TIMBER SUPPLY ANALYSIS
INFORMATION PACKAGE

TREE FARM LICENSE 8
TSR 3

Pope and Talbot Ltd.
Boundary Division

Prepared by:
Timberline Forest Inventory Consultants Ltd.
Kelowna, B.C.

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1.0 INTRODUCTION

This Information Package has been prepared by Timberline Forest Inventory Consultants Ltd. (Timberline) on behalf of Pope & Talbot Ltd. (P&T) as a source document prior to the completion of the Timber Supply Analysis for the TFL 8 TSR 3. P&T has requested a postponement of Management Plan 10 so there is no management plan accompanying this analysis.

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 Base Case 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 CASH6, 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* (BC MoFR, 2001).

Upon acceptance by the British Columbia Ministry of Forests and Range (MoFR) Timber Supply Analyst, the assumptions and methodology provided in the *Information Package* will be used by P&T to prepare and submit a timber supply analysis to the MoFR. All analysis results will be provided to the Chief Forester of British Columbia, or designate, for allowable cut determination.

2.0 TIMBER SUPPLY ANALYSIS PROCESS

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

1. Base Case - current management practice; and
2. Sensitivity analyses.

2.1 Missing Data

At the time this information package was prepared, the following information was unavailable:

- Finalized analysis units and silviculture regimes.

2.1.1 Review Requested information updates

Following MP 10, the chief forester requested the subsequent information updates. These requests are addressed in the following "Response to Requested Information" section.

- A review of the soils ESA classification and terrain stability classification to ensure appropriate land base reductions for unstable terrain;
- Track and report the area harvested in the 8,558 ha within the THLB currently classified as dense pine stands;
- Report the modelled output of harvested piece size and/or harvested tree diameter in the next timber supply analysis;
- Provide and operations-based estimate of residual uneconomic small patches that will be left across the landscape;
- Improve site index estimates in the ESSF biogeoclimatic zone.

2.1.2 Response to Requested Information

2.1.2.1 ESA Classification and Unstable Terrain Review

Terrain stability and ESA classifications were overlaid with 5 years of recent harvesting and it was determined that no significant harvesting was carried out in the ESA classifications. This implies that the landbase reduction applied is reasonable and there was no change made to the TSR 2 assumptions. The terrain classification had one block of 20 ha harvested but the remainder seemed a reasonable netdown. There was no change made to the TSR 2 assumptions.

2.1.2.2 Tracking Dense Pine Stands

Management plan 10 applied a statistical adjustment to the age, height and volume of dense pine stands identified by a survey conducted by J.S. Thrower & Associates. It was requested that these stands be reviewed to justify their inclusion in the timber harvesting landbase. After overlaying these stands with recent harvest history it was determined that 14% of the dense pine stands have been developed over a

six year time horizon. This amount of development indicates that these stands do not need to be a landbase netdown.

2.1.2.3 Reporting of Piece Size/Tree Diameter

This requested information is a modeling output and will be available and included in the analysis report.

2.1.2.4 Residual Uneconomic Patches

In the Rationale for AAC Determination for TFL 8 (December 1, 2002), the deputy chief forester stated in his Reasons for Decision that "I believe a significant number of small patches will be created across the landscape over time, that will neither be logged nor contribute to the required quantum of wildlife tree patches." In the Implementation section of that same document, he went on to request an "operations-based estimate of residual uneconomic small patches that will be left across the landscape …"

P & T has concluded that this concern is related to Item #1 in Section 8. – Recommendations within the Timber Supply Analysis Report (February 14, 2002). which in part indicated that the maximum even flow forecast dropped substantially when patches less than 3 ha in size were removed from the spatial feasibility analysis. It went on to state "Operationally, harvesting is typically limited in these types because the total volume is small and the administration and development cost to permit them are high." It went on to state "It is likely many of these areas will be harvested when surrounding timber is merchantable". In consideration of the above noted differing views regarding whether or not these small patches may be subject to harvesting, P & T is unable to fulfill the deputy chief foresters request at this time.

2.1.2.5 Improved SI estimates in the ESSF

The request for improved estimates of site index for the ESSF BEC zone was carried out in the recent SIA project by J.S. Thrower (JST, 2006), the results of which are incorporated into this analysis.

3.0 TIMBER SUPPLY OPTIONS

3.1 Base Case

3.1.1 Changes from MP 10

The base case is considered representative of current management practice and includes information updates from both the MP 10 base case (2002). Improvements from the MP 10 base case are:

- Spatial analysis, which includes:
    - Blocking layer1;
    - Adjacency for 20 years;
- Updating UWR and Visual zones;
- Harvest FDP/mountain pine beetle (MPB) at risk stands first up to 35% of the cut;
- SIA in ESSF (JST, 2006);
- Incorporating natural disturbances in the non-THLB;
- Moose Winter Range resource emphasis area; and
- MPB modelling.

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 base case. 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 base case (*i.e.* current performance) and varying only the assumption being tested (*i.e.* all other assumptions remain the same as in the base case). The sensitivities that will be carried out for this analysis are listed in Table 3.1.

Table 3.1 Sensitivity analyses

	Sensitivity
THLB definition	+/- 10% THLB
Growth and yield	+/- 10% Natural stand yields +/- 10% Managed stand yields +/- 10% Minimum harvest ages +/- 1meter Site index +/- 2 meter Site index

[1] The blocking layer forces the model to harvest an entire block. In the aspatial mode the model can infinitely split blocks.

	No genetic gains Change merchantability definition
REA assumptions	+/- 1meter VQO green up heights Turn off adjacency and turn on IRM Add Williamson Sapsucker WHA Turn off the Moose Winter Range
Biodiversity Assumptions	Model spatial OGMAs ILMB OGMAs? Turn off Disturbances in the non-THLB
Alternate Harvest Conventions	Relative oldest harvest rule Maximum volume harvested Maximum non declining harvest level Maximum 10 year harvest with mid term at natural LRSY

3.3 Alternative Harvest Flows

3.3.1 No-MPB Epidemic

Forest cover constraints and biological capacity of the net operable landbase will dictate timber availability and harvest level options that are available. With the assumption that there is no MPB epidemic, the choice of harvest flow will reflect the following objectives:

- Maintain a non-declining yield harvest forecast; and
- Achieve a stable long-term harvest level over a 250 year planning horizon.

3.3.2 MPB Epidemic

If the MPB Epidemic hits TFL 8 as projected there will be shortage of timber during the natural to managed transition. This shortage of timber makes it practical to abandon the non-declining harvest forecast and create a mid-term trough. The initial harvest level will be the non-MPB non-declining yield harvest level. After MPB mortality occurs, there will be a drop in harvest level down to the post-MPB mid term harvest level. This level will be determined by the dynamics of the MPB epidemic (i.e. amount and distribution of MPB mortality). After the timber availability recovers from this MPB mortality sufficiently, the long term harvest level will be increased to a stable level.

3.4 Other Options

There are no scenarios additional to this timber supply analysis identified at this time. An extension to MP 10 was requested so there is no full management plan to accompany the timber supply analysis.

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 Forest Inventory Consultants. 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 resource emphasis area definitions. Forested stands in the non-timber harvesting land base (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 TFL8. Disturbance requirements are calculated for each identified VQO polygon as described in section 11.2.1.

CASH6 contains a hierarchical land base 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) and MPB at risk stands (up to 50% of the cut) will be given the highest priority for harvest. 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 existing roads and streams have been buffered to provide specific area reductions from the THLB. Another 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 8 forest cover inventory has been updated for disturbance to Dec 31, 2005 and projected to 2006. In MP 10, a statistical adjustment of inventory attributes was applied to dense lodgepole pine stands, following the results of a study undertaken for P&T (JST, 1999) which is also carried through and used in this analysis. New terrestrial ecosystem mapping (TEM) data has been included and an approved site index adjustment (SIA) project for TFL 8 (JST, 2006). Both the new TEM inventory and the results of the SIA project were used in the derivation of growth and yield relationships for this analysis. Inventories of landscape units, known scenic areas, mule deer wintering areas, riparian classifications, and unstable terrain have recently been updated and are incorporated into the GIS database for use in this analysis.

5.3 Data Sources

Many sources of data were compiled to provide input to this TFL8 timber supply analysis- these are documented in Table 5.1.

Table 5.1 Data Sources

Coverage Description	Coverage Name	Source	Date
BEC Version 6.0	bec_v6	Ministry of Forests	1-May-06
Connectivity Corridors	bfd_conn	Pope & Talbot	1-Nov-06
Landscape Units	bfd_lu_utm	Pope & Talbot	1-Nov-06
Consumptive Streams	cons_stream	Pope & Talbot	1-Nov-06
Domestic watersheds	dom_watershed	Pope & Talbot	1-Nov-06
2005 Forest Development Plan	fdp_2005	Pope & Talbot	1-Nov-06
2006 Forest Development Plan	fdp_2006	Pope & Talbot	1-Nov-06
Fire Maintained Ecosystems	fmer_dbo_utm	Pope & Talbot	1-Nov-06
Terrain Hazard	haz_bd	Pope & Talbot	1-Nov-06
Kootenay Boundary Higher Level Plan BEC	kbhlpo_bec	Ministry of Forests	1-Nov-06
Mule Deer Winter Range	mdwr_dbo_utm	Pope & Talbot	1-Nov-06
Moose	moose_dbo_utm	Pope & Talbot	1-Nov-06
Points of diversion	pod_human	Pope & Talbot	1-Nov-06
Recreation Reserves	rec_reserves	Pope & Talbot	1-Nov-06
Recreation Trails	rec_trail	Pope & Talbot	1-Nov-06
Aspect	tfl_aspect	MSRM	1-Nov-03
TFL 8 Boundary	tfl_bdy	Timberline	1-Dec-00
Biodiversity Emphasis Options	tfl_beo	Ministry of Forests	1-Dec-00
Road Buffers	tfl_da_s	Timberline	1-Dec-00
Old Deer Winter Range	tfl_dwr	MSRM	1-Dec-00
Landscape Units	tfl_lu	Pope & Talbot	1-Dec-00
Ownership	tfl_own	Timberline/MoF	1-Dec-00
Riparian	tfl_rip	MSRM / Forsite / Timberline	1-Dec-00
Slope	tfl_slope	MSRM	1-Nov-03
Trans Canada Trail	tfl_tc	Pope & Talbot	1-Nov-03
Terrain C	tfl_ter_c	Pope & Talbot	1-Dec-00
Terrain D	tfl_ter_d	Pope & Talbot	1-Dec-00
Trappers	trappers	Pope & Talbot	1-Nov-06
VQO	vqo_dab_utm	Pope & Talbot	1-Nov-06
Williamson Sapsucker	wisa	Pope & Talbot	1-Nov-06
Terrestrial Ecosystem Model	tfl_tem	Oikos Ecological, J.S. Thrower & Associates, Timberline	1-Aug-06
Forest Cover	t_fc	Timberline	1-Nov-06

6.0 DESCRIPTION OF LANDBASE

This section describes the TFL 8 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 Net Harvesting Land base 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 Table 6.1. 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 classified as non-commercial 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

Classification	MP 10 Area (ha)	TSR 3 Area (ha)
Total Landbase (incl. fresh water)	**77,727**	**77,727**
Non-crown	247	247
Total TFL (incl. fresh water)	**77,480**	**77,480**
Non-forest	2,857	2,845
Non-productive	1,197	1,152
Roads, Trails and landings		1,090
Total Productive	**73,426**	**72,393**
Non-commercial	231	170
ESAs	1,558	1,533
Unstable terrain	378	254
Low site	450	384
Deciduous	333	149
Non-merchantable	1,501	614
Lake riparian reserves	13	13
Wetland riparian reserves	115	124
Stream riparian reserves	1,833	1,859
Trans-Canada trail	10	10
NSR	2,699	2,679
Total Operable Reductions	**9,121**	**7,789**
Current Net Harvesting Landbase	**64,305**	**64,605**
Future additions in NSR sensitivity	2,699	2,679
Future reductions for roads, trails, landings	2,091	2,175
Long-term Net Harvesting Landbase	**64,913**	**65,109**

6.2 Total Area

The total area of TFL 8 is 77,727 hectares- of this total, 73,483 ha are classified in the inventory as productive forest land.

6.3 Non-forest and Non-productive Forest

A total of 2,845 ha non-forested and 1,152 ha non-productive area was removed from the TFL 8 landbase (productive and THLB) as shown in Table 6.2. Both non-forest and non-productive were identified from forest cover attributes. Non forest was defined as projected type ID 6 or 8. Non productive was defined as non productive forest code: 2, 3, 6, 11, 15, 18, 25, 35, 42, 54, 60, 62 and 63.

Table 6.2 Non-forest and non-productive area reductions

Non Forest/Productive	Area Removed (ha)
Non Forest	2,845
Non Productive	1,152

6.4 Non-Commercial Brush

All land classified as non-commercial in the forest cover inventory database was excluded from the net harvesting landbase as shown in Table 6.3. In this table, as for all following netdown tables; gross, productive and removed area are shown. Area removed is productive area that has not yet been moved from the THLB to the non-THLB by prior reductions. In most cases the area removed will be lower than the productive area.

Table 6.3 Non-Commercial

	Area (ha)		
	Gross	**Productive**	**Removed**
Non Commercial	174	170	170

6.5 Operability

P&T consider all of TFL 8 to be operable and accessible.

6.6 Environmentally Sensitive Areas

All areas classified as highly environmentally sensitive (ESA1s) were removed from the net harvesting landbase, either implicitly as non-crown, non-forest, non-productive or non-commercial, or explicitly as ESA1s. Table 6.4 provides a summary of the ESA1s in TFL 8, a total of 1,533 ha was removed. In this table, P denotes environmental sensitivity due to regeneration, S is due to soils and SP is due to both soils and regeneration. Areas of moderate environmental sensitivity (ESA2s) were not removed from the net harvesting landbase in this analysis because the terrain stability surveys completed for TFL 8 (see Section 6.7) were considered to be a more accurate representation of the areas of moderate environmental sensitivity within the TFL. Furthermore, a review of P&T's operations has shown that many blocks intersect areas identified in the forest cover inventory as ESA2s.

Table 6.4 Environmentally sensitive areas

ESA	Area (ha)		
	Gross	Productive	Removed
P	43	21	21
S	634	595	595
SP	1004	917	917
Total	1,681	1,533	1,533

6.7 Terrain Stability

Terrain stability surveys have been done for the entire TFL 8 landbase. Both reconnaissance terrain survey mapping (RTSM) class U (Unstable) and detailed terrain survey mapping (DTSM) class V (High likelihood of landslide initiation following timber harvesting) areas are "expected to contain areas with a high likelihood of landslide initiation following timber harvesting or road construction", and thus were removed from the THLB. These reductions, summarized in Table 6.5, are in addition to the ESA1 reductions made for unstable soil types.

Table 6.5 Unstable terrain

Terrain Stability	Area (ha)		
	Gross	Productive	Removed[2]
V	165	160	156
U	238	131	98
Total	403	291	254

6.8 Low Site, Deciduous Leading and Non-merchantable

Table 6.6 summarizes the criteria and by which stands were identified as being non-merchantable, of low productivity or of deciduous cover. 1,146 ha of stands so classified were removed from the THLB. The problem forest type criteria is unchanged from the last analysis- MP 10. No areas classified as NSR were captured by the low productivity or non-merchantable stand criteria.

For the low site index netdown, differences from Management Plan 10 occurred because of the SIA. Site index was adjusted upwards reducing the area of stands below the 7.5 SI threshold.

Deciduous leading stand removals are less in this analysis because any areas of logged deciduous stands were removed in MP 10. Any logged stand is not considered a problem forest type whether it was

[2] The area removed is less that the total productive area because a portion of the area has already been removed because it met another netdown definitione (*i.e.* ESA)

classified as low site, deciduous or non-merchantable. This concept was applied only to the low site and non-merchantable stands in MP 10 but has been expanded to include deciduous leading for this analysis.

Table 6.6 Problem forest types

Description	Leading species Code	Inventory Type Group	Age Class	Height Class	Stocking Class	Site Index	Area (ha)		
							Gross	Productive	Removed
Low site index:									
Pine, larch leading	PL, PA, PY, LW		any	any	any	< 7.5	1,037	693	377
Spruce, balsam leading	SE, BA, BL		any	any	any	< 8.0	13	7	7
Douglas fir leading	FD		any	any	any	< 8.5	0	0	0
Deciduous:									
Deciduous leading	Deciduous	35-42	any	any	any	any	151	149	149
Non-merchantable:									
Cw/Hw leading		9-14	9	any	any	< 13.5	0	0	0
Bl spruce leading		18-24	9	2	any	< 13.5	39	39	0
Pl leading		28-31	any	any	4	any	679	664	606
Pl leading		28-31	3	1	0	< 13.5	57	7	0
Pl leading		28-31	3	2	0	< 13.5	0	0	0
Pl leading		28-31	4	2	0	< 13.5	31	28	7
						Total	**2,006**	**1,587**	**1,146**

6.9 Roads, Trails and Landings

6.9.1 Existing Roads, Trails and Landings

Forest operations create roads, trails and landings reduce the area available for growing trees. Existing roads, trails and landings are often too narrow to be identified as polygons in the digital inventory files. However, existing roads and trails have been mapped for TFL 8, and are thus available as linear features suitable for GIS buffering techniques to delineate the area degraded by existing roads. Table 6.8 provides a summary of the area removed for existing roads. The buffer widths were estimated based on a review of post harvest disturbance surveys. Note that the areas given in the table are net of any prior reductions made in the landbase classification process. Roads were buffered based upon the schedule below and followed the same process as Management Plan 10.

Table 6.7 Road buffer by Road Type

Description	Road length	Road Width
	km	m
MoTH highway	17.9	30
Secondary roads	174.6	12
Logging roads	910.3	10

Table 6.8 Existing unclassified road area summary

	Area Removed (ha)
Existing Roads	1,090

6.9.2 Future Roads, Trails and Landings

Upon harvesting, 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. Generally these stands will provide harvest volume on the first entry but not on further entries. The area contributing to the long-term sustainable harvest is net of this amount.

Based on historical site disturbance surveys on affected blocks, an area reduction of 4.5% was determined to account for the loss of area to future roads, trails and landings. This reduction will be applied to each stand whose current age is greater than 30 years, the first time it is harvested, and will result in a future reduction to the current THLB of 2,055 hectares. This methodology is consistent with the approach taken in the timber supply analysis for MP 10.

6.10 Riparian Management Areas

Riparian management areas are designed to minimize the impacts of harvesting in areas immediately adjacent to water bodies, including streams, lakes, swamps and wetlands. A riparian management area consists of a riparian management zone in which harvesting activity is restricted through basal area retention requirements, and may also include a riparian reserve zone immediately adjacent to the water body in which harvesting is fully excluded. The presence of a riparian reserve zone is dependent on the classification assigned to the water body in question.

Current operational practice on TFL 8 results in a range of basal area retention levels in riparian management zones, from 0 to 60%, with a resulting average retention level of 25%. The average retention level was applied to all riparian management zones, irrespective of riparian classification, in determining the area to be removed from the net harvesting landbase. For the purposes of timber supply modelling, the management zone width as defined in the *Forest Planning and Practices Regulation* (section 47) was reduced by the management zone retention percentage and added to the reserve zone width to arrive at a composite buffer width. GIS buffering techniques were then used to construct an effective riparian reserve zone inside of which harvesting activity was fully excluded. The composite buffer width was applied to each side of stream features, and to the terrestrial side of wetland or lake features.

6.10.1 Streams

Forsite Consultants Ltd, on behalf of P&T, has classified all streams within the TFL for timber supply analysis purposes. The classification methodology retained all known stream classifications, and inferred a classification for all other streams using all available relevant data sources and the expertise of a

fisheries specialist. A summary of the stream riparian classifications and associated landbase reductions is provided in Table 6.10.

Table 6.9 Stream Riparian Classification

Riparian Class	Length	Reserve Zone Width	Management Zone Width	Management Zone Retention	Buffer Width
	km	m	m	%	m
Lakes:					
L1	36.3	10	0	25	10
L3	15.4	0	30	25	7.5
Wetlands:					
W1	49.2	10	40	25	20
W3	90.1	0	30	25	7.5
W5	43.5	10	40	25	20
Streams:					
S1	17.3	50	20	25	55
S2	41.7	30	20	25	35
S3	182.8	20	20	25	25
S4	339.8	0	30	25	7.5
S5	23.1	0	30	25	7.5
S6	257.3	0	20	25	5

6.10.2 Wetlands and Lakes

Using the definitions provided in the *Forest Planning and Practices Regulation* (sections 48-49), GIS techniques were used to classify wetlands and lakes for the purposes of this timber supply analysis. A summary of the resulting lake and wetland riparian classifications and associated landbase reductions is provided in Table 6.10.

Table 6.10 Riparian management area reductions

Riparian	Area (ha)		
	Gross	Productive	Removed
Lake RR 1	87	10	10
Lake RR 3	32	4	3
Wetland RR 1	141	41	41
Wetland RR 3	140	38	37
Wetland RR 5	99	47	46
Stream RR 1	190	142	142
Stream RR 2	291	268	247
Stream RR 3	917	853	777
Stream RR 4	515	471	431
Stream RR 5	35	32	31
Stream RR 6	258	243	232

6.11 Trans-Canada Trail

A small segment (approximately 16 km in length) of the Trans-Canada trail intersects the northern block of the TFL. A 12 m buffer was applied to each side of the trail to identify the no-harvest zone adjacent to the trail. After other reductions to the landbase, 10 hectares were excluded from the net harvesting landbase as a consequence of lying within the no-harvest zone next to the heritage trail.

6.12 Not Satisfactorily Restocked Areas

The inventory has 2,788 ha identified as NSR as shown in Table 6.11. These areas were net out of the landbase[3]. A sensitivity analysis has been run to test the impact of including this area as THLB.

Table 6.11 NSR on TFL 8

	Area (ha)		
	Gross	**Productive**	**Removed**
NSR	2,788	2,743	2,679

P&T reported 137 ha of pre-1987 NSR on TFL 8.

6.13 Stand-level Biodiversity (Wildlife Tree Patches)

Retention of wildlife trees as single trees or in patches is one of the most valuable practices for maintaining stand level biodiversity. In a timber supply context, the retention of wildlife tree patches (WTPs) is modeled by applying a percentage reduction to stand yields at the time they are harvested by the model during the first rotation. 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. Explicit landscape level biodiversity objectives are set as indicated in Section 11.3.

As a GIS exercise, the WTP layer was overlaid with the netdown layer and the percentage of THLB currently designated as WTP as shown in Table 6.12. The result was that 72% of TFL8's WTPs fell within the THLB. Current practice as defined in P&T's Forest Stewardship Plan (FSP) is to maintain 7% of each block as a WTP and therefore 72% of that 7% is a THLB WTP. The result is 7% x 72% = 5.1% WTP impact to the THLB within each harvested block.

[3] The areas should have been included as THLB. This was identified after the analysis was complete and therefore dealt with as a sensitivity analysis.

Table 6.12 TFL8 WTP Calculation

Description	Area (ha)	%	WTP %
Productive Non-THLB	100	18%	
THLB	411	72%	5.1%
Non-forest, non-productive	59	10%	
Total	**569**		

6.13.1 Area Distributions by Age class and Leading Species

Table 6.13 and Figure 6.1 summarize the distribution of area by age for both the productive and net THLB. Age 0-10 excludes recent harvest area of 2,679 ha.

Table 6.13 Age distribution

Age	Area (ha)	
	THLB	non-THLB Productive
0 - 10	54	219
11 - 19	3,706	56
20-29	8,949	210
30-39	6,231	267
40-49	2,467	90
50-59	1,109	79
60-69	797	96
70-79	1,825	57
80-89	8,228	449
90-99	2,396	481
100-109	2,295	286
110-119	1,855	67
120-129	1,935	93
130-139	2,697	230
140-149	1,276	70
150-159	862	162
160-169	1,333	141
170-179	1,511	196
180-189	1,052	37
190-199	1,642	144
200-209	1,830	166
210-219	1,184	61
220-229	3,223	530
230-239	986	58
240-249	1,694	242
250-259	616	113
260-269	545	70
270-279	1,854	399
280-289	94	8
290-299	179	14

Age	Area (ha)	
	THLB	non-THLB Productive
300-309	59	1
320-329	34	0
330-339	17	0
340-349	43	1
350-359	24	19
Total	**64,604**	**5,111**

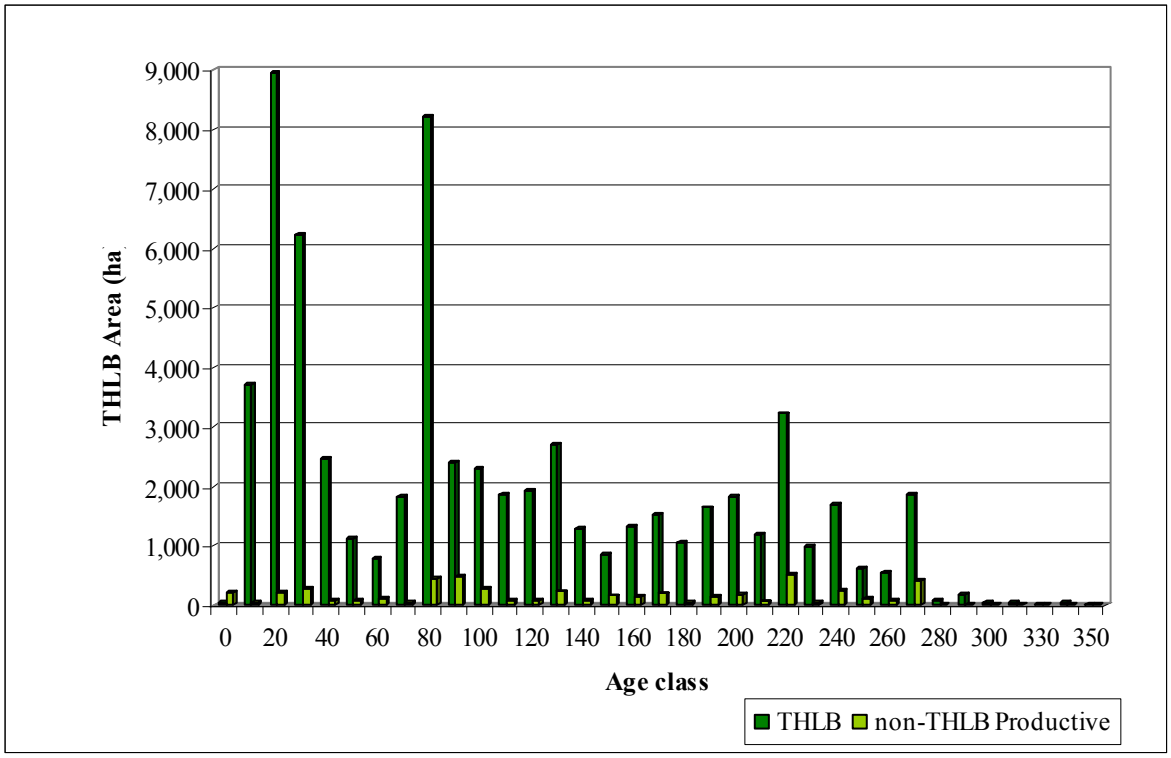

Figure 6.1 Age distribution

Table 6.14 and Figure 6.2 summarize the distribution of area by leading species for both the productive and THLB. As with the leading age distributions, NSR land is not included in the summaries.

Table 6.14 Leading species distribution

Species	Area (ha)	
	THLB	non-THLB Productive
Balsam	3,641	891
Cedar/Hemlock	284	59
Deciduous[4]	334	162
Douglas fir	14,542	631
Larch	9,441	299
Pine	31,547	1,984
Spruce	4,816	1,086
Total	**64,604**	**5,111**

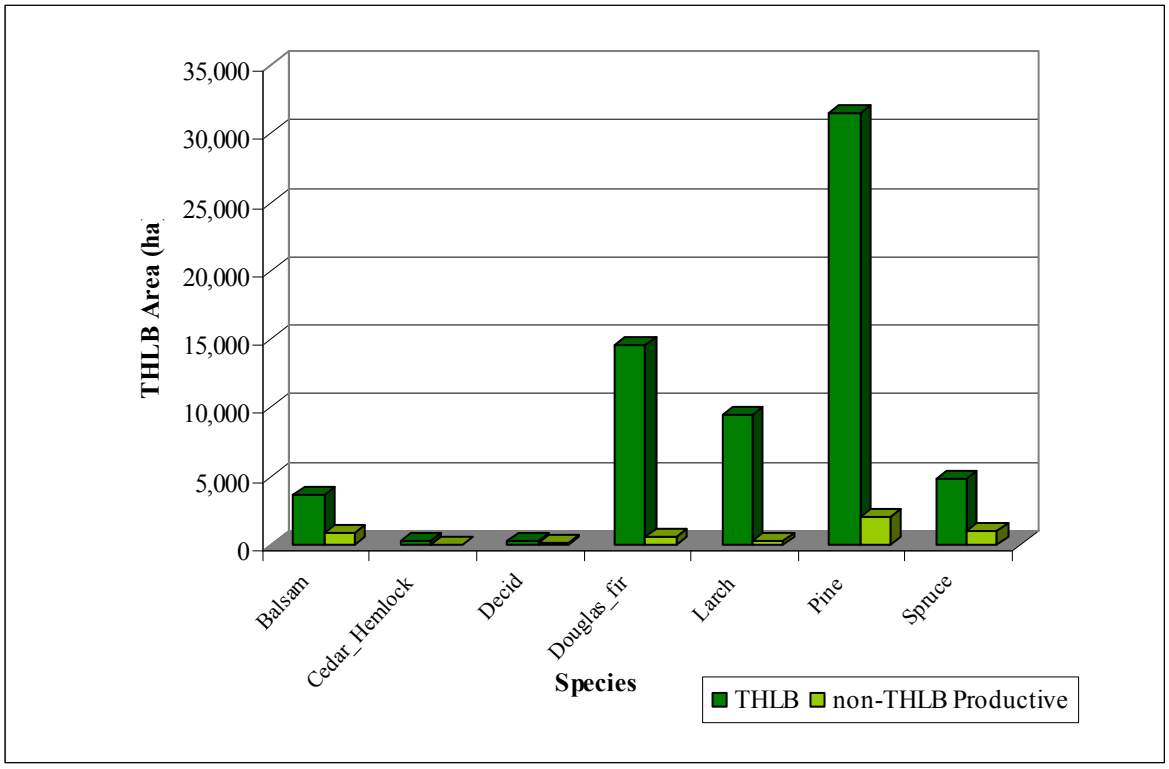

Figure 6.2 Leading Species Distribution

[4] The deciduous volume shown on the THLB is never actually harvested. The % deciduous is removed from each yield curve in the model.

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 Emphasis Areas

Unique management characteristics are modelled by grouping areas into resource emphasis areas (REAs), which are aggregates of area with similar non-timber resource concerns. Maximum disturbance (based on green-up height requirements), minimum mature and old growth forest cover objectives will be assigned to each REA according to the requirements of the particular resource. REAs are aggregated within each landscape unit to reflect operational management of the resource. Where REA classifications overlap, areas must meet all overlapping forest cover objectives before harvesting. REAs in TFL 8 can be summarized as:

- Visual Quality Objectives (VQOs);
- Forest connectivity corridors (FCC) (managed for old seral forest retention);
- Seral Stage Distribution (managed for old seral forest retention);
- Moose winter range (MWR); and
- Mule deer winter range (MDWR).

The resource emphasis areas defined for this analysis are listed in Table 7.1.

Table 7.1 Resource emphasis areas

REA Summary	Area (ha)		
	THLB	non-THLB Productive	Total
MDWR	4,637	772	5,408
MWR	2,870	587	3,458
VQO	6,132	504	6,636
Seral	64,689	7,687	72,376
FCC	13,157	1,738	14,894
Disturbing the non-THLB	0	6,737	6,737

7.3 Ecosystem Types

Figure 7.1 shows the area in each biogeoclimatic (BEC) and natural disturbance type (NDT) combination on TFL8. BEC and NDT are based on the updated Terrestrial Ecosystem Mapping (TEM). Note that the sum of the THLB and non-THLB productive area is total productive area (77,728 ha).

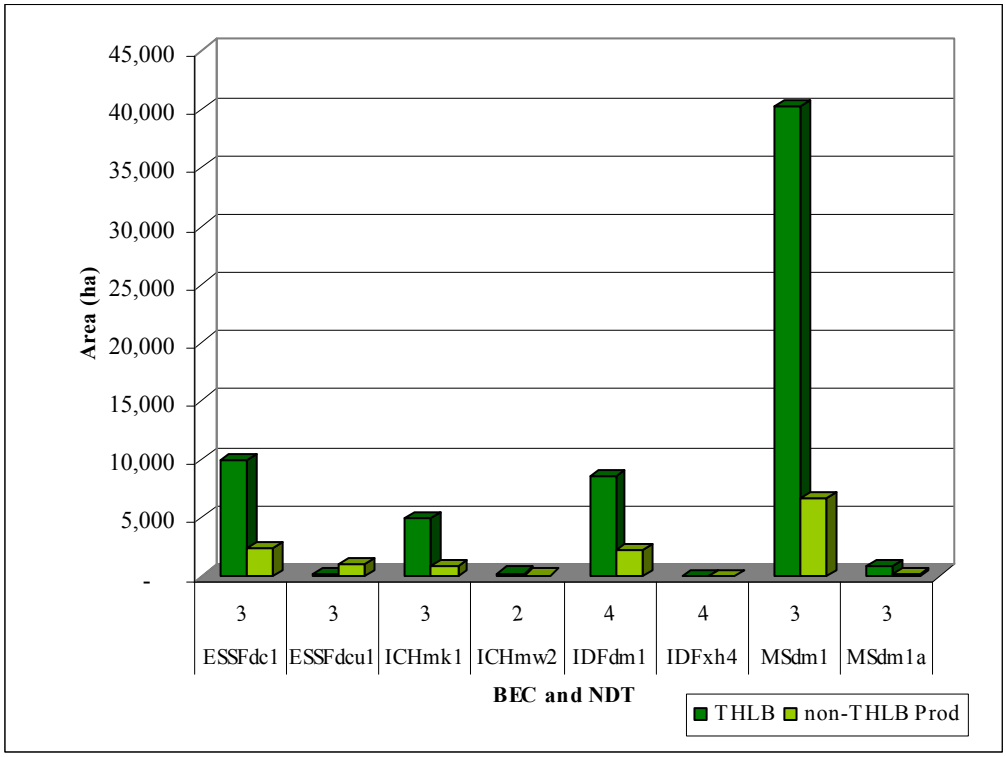

Figure 7.1 TFL8 THLB and non-THLB Productive Area by BEC-NDT

7.4 Landscape Units

Portions of three landscape units (LUs) intersect TFL 8- B1, B7 and B8. The area by LU is shown in Table 7.2.

Table 7.2 Area by LU on TFL 8

	Area (ha)		
LU	**THLB**	**non-THLB Productive**	**Total Productive**
B1	5,783	567	6,351
B7	29,846	4,876	34,722
B8	29,068	2,252	31,320
Total	**64,698**	**7,695**	**72,393**

7.5 Seral Zones

Landscape level biodiversity representation is modeled aspatially through seral zone objectives- these are applied by LU-BEC combinations. In this summary table, the Kootenay Boundary Higher level Plan Order (KBHLPO) BEC (December 2000) is shown because this is the BEC that was in place when the HLPO was written into law. The area in each LU-BEC and BEO (biodiversity emphasis option) combinations are shown in Table 7.3. This table also shows the corresponding NDT for each combination.

Table 7.3 Seral Zones for TFL 8

LU	KBHLPO-BEC	NDT	BEO	Area (ha)		
				THLB	non-THLB Productive	Total Productive
B1	**IDFdm1**	**4**	**H**	4,065	380	4,446
B1	**MSdm1**	**3**	**I**	1,714	189	1,903
B7	**ESSFdc1**	**3**	**L**	5,024	1,691	6,715
B7	**ICHmk1**	**3**	**L**	4,929	471	5,400
B7	**ICHmw2**	**2**	**L**	251	45	296
B7	**IDFdm1**	**4**	**L**	5,722	825	6,547
B7	**MSdm1**	**3**	**L**	13,874	1,889	15,763
B8	**ESSFdc1**	**3**	**L**	3,204	350	3,553
B8	**IDFdm1**	**4**	**L**	8,838	871	9,709
B8	**MSdm1**	**3**	**L**	16,982	1,068	18,050
Total				**64,602**	**7,781**	**72,383**

Note: In this table, B7-MSdm1a-L was combined with B7-MSdm1-L.

7.6 Analysis Unit Definitions

Stands are grouped into analysis units (AUs) to reduce modeling complexity. In this analysis, stand are grouped on an ecological basis- combinations of: BEC - leading site series - leading species. This approach is selected because it integrates closely with ecologically base estimates of site productivity (the SIA project by JST, 2006) and previous projects on silviculture regimes. There are 73 natural stand AUs with a corresponding set of 73 managed stand AUs (the 100 series). AU definitions and area are shown for natural and managed stands in Table 8.2 and Table 8.4.

8.0 GROWTH AND YIELD

8.1 Site Index- Inventory and SIA Productivity Estimates

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 is developed using age and height attributes in the inventory (for stands >30 years old). The SIA project by J.S. Thrower Consultants was completed (JST, 2006) and included in this analysis as the site index for managed stands. The inventory site index is shown by AU in Table 8.2 and the SIA site index is shown by AU in Table 8.4.

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 units (PSYU).

8.4 Volume Reductions

Yield tables will be reduced to account for wildlife tree patches by 5.1%.

8.5 Natural Stand Analysis Units (Yield Tables)

Natural stand yield tables (NSYTs) were developed using the batch version of VDYP (Version 6.6d). The AU description, area, inventory site index and species composition (up to species 6) are shown below in Table 8.2. The natural stand yield tables are created specifically for each inventory polygon and the yield curves are area weighted into a representative curve. The attributes in Table 8.2 are averages for reporting purposes only.

Table 8.2 Average natural stand attributes by AU

AU	Description	Area (ha)	Inv_SI	SP1	%	SP2	%	SP3	%	SP4	%	SP5	%	SP6	%
1	ESSFdc1-FR-BL	1,059	12	Bl	56	Sx	28	Pl	15	Lw	1				
2	ESSFdc1-FX-BL	177	11	Bl	80	Sx	20								
3	ESSFdc1-FR-PL	2,444	16	Pl	85	Sx	12	Lw	2	Fd	1				
4	ESSFdc1-FR-SE/S	1,145	14	Sx	54	Bl	29	Pl	17						
5	ESSFdc1-FX-SE	328	12	Sx	49	Pl	26	Bl	25						
6	ESSFdc1-EP-PL	204	13	Pl	78	Bl	12	Sx	6	Lw	3	Fd	1		
7	ESSFdc1-FG-BL	393	13	Bl	56	Pl	25	Sx	19						
8	ESSFdc1-FG-PL	2,737	15	Pl	80	Bl	11	Sx	8	Lw	1				
9	ESSFdc1-FG-SE	401	12	Sx	56	Bl	28	Pl	16						
10	ESSFdc1-RV-BL	320	13	Bl	56	Sx	36	Pl	8						
11	ESSFdc1-RV-PL	243	16	Pl	66	Bl	18	Sx	15	Lw	1				
12	ESSFdc1-RV-SE/S	462	12	Sx	57	Bl	32	Pl	11						
13	ICHmk1-RF-BL	151	18	Bl	46	Lw	22	Sx	14	C-H	9	Pl	6	At	3
14	ICHmk1-RF/SG/SO-FD	730	16	Fd	55	Lw	18	Sx	11	Pl	9	C-H	6	Bl	1
15	ICHmk1-RF-LW/CW	497	17	Lw	42	C-H	17	Fd	16	Sx	11	Pl	9	Bl	5
16	ICHmk1-RF-PL	418	19	Pl	63	Lw	14	Fd	11	Sx	8	C-H	3	Bl	1
17	ICHmk1-RF-SE	199	15	Sx	58	Lw	14	C-H	13	Bl	11	Pl	4		
18	ICHmk1-DT-FD	774	15	Fd	64	Lw	23	Pl	9	Sx	3	Bl	1		
19	ICHmk1-DT-LW	370	15	Lw	61	Fd	21	Pl	9	C-H	6	Sx	3		
20	ICHmk1-DT-PL	343	18	Pl	68	Lw	19	Fd	9	Sx	3	C-H	1		
21	ICHmk1-DA-BL	130	17	Bl	44	Lw	21	Sx	19	Pl	9	At	4	Fd	3
22	ICHmk1-DA-FD	452	16	Fd	54	Lw	20	Pl	10	Sx	7	C-H	5	Bl	4
23	ICHmk1-DA-LW	406	16	Lw	69	Pl	15	Fd	9	Sx	4	Bl	3		
24	ICHmk1-DA-PL	400	17	Pl	67	Lw	19	Fd	8	Sx	3	At	2	Bl	1
25	IDFdm1-DT-FD	1,978	16	Fd	69	Lw	17	Pl	11	Sx	3				
26	IDFdm1-DT/DW-LW	603	17	Lw	56	Fd	23	Pl	14	Sx	4	C-H	3		
27	IDFdm1-DT/DW-PL	1,673	18	Pl	69	Fd	14	Lw	12	Sx	3	At	2		
28	IDFdm1-DW-FD	344	15	Fd	75	Lw	14	Pl	10	Sx	1				
29	IDFdm1-DP-FD	1,627	15	Fd	74	Lw	15	Pl	10	Sx	1				
30	IDFdm1-DP-LW	347	16	Lw	54	Fd	25	Pl	16	Sx	3	C-H	2		
31	IDFdm1-DP-PL	1,032	17	Pl	77	Fd	13	Lw	9	Sx	1				
32	IDFdm1-SP-FD	417	16	Fd	58	Lw	23	Pl	12	Sx	7				
33	IDFdm1-SP-PL	238	19	Pl	74	Fd	12	Sx	9	At	3	Bl	2		
34	MSdm1-SF-AT	148	21	At	53	Pl	23	Sx	12	Lw	11	Fd	1		
35	MSdm1-SF/PX/XS-BL	852	16	Bl	55	Sx	18	Pl	13	Lw	7	Fd	6	C-H	1
36	MSdm1-SF-FD	2,962	16	Fd	65	Lw	20	Pl	10	Sx	4	Bl	1		
37	MSdm1-SF-LW	3,415	18	Lw	59	Fd	18	Pl	15	Sx	6	Bl	2		
38	MSdm1-SF-PL	11,339	19	Pl	75	Lw	12	Sx	5	Fd	4	Bl	3	At	1
39	MSdm1-PX-PL	887	17	Pl	80	Lw	10	Sx	4	Bl	3	Fd	2	At	1
40	MSdm1-SF-SE	919	16	Sx	53	Bl	16	Pl	15	Lw	9	Fd	6	C-H	1
41	MSdm1-PX-SE	114	14	Sx	56	Bl	23	Pl	15	Lw	3	At	2	Fd	1
42	MSdm1-DP-FD	603	15	Fd	74	Lw	16	Pl	9	Sx	1				
43	MSdm1-DP-LW	145	16	Lw	62	Fd	23	Pl	12	Sx	3				
44	MSdm1-DP-PL	169	16	Pl	78	Lw	15	Fd	6	Sx	1				
45	MSdm1-PG-FD/BL/SE	624	15	Fd	58	Lw	22	Pl	10	Bl	6	Sx	4		
46	MSdm1-PG-LW	413	15	Lw	57	Fd	23	Pl	14	Sx	5	Bl	1		
47	MSdm1-PG-PL	1,241	16	Pl	79	Lw	14	Fd	6	Sx	1				
48	MSdm1-PP-BL	252	16	Bl	57	Sx	15	Pl	12	Fd	10	Lw	6		
49	MSdm1-PP-FD	3,626	15	Fd	70	Lw	19	Pl	8	Sx	2	Bl	1		
50	MSdm1-PP-LW	2,499	17	Lw	61	Fd	20	Pl	15	Sx	3	Bl	1		
51	MSdm1-PP-PL/PY	6,614	18	Pl	79	Lw	13	Fd	5	Sx	2	Bl	1		
52	MSdm1-PP-SE	199	15	Sx	50	Bl	17	Pl	15	Lw	10	Fd	7	C-H	1
53	MSdm1-XS-LW	107	19	Lw	57	Fd	18	Pl	13	Sx	11	Bl	1		
54	MSdm1-XS-PL	403	19	Pl	70	Sx	12	Lw	8	Bl	6	Fd	3	At	1

AU	Description	Area (ha)	Inv_SI	SP1	%	SP2	%	SP3	%	SP4	%	SP5	%	SP6	%
55	**MSdm1-XS-SE/FD**	217	18	Sx	43	Pl	20	Fd	17	Bl	12	Lw	7	At	1
56	**MSdm1-SG-FD**	360	16	Fd	64	Lw	20	Pl	8	Sx	7	Bl	1		
57	**MSdm1-SG-LW**	369	18	Lw	56	Fd	17	Pl	14	Sx	9	Bl	3	C-H	1
58	**MSdm1-SG-PL**	472	19	Pl	77	Lw	12	Sx	6	Bl	3	At	2		
59	**MSdm1-SG-SE/BL**	212	16	Sx	53	Bl	24	Pl	14	Lw	6	C-H	2	At	1
60	**MSdm1-SX-PL**	246	19	Pl	75	Sx	9	Lw	8	Bl	6	Fd	2		
61	**MSdm1-SO-LW**	152	17	Lw	57	Fd	15	Pl	12	Sx	11	C-H	4	At	1
62	**MSdm1-SO-PL**	311	19	Pl	82	Sx	10	Fd	5	Bl	3				
63	**MSdm1-SO-SE/BL**	158	16	Sx	45	Bl	23	Lw	13	Pl	10	Fd	7	C-H	2
64	**MSdm1a-RF-LW**	203	20	Lw	52	Fd	17	Pl	11	Sx	10	Bl	6	C-H	4
65	**MSdm1a-RF/DA/SO-PL**	396	19	Pl	72	Lw	16	Sx	8	Fd	4				
66	**ESSFdc1-FG/FR/RV-LW**	109	16	Lw	65	Pl	16	Sx	10	Fd	5	Bl	4		
67	**ICHmk1-DT-BL**	77	17	Bl	52	Pl	16	Lw	11	Sx	9	Fd	8	C-H	4
68	**ICHmw2-HF-BL/SE**	219	19	Bl	38	Sx	33	Pl	23	Fd	4	Lw	2		
69	**IDFdm1-DT/SP/SH-SE**	245	18	Sx	60	Pl	17	Fd	13	Bl	5	Lw	3	At	2
70	**MSdm1-SX-SE/BL**	114	16	Sx	51	Bl	25	Pl	15	Lw	5	Fd	4		
71	**MSdm1-SO-FD**	78	16	Fd	58	Lw	24	Pl	9	Sx	7	Bl	2		
72	**MSdm1a-RF/DA/SO-FD**	112	16	Fd	50	Lw	28	Pl	11	Sx	6	Bl	3	At	2
73	**MSdm1a-RF/SO-SE**	73	19	Sx	48	Lw	16	Bl	14	Pl	13	Fd	8	C-H	1

8.5.1 Existing Timber Volume Check

Table 8.3 shows the inventory volume on the THLB compared to the yield curve volume. The THLB yield curve volume includes a 5.1% increase for the WTPs.

Table 8.3 Timber volume check

Polygon Volume	Yield Curve Volume	% Concurrent (yield curve/polygon)
9,779,064	9,788,377	99.9%

8.6 Silviculture Management Regimes

This section describes how each stand is regenerated after harvesting.

8.6.1 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. Regeneration delays ranging between 1 and 3 years were estimated by P&T staff for each silviculture regime and can be seen by AU in Table 8.4. Estimations were done using a review of actual regeneration delays extracted from Genus.

8.6.2 Genetic Gains

This section outlines the characteristics of seed improvement in TFL 8 and is based on information supplied by P&T (See Table 8.4).

8.6.3 Managed Stand Yield Tables

Each natural stand analysis unit has a corresponding managed analysis unit in a parallel 100s series. For example, when any natural stand in AU 1 is harvested, it is assumed to be managed under AU 101. All managed stands are assumed to be planted. Managed stand yield tables (MSYTs) were modeled using MoFR's TIPSY. Managed stand site index came from the SIA project by JST, 2006. Table 8.4 presents the managed stand AUs species composition and site index values.

Table 8.4 Managed AU descriptions (TIPSY Inputs)

AU	Description	SI	Density		%	GG	Sp2	%	GG	Sp3	%	GG	Sp4	%	GG	Sp5	%	GG
101	ESSFdc1-FR-BL	12.3	1051	PL	50	8	SX	50	10									
102	ESSFdc1-FX-BL	11.4	1046	PL	57	8	SX	43	10									
103	ESSFdc1-FR-PL	18.3	1046	PL	57	8	SX	43	10									
104	ESSFdc1-FR-SE/S	13.4	1051	PL	50	8	SX	50	10									
105	ESSFdc1-FX-SE	11.6	1051	PL	50	8	SX	50	10									
106	ESSFdc1-EP-PL	15.2	850	PL	50	8	SX	50	10									
107	ESSFdc1-FG-BL	12.7	940	PL	57	8	SX	43	10									
108	ESSFdc1-FG-PL	17.3	761	PL	81	8	SX	18	10	LW	1	26						
109	ESSFdc1-FG-SE	12.0	940	PL	57	8	SX	43	10									
110	ESSFdc1-RV-BL	12.9	1341	PL	53	8	SX	46	10	BL	1	0						
111	ESSFdc1-RV-PL	18.5	1159	PL	75	8	SX	24	10	LW	1	26						
112	ESSFdc1-RV-SE/S	11.9	1341	PL	53	8	SX	46	10	BL	1	0						
113	ICHmk1-RF-BL	17.7	1388	PL	45	8	SX	21	10	LW	34	26						
114	ICHmk1-RF/SG/SO-FD	16.2	1388	PL	45	8	SX	21	10	LW	34	26						
115	ICHmk1-RF-LW/CW	21.5	1388	PL	45	8	SX	21	10	LW	34	26						
116	ICHmk1-RF-PL	21.3	976	PL	69	8	SX	12	10	LW	17	26	PY	2	0			
117	ICHmk1-RF-SE	14.6	1388	PL	45	8	SX	21	10	LW	34	26						
118	ICHmk1-DT-FD	15.0	1116	PL	51	8	LW	33	26	SX	8	10	PY	8	0			
119	ICHmk1-DT-LW	21.5	1116	PL	51	8	LW	33	26	SX	8	10	PY	8	0			
120	ICHmk1-DT-PL	20.6	878	PL	88	8	SX	6	10	LW	6	26						
121	ICHmk1-DA-BL	16.7	1132	PL	53	8	SX	31	10	LW	16	26						
122	ICHmk1-DA-FD	16.1	1132	PL	53	8	SX	31	10	LW	16	26						
123	ICHmk1-DA-LW	22.5	1125	PL	61	8	LW	25	26	SX	14	10						
124	ICHmk1-DA-PL	21.3	1125	PL	61	8	LW	25	26	SX	14	10						
125	IDFdm1-DT-FD	15.9	868	PL	68	8	SX	2	10	PY	12	0	FD	5	0	LW	13	26
126	IDFdm1-DT/DW-LW	21.2	1077	LW	61	26	PL	32	8	SX	7	10						
127	IDFdm1-DT/DW-PL	21.0	868	PL	68	8	SX	2	10	PY	12	0	FD	5	0	LW	13	26
128	IDFdm1-DW-FD	14.9	675	PY	67	0	PL	33	8									
129	IDFdm1-DP-FD	15.2	780	LW	38	26	PL	30	8	PY	17	0	SX	2	10	FD	13	0
130	IDFdm1-DP-LW	19.6	780	LW	38	26	PL	30	8	PY	17	0	SX	2	10	FD	13	0
131	IDFdm1-DP-PL	19.6	1192	PL	49	8	LW	44	26	SX	7	10						
132	IDFdm1-SP-FD	16.8	866	LW	49	26	PL	48	8	SX	3	10						
133	IDFdm1-SP-PL	21.7	866	LW	49	26	PL	48	8	SX	3	10						
134	MSdm1-SF-AT	20.5	931	PL	73	8	SX	24	10	LW	3	26						
135	MSdm1-SF/PX/XS-BL	16.3	911	PL	52	8	SX	26	10	LW	21	26	PW	1				
136	MSdm1-SF-FD	15.8	911	PL	52	8	SX	26	10	LW	21	26	PW	1				
137	MSdm1-SF-LW	22.8	911	PL	52	8	SX	26	10	LW	21	26	PW	1				
138	MSdm1-SF-PL	20.9	931	PL	73	8	SX	24	10	LW	3	26						
139	MSdm1-PX-PL	20.8	931	PL	73	8	SX	24	10	LW	3	26						

AU	Description	SI	Density		%	GG	Sp2	%	GG	Sp3	%	GG	Sp4	%	GG	Sp5	%	GG
140	MSdm1-SF-SE	16.3	911	PL	52	8	SX	26	10	LW	21	26	PW	1				
141	MSdm1-PX-SE	13.8	911	PL	52	8	SX	26	10	LW	21	26	PW	1				
142	MSdm1-DP-FD	14.8	420	PL	50	8	LW	50	26									
143	MSdm1-DP-LW	20.2	420	PL	50	8	LW	50	26									
144	MSdm1-DP-PL	19.3	420	PL	50	8	LW	50	26									
145	MSdm1-PG-FD/BL/SE	14.5	646	PL	64	8	SX	25	10	LW	11	26						
146	MSdm1-PG-LW	20.7	646	PL	64	8	SX	25	10	LW	11	26						
147	MSdm1-PG-PL	19.6	648	PL	69	8	SX	31	10									
148	MSdm1-PP-BL	16.2	991	PL	43	8	SX	19	10	LW	35	26	FD	3	0			
149	MSdm1-PP-FD	15.2	991	PL	43	8	SX	19	10	LW	35	26	FD	3	0			
150	MSdm1-PP-LW	21.9	873	PL	60	8	LW	19	26	SX	21	10						
151	MSdm1-PP-PL/PY	20.5	701	PL	93	8	SX	7	10									
152	MSdm1-PP-SE	14.9	991	PL	43	8	SX	19	10	LW	35	26	FD	3	0			
153	MSdm1-XS-LW	23.0	1036	PL	64	8	SX	36	10									
154	MSdm1-XS-PL	21.0	885	PL	67	8	SX	32	10	LW	1	26						
155	MSdm1-XS-SE/FD	17.7	1036	PL	64	8	SX	36	10									
156	MSdm1-SG-FD	15.6	931	PL	62	8	SX	38	10									
157	MSdm1-SG-LW	23.3	931	PL	62	8	SX	38	10									
158	MSdm1-SG-PL	21.1	931	PL	62	8	SX	38	10									
159	MSdm1-SG-SE/BL	16.2	931	PL	62	8	SX	38	10									
160	MSdm1-SX-PL	21.1	931	PL	62	8	SX	38	10									
161	MSdm1-SO-LW	23.2	1388	PL	45	8	SX	21	10	LW	34	26						
162	MSdm1-SO-PL	21.6	976	PL	69	8	SX	12	10	LW	17	26	PY	2	0			
163	MSdm1-SO-SE/BL	15.7	840	PL	67	8	SX	33	10									
164	MSdm1a-RF-LW	23.8	1388	PL	45	8	SX	21	10	LW	34	26						
165	MSdm1a-RF/DA/SO-PL	22.2	1388	PL	45	8	SX	21	10	LW	34	26						
166	ESSFdc1-FG/FR/RV-LW	17.3	1046	PL	57	8	SX	43	10									
167	ICHmk1-DT-BL	16.4	1116	PL	51	8	LW	33	26	SX	8	10	PY	8	0			
168	ICHmw2-HF-BL/SE	19.3	1388	PL	90	8	LW	10	26									
169	IDFdm1-DT/SP/SH-SE	18.1	1192	PL	49	8	LW	44	26	SX	7	10						
170	MSdm1-SX-SE/BL	16.1	931	PL	62	8	SX	38	10									
171	MSdm1-SO-FD	16.2	840	PL	67	8	SX	33	10									
172	MSdm1a-RF/DA/SO-FD	15.9	976	PL	69	8	SX	12	10	LW	17	26	PY	2	0			
173	MSdm1a-RF/SO-SE	19.3	1027	PL	50	8	SX	43	10	LW	7	26						

The planting densities for some Aus are quite low because in MP 10 there was an adjustment made for natural regeneration using an ingress model. In this analysis there was several TASS runs tested to model the impact of ingress,[5] however the managed stand yield tables used in the analysis did not include the ingress model. A sensitivity analysis was done to test the impact on MSYT of planting all stands at 1,400 stems per hectare.

[5] The Ingress model became too complicated given the timelines for the analysis.

8.7 Silviculture History

8.7.1 Immature Managed Stands

All stands with a current age less than 31 are assigned to managed stand yield curves, reflecting the length of silviculture history of the license. Stands older than 30 years are assigned to natural stand yield curves.

8.7.2 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 (see section 8.6.1) 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. In TFL8, there are 2,679 ha of NSR- the bulk of which is current NSR- all NSR will be modeled as such.

9.0 PROTECTION

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.

TFL 8 has good road access virtually throughout, so any occurrence of catastrophic stand damage is both relatively easily detected and accessible for salvage harvesting. Salvage operations may be carried out under amendments to existing cutting authorities, by initiating new cutting permit, under the blanket salvage cutting authority (CP 999) or under the MoF Small Salvage program. Stands within the THLB that are damaged and not recovered are usually small, isolated or of marginal quality. In addition anticipated NRLs from the current MPB epidemic will be modeled explicitly so they are not included in the table below.

Annual unsalvaged losses are estimated at 984 m^3/year and are summarized in Table 9.1 below. See appendix 1.0 for further detail into the calculations and rationale behind these 2007 NRL figures for this analysis.

Table 9.1 Estimated non-recoverable losses

Damage agent	Estimated NRL (m^3/yr)
Wildfire	45
Mountain Pine Beetle	160
Douglas Fir Bark Beetle	63
Spruce Bark Beetle	45
Catastrophic Blowdown	215
Non-catastrophic in-block Blowdown	75
Non-catastrophic Blowdown adjacent to new roads	30
Non-catastrophic Blowdown adjacent to existing roads	276
Retention Trees	75
Total Non-recovered Losses	**984**

Small scale salvage (SSS) volume has not been included in the NRLs. The approximate volume awarded from TFL 8 from 2003 - 2006 was 27,000 cubic meters, or 9,000 m3 per year, although this is not necessarily the volume harvested. Small Scale Salvage volume is off quota or charged to the FS Reserve (reserve attached to the TSA). If the SSS volume is to be charged against the TFL 8 AAC it would be a direct removal from the harvest level (*i.e.* 186,000 m^3/year AAC – 9,000 m^3/year SSS = 177,000 m^3/year).

10.0 MPB MODELLING

Currently TFL 8 and the Arrow/Boundary Forest District are experiencing endemic MPB populations that are on the decline (Rick Mazzocchi, 2007). However, it is projected that on TFL 8 7,300 ha of THLB will be severely affected by MPB by 2011 and an additional 2,100 ha by 2016 (Eng et.al., 2006). The current endemic levels and the projected epidemic levels of MPB in TFL 8 introduce complexity to the immediate management decision. To address this complexity the analysis will run a current practice scenario with endemic MPB as well as a current practice with epidemic MPB.

Current practice with endemic MPB models the MPB affected stands as being harvested or lost through non recoverable losses. This section details the modeling procedure for the epidemic MPB scenarios. The MPB modeling assumptions apply during the first 10 years of modeling.

10.1.1 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 pine. The percent of each grid that is affected is calculated by multiplying the percent pine 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 10.1.

Table 10.1 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.

The projections used in the analysis are for 2007 , which include the 2006 forest health overview.

10.1.2 Shelf Life

The shelf life for solid pine defines the amount of time the pine volume is available for harvest after being affected by MPB. The shelf life of two years has been assumed for several similar analyses in the Southern Interior Forest Region (SIFR). For this analysis we will evaluate the impact of using a 2 year, 5 year and a 7 year shelf life.

10.1.3 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).

The 20% retention is offset by the existing retention in areas such as OGMAs, riparian reserves, unmerchantable stands, ESAs, and deciduous stands. Summaries have been completed for TFL8 show that 7% is already retained, which would require an additional 13% retention in this analysis. This retention is modeled in the same manner as WTPs: by applying a percentage reduction to stand yields at the time they are harvested by the model during the first rotation.

10.1.4 Non-pine Harvest

Due to economic realities associated with mill consumption there is a need for non-pine volume to be harvested. The volume of non-pine assumed to be harvested will be varied in sensitivities during the first 5 years of MPB epidemic.

10.1.5 MPB Harvest Queuing

Harvest queuing is the order in which the stands are prioritized for harvest. In the Current Management Scenario the harvest queuing is controlled for the first 15 years in order to force harvest into MPB-attacked stands. In years 2006-2020 the areas very severely affected by 2014 will be targeted for harvest. If a 2 year shelf life is used, these stands are eligible until the end of 2015, if a 5 year shelf life means these stands are eligible until 2018 and a 7 year shelf life means these stands are eligible until 2020.

Stands not harvested in the years identified will be assumed to be unavailable for harvest and the volume will be lost. When stands are prioritized for harvest:

1. Minimum harvest age is reduced to age 40 to ensure that stands are not inappropriately limited from harvest;
2. Spatial adjacency is not enforced;
3. Visual requirements are not enforced for targeted stands; and
4. All other landbase requirements are enforced (*e*.g. OGMAs).

10.1.6 Unharvested MPB stands

Once the shelf life has expired, pine that was harvested regenerates on a managed stand yield curve. Pine that was not harvested is removed (according to the rules below) and landbase requirements are restored to normal.

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

1. MPB very severely affected pine leading stands:
    a. 100% of their volume removed;

   b. 15 year regeneration delay;
   c. Grow back on a natural stand yield curve.

2. Stands with severe, moderate or low MPB infestation continue growing on the natural stand yield curve with volume reductions according to the mid point of infestation class (see Table 10.1 for infestation classes). Severe infestation (30-50% of stand attacked by MPB) has a mid point volume reduction of 40%. Similarity, moderate infestation has a volume reduction of 20% and low infestation has a volume reduction of 5%.
3. As on the THLB, on non-THLB productive land, pine leading stands that are projected to be very severe impacted by 2014 are all reduced by 100% in 2017.

The visual requirements and disturbances in the non-THLB are returned to normal after 15 years.

11.0 INTEGRATED RESOURCE MANAGEMENT

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

11.1 Forest Resource Inventories

The status of the non-timber resource inventories was provided in section 5.3 “Data Sources”.

11.2 Forest Cover Requirements

The analysis will apply forest cover objectives to specific REAs 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 REAs. Productive forest stands that have been excluded from the THLB such as inoperable and uneconomic forest types may be 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. Mule deer winter range (MDWR) and mose winter range (MWR) 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. Seral requirements and connectivity corridors are managed by the application of retention constraints.

11.2.1 VQOs

Explicit spatial VQOs have been established in TFL 8. Visual objectives must be met at the VQO polygon level. Each VQO polygon has a visual quality class (VQC) associated with it- retention (R), partial retention (PR) or modification (M). This VQC has a maximum percentage to be below a given height associated with it. Each VQO polygon has a specific retention requirement calculated (height) depending on slope distribution in the polygon. The retention requirements (VQC and height) by VQO polygon for TFL 8 are shown in Table 11.1 below.

Table 11.1 VQO area and retention requirements

	VQC			
VQO ID Number	**Rating**	**Minimum %**	**Height (m)**	**Slope %**
4	M	25	3.83	26.6
7	PR	15	3.82	26.4
11	M	25	4.43	38.6
17	M	25	4.56	32.7
18	PR	15	4.95	44.4
19	M	25	4.13	32.6
22	M	25	3.04	10.7
23	M	25	3.29	15.8
25	M	25	4.14	32.8
26	M	25	4.29	35.8
27	M	25	4.43	38.5
28	M	25	4.5	40
29	M	25	4	3
31	PR	15	3.64	22.8
32	PR	15	3.95	28.9
33	PR	15	3.5	19.9
34	PR	15	3.45	19
36	PR	15	3.5	20
37	PR	15	4.52	40.3
38	PR	15	3.3	15.9
39	PR	15	4.39	37.8
40	PR	15	4.15	33
41	PR	15	3.74	24.8
42	R	5	3.06	11.3
43	PR	15	4.31	36.1
44	PR	15	4	3
45	M	25	4.33	36.7
46	M	25	4.11	32.1
47	PR	15	3.47	19.3

11.2.2 Mule Deer Winter Range

MDWR will be managed through the application of mature retention and disturbance constraints applied to each MDWR planning cell, consistent with GAR order #U-8-008 signed May 8, 2006. In the previous analysis, these areas were modeled to be managed using a combination of single tree selection (STS), patch cut (PC) and conventional clear-cut harvesting. After review of current practice, it was found that there was minimal to no STS and PC harvesting, therefore in this analysis harvesting in MDWR will be

modeled as clear cut with maximum disturbance requirements and minimum retention requirements being imposed.

11.2.2.1 Retention Objectives

Table 11.2 shows the minimum stand age by snowpack zone from the GAR order. For each MDWR planning cell these snowpack zone ages are area weighted and paired with minimum retention percentages that are listed explicitly in the GAR order. These retention constraints are shown for each planning cell in TFL 8 in Table 11.3. For example, in MDWR planning cell 4, a minimum of 19.5% over 112 years must be retained to satisfy MDWR guidelines. Note that the BEC used to calculate retention age is the most recent version of the BEC from the 2006 accuracy assessed terrestrial ecosystem mapping (TEM) project (Timberline, 2006). Also note that these constraints are applied within the productive forest area excluding the fire maintained ecosystems (FMER) defined as open forest and open range.

Table 11.2. MDWR guidelines- Minimum Stand Age by Snowpack Zone

KBHLPO-BEC	Snowpack Zone	Minimum Stand Age (yrs)
PPxh		101
IDFxh		101
IDFdm1 *	Shallow	101
ICHdw		121
IDFdm1 **		101
MS (all)	Moderate	101
ICHmk1		121
ICHmw2		121
ESSF (all)	Deep	121

* <1000 m elevation with aspects 135-270^{o}

** All other IDFdm1

Table 11.3 MDWR Guidelines- % Retention and Area Weighted Stand Age by Planning Cell

MDWR Planning Cell	Retention %	Area Weighted Minimum Retention Age (yrs)
4	19.5	115
5	20	112
8	16.8	120
38	20	120
40	20	108
41	18	112
42	20	106
43	18.2	106
46	20	109
47	21.5	115
48	20	120
49	17.9	109
50	17.3	100
52	19.9	103

Table 11.4 shows the areas in each planning cell after reduction for open forest and open range by snowpack.

Table 11.4 Area by Planning Cell by Snowpack Zone and FMER

Planning Cell	FMER	Snowpack				Total MDWR Productive Area
		Shallow	Moderate-IDF/MS	Moderate-ICH	Deep	
4	194		406	145		551
5	720		666	429		1,094
8	23		33			33
38	61		125	2		128
40	89		23	34		58
41	202		144	92		236
42	191		74	182		256
43	164		77	192		269
46	289		220	303	19	543
47	105		309	123	38	470
48			518			518
49	109		271	325		596
50	36			125		125
52	322		4	457	70	531
Total	**2,505**	**0**	**2,870**	**2,411**	**127**	**5,408**

11.2.2.2 Disturbance Objectives

Consistent with the GAR order, the disturbance objective modelled in this analysis is that a maximum of 33% will be below 20 years in each MDWR planning cell. In the GAR order, it was explicitly stated that this disturbance objective be applied to moderate snowpack, however in this analysis it was modelled everywhere- a close approximation because moderate snowpack accounts for 98% of the total 5,408 ha MDWR.

11.2.3 Moose Winter Range

Moose winter range (MWR) is an additional forest cover objective since the last analysis. It is modelled through the application of retention and disturbance objectives consistent with GAR order #U-8-007. MWR is not applied to areas that are identified as MDWR. The timber supply impact of this will be tested as a sensitivity. Table 11.5 shows the MWR disturbance and retention objectives as in the GAR order and Table 11.6 shows the area by MWR planning cell.

Table 11.5 MWR objectives

	Percentage	Age/Height Threshold
Maximum Disturbance	20%	16 m height
Minimum Retention	60%	30 yrs age

Table 11.6 MWR Planning Cell Areas

MWR Planning Cell	Area (ha)		
	THLB	non-THLB Productive	Total
1	117	15	132
2	419	82	501
3	97	2	99
4	174	12	186
7	1,169	321	1,490
8	88	6	94
10	516	105	622
12	291	43	334
Total	2,870	587	3,458

11.2.4 Williamson Sapsucker

Draft wildlife habitat areas (WHAs) for the Williamson Sapsucker will not be enacted until after completion of this analysis. Therefore they will not be part of the basecase however their impact may be tested in a sensitivity.

11.2.5 Integrated Resource Management

The IRM zone has not been specifically modeled in this analysis because it does not reflect any operational reality for P&T's management of TFL 8. Instead spatial adjacency has been modeled for the initial 20 years. Spatial adjacency makes stands unavailable for harvest until neighboring stands have achieved greenup. The impact of turning on the IRM disturbance requirement allowing no more than 25% below the height of 2 meters will be tested as sensitivity.

11.3 Biodiversity

11.3.1 Landscape level Biodiversity

The management of landscape level biodiversity is through retention constraints of old seral stages. The timber supply impact of landscape level biodiversity management by proposed OGMAs will be tested as a sensitivity. Seral zones are defined by LU, KBHLPO-BEC (December 2000) and BEO. A summary of the seral zone objectives are shown below in Table 11.7.

Table 11.7 TFL 8 Seral Zones

Seral Zone	Old retention requirement (% > age)
B1-ICHmk1-I	14% >140
B1-IDFdm1-H	26% >250
B1-MSdm1-I	14% >140
B7-ESSFdc1-L	5% >140
B7-ICHmk1-L	5% >140
B7-ICHmw2-L	3% >250
B7-IDFdm1-L	5% >250
B7-MSdm1-L	5% >140
B8-ESSFdc1-L	5% >140
B8-IDFdm1-L	5% >250
B8-MSdm1-L	5% >140

11.3.2 Forest Connectivity Corridors

Because aspatial landscape level biodiversity targets are being used, forest connectivity corridors (FCC) will require preferential allocation of targets as per HLPO. They are dealt with through the application of retention requirements for mature and old seral stages. The retention requirements by FCC (again by LU, KBHLPO-BEC and BEO) are shown below in Table 11.8.

Table 11.8 FCC Requirements

FCC Zone	% Greater than Age	
	Mature and Old	**Old**
B1-IDFdm1-H	69% >100	26% >250
B1-MSdm1-I	26% >100	14% >140
B7-ESSFdc1-L	14% >120	5% >140
B7-ICHmw2-L	15% >100	3% >250
B7-MSdm1-L	14% >100	5% >140
B8-ESSFdc1-L	14% >120	5% >140
B8-MSdm1-L	14% >100	5% >140

11.3.3 Stand Level Biodiversity

The practice of leaving wildlife tree patches (WTPs) was modeled by reducing the average volume per hectare that is harvested, to account for trees that must be left within cutblocks. The methodology for determining this allowance has been described in Section 0.

11.4 Cultural Heritage Resources

There are no known cultural heritage resources with any associated timber supply impact within the boundaries of TFL 8.

11.5 Timber Harvesting

11.5.1 Minimum Merchantability Standards

Minimum harvest age was assessed for each analysis unit, as the age at which the mean annual increment (MAI) in stand volume reaches 95% of it's maximum value. 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). The distribution of net landbase area by minimum harvest age categories is illustrated in Table 11.9[6].

Table 11.9 Minimum Harvest ages, at 95% of culmination MAI

AU	MHA	MAI	DBH	Volume	AU	MHA	MAI	DBH	Volume
1	110	1.4	27.3	157	**101**	110	2.5	26.3	274
2	110	1.5	28.1	164	**102**	110	2.1	25.2	234
3	80	2.2	20.0	172	**103**	70	4.8	27.9	337
4	120	1.8	28.7	212	**104**	110	2.9	27.5	314
5	130	1.7	29.4	221	**105**	110	2.5	26.3	274
6	100	1.7	20.4	168	**106**	90	3.6	30.4	325
7	110	1.5	26.7	161	**107**	100	2.7	27.6	273
8	90	1.9	20.2	172	**108**	80	3.2	29.5	254
9	130	1.6	29.0	210	**109**	110	2.4	27.4	264
10	100	1.6	27.1	162	**110**	90	3.0	23.5	271
11	80	2.3	20.8	182	**111**	70	4.2	25.4	292
12	120	1.6	28.1	188	**112**	100	2.7	23.5	267
13	80	2.3	28.0	186	**113**	70	4.0	22.8	277
14	110	1.6	30.2	171	**114**	80	3.3	22.4	261
15	110	1.8	29.5	193	**115**	60	5.2	23.6	311
16	90	1.9	23.3	175	**116**	60	4.7	26.7	281
17	110	2.1	30.3	232	**117**	80	2.9	21.5	229
18	110	1.6	29.9	173	**118**	80	2.4	22.1	188
19	120	1.5	29.9	184	**119**	60	4.9	25.1	291
20	80	2.0	20.8	157	**120**	50	4.6	26.7	232
21	100	1.9	29.0	186	**121**	80	4.0	26.2	318
22	110	1.6	30.0	173	**122**	80	3.5	25.3	283
23	110	1.7	28.6	189	**123**	60	5.8	26.7	346
24	90	1.9	20.2	171	**124**	60	4.9	25.3	292
25	110	1.6	30.6	177	**125**	80	2.4	25.3	195
26	110	1.7	29.2	190	**126**	70	4.5	26.1	312
27	80	2.3	21.8	180	**127**	60	4.2	27.0	250
28	110	1.6	31.0	179	**128**	120	2.3	30.6	272
29	110	1.6	30.7	172	**129**	100	2.0	26.0	197
30	110	1.6	28.7	181	**130**	80	3.7	29.2	293
31	80	2.1	21.0	165	**131**	60	4.0	23.0	242
32	110	1.7	30.5	183	**132**	80	2.7	25.8	218
33	80	2.2	21.6	175	**133**	70	4.7	29.2	332

[6] If MPB epidemic is being modeled, for very severely affected stands that are prioritized for harvest, the MHA is reduced to age 40 to ensure that stands are not inappropriately limited from harvest

AU	MHA	MAI	DBH	Volume	AU	MHA	MAI	DBH	Volume
34	110	1.6	19.6	178	**134**	60	5.1	28.3	307
35	90	1.9	27.4	169	**135**	80	3.2	26.9	254
36	110	1.5	30.0	169	**136**	80	3.2	26.9	254
37	110	1.8	29.4	195	**137**	60	6.2	30.0	370
38	80	2.3	20.4	181	**138**	60	5.1	28.3	307
39	80	2.2	20.0	172	**139**	60	5.1	28.3	307
40	110	2.0	30.1	224	**140**	80	3.2	26.9	254
41	120	1.8	27.8	211	**141**	90	2.5	25.9	225
42	120	1.4	31.4	171	**142**	90	1.3	29.3	120
43	110	1.7	28.6	184	**143**	80	2.6	35.0	209
44	90	1.8	20.5	162	**144**	80	2.3	33.5	183
45	110	1.4	29.5	156	**145**	100	2.2	30.1	215
46	120	1.6	29.8	197	**146**	70	4.6	33.8	321
47	90	2.0	21.0	182	**147**	70	4.5	33.7	313
48	100	1.9	29.3	188	**148**	80	2.9	25.0	235
49	110	1.4	29.7	155	**149**	90	2.6	25.1	238
50	120	1.7	30.1	201	**150**	70	5.4	30.8	375
51	80	2.2	20.2	172	**151**	60	3.9	29.7	231
52	110	2.0	28.7	215	**152**	90	2.6	25.1	238
53	110	1.9	29.7	206	**153**	60	7.1	30.1	425
54	70	2.5	20.3	177	**154**	70	5.4	31.1	378
55	100	1.9	28.9	193	**155**	70	4.5	27.4	316
56	110	1.6	30.1	171	**156**	90	3.6	29.0	320
57	110	2.0	30.0	217	**157**	60	6.5	30.6	389
58	80	2.4	21.2	190	**158**	70	5.6	30.9	395
59	100	2.2	28.4	222	**159**	90	3.6	29.0	320
60	70	2.5	19.9	176	**160**	70	5.6	30.9	395
61	100	1.9	28.9	189	**161**	60	6.1	25.1	368
62	70	2.3	19.5	161	**162**	60	5.1	27.4	307
63	100	2.0	28.2	197	**163**	80	3.5	29.1	278
64	100	2.2	28.8	217	**164**	60	6.7	26.0	399
65	80	2.1	19.8	167	**165**	60	5.7	24.4	339
66	110	1.8	28.2	201	**166**	80	4.5	28.5	359
67	100	2.0	29.9	203	**167**	80	2.7	23.1	217
68	90	1.9	26.5	172	**168**	70	4.4	23.7	311
69	100	2.3	29.5	229	**169**	70	3.4	22.9	236
70	110	1.9	29.5	210	**170**	90	3.6	29.0	320
71	110	1.8	30.4	193	**171**	80	3.5	29.1	278
72	110	1.6	28.6	178	**172**	110	2.9	19.5	314
73	90	2.3	29.0	209	**173**	70	5.1	28.5	354
Average	**101**	**1.9**	**26.7**	**185**		**78**	**3.9**	**27.2**	287

It should be recognized that the application of cover constraints in particular zones may delay stand entry well beyond these minimum ages. This will result in realized long-term harvest levels that are lower than the theoretical Long Run Sustained Yield (LRSY), which is based on harvesting all stands at culmination age. LRSY values calculated on the basis of both natural and managed stand yield curves are shown in Table 11.10.

Table 11.10 LRSY values for natural and managed stands

	THLB Area (hectares)			CMAI		LRSY	
	Natural	Managed	Total	Natural	Managed	Natural	Managed
Totals	46,046	18,651	64,698	1.97	4.18	127,703	270,387

11.5.2 Silviculture Systems

Current management practice on TFL 8 indicates that clear cut harvesting is the only silvicultural system.

11.5.3 Initial Harvest Rate

The current AAC for TFL 8 is 175,000 m^3/yr plus NRLs. Therefore, the initial gross harvest level for the current management strategy option was set to the AAC plus NRLs (m^3/yr), providing a starting point for the analysis.

11.5.4 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. If the scenario is an MPB scenario, MPB at-risk pine stands are queued up first for harvesting (until the maximum target volume is reached). During this time, this prioritized harvest order takes precedence over the oldest first harvest rule.

11.5.5 Harvest Flow Objectives

11.5.6 No-MPB Epidemic

Forest cover constraints and biological capacity of the net operable landbase will dictate timber availability and harvest level options that are available. With the assumption that there is no MPB epidemic, the choice of harvest flow will reflect the following objectives:

- Maintain a non-declining yield harvest forecast; and
- Achieve a stable long-term harvest level over a 250 year planning horizon.

11.5.7 MPB Epidemic

With the assumption that a MPB epidemic will occur, the harvest flow across the 250 year planning horizon will look very different. The initial harvest level will be assumed to be at the non-MPB non-declining yield harvest level. After MPB mortality occurs, there will be a drop in harvest level down to the post-MPB mid term harvest level. This level will be determined by the dynamics of the MPB epidemic (i.e. amount and distribution of MPB mortality). After the timber availability recovers from this MPB mortality sufficiently, the long term harvest level will be increased to a stable level.

11.5.8 Disturbing the Non-THLB

When modeling, the entire productive land base is available to fulfill various land base 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 modelled. 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 land base. 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*. Note that the KBHLPO-BEC (December 2000) is used in this case as the seral targets are tied to the HLPO. The method used for this analysis is to:

1. Impose an annual disturbance to the non-THLB of each KBHLPO-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 KBHLPO-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 KBHLPO-BEC zone on TFL 8, 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. . Note that during the MPB uplift period, disturbing the inoperable will not be modeled specifically but will be assumed to be taken into account by MPB mortality.

This process has been carried out by:

1. Determining the KBHLPO-BEC zones and their area breakdown on TFL 8;
2. Using the Biodiversity Guidebook to determine the NDT, disturbance interval, age of mature age and of old for each KBHLPO-BEC zone;
3. Estimate the seral stage distribution following the Biodiversity Guidebook procedure;
4. Determine the appropriate old seral requirement for each KBHLPO-BEC zone; and
5. Determine the annual disturbance for each KBHLPO-BEC zone.

Table 11.11 provides the summary information for the KBHLPO-BEC zones on TFL 8.

Table 11.11 Disturbance intervals and age of mature and old by KBHLPO-BEC zone

NDT	BEC	Disturbance Interval	Mature Age	Old Age	THLB	Non-THLB Productive	TOTAL
3	**ESSF**	150	120	140	10,022	3,257	13,279
3	**ICH**	150	100	140	4,946	765	5,711
4	**IDF**	250	100	250	8,505	2,194	10,699
3	**MS**	150	100	140	41,005	6,756	47,761

(1) From biodiversity guidebook

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 11.12 shows the seral stage distribution for the two fire return intervals that occur in TFL 8 (150 years and 250 years).

Table 11.12 Cumulative age distribution using by mean disturbance interval

Age	150		250	
	Greater than	Less Than	Greater than	Less Than
20	88%	12%	92%	8%
40	77%	23%	85%	15%
60	67%	33%	79%	21%
80	59%	41%	73%	27%
100	51%	49%	67%	33%
120	45%	55%	62%	38%
140	39%	61%	57%	43%
160	34%	66%	53%	47%
180	30%	70%	49%	51%
200	26%	74%	45%	55%
220	23%	77%	41%	59%
240	20%	80%	38%	62%
250	19%	81%	37%	63%

Table 11.13 shows the area that will be disturbed each year in each KBHLPO-BEC zone and also shows the seral zone requirements that will be placed on the KBHLPO-BEC zones in order to achieve the desired NROV.

Table 11.13 Annual disturbance and seral requirement for the non-THLB

NDT	BEC	Disturbance Interval	Non-THLB Prod Area	Annual Disturbance (%)	Annual Disturbance (ha)	Seral requirements			
						Mature Plus Old		Old	
						Percentage	Age	Percentage	Age
3	ESSF	150	3,257	0.67%	22	45%	120	39%	140
3	ICH	150	765	0.67%	5	51%	100	39%	140
4	IDF	250	2,194	0.40%	9	67%	100	37%	250
3	MS	150	6,756	0.67%	45	51%	100	39%	140

11.6 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 land base 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 11.13.

12.0 SENSITIVITY ANALYSES

This section briefly describes the sensitivity analyses that will be performed on the TSR 3 base case. The sensitivities reflect the stability of the base case in the face of uncertainty surrounding specific analysis assumptions. They also reflect the impact of alternative management or potential changes in forest practices.

12.1 Landbase definition

12.1.1 Timber Harvesting Landbase +/- 10%

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

12.2 Growth and Yield Assumptions

12.2.1 Natural Stand Yields +/- 10%

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

12.2.2 Managed Stand Yields +/- 10%

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

12.2.3 Minimum Harvest Ages +/- 10 years

Minimum harvest ages will be altered to measure timber supply impact

12.2.4 Site Index +/- 1 meter and +/- 2 meter

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

12.2.5 Merchantability definition

Utilization levels will be changed to measure the timber supply impact of changing the top DIB from a 4 to a 5 inch top.

12.3 MPB Assumptions

12.3.1 Quicker MBP Spread

This sensitivity will test the timber supply impact of modeling MPB spread as though what was predicted for 2016 occurred 5 years earlier in 2011.

12.3.2 Shelf life and %MPB Harvest Sensitivities

These sensitivities will test the timber supply impact of different shelf lives and harvesting differing amounts of MPB-attacked wood in the first 10 years. Alternative shelf lives that are tested are 2, 5 and 7 years. Alternative %MPB harvested will range from 10% to the maximum able to be achieved.

12.4 Resource Management Areas Assumptions

12.4.1 Green-up Heights +/- 1 meter

Green-up heights will be altered to measure the timber supply impact.

12.4.2 Turn off Adjacency and Turn on IRM

Disturbance constraints allowing no more than 25% below two meters will be applied to the THLB to measure the timber supply impact.

12.4.3 Williamson Sapsucker

This will investigate the timber supply impact of introducing the Williamson Sapsucker WHA.

12.4.4 Moose Winter Range

This will investigate the timber supply impact of the recently introduced MWR objective.

12.5 Biodiversity Assumptions

12.5.1 Spatial OGMAs

Model landscape level biodiversity requirements through the explicit proposed spatial OGMAs to evaluate the timber supply impact. The OGMA version is the Frank Wilmers November 2006 version.

12.5.2 Turn off disturbances in the non-THLB

This will allow the non-THLB to age continuously.

12.6 Alternate Harvest Conventions

12.6.1 Alternate Harvest Rules

The base case 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.

12.6.2 Alternate Harvest levels

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

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APPENDIX 1.0 NRL RATIONALE AND DATA

Estimates of Annual Non-Recoverable Losses on TFL8 (2007)

TFL 8 has good road access virtually throughout, so any occurrence of catastrophic stand damage is both relatively easily detected and accessible for salvage harvesting. Salvage operations may be carried out under amendments to existing cutting authorities, by initiating new cutting permit, under the blanket salvage cutting authority (CP 999) or under the Ministry of Forests Small Scale Salvage program. Stands within the Timber Harvesting Land Base that suffer catastrophic damage and not recovered are usually small, isolated or of marginal quality.

Wildfires:

During the past twenty years there has been very low occurrence of large stand destroying fires on TFL8. Most of the fires that do occur are caused by lightning. The vast majority of these are contained and extinguished while less than one hectare in size. These fires generally cause very little mortality and do not result in new openings or revisions to existing forest cover polygons. In consideration of the above, it is assumed that the scattered mortality that does occur, is accounted for in the VDYP yield curves.

Since 1986 there have been six fires on or partly on the TFL larger than one hectare, which resulted in greater tree mortality than described above:

- "Fall" fire in 1986 located in Windfall Creek – the majority of the mortality occurred on Non-productive ground (not within the THLB), however it is estimated that approximately 100 stems on the THLB, with an average volume of 0.60 m3/stem were killed. None of these losses were salvaged.
- In 1988 two fires were accidentally ignited by Mechanical site prep equipment working on CP 5C in Blind Valley and CP 13A in East Trapping Creek. The fires were mostly contained within existing cutblocks and mortality was confined to scattered seedtrees and a very small amount of fringe burn. On CP 5C approximately 50 trees with an average volume of 1.0 m3/stem were killed and on CP 13A approximately 50 stems averaging 2.0 m3/stem died. None of these losses were salvaged.
- "Bea" fire in 1989 originating at a nearby wood processing facility spread onto TFL 8 near Carmi. All timber killed by the fire and damaged along fire access trails was salvaged under the authority of CP 9C.
- Fire #-N60564 in 2000 located in Ingram Creek was alleged to have been ignited by industrial activity on CP 7F. Substantial mortality occurred, however all of the merchantable dead and damaged timber has since been salvaged under the authority of CP 7F. Based on cruise compilation comparisons, it is estimated that damage as a consequence of the fire resulted in a loss of approximately 446 m3 of merchantable timber.
- In 2003 Fire #N60174 north of Carmi, ignited within the Boundary TSA and subsequently spread to include a small area on TFL 8. Most of the area within TFL 8 that was affected by the fire was salvaged under CP 10B. A portion of the burned area was not within the THLB (Open Range types or forested types with Es designation). In addition an estimated 250 m3 of merchantable timber within the THLB was not salvaged.

In the period from 1986 to 2005 the total non-recovered volume loss due to wildfire is estimated at 706 m3 or 35 m3 per year.

Bark Beetles

Due to the cyclical nature of Bark Beetle epidemics it is not appropriate to examine short periods of history to derive estimates of long term future losses. For example TFL 8 experience significant Mountain Pine Beetle attack during the 1980's and early 1990's, and virtually none since that time and none anticipate in the near future.

IBM:

1986 to 1995 - the vast majority of Pine Beetle infested timber was salvage under normal cutting authorities. A temporary A.A.C. uplift was granted by the Chief Forester in 1992 to address significant increases in beetle populations. Despite these efforts it is estimate that approximately 5 hectares/year with 20% mortality on 215 m3/ha remained unsalvaged.

1996 to 2000 – virtually no mountain pine beetle has been detected on TFL 8 between 1996 and 2000. Any incidental endemic attacks during this period are assumed to be accounted for in VDYP yield curves.

2001 to present - isolated incidence of mountain pine beetle started to occur in approximately 2002 but most of these have been addressed in normal CP development. It is estimated that approximately 400 ha/year with 0.25% mortality on stands of 210 m3/ha remained unsalvaged in mixed stands and stands with low priority for salvage.

Long term annual losses are therefore estimated to be: ((10yr x 5ha/yr x 20% x 215m3/ha)+(5yr x 400ha/yr x 0.25% x 210m3/ha))/20yrs or 160 m3/year.

This is a bit unrealistic given the current IBM infestation and projections. Requires further work by district forest health officer.

IBD:

1986 to 1995 – No losses to Douglas Fir Bark Beetle were noted on TFL 8 during this time.

1996 to present – an estimated 5 hectares per year with approximately 10% mortality occurs in stands averaging 250 m3/ha.

Long term annual losses are therefore estimated to be: (10yrs x 5ha x 10% x 250m3/ha)/20yrs or 62 m3/year.

IBS:

1986 to 1995 – No losses to Spruce Bark Beetle were noted on TFL 8 during this time.

1996 to present – Small but significant amounts of Spruce Bark Beetle attack began occurring in the late 1990's. Most incidences were associated with minor blowdown events in riparian management areas (not in THLB) an estimated 3 hectares per year with approximately 10% mortality occurs in stands averaging 300 m3/ha.

Long term annual losses are therefore estimated to be: (10yrs x 3ha x 10% x 300m3/ha)/20yrs or 45 m3/year.

Windthrow

No major windthrow event has occurred on TFL 8 since the October 16, 1991 storm which damaged hundreds of hectares. Virtually all of this damage was salvaged under normal cutting authorities or the blanket salvage permit, in conjunction with the A.A.C. uplift noted above.

Catastrophic Blowdown:

These losses are limited to isolated damage occurring in scattered patches and ranging in sizes up to 1.0 hectare. They are generally located in inaccessible areas or harvesting is considered uneconomical due to small volumes or marginal timber quality. It is estimated that these occurrences total 1.0 hectares/year at 215 m3/ha.

Non-Catastrophic Blowdown within and adjacent to existing cutblocks:

A portion of in-block blowdown occurs within Wildlife Tree Patches or Riparian Management Areas reserves not included in the THLB. Other portions of in-block blowdown is accounted for in the estimate below of residual seedtrees that do not survive until the next rotation. These losses are limited to in-block residual stems or fringe blowdown. It is estimated that 10 stems per cutblock averaging 0.3 m3/stem are effected on 25 cutblocks per year. Total losses amount to 75 m3/ year.

Non-Catastrophic Blowdown adjacent to new roads:

The majority of blowdown occurring adjacent to roads occurs in the first one to two years following construction as the new cut edge of the right-of-way stabilizes. Any large areas or concentrations of individual trees that blowdown are addressed through our salvage program. It is estimates that approximately 1.0 m3/km of un-salvaged loss occurs on an estimate of 30 km of new road/year. This loss is expected to be reduced over time as the entire TFL becomes roaded. (Similar to the principle of deducting landbase for future roads trails and landings only once per polygon)

Non-Catastrophic Blowdown adjacent to existing roads:

Small and infrequent occurrences of blowdown continue adjacent to old existing roads. Losses are estimated at 0.25 m3/km/year on an existing road network of 1103 km for a total of 276 m3/ year.

Retention Tree Mortality

These losses are limited to seedtrees that do not survive until the next harvest entry in the stand, other than specific wildfire events noted above. Approximately 20 % or five 25 hectare cutblocks per year are harvested with seedtree prescriptions. Typical prescriptions retain 4 to 8 stems/ha averaging 1.0 m3/stem. It is estimated that 10% of these stems do not survive until the next rotation and will not be salvaged because it would be uneconomical or because of risks of damage to new plantations.

Long term annual losses are therefore estimated to be: (5 cutblocks x 25 ha/cutblock x 6 st/ha x 1.0 m3/ha x 10%) or 75 m3/year.

Snow Damage

In December 1996 an winter storm dropped unusually heavy amounts of wet snow followed by freezing cold. The frozen snow and ice that accumulated in tree crowns cause widespread breakage and uprooting of stems. The majority of the damage that occurred on the TFL was salvaged in CP's 7D and 7E. Other small amounts of damaged trees were not recovered because they were small and isolated areas or non-merchantable in size. The damage did not create any new polygons that would not be considered natural openings in the stand. In consideration of the above, it is assumed that the scattered mortality that did occur, is accounted for in the VDYP yield curves.

Floods

There is no history of floods causing stand mortality on the TFL. Therefore it is assumed that any incidental losses that may occur are accounted for in VDYP yield curves.

Summary:

Damage agent	Total calculated 20Yr loss	Average Annual Loss
Wildfire	906	45
Mountain Pine Beetle	3200	160
Douglas Fir Bark Beetle	1250	63
Spruce Bark Beetle	900	45
Catastrophic Blowdown	4300	215
Non-catastrophic in-block Blowdown	1500	75
Non-catastrophic Blowdown adjacent to new roads	600	30
Non-catastrophic Blowdown adjacent to existing roads	5520	276
Retention Trees	1500	75
Total Non-recovered Losses	19676	984