TIMBER SUPPLY ANALYSIS
INFORMATION PACKAGE

TREE FARM LICENSE 23
TIMBER SUPPLY REVIEW 2008

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1.0 INTRODUCTION

This information package has been prepared by Timberline Natural Resource Group Ltd. (Timberline) on behalf of International Forest Products Limited (Interfor) as a source document prior to the completion of the timber supply review (TSR) 2008 for Tree Farm License (TFL) 23.

This document serves as a summary of the inputs and assumptions made in preparing the timber supply analysis data model. Included are inventory and landbase summaries and management assumptions for timber and non-timber resources as they relate to timber supply. The analysis involves modeling a basecase which is intended to represent current management practices. In addition, a number of sensitivity analyses will also be conducted to test the impact of different assumptions on timber supply. All analysis simulations will be completed using CASH, Timberline's proprietary forest estate model. This information package follows the suggested format outlined in the *Guide for Tree Farm License Management Plans (20-month) and Calendar Year Reports* (MoFR, 2001).

The objectives modeled in the basecase are as described in the TFL 23 2006-2011 Forest Stewardship Plan, Amendment #1 submitted January 4, 2007. These objectives are guided by the Kootenay-Boundary Higher Level Plan Order (KBHLPO) dated October 26, 2002 and the following orders: Order –KBHLP-02, Order-KBHLP-03, Order-KBHLP-04 and Order-KBHLP-06 and the Revelstoke Higher Level Plan Order (RHLPO) dated March 25, 2005.

Upon acceptance by the British Columbia (BC) Ministry of Forests and Range (MoFR) timber supply analyst, the assumptions and methodology provided in the information package will be used by Interfor to prepare and submit a timber supply analysis to the MoFR. All analysis results will be provided to the Chief Forester of BC, or designate, for allowable cut determination.

2.0 TIMBER SUPPLY ANALYSIS PROCESS

Multiple management options will be considered and modeled in this analysis. The main models considered are:

1. Basecase - current management practice; and
2. Sensitivity analyses.

2.1 Missing Data

At the time this information package was prepared, there was no information unavailable.

2.1.1 Review Requested information updates

Following MP 9, the chief forester requested the subsequent information updates. These requests are addressed in the following "Response to Requested Information" section.

- Requested that the licensee work closely with MoE staff to refine appropriate management objectives for "high value fish streams". MoE will work closely with the licensee to define possible 'Fishery Sensitive Watersheds' (FRPA Objective).
- Requested that Interfor provide sensitivity analyses to explore the implications of proportional representation (area of old seral forest by site series) to the TFL 23 timber supply.
- Refine the ESA classification of difficult-to-regenerate areas (Ep) on TFL 23 to identify any areas with potential regeneration concerns, paying particular attention to the areas within the 'aerial' operability class;
- Monitor the timber volumes harvested from the 'aerial' operability class to ensure that the operable profile of stands from these areas is adequately represented in the AAC;
- Further refine the modelling and assumptions of adjacency and green-up in time for the next determination; and
- In co-operation with BCFS staff, update applicable maps and associated records to ensure the respective estimates of the area of Schedule 'A' lands are consistent.

2.1.2 Response to Requested Information

2.1.2.1 High Value Fish Streams

No high value fish streams have been identified within TFL 23. Management guidelines for regular fish streams are noted in Section 6.10, Riparian Management Areas.

2.1.2.2 Proportional Representation

A sensitivity will be provided in this analysis to determine the impact of retaining old seral forest by site series.

2.1.2.3 Refine Ep ESA Classification

In the previous TSR, 100% of the ESA1P (High sensitivity to regeneration problems) were excluded from the harvesting landbase. An analysis of these areas showed that 2% (50 ha) of these area's have been harvested and successfully regenerated. Given the small area associated with harvesting in these area's, the netdown will continue to be 100%.

2.1.2.4 Monitor Volumes from the Aerial Operability Class

TFL 23 has an "aerial operability" partition of 56,000m^3/year. The aerial operability partition AAC and the conventional AAC have been managed separately. Table 2.1 shows the amount of harvest in the aerial and conventional partitions from 1995 till 2007. Figure 2.1 is the graphical representation of this data.

Table 2.1 Harvest Volume Monitoring – General and Partition

Year	Aerial Operability Partition		Conventional Harvest	
	AAC	Actual Harvest	AAC	Actual Harvest
1995	50,000	0	549,300	433,669
1996	50,000	15,112	549,300	585,840
1997	50,000	47,306	549,300	655,107
1998	50,000	18,646	549,300	611,087
1999	50,000	12,359	549,300	604,104
2000	50,000	0	549,300	588,926
2001	50,000	12,196	549,300	480,997
2002	50,000	2,664	549,300	545,476
2003	50,000	18,304	549,300	434,653
2004	50,000	49,430	549,300	713,769
2005	46,913	18,138	549,300	571,639
2006	46,913	0	456,584	503,854
2007	46,913	0	456,584	343,997

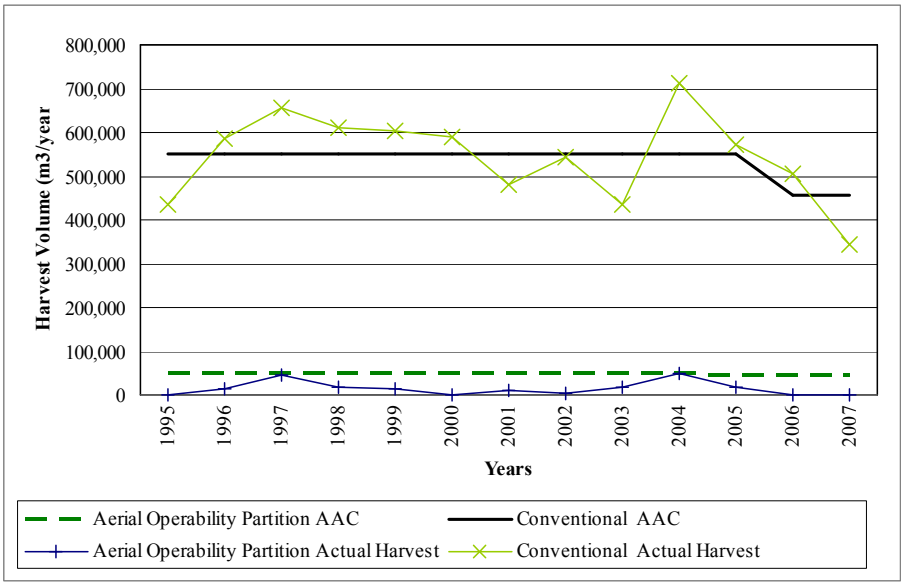

Figure 2.1 Harvest volume monitoring – AAC and Partition

2.1.2.5 Refine Green-up and Adjacency Modeling

In this analysis, two options are used to model adjacency requirements.

1. The integrated resource management (IRM) resource management zone (RMZ) is used to apply a the requirement that no more than 25% of each zone can be less than 2.5m height. This is applied on the timber harvest landbase (THLB) by each landscape unit (LU) and biogeoclimatic zone (BEC) combination; and
2. Spatial adjacency is enforced by the timber supply model for 20 years. That is, no stand can be harvested until all of it's neighbours are at least 2.5 m in height.

The Base case uses only the IRM requirement and the spatial adjacency is modeled in a sensitivity.

2.1.2.6 Confirm Schedule 'A' Area

Interfor have consulted with MoFR Timber Tenures Branch to confirm the Schedule 'A' area of TFL 23.

3.0 TIMBER SUPPLY OPTIONS

3.1 Basecase

The basecase is considered representative of current management practice and includes information updates from the MP 9 basecase (1999). Improvements from the MP 9 basecase are:

- Landbase summary (netdown) has been updated;
- Analysis units (AUs) (Growth and yield aggregations) have been created using BEC and leading site series;
- Managed stand yield assumptions have been revisited by Interfor;
- Updated inventory and disturbances;
- New visuals database;
- New caribou dataset;
- New Ungulate Winter Range (UWR);
- Draft Spatial OGMAs; and
- Incorporating natural disturbances in the non-timber harvesting landbase (non-THLB).

3.2 Sensitivity Analyses

Sensitivity analysis provides a measure of the reasonable upper and lower bounds of the harvest forecast, reflecting the uncertainty of assumptions made in the basecase. The magnitude of the increase and decrease in the sensitivity variable reflects the degree of uncertainty surrounding the assumption associated with that given variable. By developing and testing a number of sensitivity analyses, it is possible to determine which variables most influence results. To allow meaningful comparison of sensitivity analyses, they are usually performed using the basecase (*i.e.* current performance) and varying only the assumption being tested (*i.e.* all other assumptions remain the same as in the basecase).

The sensitivities that will be carried out for this analysis are listed in

Table 3.1.

Table 3.1 Sensitivity Analyses

	Sensitivity
THLB Definition	Basecase +/- 10% THLB
Growth and yield	+/- 10% Natural stand yields +/- 10% Managed stand yields +/- 10% Minimum harvest ages +/- 1m managed site index +/- 1m natural site index No genetic gains
REA assumptions	+/- 1m green-up heights No IRM Adjacency instead of IRM No visuals Old caribou- SARCO requirements
Biodiversity Assumptions	Model aspatial seral Use optimized OGMAs No disturbances in the non-THLB
MPB Assumptions	No MPB Harvest Prioritization Slower MPB Spread
Alternate Harvest Conventions	Relative oldest harvest rule Maximum volume harvest rule Maximum 10 year harvest level

3.3 Other Options

There are no other options identified at this time.

4.0 FOREST ESTATE MODEL

4.1 Model description

The analyses will be carried out using CASH6 (Critical Analysis of Schedules for Harvesting) version 6.2l, a proprietary timber supply model developed by Timberline. The model uses a geographic approach to landbase and inventory in order to adhere as closely as possible to the intent of forest cover requirements on harvesting. Maximum disturbance and minimum thermal and old growth retention forest cover requirements are explicitly implemented.

A variable degree of spatial vs. aspatial resolution is available depending on inventory and RMZ definitions. Forested stands in the non-timber harvesting landbase (THLB) can be included to better model forest structure and contribute to forest cover objectives. These may be areas classed as environmentally sensitive or inoperable areas to name a few.

In their current implementation, forest cover objectives require an area over which to operate. The control area for an objective should correspond to a realistic element in the landscape. For example, the requirements associated with visual quality objectives (VQOs) are designed to operate on the scene visible from discrete sets of viewpoints- legal VQOs have been established in TFL 23. Disturbance requirements are calculated for each identified VQO as described later in this document.

CASH6 contains a hierarchical landbase organization to assist in implementing control areas. Numerous levels of land aggregation are used to define both geographically separate areas and areas of similar management regime. Forest cover constraints can be applied at up to 5 overlapping levels. CASH6 functionality includes the capability to model both height-based and age-based green-up.

4.2 Timber Supply Analysis

Timber supply analysis for the full two hundred and fifty (250) year planning horizon will be carried out using CASH6 operating with spatial adjacency for 20 years. The forest development plan (FDP) will be given the highest priority for harvest (b_status = ‘P’). Blocks that have been recently harvested and not captured in the inventory will be harvested first in the model.

5.0 CURRENT FOREST COVER INVENTORY

This section describes the base mapping, forest inventory and other data sources.

5.1 Base Mapping

All spatial information is registered to the Terrain Resource Inventory Mapping (TRIM), North American Datum (NAD) 83 base. Inventory data has been prepared using the ARC/INFO Geographic Information System (GIS). Use of GIS ensures that spatial relationships between the various inventory attributes are maintained throughout the analysis process. One example is the classification of THLB vs. non-THLB productive landbase. Forest on the non-THLB productive landbase is not available for harvesting but can contribute to forest cover objectives for non-timber resources (depending on its structural state).

5.2 Forest Cover Inventory

The TFL 23 forest cover inventory was sourced from the Interfor and has been updated for disturbances to 2008 and projected to January 1, 2008. This is an older inventory that will be improved prior to the next TSR.

For more information on improvements that will be made prior to the next TSR, see the '*Vegetation Resources Inventory Strategic Inventory Plan for Tree Farm Licence 23*, By A.Y. Omule, Rural Forestry International Ltd., 28 January 2007 which is available at the following link:

http://www.for.gov.bc.ca/hts/vri/reports&pub/tfl_vsips/tfl23_vrigs_vsip.pdf

5.3 Data Sources

Many sources of data were compiled to provide input to this TFL23 timber supply analysis- these are documented in Table 5.1.

Table 5.1 Data Sources

Inventory Category	*Data Source*	*Mapping Scale*	*Date of Completion*	*Date of Acceptance*	*Authority*
Ungulate Winter Range	*INTERFOR*	*1:50000*	*2006.01.19*	*2006.01.19*	*MoE*
Harvest Blocks	*INTERFOR*	*1:20000*	*2008.09.15*	*2008.09.15*	*INTERFOR*
Old Caribou Areas	*ILMB*	*1:50000*	*2004.02.13*	*2005.09.01*	*ILMB*
Sarco Caribou	*INTERFOR*	*1:20000*	*2008.12.17*	*2007.09*	*MoE*
Exterior TFL Boundary	*MoF*	*1:20000*	*Archival TSR*	*Archival TSR*	*ILMB*
Community Watersheds	*MoE*	*1:20000*	*2003.06.11*	*2003.06.11*	*MOE*
Domestic Watersheds	*MoE*	*1:50000*	*2004.04.17*	*2001.10*	*MOE*
Environmentally Sensitive Areas	*MoF*	*1:20000*	*1995*	*1995*	*INTERFOR*
Forest Cover	*MoF*	*1:20000*	*2005.01.01*	*2005*	*INTERFOR*

Inventory Category	*Data Source*	*Mapping Scale*	*Date of Completion*	*Date of Acceptance*	*Authority*
Fire Boundaries	*INTERFOR*	*1:50000*	*2003.04.11*	*2003.12.11*	*INTERFOR*
Logged Blocks	*LRDW/INTERFOR*	*1:20000*	*2008.09.15*	*2008.09.15*	*INTERFOR*
Landscape Units	*MOE Nelson*	*1:20000*	*2008.01.22*	*2008.01.22*	*MAL*
Merchantability	*TNRG*	*1:20,000*	*2005.09.28*	*2005.09.28*	*TNRG*
Mountain Pine Beetle Projections 1999-2004	*MoF*	*1:250,000*	*September 2008*	*September 2008*	*MoF*
Old Growth Management Areas	*ILMB*	*1:20000*	*2008 September*	*Latest available at the time.*	*ILMB*
Operability Line	*INTERFOR*	*1:20000*	*1998*	*1998*	*INTERFOR*
Ownership	*INTERFOR*	*1:20000*	*2008.09.15*	*2008.09.15*	*INTERFOR*
Predictive Ecosystem Mapping	*INTERFOR*	*1:20000*	*2005*	*2008.09.15*	*INTERFOR*
BEC from PEM	*INTERFOR*	*1:250000*	*2003*	*2003*	*MoF*
Connectivity corridors	*MOE Nelson*	*1:250000*	*1995.07*	*2005.03.02*	*MOE Nelson*
Road Buffers	*INTERFOR*	*1:20000*	*2008.09.15*	*2008.09.15*	*INTERFOR*
Riparian Buffers	*INTERFOR*	*1:20000*	*2008.09.15*	*2008.09.15*	*INTERFOR*
Terrain Stability	*Terratech*	*1:20000*	*2001.07.18*	*2001.07.18*	*INTERFOR*
Parks	*LRDW*	*VARIABLE*	*ONGOING*	*2004.07*	*BC Parks*
Arrow District VQO	*KSDP*	*1:50000*	*2004.01.15*	*2004.01.15*	*MoF*
Columbia District VQO	*KSDP*	*1:50000*	*2004.01.15*	*2004.01.15*	*MoF*
Wildlife Habitat Areas	*INTERFOR*	*1:20000*	*2005.03.23*	*2005.03.23*	*MOE*
Wildlife Tree Patches	*INTERFOR*	*1:20000*	*2008.09.15*	*2008.09.15*	*INTERFOR*

6.0 DESCRIPTION OF LANDBASE

This section describes the TFL 23 landbase and the methodology used to determine the way in which land contributes to the analysis. Some portions of the productive landbase, while not contributing to harvest, may be available to meet other resource needs.

6.1 Timber Harvesting Landbase Determination

Table 6.1 presents the results of the landbase classification process to identify the THLB. This landbase classification process is applied in the order specified in the table and is compared to the areas removed in MP 9 in 1999 (shown as the "HLPO Reduction" column). Areas that would be classified in more that one category will be shown in the first occurring category. For example, stands within riparian boundaries might also be classified as non-commercial. These areas would be accounted for in the non-commercial category because it comes earlier in the classification process. Therefore, in most cases the net reduction will be less than the total area in the classification.

Table 6.1 Timber Harvesting Landbase Determination

Land Classification	HLPO Reduction (ha)	Gross / Productive Area (ha)	TSR Reduction (ha)
Gross MoF TFL Boundary	**551,485**		**551,471**
Private, non-TFL	0	6,483	6,456
Parkland	269	177	20
BCTS	0	157,393	157,363
Non-productive , Non-forest	182,890	182,153	121,469
Road	4,214	6,307	4,294
Non-commercial brush	190	188	167
Non-productive Reductions	**187,563**		**289,770**
Productive Forest	**363,922**		**261,701**
Inoperable	100,798	71,258	71,258
Low Productivity	3,132	8,459	2,163
Uneconomic	4,104	13,957	3,834
Deciduous	1,744	1,860	1,160
Riparian	9,934	9,133	6,069
Soils (Terrain IV, V)	9,588	33,736	6,819
Regeneration ESA	3,350	21,742	2,121
Wildlife Tree Patches	0	1,313	1,199
Trails and Landings	2,957	66,358	2,489
OGMA	0	41,832	11,279
Caribou	0	34,135	8,687
Total Productive Reductions	135,607		117,078
Current Timber Havesting Landbase	**228,315**		**144,623**

6.2 Total Area and Private Land

The minor difference in gross area for the TSR is attributed to small boundary adjustments. Certain schedule A lands were removed from TFL 23 as part of negotiations between Interfor, BCTS and the government. The private land removal here is 6,456 ha but has no benchmark to compare this to in previous analysis. The ownership layer was compiled by Interfor to best represent the current state of the TFL boundary.

6.3 Parkland

Interfor provided an updated ownership layer for TFL 23 with altered boundary and attribute information. This layer had the parkland removed from the TFL. The 20 ha of park that is removed results from the overlap with the tpas provincial park boundary dataset.

6.4 BCTS

In total 157,363 ha of TFL 23 has been transferred to BCTS. This was removed from the gross landbase.

6.5 Non-Productive and Non-Forested

Non-productive, non-forest area was removed from the TFL. In total, 121,469 hectares were removed. Previous analysis removed about 61,000 more hectares at this stage. This discrepancy is due to the non-productive non-forest areas contained within the BCTS portion of the landbase. As mentioned above, once these areas are taken out in an earlier netdown step, the area is no longer available to be accounted for at a later netdown step.

6.6 Existing Roads

Road information is managed in a database as linear features by Interfor. Field sampling was undertaken to determine an appropriate measurement to apply as a buffer to a road feature. This measurement should represent area that is considered permanent access and not be available for timber production. Based on the field sampling, a right-of-way width of 12 metres, including landings, was applied to all existing roads. In total 4,294 hectares were removed from the productive landbase to account for existing roads.

6.7 Non-Commercial Brush

Land classified as being occupied by non-commercial species (coded type identity 5 in the inventory) is excluded. Non-commercial exclusions total 167 hectares for TFL 23.

6.8 Inoperable

Three following classes are used to define operability on TFL 23:

- Conventional (class A) – areas accessible by road that will be harvested using ground-based or conventional yarding equipment;
- Immature above the operability line (class Q) – individual stands of immature timber that will be available for harvest in the future using existing harvesting systems;
- Aerial (class H) – areas having reduced access that will be harvested with helicopter or long-line yarding equipment; and
- Inaccessible (class I or N) – areas not accessible for harvesting under any of the aforementioned methods due to either economic or physical limitations. Under different economic conditions, some of the timber currently designated inaccessible may be reclassified as aerial. For example many over-mature hemlock-balsam stands were not included in the aerial category although there are no physical limitations that would prevent them from being harvested.

All areas classified as inaccessible are removed from the harvestable landbase. Table 6.2 summarizes the reductions associated with inaccessible areas for this option of the analysis.

Table 6.2 Operable Reductions

Landbase Reduction	Productive (ha)	Area Removed (ha)
Inoperable	71,258	71,258

6.9 Low Productivity, Uneconomic and Deciduous Leading

Sites may have low productivity either because of inherent site factors (nutrient availability, exposure, moisture, etc.) or because they are insufficiently stocked with merchantable tree species. Sites that are currently occupied by non-merchantable stands may be productive with other species or following silviculture treatments.

Uneconomic and low productivity stands are defined as follows:

- Leading deciduous;
- Over-mature hemlock stands on slopes > 50%;
- Over-mature balsam stands; or
- Any sites with an inventory site index less than 8.0.

Table 6.3 shows the total area and area removed in this category where the “uneconomic” category is the over-mature hemlock and balsam stands mentioned above.

Table 6.3 Problem Forest Types

Landbase Reduction	Productive (ha)	Area Removed (ha)
Deciduous	1,860	1,160
Uneconomic	14,332	3,834
Low Productivity	8,085	2,163

6.10 Riparian Management Areas

FRPA stream, lake and wetland classifications were used to establish riparian reserve zone (RRZ) and riparian management zone (RMZ) widths. Formal stream inventories have been undertaken on approximately 75% of TFL 23. The balance has not been inventoried. A methodology was established to:

- Determine an estimate of riparian reserve areas on surveyed streams, and
- Determine an estimate of riparian reserve areas on un-surveyed streams.

In the GIS data set, all inventoried streams, lakes and wetland features were buffered the appropriate width using 100 percent of the riparian reserve zone width and 25 percent of the riparian management zone width. Once all inventoried streams were buffered, an average buffer width of 38.4 m for classes S1-S4 was calculated.

For unclassified streams, polygons of slopes up to 20 percent were created. Streams contained within these 20% polygons were assumed to be fish-bearing. These streams were given a 38.4 meter buffer and the area reserved from harvest. Table 6.4 summarizes the riparian zone widths, retention requirements and buffer distances for each riparian class. Table 6.5 summarises the total area and area removed from the THLB because of riparian exclusions.

Table 6.4 Riparian Buffer Widths

Riparian Class	Reserve Zone Width (RRZ) (m)	Management Zone Width (m)	Management Zone Retention (m)	Management Zone Buffer Distance (RMZ) (m)	Total Spatial Buffer (RRZ +RMZ) (m)
Lakes					
L1	10	0	25%	0	30[1]
L2	10	20	25%	5	15
L3	0	30	50%	15	15
L4	0	30	25%	7.5	7.5
Wetlands					
W1	10	40	50%	20	30
W2	10	20	25%	5	15
W3	0	30	25%	7.5	7.5
W4	0	30	25%	7.5	7.5
W5	10	40	25%	10	20
Streams					
S1	50	20	50%	10	60
S2	30	20	50%	10	40
S3	20	20	50%	10	30

[1] 30 meters does not follow the convention but was used in MP9

Riparian Class	Reserve Zone Width (RRZ) (m)	Management Zone Width (m)	Management Zone Retention (m)	Management Zone Buffer Distance (RMZ) (m)	Total Spatial Buffer (RRZ +RMZ) (m)
S4	0	30	25%	7.5	7.5
S5	0	30	25%	7.5	7.5
S6	0	20	5%	1	1
Fish Bearing Unclassified (slope < 20%). Average value (S1-S4)used					**38.4**

Table 6.5 Riparian Reductions

Landbase Reduction	Productive (ha)	Area Removed (ha)
Riparian	9,133	6,069

6.11 Terrain Stability and Environmentally Sensitive Areas

Sensitive areas are designated based on a number of inventory attributes. In the context of timber supply analysis, areas may be excluded from the THLB for the following conditions:

- Areas with significant avalanche concerns;
- Actual or potential sensitive or unstable soils; and
- Severe regeneration problems caused by geo-climatic factors.

Two types of unstable terrain were removed from the landbase stability class = U (unstable) and P (potentially unstable). Only a portion of the areas identified as unstable or potentially unstable were removed as per MP 10:

- 50% of unstable terrain; and
- 8% of potentially unstable terrain.

Terrain classification information has replaced most of the ESA information previously used to remove sensitive soil sites, however, ESA was used to identify sites with low regeneration potential. Table 6.6 shows the total area and area removed from the THLB by sensitive area type.

Table 6.6 Unstable terrain

Landbase Reduction	Productive (ha)	Area Removed (ha)
Potentially Unstable	44,612	1,889
Unstable Terrain	33,736	4,929
ESA	21,742	2,121

6.12 Wildlife Tree Patches

Retention of wildlife trees as single trees or in patches is a valuable practice for maintaining stand level biodiversity. Under current practices, 7% of the total area (Net Area to be Reforested [NAR] plus

Permanent Access Structures [PAS]) in cutblocks will be retained in wildlife tree patches (WTPs). Where possible, WTPs are located in the non THLB.

Existing mapped WTPs were provided by Interfor and were removed from the THLB and are shown in Table 6.7.

Table 6.7 Wildlife Tree Patch Areas

Landbase Reduction	Productive (ha)	Area Removed (ha)
Wildlife tree patch	1,313	1,199

Future WTPs are modeled by applying a percentage reduction to stand yields at the time they are harvested. This modeling approach means that WTPs are not counted for their contribution toward landscape level biodiversity requirements, although in reality some WTPs may contribute to both landscape level forest structure and old growth habitat. In this analysis, future WTPs are accounted for by a 1.4% reduction.

6.13 Mountain Caribou – Central Kootenay Planning Unit

Mountain caribou will be managed as described in the Government Actions Regulation (GAR) Order #U-4-014. No harvesting will take place within the boundaries of the area established for mountain caribou except as outlined under the general wildlife measures specified in the order. From the 34,128 ha of land identified as caribou removal only 8,681 ha were removed from the THLB. The reduced amount is due to previous landbase removals that overlap the caribou area.

Table 6.8 Overlapping Caribou Netdowns

Landbase Classification	Area (ha)
Total caribou	**91,549**
Non-TFL	1,487
TFL caribou	**90,062**
BCTS	35,365
Non-productive , Non-forest	20,437
Road	133
Non-Productive caribou	**55,934**
Productive caribou	**34,128**
Inoperable	20,099
Low Productivity	1,414
Deciduous	7
Riparian	522
Regeneration ESA	498
Wildlife Tree Patches	28
OGMA	1,601

Aspatial netdowns[2]	1,270
THLB impacted caribou	**8,687**

6.14 Trails and Landings

Based on current forest practices on TFL 23, skid trails and landings are considered temporary access structures to be brought back into production, and therefore maintain their productive contribution to produce timber. Future trails are rehabilitated after harvesting and either planted or regenerated naturally. Therefore no additional losses are attributed to these future disturbances. In addition, the increased use of cable and aerial harvesting systems has reduced the number of skid trails constructed during harvesting operations.

Existing trails and landings are often too small to be captured in the GIS data and are removed by making landbase reductions to areas where harvesting has taken place. To reflect legacy landing and trail areas that will not be returned to productive status, 4% of the total area harvested in the past was removed from the productive forest. The area reduction associated with these areas is 2,489 ha (4% of THLB 66,358) as shown in Table 6.9.

Table 6.9 Trails and Landings

Landbase Reduction	Area Removed (ha)
Trails and Landings	2,489

6.15 Future Roads

Future roads are not treated as a netdown, but instead captured in the timber supply model. At the time of the first harvest a component of each stand is placed into a category that will remain in a disturbed state for perpetuity. If the area harvested is included in an area associated with forest cover constraints relating to integrated resource management, the road area will become part of the disturbance area permanently. These stands will provide harvest volume on the first entry but not on further entries and the area contributing to the long-term sustainable harvest is net of this area. Four percent of each stand currently over 30 years old is removed for future roads.

6.16 Old Growth Management Areas

Draft old growth management areas (OGMAs) have been established to meet the old seral forest requirements identified in objective 2 of the KBHLPO. The basecase will include the removal of the draft OGMAs. Table 6.10 shows the total area classified as OGMAs and the THLB removal.

[2] Aspatial netdowns are the terrain stability and trails and landings.

Table 6.10 Old Growth Management Areas

Landbase Reduction	Productive (ha)	Area Removed (ha)
OGMA	41,832	11,279

6.17 Area Distribution Summaries

Figure 6.1 summarizes the distribution of area by age for both the non-THLB productive and THLB.

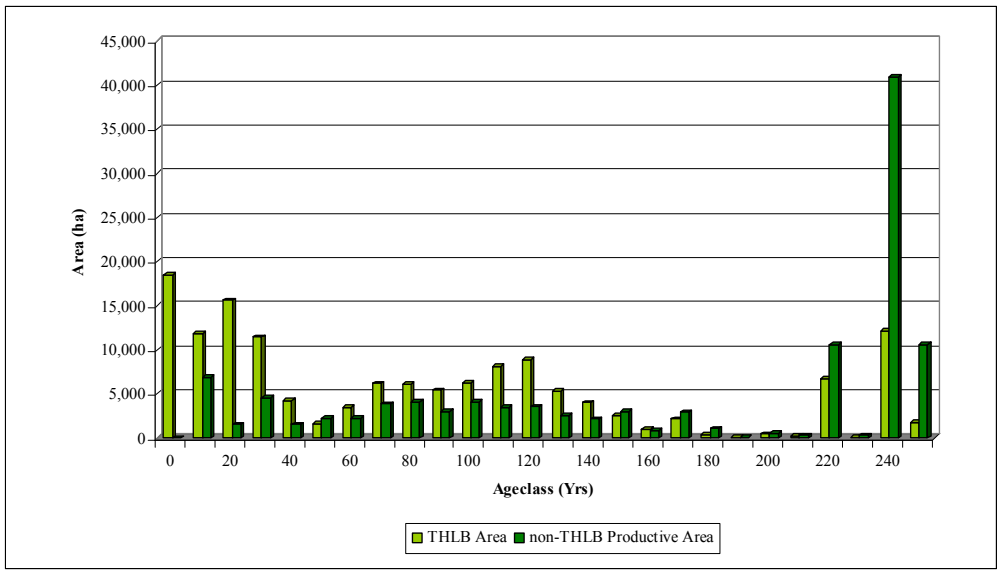

Figure 6.1 Age class distribution

Figure 6.2 summarizes the distribution of area by leading species for both the non-THLB productive and THLB.

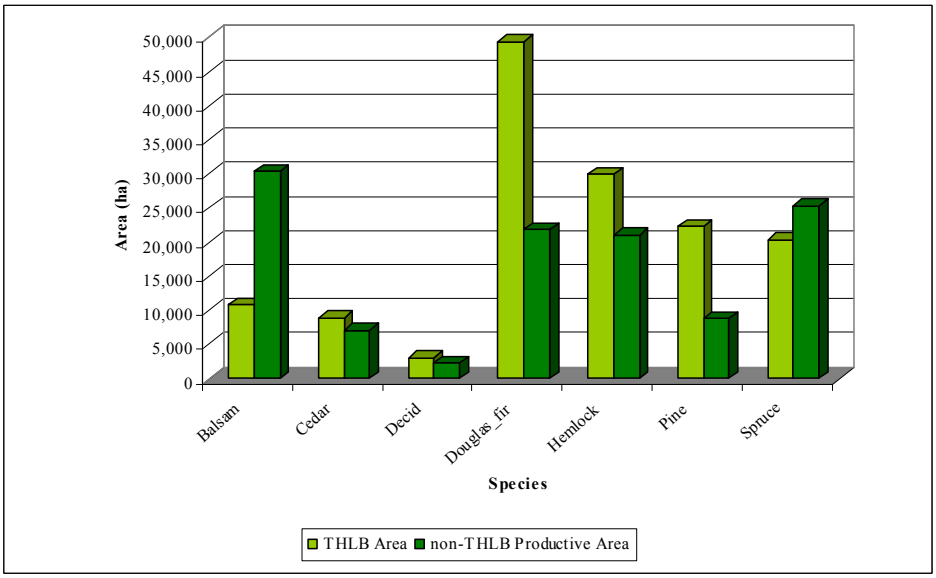

Figure 6.2 Leading Species Distribution

7.0 INVENTORY AGGREGATION

7.1 Introduction

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 obscures neither differences in biological productivity nor differences in management objectives and prescriptions. It is important to note that aggregation of the landbase will be consistent in all options and sensitivity analyses. This is to ensure that differences in results reflect differences in management decisions and not inventory aggregation.

7.2 Resource Management Zones

Unique management characteristics are modeled by grouping areas into resource management zones (RMZs), which are aggregates of area with similar non-timber resource concerns. Maximum disturbance (based on green-up height requirements), and minimum retention (mature/old growth forest cover objectives) will be assigned to each RMZ according to the requirements of the particular resource. RMZs may be aggregated within each landscape unit to reflect operational management of the resource. Where RMZ classifications overlap, areas must meet all overlapping forest cover objectives before harvesting. RMZs in TFL 23 can be summarized as:

- Caribou zones (SARCO);
- MDWR zones;
- Moose range;
- Community watersheds (CWS) and domestic watersheds (DWS);
- Visual Quality Objectives (VQOs). Scenic areas and Visual Quality Objectives have been established pursuant to Sections 7(1) and 7(2) respectively of the Government Actions Regulation (GAR). For the Arrow Boundary Forest District, objectives were established December 31, 2005;
- Landscape level biodiversity (seral stage) is managed through spatially explicit retention of OGMAs. Connectivity was considered as one of several factors when draft OGMAs were mapped so forest connectivity corridors (FCC) are not modeled in this analysis. The OGMAs are consistent with objective 5 of the KBHLPO.

The area in each RMZ in this analysis is shown in Table 7.1. Caribou zones and OGMAs are not shown in this table because they are complete removals from the THLB and are shown in Table 6.1.

Table 7.1 Resource Management Zone Areas

RMZ	Area (ha)		
	THLB	non-THLB Productive	Total Productive
CWS	964	851	1,815
IRM	40,667	0	40,667
VQO	52,777	22,810	75,588
DWS	25,114	15,440	40,554
MDWR	16,351	6,170	22,521
MOOSE	18,571	2,890	21,461
DIST_INOP	0	116,644	116,644

7.3 Ecosystem Types

Figure 7.1 shows the area in each BEC zone on TFL23. The BEC is based on the updated Predicted Ecosystem Mapping (PEM). The ICHmw2 BEC zone is 57% of the THLB area.

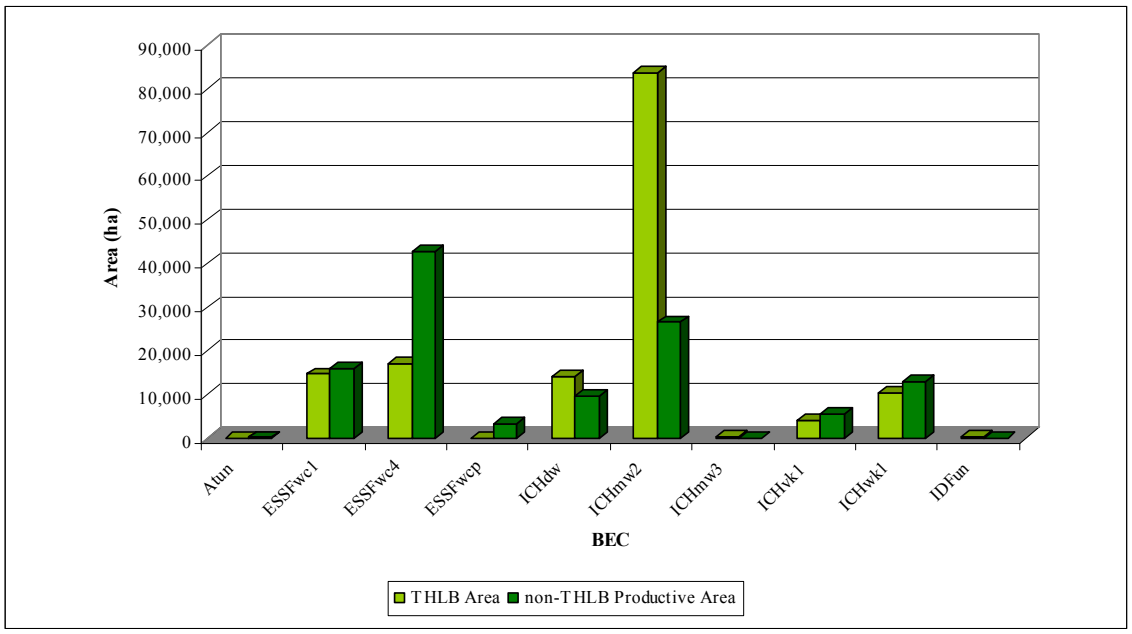

Figure 7.1 THLB and non-THLB Productive Area by BEC

7.4 Landscape Units

The area by LU is shown in Table 7.2. There is 35 ha THLB with a blank LU field and this area was left out of the zones defined by landscape unit.

Table 7.2 Area by LU on TFL 23

Landscape Unit	Area (ha)		
	THLB	non-THLB Productive	Total Productive
N510	21,513	10,018	31,531
N511	9,575	3,596	13,172
N516	0	13	13
N518	14,722	12,839	27,561
N520	12,006	5,113	17,119
N521	7,214	5,283	12,497
N526	23,697	7,440	31,137
N527	29,082	12,899	41,980
N528	418	74	491
N529	16,020	33,951	49,971
N530	2,477	7,697	10,175
N531	7,070	17,305	24,375
R1	190	123	312
R2	72	44	116
R4	667	79	747
Total	144,055	116,393	260,449

7.5 Analysis Unit Definitions

Stands are grouped into AUs to reduce modeling complexity. Grouping stands by similar species composition, site productivity and silviculture regime captures similarities in growth and response to silviculture treatments. In this analysis, AU definitions differ for the natural and managed stands.

7.5.1 Natural Stand AUs

For this analysis a balance was found by rounding certain stand level attributes and then aggregating in cases where the rounded attributes were identical. The rounding and classification process involved:

- Rounding age to the nearest 10 years;
- Rounding inventory site index to the nearest multiple of 3;
- Finding the leading species;
- A stands MPB characteristics:
  - The projected 2017 MPB severity rating: very severe (V), severe(S), moderate (M), low (L) or not affected;
  - If a stands is very severe (V) MPB affected: finding the year a stand became "very severe" MPB affected (from selected years: 2010/ 2012/2015/2017); and
- BEC zone.

After this classification process, stands with the same rounded age, rounded site index, leading species, MPB characteristics, harvest type, BEC zone (from PEM) and dry/wet belt classification were grouped together in AUs. Table 7.3 shows a few examples AU keys.

Table 7.3 Natural Stand AU Example Definitions

Age	SI	MPB 2017	V year	Leading Species	BEC zone
100	18	V	2012	Pine	IDFxh1
100	21	V	2006	Pine	IDFxh1
100	21	V	2008	Spruce/Balsam	ESSFvc
100	6	V	2004	Spruce/Balsam	ESSFvc
100	6	V	2002	Douglas-fir	MSxk
100	6	V	2008	Pine	MSxk

This process was used for aggregation purposes only. In other calculations, the attributes are area weight averaged for each AU which provides for a more accurate representation (for example average age and site index).

Natural stands are aggregated into AUs as described above. The aggregation process resulted in 636 natural AUs in TFL 23. The MoFR Variable Density Yield Prediction (VDYP) model (Version 6.6d) was used to develop natural stand yields at the AU level. A yield curve was first generated for each stand using the species composition, crown closure and height of the stand. These yield curves were then area weight averaged to produce one yield curve for each AU. Volumes were calculated net of secondary deciduous species volume contributions. The average inputs to VDYP are not presented because of the large number of natural AUs.

7.5.2 Managed Stand AUs

Managed AUs have been aggregated on BEC zone and leading site series (from the updated PEM). This reflects the management reality that the planting regime implemented is dependent upon site conditions that are described and aggregated by the ecological description. Any BEC/leading site series combinations less than 10 ha were aggregated into the most similar larger AU.

Managed stand AUs are split into two groups:

- Existing managed (managed AU # 1 – 20); and
- Future managed (managed AU # 21 – 40).

Existing managed stands are those stands that are less then 35 years old in the inventory and are harvested before 2005. Stand actually harvested or modelled as being harvested after 2005 are regenerated using future managed stands. Table 7.4 shows the AU number, AU definition (BEC/leading site series), the total THLB area in each AU and the average inventory and SIBEC site index.

Table 7.4 Managed Stand AU Definition and Area Summary

Existing Managed AU #	Future Managed AU #	Description	THLB area (ha)	Inv SI	SIBEC
1	**21**	ESSFwc1-01	10,365	16.30	16.44
2	**22**	ESSFwc1-02	4,057	16.24	16.37
3	**23**	ESSFwc4-01	13,800	14.79	14.85
4	**24**	ESSFwc4-02	1,755	15.04	15.17
5	**25**	ESSFwc4-03	818	16.52	16.11
6	**26**	ESSFwc4-04	474	15.18	15.23
7	**27**	ESSFwcp-01	26	12.00	12.00
8	**28**	ICHdw-01a	13,585	18.92	23.63
9	**29**	ICHdw-02	168	17.31	18.36
10	**30**	ICHmw2-01	2,015	18.48	19.92
11	**31**	ICHmw2-02	104	16.19	17.74
12	**32**	ICHmw2-03	19,947	18.17	21.14
13	**33**	ICHmw2-04	61,003	18.56	20.22
14	**34**	ICHvk1-03	2,037	16.57	18.03
15	**35**	ICHvk1-04	1,965	17.77	20.20
16	**36**	ICHwk1-01	3,891	17.15	19.48
17	**37**	ICHwk1-02	548	17.68	18.36
18	**38**	ICHwk1-04	5,599	17.15	18.05
19	**39**	ICHwk1-05	313	14.35	22.69
20	**40**	IDFun-04	371	18.49	18.49

8.0 GROWTH AND YIELD

8.1 Productivity Estimates- Inventory Site Index and SIBEC

The growth potential of modeled stands is quantified using site index. Site index is defined as the potential height of a site tree at breast height age 50 grown on the site. The inventory site index used for natural stands is developed using age and height attributes in the inventory (for stands >30 years old).

Productivity estimates for managed stands use the "site index estimates by site series" (SIBEC) from the accuracy assessed PEM (http://www.for.gov.bc.ca/hre/sibec/). SIBEC is applied by BEC- site series and leading managed species. The leading managed species for each stand is defined by BEC-site series by Interfor. Because the PEM is averaged into forest cover polygons during GIS processing, each stand can contain up to 10 site series (e.g. 60 % ESSFwc1-01 and 40% ESSFwc1-02). SIBEC is applied to each stand proportionally to the site series distribution. In areas where SIBEC estimates do not exist, the site index was defaulted to the inventory site index. The managed stand site index was calculated for each stand and then area weight averaged into each managed AU. The inventory site index and the SIBEC is shown by managed AU in Table 7.4.

8.2 Utilization Levels

The utilization levels modeled are listed in Table 8.1. They reflect current standards and performance and are consistent with the VDYP defaults.

Table 8.1 Utilization levels

Leading Species	Minimum DBH (cm)	Stump Height (cm)	Minimum Top DIB (cm)
Pine	12.5	30.0	10.0
Non-pine species	17.5	30.0	10.0

Note: DBH = diameter breast height, DIB = diameter inside bark

8.3 Decay, Waste and Breakage

Decay waste and breakage (DWB) has been included in this analysis via VDYP, which is set for each forest inventory zone (FIZ) and public sustained yield unit (PSYU). The FIZ and PSYU for TFL 23 are "G" and 128 respectively.

8.4 Volume Reductions

Yield tables will be reduced to account for wildlife tree patches by 1.4%. This is consistent with the last management plan.

8.5 Silviculture Management Regimes

This section describes how each stand is regenerated after harvesting.

8.5.1 Regeneration Delay

Regeneration delay is the time elapsed between harvesting and the establishment of a new stand of trees. The end of the regeneration delay is time zero for a yield table; it is the point in time when measurable stand growth begins. For this analysis, regeneration delays will be applied in the timber supply model, rather than in the yield curve construction. The regeneration delay is 2 years and was estimated by Interfor staff.

8.5.2 Genetic Gains

Based on sowing years 2005-2009, the weighted average genetic gain is 6.2% for TFL 23. Orchard production forecasts indicate that future supply of class A seed will increase as will the associated genetic worth. As the availability of class A seed increases so will its use on TFL 23. In 5 years it is estimated that 75% of seed use on TFL 23 will originate from class A sources. In 5 years estimated weighted average genetic gain of all seed use is 12%. This analysis used 6.2 % which is a modest estimate looking forward. Table 8.2 shows amount of each class seed used annually since 2005 and the weighted average used in this analysis. Numbers shown are in 000's of seedlings. The number of trees with genetic gain (column "GW trees") is less than the class A column because PW is class A but has a genetic worth (GW) of zero. Genetic gains are applied to the future managed stands only (not existing managed).

Table 8.2 Determining Genetic Gains for TFL 23

Sowing Year	Class A	Class B+	Class B	Total	Wtd. GW	GW trees	GW=0	GW- all trees	Area Wtd GW
2005	2,402.9	36	1538	3,976.9	10	2,167.0	1,809.9	5.4	1.8
2006	1,897.6	46	1,597.7	3,541.3	15	1,612.9	1,928.4	6.8	2.0
2007	1,524.1	8	1,236.7	2,768.8	14	1,342.4	1,426.4	6.8	1.5
2008	493	63	1,102.5	1,658.5	22	399	1,259.5	5.3	0.7
2009	151.6	0	125	276.6	15	151.6	125	8.2	0.2
Total	**6,469.2**	**153**	**5,599.9**	**12,222.1**		**5,672.9**	**6549.2**	**Wtd Avg.**	**6.2%**

8.5.3 Existing Managed and Future Managed Stand Yield Tables

Managed AUs have been aggregated on BEC zone and leading site series (from the updated PEM). Managed stand AUs are split into two groups: existing managed and future managed. Existing managed stands are those stands that are less then 35 years old in the inventory and are harvested pre-2005. Future managed stands are those that were harvested post 2005 or are forecast to be harvested in the analysis.

Both existing managed and future managed stand yield tables (MSYTs) were modeled using MoFR's "Table Interpolation Program for Stand Yields" (TIPSY). Table 8.3 presents the managed species composition by AU. Assumptions that are constant for all managed AUs are:

- Site index is estimated from SIBEC (see Table 7.4);
- Regeneration method: all planted;
- Initial planted stocking: 1,320 stems/ha (no additional allowances made for natural regeneration);
- Regeneration delay: 2 years;
- Standard operational adjustment factors (OAFs) of 15% and 5% were used in managed stands in all cases except for armillaria areas. OAF1 accounts for stocking holes in stands and OAF2 accounts for age dependent losses such as disease.

The assumption that differs between existing managed and future managed is that of GG: a GG of 0% is used for existing managed and a GG of 6.2% is used for future managed AUs.

Table 8.3 Existing and Future Managed AU TIPSY Inputs

Existing Managed AU #	Future Managed AU #	Description	Sp1	Sp1 %	Sp2	Sp2 %	Sp3	Sp3 %
1	**21**	ESSFwc1-01	S	80	Fd	10	Cw	10
2	**22**	ESSFwc1-02	S	80	Fd	10	Cw	10
3	**23**	ESSFwc4-01	S	85	Bl	15		
4	**24**	ESSFwc4-02	S	75	Pl	25		
5	**25**	ESSFwc4-03	S	80	Bl	20		
6	**26**	ESSFwc4-04	S	70	Pl	30		
7	**27**	ESSFwcp-01	S	80	Fd	10	Cw	10
8	**28**	ICHdw-01a	Fd	50	Pw	40	Lw	10
9	**29**	ICHdw-02	Fd	50	Pw	25	Py	25
10	**30**	ICHmw2-01	Fd	40	Lw	30	Pw	30
11	**31**	ICHmw2-02	Fd	50	Lw	25	Pw	25
12	**32**	ICHmw2-03	Fd	50	Lw	30	Pw	20
13	**33**	ICHmw2-04	Fd	40	Lw	40	Pw	20
14	**34**	ICHvk1-03	S	40	Cw	30	Fd	30
15	**35**	ICHvk1-04	S	40	Cw	30	Fd	30
16	**36**	ICHwk1-01	S	40	Cw	30	Fd	30
17	**37**	ICHwk1-02	S	40	Cw	30	Fd	30
18	**38**	ICHwk1-04	S	40	Cw	30	Fd	30
19	**39**	ICHwk1-05	S	40	Cw	30	Fd	30
20	**40**	IDFun-04	Fd	60	Py	40		

8.6 Silviculture History

8.6.1 Immature Managed Stands

All stands with a current age less than 36 are assigned to managed stand yield curves, reflecting the length of silviculture history of the license. Stands older than 35 years are assigned to natural stand yield curves.

8.6.2 Current and Backlog Not Satisfactorily Restocked Areas

For every stand scheduled for harvest there is a target period for regeneration following harvest. Land that fails to regenerate during this period is considered backlog NSR. Land that has been harvested recently, for which the regeneration delay period has not yet expired, is current NSR. Current NSR is part of the working forest and will be regenerated on schedule. It is assumed that all NSR area will be replanted within the first five (5) years of the planning horizon and will be modeled by assigning the areas to managed stand yield tables.

9.0 NON RECOVERABLE LOSSES

Damage to timber caused by fire, wind, insects, diseases and other pests contribute to loss in harvestable volumes. This volume loss is difficult to quantify, although losses to insect and disease that normally occupy stands (endemic losses) are accounted for in empirical yield curve estimates. Depending on the type of damage and stand accessibility, losses due to catastrophic or epidemic events may be either salvageable or unsalvageable. These non-recoverable losses are not accounted for in the yield curves.

Annual unsalvaged losses are estimated at 16,500 m^3/year (years 1 – 100) and 14,500 m^3/year (years 100 onwards) and are summarized in Table 9.1 below. These numbers are taken from MP 9 estimates and pro-rated for the new size of the TFL THLB (63%).

Table 9.1 Estimated non-recoverable losses

Category	Loss (m3/year)	
	Year 1 - 100	Year 100 +
Fire	4,485	4,485
Insects	8,212	8,212
Disease	1,826	0
Wind	1,895	1,895
Total	**16,417**	**14,592**

9.1 Mountain Pine Beetle Losses

Losses attributed to the mountain pine beetle (MPB) are modeled separately from the NRL estimation and explicitly in this analysis. This section details the MPB modeling assumptions.

9.2 MPB Projections

Since 1999, the MoFR has been projecting the spread of MPB throughout the province and recalibrating the projections each year with the forest health overview. The projections have been made using raster based stochastic modelling in SELES. The output provided from the MoFR are two 400m X 400m (16 ha) grids for each year projected. The first grid has the percent of the pine affected by MPB and the second has the percent of the stand that is pine. The percent of each grid that is affected is calculated by multiplying the percent pine MPB affected by the percent pine.

To provide consistency in reporting the percent of the stand affected has been classified using the forest health overview (FHO) classification system. This classification system is shown in Table 9.2.

Table 9.2 MoFR Severity Class Definition

Classification	Classification abbreviation	% of stand attacked by MPB
Trace	T	0 – 1 %
Light	L	1 – 10 %
Moderate	M	10 -30 %
Severe	S	30 – 50 %
Very Severe	V	> 50 %

One important variance from the FHO classification system is that the MoFR MPB projections are reported showing the accumulative impact of MPB instead of the annual impact. This was done because the MPB projections rarely showed annual impacts beyond the trace and low classes and because the overall impact is more important for making strategic level decisions.

Figure 9.1 summarizes MPB severity between the years 2010 and 2017. From this projection summary, it can be seen that almost all of the potential infection area is affected by 2010. From this time onwards, the general trend is for already infected stands to become more infected- their severity rating increases from low → moderate → severe → very severe. By the year 2017, this movement towards increasing severity has run its course and all the area is affected to its potential.

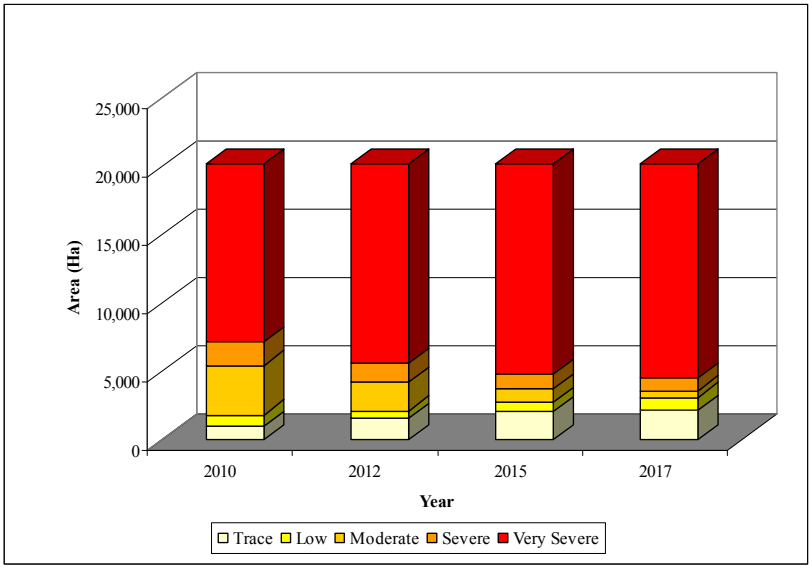

Figure 9.1 Summary of Area by MPB Severity

9.3 Shelf Life

Shelf life is defined as the time a stand will remain economically viable to harvest. In this analysis, that this economic limit is when a stand has 150 m^3/ha of merchantable sawlog volume. Figure 9.2 show the percentage of volume that is considered viable as sawlogs is dependent on the time since affected. This time is taken from the year that a stand first becomes "very severely" (over 50%) affected by MPB.

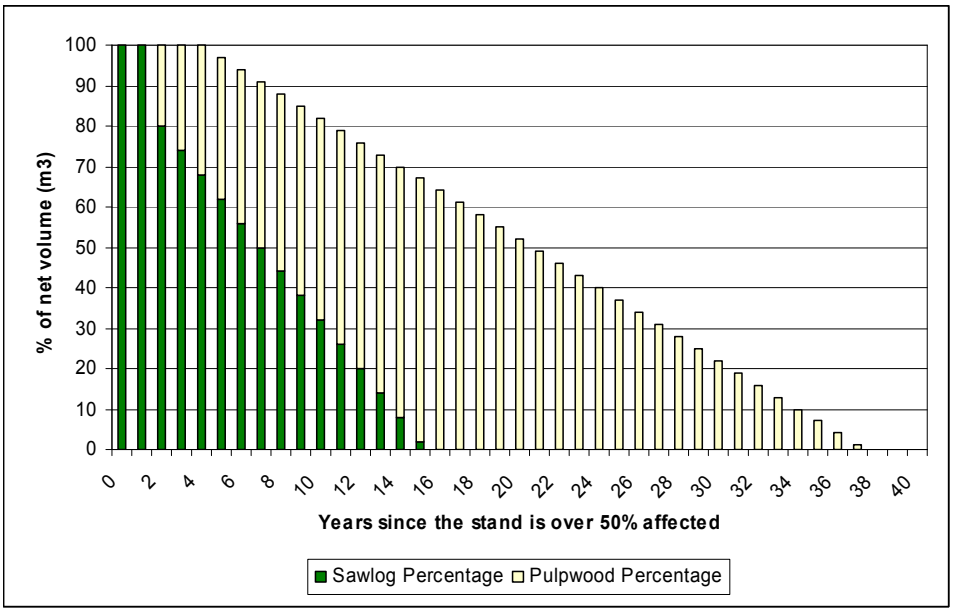

Figure 9.2 Shelf Life decay Curve

9.4 Large Scale Salvage Retention

In areas that are heavily infested with MPB it is appropriate to have large scale salvage, which increase the size of openings (Eng, 2004). In such cases it is recommended that stand level retention is increased. The retention percentage recommended is 20% (Eng, 2004). It was calculated that there was already enough non-THLB MPB affected areas to account for this 20% retention, so no additional stand level retention is modelled.

9.5 Pine and Non-Pine Harvest

After discussion with Interfor, no explicit pine harvest target was set but instead V MPB affected pine leading stands were prioritized for harvest as they became affected (after Forest development plan (FDP) blocks).

9.6 Unharvested MPB stands

Stands that are not harvested before their merchantable sawlog volume drops below 150 m^3/ha are assumed to be unavailable for harvest and have their pine volume lost. The schema below (Figure 9.3) shows how the productive landbase is classified into various MPB classes and the reductions that apply to each of these classes.

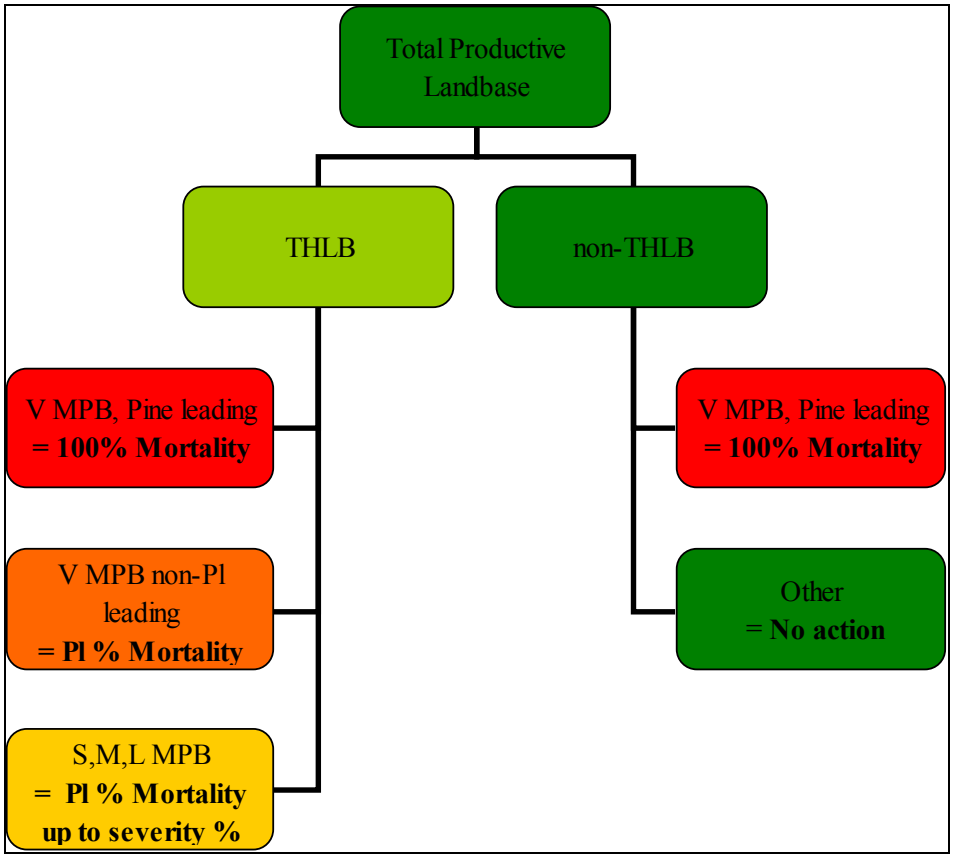

Figure 9.3 MPB Affected Stand Classification and Volume Reduction

If a stand is not harvested, it is treated according to the following rules:

1. V MPB affected pine leading stands:
    - 15 year regeneration delay;
    - Grow back on a natural stand yield curve.
2. S, M, L MPB affected stands and V MPB affected stands that are not pine leading:
    - Stands with severe, moderate or low MPB infestation continue growing on the natural stand yield curve with volume reductions according to level of infestation (S-40%, M - 20% and L - 5%). Stands cannot have their volume reduced by more than their pine percentage. These volumes reductions are applied 5 years after infection.
3. On non-THLB productive land, pine leading stands that are projected to be very severe impacted by 2017 are all reduced by 100%.

10.0 INTEGRATED RESOURCE MANAGEMENT

This section provides details on how modeling methodology will address non-timber resource requirements.

10.1 Forest Resource Inventories

The source of the non-timber resource inventories was provided in section 5.3 "Data Sources".

10.2 Forest Cover Requirements

The analysis will apply forest cover objectives to specific RMZs such as wildlife habitat guidelines, biodiversity, hydrologic green-up, and VQOs. Forest cover objectives explicitly implement maximum and minimum limits on the amount of young second growth and/or old growth found in each RMZ. Productive forest stands that have been excluded from the THLB such as inoperable and uneconomic forest types are included to better model forest structure and disturbance levels. If an area has multiple overlapping forest cover objectives, this area must satisfy all the objectives before harvesting is allowed.

Timberline's proprietary simulation model CASH6 has the option of using a pseudo-geographic or full spatial approach to modeling timber availability, giving considerable flexibility depending on data structure and analysis objectives. This allows the analysis to mirror, as closely as possible, the intent of forest cover objectives on harvesting in operations.

In CASH, there are three forest cover constraint classes available for modeling within each forest cover group:

- Disturbance - the maximum area that can be younger than a specified age or shorter than a specified height. This is intended to model cutblock adjacency and green-up requirements.
- Mature Retention - the minimum proportion of area that must be retained over a lower retention age. This is intended to model snow interception cover for wildlife.
- Old growth Retention - the minimum area that must be older than, or as old as, a specified age. This is intended to model both retention of cover and retention of old growth.

The use of forest cover objectives as described above improves forest management modeling by ensuring that non-timber resources are given appropriate consideration. For example, mule deer winter range (MDWR) will be managed through the application of retention and disturbance constraints. Known scenic areas will be managed by the application of VQOs in the form of disturbance constraints.

10.2.1 Visuals

Explicit spatial VQOs have been established in TFL 23. Visual objectives must be met at the visual polygon level. Each VQO polygon has a visual quality class (VQC) associated with it: partial retention (PR) or modification (M). This VQC has a maximum percentage to be below a given height associated with it (15% for PR and 25% for M). Each VQO polygon has a specific retention requirement calculated

(height) depending on slope distribution in the polygon. The retention requirements (VQC and height) for TFL 23 are shown in Table 10.1 below. Since the height is different for each visual polygon, areas were summarized by VQC class and height rounded to the nearest integer.

Table 10.1 VQO Area and Retention Requirements

VQC-Retention %	Height (rounded to integer)	Area (ha)		
		THLB	non-THLB Productive	Total Productive
PR-15%	**4**	3,043	594	3,637
PR-15%	**5**	13,587	7,577	21,165
PR-15%	**6**	40	16	56
PR-15%	**7**	92	3	95
M-25%	**3**	138	61	199
M-25%	**4**	22,667	5,083	27,750
M-25%	**5**	12,151	8,064	20,215
M-25%	**6**	1,059	1,412	2,471
Total		52,777	22,810	75,588

10.2.2 Mule Deer Winter Range

MDWR requirements are legislated through the Ungulate Winter Range Order #U-4-001. This can be found at the MoFR approved ungulate winter ranges website at http://www.env.gov.bc.ca/wld. The general wildlife measures (GWMs) in this document outline two types of requirements: mature retention requirements and disturbance requirements. These are applied to the productive area of each MDWR management unit.

The requirements are based upon the attribute of snow interception cover (SIC) that is identified spatially by BEC zone. The MDWR requirements that are applied by BEC are shown in Table 10.2 and the area that this is applied to is shown in

Table 10.3.

Table 10.2 MDWR Disturbance and Retention Requirements

BEC Zone	Disturbance Requirement		Retention Requirement	
	Maximum %	Maximum Age	Minimum %	Minimum Age
ICHxw, IDFun	40%	21	20%	81
ICHdw, MSdk			30%	81
ICHmw, ICHwk			40%	101

Table 10.3 MDWR Area by Requirement

BEC	Area (ha)		
	THLB	non-THLB Productive	Total Productive
ICHxw, IDFun	0	0	0
ICHdw, MSdk	8,601	1,538	10,140
ICHmw, ICHwk	7,749	4,632	12,381
Total	16,351	6,170	22,521

10.2.3 Moose

Moose requirements are legislated through the Ungulate Winter Range Order #U-4-001. This can be found at the MoFR approved ungulate winter ranges website at http://www.env.gov.bc.ca/wld. The general wildlife measures (GWMs) in this document outline two types of requirements: mature retention requirements and disturbance requirements. These are applied to the productive area of each moose management unit:

- A maximum of 40% can be less than 21 years old; and
- A minimum of 20% must be greater than 60 years old.

Table 10.4 shows the area by moose management unit.

Table 10.4 Moose Management Unit Areas

Moose Management Unit	Area (ha)		
	THLB	non-THLB Productive	Total Productive
4	93	26	120
50	3,385	448	3,833
55	2,110	258	2,368
59	2,495	200	2,695
60	2,621	587	3,208
63	2,553	484	3,037
69	3,009	575	3,584
70	853	154	1,007
76	1,451	158	1,609
Total	18,571	2,890	21,461

10.2.4 Integrated Resource Management

The IRM zone is modeled by enforcing a maximum disturbance allowed on the THLB by each LU-BEC combination. A maximum of 25% can be less than 2.5 m height in each LU-BEC zone. Areas are only in the IRM zone if they are on the THLB and are not covered by any other RMZ. The area by IRM zone is shown in Table 10.5. Spatial adjacency has also been modeled for the initial 20 years. Spatial adjacency makes stands unavailable for harvest until neighboring stands have achieved green-up (2.5m).

Table 10.5 Integrated Resource Management Zone Areas

LU-BEC	Area (ha)		
	THLB	non-THLB Productive	Total Productive
N510-ESSFwc1	930	0	930
N510-ESSFwc4	831	0	831
N510-ICHdw	2,651	0	2,651
N510-ICHmw2	2,911	0	2,911
N511-ESSFwc1	3	0	3
N511-ESSFwc4	3	0	3
N511-ICHdw	7	0	7
N511-ICHmw2	3	0	3
N511-IDFun	4	0	4
N518-ESSFwc1	0	0	0
N518-ESSFwc4	10	0	10
N518-ESSFwcp	15	0	15
N518-ICHdw	12	0	12
N518-ICHmw2	0	0	0
N520-ESSFwc1	222	0	222
N520-ESSFwc4	10	0	10
N520-ESSFwcp	1	0	1
N520-ICHmw2	1,279	0	1,279
N520-ICHwk1	479	0	479
N521-ESSFwc1	574	0	574
N521-ESSFwc4	1,040	0	1,040
N521-ICHmw2	1,709	0	1,709
N526-ESSFwc1	265	0	265
N526-ESSFwc4	94	0	94
N526-ICHmw2	5,322	0	5,322
N527-ESSFwc1	2,158	0	2,158
N527-ESSFwc4	2,216	0	2,216
N527-ICHmw2	3,313	0	3,313
N527-ICHwk1	2,154	0	2,154
N528-ICHmw2	378	0	378
N529-ESSFwc1	193	0	193
N529-ESSFwc4	213	0	213
N529-ESSFwcp	1	0	1
N529-ICHmw2	4,179	0	4,179
N529-ICHwk1	932	0	932
N530-ESSFwc1	16	0	16
N530-ESSFwc4	7	0	7
N530-ICHmw2	231	0	231
N530-ICHvk1	9	0	9
N530-ICHwk1	39	0	39
N531-ESSFwc1	633	0	633
N531-ESSFwc4	449	0	449
N531-ESSFwcp	6	0	6
N531-ICHmw2	356	0	356
N531-ICHvk1	3,370	0	3,370
N531-ICHwk1	1,298	0	1,298
R1-ESSFwc1	0	0	0

LU-BEC	Area (ha)		
	THLB	non-THLB Productive	Total Productive
R1-ESSFwc4	14	0	14
R1-ICHmw2	105	0	105
R1-ICHwk1	23	0	23
R2-ICHmw3	0	0	0
Total	40,667	0	40,667

10.3 Biodiversity

10.3.1 Landscape level Biodiversity

Landscape level biodiversity is accounted for by old growth management areas (OGMAs) OGMAs cannot be harvested but are available to contribute to resource management requirements. As shown in the netdown, 11,279 ha were removed from the THLB for OGMAs.

10.3.2 Stand Level Biodiversity

The practice of leaving wildlife tree patches (WTPs) was modeled by reducing the average volume per hectare harvested, in order to account for trees that must be left within cutblocks. 1.4% was the reduction factor used in the analysis, consistent with the last management plan.

10.4 Cultural Heritage Resources

There are no known cultural heritage resources with any associated timber supply impact within the boundaries of TFL 23.

10.5 Timber Harvesting

10.5.1 Minimum Merchantability Standards

Minimum harvest age (MHA) was assessed for each AU, as the age at which the mean annual increment (MAI) in stand volume reaches 90% of it's maximum value with a minimum harvest volume of 150 m^3/ha to reflect operational reality. Culmination age is defined as the age at which stand volume, less decay, waste and breakage, is maximized (to a precision of one decimal place). Because of the large number of natural AUs, the specific MHAs are not shown here.

10.5.2 Silviculture Systems

Current management practice on TFL 23 indicates that clear cut harvesting is the only silvicultural system.

10.5.3 Initial Harvest Rate

The current AAC for TFL 23 is 680,000 m^3/yr plus NRLs. However, there have been significant reductions to the THLB (BCTS and private land removals) and the currently allotted harvest level is 460,000 m^3/year. The initial harvest rate will be a product of the biological capacity of the remaining landbase and the analysis.

10.5.4 Harvest Rule

Harvest rules are used by the simulation model to rank stands for harvest. The harvest rule is oldest first. With this rule, older stands are queued for harvest ahead of younger stands. Harvest rules interact with forest cover constraints to determine the actual order of harvesting within the model. If a higher ranked stand is in a constrained zone and cannot be harvested then the model will choose the next highest ranked stand that is unconstrained to be harvested.

10.5.5 Disturbing the Non-THLB

When modeling, the entire productive landbase is available to fulfill various landbase requirements (i.e. seral requirements, retention requirements and thermal requirements). The productive area that is not part of the THLB (non-THLB) will continuously age throughout the planning horizon because harvesting is traditionally the only form of disturbance modeled. This causes concern because eventually, in the model, all the non-THLB becomes old. This can lead to the non-THLB fulfilling an unrealistic portion of forest cover requirements, thereby reducing the impact on the timber harvest landbase. In reality, there will be some level of natural disturbance within the non-THLB, but there is much debate around the frequency, location, and size of these disturbances.

This Section describes the process of disturbing the non-THLB used for this analysis. The intentions are to achieve the early, mature and old seral percentages for each BEC variant in accordance with the natural range of variation defined in the *Biodiversity Guidebook*. The method used for this analysis is to:

1. Impose an annual disturbance to the non-THLB of each BEC zone. The size of the disturbance will be determined from the disturbance frequency in the *Biodiversity Guidebook*; and
2. A seral requirement will be imposed on the non-THLB of each BEC variant, which will force the non-THLB to achieve a seral zone distribution similar to the natural range of variation (NROV) from the *Biodiversity Guidebook*.

This process will achieve the natural range of variation (NROV) for each BEC zone on TFL 23, however, by design, there will be some variations within individual landscape units. The model will recruit the oldest stands in order to achieve the seral requirements as soon as possible and it will disturb the remaining area using the harvest (disturb) oldest first. This will impose the desired disturbance each year and achieve a seral stage distribution compatible with the NROV.

This process has been carried out by:

1. Determining the BEC zones and their area breakdown on TFL 23;

2. Using the Biodiversity Guidebook to determine the NDT, disturbance interval, age of mature age and of old for each BEC zone;
3. Estimate the seral stage distribution following the Biodiversity Guidebook procedure;
4. Determine the appropriate old seral requirement for each BEC zone; and
5. Determine the annual disturbance for each BEC zone.

Table 10.6 provides the seral zone requirements that will be placed on the BEC zones in order to achieve the desired NROV summary information for the BEC zones on TFL 23.

Table 10.6 Disturbance intervals and age of mature and old by BEC zone

BEC	Seral requirements			
	Mature Plus Old		Old	
	%	Age	%	Age
ESSFwc1	71	120	49	250
ESSFwc4	71	120	49	250
ESSFwcp	71	120	49	250
ICHdw	51	100	39	140
ICHmw2	61	100	29	250
ICHvk1	67	100	37	250
ICHwk1	67	100	37	250

The seral stage distribution is estimated using the negative exponential equation from Appendix 4 of the *Biodiversity Guidebook*. The negative exponential equation uses disturbance return interval and gives the percent older than the input age:

Percent older than specified age = exp (-[age/return interval])

Table 10.7 shows the seral stage distribution for the fire return intervals that occur in TFL 23.

Table 10.7 Cumulative age distribution using by mean disturbance interval

Age	150		200		250		350	
	>	<	>	<	>	<	>	<
20	88%	12%	90%	10%	92%	8%	94%	6%
40	77%	23%	82%	18%	85%	15%	89%	11%
60	67%	33%	74%	26%	79%	21%	84%	16%
80	59%	41%	67%	33%	73%	27%	80%	20%
100	51%	49%	61%	39%	67%	33%	75%	25%
120	45%	55%	55%	45%	62%	38%	71%	29%
140	39%	61%	50%	50%	57%	43%	67%	33%
160	34%	66%	45%	55%	53%	47%	63%	37%
180	30%	70%	41%	59%	49%	51%	60%	40%

200	26%	74%	37%	63%	45%	55%	56%	44%
220	23%	77%	33%	67%	41%	59%	53%	47%
240	20%	80%	30%	70%	38%	62%	50%	50%
250	19%	81%	29%	71%	37%	63%	49%	51%

Table 10.8 shows the area that will be disturbed each year in each BEC zone.

Table 10.8 Annual disturbance and seral requirement for the non-THLB

BEC	Disturbance Interval	Non-THLB Prod Area	Annual Disturbance (%)	Annual Disturbance (ha)
ESSFwc1	350	14,251	0.29%	41
ESSFwc4	350	39,722	0.29%	113
ESSFwcp	350	3,204	0.29%	9
ICHdw	150	8,474	0.67%	56
ICHmw2	200	21,069	0.50%	105
ICHvk1	250	4,617	0.40%	18
ICHwk1	250	11,800	0.40%	47

10.6 Natural Range of Variation

When reporting on environmental trends it is important to provide a baseline for comparison. The current status of our forest does not provide for an appropriate baseline for comparison because it has resulted from anthropogenic pressures. However, much like our inability to predict how nature will disturb the inoperable, we are unable to predict how nature would have disturbed the landbase had humans not intervened. For the purpose of this analysis the natural range of variation will be based on the exponential equation used to create Table 10.8.

11.0 SENSITIVITY ANALYSES

This section briefly describes the sensitivity analyses that will be performed on the basecase. The sensitivities reflect the stability of the basecase in the face of uncertainty surrounding specific analysis assumptions. They also reflect the impact of alternative management or potential changes in forest practices.

11.1 Landbase definition

11.1.1 Timber Harvesting Landbase +/- 10%

Area will be shifted between the noncontributing and net landbase components to simulate changes in the operable landbase definition.

11.2 Growth and Yield Assumptions

11.2.1 Natural Stand Yields +/- 10%

All natural stand yield curves will be adjusted to measure the timber supply impact.

11.2.2 Managed Stand Yields +/- 10%

All managed stand yield curves will be adjusted to measure the timber supply impact.

11.2.3 Minimum Harvest Ages +/- 10 years

Minimum harvest ages will be altered to measure timber supply impact

11.2.4 Site Index +/- 1 meter

Managed and natural stand site index will be altered to measure the timber supply impact.

11.3 Resource Management Areas Assumptions

11.3.1 Green-up Heights +/- 1 meter

Green-up heights will be altered to measure the timber supply impact (IRM will use 1.5m and 3.5m).

11.3.2 Aspatial Seral Requirements

Using aspatial old seral retention requirements to satisfy landscape level biodiversity requirements instead of spatial OGMAs.

11.3.3 Optimized OGMAs

Using OGMAs identified in the "TFL 23 OGMA Optimization" Project (Timberline, 2009) in place of the ILMB draft spatial OGMAs used in the basecase.

11.3.4 Visuals

Visual requirements will be removed to measure the timber supply impact.

11.3.5 Caribou

Previous caribou retention requirements will be applied in place of the present netdowns.

11.4 Alternate Harvest Conventions

11.4.1 Alternate Harvest Rules

The basecase harvest rule is the oldest first harvest rule. This sensitivity will evaluate the impact of modelling alternative harvest rules, including:

- Relative oldest first (the difference in age relative to minimum harvest age); and
- Maximum volume harvested.

11.4.2 Alternate Harvest levels

This sensitivity will test a different harvest level option: the maximum harvest level for 10 years while maintaining a midterm harvest level above the natural stand LRSY.

11.5 Mountain Pine Beetle

11.5.1 No MPB Harvest Prioritization

The basecase prioritizes MPB affected stands in order of severity, with higher severity stands being prioritized first. This sensitivity will test the harvest level impact of using no prioritization for MPB affected stands and only using the harvest oldest first rule in place.

11.5.2 MPB spread slows

Model the impact of the MPB spread occurring slower than projected. The projections will be adjusted by 5 years.

12.0 REFERENCES

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13.0 APPENDIX 1: MANAGED STAND YIELD TABLES

Table 13.1 Existing Managed AU Yield Tables

Existing Managed	ESSFwc1-01-ex_man	ESSFwc1-02-ex_man	ESSFwc4-01-ex_man	ESSFwc4-02-ex_man	ESSFwc4-03-ex_man	ESSFwc4-04-ex_man	ESSFwcp-01-ex_man	ICHdw-01a-ex_man	ICHdw-02-ex_man	ICHmw2-01-ex_man	ICHmw2-02-ex_man	ICHmw2-03-ex_man	ICHmw2-04-ex_man	ICHvk1-03-ex_man	ICHvk1-04-ex_man	ICHwk1-01-ex_man	ICHwk1-02-ex_man	ICHwk1-04-ex_man	ICHwk1-05-ex_man	IDFun-04-fut_man
10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30	0	0	0	1	0	1	0	12	0	2	0	5	3	1	5	3	2	1	26	0
40	14	14	3	14	13	16	0	81	11	30	11	47	36	32	69	57	37	33	123	13
50	71	71	39	58	65	61	4	173	55	92	49	121	100	104	162	144	113	106	231	58
60	144	144	97	118	136	120	30	259	120	161	106	191	168	184	248	230	196	187	327	120
70	210	210	162	179	200	180	73	339	179	223	161	257	229	254	328	304	266	257	413	176
80	271	271	217	230	259	229	122	413	235	283	210	318	288	321	398	376	335	324	481	227
90	331	331	270	279	319	278	170	473	288	337	256	374	340	381	457	434	395	385	537	278
100	379	379	322	324	365	321	213	525	337	385	300	424	388	432	504	482	445	435	593	324
110	414	414	363	359	398	355	252	567	380	426	337	465	429	473	547	523	486	476	636	367
120	443	443	392	383	423	378	293	600	419	462	371	499	463	509	589	563	522	512	668	405
130	467	467	416	403	443	397	329	626	452	491	401	530	491	543	623	600	558	546	696	438
140	486	486	434	419	459	413	359	649	482	516	427	556	516	575	647	628	590	579	720	468
150	505	505	449	432	473	426	383	669	506	538	450	577	539	604	669	649	617	607	740	493
160	520	520	462	444	484	438	404	687	527	558	468	594	557	624	688	668	635	627	757	515
170	534	534	473	454	492	447	421	703	546	572	483	608	571	640	704	685	652	643	771	534
180	544	544	481	461	500	455	435	718	562	585	497	620	583	656	719	699	667	659	771	552
190	548	548	487	468	501	461	448	731	577	596	510	631	594	669	731	712	681	672	771	567
200	551	551	493	473	501	467	459	743	589	606	521	641	602	681	741	724	693	684	771	579
210	554	554	496	472	501	466	469	751	600	615	531	650	605	692	749	732	703	695	771	590
220	556	556	495	472	500	465	479	758	611	622	541	657	609	701	756	739	712	704	771	600
230	557	557	495	471	499	465	487	765	620	629	548	664	612	710	763	746	719	712	771	608
240	559	559	494	470	497	464	494	768	627	635	555	670	615	715	763	751	725	718	771	615
250	560	560	493	469	496	464	500	771	634	640	561	676	618	720	763	757	729	722	771	622
260	561	561	491	468	495	462	506	774	641	646	566	681	621	724	763	757	734	726	771	628
270	561	561	489	466	494	461	511	777	647	650	572	684	623	728	763	757	738	730	771	633
280	561	561	487	465	492	460	512	777	652	653	576	688	625	731	763	757	741	734	771	637
290	559	559	485	463	489	458	512	777	655	656	580	691	626	734	763	757	745	737	771	640
300	559	559	485	463	489	458	512	777	655	656	580	691	626	734	763	757	745	737	771	640
310	559	559	485	463	489	458	512	777	655	656	580	691	626	734	763	757	745	737	771	640
320	559	559	485	463	489	458	512	777	655	656	580	691	626	734	763	757	745	737	771	640
330	559	559	485	463	489	458	512	777	655	656	580	691	626	734	763	757	745	737	771	640
340	559	559	485	463	489	458	512	777	655	656	580	691	626	734	763	757	745	737	771	640
350	559	559	485	463	489	458	512	777	655	656	580	691	626	734	763	757	745	737	771	640

Table 13.2 Future Managed AU Yield Tables

Future Managed	ESSFwc1-01-fut_man	ESSFwc1-02-fut_man	ESSFwc4-01-fut_man	ESSFwc4-02-fut_man	ESSFwc4-03-fut_man	ESSFwc4-04-fut_man	ESSFwcp-01-fut_man	ICHdw-01a-fut_man	ICHdw-02-fut_man	ICHmw2-01-fut_man	ICHmw2-02-fut_man	ICHmw2-03-fut_man	ICHmw2-04-fut_man	ICHvk1-03-fut_man	ICHvk1-04-fut_man	ICHwk1-01-fut_man	ICHwk1-02-fut_man	ICHwk1-04-fut_man	ICHwk1-05-fut_man	IDFun-04-fut_man
10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30	0	0	0	2	0	2	0	18	1	3	1	8	5	2	8	6	2	2	37	1
40	19	19	7	20	17	22	0	97	16	38	15	59	45	42	84	71	48	43	143	19
50	85	85	48	69	78	72	7	191	66	106	59	137	115	120	181	163	130	123	252	69
60	161	161	112	134	153	136	38	280	134	176	120	207	183	203	268	248	215	206	352	134
70	228	228	178	194	217	195	84	362	193	240	174	276	247	273	350	327	286	277	437	190
80	293	293	234	246	280	246	136	436	251	300	225	337	305	341	420	397	356	345	503	244
90	351	351	290	299	338	297	184	494	305	355	272	394	359	401	476	454	415	404	561	294
100	395	395	340	341	381	338	227	546	353	403	315	442	406	450	523	500	463	453	616	340
110	430	430	378	372	413	368	268	585	396	443	352	482	446	490	568	541	503	493	652	383
120	457	457	406	396	436	391	309	616	434	478	385	516	479	524	608	582	539	528	684	420
130	479	479	427	414	455	409	343	641	467	505	415	546	506	560	636	617	575	563	710	452
140	499	499	445	430	470	424	372	663	495	530	440	569	530	591	660	639	606	595	733	481
150	516	516	459	442	483	436	394	682	517	551	461	588	551	616	680	660	627	619	751	504
160	531	531	471	454	492	447	414	699	537	568	477	604	566	633	698	678	645	636	767	525
170	544	544	481	462	500	455	430	714	555	581	492	617	580	649	714	694	661	652	767	543
180	547	547	488	469	503	462	444	727	571	593	505	628	591	664	727	708	675	667	767	560
190	551	551	494	475	503	468	455	740	584	603	517	638	601	676	738	720	688	679	767	574
200	554	554	498	475	503	468	466	749	595	612	527	647	604	688	746	729	699	690	767	585
210	556	556	497	474	503	468	476	756	606	620	536	655	607	697	754	736	709	700	767	595
220	558	558	497	473	501	467	485	762	615	626	545	662	610	706	754	743	716	708	767	604
230	559	559	496	473	500	467	492	767	623	632	551	668	613	713	754	749	722	715	767	611
240	560	560	495	472	498	466	499	770	630	637	557	673	616	717	754	754	727	720	767	618
250	561	561	493	470	497	464	505	772	636	642	563	678	619	722	754	754	731	724	767	624
260	562	562	491	468	496	463	510	775	642	647	568	682	621	725	754	754	735	728	767	629
270	562	562	489	467	495	462	512	777	647	651	573	686	623	729	754	754	739	731	767	634
280	560	560	487	465	492	460	512	777	652	654	577	689	625	732	754	754	742	734	767	637
290	558	558	485	464	488	459	513	777	655	657	580	692	626	735	754	754	742	738	767	641
300	558	558	485	464	488	459	513	777	655	657	580	692	626	735	754	754	742	738	767	641
310	558	558	485	464	488	459	513	777	655	657	580	692	626	735	754	754	742	738	767	641
320	558	558	485	464	488	459	513	777	655	657	580	692	626	735	754	754	742	738	767	641
330	558	558	485	464	488	459	513	777	655	657	580	692	626	735	754	754	742	738	767	641
340	558	558	485	464	488	459	513	777	655	657	580	692	626	735	754	754	742	738	767	641
350	558	558	485	464	488	459	513	777	655	657	580	692	626	735	754	754	742	738	767	641