Tree Farm Licence 33 – Management Plan 10

TIMBER SUPPLY ANALYSIS REPORT

Version 1.0

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Project 11-544

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Executive Summary

This report documents the timber supply analysis for Management Plan #10 for Tree Farm Licence 33 (TFL 33) held by Canoe Forest Products Ltd. (CFP). Reviews of the timber supply for Tree Farm Licences are typically completed once every ten years to capture changes in data, practices, policy or legislation influencing forest management. The last timber supply analysis for TFL 33 was completed in 1999 when Management Plan #8 was prepared. An updated timber supply analysis was not completed when Management Plan #9 was submitted in 2005. In March 2011, the Chief Forester of British Columbia made an Allowable Annual Cut (AAC) determination of 21,000 m^3/year using the analysis completed in 1999, with consideration of factors that might change the timber supply since that analysis was completed. The current timber supply analysis will provide information for the Chief Forester to be used in making a new AAC determination and approved MP to be in place by March 31, 2021.

The timber supply analysis provides forecasts of future harvest levels over time with consideration of a wide range of physical, biological, social and economic factors. These factors encompass both the timber and non-timber values found in the forests and ensure that timber harvesting objectives are balanced against social and ecological values such as wildlife, biodiversity, watershed health, and recreational opportunities.

An Information Package (IP) that provides detailed technical information and assumptions regarding current forest management practices, policy and legislation for use in the analysis underwent 60 days of public review beginning in March, 2020. An updated Information Package that reflects changes made in response to the public review is included in Appendix 1. The Information Package was accepted by the Ministry of Forests, Lands, Natural Resource Operations & Rural Development on July 20th, 2020.

This report focuses on a forest management scenario known as the “Base Case” scenario that reflects current management practices in TFL 33. A number of sensitivity analyses are also presented that assess how results might be affected by uncertainties in data or assumptions. Together, these analyses form a solid foundation for discussions with government, First Nations, and stakeholders in the determination of an appropriate timber harvesting level.

TFL33 covers an area of 8,396 hectares and is situated within the Columbia wet-belt on the western slopes of the Shuswap Mountain Range. The main changes affecting forest management since the 1999 analysis include:

- Forest inventory attributes updated using LiDAR. Although this update did not follow published FLNRORD standards, it appears that current volumes may be better represented than if the original inventory had simply been projected.
- Development of improved site index estimates for managed stands
- Updated version of VDYP used for natural stand yield tables
- Updated version of TIPSY used for managed stand yield tables
- Approval of two Government Actions Regulation (GAR) Orders to guide caribou management
- Approval of a GAR Order to guide mule deer management
- Completion of terrain stability mapping, to be used instead of ESA mapping
- Use of Old Growth Management Areas to meet landscape level biodiversity objectives
- Use of a heuristic timber supply model rather than a simulation model

The Base Case scenario harvests 23,160 m^3/year which is about 10% higher than the current AAC. This harvest level is maintained for 30 years, after which it increases to 29,680 m^3/year for another 40 years. The long-term harvest level after 70 years is 38,490 m^3/year for the the remainder of the 300 year planning horizon (Figure 1).

The sensitivity analyses indicate that there is very little downward pressure on the short-term harvest when factors that typically reduce short-term harvest flows (i.e. THLB reductions, natural stand yield reductions, minimum harvest age increases) are applied provided a later transition to the mid-term harvest level is allowed (Table 1).

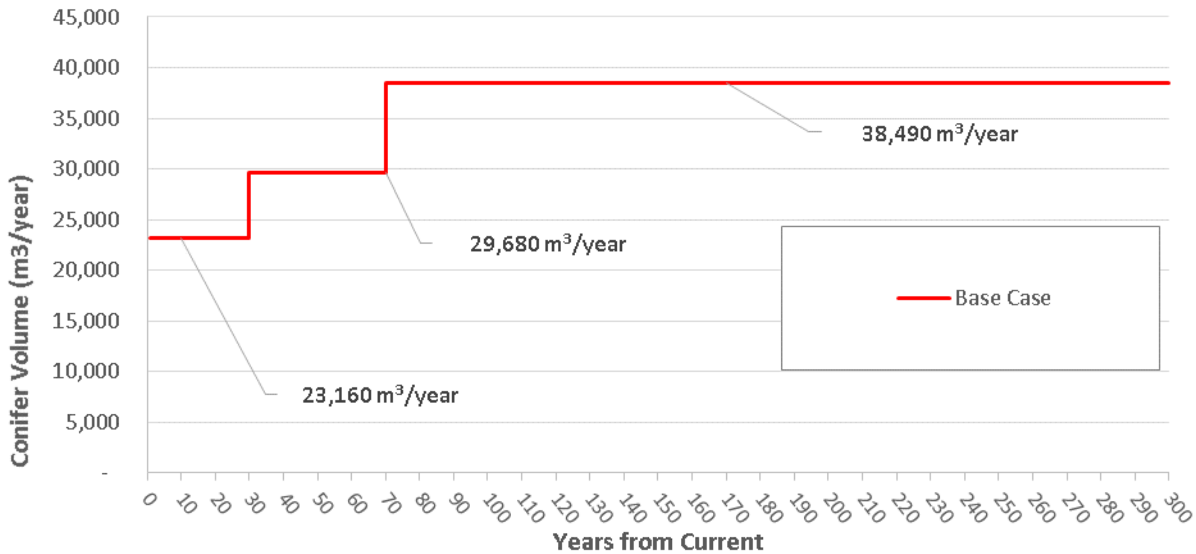

Figure 1 Base Case harvest projection

Table 1 Summary of sensitivity analyses

	Changes to Harvest Forecast from Base Case		
Scenario	**Short-term**	**Mid-term**	**Long-term**
THLB + 10%	+ 9.8%	+ 5.1%	+ 6.0%
THLB – 10%	- 10.4%	- 10.7%	- 9.3%
THLB – 10% (Maintain short-term harvest)	- 0.5%	-10.9%, Delay transition 15 years	- 9.4%
Natural Stand Yields + 10%	+ 14.4%	- 0.1%*	- 0.1%*
Natural Stand Yields – 10%	- 3.7%	- 4.7%	- 0.2%*
Natural Stand Yields – 10% (Maintain short-term harvest)	- 0.3%*	- 4.6%, Delay Transition 10 years	- 0.2%*
Managed Stand Yields + 10%	- 0.2%*	+ 8.0%	+ 10.1%
Managed Stand Yields – 10%	- 0.2%*	- 6.2%	- 10.2%
Standard OAF2			
Minimum Harvest Age + 10 Years	- 0.7%	-2.3 %, Delay Transition 10 years	- 0.5%, Delay Transition 10 years
Minimum Harvest Age – 10 Years	- 0.1%*	- 0.3%*	- 1.4%
No Harvest Block Size Restrictions	+ 4.4%	+ 3.7%	+ 1.3%

** Changes <= 0.3% not considered a significant difference in this analysis report*

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List of Acronyms

AAC	Allowable Annual Cut
AU	Analysis Unit
BEC	Biogeoclimatic Ecosystem Classification
CFLB	Crown Forested Land Base
CFP	Canoe Forest Products Ltd.
CMI	Change Monitoring Inventory
DBH	Diameter at Breast Height
ERR	Enhanced Riparian Reserve
ESA	Environmentally Sensitive Area
ESSF	Engelmann Spruce Sub-alpine Fir
FAIB	Forest Analysis and Inventory Branch
FLNRORD	Ministry of Forests, Lands, Natural Resource Operations and Rural Development
FSP	Forest Stewardship Plan
GAR	Government Actions Regulation
GIS	Geographic Information System
ICH	Interior Cedar Hemlock
IP	Information Package
LRMP	Land and Resource Management Plan
LRSY	Long Range Sustained Yield
LU	Landscape Unit
MAI	Mean Annual Increment
MHA	Minimum Harvest Age
MOE	Ministry of Environment
MP	Management Plan
NDT	Natural Disturbance Type
NRL	Non-Recoverable Losses
OAF	Operational Adjustment Factor
OGMA	Old Growth Management Area
SIA	Site Index Adjustment
TFL	Tree Farm Licence
THLB	Timber Harvesting Land Base
TIPSY	Table Interpolation of Stand Yields
TSA	Timber Supply Area
TSR	Timber Supply Review
VAC	Visual Absorption Capacity
VDYP	Variable Density Yield Projection
VQO	Visual Quality Objective
WTP	Wildlife Tree Patch
WTR	Wildlife Tree Retention

Document Revision History

Version	Date	Description
1.0	August 2020	Initial Analysis Report

1 Introduction

Canoe Forest Products Ltd. (CFP) is the holder of Tree Farm Licence 33 (TFL 33), and is currently in the process of preparing Management Plan (MP) #10. Reviews of the timber supply for Tree Farm Licences are typically completed once every ten years to capture changes in data, practices, policy or legislation influencing forest management. The last timber supply analysis for TFL 33 was completed in 1999 when Management Plan #8 was prepared. An updated timber supply analysis was not completed when Management Plan #9 was submitted in 2005. In March 2011, the Chief Forester of British Columbia made an Allowable Annual Cut (AAC) determination of 21,000 m^3/year using the analysis completed in 1999, with consideration of factors that might change the timber supply since that analysis was completed. The goal is to have a new AAC determination and approved MP in place by March 31, 2021.

This timber supply analysis provides forecasts of future harvest levels over time with consideration of a wide range of physical, biological, social and economic factors. These factors encompass both the timber and non-timber values found in our forests and ensure that timber harvesting objectives are balanced against social and ecological values such as wildlife, biodiversity, and recreational opportunities.

An Information Package (IP) that provides detailed technical information and assumptions regarding current forest management practices, policy and legislation for use in the analysis underwent 60 days of public review beginning in March, 2020. An updated Information Package that reflects changes made in response to the public review is included in Appendix 1. The Information Package was accepted by the Ministry of Forests, Lands, Natural Resource Operations & Rural Development on July 20th, 2020.

This Analysis Report (AR) summarizes the results of the timber supply analysis for the Base Case scenario which is intended to reflect current management practices on the TFL. It includes three alternative harvest flows, as well as a number of sensitivity analyses intended to provide insight into how results may be affected by uncertainties in data or assumptions. This analysis report provides a focus for public discussion, and will provide British Columbia's Chief Forester with much of the information that is needed to make an informed AAC determination. This report does not define a new AAC, and is intended only to provide insight into the likely future timber supply of TFL 33. The final harvest will be determined by the Chief Forester and published along with a rationale in an AAC Determination document.

2 Description of Tree Farm Licence 33

2.1 LOCATION

TFL 33 covers an area of 8,396 hectares and is situated within the Columbia wet-belt on the western slopes of the Shuswap Mountain Range. It lies immediately to the north of the District Municipality of Sicamous adjacent to Shuswap Lake (see Figure 2). The elevation ranges from approximately 347 metres at lake level to approximately 1700 metres on Queest Mountain. There are six biogeoclimatic subzones in the TFL, including ICHmw2, ICHwk1, ICHdw4, ESSFwc2, ESSFwcp, and ESSFwcw.

Access through TFL 33 is important for both summer and winter sports (mountain biking, hiking, ATV'ing, and snowmobiling. Hunters also utilize the access through the TFL in the fall. Access along the foreshore adjacent to the TFL is by boat only, and houseboats use the Provincial Park system for moorage during the summer. Visual quality of TFL 33 as seen from Shuswap Lake is an important management consideration.

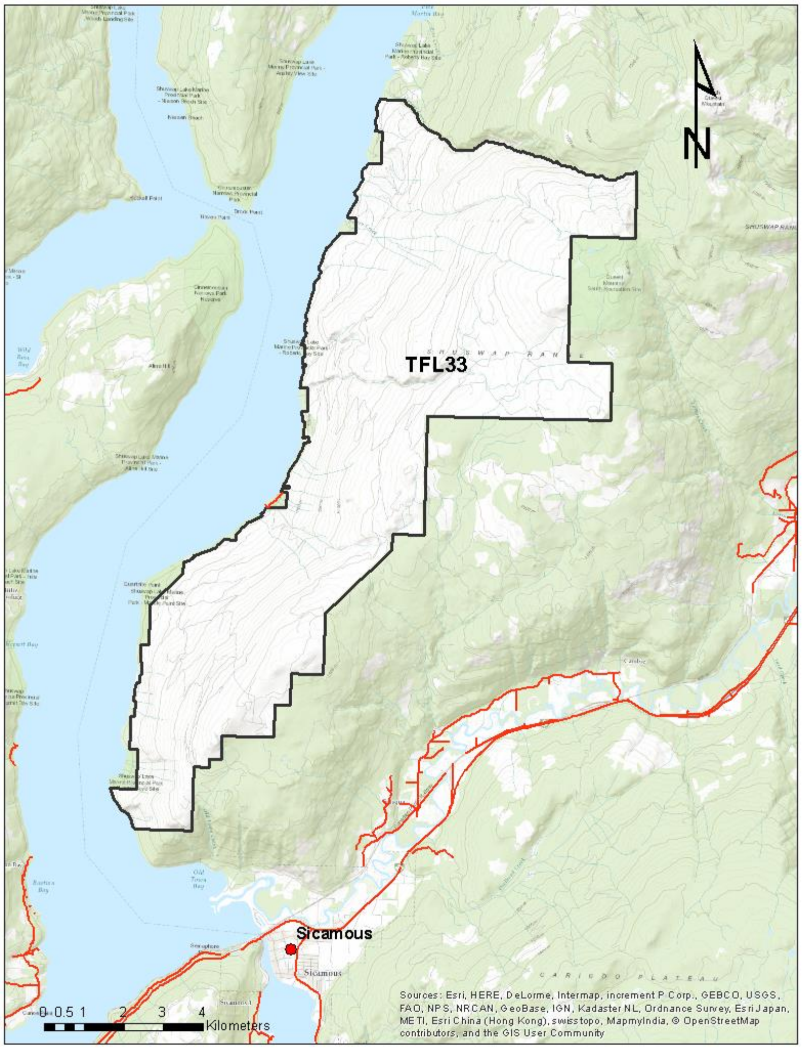

Figure 2 TFL 33 overview map

2.2 CURRENT ATTRIBUTES

2.2.1 SPECIES COMPOSITION

The species composition derived from individual stand composition percentages for the THLB and non-THLB area is shown in Figure 3. Douglas-fir (30.3%) is the predominant species on the THLB. Spruce (16.2%), cedar (16.0%), subalpine fir (14.3%), and hemlock (10.5%) are the next most common species on the THLB. Larch, lodgepole pine, white pine and deciduous species are all present in smaller amounts.

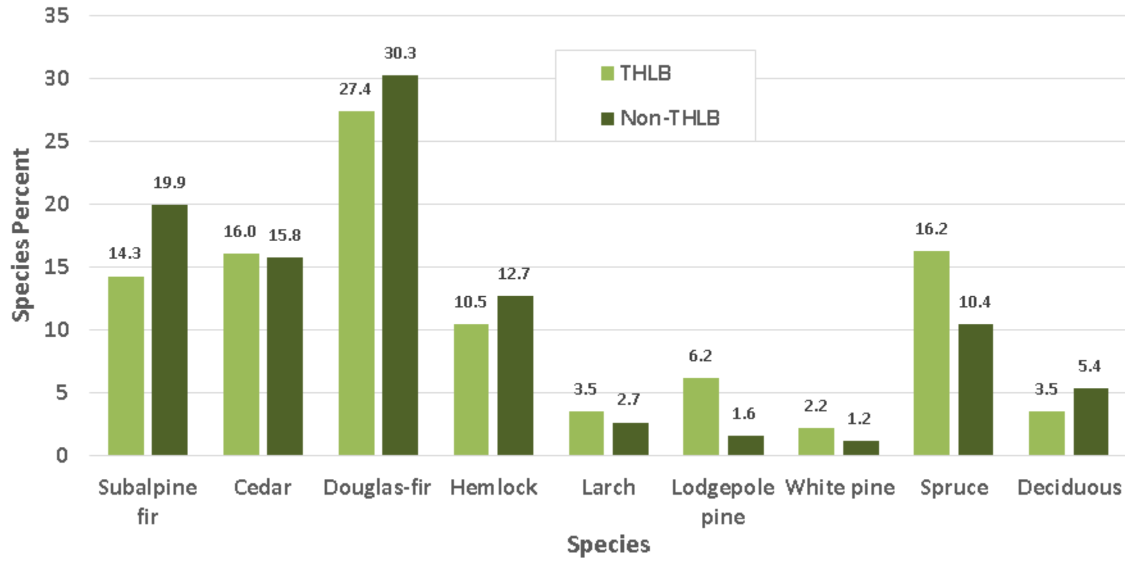

Figure 3 Overall species composition derived from individual stand composition percentages

2.2.2 AGE CLASS DISTRIBUTION

The current age class distribution for TFL 33 is shown in Figure 4. Roughly 49% of the THLB is less than 60 years old, reflecting the harvest history on the TFL. In contrast, roughly 97% of the non-THLB is at least 80 years old, and about 84% is at least 120 years old.

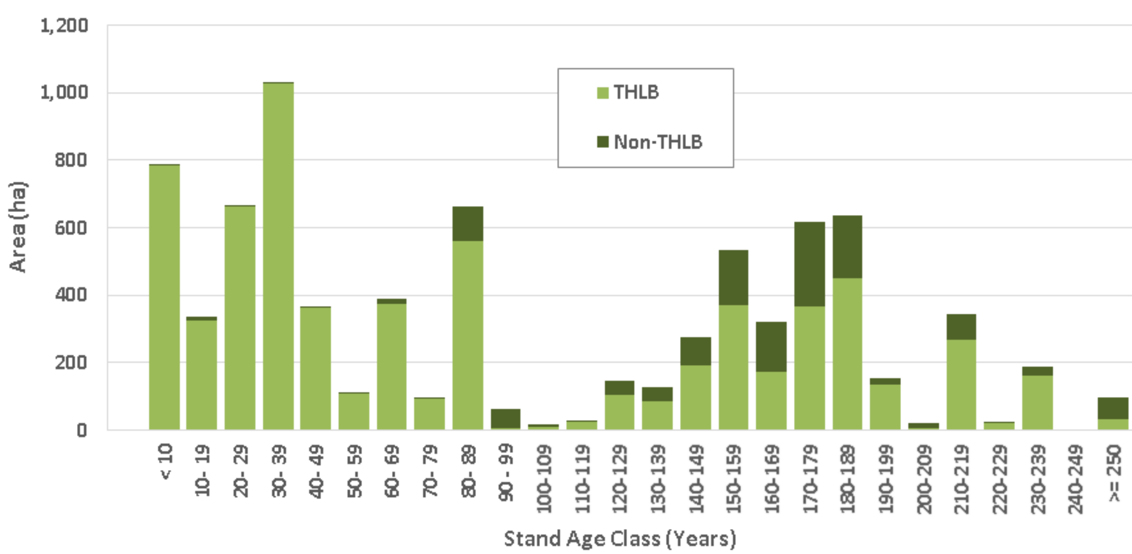

Figure 4 Age class distribution

2.2.3 BIOGEOCLIMATIC CLASSIFICATION

The area distribution of biogeoclimatic classifications and natural disturbance types (NDT) for the THLB, non-THLB, and non-CFLB are shown in Figure 5, and the spatial distribution of BEC variants is shown in Figure 6. The majority of the TFL is in the Interior Cedar Hemlock zone (ICH), with similar representation in three different ICH variants. The remainder of the TFL is in the Engelmann Spruce Subalpine Fir (ESSF) biogeoclimatic zone.

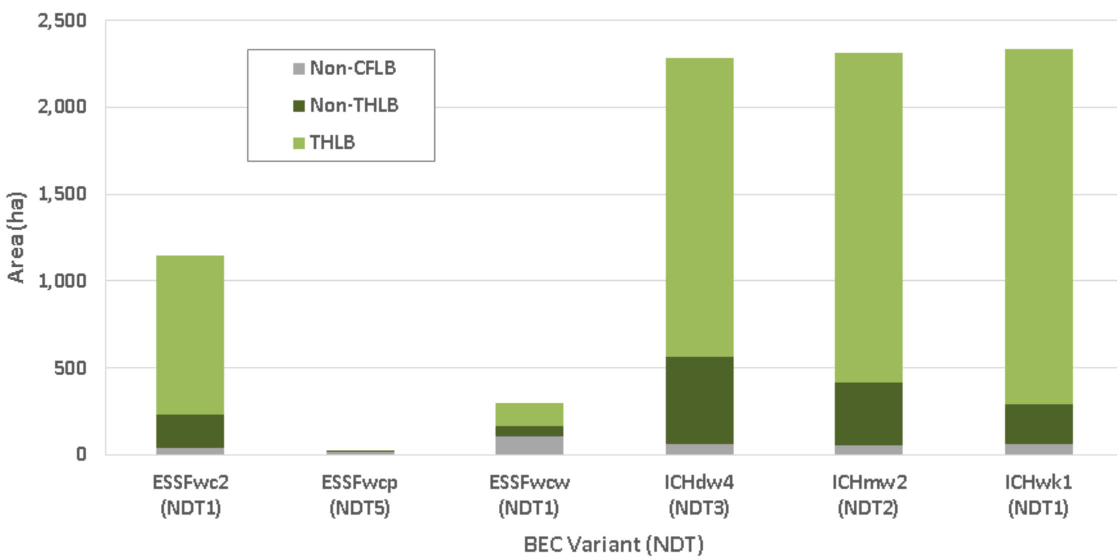

Figure 5 Area distribution of BEC (version11) variants

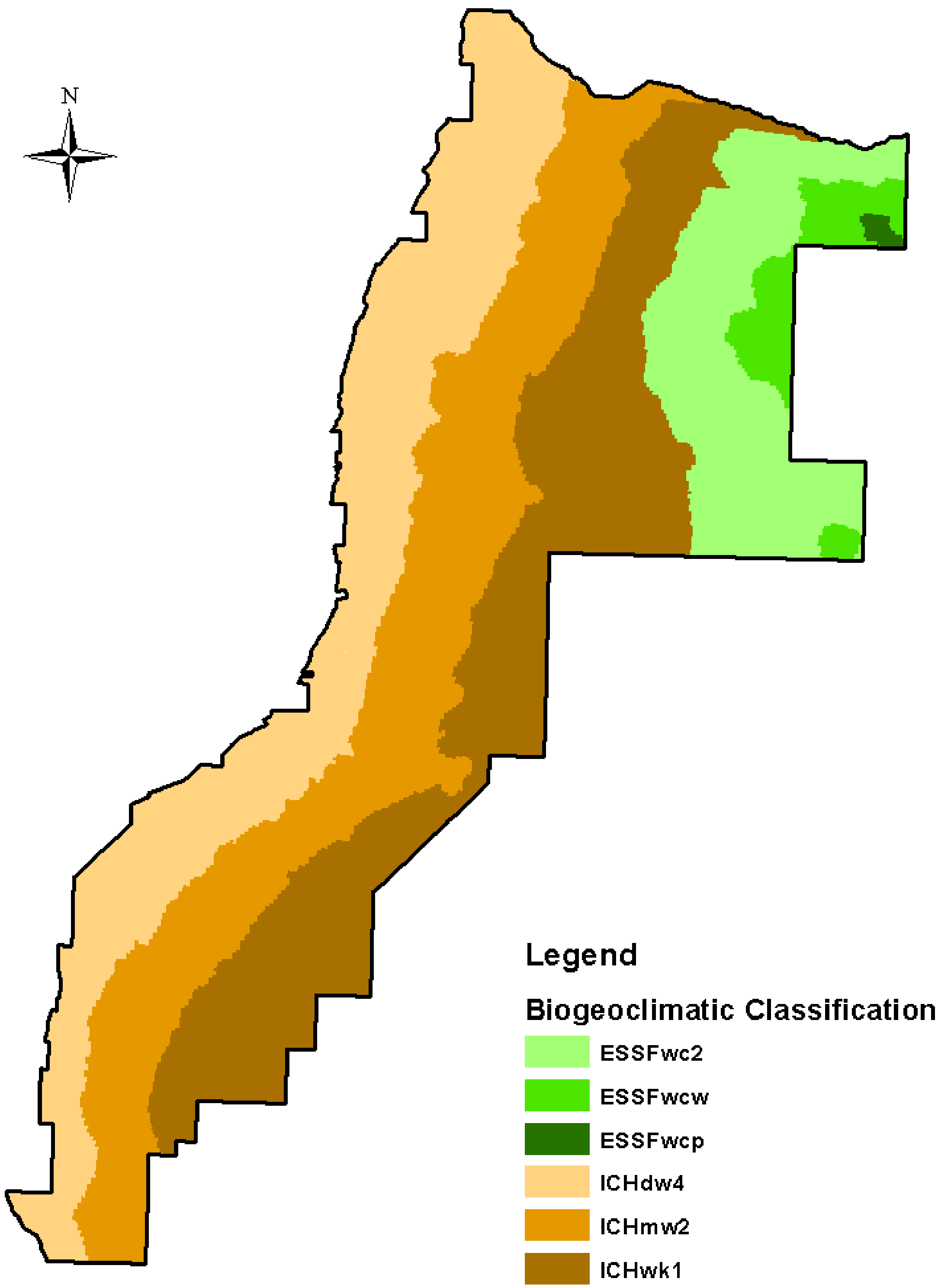

Figure 6 Spatial distribution of BEC variants

3 Timber Supply Analysis Assumptions

3.1 LAND BASE DEFINITION

The Crown Forested Land Base (CFLB) is the subset of the TFL that is forested and able to contribute toward non-timber values such as biodiversity. It excludes non-crown land, non-forest and non-productive areas.

The Timber Harvesting Land Base (THLB) is the subset of the TFL where harvesting is anticipated to occur now or in the future. The THLB excludes areas that are uneconomic for timber harvesting, or are otherwise reserved for non-timber values such as wildlife habitat. The THLB is contained entirely in the CFLB. Table 2 summarizes the CFLB and THLB used to develop the Base Case scenario for TFL 33.

Table 2 TFL 33 land base area summary

Land Base Element	Gross Area (ha)	CFLB Area (ha)	Net Area (ha)	Percent of Total Area (%)	Percent of CFLB (%)
Total area	**8,396**		**8,396**	**100.0%**	
Less:					
Non-Forest	180		180	2.1%	
Existing Roads, trails and landings	176		172	2.0%	
Crown Forested Land Base (CFLB)			**8,044**	**95.8%**	**100.0%**
Less:					
Caribou Habitat	180	158	157	1.9%	2.0%
Queest Mountain Snowmobile Trail	14	10	10	0.0%	0.1%
Unstable Terrain	911	882	565	6.7%	7.0%
Riparian Management Areas	83	79	53	0.6%	0.7%
Enhanced Riparian Reserves	66	66	49	0.6%	0.6%
Non-Merchantable Deciduous Leading	60	59	46	0.5%	0.6%
Non-Merchantable Conifer Leading	301	271	151	1.8%	1.9%
Old Growth Management Areas	304	303	196	2.3%	2.4%
Existing Wildlife Tree Patches	133	131	106	1.3%	1.3%
Timber Harvesting Land Base (THLB) - Current			**6,712**	**79.9%**	**83.4%**
Less:					
Future Wildlife Tree Retention			359	4.3%	4.5%
Less:					
Future Roads and Landings (aspatial)			66	0.8%	0.8%
Future Timber Harvesting Land Base			**6,287**	**74.9%**	**78.2%**

3.2 FOREST COVER INVENTORY

TFL 33 has not had an entirely new inventory completed since 1977. However, there have been periodic updates for disturbance and silviculture since then, along with updated projections of age, height and volume. Recognizing the older vintage of the inventory, Canoe Forest Products elected to use LiDAR to improve the inventory for use in this Management Plan.

Data sources used to improve the inventory included LiDAR acquired in 2015, recent photography, spatial depletion layers, and silviculture records. The general approach used was:

- Update polygon boundaries where they were obviously incorrect using the LiDAR canopy height model and recent photography
- Update for depletions
- Update ages and species for new openings using silviculture records
- Update stand height using LiDAR
- Update crown cover using LiDAR
- Update stems per hectare using LiDAR and silviculture records
- Update site index for stands greater than 20 years old using LiDAR heights and inventory ages

Analysis completed using operational cruise volumes as a reference suggests that the updated inventory provides a much better estimate of volume than the original inventory. Overall, the volumes predicted by VDYP for the updated inventory were 98.1% of those estimated in the cruises. However, there were differences observed for the two biogeoclimatic zones in the TFL. The VDYP volumes were 5.9% higher than the cruise volumes in the ICH, and only 80.2% of the cruise volumes in the ESSF. Further details about the process used to update the inventory may be found in the Appendices of the Information Package.

3.3 MANAGEMENT PRACTICES

Management practice assumptions can be grouped into three broad categories, including Integrated Resource Management, Silviculture, and Harvesting. The following sections provide a high level overview of the management practice assumptions used in the analysis. Additional detail is provided in the Information Package (see Appendix 1).

3.3.1 INTEGRATED RESOURCE MANAGEMENT

Forest cover requirements and/or disturbance limits are applied within the timber supply model to accommodate the timber and non-timber resource objectives. These requirements are used by the model to limit harvesting within the THLB. The forest estate model used for this analysis (PATCHWORKS ™) does not require that unique, mutually exclusive zones be established to model non-timber resource requirements. Rather, stands are assigned to non-timber values based on their geographic location to allow targets to be formulated for those values in the modeling framework. In general, a single stand will often belong and contribute to the status of more than one non-timber resource.

Table 3 summarizes the modelling assumptions that are applied for this analysis.

Table 3 Summary of non-timber values and modelling assumptions

Non-Timber Value	CFLB Area (ha)	THLB Area (ha)	Forest Resource Requirements
Visual Quality	5,851	4,635	Modelled as a limit on the CFLB area within individual visual landscape inventory polygons that can be below Visually Effective Green-up (VEG) height. • Retention: Maximum 8.3% < 6 metres tall • Partial Retention: Maximum 20.0% < 5 metres tall • Modification: Maximum 26.7% < 5 metres tall
Mule Deer Winter Range	682	343	Modelled as minimum hectares of retention of snow interception cover within individual mule deer planning cells. Snow interception cover defined as Douglas-fir leading stands at least 100 years old.
Landscape Level Biodiversity	8,043	6,354	Modelled as requirement to achieve 2/3 of old seral requirements by end of second rotation (year 2165) and 100% of old seral requirements by end of third rotation (year 2245). Targets established by biogeoclimatic subzone (BEC version 5) as required in the 2004 "*Order Establishing Provincial Non-Spatial Old Growth Objectives*"
Marble Point Properties	250	203	Modelled by restricting harvest to 3 hectares per year, in order to address operational concerns from adjacent property owners.
Adjacency	1,719	1,719	Modelled as a limit (maximum 30%) of the area of otherwise unconstrained THLB that can be less than 2 metres in height:

3.3.2 SILVICULTURE

All harvesting was modelled as clear-cut with reserves. Historical and current silviculture practices were used to develop the silviculture assumptions for managed stands (stands less than 53 years old). Five historic silviculture eras were identified based on regeneration practices and the use of Class A seed. Site index for managed stands was estimated using the results from a site index adjustment project completed by J.S. Thrower & Associates Ltd. in 2003.

Yield tables were developed for each existing managed stand using the current species information from the inventory along with the planting density, regeneration delay, and genetic worth for the appropriate silviculture era. Species composition for future managed stands reflects current silviculture practices by BEC subzone, as follows:

- ICHmw2/ICHdw4: Fd55 Lw15 Cw15 Pw10 Pl5
- ICHwk1: Fd55 Cw30 Pw10 Sx5
- ESSF: Se80 Bl20

3.3.3 HARVESTING

Assumptions about timber harvesting practices have been built into the model, including the following:

- Minimum harvest ages by analysis unit to sure a viable log is produced and long term volume production is maximized. Criteria include minimum conifer volume of 200 m^3 per hectare and achievement of 95% of the maximum mean annual increment
- Land base definition criteria (unstable slopes, low sites, etc.)
- Harvest block size requirements
  - Harvest units less than one hectare were not allowed. Areas smaller than this were either held until they could be aggregated with adjacent units, or were not harvested during the planning horizon.
  - Harvest units between one and five hectares were limited to five percent of the total harvest area within a five year period.
  - Harvest units greater than 40 hectares were not allowed.

3.4 FOREST DYNAMICS

Forest dynamics represent the changing state of the forest through time. Changes occur as the forest ages, or when natural or human caused disturbances occur. The ways in which the analysis addressed these factors are described below.

3.4.1 GROWTH AND YIELD PROJECTIONS

Timber growth and yield refers to the prediction of the growth and development of forest stands over time, and of particular interest, the volume and size of trees that will occur at the time of harvest. The estimate of net timber volume in a stand assumes a specific utilization level, or set of dimensions, that establishes the minimum tree and log sizes that are removed from a site. Utilization levels used in estimating timber volumes specify minimum diameter near the base and the top of a tree.

Two growth and yield models were used to estimate the yield tables for each individual stand in the forest inventory. The Variable Density Yield Prediction Model (VDYP7) was used to create a yield tables for natural stand in the inventory (i.e. stands at least 53 years old).

The Table Interpolation for Stand Yields (TIPSY) model, version 4.4 was used to create yield tables for stands that are 52 years of age and younger, and for stands that will be regenerated in the future. The required inputs for TIPSY were developed using using current species information from the inventory for existing stands (or current silviculture practices for future stands) along with the planting density, regeneration delay, and genetic worth for the appropriate silviculture era. Site index was estimated using the results from a site index adjustment project completed by J.S. Thrower & Associates Ltd. in 2003. The provincial default values of 15% for OAF 1 and 5% for OAF 2 were be used for this analysis, except for Douglas-fir and cedar leading stands which used an OAF 2 of 10% to account for losses due to root disease.

Based on these yield tables, the current timber inventory or growing stock on the THLB is approximately 1.28 million m^3, of which approximately 1.04 million m^3 is greater than or equal to the minimum harvest ages.

3.4.2 NATURAL DISTURBANCE

Timber losses due to natural causes such as fire, blowdown, or epidemic insect attacks in the THLB that are not salvaged were incorporated into the timber supply analysis as a volume reduction of 571 m^3/year applied to the projected timber supply forecast. All harvest flows provided in this analysis report have been adjusted to account for these un-salvaged losses.

3.5 TIMBER SUPPLY MODEL

The PATCHWORKS ™ modeling software was used for forecasting and analysis. This suite of tools is sold and maintained by Spatial Planning Systems Inc. of Deep River, Ontario (www.spatial.ca).

PATCHWORKS is a fully spatial forest estate model that can incorporate real world operational considerations into a strategic planning framework. It utilizes a practical goal seeking approach to simulate forest growth and schedule activities such as harvesting and silviculture across the land base to find a solution that best balances the targets/goals defined by the user. Realistic spatial harvest allocations can be optimized over long-term planning horizons because PATCHWORKS integrates operational-scale decision making within a strategic analysis environment.

The PATCHWORKS model continually generates alternative solutions until the user decides a stable solution has been found. Solutions with attributes that fall outside of specified ranges (targets) are penalized and the goal seeking algorithm works to minimize these penalties, resulting in a solution that reflects the user objectives and priorities.

Targets can be applied to any aspect of the problem formulation. For example, the solution can be influenced by issues such as desired mature/old forest retention levels, young seral disturbance levels, patch size distributions, conifer harvest volume, growing stock levels, and visual quality objectives. For this analysis, PATCHWORKS was configured to consider the range of non-timber values that exist on TFL 33 while evaluating possible harvest flows.

3.6 MAJOR CHANGES FROM THE PREVIOUS TIMBER SUPPLY ANALYSIS

There have been a number of changes incorporated into this analysis when compared with the analysis completed in 1999. The most significant of these include the following:

- Inventory attributes updated using LiDAR. Although this update did not follow published FLNRORD standards, it appears that current volumes may be better represented than if the original inventory had simply been projected.
- Development of improved site index estimates for managed stands
- Updated version of VDYP used for natural stand yield tables
- Updated version of TIPSY used for managed stand yield tables
- Approval of two Government Actions Regulation (GAR) Orders to guide caribou management
- Approval of a GAR Order to guide mule deer management
- Completion of terrain stability mapping, to be used instead of ESA mapping
- Use of Old Growth Management Areas to meet landscape level biodiversity objectives

- Use of a heuristic timber supply model rather than a simulation model

Overall, these changes result in a 4.8% increase in the CFLB area and a reduction of 3.8% in THLB area when compared to the 1999 analysis.

4 Base Case Analysis

The Base Case scenario presented in this report is based on the best information currently available and reflects current management practices in the TFL. The current AAC for TFL 33 is 21,000 m^3/year effective March 31st, 2011. Unsalvaged losses in the THLB are estimated to be 571 m^3/year, and have been subtracted from the graphs, tables and harvest forecasts in this report unless otherwise noted.

4.1 LONG RANGE SUSTAINED YIELD

The Long Range Sustained Yield (LRSY) is calculated as the sum of the future THLB area of each regenerated analysis unit, multiplied by the maximum mean annual increment (MAI) of the analysis unit. LRSY represents the theoretical maximum even-flow sustained yield that can be achieved on the land base, and is used as a benchmark to evaluate the model runs.

In order to achieve LRSY, each stand must be harvested at the age where the MAI is greatest. In practice, this does not occur for every stand because some stands may not be available for harvest at the specified age due to non-timber resource requirements. Also, minimum harvest ages for this analysis have been reduced from the optimum age to allow harvest once the stand has achieved 95% of the maximum MAI. In some cases, the model may harvest stands at this reduced age depending on the availability of other stands.

The LRSY calculated for the Base Case scenario is 41,296 m^3/year. After accounting for unsalvaged losses (i.e. reducing by 571 m^3/year), the LRSY for comparison with harvest flows is 40,725 m^3/year.

4.2 ALTERNATIVE HARVST FLOW SCNARIOS

Numerous alternative harvest forecasts are possible for a given set of modelling assumptions. These alternative flows represent trade-offs between short, mid, and long term harvest level objectives. Three potential alternative harvest flows were developed for this analysis, and are presented in Figure 7.

The ***Highest Initial Harvest Scenario*** is based on achieving the highest possible initial harvest rate without compromising the mid or long-term harvest levels. This scenario maintains an even-flow harvest level of 28,190 m^3/year (34.2% higher than the current AAC) for 70 years, and then transitions to a long-term harvest level of 38,390 m^3/year.

The ***Current AAC Plus 10% Scenario*** initially harvests the current AAC plus an additional 10 percent. The transition to the long-term harvest level is made in one step as early as possible without compromising the long-term level. This scenario maintains an even-flow harvest level of 23,100 m^3/year for 55 years, and then transitions to a long-term harvest level of 38,490 m^3/year.

The ***Base Case Scenario*** is similar to the ***Current AAC Plus 10% Scenario***, except it transitions to a higher mid-term level after 30 years, which is the approximate time that existing managed stands become old enough to harvest. The transition to the long-term harvest level occurs at the same time as the ***Highest Initial Harvest Scenario.*** Under this scenario, harvest rate is 23, 160 m^3/year for the first 30 years, followed by an increase to 29,680 m^3/year which is maintained for the next 40 years. The long-term harvest level is 38,490 m^3/year.

Although a higher initial harvest flow is possible, the ***Base Case Scenario*** is preferred by Canoe Forest Products because it provides a small increase relative to the current AAC, provides an earlier transition to a higher mid-term harvest level, and provides additional operational flexibility.

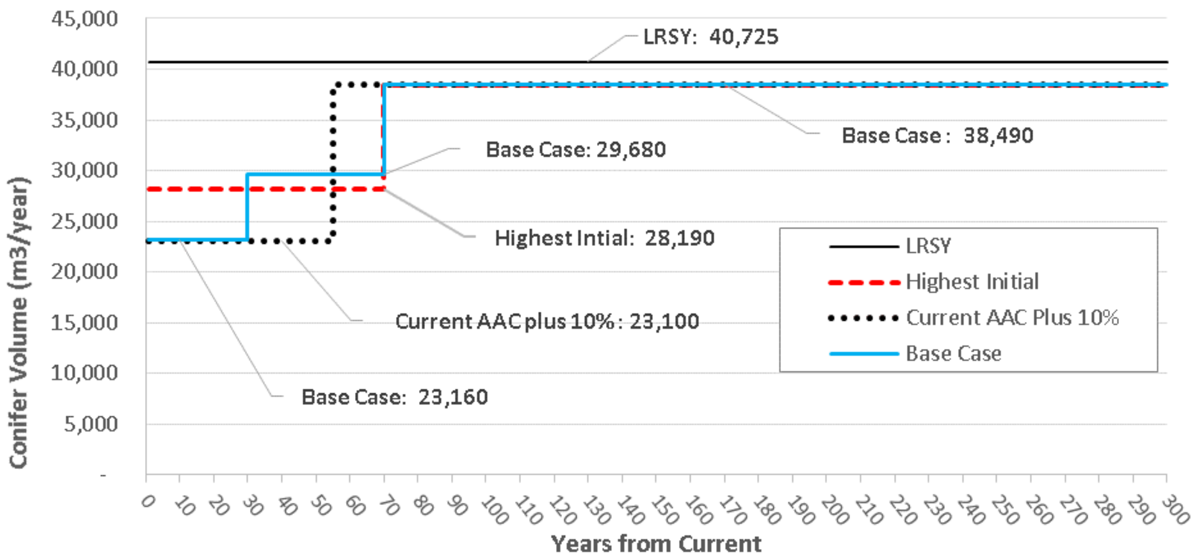

Figure 7 Alternative harvest forecasts for TFL 33

4.3 BASE CASE ATTRIBUTES

Various forest management assumptions have been modelled in the Base Case analysis, many of which influence the condition of the forest over time. This section describes the attributes of stands being harvested and the overall state of the forest throughout the planning horizon in order to understand and evaluate the Base Case harvest forecast. Using the information presented in this section, it is possible to validate these assumptions and review their impact on the overall composition of the forest.

4.3.1 GROWING STOCK

Total growing stock represents the net volume of all trees on the timber harvesting land base that are larger than the minimum size specified by the utilization standards (i.e. 12.5 cm DBH for lodgepole pine, 17.5 cm DBH for other species). A flat total growing stock in the long-term indicates that the rate of harvest is more or less equal to the rate of forest growth. Merchantable growing stock represents that portion of the total growing stock that is greater than or equal to the minimum harvest age.

The total and merchantable growing stock on the THLB throughout the 300 year planning horizon are shown in Figure 8. Approximately 1.04 million m^3 of the initial 1.28 million m^3 total growing stock is currently above minimum harvest age. Total growing stock declines slightly over the first 10 years and then increases, achieving a stable long-term level of about 1.41 million m^3 in approximately 100 years. In comparison, merchantable growing stock decreases more rapidly over the first 20 years, with a long-term level of about 0.69 million m^3.

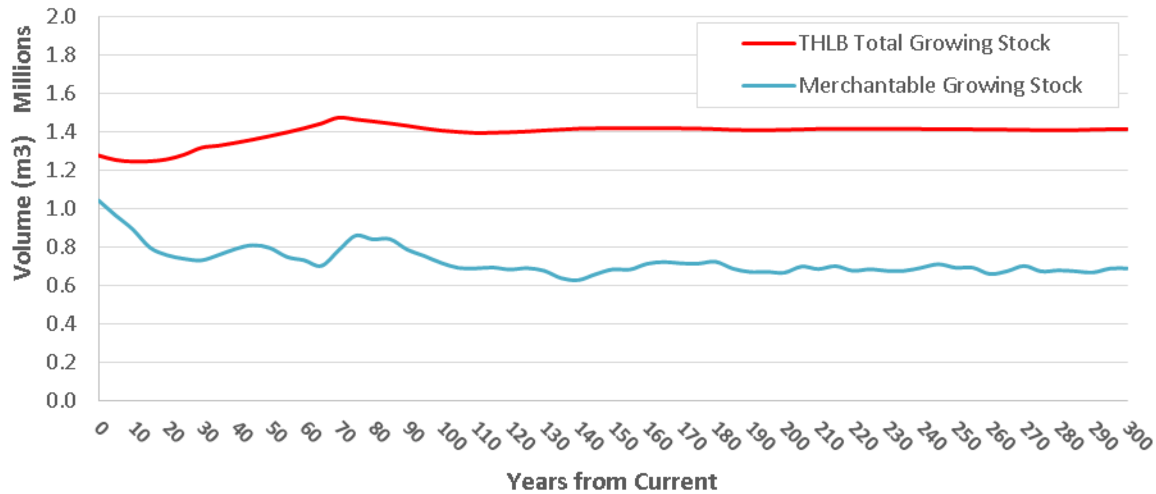

Figure 8 Total and merchantable growing stock on the THLB for the Base Case

4.3.2 AGE CLASS

The age class on the THLB at years 0, 100, 200 and 300 is illustrated in Figure 9. The forest is almost in a regulated state within 100 years as harvesting transitions to managed stands that are harvested close to their culmination age on an ongoing basis. It is also noted that over time, there is very little THLB area that is over 250 years old, which indicates that the old seral requirements are being met on the non-THLB area.

Figure 9 Age class on the THLB for the Base Case

4.3.3 HARVEST ATTRIBUTES

Figure 10 shows the contribution of both natural and managed stands to the Base Case harvest forecast. It can be seen that the first significant harvest of existing managed stands occurs in about 30 years, and that very little volume is harvested from existing natural stands beyond about 90 years from now. This transition to harvesting managed stands is important for short and mid-term timber supply because the current stock of existing natural stands must be metered out until these managed stands achieve minimum harvest age.

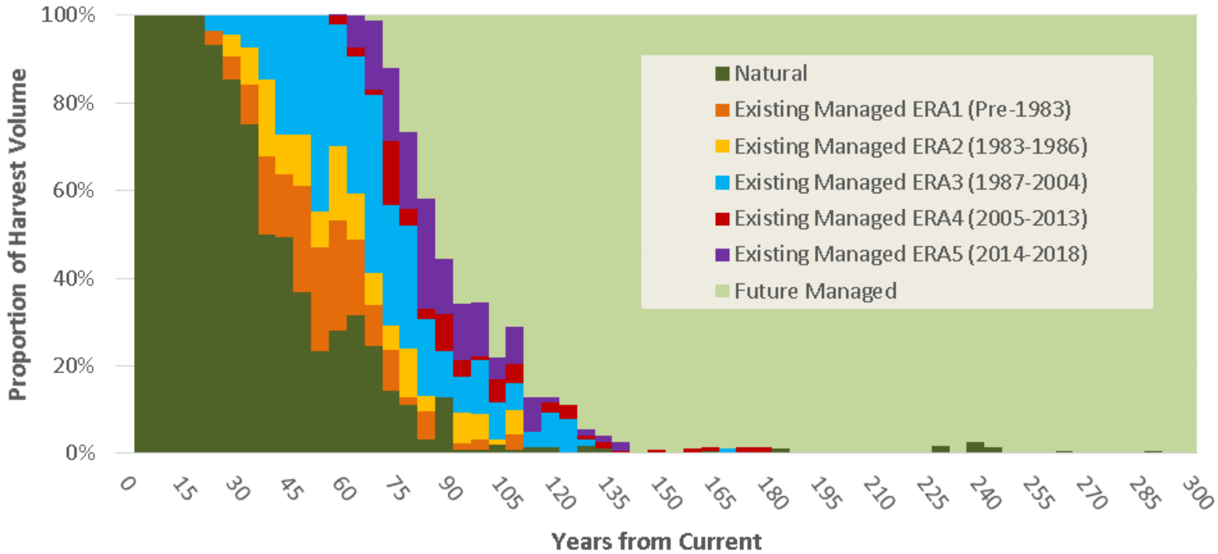

Figure 10 Contribution of natural and managed stands to the harvest flow for the Base Case

Harvest age also provides an indicator of the type and age of stands harvested over time. Figure 11 illustrates the average harvest age for the Base Case, while Figure 12 shows the age class distribution of harvested stands. Harvest initially occurs in older natural stands, with almost 84% of the harvest in the first 20 years occurring in stands at least 121 years old. Average harvest age decreases over time as harvesting transitions into managed stands, with the long-term average harvest age being approximately 91 years. The majority of managed stands harvested are at least 71 years old, although some younger stands are harvested, particularly between 25 and 40 years from now.

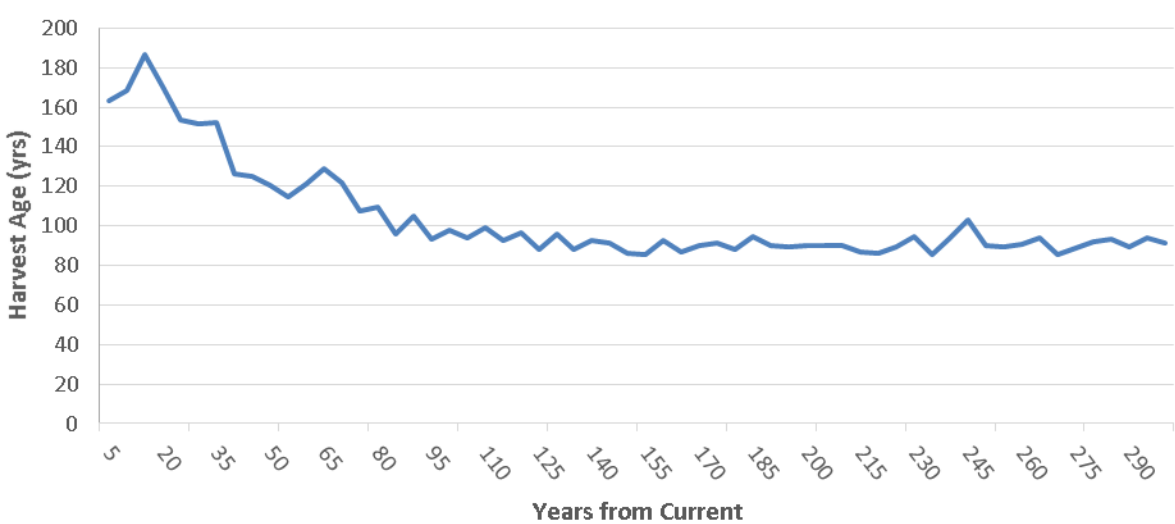

Figure 11 Average harvest age for the Base Case

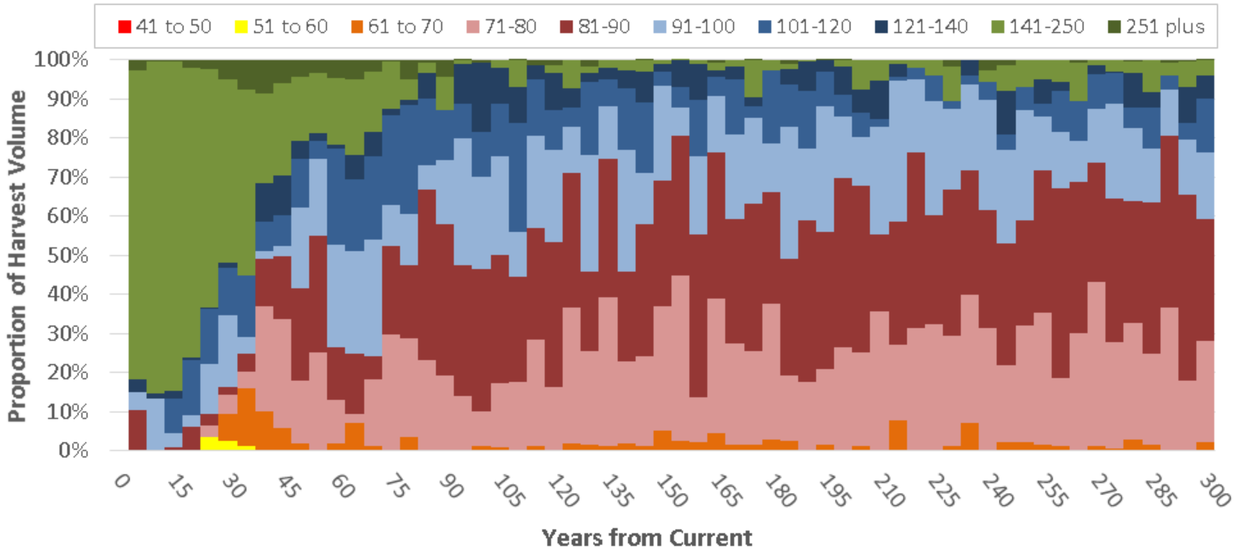

Figure 12 Age class distribution of harvested stands for the Base Case

Average harvest volume per hectare is illustrated in Figure 13. Harvest volumes per hectare increase over time as harvesting transitions to managed stands that are established with improved density control and genetic gains from using select seed. In the long-term, the average harvest volume is approximately 565 m^3/hectare.

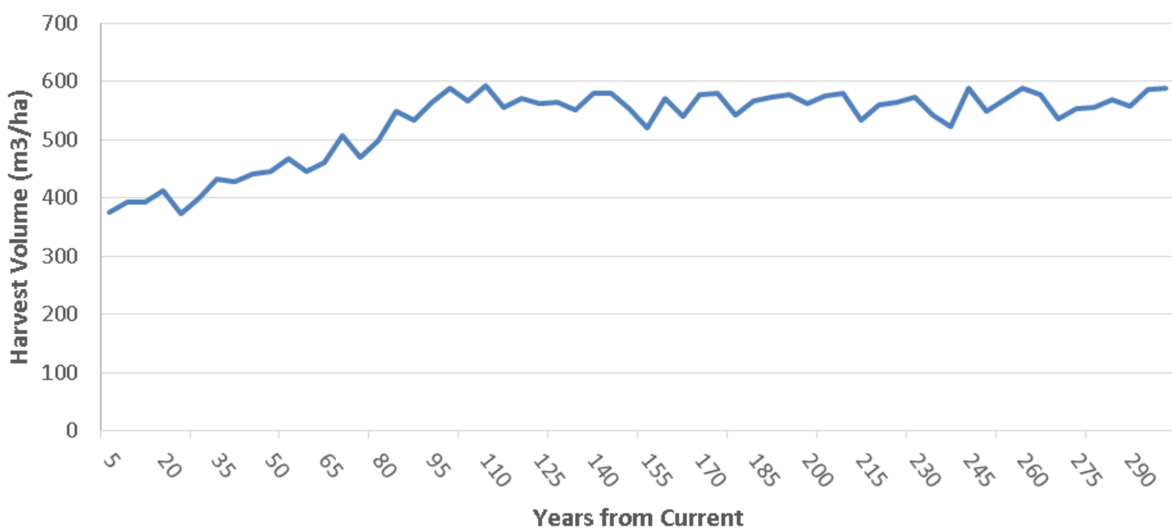

Figure 13 Average harvest volume per hectare for the Base Case

Harvest area has an inverse relationship with harvest volume per hectare. As harvest volumes per hectare increase, less area is needed to support the harvest level. Figure 14 shows the annual harvest area for the Base Case. Approximately 60 hectares is harvested each year for the first thirty years, then increases to a long-term average of about 70 hectares per year, reflecting the higher overall harvest level relative to the short-term.

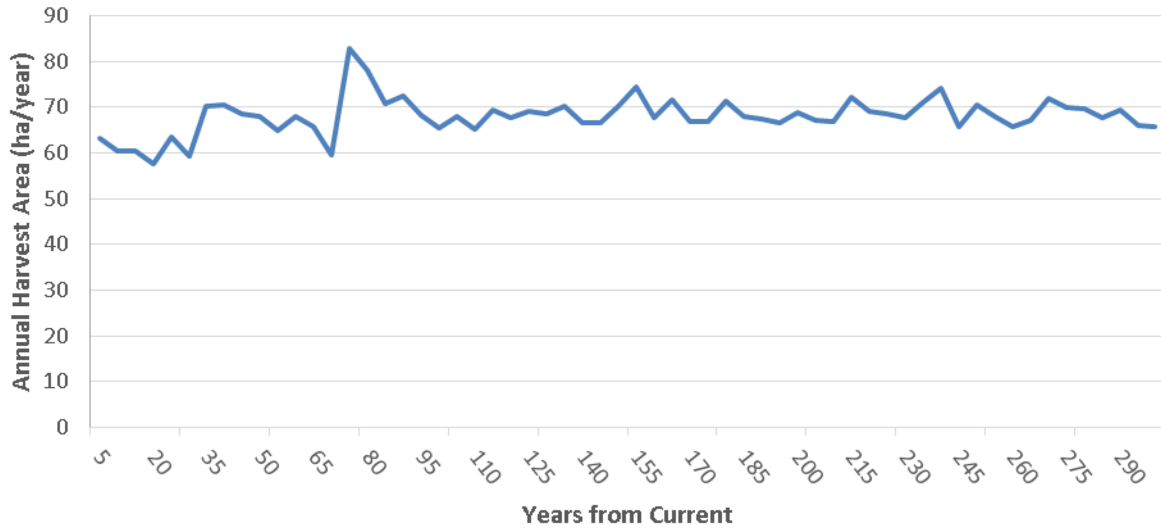

Figure 14 Annual harvest area for the Base Case

Various species contribute to the Base Case harvest, as illustrated in Figure 15. Hemlock decreases over time as harvesting transitions to managed stand with less hemlock in them, while Douglas-fir, spruce, and white pine all increase. The proportion of lodgepole pine is higher in the mid-term than for the rest of the planning horizon, which reflects past silviculture practices on the TFL.

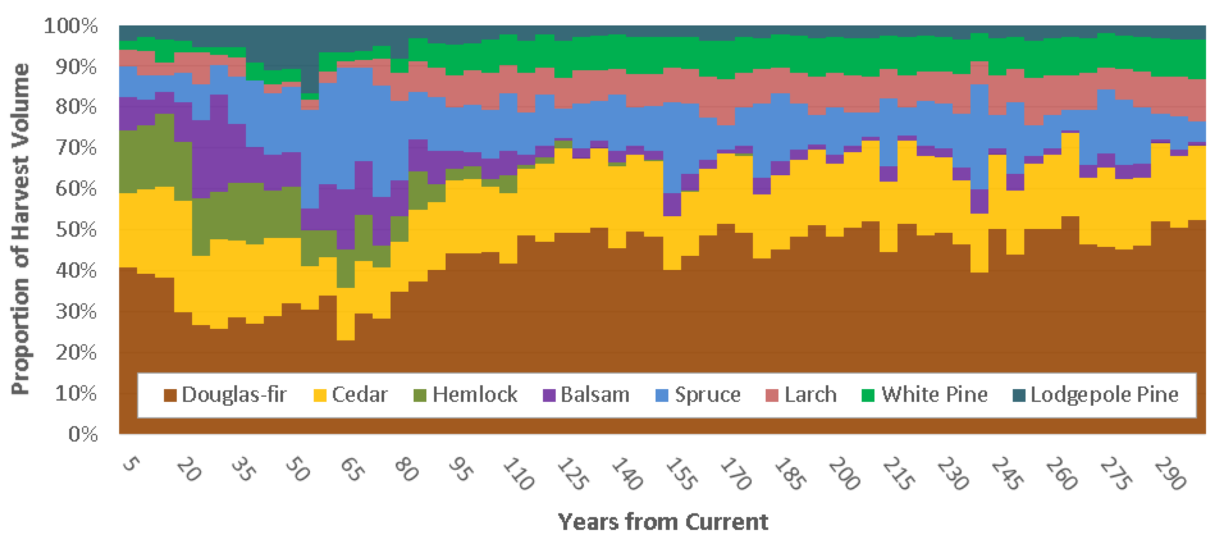

Figure 15 Harvested species for the Base Case

Figure 16 summarizes the harvest block size for the Base Case. It can be seen that the objective to prevent harvest of blocks less than 1 hectare and greater than 40 hectares in size was achieved, and that the model was successful in limiting the proportion of blocks less than 5 hectares to roughly 5% of the total harvest area. Overall, about 70% of the harvest area is in blocks less than 15 hectares in size.

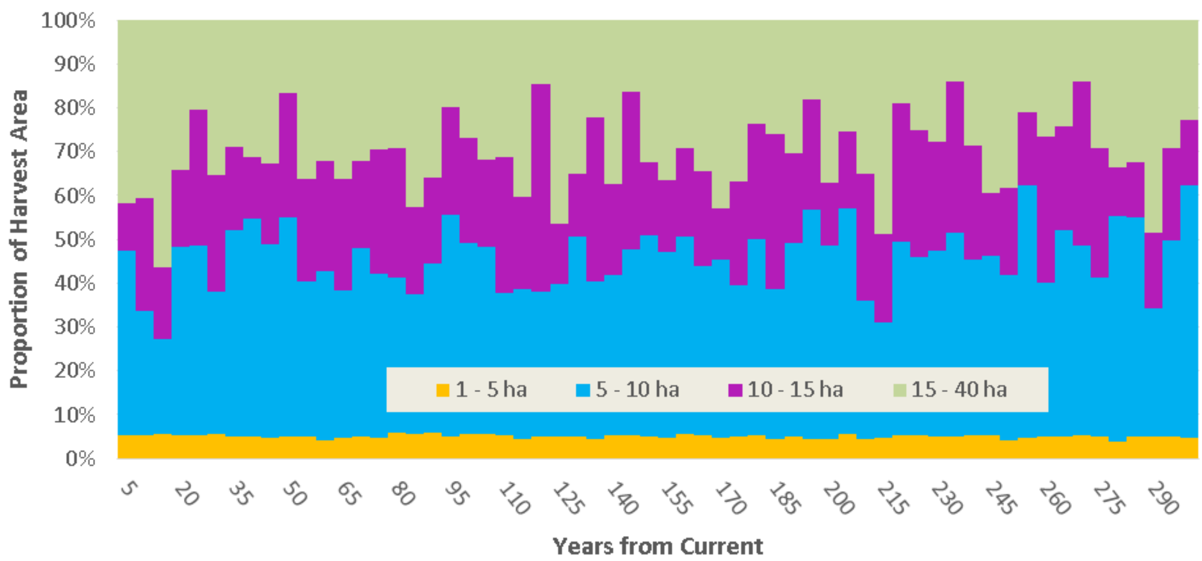

Figure 16 Harvest block size for the Base Case

Figure 17 summarizes the proportion of harvest by slope class. These proportions are in line with past harvest performance on the TFL as reported in the Information Package.

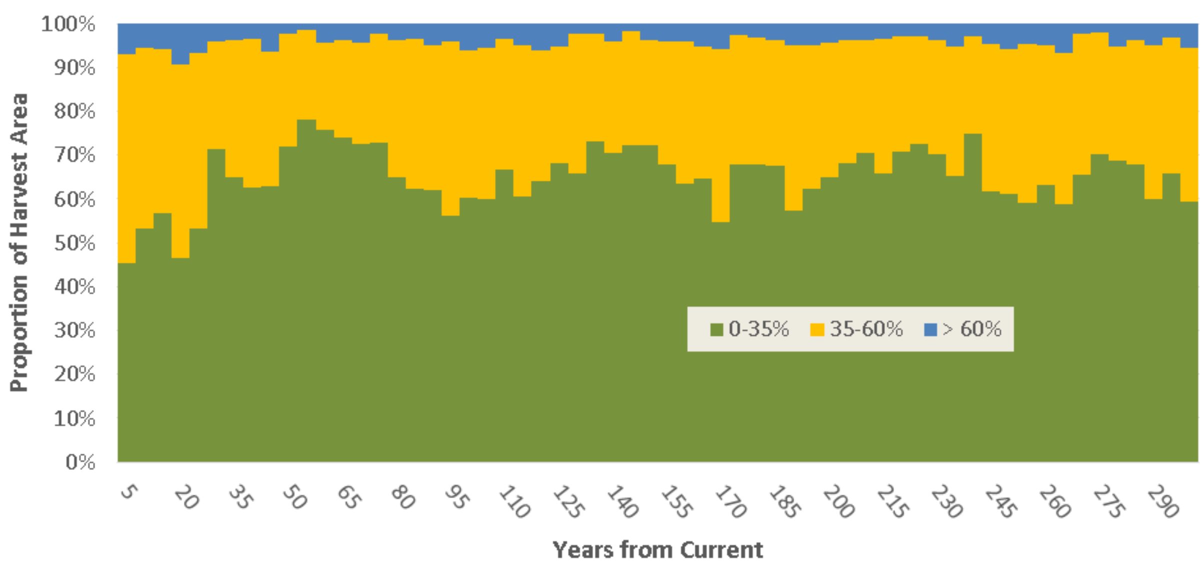

Figure 17 Harvested slope class for the Base Case

4.4 NON-TIMBER OBJECTIVES ANALYSIS

In the Base Case, five objectives related to non-timber values are modelled to ensure that these values are represented on the land base. The objectives include old seral targets, visual quality objectives, mule deer winter range, cutblock adjacency, and consideration of adjacent property owners in the Marble Point area.

4.4.1 OLD SERAL

Non-legal, spatial Old Growth Management Areas (OGMAs) have been established in TFL 33 in order to manage for the old growth requirements outlined in the *Order Establishing Provincial Non-Spatial Old Growth Objectives, June 2004.* Consistent with provincial policy for landscape units with a low biodiversity emphasis, these OGMAs were designed to initially meet 1/3 of the full old seral targets with the expectation that a recruitment strategy will be developed to meet the full target by the end of the third rotation, or 240 years.

To address the recruitment of additional old seral stands, the model was configured to achieve 2/3 of the full old seral targets by the year 2165 and to achieve the full targets by the year 2245 (Section 3.3.1 and Appendix 1). Note that BEC version 5 was used as this was the BEC version that was current when the Order was developed, and that the years in which the incremental targets must be reached have been reduced by fifteen years to account for the elapsed time since the Order was established.

Figure 18 shows the amount of old seral relative to the required targets for the four biogeoclimatic subzones in the TFL. It can be seen that the amount of old seral in three of the BEC subzones is initially below the full target requirement, but that sufficient recruitment occurs to meet 2/3 of the target by the end of the second rotation and the full target by the end of the third rotation. As a result, old seral requirements are not limiting timber supply.

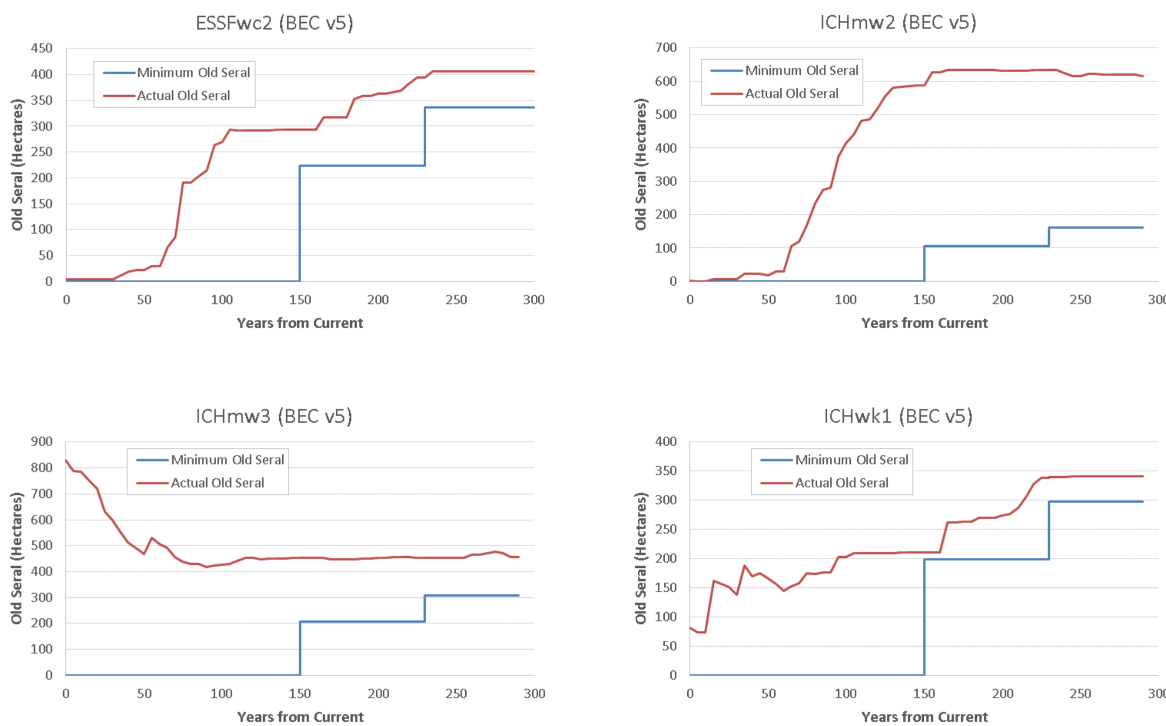

Figure 18 Old seral status for the Base Case

4.4.2 VISUAL QUALITY OBJECTIVES

There are three visual landscape inventory polygons with visual quality objectives (VQOs) within TFL 33. VQO requirements were modelled a a maximum disturbance objective limiting the proportion of the forested landbase (i.e. CFLB) less than a visually effective green-up (VEG) height within each VQO polygon (Section 3.3.1 and Appendix 1).

Figure 19 shows the proportion of the CFLB area less than the VEG height relative to the maximum allowed proportion for each VQO polygon. It can be seen that both the Modification and Partial Retention VQO polygons have disturbance levels well below the target throughout the planning horizon. However, this is not the case for the Retention VQO. As only 7.1% of the timber harvesting land base is in the Retention VQO, this objective likely accounts for a small downward pressure on timber supply.

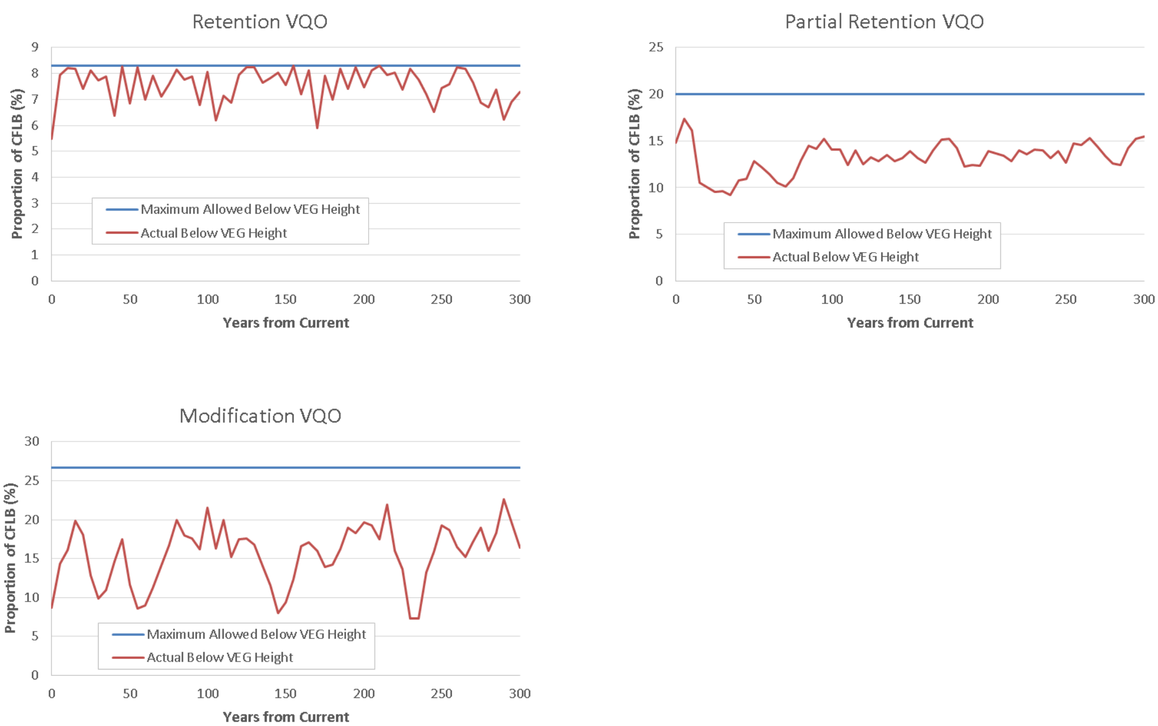

Figure 19 VQO status for the Base Case

4.4.3 MULE DEER WINTER RANGE

The requirements for mule deer winter range in TFL 33 are outlined in Government Actions Regulation (GAR) Order #u-8-001, which requires the retention of a specified amount of snow interception cover (SIC) in each mule deer winter range planning cell (see Section 3.3.1 and Appendix 1). These requirements were modelled as a cover objective by planning cell, with SIC defined as Douglas-fir leading stands at least 100 years old.

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Figure 20 shows the status of snow interception cover relative to the required amount for each of the three planning cells. Note that planning cell 1165 was combined with 1164 due to only a small portion of it being within the TFL. It can be seen that two of the planning cells initially do not meet the SIC requirements, and are then generally only a few hectares above the minimum threshold for the remainder of the planning horizon. The third planning cell initially has a surplus of SIC, which is reduced to the minimum amount within 60 years as harvesting progresses. Although it is apparent that the MDWR requirements are constraining, there is only 5.4% of the timber harvesting land base where these objectives apply. Therefore, MDWR likely accounts for a small downward pressure on timber supply.

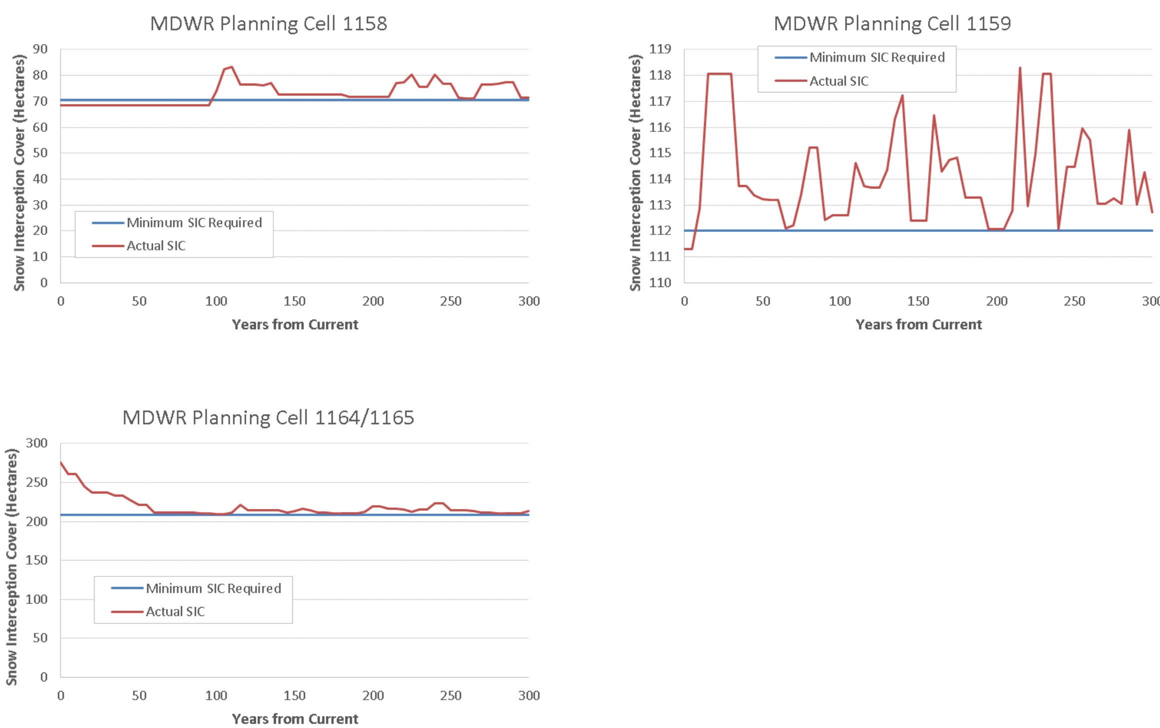

Figure 20 Mule deer winter range status for the Base Case

4.4.4 CUTBLOCK ADJACENCY

The green-up height specified in the Canoe Forest Products Forest Stewardship Plan is 2 metres, and is the height that a harvested opening must achieve before adjacent areas may be harvested. This requirement was modelled using a surrogate objective that ensure that no more than 30% of the THLB area not overlapping another non-timber objective (i.e. VQO and MDWR) can be less than 2 metres tall.

Figure 21 shows the proportion of the THLB outside VQO and MDWR that is less than 2 metres tall relative to the maximum target of 30%. It can be seen that this objective is not limiting timber supply in the analysis.

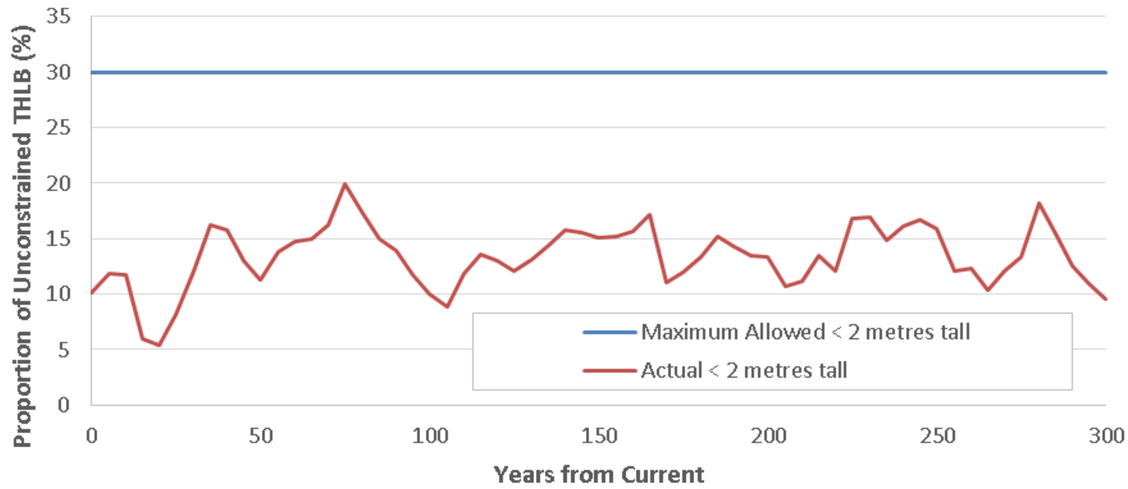

Figure 21 Surrogate cutblock adjacency status for the Base Case

4.4.5 MARBLE POINT PROPERTIES

The Base Case was constrained to limit harvesting to 3 hectares per year within a 252 hectare polygon above Marble Point in response to operational concerns expressed by adjacent property owners. As shown in Figure Figure 22, the annual harvest area within this polygon is generally less, with only a few five year periods approaching the maximum level.

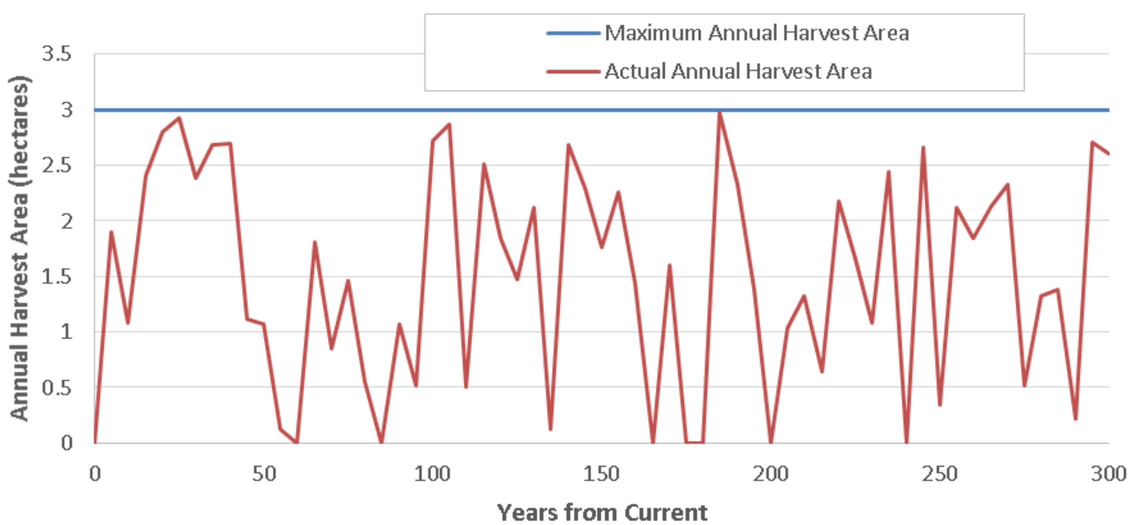

Figure 22 Annual harvest area in the Marble Point polygon

4.5 DIFFERENCES IN THE BASE CASE FROM THE PREVIOUS (1999) ANALYSIS

The last timber supply analysis for TFL 33 was completed in 1999. In addition to a Base Case scenario, an LRMP scenario was presented that was intended to approximate the requirements of the Okanagan Shuswap Land and Resource Management Plan that was being prepared at that time. Although the 1999 Base Case scenario had substantially lower harvest flows than the LRMP scenario, the LRMP scenario provides a more direct comparison with the current forest management requirements in the TFL than the 1999 Base Case, and is also much closer to the AAC determination that was made in December, 2000. Therefore, the 1999 LRMP scenario will be used to evaluate differences from the previous analysis.

Figure 23 shows a comparison of the projected harvest flows for the Base Case scenario with those from the LRMP scenario completed in 1999. Note that 20 years have passed since the 1999 analysis was completed and this has been reflected in the figure by subtracting 20 years from the front end of the forecast. It is also worth noting that the initial harvest flow is almost 3,000 m^3/year less than the 21,000 m^3/year that was made in the 2000 determination after the Chief Forester accounted for upward and downward pressures on timber supply.

The current analysis provides substantially higher short-term, mid-term, and long-term harvest flows when compared with the 1999 analysis. Although there are a number of differences in the assumptions between the analyses, the two most significant drivers that likely account for the majority of the harvest level increase are the use of LiDAR to update the current inventory and the use of adjusted site indices for managed stands.

As documented in the Information Package, a comparison of VDYP volumes with cruise data was completed for approximately 440 hectares. Although the results cannot be reliably extrapolated across the entire land base, the analysis indicated that average volumes per hectare for the cruised areas were predicted to be about 16% higher for the LiDAR improved inventory than if the original attributes were simply projected to the current date using VDYP. This increase in natural stand volumes would be expected to increase short-term timber supply.

The 1999 analysis used the inventory site index for all managed stands. It is generally recognized in British Columbia that these site indices calculated using existing natural stand attributes are lower than the potential post-harvest site index for regenerated stands. The current analysis uses the results of a site index adjustment (SIA) project based on field measurements specific to TFL 33. This SIA project indicated that the post-harvest regenerated site indices are about 30% higher than those indicated in the inventory for existing natural stands. This higher site index results in higher predicted volumes for managed stands which explains the higher long-term harvest levels observed in the current analysis.

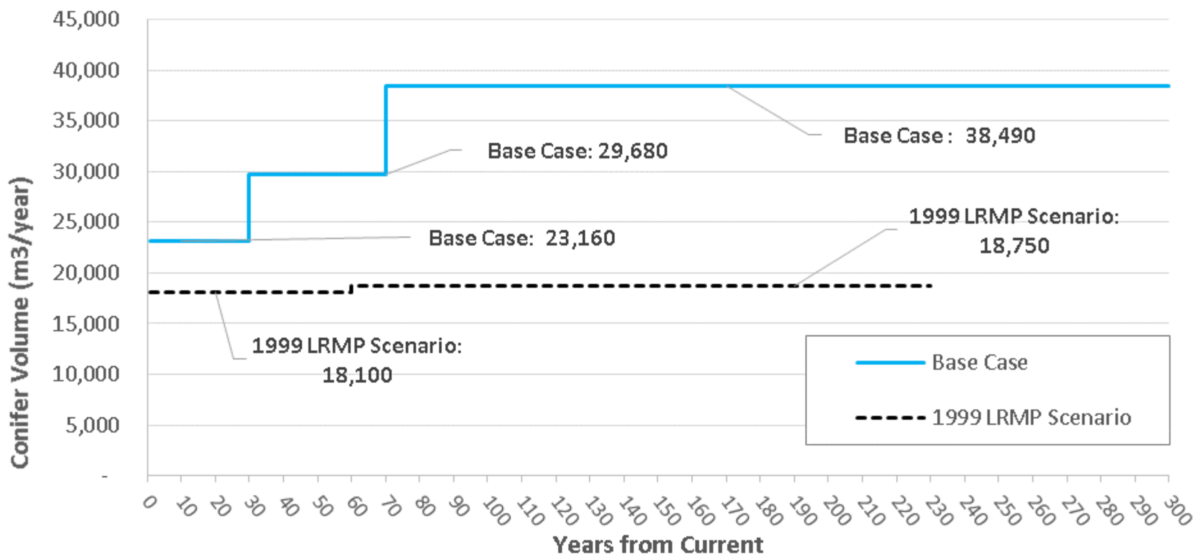

Figure 23 Base Case comparison with 1999 analysis

5 Base Case Sensitivity Analyses

The data and assumptions used in timber supply analyses are often subject to uncertainty. To provide perspective on the impacts of changes to data or assumptions, sensitivity analyses are commonly performed. Usually only one variable (data or assumption) from the information used in the Base Case is changed in order to explore the sensitivity of that variable. Sensitivity analysis is a key component of the timber supply analysis process as it provides the Chief Forester with the information necessary to gauge the potential impact of uncertainty around assumptions and data that make up the Base Case.

Table 4 lists the sensitivity analyses that were completed against the TFL 33 Base Case scenario. Further details and the results from the sensitivity analyses are provided in subsequent sections.

Determining harvest flows for sensitivity analyses are subjective. In order to provide meaningful comparison, the harvest flows were chosen to attempt to understand the implications for short-term harvest flow, particularly if there is potential for reduction from those of the Base Case. In some cases, two alternate harvest flows are presented for a single sensitivity variable to illustrate the potential variation that can occur.

Another consideration when evaluating the sensitivity analyses is that the heuristic nature of the Patchworks model can make it difficult to achieve harvest flows that are exactly equal despite identical harvest requests and target weighting in different scenarios. When interpreting the results from the sensitivity analysis, this report assumes that differences in harvest flow less than or equal to 0.3% are not indicative of a significant difference (i.e. this equates to changes of less than 69 m^3/year in the short-term, and 115 m^3/year in the long-term).

Table 4 Sensitivity analyses

Category	Sensitivity	Description of Change
Land Base Definition	THLB Area	Change the THLB area by +/- 10%
Growth and Yield	Natural Stand Yields	Change the natural stand yield by +/- 10%
	Managed Stand Yields	Change the managed stand yield by +/- 10%
	Operational Adjustment Factors	Use standard OAF2 values for all stands, including those susceptible to root disease.
	Minimum Harvest Ages	Change the minimum harvest ages for all stands by +/- 10 years
Integrated Resource Management	Not Applicable	Not Applicable
Timber Harvesting	Harvest Block Size	Turn off harvest block size objectives

5.1 SIZE OF THE TIMBER HARVESTING LAND BASE

Several factors that determine the size of the THLB have uncertainty around their definitions (terrain stability, non-merchantable types, roads, etc.). Different market conditions in the future or changes in harvesting or mill technology can also serve to reduce or expand the land base considered to be economic.

In order to understand the risks associated with THLB estimation, two model runs were completed that increase and decrease the size of the THLB by 10%. This was accomplished by adjusting the aspatial retention factors used in the model, plus increases/decreases to each polygon area input into the model if required to achieve the full 10% change. Table 5 provides further details on how this was accomplished.

Table 5 Modelling approach for the THLB +/- sensitivity analyses

Scenario	Modelling Approach
Base Case	Each polygon was assigned as THLB / non-THLB according to the Base Case netdown, and these polygon areas were used in the model. If applicable, additional aspatial reduction factors were applied in the model for each THLB polygon to account for wildlife tree retention and terrain class IV partial netdown in order to model the final THLB area.
THLB Plus 10%	Aspatial reduction factors reduced to zero for each THLB polygon. As this resulted in less than the full 10% required THLB increase, each THLB polygon area was increased by a further 1.117% in the model. Each non-THLB polygon was decreased by 7.12% to maintain the original CFLB area.
THLB Less 10%	Aspatial reduction factors for each THLB polygon were increased by 10% in the model to effectively reduce the final THLB area by 10%.

A percentage increase or decrease in the THLB typically has a proportional change on the harvest flow. Accordingly, initial harvest flows were created using this assumption. However, an alternate flow for the THLB Less 10% scenario was also created that had the objective of maintaining the Base Case short-term harvest level with a later transition to the same mid-term level as that where a proportional reduction was considered.

Figure 24 and Table 6 summarize the resulting harvest flows when the THLB area is increased/decreased by 10 percent. When the THLB is increased by 10%, the short-term harvest level increases by a similar amount (9.8%) relative to the Base Case as expected. However, mid-term and long-term harvest levels only increase by about 50% of the expected amount. A review of the various non-timber objectives indicates that the old seral requirements for ESSFwc2, ICHmw3, and ICHwk1 become constraining in the long-term because there is not as much non-THLB available that is maintained in an old-seral condition. Because these three BEC zones account for almost 78% of the forested land base, the old seral requirements become limiting to timber supply as a result.

Reducing the THLB by 10% results in reductions in short, mid, and long-term harvest levels that are similar in magnitude to the THLB reduction as expected. However, the alternate harvest flow for this sensitivity analysis confirms that it is possible to maintain a short-term harvest level similar to the Base Case by delaying the transition to the mid-term harvest level by 15 years.

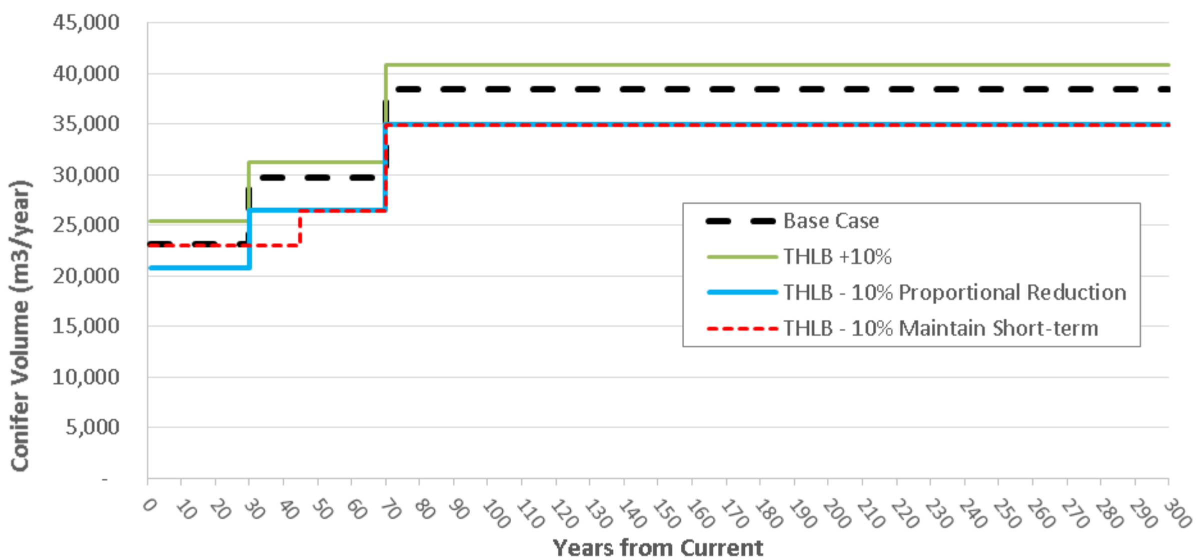

Figure 24 Harvest flows for the THLB +/- 10% sensitivity analyses

Table 6 Harvest flow differences for the THLB +/- sensitivity analyses

Scenario	Short-term	Mid-Term	Long-term
THLB Plus 10%	Increase in harvest level of 9.8% to 25,430 m^3/yr.	Increase in harvest level of 5.1% to 31,180 m^3/yr.	Increase in harvest level of 6.0% to 40,820 m^3/yr.
THLB Less 10% with proportional reduction	Decrease in harvest level of 10.4% to 20,750 m^3/yr.	Decrease in harvest level of 10.7% to 26,500 m^3/yr.	Decrease in harvest level of 9.3% to 34,900 m^3/yr.
THLB Less 10% maintain short-term	Decrease in harvest level of 0.5% to 23,050 m^3/yr.	Decrease in harvest level of 10.9% to 26,450 m^3/yr. Mid-term transition 15 years later.	Decrease in harvest level of 9.4% to 34,870 m^3/yr.

5.2 NATURAL STAND YIELDS

Stand yields are a critical input into timber supply analysis. The short and mid-term timber supply is influenced by the availability of timber in natural stands that make up the current growing stock because these stands provide all of the timber harvesting opportunities before existing managed stands reach minimum harvest age.

Natural stand yields were created using the VDYP yield model, which predicts yields from stand attributes in the forest inventory. Uncertainty in these yields can result from inaccuracies in the VDYP model, in decay estimates, or in the stand attributes themselves.

The approach used to investigate uncertainty in natural stand yields is summarized in Table 7.

Table 7 Modelling approach for natural stand yield +/- 10% sensitivity analyses

Scenario	Modelling Approach
Base Case	Yield tables for each natural stand were created using VDYP 7 and attributes (age, height, crown closure, and stems per hectare) from the forest inventory.
Natural Yields Plus 10%	The yield table associated with each natural stand in the Base Case was increased by 10%. Minimum harvest ages were adjusted to reflect the revised volumes.
Natural Yields Less 10%	The yield table associated with each natural stand in the Base Case was decreased by 10%. Minimum harvest ages were adjusted to reflect the revised volumes.

Figure 25 and Table 8 summarize the changes to timber supply that result from increasing and decreasing natural stand yields by 10%. For the increase in natural stand volumes, the harvest flow objective chosen was to maximize the short-term harvest level while maintaining the same mid-term and long-term harvest flows as the Base Case. This approach resulted in an increase in the short-term harvest by 14.4% relative to the Base Case.

Two alternate harvest flows were selected for the decrease in natural stand volumes sensitivity. The first maintained the time of transition to the mid-term, with resulting decreases in both the short-term (3.7%) and mid-term (4.7%). The long-term harvest flow transition and magnitude was similar to that of the Base Case.

The second harvest flow objective for the decrease in natural stand volumes sensitivity was to maintain the Base Case short-term harvest flow with a later transition to a similar mid-term as the previous flow. This scenario shows that it is possible to maintain the Base Case harvest level with a 10% reduction in natural stand volumes. However, the transition to the mid-term is delayed by 10 years, with a mid-term level that is 4.6% less than the Base Case. The long-term harvest flow transition and magnitude is similar to that of the Base Case.

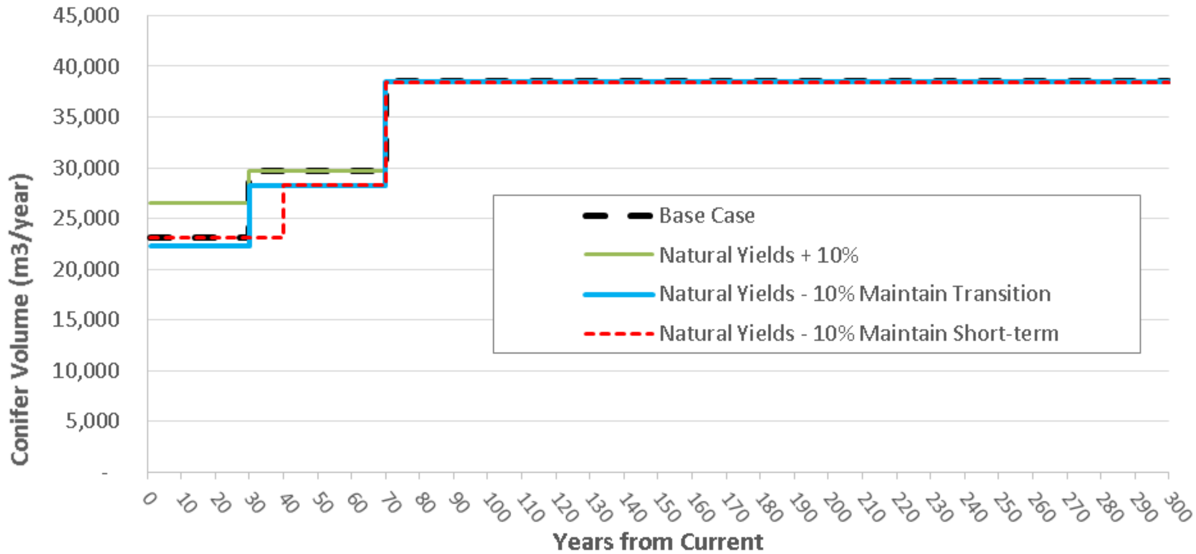

Figure 25 Harvest flows for the natural stand yields +/- 10% sensitivity analyses

Table 8 Harvest flow differences for the natural stand yields +/- 10% sensitivity analyses

Scenario	Short-term	Mid-Term	Long-term
Natural Yields Plus 10%	Increase in harvest level of 14.4% to 26,490 m³/yr.	No significant change. Decrease in harvest level of 0.1% to 29,640 m³/yr.	No significant change. Decrease in harvest level of 0.1% to 38,460 m³/yr.
Natural Yields Less 10% with no change to mid-term transition	Decrease in harvest level of 3.7% to 22,310 m³/yr.	Decrease in harvest level of 4.7% to 28,290 m³/yr.	No significant change. Decrease in harvest level of 0.2% to 38,420 m³/yr.
Natural Yields Less 10% maintain short-term	No significant change. Decrease in harvest level of 0.3% to 23,100 m³/yr.	Decrease in harvest level of 4.6% to 28,330 m³/yr. Mid-term transition 10 years later.	No significant change. Decrease in harvest level of 0.2% to 38,420 m³/yr.

5.3 MANAGED STAND YIELDS

Managed stand yields are created with the TIPSY model, which predicts yields for managed stands using site index and stand attributes such as species, density, operational adjustment factors, and expected gains from planting stock grown using select seed. The over or under estimation of any of these factors can lead to uncertainties in the yields of these future stands. Three scenarios were completed to understand the potential changes to managed stand yields. The approach used to investigate uncertainty in managed stand yields is summarized in Table 9.

Table 9 Modelling approach for managed stand yield +/- 10% sensitivity analyses

Scenario	Modelling Approach
Base Case	The yield tables for each existing and future managed stand were created using TIPSY 4.4 with site index estimated using the 2003 J.S. Thrower and Associates Ltd. site index adjustments specific to TFL 33. Other inputs were based on historic and anticipated future silviculture regimes. Non-standard operational adjustment factor 2 (OAF2) of 10% was used for Douglas-fir and cedar leading stands to account for losses due to root disease.
Managed Yields Plus 10%	Each managed stand yield table was increased by 10%. Minimum harvest ages were adjusted to reflect the revised volumes.
Natural Yields Less 10%	Each managed stand yield table was decreased by 10%. Minimum harvest ages were adjusted to reflect the revised volumes.
Standard OAF2	Standard OAF2 value of 5% was used for Douglas-fir and cedar leading stands.

Figure 26 and Table 10 summarize the changes to harvest flows when managed stand yields are increased/decreased by 10%, and when standard values for OAF 2 are used.

When the managed stand yields are changed by +/-10%, it can be seen that the change in long-term harvest level is almost directly proportional to the change in managed stand volume. This is consistent with expectations, since long-term harvest is sourced almost entirely from managed stands.

The mid-term harvest level is also changed as a result of changing managed stand yields because a portion of the mid-term harvest is sourced from managed stands. A 10% increase results in an 8.0% harvest level increase, and a 10% decrease results in a 6.2% harvest decrease. As expected, short-term harvest levels are essentially unchanged.

Unlike the +/- 10% sensitivity, using the standard OAF2 value only affects a subset of the managed stand yield tables (i.e. Douglas-fir and cedar leading). The long range sustained yield calculated using these yield tables increases by 4.35% relative to the Base Case. This is reflected by a 4.1% increase in long-term harvest levels, as expected. However, there is no increase to the mid-term harvest level unlike the scenario where all managed stand yields are increased by 10%.

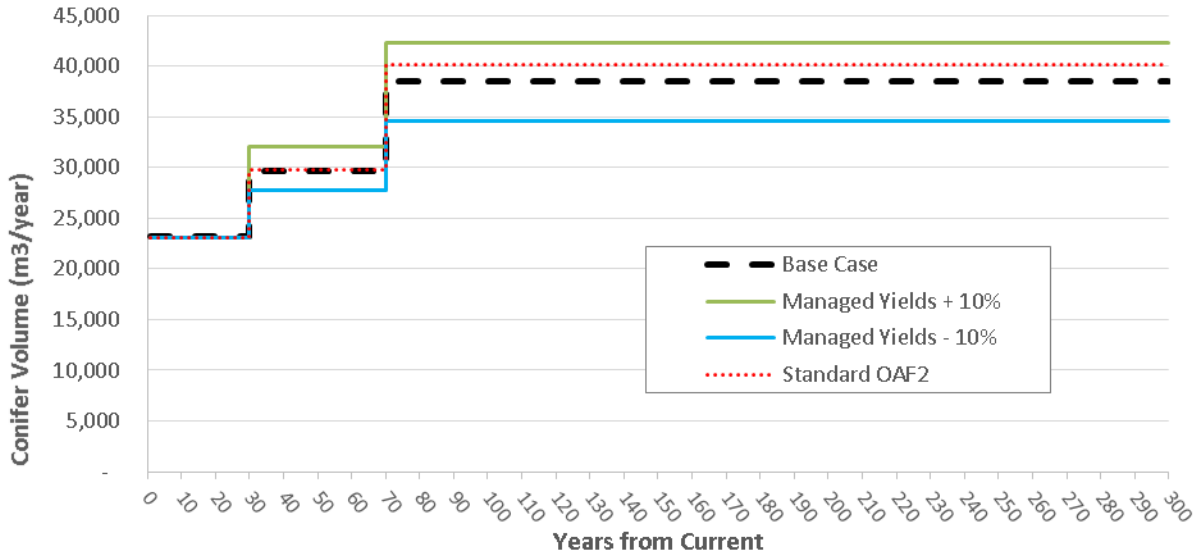

Figure 26 Harvest flows for the alternate managed stand yields sensitivity analyses

Table 10 Harvest flow differences for the alternate managed stand yields sensitivity analyses

Scenario	Short-term	Mid-Term	Long-term
Managed Yields Plus 10%	No significant change. Decrease in harvest level of 0.2% to 23,114 m³/yr.	Increase in harvest level of 8.0% to 32,040 m³/yr.	Increase in harvest level of 10.1% to 42,390 m³/yr.
Managed Yields Less 10%	No significant change. Decrease in harvest level of 0.2% to 23,100 m³/yr.	Decrease in harvest level of 6.2% to 27,830 m³/yr.	Decrease in harvest level of 10.2% to 34,560 m³/yr.
Standard OAF2	No significant change. Decrease in harvest level of 0.2% to 23,100 m³/yr.	No significant change. Decrease in harvest level of 0.3% to 29,600 m³/yr.	Increase in harvest level of 4.1% to 40,080 m³/yr.

5.4 MINIMUM HARVEST AGES

Uncertainty around the age that stands become merchantable for harvest is linked to both our ability to predict the future growth of stands and our ability to understand future conditions that will define merchantability (markets/products).

Establishing minimum harvest ages associated with the maximum mean annual increment tends to optimize growth potential and long-term harvest levels. Alternatively, allowing stands to be harvested earlier than when maximum MAI is achieved provides flexibility in the transition from short to mid/long-term harvest levels. The modelling approach used to investigate the effect of changing minimum harvest ages is summarized in Table 11.

Table 11 Modelling approach for alternate minimum harvest age sensitivity analyses

Scenario	Modelling Approach
Base Case	Stands must meet both of the following criteria: 1) Minimum conifer volume of 200 m^3/ha, and 2) Mean annual increment equal to at least 95% of the maximum MAI.
Minimum Harvest Age Plus 10 Years	Increase minimum harvest ages by 10 years from those used in the Base Case.
Minimum Harvest Age Less 10 Years	Decrease minimum harvest ages by 10 years from those used in the Base Case. Stands must still have at least 200 m^3/hectare in order to be merchantable.

Figure 27 and Table 12 summarize the changes to timber supply that result from increasing and decreasing minimum harvest ages by 10 years. When minimum harvest ages are increased by 10 years, there is a small drop in short-term harvest level (0.7%), moderate drop (2.3%) in mid-term harvest level, and small drop (0.5%) in long-term harvest level. In addition, the transition to both the mid-term and the long-term occur 10 years later than in the Base Case.

There is virtually no change to the short and mid-term harvest levels when minimum harvest ages are decreased by 10 years. However, long-term harvest level is reduced by 1.4% relative to the Base Case.

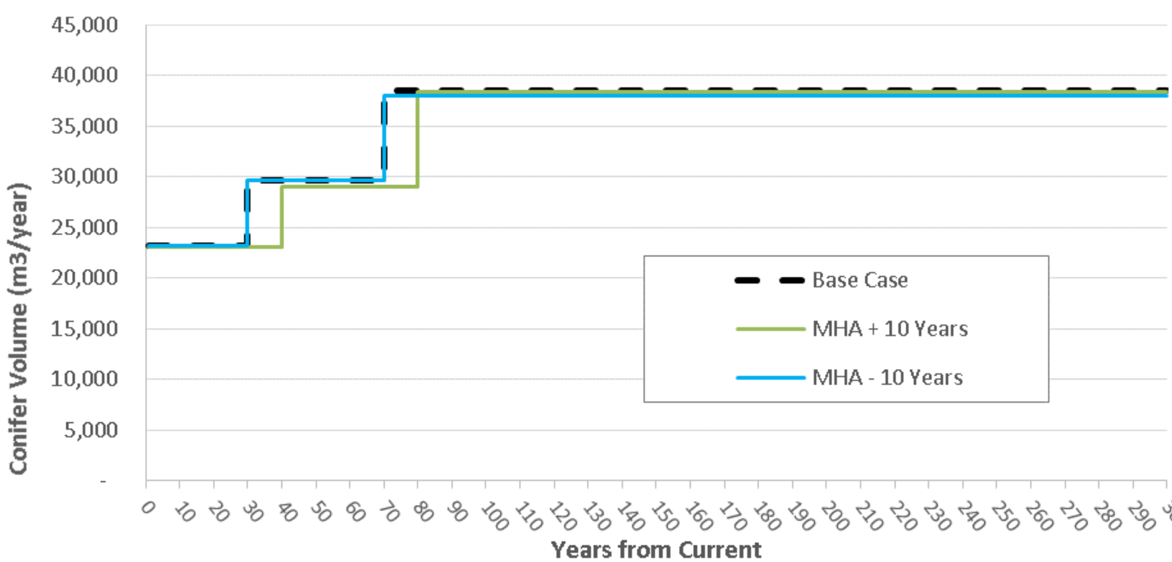

Figure 27 Harvest flows for the minimum harvest age +/- 10 years sensitivity analyses

Table 12 Harvest flow differences for the minimum harvest age +/- 10 years sensitivity analyses

Scenario	Short-term	Mid-Term	Long-term
Minimum Harvest Age Plus 10 Years	Decrease in harvest level of 0.7% to 23,000 m^3/yr.	Decrease in harvest level of 2.3% to 29,010 m^3/yr. Transition to mid-term occurs 10 years later.	Decrease in harvest level of 0.5% to 38,300 m^3/yr. Transition to long-term occurs 10 years later
Minimum Harvest Age Less 10 Years	No significant change. Decrease in harvest level of 0.1% to 23,150 m^3/yr.	No significant change. Decrease in harvest level of 0.3% to 29,590 m^3/yr.	Decrease in harvest level of 1.4% to 37,960 m^3/yr.

5.5 HARVEST BLOCK SIZE

Aggregated harvest blocks are created in the model as a result of adjacent harvesting that occurs within an individual five year period. The Base Case implemented restrictions on small cutblock size so that the analysis reflects operational reality by avoiding harvest of small isolated units, or "slivers" created during the spatial data preparation phase. In addition, it prevented creation of harvest blocks larger than 40 hectares. A sensitivity analysis was completed to evaluate implications for timber supply if there are no restrictions on harvest block size, as outlined in Table 13.

Table 13 Modelling approach for the unrestricted harvest block size sensitivity analysis.

Scenario	Modelling Approach
Base Case	Harvest aggregation patching used to limit harvest block size (i.e. adjacent harvesting within a 5 year period) as follows: No harvest blocks < 1 ha. Limit harvest blocks between 1 and 5 ha to approximately 5% (soft constraint). No harvest blocks > 40 ha.
No Harvest Block Size Restrictions	No targets for harvest block sizes. Harvesting of units < 1 ha and > 40 ha permitted.

Figure 28 and Table 14 summarize the changes to harvest flows when no harvest block size restrictions are modelled. There are a moderate increases in the short (4.4%) and mid-term (3.7%), and a smaller increase (1.3%) in the long-term. Figure 29 illustrates the resulting harvest block size distribution. There is a much larger proportion of small blocks, with approximately 51% on average being 5 hectares or smaller, and 2.5% smaller than 1 hectare. Although blocks larger than 40 hectares were allowed, there is only one period where this occurred. These results are indicative of the greater flexibility that small blocks allow in harvesting within areas with non-timber objectives (i.e. retention VQO and mule deer winter range) that were constraining in the base case.

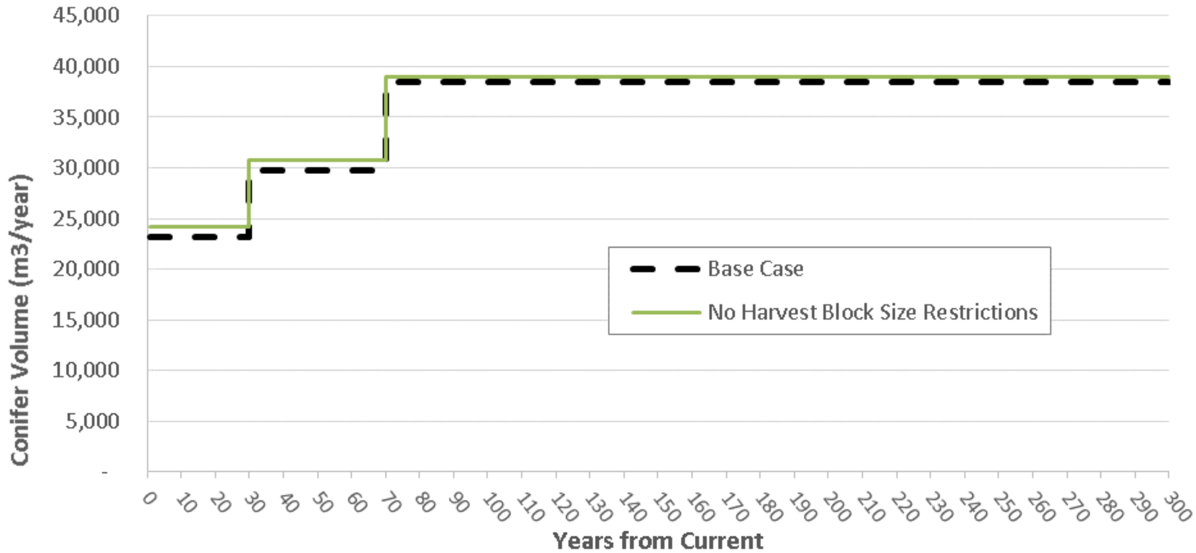

Figure 28 Harvest flow for the unrestricted harvest block size sensitivity analysis

Table 14 Harvest flow difference for the unrestricted harvest block size sensitivity analysis

Scenario	Short-term	Mid-Term	Long-term
No Harvest Block Size Restrictions	Increase in harvest level of 4.4% to 24,180 m^3/yr.	Increase in harvest level of 3.7% to 30,770 m^3/yr.	Increase in harvest level of 1.3% to 38,980 m^3/yr.

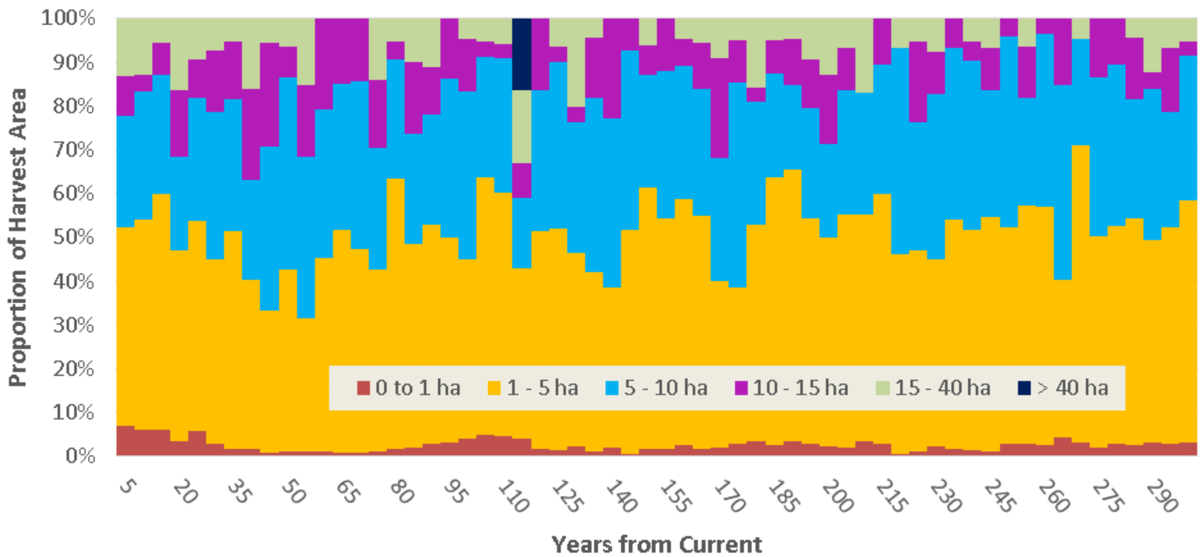

Figure 29 Harvest block size for the unrestricted harvest block size sensitivity analysis

6 Summary

The Base Case scenario harvests 23,160 m^3/year for 30 years, then increases to 29,680 m^3/year for another 40 years. The long-term harvest level after 70 years is 38,490 m^3/year for the the remainder of the 300 year planning horizon. Two alternative harvest flows were also completed. The first shows that it is possible to maintain a higher initial harvest level of 28, 190 m^3/year for 70 years before transitioning to the long-term level. The second alternative flow has the same initial harvest level as the Base Case, but transitions directly to the long-term harvest level in 55 years (i.e. 15 years earlier, without an intermediate mid-term increase).

A number of sensitivity analyses were completed to assess the impacts of potential uncertainty in data and modelling assumptions. The results from these model runs are summarized in Table 15

Table 15   Summary of sensitivity analyses

	Changes to Harvest Forecast from Base Case		
Scenario	**Short-term**	**Mid-term**	**Long-term**
THLB + 10%	+ 9.8%	+ 5.1%	+ 6.0%
THLB – 10%	- 10.4%	- 10.7%	- 9.3%
THLB – 10% (Maintain short-term harvest)	- 0.5%	-10.9%, Delay transition 15 years	- 9.4%
Natural Stand Yields + 10%	+ 14.4%	- 0.1%*	- 0.1%*
Natural Stand Yields – 10%	- 3.7%	- 4.7%	- 0.2%*
Natural Stand Yields – 10% (Maintain short-term harvest)	- 0.3%*	- 4.6%, Delay Transition 10 years	- 0.2%*
Managed Stand Yields + 10%	- 0.2%*	+ 8.0%	+ 10.1%
Managed Stand Yields – 10%	- 0.2%*	- 6.2%	- 10.2%
Standard OAF2			
Minimum Harvest Age + 10 Years	- 0.7%	-2.3 %, Delay Transition 10 years	- 0.5%, Delay Transition 10 years
Minimum Harvest Age – 10 Years	- 0.1%*	- 0.3%*	- 1.4%
No Harvest Block Size Restrictions	+ 4.4%	+ 3.7%	+ 1.3%

** Changes <= 0.3% not considered a significant difference in this analysis report*

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Appendix 1 Information Package