TISC CARIBOO REGION
STAND TREATMENTS ANALYSIS

100 MILE HOUSE TSA
TIMBER SUPPLY ANALYSIS REPORT

Prepared for:
Timber Investments Strategy Committee
Cariboo Forest Region

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EXECUTIVE SUMMARY

This is a study of the availability of timber on the crown forest component of the 100 Mile House TSA. The analysis reviews a number of opportunities to improve the available timber supply by application of silviculture treatments. All analysis simulations were completed with FSSIM3.0 the Ministry of Forests' (MoF) computer simulation model.

The "Base Case" analysis scenario attempts to include assumptions and inputs most closely resembling current management on the TSA based on the current MoF *100 Mile House Timber Supply Area Timber Supply Review Data Package* (April 1998). 10 additional scenarios were evaluated in the analysis.

All analysis results are subdivided into clearcut selection and PA16 harvest profile groups. The PA16 cut includes small portions of Fd-Drybelt and MDWR selection areas.

The Base Case results show an initial harvest rate of 1,291,000m^3/year for the TSA clearcut area for the entire 250 year planning horizon. Fd Drybelt harvest ranged from 94,645 to 141,700 m^3/year over the 250-year simulation. MDWR selection areas contributed between 5,254m^3/year and 59,400 m^3/year. PA16 has a requirement to provide 112,000 m^3/year and this was maintained over all 25 periods of the Base Case simulation. All analysis runs included 34,370m^3/year of non-recoverable losses (NRLs) in addition to the harvest levels reported above.

Simulation results indicate that the critical period for developing the harvest rate is approximately 130 to 150 years into the future. During this period the inventory of merchantable (stands in the net operable landbase above minimum harvest age) reaches a minimum level. In addition, landscape level old growth requirements increase to the maximum low emphasis level at this time. This reduces the availability of mature timber during this phase of the simulation. To a lesser extent the period 70 years into the future plays a similar role in determining the harvest. During this period the inventory of mature volume is higher

The short-term harvest rate can be increased above the 1,291,000m^3/year level indicated for the Base Case but this requires a compensating decrease in the long-term level to allow the harvest to be maintained through periods 13 to 15 when available timber is at a minimum.

Scenario results indicate that any treatments that make managed stands available earlier (decreased regeneration delay, reduced minimum harvest age) or provide more volume from managed stands (fertilization, tree improvement) will improve the annual harvest level predicted for the Base Case. Alternatively, changes to disturbance forest cover constraints do not impact significantly on harvest levels.

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1.0 INTRODUCTION

This is the report of a timber supply analysis completed on behalf of the Cariboo Forest Region Timber Investments Strategy Committee (TISC). Timber supply is the quantity of timber available for harvest over time. The methodology includes use of a forest-level simulation model which predicts the development of a forest over a 250-year planning horizon given a description of initial forest conditions, expected patterns of growth, and a set of rules related to harvesting and regenerating the forest. In addition, management assumptions related to non-timber forest resources are included in the analysis process.

Timber supply analysis involves three main steps:

- Collection and preparation of information and data. This information has been summarized and documented in *TISC Cariboo Region Stand Treatments Analysis 100 Mile House Information Package (October 1998),* (Information Package). Landbase information was provided by MoF Cariboo Region (FIP data) and the 100 Mile House District (ISIS data). The majority of the assumptions used to develop the Base Case option are based on the *100 Mile House Timber Supply Area Timber Supply Review Data Package* (April 1998) (MoF Data Package).
- Using the data in FSSIM3.0 (version released 98.09.24), the MoF's computer forest estate model, to develop harvest forecasts. A number of treatment scenarios are also performed to test the impact of alternative inputs on timber supply during this step.
- Interpretation and reporting of results.

2.0 DESCRIPTION OF OPTIONS

A number of analysis scenarios were identified for evaluation. Due to the unique nature of the 100 Mile TSA, which includes Pulpwood Agreement 16 (PA16) and selection harvest areas the original analysis scenarios were modified in some cases. A list of analysis scenarios is described below.

Base Case

The management assumptions, landbase netdowns, general growth and yield parameters and forest cover requirements outlined in the MoF Data Package were used in this scenario. Some changes to the development of analysis units were made in the current analysis.

Base Case+OGSI Adjustments

Old growth site index (OGSI) adjustment equations are now available for interior spruce and lodgepole pine. These adjustments reflect the fact that site index estimates on old growth (> 140 years old) stands are underestimated for managed stands of the same

species on the same site. Since the commencement of this analysis MoF Research Branch have published updated adjustment equations which define eligible stands by inventory site index range and biogeoclimatic ecological classification (BEC). Therefore the full OGSI adjustment has been applied to eligible old growth interior spruce and lodgepole pine stands for this scenario. Results of this simulation were used as the basis for all remaining treatment scenarios included in this analysis.

Reduced Time to Green-up

The IRM and Visual disturbance constraint areas had the years to green-up reduced by 3 years to 13 and 12 years, respectively. This was intended to reflect stand treatments (brushing, fertilization) that enhance early stand growth and thereby reduce the time required to achieve green-up.

Reduced Regeneration Delay

In this scenario regeneration delays defined for the Base Case+OGSI were reduced by two years. This included all existing NSR (current and backlog).

Genetically-Improved Planting Stock (Tree Improvement)

Tree Improvement gains were included in this scenario based on an estimated maximum 12% volume gain at rotation age. In this treatment scenario site index adjustments were made to each of the regeneration analysis unit TIPSY yield tables to achieve a 12% volume gain at culmination. Two candidate groups were reviewed in this scenairio – one including lodgepole pine, the other without lodgepole pine. Currently 90% of all pine is established naturally after harvesting in the TSA.

Alternative Thinning Densities

Alternative thinning densities for managed stands were included in this set of treatment scenarios. Revised TIPSY managed stand yield tables were developed for all TSA clearcut Douglas-fir, lodgepole pine and interior spruce managed stands.

Fertilization & Spacing

In these scenarios all eligible lodgepole pine managed stands were given a volume increase of 15m3/ha at rotation age to represent gains from one fertilization treatment during the rotation. In one scenario all "good" site pine stands (SI50 > 20) were included in the treatment, the other scenario added "medium" site pine stands (SI> 13) to the treatment candidate list.

Eliminate Backlog NSR

This scenario evaluates the impact on timber supply of eliminating backlog NSR (areas harvested prior to 1987 that do not meet stocking requirements) in 5 years compared to 10 years in the Base Case+OGSI scenario.

Maximize PA16 Harvest

Initially, this timber supply analysis was to review the impact of returning some of the problem forest types (PFTs) to the TSA timber harvesting landbase. However, the 100 Mile House TSA has a legal obligation to designate all PFTs to PA16 held by Ainsworth Lumber. The PA16 harvest target will be maximized in this scenario to estimate the total contribution possible from stands assigned to the Licence. In all other analysis scenarios the PA16 harvest target was 112,000m3/year for the entire 250 year planning horizon.

3.0 INFORMATION PREPARATION

Many pieces of information are required to conduct a timber supply analysis. Each piece falls into one of three categories:

- Landbase inventory;
- Timber growth and yield; or
- Management practices.

3.1 Landbase Inventory

Landbase inventory information used in this analysis comes from the MoF's forest inventory data (FIP), Integrated Silviculture Information System (ISIS) and additional digital data for non-standard inventory types including wildlife habitat, riparian areas, Cariboo-Chilcotin Land Use Plan (CCLUP) zones and visually sensitive areas. FIP forest cover data does not include any of the stocking class rollover information completed in 1998. All mapped information (FIP and non-standard inventory data) was merged using ARC/INFO GIS software.

ISIS data was used to develop MSYT attributes for the existing component of the forest that is currently growing under managed stand conditions. Initially, it was planned to replace FIP stand attribute information with attributes from the ISIS database for the appropriate component of the inventory. However, the two data sets did not have matching forest cover polygon identification data and a direct merge was not possible.

The net operable landbase (also called the working forest or timber harvesting landbase) consists of all the productive forest within the TSA and the area of PA16 that is, or will be available for timber management over the long term. This landbase is determined by reducing the total landbase according to specified management assumptions. Complete details of the reductions made in developing the net operable landbase are provided in the Information Package. Table 3.1 summarizes the landbase netdowns for the Base Case option.

Table 3.1 - Timber Harvesting Landbase Determination – Base Case

Land Classification	Total Area[1] (ha)	Net Reduction		Net Remainder	
		Area (ha)	Volume [2] (1000s m^3)	Area (ha)	Volume [2] (1000s m^3)
Total Area	1,234,386			1,234,386	145,301
Non-crown land		142,854	8,498		
Parks		50,324	6,263		
Non-prod forest & Non-forest	133,442	133,442	427		
Non-commercial (NCBr)	366	366	25		
Productive Forest				907,400	130,088
Productive reductions:					
ESAs:					
Soils	17,889	14,301	1,613		
Regeneration	5,096	3,246	334		
Avalanche hazard	64	56	6		
Inoperable	153,339	11,843	2,040		
Roads, trails & landings		18,675	1,397		
Riparian reserves:					
Class A lakes	51,922	2,286	501		
Streams, wetlands, lakes		57,333	8,309		
Caribou habitat	20,549	6,959	1,617		
Wildlife tree patches		73,433	11,899		
Productive Forest Reductions		188,132	27,716		
Current Net Operable Landbase					
PA16 [3]					
Forested land	120,202			93,460	6,898
NSR	5,962			4,575	
TSA					
Forested land	741,735			590,722	95,474
NSR	39,500			30,511	
Total				719,268	102,372
Less future roads					
PA16		2,341	262		
TSA		17,607	3,620		
Long-term Net Operable Landbase					
PA16				95,694	6,636
TSA				605,768	92,142
Total				701,462	98,778

[1] Total area includes all crown area (total area less non-crown & parks) for a given land category.
[2] Volumes include some Py and deciduous for specific components of the landbase.
[3] PA16 area is modeled as a partition within the net operable landbase in the timber supply analysis.

3.2 Inventory Aggregation

In order to reduce the complexity of the forest description for the purposes of timber supply analysis simulation, aggregation of individual forest stands is necessary. However, it is critical that this aggregation does not obscure either the biological differences in forest stand productivity or differences in management objectives and

prescriptions.

Three levels of aggregation were used in preparing the inventory for analysis:

- Biodiversity Unit-Biogeoclimatic Ecological Classification/Natural Disturbance Types (BU-BEC/NDTs) were defined based on the biodiversity units defined for the TSA and MoF BEC mapping to the variant level. Landscape level biodiversity objectives were assigned to these broad landbase aggregates in the form of minimum old growth requirements. 114 BU-BEC/NDTs were defined for the analysis and constraint groups were included in the modeling data set to represent them.
- Disturbance/Green-up constraint groups are the areas with similar non-timber resource concerns. Visually sensitive areas, Clinton Creek Community Watershed and general IRM are the disturbance groups included in the analysis database. Specific forest cover constraints related to green-up and disturbance were assigned to three constraint groups for the analysis.
- Analysis Units (AUs) were assigned to stands with similar biological (species composition and site productivity), management and/or silviculture regimes to model the growth of individual stands during the analysis process. VDYP natural stand yield tables and TIPSY managed stand yield tables were used to represent the growth of the various stands included in the analysis.

Other reporting and harvest target groups were also defined for various aspects of the analysis. A complete description of the landbase aggregates listed above are provided in the Information Package.

3.3 Timber Growth and Yield

Timber growth and yield refers to the prediction of growth and development of individual forest stands over time. Stand volumes are estimated by using stand attributes (species composition, site productivity, density/crown closure and allowances for decadence) in various growth models.

MoF Variable Density Yield Prediction model (VDYP version 6.4) was used to develop natural stand yield tables (NSYTs) for the following stand types:

- Existing stands assumed to have been established naturally (33 years and older);
- All existing and regeneration yields for selection harvest areas (Fd Drybelt and MDWR selection areas); and
- All existing and regeneration yields for deciduous-leading types.

Existing managed stands (1 – 32 years old) and the majority of future managed stand yields were estimated with the MoF model Table Interpolation Program for Stand Yields (BatchTIPSY Version 2.0 Beta5) (TIPSY). A number of TIPSY yield tables were developed to address various analysis scenarios (OGSI adjustments, fertilization and tree improvement, *etc*.).

3.4 Management Practices

Timber supply is directly linked to forest management activities. In all analysis scenarios the timber supply is investigated using many current management practices. FPC requirements including riparian management zones and stand-level biodiversity, exclusions for caribou habitat, visual sensitivity requirements and landscape level biodiversity objectives have all been included in the analysis.

Non-recoverable losses (NRLs - expected timber losses due to fire, pest, and wind damage) were included in all harvest simulations. These estimated losses are added to the target harvest level during modeling.

Utilization levels reflect B.C. interior close utilization standards. PA16 utilization levels are approximately 10.0cm DBH and 8.0cm top. Natural and managed stand yield tables typically use the approximate age of culmination of mean annual increment (MAI) and minimum diameter requirements as the basis for establishing minimum harvest age.

Cutblock "adjacency" and green-up objectives are addressed by including maximum disturbance limits and minimum green-up ages within each constraint group defined for the landbase (visually sensitive areas, Clinton Creek Community Watershed, general IRM areas). Selection harvest areas maintain a required level of forest cover by allowing only partial removal of mature stands.

Including an old growth requirement (weighted 10% high-45% intermediate-45% low) from the Forest Practices Code (FPC) Biodiversity Guidebook ensures that landscape level biodiversity requirements are accounted for in the analysis. This methodology of using an average old growth requirement is based on MoF direction as outlined in the 97.12.01 memo from Timber Supply Branch. The low emphasis old growth requirement is increased from 1/3 to full FPC amount over three rotations ("ramping-up") as recommended by MoF.

For all analyses the harvest rule of "relative-oldest first" was used.

Recent inventory information was collected on the 100 Mile House TSA for both timber and non-timber resources. Coupled with updated management guidelines, these non-timber resources can be more thoroughly addressed in timber supply analysis compared to previous analyses.

4.0 ANALYSIS METHODS

MoF's timber supply simulation model FSSIM 3.0 (Forest Service Simulator) has been used to assess the long-term timber supply for this analysis. A forest projection model such as FSSIM 3.0 allows a harvest level to be imposed on a forest. The forest is grown according to a set of rules and age-based relationships. A timber supply analyst can determine if a chosen harvest level can be sustained or, by modifying some of the inputs, determine the timing, duration and nature of management programs required to maintain or improve a given level of harvest. In addition, FSSIM 3.0 has the ability to impose forest cover constraints on harvesting.

In FSSIM 3.0 the existing state of the forest is assessed on input to the model. This initial state impacts on all future activities and available timber. The existing forest may contain areas to which access is limited from the beginning of the planning horizon by virtue of the forest cover constraints assigned in the modeling process. This may be the outcome of assigning a set of cover constraints on a forest that has never been modeled under specific cover constraints in the past. In this situation, parts of the forest remain unavailable for harvest until such time that sufficient growth has taken place to achieve acceptable levels of green-up, disturbance, or retention.

The following objectives were used in developing harvest schedules during the modeling simulations:

- To sustain a harvest level as high as the current AAC of 1,362,000m3/year (which includes 1,250,000m3/year for the TSA harvest and 112,000m3/year for PA16) plus 34,370m3/year of non-recoverable losses;
- Decrease the periodic harvest rate in acceptable steps (up to 10%) during the periods when declines are required to meet all objectives associated with the various resources on the entire TSA;
- Achieve an essentially even-flow of timber that approaches the long-term sustainable level that considers forest cover requirements;
- Avoid merchantable volume shortfalls during the 250-year planning horizon;
- Achieve stable inventory levels in the long-term; and
- Explore opportunities to increase the harvest rate by implementing management programmes while maintaining the requirements of non-timber resources.

In addition, forest cover requirements must be met within each of the forest cover constraint groups during each period of the 250-year planning horizon. If forest cover requirements are not satisfied, the harvest level may be forced to decline. This ensures that integrated resource management issues are properly addressed.

5.0 ANALYSIS RESULTS

Results of the various analyses are presented in tabular form. Additional graphic results display trends in timber inventory (stock) and harvest levels. Tables provide the actual harvest levels achieved during each period of the simulation. For each of the analysis scenarios presented the tabular results include a breakdown of the following harvest components:

- TSA clearcut;
- TSA Fd-Drybelt selection;
- TSA MDWR selection; and
- PA16, including clearcut, Fd-Drybelt and MDWR selection.

Graphic presentations of the periodic harvest typically include only the TSA clearcut component. This area is often the only candidate for treatment within a given analysis scenario. All harvest levels reported are net of non-recoverable losses, estimated at 34,370m3/year.

5.1 Base Case

Inputs for the Base Case have been described briefly in the previous sections and in more detail in the Information Package.

Harvest Schedule

The Base Case harvest schedule was chosen after reviewing various harvest flow alternatives. Forest-level modeling can offer many possible solutions given various harvest flow strategies. A number of alternatives to harvest flow are possible with a given analysis scenario. The harvest flow selected for the Base Case and all additional scenarios is an "even-flow" schedule.

Typically there are inventory (age class distributions) and forest cover requirement issues that result in the harvest rate increasing and/or decreasing at different times during the planning horizon. However, in the 100 Mile House TSA the even-flow schedule provided the optimal supply of timber over the long-term. The contribution to the annual harvest rate of the various landbase components in the 100 Mile House TSA are summarized in Table 5.1. For comparison, an alternative harvest flow (TSA clearcut only) in which the initial harvest rate is increased is also provided.

Table 5.1 –Base Case Harvest Schedule

Simulation Period	Annual Harvest Level by Landbase Component					
	TSA Clearcut (Increase Short-term)	TSA Clearcut (Even-flow)	Fd-Drybelt Selection	MDWR Selection	PA16	Total [1]
1	1,349,000	1,291,000	141,700	59,400	112,000	1,604,100
2	1,349,000	1,291,000	130,238	38,672	112,000	1,571,910
3	1,349,000	1,291,000	141,700	55,196	112,000	1,599,896
4	1,349,000	1,291,000	141,700	5,254	112,000	1,549,954
5	1,349,000	1,291,000	99,629	13,101	112,000	1,515,730
6	1,349,000	1,291,000	94,645	59,400	112,000	1,557,045
7	1,349,000	1,291,000	120,767	59,400	112,000	1,583,167
8	1,349,000	1,291,000	117,665	59,400	112,000	1,580,065
9	1,258,600	1,291,000	94,719	59,400	112,000	1,557,119
10	1,258,600	1,291,000	110,654	59,400	112,000	1,573,054
11	1,258,600	1,291,000	106,597	59,400	112,000	1,568,997
12	1,258,600	1,291,000	141,700	59,400	112,000	1,604,100
13	1,258,600	1,291,000	141,700	59,400	112,000	1,604,100
14	1,258,600	1,291,000	141,700	59,400	112,000	1,604,100
15	1,258,600	1,291,000	141,700	59,400	112,000	1,604,100
16	1,258,600	1,291,000	141,700	59,400	112,000	1,604,100
17	1,258,600	1,291,000	141,700	59,400	112,000	1,604,100
18	1,258,600	1,291,000	141,700	59,400	112,000	1,604,100
19	1,258,600	1,291,000	141,700	59,400	112,000	1,604,100
20	1,258,600	1,291,000	141,700	59,400	112,000	1,604,100
21	1,258,600	1,291,000	132,600	59,400	112,000	1,595,000
22	1,258,600	1,291,000	137,986	59,400	112,000	1,600,386
23	1,258,600	1,291,000	124,068	59,400	112,000	1,586,468
24	1,258,600	1,291,000	123,884	59,400	112,000	1,586,284
25	1,258,600	1,291,000	138,562	59,400	112,000	1,600,962

[1] Includes Even-flow TSA Clearcut harvest

The Base Case even-flow harvest rate of 1,291,000 is 3% above the current AAC of 1,250,000m3/year. The average annual harvest from the TSA component (clearcut, Fd-drybelt selection and MDWR selection) is 1,443,100m3/year (net of NRLs) which is 15% higher than the current AAC.

As shown in Table 5.1 the "Increase Short-term" harvest schedule has a lower long-term harvest rate compared to the even-flow schedule. The total harvest over the 250-year planning horizon is approximately 0.4% higher under the even-flow schedule. The even-flow schedule provides the benefit of the higher rate of harvest over the entire planning horizon compared with the increase short-term approach. The annual harvest for the two TSA clearcut harvest schedules developed in the Base Case are presented in Figure 5.1.

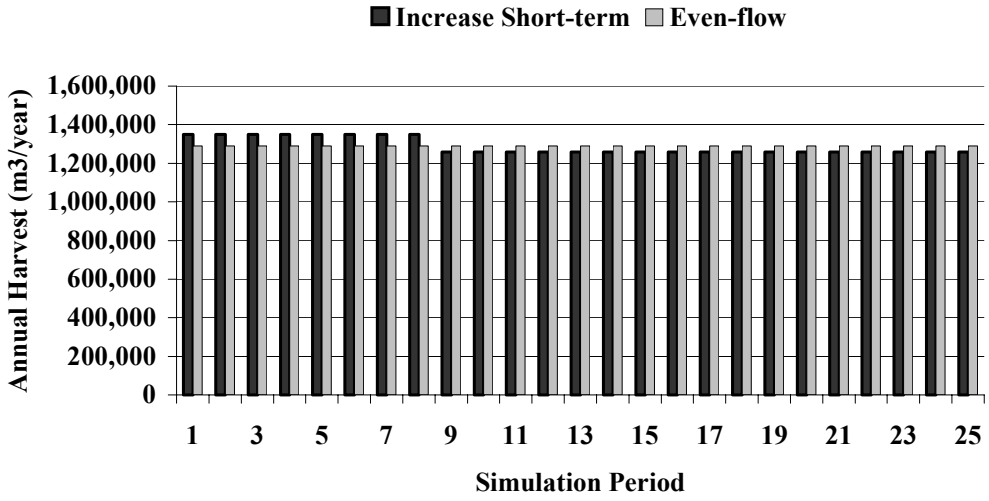

Figure 5.1 –Base Case Harvest Levels

The TSA clearcut and PA16 harvest levels are stable over time. There are some fluctuations in selection harvest levels due to the current age class distribution for the forests in those areas and the history of past harvesting. Inventory levels for the Base Case are presented graphically in Figure 5.2.

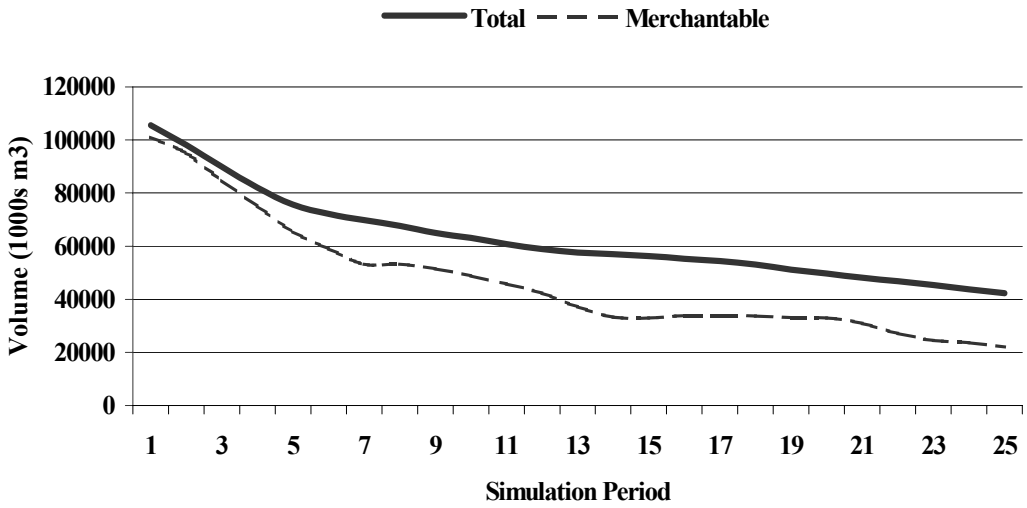

Figure 5.2 –Base Case Inventory Levels

Figure 5.3 provides the initial age class distribution for both the net operable forest and productive forest area that does not contribute to the annual harvest (classified as "I" inoperable in the analysis data set).

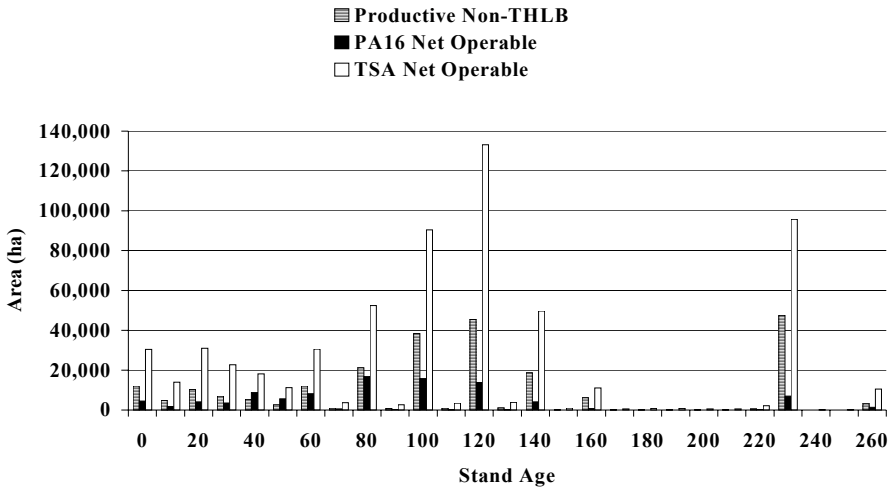

Figure 5.3 – Base Case Initial Age Class Distribution

Timber Availability

The existing inventory of merchantable timber on the 100 Mile House TSA is approximately 98 million cubic metres. Short term harvesting utilizes this inventory until existing and future managed stands become available. The key factors influencing the harvest rate are:

- The amount of mature timber on the TSA; and
- The time when the low point in the merchantable inventory is reached.

There is a fixed volume of existing mature and unmanaged second growth on the TSA. Stands at least 121 years old comprise the TSA clearcut harvest during the first 7 decades of the Base Case simulation. The large inventory currently between 90 and 130 years of age supports the early harvest. During periods 8 through 15 stands aged between 71 and 120 years of age (existing and future managed stands) are the major contributors to the harvest.

It is during period 14 that old growth requirements are "ramped-up" from 2/3 to full levels for the low emphasis component of the old growth percentage. Therefore during periods 14 and 15 additional merchantable timber is placed in reserve to satisfy the old growth objective. Beyond period 15 some older stands (> 140 years) contribute to the annual harvest. Overall managed stands (aged 71 – 110 years) comprise the bulk of the harvest from decade 9 through 25.

Periods 14 and 15 represent the critical time in the planning horizon for developing a TSA clearcut harvest schedule. At this time the merchantable volume of timber reaches the first low point. This is due in part to the time just prior to the second rotation of managed stands becoming available for harvest. These stands were established on sites harvested 50 to 70 years into the simulation. There is a recovery after this time before a pattern of inventory levels is established with low points every 80 –90 years thereafter, representing the approximate average rotation time for managed stands (see Figure 5.2).

Any change to the harvest rate before period 14 can be combined with a similar but opposite change in harvest rate after period 15. This is demonstrated by the increase short-term harvest flow for the Base Case. There is no opportunity to increase the long-term harvest rate above the even-flow level.

The Fd-Drybelt selection harvest is generally in older stands, sometimes over 400 years of age. During the periods when the harvest is forced into younger, low volume stands there is a corresponding drop in the annual harvest rate for this selection area. An annual target of 141,700m3 was established based on the average annual harvest contribution from this area without any targets in place. The target of 141,700m3/year was imposed to provide a relatively stable harvest flow from this component of the TSA.

The MDWR Selection area also harvests older stands but there is a tendency for harvesting in a broader range of age classes compared with the Fd-Drybelt Selection area. The harvest target for this area was developed in the same fashion as the target for the Fd-Drybelt Selection area.

The PA16 harvest is based solely on the 112,000m3/year requirement. The area is made up of 13% Fd-Drybelt and 3.5% MDWR Selection areas. Harvesting takes place in older stands throughout the planning horizon because the area is associated with many low productivity areas which were assigned to yield tables with much older minimum harvest ages. Also because the harvest target is not maximized for this area and the harvest rule is relative oldest first, there is no requirement to harvest in younger stands in this scenario.

Initially, approximately 4,000 ha of landbase is harvested per year. Over time this amount increases to as high as 6,400 ha in the last decades of the simulation. More area is harvested in the selection harvest areas as they contribute much less volume per hectare once they are on the prescribed selection harvest regime.

Forest Cover Requirements

Forest cover requirements related to maximum disturbance and green-up do not play a significant role in developing the harvest schedule at any time during the planning horizon. Only the Clinton Creek Community Watershed forest cover group reaches the limit of disturbance during all periods of the analysis. However, this group represents less than 1% of the net operable landbase so it does not play a significant role in developing the overall harvest rate for the landbase.

Many BU-BEC/NDTs do not satisfy old growth requirements at the beginning of the planning horizon. Figure 5.3 shows that there is a minimum of area between ages 141 and 150 and greater than 250 years of age which explains the old growth deficit early in the planning horizon. The inventory ages may distort this somewhat as they are often the midpoint age of a 20 year class in the FIP file and might be distributed across the age class more evenly than indicated in Figure 5.3.

Initially, 65 of the BU-BEC/NDTs do not satisfy the stated old growth objectives. This represents 659,000ha of the total 908,000ha of productive forest. However, harvesting is not necessarily suspended in areas that do not meet old growth objectives. FSSIM will

recruit the oldest stands to eventually make up the old growth deficit and then harvests remaining stands that are older than minimum harvest age, providing no other analysis constraints will be violated.

The effect of "ramping-up" the old growth requirement creates timber shortfalls during periods 7 and 14. This is complicated by the fact that the 70 year interval between old growth percentage increases is just short of the minimum harvest age for managed stands. Therefore managed stands are not quite available if they were established about the time of the previous "ramping-up" and more of the older stands must be drawn upon to satisfy the harvest request.

5.2 Base Case+OGSI Adjustments

As stated in Section 2 this scenario evaluated the impacts of including OGSI adjustments for eligible sites when regenerated to managed stand conditions. Lodgepole pine and interior spruce are the eligible species. Table 5.2 summarizes the harvest forecast developed for this scenario.

Table 5.2 – Base Case+OGSI Adjustments Harvest Schedule

Simulation Period	Annual Harvest Level by Landbase Component					
	TSA Clearcut (Base Case)	TSA Clearcut (Base + OGSI)	Fd-Drybelt Selection	MDWR Selection	PA16	Total [1]
1	1,291,000	1,339,000	141,700	59,400	112,000	1,652,100
2	1,291,000	1,339,000	130,221	38,578	112,000	1,619,799
3	1,291,000	1,339,000	141,700	55,295	112,000	1,647,995
4	1,291,000	1,339,000	141,700	5,254	112,000	1,597,954
5	1,291,000	1,339,000	99,291	13,101	112,000	1,563,392
6	1,291,000	1,339,000	94,313	59,400	112,000	1,604,713
7	1,291,000	1,339,000	120,453	59,400	112,000	1,630,853
8	1,291,000	1,339,000	117,481	59,400	112,000	1,627,881
9	1,291,000	1,339,000	94,483	59,400	112,000	1,604,883
10	1,291,000	1,339,000	110,340	59,400	112,000	1,620,740
11	1,291,000	1,339,000	106,413	59,400	112,000	1,616,813
12	1,291,000	1,339,000	141,700	59,400	112,000	1,652,100
13	1,291,000	1,339,000	138,354	59,400	112,000	1,648,754
14	1,291,000	1,339,000	141,700	59,400	112,000	1,652,100
15	1,291,000	1,339,000	141,700	59,400	112,000	1,652,100
16	1,291,000	1,339,000	141,700	59,400	112,000	1,652,100
17	1,291,000	1,339,000	141,700	59,400	112,000	1,652,100
18	1,291,000	1,339,000	141,700	59,400	112,000	1,652,100
19	1,291,000	1,339,000	141,700	59,400	112,000	1,652,100
20	1,291,000	1,339,000	141,700	59,400	112,000	1,652,100
21	1,291,000	1,339,000	131,614	59,400	112,000	1,642,014
22	1,291,000	1,339,000	137,786	59,400	112,000	1,648,186
23	1,291,000	1,339,000	123,918	59,400	112,000	1,634,318
24	1,291,000	1,339,000	122,102	59,400	112,000	1,632,502
25	1,291,000	1,339,000	137,980	59,400	112,000	1,648,380

[1] Includes Base+OGSI TSA Clearcut harvest

The short-term harvest gain is approximately 4% over the Base Case in this scenario. Additional productivity expressed by sites previously occupied by old growth lodgepole pine and interior spruce provides additional volume for approximately 34,900ha of the clearcut TSA and 2,900ha of PA16 clearcut areas. However, the PA16 harvest target was not adjusted in this scenario.

Selection areas were not given an OGSI adjustment because they regenerate to natural stands. The OGSI adjustment on MSYTs reduces the impact of the critical period 130 – 150 years into the future because there is more merchantable volume at that time. In addition some of the affected stands have reduced minimum harvest ages with OGSI adjustments.

Based on a simple calculation of improvements in estimated productivity at culmination age (long-run sustained yield or LRSY) the maximum gain associated with the OGSI adjustment is approximately 5% over the Base Case. However, due to the requirements for old growth forest the actual long-term harvest level is slightly lower than this estimate. Figure 5.4 provides a graphic comparison of the Base Case and Base Case+OGSI harvest levels over time.

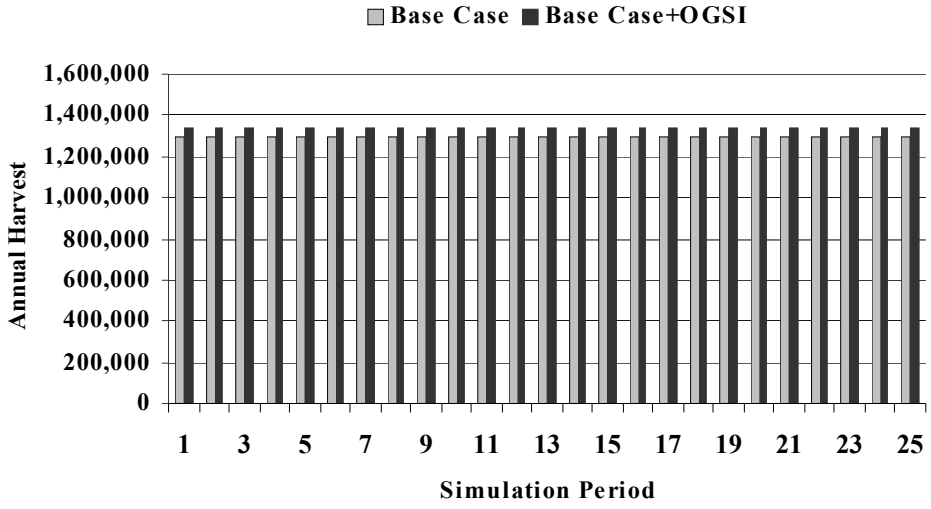

Figure 5.4 – Base Case+OGSI and Base Case Harvest Levels

The Base Case+OGSI scenario is the basis for all subsequent analysis results discussed in the following sections. This is based on the assumption that the OGSI adjustments are something that will take place with existing management procedures and do not require additional treatment.

5.3 Reduced Time to Green-up

In this scenario the time required to achieve green-up was reduced by three years. This modification is based on the assumption that treatments will be carried out during the early stages of stand development to allow stands to add height increment more quickly. The IRM area represents approximately 411,000 ha of the TSA clearcut landbase, while the Visual areas cover approximately 46,000 ha. Table 5.3 provides the harvest rate developed for this scenario and compares it to the Base Case+OGSI TSA clearcut harvest.

Table 5.3 – Reduced Time to Green-up Harvest Schedule

Simulation Period	Annual Harvest Level by Landbase Component					
	TSA Clearcut (Base+OGSI)	TSA Clearcut (Reduced Green-up)	Fd-Drybelt Selection	MDWR Selection	PA16	Total [1]
1	1,339,000	1,339,200	141,700	59,400	112,000	1,652,300
2	1,339,000	1,339,200	130,220	38,580	112,000	1,620,000
3	1,339,000	1,339,200	141,700	55,294	112,000	1,648,194
4	1,339,000	1,339,200	141,700	5,254	112,000	1,598,154
5	1,339,000	1,339,200	99,292	13,101	112,000	1,563,593
6	1,339,000	1,339,200	94,313	59,400	112,000	1,604,813
7	1,339,000	1,339,200	120,453	59,400	112,000	1,631,053
8	1,339,000	1,339,200	117,482	59,400	112,000	1,628,082
9	1,339,000	1,339,200	94,483	59,400	112,000	1,605,083
10	1,339,000	1,339,200	110,339	59,400	112,000	1,620,939
11	1,339,000	1,339,200	106,414	59,400	112,000	1,617,014
12	1,339,000	1,339,200	141,700	59,400	112,000	1,652,300
13	1,339,000	1,339,200	138,354	59,400	112,000	1,648,954
14	1,339,000	1,339,200	141,700	59,400	112,000	1,652,300
15	1,339,000	1,339,200	141,700	59,400	112,000	1,652,300
16	1,339,000	1,339,200	141,700	59,400	112,000	1,652,300
17	1,339,000	1,339,200	141,700	59,400	112,000	1,652,300
18	1,339,000	1,339,200	141,700	59,400	112,000	1,652,300
19	1,339,000	1,339,200	141,700	59,400	112,000	1,652,300
20	1,339,000	1,339,200	141,700	59,400	112,000	1,652,300
21	1,339,000	1,339,200	131,614	59,400	112,000	1,642,214
22	1,339,000	1,339,200	137,786	59,400	112,000	1,648,386
23	1,339,000	1,339,200	123,918	59,400	112,000	1,634,518
24	1,339,000	1,339,200	122,102	59,400	112,000	1,632,702
25	1,339,000	1,339,200	137,980	59,400	112,000	1,648,580

[1] Includes Reduced Green-up TSA Clearcut harvest

The increase over the Base Case+OGSI harvest rate in this scenario is negligible confirming that disturbance forest cover constraints do not play an important role in this analysis. The Reduced Green-up scenario assumptions for regeneration delay, minimum harvest age and harvest volume are the same as those in the Base Case+OGSI simulation. These factors have a greater influence on the harvest schedule as indicated in the remainder of the treatment scenarios. Figure 5.5 presents the Base Case+OGSI and

Reduced Green-up harvest schedules in graphic form.

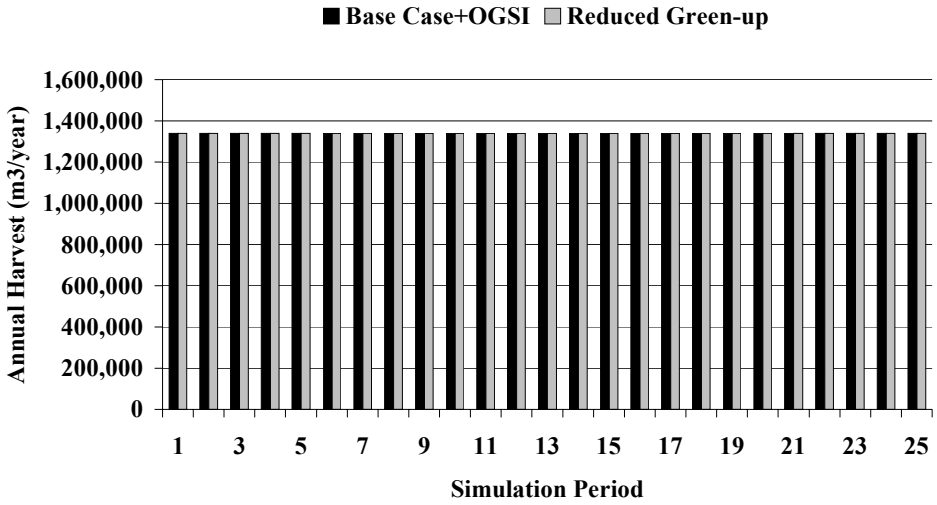

Figure 5.5 – Reduced Green-up & Base Case+OGSI Harvest Levels

5.4 Reduced Regeneration Delay

The expected time for stands to become established was reduced by two years in this scenario. This modification is based on the assumption that planting of harvested areas will take place within 2 years for Douglas-fir (clearcut) and spruce regeneration compared to four years in the Base Case+OGSI scenario. Regeneration delays were reduced to five years for the lodgepole pine (established naturally) and PA16 areas. Selection harvest areas are not modified for this scenario. Table 5.4 provides the harvest rate developed for this scenario and compares it to the Base Case+OGSI TSA clearcut harvest.

Table 5.4 – Reduced Regeneration Delay Harvest Schedule

Simulation Period	Annual Harvest Level by Landbase Component					
	TSA Clearcut (Base+OGSI)	TSA Clearcut (Reduced Regen Delay)	Fd-Drybelt Selection	MDWR Selection	PA16	Total [1]
1	1,339,000	1,367,000	141,700	59,400	112,000	1,680,100
2	1,339,000	1,367,000	130,215	38,269	112,000	1,647,484
3	1,339,000	1,367,000	141,700	55,623	112,000	1,676,323
4	1,339,000	1,367,000	141,700	5,095	112,000	1,625,795
5	1,339,000	1,367,000	99,382	13,268	112,000	1,591,650
6	1,339,000	1,367,000	94,315	59,400	112,000	1,632,715
7	1,339,000	1,367,000	120,439	59,400	112,000	1,658,839
8	1,339,000	1,367,000	117,494	59,400	112,000	1,655,894
9	1,339,000	1,367,000	94,485	59,400	112,000	1,632,885
10	1,339,000	1,367,000	110,325	59,400	112,000	1,648,725
11	1,339,000	1,367,000	106,425	59,400	112,000	1,644,825
12	1,339,000	1,367,000	141,700	59,400	112,000	1,680,100
13	1,339,000	1,367,000	138,653	59,400	112,000	1,677,053
14	1,339,000	1,367,000	141,700	59,400	112,000	1,680,100
15	1,339,000	1,367,000	141,700	59,400	112,000	1,680,100
16	1,339,000	1,367,000	141,700	59,400	112,000	1,680,100
17	1,339,000	1,367,000	141,700	59,400	112,000	1,680,100
18	1,339,000	1,367,000	141,700	59,400	112,000	1,680,100
19	1,339,000	1,367,000	141,700	59,400	112,000	1,680,100
20	1,339,000	1,367,000	141,700	59,400	112,000	1,680,100
21	1,339,000	1,367,000	132,307	59,400	112,000	1,670,707
22	1,339,000	1,367,000	137,389	59,400	112,000	1,675,789
23	1,339,000	1,367,000	124,206	59,400	112,000	1,662,606
24	1,339,000	1,367,000	123,333	59,400	112,000	1,661,733
25	1,339,000	1,367,000	137,950	59,400	112,000	1,676,350

[1] Includes Reduced Regen Delay TSA Clearcut harvest

Decreasing regeneration delays by two years results in an increase in the annual harvest rate of approximately 2%. Unlike the Reduced Green-up scenario, timing of achieving both green-up and minimum harvest age is reduced under the assumptions of this scenario. The results demonstrate that achieving minimum harvest age in less time is a more important aspect of the timber supply compared with achieving green-up.

It was, however, assumed that all managed stands would become established two years sooner than in the Base Case+OGSI scenario. This goal may be reasonable for planted stands but not as easy to predict with managed stands that are established naturally (*ie*. pine). Figure 5.6 shows the improvement in harvest for the Reduced Regeneration Delay scenario compared to the Base Case+OGSI.

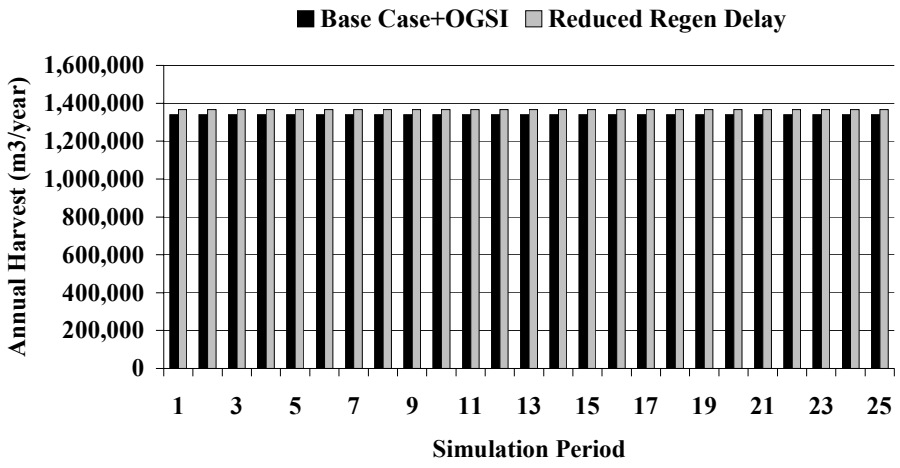

Figure 5.6 – Reduced Regeneration Delay & Base Case+OGSI Harvest Levels

5.5 Genetically Improved Planting Stock (Tree Improvement)

5.5.1 Lodgepole Pine Included in Tree Improvement

Genetic improvements were assumed to increase stand volume by 12% at rotation age. These volume adjustments were made by modifying SI50 values for eligible managed stand yield tables. In this case all managed stands were assumed to be planted and were assumed to achieve the gains associated with genetic improvements.

Results of this scenario may be overly optimistic because of the assumption that all future pine stands will be regenerated by planting, compared with only 10% in the Base Case approach. The results for tree improvement including lodgepole pine are presented in Table 5.5.

Table 5.5 – Tree Improvement (Including Lodgepole Pine) Harvest Schedule

Simulation Period	Annual Harvest Level by Landbase Component					
	TSA Clearcut (Base+OGSI)	TSA Clearcut (Genetic Improvement)	Fd-Drybelt Selection	MDWR Selection	PA16	Total [1]
1	1,339,000	1,500,000	141,700	59,400	112,000	1,813,100
2	1,339,000	1,500,000	129,522	37,316	112,000	1,778,838
3	1,339,000	1,500,000	141,700	56,623	112,000	1,810,323
4	1,339,000	1,500,000	141,700	5,095	112,000	1,758,795
5	1,339,000	1,500,000	99,821	13,268	112,000	1,725,089
6	1,339,000	1,500,000	94,413	59,400	112,000	1,765,813
7	1,339,000	1,500,000	120,214	59,400	112,000	1,791,614
8	1,339,000	1,500,000	117,621	59,400	112,000	1,789,021
9	1,339,000	1,500,000	94,583	59,400	112,000	1,765,983
10	1,339,000	1,500,000	110,100	59,400	112,000	1,781,500
11	1,339,000	1,500,000	107,380	59,400	112,000	1,778,780
12	1,339,000	1,500,000	141,700	59,400	112,000	1,813,100
13	1,339,000	1,500,000	134,798	59,400	112,000	1,806,198
14	1,339,000	1,500,000	141,700	59,400	112,000	1,813,100
15	1,339,000	1,500,000	140,079	59,400	112,000	1,811,479
16	1,339,000	1,500,000	141,700	59,400	112,000	1,813,100
17	1,339,000	1,500,000	141,700	59,400	112,000	1,813,100
18	1,339,000	1,500,000	141,700	59,400	112,000	1,813,100
19	1,339,000	1,500,000	141,700	59,400	112,000	1,813,100
20	1,339,000	1,500,000	141,700	59,400	112,000	1,813,100
21	1,339,000	1,500,000	134,036	59,400	112,000	1,805,436
22	1,339,000	1,500,000	137,369	59,400	112,000	1,808,769
23	1,339,000	1,500,000	124,888	59,400	112,000	1,796,288
24	1,339,000	1,500,000	123,308	59,400	112,000	1,794,708
25	1,339,000	1,500,000	137,294	59,400	112,000	1,808,694

[1] Includes Tree Improvement TSA Clearcut harvest

There is an increase of 12% in periodic harvest associated with genetically improved planting stock compared with the Base Case+OGSI simulation. All of the TSA clearcut landbase is affected by this treatment and the results are therefore significant.

Improved managed stand yield tables developed for this scenario have reduced minimum harvest ages as well as improved volume at any comparative age. This is because site index adjustments were made to the managed stand yield table inputs instead of simply increasing volume at the existing minimum harvest age. On average minimum harvest ages are 12 years younger than in the Base Case+OGSI scenario.

Lower minimum harvest age is very important to the supply because managed stands are often harvested as soon as they become available in the mid and long-term of the simulation. In the Base Case+OGSI scenario managed stands (second growth) begin contributing to the periodic harvest in decade 8. Approximately 25% of the total TSA clearcut harvest is from managed stands during this decade. In the Tree Improvement scenario second growth stands contribute to the annual harvest beginning in decade 7 and in decade 8 they make up about 85% of the harvest.

Also, because the transition to harvesting predominantly second growth occurs earlier there is less pressure on the existing inventory of mature and near-mature timber to contribute to the periodic harvest. Therefore the older stands can be reserved to meet old growth requirements.

Although the volumes are improved at any age compared to the Base Case+OGSI yield tables, there is more area harvested each decade in the Tree Improvement scenario. As much as 42% more area is harvested in a decade compared to the Base Case+OGSI simulation. The reduced minimum harvest ages mean that each stand is contributing less volume per hectare. However, this is not an issue on the 100 Mile TSA because disturbance forest cover constraints do not limit the harvest during any simulation period.

5.5.2 Lodgepole Pine Excluded from Tree Improvement

In this Tree Improvement scenario, only species that are regenerated exclusively by planting (spruce and Douglas-fir clearcut) were assigned to genetically improved yield tables. The minor component of lodgepole pine managed stands that are planted (10%) maintained the Base Case+OGSI site index. Results of this scenario are shown in Table 5.6.

Table 5.6 – Tree Improvement (No Lodgepole Pine) Harvest Schedule

Simulation Period	Annual Harvest Level by Landbase Component					
	TSA Clearcut (Base+OGSI)	TSA Clearcut (Genetic Improvement)	Fd-Drybelt Selection	MDWR Selection	PA16	Total [1]
1	1,339,000	1,376,200	141,700	59,400	112,000	1,689,300
2	1,339,000	1,376,200	130,223	38,002	112,000	1,656,425
3	1,339,000	1,376,200	141,700	55,907	112,000	1,685,807
4	1,339,000	1,376,200	141,700	5,095	112,000	1,634,995
5	1,339,000	1,376,200	99,289	13,268	112,000	1,600,757
6	1,339,000	1,376,200	94,313	59,400	112,000	1,641,913
7	1,339,000	1,376,200	120,454	59,400	112,000	1,668,054
8	1,339,000	1,376,200	117,481	59,400	112,000	1,665,081
9	1,339,000	1,376,200	94,483	59,400	112,000	1,642,083
10	1,339,000	1,376,200	110,340	59,400	112,000	1,657,940
11	1,339,000	1,376,200	106,413	59,400	112,000	1,654,013
12	1,339,000	1,376,200	141,700	59,400	112,000	1,689,300
13	1,339,000	1,376,200	137,978	59,400	112,000	1,685,578
14	1,339,000	1,376,200	141,700	59,400	112,000	1,689,300
15	1,339,000	1,376,200	141,700	59,400	112,000	1,689,300
16	1,339,000	1,376,200	141,700	59,400	112,000	1,689,300
17	1,339,000	1,376,200	141,700	59,400	112,000	1,689,300
18	1,339,000	1,376,200	141,700	59,400	112,000	1,689,300
19	1,339,000	1,376,200	141,700	59,400	112,000	1,689,300
20	1,339,000	1,376,200	141,700	59,400	112,000	1,689,300
21	1,339,000	1,376,200	131,936	59,400	112,000	1,679,536
22	1,339,000	1,376,200	137,811	59,400	112,000	1,685,411
23	1,339,000	1,376,200	123,571	59,400	112,000	1,671,171
24	1,339,000	1,376,200	122,444	59,400	112,000	1,670,044
25	1,339,000	1,376,200	137,986	59,400	112,000	1,685,586

[1] Includes Tree Improvement TSA Clearcut harvest

An improvement of approximately 3% is realized with genetic gains applied only to Douglas-fir and spruce stands compared to the Base Case+OGSI scenario. This is related to the area included in the treatment, which is about 22% of the area included in the previous simulation. The same basic reasons for improvement apply to this simulation as noted for tree improvement including lodgepole pine. Figure 5.7 provides a graphic summary of the tree improvement and Base Case+OGSI scenario.

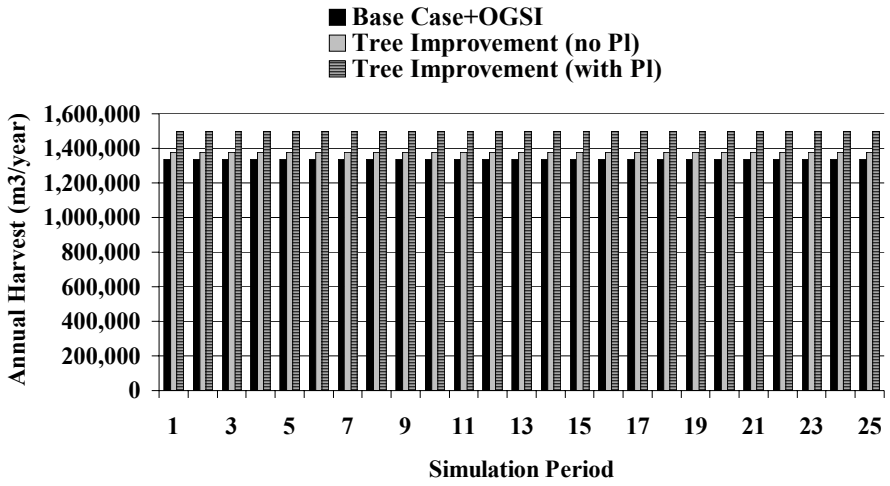

Figure 5.7 – Tree Improvement & Base Case+OGSI Harvest Levels

5.6 Alternative Thinning Densities

Alternative thinning densities were reviewed in this series of analysis simulations for the main species in managed stands – lodgepole pine, Douglas-fir and spruce. Increases and decreases over the published thinning densities in the MoF Data Package were made for the following analysis simulations.

5.6.1 Increased Density

Pine and spruce final densities were increased to 3,600 stems/ha and Douglas-fir final densities were increased to 3,000 stems/ha in this scenario. Results of the simulation are compared to the Base Case+OGSI results in Table 5.7.

Table 5.7 – Increased Thinning Density Harvest Schedule

Simulation Period	Annual Harvest Level by Landbase Component					
	TSA Clearcut (Base+OGSI)	TSA Clearcut (Increased Thin Density)	Fd-Drybelt Selection	MDWR Selection	PA16	Total [1]
1	1,339,000	1,323,900	141,700	59,400	112,000	1,637,000
2	1,339,000	1,323,900	130,191	38,619	112,000	1,604,710
3	1,339,000	1,323,900	141,700	55,252	112,000	1,632,852
4	1,339,000	1,323,900	141,700	5,254	112,000	1,582,854
5	1,339,000	1,323,900	99,317	13,101	112,000	1,548,318
6	1,339,000	1,323,900	94,313	59,400	112,000	1,589,613
7	1,339,000	1,323,900	120,446	59,400	112,000	1,615,746
8	1,339,000	1,323,900	117,488	59,400	112,000	1,612,788
9	1,339,000	1,323,900	94,483	59,400	112,000	1,589,783
10	1,339,000	1,323,900	110,333	59,400	112,000	1,605,633
11	1,339,000	1,323,900	106,420	59,400	112,000	1,601,720
12	1,339,000	1,323,900	141,700	59,400	112,000	1,637,000
13	1,339,000	1,323,900	138,476	59,400	112,000	1,633,776
14	1,339,000	1,323,900	141,700	59,400	112,000	1,637,000
15	1,339,000	1,323,900	141,700	59,400	112,000	1,637,000
16	1,339,000	1,323,900	141,700	59,400	112,000	1,637,000
17	1,339,000	1,323,900	141,700	59,400	112,000	1,637,000
18	1,339,000	1,323,900	141,700	59,400	112,000	1,637,000
19	1,339,000	1,323,900	141,700	59,400	112,000	1,637,000
20	1,339,000	1,323,900	141,700	59,400	112,000	1,637,000
21	1,339,000	1,323,900	131,754	59,400	112,000	1,627,054
22	1,339,000	1,323,900	137,790	59,400	112,000	1,633,090
23	1,339,000	1,323,900	124,004	59,400	112,000	1,619,304
24	1,339,000	1,323,900	121,999	59,400	112,000	1,617,299
25	1,339,000	1,323,900	137,890	59,400	112,000	1,633,190

[1] Includes Increased Thinning Density TSA Clearcut harvest

The harvest rate for the Increased Thinning scenario is approximately 1% below that developed for the Base Case+OGSI simulation. This small difference is likely due to subtle differences in managed stand minimum harvest age between the two scenarios and the volume available at those ages.

Generally, the volumes provided at a given age are lower with increased density due to the basic distribution of basal area (and volume) over the number of stems. Also increased competition tends to reduce the total volume generated within a stand.

5.6.2 Decreased Thinning Density

Pine and spruce final densities were decreased to 1,200 stems/ha and Douglas-fir final densities were decreased to 1,000 stems/ha in this scenario. Results of the simulation are compared to the Base Case+OGSI results in Table 5.8.

Table 5.8 – Decreased Thinning Density Harvest Schedule

Simulation Period	Annual Harvest Level by Landbase Component					
	TSA Clearcut (Base+OGSI)	TSA Clearcut (Decreased Thin Density)	Fd-Drybelt Selection	MDWR Selection	PA16	Total [1]
1	1,339,000	1,301,700	141,700	59,400	112,000	1,614,800
2	1,339,000	1,301,700	130,238	38,672	112,000	1,582,610
3	1,339,000	1,301,700	141,700	55,196	112,000	1,610,596
4	1,339,000	1,301,700	141,700	5,254	112,000	1,560,654
5	1,339,000	1,301,700	99,276	13,101	112,000	1,526,077
6	1,339,000	1,301,700	94,313	59,400	112,000	1,567,413
7	1,339,000	1,301,700	120,457	59,400	112,000	1,593,557
8	1,339,000	1,301,700	117,477	59,400	112,000	1,590,577
9	1,339,000	1,301,700	94,483	59,400	112,000	1,567,583
10	1,339,000	1,301,700	110,343	59,400	112,000	1,583,443
11	1,339,000	1,301,700	106,409	59,400	112,000	1,579,509
12	1,339,000	1,301,700	141,700	59,400	112,000	1,614,800
13	1,339,000	1,301,700	138,487	59,400	112,000	1,611,587
14	1,339,000	1,301,700	141,700	59,400	112,000	1,614,800
15	1,339,000	1,301,700	141,700	59,400	112,000	1,614,800
16	1,339,000	1,301,700	141,700	59,400	112,000	1,614,800
17	1,339,000	1,301,700	141,700	59,400	112,000	1,614,800
18	1,339,000	1,301,700	141,700	59,400	112,000	1,614,800
19	1,339,000	1,301,700	141,700	59,400	112,000	1,614,800
20	1,339,000	1,301,700	141,700	59,400	112,000	1,614,800
21	1,339,000	1,301,700	131,690	59,400	112,000	1,604,790
22	1,339,000	1,301,700	137,775	59,400	112,000	1,610,875
23	1,339,000	1,301,700	124,004	59,400	112,000	1,597,104
24	1,339,000	1,301,700	122,014	59,400	112,000	1,595,114
25	1,339,000	1,301,700	137,852	59,400	112,000	1,610,952

[1] Includes Decreased Thinning Density TSA Clearcut harvest

A 3% decline in annual harvest was noted for this scenario compared with Base Case+OGSI. The majority of this decrease is associated with managed lodgepole pine stands that contribute less volume at minimum harvest age compared with the Base Case+OGSI. Minimum harvest ages were similar for the pine component of the landbase but the lower final density does not take full advantage of the productive capacity of the landbase. Figure 5.8 provides a graphic summary of the alternative density scenarios and the Base Case+OGSI harvest schedule.

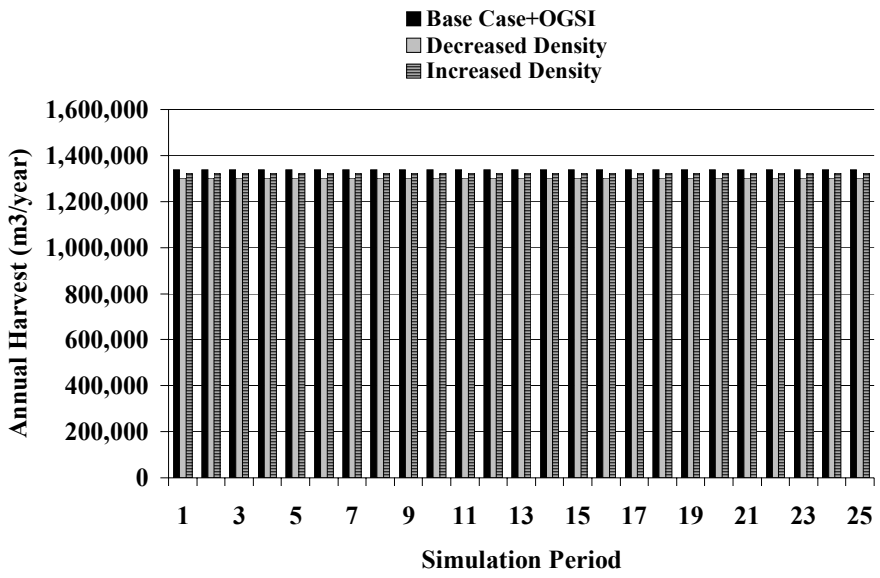

Figure 5.8 – Alternative Thinning Densities & Base Case+OGSI Harvest Levels

5.7 Spacing & Fertilization

Fertilization of lodgepole pine stands with acceptable site productivity (SI50 between 13.3 and 32.4) was evaluated in this scenario. One fertilization application during the rotation is assumed to improve harvest volume by 15m3/ha. Based on the results of the Alternative Thinning Densities scenario, the Base Case thinning densities (pine 2,300; spruce 2,200; Douglas-fir 1,500) were used in this scenario in addition to the volume gains associated with fertilization. No changes to minimum harvest age were made. Two simulations were completed for this aspect of the analysis.

5.7.1 Treat Good Site Lodgepole Pine (SI > 20)

In this scenario only "good" site managed lodgepole pine stands were considered eligible for treatment. Table 5.9 summarizes the results of this simulation and compares the TSA clearcut results to the Base Case+OGSI TSA clearcut harvest schedule.

Table 5.9 – Space & Fertilize Good Site Pine Harvest Schedule

Simulation Period	Annual Harvest Level by Landbase Component					
	TSA Clearcut (Base+OGSI)	TSA Clearcut (Space & Fert Pl-G)	Fd-Drybelt Selection	MDWR Selection	PA16	Total [1]
1	1,339,000	1,343,300	141,700	59,400	112,000	1,656,400
2	1,339,000	1,343,300	129,546	37,383	112,000	1,622,229
3	1,339,000	1,343,300	141,700	56,483	112,000	1,653,483
4	1,339,000	1,343,300	141,700	5,328	112,000	1,602,328
5	1,339,000	1,343,300	99,798	13,101	112,000	1,568,199
6	1,339,000	1,343,300	94,405	59,400	112,000	1,609,105
7	1,339,000	1,343,300	120,334	59,400	112,000	1,635,034
8	1,339,000	1,343,300	117,601	59,400	112,000	1,632,301
9	1,339,000	1,343,300	94,511	59,400	112,000	1,609,211
10	1,339,000	1,343,300	110,220	59,400	112,000	1,624,920
11	1,339,000	1,343,300	106,533	59,400	112,000	1,621,233
12	1,339,000	1,343,300	141,700	59,400	112,000	1,656,400
13	1,339,000	1,343,300	140,292	59,400	112,000	1,654,992
14	1,339,000	1,343,300	141,700	59,400	112,000	1,656,400
15	1,339,000	1,343,300	141,700	59,400	112,000	1,656,400
16	1,339,000	1,343,300	141,700	59,400	112,000	1,656,400
17	1,339,000	1,343,300	141,700	59,400	112,000	1,656,400
18	1,339,000	1,343,300	141,700	59,400	112,000	1,656,400
19	1,339,000	1,343,300	141,700	59,400	112,000	1,656,400
20	1,339,000	1,343,300	141,700	59,400	112,000	1,656,400
21	1,339,000	1,343,300	131,576	59,400	112,000	1,646,276
22	1,339,000	1,343,300	138,040	59,400	112,000	1,652,740
23	1,339,000	1,343,300	123,917	59,400	112,000	1,638,617
24	1,339,000	1,343,300	121,891	59,400	112,000	1,636,591
25	1,339,000	1,343,300	137,991	59,400	112,000	1,652,691

[1] Includes Space & Fertilize Good Site Pine TSA Clearcut harvest

The impact of fertilizing only the "good" site pine is minimal (<0.5%) compared to the Base Case+OGSI harvest rate. The area affected is approximately 67,000 ha of the TSA clearcut landbase (approximately 15%) and the impact on yield is less than 5% at rotation.

5.7.2 Treat Good & Medium Site Lodgepole Pine (SI > 13)

In this component of the analysis both "good" and "medium" site lodgepole pine stands were treated. Results of the harvest schedule developed for this simulation are presented in Table 5.10.

Table 5.10 – Space & Fertilize Good & Medium Site Pine Harvest Schedule

Simulation Period	Annual Harvest Level by Landbase Component					
	TSA Clearcut (Base+OGSI)	TSA Clearcut (Space & Fert Pl-G/M)	Fd-Drybelt Selection	MDWR Selection	PA16	Total [1]
1	1,339,000	1,371,900	141,700	59,400	112,000	1,685,000
2	1,339,000	1,371,900	130,223	38,002	112,000	1,652,125
3	1,339,000	1,371,900	141,700	55,907	112,000	1,681,507
4	1,339,000	1,371,900	141,700	5,095	112,000	1,630,695
5	1,339,000	1,371,900	99,289	13,268	112,000	1,596,457
6	1,339,000	1,371,900	94,313	59,400	112,000	1,637,613
7	1,339,000	1,371,900	120,454	59,400	112,000	1,663,754
8	1,339,000	1,371,900	117,481	59,400	112,000	1,660,781
9	1,339,000	1,371,900	94,483	59,400	112,000	1,637,783
10	1,339,000	1,371,900	110,340	59,400	112,000	1,653,640
11	1,339,000	1,371,900	106,413	59,400	112,000	1,649,713
12	1,339,000	1,371,900	141,700	59,400	112,000	1,685,000
13	1,339,000	1,371,900	137,978	59,400	112,000	1,681,278
14	1,339,000	1,371,900	141,700	59,400	112,000	1,685,000
15	1,339,000	1,371,900	141,700	59,400	112,000	1,685,000
16	1,339,000	1,371,900	141,700	59,400	112,000	1,685,000
17	1,339,000	1,371,900	141,700	59,400	112,000	1,685,000
18	1,339,000	1,371,900	141,700	59,400	112,000	1,685,000
19	1,339,000	1,371,900	141,700	59,400	112,000	1,685,000
20	1,339,000	1,371,900	141,700	59,400	112,000	1,685,000
21	1,339,000	1,371,900	131,936	59,400	112,000	1,675,236
22	1,339,000	1,371,900	137,822	59,400	112,000	1,681,122
23	1,339,000	1,371,900	123,571	59,400	112,000	1,666,871
24	1,339,000	1,371,900	122,433	59,400	112,000	1,665,733
25	1,339,000	1,371,900	137,996	59,400	112,000	1,681,296

[1] Includes Space & Fertilize Good & Medium Site Pine TSA Clearcut harvest

The increase over the Base Case+OGSI annual harvest rate is approximately 3% in this treatment scenario. This increase is due to the considerably larger segment of the landbase (approximately 252,000 ha) affected by this treatment. Most of the gains associated with spacing and fertilization are realized in the harvest rate. Slightly more than half of the clearcut harvest area is eligible for treatment and the average gain in volume is about 5% over Base Case+OGSI volumes.

It is likely that further increases are possible if fertilization allowed reductions in managed stand minimum harvest age. Figure 5.9 provides a graphic comparison of the spacing and fertilization harvest schedules.

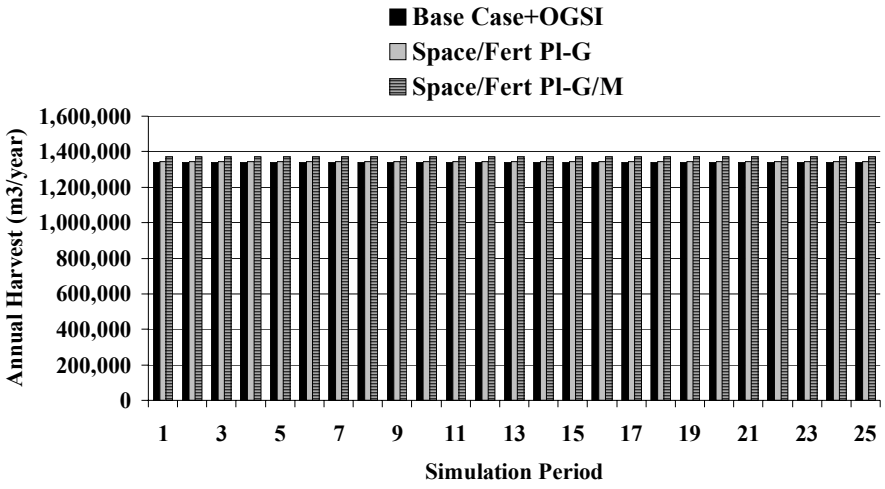

Figure 5.9 – Spacing & Fertilization & Base Case+OGSI Harvest Levels

5.8 Eliminate Backlog NSR

This scenario uses the same input data as the Base Case+OGSI simulation. However, the backlog component of the NSR (areas logged prior to 1987) is assumed to regenerate in 5 years compared with 10 years in the Base Case. Table 5.11 summarizes the results of this analysis scenario.

Table 5.11 – Eliminate Backlog NSR in 5 Years Harvest Schedule

Simulation Period	Annual Harvest Level by Landbase Component					
	TSA Clearcut (Base+OGSI)	TSA Clearcut (Eliminate Backlog)	Fd-Drybelt Selection	MDWR Selection	PA16	Total [1]
1	1,339,000	1,339,500	141,700	59,400	112,000	1,652,600
2	1,339,000	1,339,500	130,221	38,576	112,000	1,620,297
3	1,339,000	1,339,500	141,700	55,297	112,000	1,648,497
4	1,339,000	1,339,500	141,700	5,254	112,000	1,598,454
5	1,339,000	1,339,500	99,295	13,101	112,000	1,563,896
6	1,339,000	1,339,500	94,325	59,400	112,000	1,605,225
7	1,339,000	1,339,500	120,441	59,400	112,000	1,631,341
8	1,339,000	1,339,500	117,482	59,400	112,000	1,628,382
9	1,339,000	1,339,500	94,495	59,400	112,000	1,605,395
10	1,339,000	1,339,500	110,327	59,400	112,000	1,621,227
11	1,339,000	1,339,500	106,414	59,400	112,000	1,617,314
12	1,339,000	1,339,500	141,700	59,400	112,000	1,652,600
13	1,339,000	1,339,500	138,379	59,400	112,000	1,649,279
14	1,339,000	1,339,500	141,700	59,400	112,000	1,652,600
15	1,339,000	1,339,500	141,700	59,400	112,000	1,652,600
16	1,339,000	1,339,500	141,700	59,400	112,000	1,652,600
17	1,339,000	1,339,500	141,700	59,400	112,000	1,652,600
18	1,339,000	1,339,500	141,700	59,400	112,000	1,652,600
19	1,339,000	1,339,500	141,700	59,400	112,000	1,652,600
20	1,339,000	1,339,500	141,700	59,400	112,000	1,652,600
21	1,339,000	1,339,500	131,633	59,400	112,000	1,642,533
22	1,339,000	1,339,500	137,758	59,400	112,000	1,648,658
23	1,339,000	1,339,500	123,927	59,400	112,000	1,634,827
24	1,339,000	1,339,500	122,116	59,400	112,000	1,633,016
25	1,339,000	1,339,500	137,946	59,400	112,000	1,648,846

[1] Includes Eliminate Backlog TSA Clearcut harvest

The improvement in annual harvest with a reduced regeneration lag for backlog NSR is insignificant compared to the Base Case+OGSI harvest schedule. This indicates that the inventory of mature timber is sufficient to carry the harvest in the early decades of the analysis. The total area of backlog NSR is only about 4,500 ha (1%) of the TSA clearcut landbase so it does not play a significant part in determining the annual harvest rate.

Figure 5.10 presents a graphic summary of the harvest schedule developed for the reduced backlog regeneration time in comparison to the Base Case+OGSI harvest.

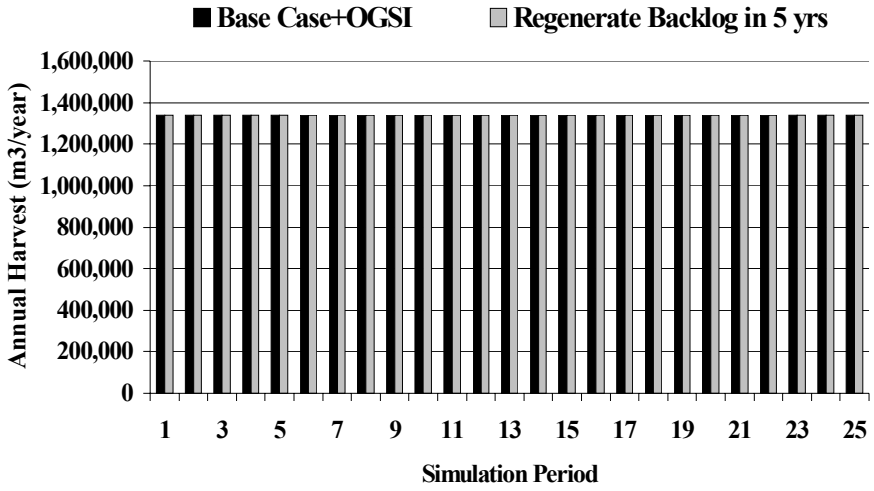

Figure 5.10 – Regenerate Backlog in 5 Years & Base Case+OGSI Harvest Levels

5.9 Maximize PA16 Harvest Rate

This scenario uses the same input data as the Base Case+OGSI simulation. However, the harvest drawn from the PA16 area is maximized over the 250 year planning horizon in order to fully understand the productive capacity of this segment of the 100 Mile House landbase. Table 5.12 summarizes the results of this analysis scenario.

Table 5.12 – Maximize PA16 Harvest Schedule

Simulation Period	Annual Harvest Level by Landbase Component					
	TSA Clearcut (Base+OGSI)	PA16 (Base Case+OGSI)	Fd-Drybelt Selection	MDWR Selection	PA16 (Maximize)	Total [1]
1	1,339,000	112,000	141,700	59,400	128,800	1,668,900
2	1,339,000	112,000	130,218	38,576	128,800	1,636,594
3	1,339,000	112,000	141,700	55,297	128,800	1,664,797
4	1,339,000	112,000	141,700	5,254	128,800	1,614,754
5	1,339,000	112,000	99,287	13,101	128,800	1,580,188
6	1,339,000	112,000	94,313	59,400	128,800	1,621,513
7	1,339,000	112,000	120,470	59,400	128,800	1,647,670
8	1,339,000	112,000	117,465	59,400	128,800	1,644,665
9	1,339,000	112,000	94,483	59,400	128,800	1,621,683
10	1,339,000	112,000	110,356	59,400	128,800	1,637,556
11	1,339,000	112,000	106,393	59,400	128,800	1,633,593
12	1,339,000	112,000	141,700	59,400	128,800	1,668,900
13	1,339,000	112,000	138,615	59,400	128,800	1,665,815
14	1,339,000	112,000	141,700	59,400	128,800	1,668,900
15	1,339,000	112,000	141,700	59,400	128,800	1,668,900
16	1,339,000	112,000	141,700	59,400	128,800	1,668,900
17	1,339,000	112,000	141,700	59,400	128,800	1,668,900
18	1,339,000	112,000	141,700	59,400	128,800	1,668,900
19	1,339,000	112,000	140,025	59,400	128,800	1,667,225
20	1,339,000	112,000	141,700	59,400	128,800	1,668,900
21	1,339,000	112,000	131,994	59,400	128,800	1,659,194
22	1,339,000	112,000	139,218	59,400	128,800	1,666,418
23	1,339,000	112,000	125,665	59,400	128,800	1,652,865
24	1,339,000	112,000	123,087	59,400	128,800	1,650,287
25	1,339,000	112,000	136,686	59,400	128,800	1,663,886

[1] Includes Maximize PA16 harvest

Only the PA16 harvest rate changes in this scenario; inputs and assumptions for other harvest partitions remain consistent with the Base Case+OGSI scenario. The PA16 harvest rate increased by 15% compared with the same harvest partition in the Base Case+OGSI analysis simulation.

This scenario identifies that there is a surplus of mature timber within the PA16 landbase, allowing for the improved harvest rate. A significant component of the landbase assigned to PA16 has mature available timber. Initially there are over 9.7 million cubic metres of merchantable timber within the PA16 area which supports the harvest until managed stands become available.

Many of the stands in the PA16 landbase are low productivity types. Even though these areas may have reasonable volumes of standing timber because the stands are very old. However, when they regenerate after harvest the time to reach minimum merchantability is very long (in some cases > 200 years). These areas are therefore only harvested once during the simulation.

Selection harvest areas within PA16 are exclusively low productivity sites (SI50 < 7.6m).

The long-term regeneration selection harvest yields for these areas have an average MAI of less than 0.5m3/ha/year. These areas only contribute up to 20m3/ha during the first selection harvest entry. Figure 5.11 provides a comparison of the Base Case+OGSI PA16 harvest schedule and the Maximize PA16 harvest schedule.

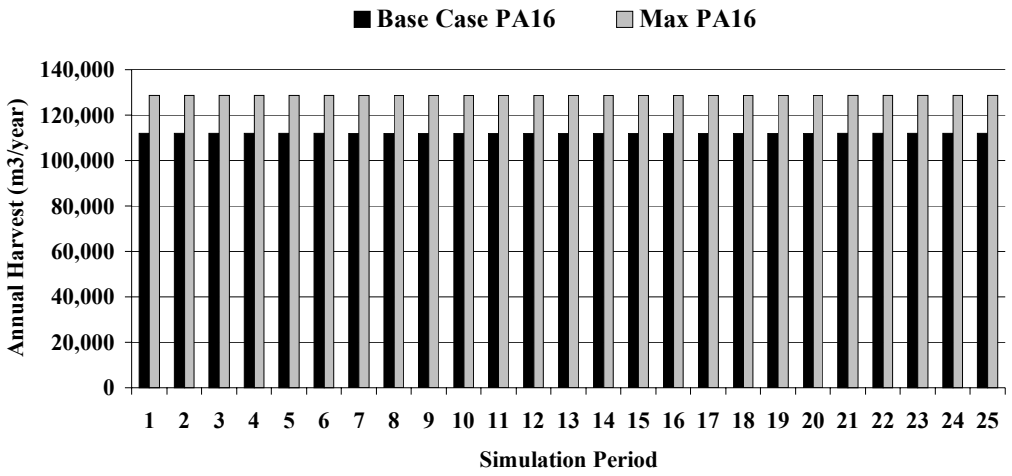

Figure 5.11 – Max PA16 & Base Case+OGSI PA16 Harvest Levels

6.0 DISCUSSION

This analysis demonstrates the stable nature of the timber supply on the various landbase partitions of the 100 Mile House TSA. The Base Case harvest level is higher than the current AAC for the TSA even though the timber harvesting landbase is smaller than reported for the last timber supply analysis for the TSA.

Results of the analysis indicate that "even-flow" is a suitable harvest flow policy. Increases in annual harvest above the even-flow rate require a corresponding drop in harvest at other times, sometimes larger than the increase depending on the timing. Harvesting during the early decades is supported by an inventory of existing, predominantly mature, natural stands of timber distributed across the landbase.

Improved forest and non-timber resource inventories have allowed a more thorough review of the landbase prior to defining various analysis inputs and assumptions. The only drawback to the inventory preparation is the definition of many PA16 lands that are based on percentage components of certain timber types. This excludes the possibility of locating and/or mapping some of the PA16 stands.

The majority of annual harvest adjustments related to the various treatments were associated with the TSA clearcut partition of the landbase. OGSI adjustments that result in improved managed stand yields provide an immediate improvement to the annual harvest rate for the TSA clearcut area. Based on recent publications by MoF Research Branch, the OGSI adjustments for designated areas are likely to be included as base line

information in future analyses.

Improving timber availability during the critical periods approximately 70 years and 130 to 150 years into the future allows an increase in the harvest level over the entire planning horizon. During these periods old growth requirements are increased and a large segment of managed stands have not yet reached minimum harvest age. Also, by the seventh decade the standing inventory of mature natural stands has been depleted and managed stands become much more important in supporting the annual harvest.

Any volume increases to managed stands as a result of tree improvement or fertilization treatments result in harvest gains of between 2.5% and 10.5%. These gains are based on treating all eligible stands and therefore may be overly optimistic, as this level of treatment may not be operationally realistic.

The PA16 harvest level of 112,000m3/year is not taking full advantage of the inherent productivity of this landbase component. This is demonstrated by the Maximize PA16 harvest rate which was 15% higher than the Base Case+OGSI harvest rate for PA16.

Forest cover constraints related to disturbance do not negatively influence the harvest schedule. Reducing time to green-up did not impact the annual harvest rate. However, improving regeneration delay has a noticeable impact on the periodic harvest. This relates to the importance of the timing of availability of managed stands 60 to 80 years into the future and the volume offered by those managed stands. Therefore treatments that reduce minimum harvest ages for managed stands and/or increase the volume associated with those stands are likely to provide the best improvements to timber supply.

The landbase has addressed FPC requirements such as biodiversity (landscape and stand level) and riparian concerns through old growth management and landbase netdowns. The large inventory of mature timber provides a consistent flow of volume prior to managed stands supporting the majority of the harvest approximately 70 years into the future and beyond.

Overall the 100 Mile House TSA provides a good opportunity for management actions that will result in improved timber supply. The lack of significant forest cover-related issues on the majority of the landbase means that harvest levels will reflect the full stand level improvements related to treatments.