per Hectare Harvested

11.7.2 Average Harvest Age

As noted in Section 11.2, during the surge cuts, coniferous minimal stand age was set to 70 years for first 20 years; deciduous minimal stand age was set to 80 years for first 10 years. This strategy is supported by the PFMS outputs. The PFMS outputs suggest that average conifer harvest age during surge cut varies from 105 to 130 years; deciduous stands during surge cut vary between 103 and 118 years.

PFMS results also suggest that coniferous average harvest age increases for the initial 25 years (Figure 11-5). It could be explained by un-even age class distribution and conifer surge cut. During this period, the average harvest age on the coniferous land base increases from 108 to 139. Starting period five, however, the TSA model projects a general decline of average harvest age; it is projected to reach 62 years at the end of planning period. A sharp decline in coniferous harvest age for the last five periods coincides with a drop in average volume per hectare only to be off-set by a sharp increase in area harvested (Section 11.7.6). Deciduous stand average harvest age follows a similar pattern but vary between 70 (period 40) and 130 years (period15).

The revised TSA model projects two spikes in average harvest stand age: one for coniferous stands at period five and one for deciduous stands at period 18. These spikes can be explained by changes in relative distribution of primary and incidental volumes from a constant harvest land base. For example, the spike in coniferous average harvest age is explained by increased contribution of incidental coniferous volume without increases in conifer harvest area. A similar explanation applies to the spike in the deciduous average harvest age. Deciduous stands exhibit similar pattern but their three spikes are projected for periods 15 and 31.

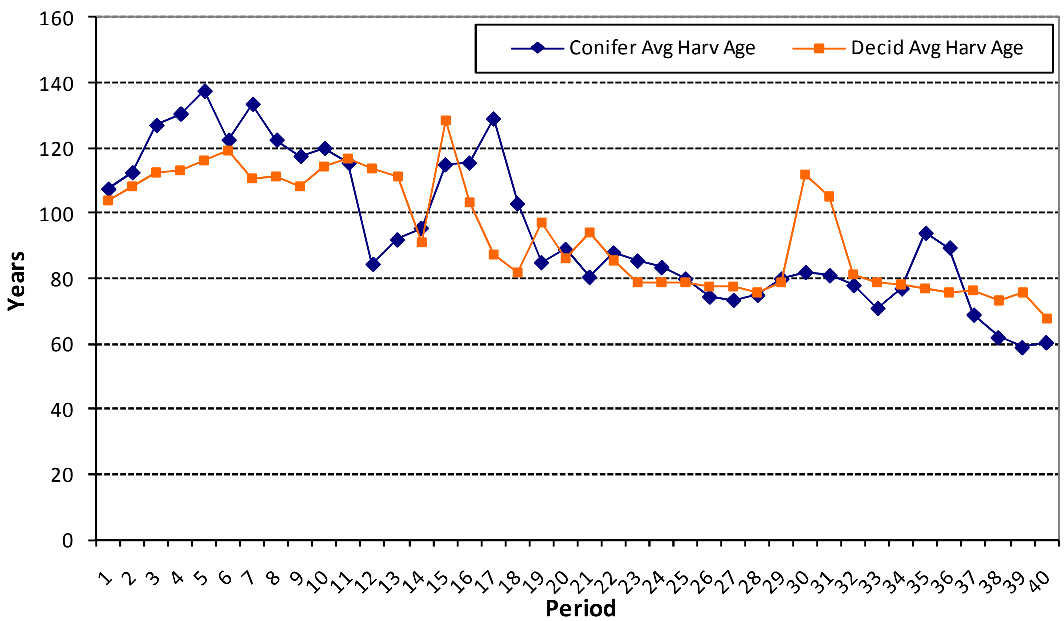


Figure 11-5 FMA Average Harvest Age

11.7.3 Piece Size Analyses

Weyerhaeuser's previous studies have assessed various options for modeling piece size. As a result, it was determined that piece size modeled through a surrogate variable quadratic mean diameter (qDBH) was stronger than the piece size estimate using trees/m^3 for all the major strata (Appendix IX of Appendix 5).

In general terms, both the projected coniferous and deciduous qDBH will decrease over time. The coniferous qDBH reduction rate is projected to decrease from 18 to 15 cm over the planning horizon.

However, deciduous qDBH is projected to first increase from 25 to 27 cm over the first five periods then to decline (exceptions are two spikes in qDBH when they are projected to increase in periods 15 and 30). At the end of the planning horizon, deciduous qDBH is projected to reach 20 cm.

Figure 11-6 shows the average piece size (qDBH) trends for the FMA area over the planning horizon.

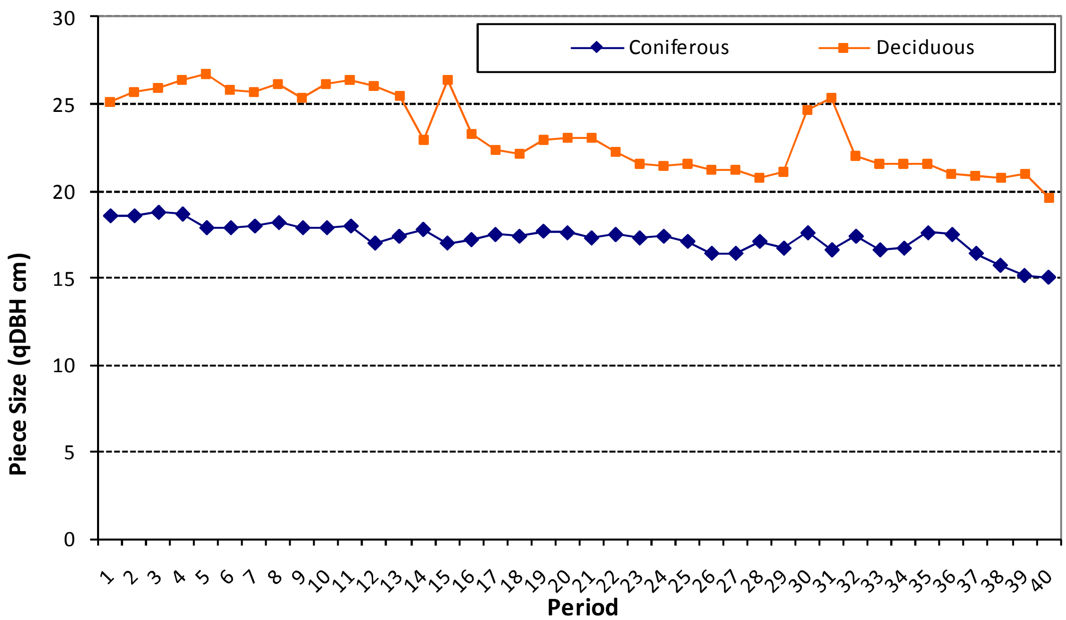


Figure 11-6 FMA Harvested Piece Size (qDBH)

11.7.4 Operable Growing Stock

Both softwood and hardwood operable growing stocks exhibit a declining trend over the first half of the planning horizon. During the second half of the planning horizon, however, primary coniferous operable growing stock is projected slightly to increase while primary deciduous growing stock is projected to continue, however slightly, to decline. Both primary softwood and hardwood primary operable growing stock are stable over the last quarter of the planning horizon (Figure 11-7). These patterns are typical of mature forest with predominately mature standing merchantable volume at the beginning of the modeling start date. Total conifer operable growing stock is projected to decline from 91 to 42 million m^3 only to increase back to 48 million m^3. Total deciduous operable growing stock is projected to decrease from about 61 million m^3 at the beginning of the planning horizon to about 17 million m^3 end of the planning horizon. Opposite to coniferous operable growing stock, a considerable amount of total operable deciduous growing stock is composed of incidental operable growing stock. Coniferous incidental operable growing stock is projected to remain rather small.

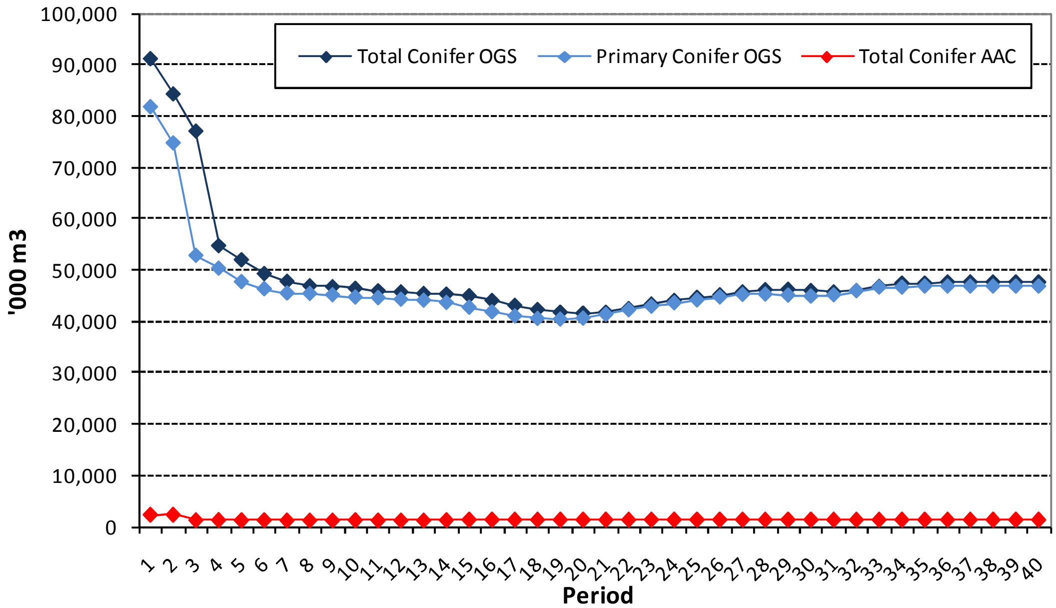


Figure 11-7 FMA Coniferous Operable Growing Stock and AAC Projections

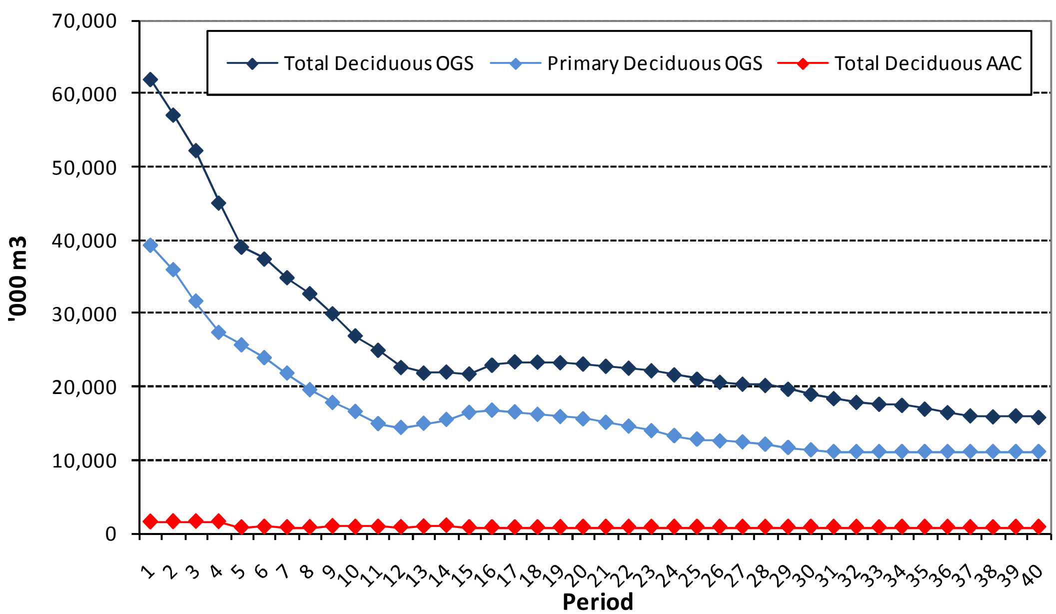


Figure 11-8 FMA Deciduous Operable Growing Stock and AAC Projections

11.7.5 Seral Stage Retention

The PFMS will modify future forest conditions by changing stand ages and their composition. Similar to the 1999 DFMP and 2007 MPB Plan, Weyerhaeuser compares the 1946 ecological objectives and seral stage conditions to the PFMS seral stage conditions. The seral stage targets were aggregated by Natural

Subregion groups, stand species composition, and three age classes (80+, 120+, and over 140 years old stands). The PFMS objective was set to maintain at least 1946 ecological targets.

Table 11-7 provides a comparison between 1946 seral stage targets and the PFMS outputs. Overall, the seral constraint targets were easily met with the exception of white spruce targets in Subalpine NSR over 80 and 120 years old and Upper Foothills NSR over 80 years old stands. From the modeling perspective, 1946 targets appear to be met over the next 40 years.

Table 11-7 Seral Stage Retention by NSR, Species Groups, and Age Classes

Natural Subregion Groups	Species	Age	Ecological Objectives (1946*)	200 Year Minimum Value PFMS Playback (2009 - 2209)	Notes
MIX	AW	80+	1.60%	6.70%	
MIX	PL	80+	0.52%	17.07%	
MIX	SB	80+	4.27%	33.19%	
MIX	SB	120+	0.23%	10.87%	
MIX	SB	140+	0.23%	5.32%	
MIX	SW	80+	0.38%	20.35%	
MIX	SW	120+	0.13%	5.39%	
MIX	SW	140+	0.08%	3.79%	
LF	PL	80+	5.53%	18.24%	
LF	PL	120+	2.21%	6.20%	
LF	PL	140+	0.55%	2.07%	
LF	SB	80+	11.11%	27.30%	
LF	SB	120+	4.94%	24.29%	
LF	SB	140+	0.62%	13.53%	
LF	SW	80+	13.60%	35.59%	
LF	SW	120+	3.24%	28.29%	
LF	SW	140+	0.65%	14.47%	
SA	PL	80+	21.94%	32.88%	
SA	PL	120+	3.99%	19.80%	
SA	PL	140+	1.00%	13.92%	
SA	SB	80+	39.00%	47.75%	
SA	SB	120+	22.00%	31.17%	
SA	SB	140+	10.00%	16.89%	
SA	SW	80+	74.89%	33.61%	Below in Periods 9…33, 39
SA	SW	120+	28.89%	28.39%	Below in Period 27
SA	SW	140+	14.98%	22.51%	
UF	PL	80+	11.29%	25.36%	
UF	PL	120+	1.74%	10.65%	
UF	PL	140+	0.52%	4.87%	
UF	SB	80+	29.24%	44.07%	
UF	SB	120+	12.90%	29.54%	
UF	SB	140+	5.16%	22.52%	
UF	SW	80+	39.56%	30.28%	Below in Periods 10..40 (except 30)
UF	SW	120+	11.54%	19.21%	
UF	SW	140+	2.47%	12.94%	

11.7.6 Area Harvested

Excluding surge cut periods, the area harvested over time is fairly consistent, with conifer harvests exhibiting the greatest variability towards the end of planning horizon and deciduous harvest at the beginning of the planning period (periods 2 through 4). The coniferous harvest area increase at the end of planning horizon is off-setting average harvest volume and average age described in Section 11.7.1 and Section 11.7.2, respectively.

The deciduous harvest area generally increases towards the end of the planning horizon. During the coniferous and deciduous surge cut periods, area harvested increases and approximately 48,000 ha and 20,000 ha for coniferous and deciduous harvests, respectively.

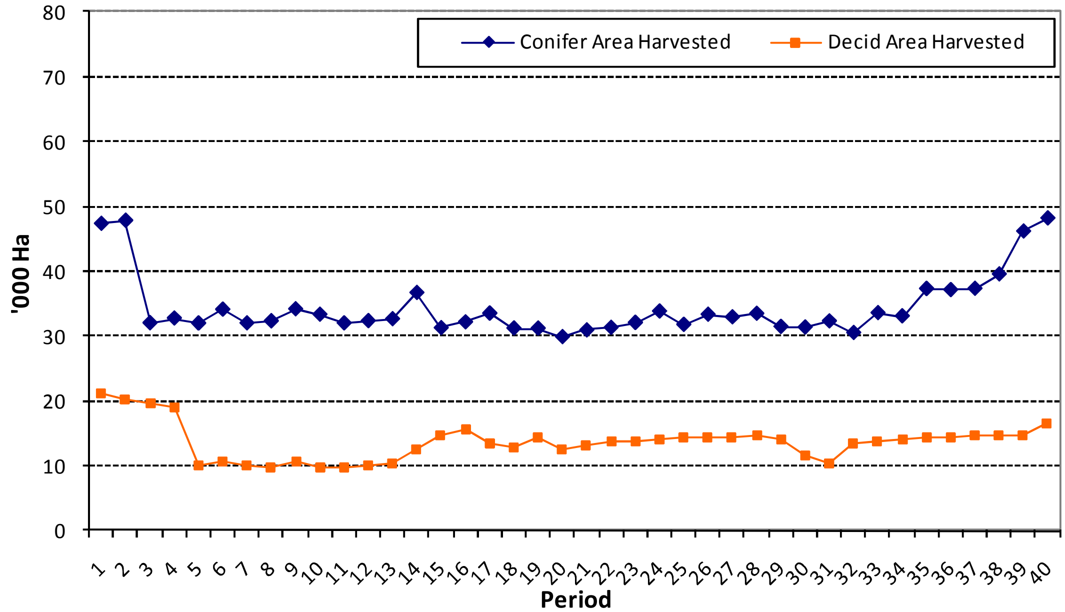


Figure 11-9 Projected Harvest Area

11.7.7 Age Class Distribution

Age class distribution summaries for net land base were prepared for three time periods:

1. Initial age class distribution in 2009 (effective date);
2. Age class distribution in 2 periods (10 years) in 2019; and
3. Age class distribution in 10 periods (50 years) in 2059.

The initial age class structure of the net harvestable land base is skewed towards the mature seral stages with a noticeable presence of young conifer stands (< 40 years old). A large concentration of merchantable timber is observed between 60 and 120 years of age, with a relative shortage of older (> 180 years) stands. The PMFS focus has been the liquidation of land base between 100 and 120 years old. Harvests of this age class appear to be the dominant focus until sufficient area is converted to younger stands and the forest age class distribution becomes more balanced.

Figure 11-10 provides a snapshot of the age class distribution over three time periods – present, in 10 years, and in 50 years. In 50 years, a new disproportionate age class distribution is projected capturing the results of the projected spread of the MPB infestation and current management strategies to mitigate it.

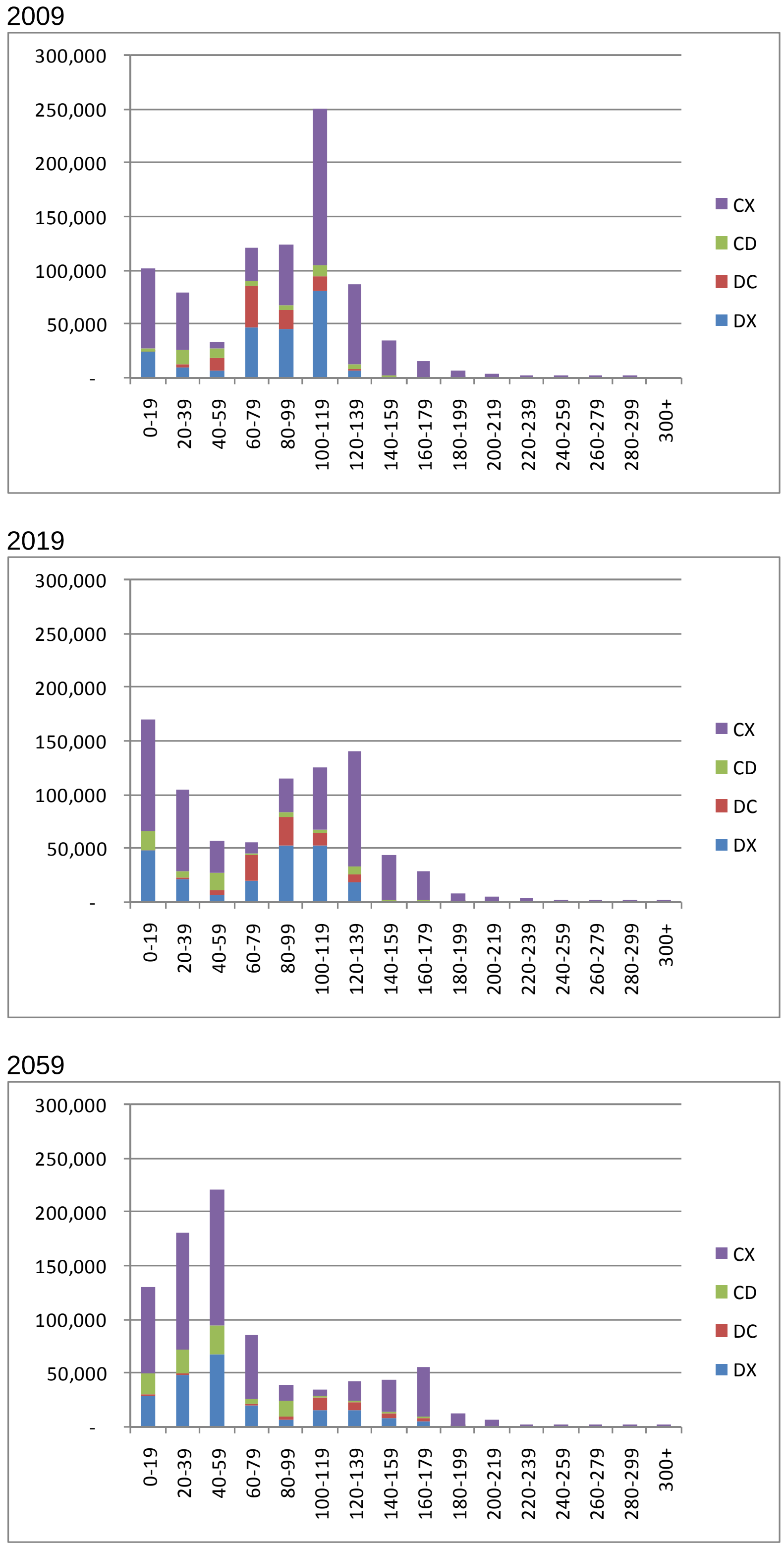


Figure 11-10 Age Class Distribution of the Net Harvestable Land Base

These age class distributions only account for forest management activities and forest dynamics. They do not model the effects of other industries or natural disturbances.

11.7.8 Mountain Pine Beetle Analysis

There were two types of MPB analysis completed following the completion of the PFMS. The first analysis was related to the review of highly susceptible pine area and volume loss due to MPB infestation. The second analysis was based on pine and non-pine stand even flow analyses. Results from both analyses are provided next.

11.7.8.1 MPB Susceptible Stand Reduction

Figure 11-11 shows the achieved MPB susceptible stand reduction in two MPB zones – Zone 1 and Zone 2. The PFMS strategy was developed to harvest highly susceptible stands during the surge cut (first two periods) or face merchantable pine volume reduction. Even though Zone 1 and Zone 2 management strategies and harvest levels were set independently, Woodstock results suggest that highly susceptible MPB areas have been eliminated by the end of the coniferous surge cut (first ten years). PFMS suggested that neither stand mortality nor volume loss will occur due to MPB infestation during planning horizon.

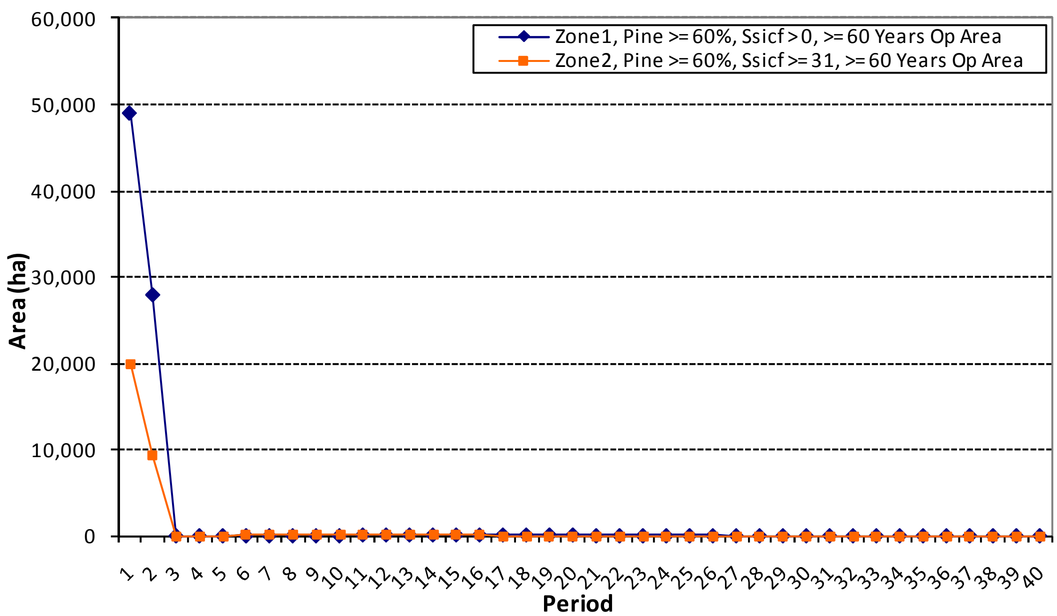


Figure 11-11 MPB Zone 1 and Zone 2 Susceptible Area Reduction

On November 23 ASRD has provided a direction on how to proceed with TSA analysis for the FMA area. In part of this direction, ASRD has provided a table summarizing AAC Even Flows by MPB Zone and Period. It was our understanding that these volumes were to be reported using the categories provided rather than constraining the PFMS formulation. However after recent review of the guidance, it appears that ASRD direction could be suggesting something different from what we have did for the Timber Supply Review.

11.7.8.2 Pine and Non-Pine Conifer Volume Even Flows

On November 23 2010, ASRD provided a direction on how to proceed with TSA analysis for the FMA area including pine and non-pine volume reporting. In part of its direction, ASRD provided a table summarizing AAC Even Flows by Stand Types, MPB Zone and harvest period. Results meeting this requirement are summarized in Table 11-9.

Provided pine and non-pine AAC volume results were prepared based on two main assumptions. First, a general understanding was that harvest volumes were to be reported post PFMS using ASRD provided categories. During the PMFS modeling, there was no intent to additionally constrain even-flow pine and non-pine volumes; the existing two even-flow constraints were deemed to be sufficient. The first even-flow constraint was set by primary conifer (surge cut period separated from the rest of the planning periods) and, second even-flow constraint was set for primary conifer flow only in MPB Zone 1. The ASRD requirement to track "…coniferous harvest levels [] as an even-flow for each separate component listed" in Table 11-9 was not done because eliminating MPB harvests even without even-flow requirements was a challenging GIS exercise as existing operational plans and aggressive nature of the MPB management strategy were given priority. Also, it was assumed that incorporation of additional even-flow targets would require operational harvest schedule to harvest areas that are currently hard to access and it would become impediment for efficient MPB management strategy deployment on the ground.

Another challenge reporting ASRD volumes was that stand type and primary volume classes (SRD Description in Table 11-9) were not explicitly tracked in the PFMS model. Instead, it was assumed that a combination of yield strata and MPB Theme will provide a reasonable approximation for the required stand types. ASRD stand types were derived using available information in the PFMS and are summarized in Table 11-8.

Table 11-8 Gross Area Summary by Pine Stand Types

Stand Types	Description	Area (ha)
Pine Leading	Yield Strata 1, 2, 3, 8, 10, 11, 13	259,393
Pine Containing	All other yield strata, where MPB Theme10 <> "ZZ"	215,959
Non-Pine	All other yield strata, where MPB Theme10 = "ZZ"	598,853
Total Area		1,074,205

Table 11-9 provides conifer gross AAC even flow summaries based on the PFMS Spatial Playback.

Table 11-9 Average Gross Primary Conifer Volume AAC Even Flows by MPB Zone and Pine Stand Type

SRD Description	MPB Zone	Stand Type	Years 1-10	Year 11-200
Con1	1	Pine Leading	1,250,956	321,850
Con2*pine*	1	Pine Containing	210,289	30,220
Con2nonpine	1	Non-Pine	139,996	462,737
Con3	2	Pine Leading	526,413	231,828
Con4*pine*	2	Pine Containing	73,319	31,199
Con4nonpine	2	Non-Pine	19,484	85,846
Con5	3	All	28,968	181,163
Total AAC	All	All	2,249,426	1,344,843

11.7.9 Water Quantity and Quality

The ECA-Alberta (EFM 2003) model was used to determine cumulative effects of SHS on water yields in the FMA area. In the ECA-Alberta model, "Equivalent Clearcut Area" (ECA) is used to describe the current effective area represented by new and recovering disturbance within a selected watershed and suggests the cumulative effects of harvest plans with or without considering other disturbances at the watershed scale. In addition to the hydrologic recovery status, ECA-Alberta provides an estimate of changes to annual yield throughout the simulation relative to a baseline annual stream flow.

The objective of this indicator is to screen harvest plans for hydrologic impacts at a watershed units, using 20% increase in annual water yield as a threshold to trigger further analysis. The net land base assignment document (Appendix 3) identified 19 base level (aggregated) watersheds that were broken into 305 unique watersheds in the Weyerhaeuser Grande Prairie FMA area; these watersheds were subject to water quality and quantity review.

For each watershed, ECA and water yield were simulated throughout the spatial planning horizon (70 years), with starting year of 2009. Because harvests occur annually, planned periodic harvest entries were annualized to provide a more realistic pattern of hydrologic recovery. Year of harvest for each entry was calculated as follows:

1. If the cutblock had sequenced or planned year record, this was chosen as the year of entry (if both were present, sequenced year was chosen in preference to planned year);
2. If no records were present, the year of entry was randomly assigned a start year in the specified period; and
3. Regeneration lags were based on the stand leading tree species groups: 2.5 years of coniferous stand and 1.7 years of deciduous stands.

Hydrologic recovery can be simulated in one of two ways: by basal area growth, which requires an estimate of the age of full hydrologic utilization, or through annual volume growth estimation. The later method was chosen because it is based on a close relationship between volume growth and stand leaf area index even though it results in faster hydrologic recovery than the basal area growth approach.

The ECA-AB model determined potential water yield increases due to PFMS SHS at the both levels – base (aggregated) level and then at the unique watershed level. Only one unique watershed had no scheduled harvests over the 70 years.

The ECA-AB model results indicate that at the unique watershed level, 291 watersheds projected with no significant water yield increase (i.e., less than 20%) and 13 had projected water yield increases over the 20% threshold. Figure 8 12 identifies unique watersheds used in the analysis and areas of projected water yield increased over 20% threshold. Thirteen unique watersheds exceeding 20% projected water yield increase are further summarized in Table 11-10; the results are ordered by year / period in which projected water yields will be above the threshold.

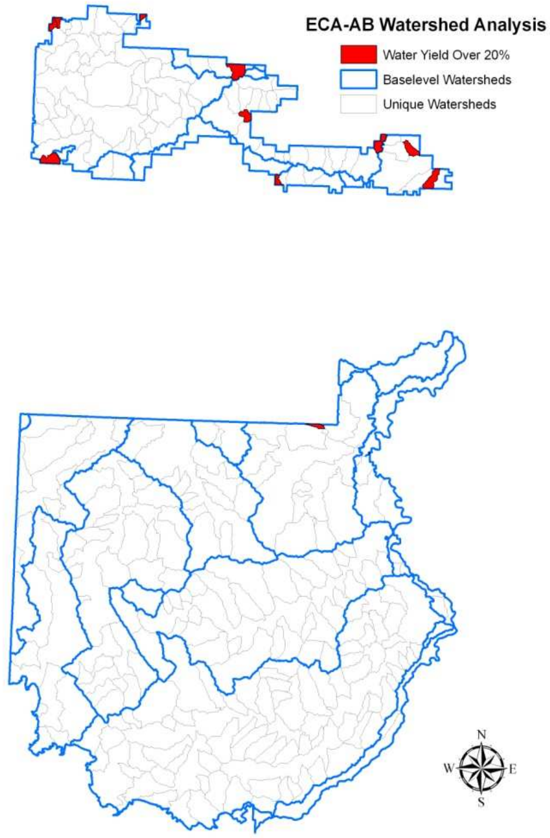


Figure 11-12 FMA Base Level (Aggregated) and Unique Watersheds with Projected Water Yield Increase Over 20%

Table 11-10 Watershed Overview with Projected Water Yield Increase Over 20%

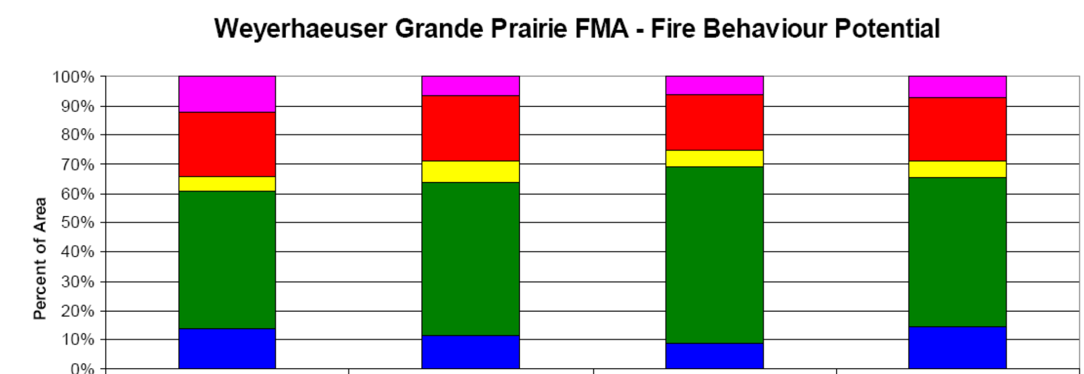
Watershed	Total Watershed Area (ha)	Total Area Cut (ha)	ECA (ha)	ECA (%)	Max Water Yield Increase (%)	Year and Period of Max Water Yield
A08E13B08	351.3	254.5	239.3	68.16	34.11	2018 (Period 2)
A08D12D03	1200.2	543.9	442.6	36.89	20.41	2019 (Period 3)
A08E13B07	269.7	208.7	158.4	58.67	28.48	2019 (Period 3)
A08E13B05B	161.5	113.2	77.5	47.82	27.17	2024 (Period 4)
A09C10A01C	8.7	7.4	5.0	55.56	37.34	2027 (Period 4)
A08E13F01D	951.1	627.1	477.4	50.20	27.44	2029 (Period5)
A08C11E01	585.9	413.3	275.5	47.01	21.59	2054 (Period 10)
A09D25C01	290.9	179.0	112.8	38.75	28.71	2055 (Period 10)
A09C10N01	757.5	371.6	348.0	45.91	23.04	2056 (Period 10)
A08C11D05	517.6	358.0	358.0	69.12	36.13	2060 (Period 11)
A09C10N03	987.1	640.5	405.1	41.04	22.78	2066 (Period 12)
A09D26F02	285.6	233.5	182.1	63.66	31.30	2068 (Period 12)
A08C11D06	210.1	201.7	135.7	64.60	30.99	2074 (Period 14)

Overall for these 13 watersheds, the maximum water yield increase ranges from 20.41% to 37.34%, and the watershed area from 8.7 ha to 1200.2 ha. Although the water yield increase for many of these watersheds is significantly above the 20% threshold, all but one is less than 1,000 ha.

Only one watershed – A08E13B08 – is projected to provide water yields over 20% threshold over the next ten years. The remaining 12 watersheds have projected maximum water yields at a later time; all these watersheds may require more detailed review.

11.7.10 FireSmart Assessment

FireSmart management and wildfire treat assessment was completed by ASRD (Appendix16) following the selection of the PFMS and SHS. ASRD analysis concluded that during the spring was the greatest fire threat potential. During this time, cured grass fuel types common to disturbed areas and leafless deciduous stands are main contributors to the high fire threat potential. Following cured fuels green-up in the summer the rating reduces.



	Current	Year 10	Year 20	Year 50
Extreme	133,628	69,228	66,860	79,574
Very High	236,113	243,396	206,921	234,441
High	57,458	78,215	61,792	59,565
Moderate	506,438	569,973	652,135	553,866
Low	151,282	125,229	98,629	158,891

Figure 11-13 FMA Ffire Behaviour Prediction in 0 (current), 10, 20, and 50 Years

Analysis suggest that the extreme fire behavior potential was reduced by 64,400 ha by year 10 through locating harvest disturbances in highly fire prone stands; it is further projected to decrease by 2,368 ha by year 20. As harvested areas mature, the extreme fire behavior potential is projected to increase by year 50. However, extreme fire behavior potential is reduced from its current levels by 54,054 ha over 50 years.

PFMS SHS predicted reduced fire behavior in community zones. Figure 11-14 summarizes FireSmart fire behavior predictions in these zones. The combined high, very high and extreme fire behavior potential was reduced by 515 ha and 3,578 ha by year 10 and 20, respectively. Similar to trends in entire FMA area, as harvested areas mature, the extreme fire behavior potential is projected to increase by year 50. However, extreme fire behavior potential is reduced from its current levels by 325 ha over 50 years; very high fire behavior potential is reduced by 2,504 ha over the same time.

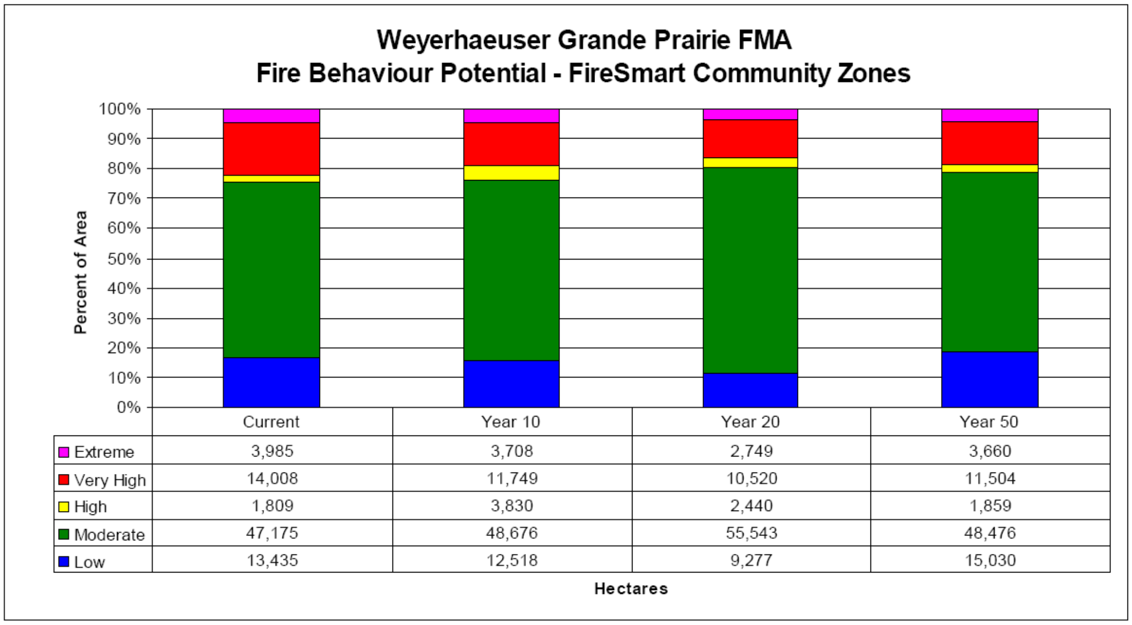


Figure 11-14 FireSmart Community Zone Fire Behaviour Prediction in 0 (current), 10, 20, and 50 Years

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