ENHANCED TYPE 2 SILVICULTURE ANALYSIS
BOUNDARY TSA
INFORMATION PACKAGE

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TABLE OF CONTENTS

TABLE OF TABLES

TABLE OF FIGUES

1.0 INTRODUCTION

British Columbia Timber Sales (BCTS) have contracted Timberline Natural Resource Group (Timberline) to carry out an Enhanced Type 2 Silviculture Analysis (Type 2) for the Boundary Timber Supply Area (TSA). The project has been funded by the Forest Investment Account (FIA). The purpose of this project is to provide decision support for developing silviculture strategies and prioritize Forest for Tomorrow (FFT) spending in the Boundary TSA. One of the key motivating factors behind the completion of this project is the need to mitigate environmental and timber supply impacts from the predicted MPB epidemic.

This document is the first of three reports for this project:

1. Information (data) package;
2. Analysis report; and
3. Preferred silviculture strategy (integrated into the analysis report).

The starting point for the analysis is a basecase, which uses the best information available and projects the most likely outcome without government intervention. The assumptions used in this analysis have been collated from the initial project orientation meeting for stakeholders (8th November 2008 in Grand Forks) and by reviewing and revising the latest two analyses: the Ministry of Forests and Range (MoFR) Timber Supply Review 2 (TSR 2); and the Spatial Timber Supply Analysis done by Timberline in 2004. Using this basecase, many sensitivities are run to look for opportunity to mitigate the mid-term timer supply impact caused by the MPB epidemic. Ultimately the project will provide:

- An understanding of the how the projected MPB epidemic will affect the timber supply and environmental objectives in the Boundary TSA;
- An understanding of how today's forest management can influence the future timber supply and environmental objectives;
- An understanding of the timber supply impacts of recent GAR orders such as the grizzly bear and MDWR
- Provide direction to help prioritize silviculture projects that may be funded by the FFT program.

In addition to the Type 2 Silviculture work there were the following additional Phases:

- Optimization analysis using *Patchworks*;
- Carbon budget modelling using the CBM-CF3;
- Merchantability modelling, which has been used in the optimization analysis;
- Habitat supply modelling using habitat elements (CWD, Snags, deciduous percent and shrubs)

2.0 CURRENT FOREST COVER INVENTORY

This section documents the inventory and other information used in the type 2 analyses.

2.1 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).

2.2 Vegetation Resource Inventory

The Vegetation Resource Inventory (VRI) was downloaded from the LRDW in October 2007 and had been updated for disturbance and projected to 2006 by the Ministry. In order to complete the disturbance update RESULTS blocks and licensee forest development plan information was incorporated into the resultant database. After running VDYP, disturbance updates and various netdown queries it became obvious that there were serious issues surrounding inventory attributes.

It was found that the most recent version of inventory was unreliable. It was unclear whether the problems were introduced through the rollover to VRI format, the flattening process employed by the MoFR; or the disturbance update process. Some examples of issues identified are:

- Inventory information was blank for stands updated for disturbance, and sometimes these stands were classified as NTA, other times they were left blank;
- Over 40,000 ha of forest stands became stocking class 4 when run through VDYP. This resulted in a severe underestimation of volume on these stands. While the projection of stocking class to 4 may be accurate for some of the stands in the boundary TSA, it was not deemed realistic for the number of stands that were actually being assigned a stocking class of 4.
- Over 50,000 ha were indicated as being age 0, with no additional information. Most of the area was not indicated as being harvested in RESULTS. After visually checking several hundred of the stands in question using satellite imagery there was no clear trend (some stands were clearly harvested and some stands were clearly not harvested).

After various attempts to clean up the inventory and numerous runs through the netdown and resultant process we decided to use the 2003 update of the VRI and deplete disturbances ourselves using the 2007 cut of RESULTS information. In addition, we updated the VRI with the December 2005 Pope & Talbot FDP (the latest one we were able to acquire).

2.3 Defaults

The following defaults were applied to the analysis:

- Approximately 8,000 ha had no inventory species and were defaulted to 100% pine;
- Reset ages based on RESULTS data (approximately 5,000 ha);
- FDP blocks with codes; A, CP and PA were prioritized for harvest; and
- For VDYP inputs, if the stocking class was 0 or blank and the stand was mature, then this was defaulted to 1.

2.4 Data Sources

Many sources of data were compiled to provide input to the timber supply analyses. These sources are documented in Table 2.1

Table 2.1 Data sources

Issue or Data	Description, Source	Coverage Name	Version or Date Stamp
Administrative and Land Base Issues			
TSA, Forest District Boundary	Forest district boundary. TSA boundary defined in combination with ownership.	tfd_dbo	8-Jul-03
Forest inventory zones	VRI, MSRM	vri	2003 Update
Ownership	Ownership, Ministry of Forests	qown_alter	1-Dec-03
Public sustained yield units	VRI, MSRM	vri	2003 Update
Woodlots	Included in ownership coverage, Ministry of Forests	woodlots	1-Dec-07
Landscape units	Ministry of Forests	tlu_bd	Unknown
Base Inventories			
Forest Inventory	VRI (including disturbance update) and associated attribute tables, MSRM	vri	2003 Update
RESULTS Update	2007 RESULTS cut of all disturbance blocks	bd_results	2007 Update
Ecosystem inventory	Boundary PEM by TFIC	tecp_bnd	3-Apr-03
Operability and Harvest Planning			
Operability	Current Operability from MSRM	topr_bd	3-Jul-03
Environmentally sensitive areas	(ESAs) from previous Forest Cover, Ministry of Forests	fesa_dbo	3-Jul-03
Terrain classification mapping	DBO Terrain hazard coverage - combined level C and D high risk polygons. GEOSense	fhaz_dbo	3-Jul-03
Road Buffers	Boundary TRIM, NTS and Tenures Linear Feature Buffers	frdbuf_db	3-Jul-03
Forest development plan	MSRM, DBO Licensees	pope_fdp	1-Dec-05

Issue or Data	Description, Source	Coverage Name	Version or Date Stamp
Integrated Resource Management Issues			
Enhanced resource development zones	KBHLP required data set (ERDZ), Nelson MSRM warehouse.	aerdz_bd	3-Jul-03
Connectivity	KBHLP required data set, Nelmarc	qcon_bd	3-Jul-03
Old growth management areas	OGMA updates from Frank Wilmer	aog_bd	Acquired updated version December 2007
Biodiversity emphasis	KBHLP required data set. No impact on analysis, but was considered when OGMA were spatially defined.	qbeo_bd	3-Mar-03
Goat Winter Range	MSRM	gtwr_dbo	3-May-03
Mule Deer Winter Range	MSRM	mdwr_dbo	3-May-03
Moose Winter Range	MSRM	moose_wr	3-May-03
Grizzly Bear	MSRM	qgrz_bd	3-Jul-03
Wildlife tree patches	some included in FDP	tfdp_dbo03	3-Oct-03
Resource Management Zones	MSRM	qrmz_dbo	unknown
Scenic areas	HLP Scenic Areas	qsce_bd	3-Jul-03
VQO	Updated VQO	avqo_05	Acquired December 2007 update
Grzzly WHA's	Grizzly bear wildlife habitat areas	griz_wha	1-Dec-07
Williamsons Sapsucker	Williamson sapsucker	wisa_bd	1-Dec-07
BEC	Biogeoclimatic Zones	abec_bc	1-Mar-06
Riparian and Water Issues			
Community watersheds	MSRM	tcws_bd	3-Jul-03
Domestic watersheds	Not used. Consumptive Intakes used instead.		
Consumptive Intakes	Forest inventory polygons that contained POD's (Points of diversion) were identified and removed from the land base as consumptive intakes.	tcoin_r4	unknown
Riparian Buffers	Riparian buffers, MSRM. Strategic use only.	ftrip_dbo	3-Jul-03

3.0 TIMBER FLOW OBJECTIVES

The forest cover objectives and the biological capacity of the net THLB will dictate the harvest level. However, there are a number of alternative harvest flows possible as many management objectives must be met. In this analysis, the main objectives are:

- To start with an initial harvest level of the current AAC: 700,000 m^3/year of which 30% will be sourced from non-pine stands;
- The mid-term harvest level will reflect the maximum available harvest, while maintaining the landbase objectives; and
- Have a long run harvest level that is sustainable and reflects managed stand yields over a 250 year horizon.

4.0 DESCRIPTION OF THE LANDBASE

This section describes the Boundary TSA landbase and the methodology used to determine the way in which area contributes to the analysis. Some portions of the productive landbase, while not contributing to harvest, may be available to meet other resource needs. The area identified as the timber harvestable land base (THLB) is the area that is available for timber harvesting in the model.

4.1 Landbase Classification

The classification of landbase for this analysis as described in this section is based on the procedure outlined in the *Supplemental Guide for Preparing Timber Supply Analysis Data Packages* (MoFR, 2003a). The order of classification is depicted in Table 4.1; detailed descriptions of each classification step are included in subsequent sections.

The landbase classification steps are consistent with TSR 2 except for additional reductions for woodlot licenses and OGMAs. Two recent woodlot coverages were added to this analysis from the TIMBERLINE database. Also, a 2007 OGMA coverage was downloaded from the MoFR FTP site and added to our analysis. In addition, analysis for consumptive intakes was removed from the netdown at the client's request.

The final classification indicates a long-term net harvesting landbase of 276,474 ha which is 4% less than TSR 2 (288,247 ha). There is some uncertainty surrounding the area reported as being netted out for parks in TSR 2. The area in parks is shown in the netdown table as being 70,440 ha, however, the actual gross park area is only 76,726 of which 22,375 ha is non-productive, non-forest. This discrepancy has been discussed with MSRM and MoFR and has been attributed to a reporting oversight in TSR 2.

Table 4.1 Landbase Classification

Land Classification	TSR II Area (ha)	Area (ha)
Boundary TSA Gross Area	**578,609**	**581,073**
Non-crown	63,968	63,798
Woodlots	0	20,067
Total TSA	**514,641**	**497,207**
Non-forest, Non-Productive	84,313	34,046
Non-Commercial	575	552
Existing Roads and Landings	4,868	5,191
Productive Forest	**424,886**	**457,419**
Parks	70,440	68,908
Riparian	5,681	5,015
ESA's and Terrain	26,438	30,410
Low Timber Potential	2,860	22,059
Deciduous	2,920	2,143
Inoperable	22,118	29,686
Problem Forest Types	6,182	2,662
Consumptive Intakes	0	0
OGMA	0	19,521
Partial Netdowns		557
Total Productive Reductions	**136,639**	**180,405**
Timber Harvesting Landbase	**288,247**	**276,457**

4.2 Landbase Summary

The gross area in the TSA was determined using a combination of the boundary forest district and ownership classification. All land within the forest district boundary and **not** classified as 76-N (crown and private TFLs) are within the scope of this analysis.

4.2.1 Land Not Administered by the Ministry of Forests

All land ownerships not contributing to TSA harvests are reclassified as non-crown land. This is achieved by excluding all areas classified as 40-N or 50-N in the MoFR ownership layer. In addition, 17,937 ha of woodlots were removed from the landbase for this analysis. There were no timber licenses present on this landbase.

4.2.2 Woodlots

Woodlots have been netted out of the THLB in this analysis. In addition to the data already present, Timberline has added two recent woodlot coverages to provide a more realistic woodlot area estimate. They have been included in the landbase summary table to provide a comparison to TSR 2, as they were included in that analysis.

4.2.3 Non-forest and Non-productive

All stands with an np_code greater than zero and classified as NTA were classified as non-forest, non-productive. Non-forested regions were broken out further into non-commercial areas to facilitate comparison with TSR 2. 34,046 hectors classifies as non-forest non-productive were netted out of the THLB.

4.2.4 Non-commercial and Non-commercial Brush

Forest cover stands classified as NCBR or NC were removed from the harvestable landbase, as shown in Table 4.1 552 hectors classified as non-commercial and non commercial brush were removed from the THLB.

4.2.5 Roads and Landings

A buffered roads coverage was provided to Timberline by MSRM. It contains buffered TRIM, NTS and Tenures linear features. These buffers were determined according to TSR 2 values (Page 101, AAC Rationale). 5,991 hectors were removed from the THLB to accommodate future roads and landings.

4.2.6 Parks and Protected Areas

Parks were identified using ownership codes '63-N' and '67-N'.Table 4.2 summarizes park areas and their impact on the net landbase.

Table 4.2 Parks and Protected Areas

Description	Area (ha)		
	Gross	**Productive**	**Area Removed**
PARK	78,330	68,906	68,905
Total:	**78,330**	**69,056**	**69,055**

4.2.7 Riparian Management Areas

A buffered riparian coverage was received from MSRM and deemed the best information available without a more extensive stream survey. The resolution on this buffered layer did not allow for area summaries by stream class and, therefore, only total riparian areas are listed. Riparian management areas are composed of a reserve zone that is 100% removed and a management zone that is reduced by a percentage based upon stream class. In order to avoid the partial netdown for management zones, the reserve zone buffers were increased in width based on the reduction percentage multiplied into the management buffer distance (i.e. a management zone requiring 25% retention in a 20m buffer was modelled using a 5m buffer with 100% retention). Table 4.3 shows the area removed for riparian management areas.

Table 4.3 Riparian Management Areas

Description	Area (ha)		
	Gross	Productive	Area Removed
Riparian	16,545	5,524	5,012
Total:	**16,545**	**5,524**	**5,012**

4.2.8 Environmentally Sensitive Areas and Terrain Stability

Forest cover inventories include an environmental sensitivity rating for areas such as sensitive soils, avalanches and areas that will have regeneration difficulties. The VRI used for this analysis did not include sensitivity ratings, therefore, a separate layer based on the forest cover's ESA field was provided from MSRM. The ESA 'low' netdown applied in TSR 2 was replaced with the use of terrain stability mapping. Table 4.4 summarizes these netdowns.

Table 4.4 ESA's and Terrain Stability

Description	Area (ha)		
	Gross	Productive	Area Removed
ESA	49,642	43,082	30,402
Total:	**49,642**	**43,082**	**30,402**

4.2.9 Low Timber Productivity

Sites with low timber growing potential are not available for timber harvest. The criteria used for this analysis were identical to those used in TSR 2. Stands with a logging history were not removed.

Table 4.5 Low Timber Productivity

Species	Inventory Type Groups	Site Index (m@ 50 years)
PL leading	28-31	< 7.5
FD leading	1-8	< 8.5
L leading	34	< 7.5
Cw, Hw, Pw	9-17, 27	< 9.0
S, B leading	18-26	< 8.0

Table 4.6 shows the area meeting the low site definition.

Table 4.6 Low Timber Productivity

Description	Area (ha)		
	Gross	Productive	Area Removed
Low Productivity	175,107	31,968	18,574
Total:	**175,107**	**31,968**	**18,574**

4.2.10 Non-merchantable Deciduous Forest Types

Deciduous forest stands are identified as non-merchantable when they are not a target species for timber supply. Inventory stands classified as deciduous were removed as long as they had no prior logging history. Table 4.7 summarizes this netdown.

Table 4.7 Non-merchantable Deciduous Netdowns

Description	Area (ha)		
	Gross	Productive	Area Removed
Deciduous	6,546	4,677	2,143
Total:	**6,546**	**4,677**	**2,143**

4.2.11 Areas Considered Inoperable

Operability mapping for the Boundary TSA was received from MSRM and is summarized in Table 4.8. Forested stands classified as inoperable but having a harvest history were not considered inoperable because they have had previous logging activity.

Table 4.8 Inoperable areas

Description	Area (ha)		
	Gross	Productive	Area Removed
Inoperable Areas	111,679	94,474	29,685
Total:	**111,679**	**94,474**	**29,685**

4.2.12 Problem Forest Types

Certain stands are classified as problem forest types and are removed from the landbase as these stands contain only marginal timber. TSR 2 evaluated the inventory and determined criteria for locating these timber types. It was assumed that the area identified as problem forest types in TSR 2 are still problem forest types today. To be consistent with TSR 2, the age definitions have been adjusted by seven years to account for the elapsed time (2003 was the update year of the forest cover used in TSR 2, 2007 is the update year for this analysis, 4 years is the elapsed time between the two analyses).

Site index ranges were also changed in order to capture an equivalent area for netdown. These were changed to avoid the partial netdowns that were applied to each problem forest type in TSR 2. To summarize, the site index endpoint used in Table 4.9 were chosen because they netted out the exact amount of landbase required to match TSR 2 areas. The overall reduction appears slightly different than TSR 2 because of the woodlots being removed from this analysis.

Table 4.9 Problem Forest Types

Description	Area (ha)		
	Gross	Productive	Area Removed
Problem Forest Types	3,952	3,908	2,662
Total:	**3,952**	**3,908**	**2,662**

4.2.13 Consumptive Intakes

Forest cover polygons containing a consumptive water intake were removed from the landbase. This is additional to TSR 2. The client has requested that we remove consumptive intakes from this analysis.

4.2.14 Old Growth Management Areas

Old growth management areas were defined within the Boundary TSA by MSRM. BCTS will be providing further updates to the OGMA coverage and this data may be used for a sensitivity analysis. The updated OGMA coverage has been included in the analysis and can will be tested in a sensitivity analysis

OGMAs currently identified were removed from the harvestable landbase during the classification in order to meet landscape level biodiversity objectives. OGMAs meet the old growth requirements referenced in Objectives 1, 2, and 5 of the KBHLPO, but do not meet the mature requirements. Table 4.10 summarizes this netdown. These objectives are documented in Section 8.7.2.

Table 4.10 Old Growth Management Areas

Description	Area (ha)		
	Gross	Productive	Area Removed
OGMA	48,264	40,771	19,519
Total:	**48,264**	**40,771**	**19,519**

4.2.15 Partial Netdowns

The only partial netdowns required on the boundary TSA were for landings. In order to account for the loss of productive land to landings a 1% netdown to all stands in ageclass 1, (0 to 20 years of age), was applied. This reduced the THLB by 411 ha.

4.2.16 Future roads, Trails and Landings

It is assumed that all stands older than age 40 will be roaded in the future at the time of harvest. In these cases, 6% area reductions were made in the timber supply analysis after the volume is credited to the harvest.

5.0 LANDBASE SUMMARIES

5.1 Landbase Classification

Figure 5.1 displays the productive area classification for the Boundary TSA. 56% of the TSA area is THLB.

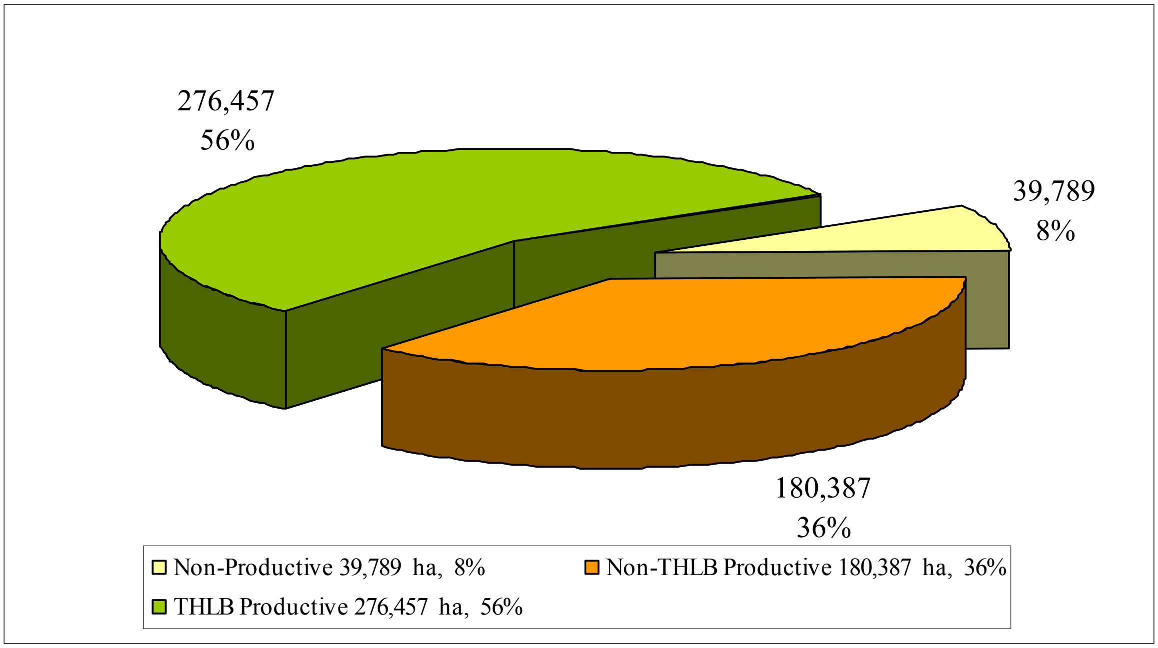

Figure 5.1 Classification of the Boundary TSA

5.2 Forest Inventory

5.2.1 Initial Age Distribution

Figure 5.2 shows the initial age distribution for the Boundary TSA. This figure is separated into THLB area and non-THLB productive area and each age was rounded to a 10 year ageclass. The harvest activity in the Boundary TSA is shown in the first three columns- the large fluctuation in area between ageclass 0/10/20 is an abstract from reality (a product of rounding).

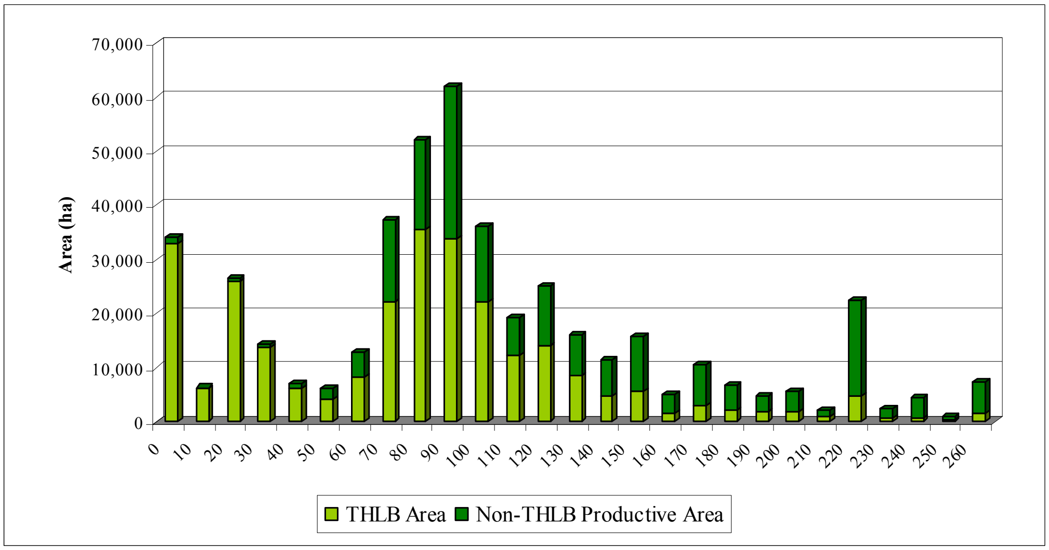

Figure 5.2 Ageclass Distribution of the Boundary TSA

5.2.2 Leading Species

Figure 5.3 summarizes area by leading species in the Boundary TSA. Again, this figure is separated into THLB and non-THLB productive area. 51% of the THLB is pine leading and 36% is Douglas-fir leading.

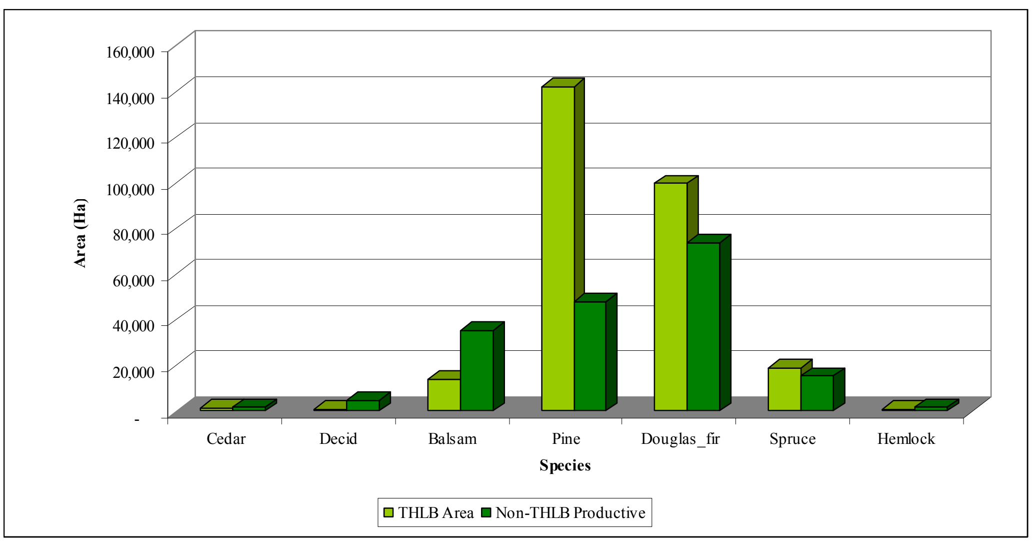

Figure 5.3 Leading Species of the Boundary TSA

5.2.3 BEC and NDT

Figure 5.4 displays the BEC and NDT distribution for the Boundary TSA. The three most common BEC zones are MDdm1, ICHmk1 and ESSFdc1 respectively.

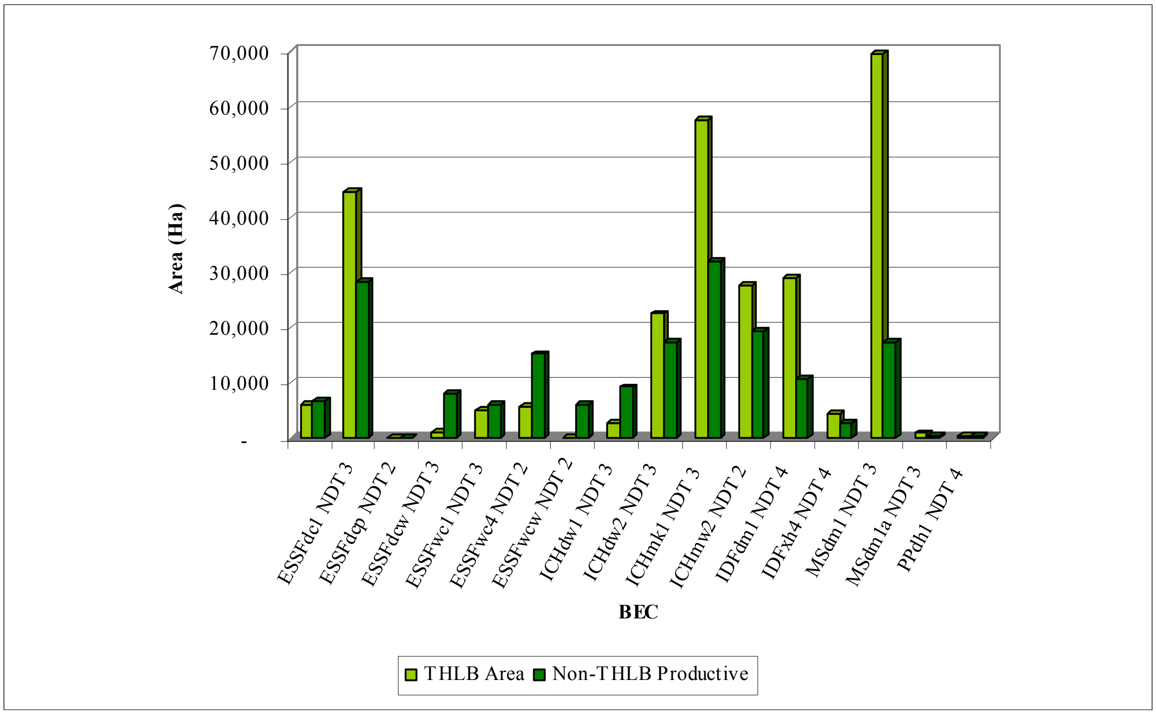

Figure 5.4 BEC and NDT Distribution of the Boundary TSA

5.2.4 Landscape Units (LUs)

Figure 5.5 summarizes the area for each landscape unit in the Boundary TSA. The LU Kettle is the most dominant LU.

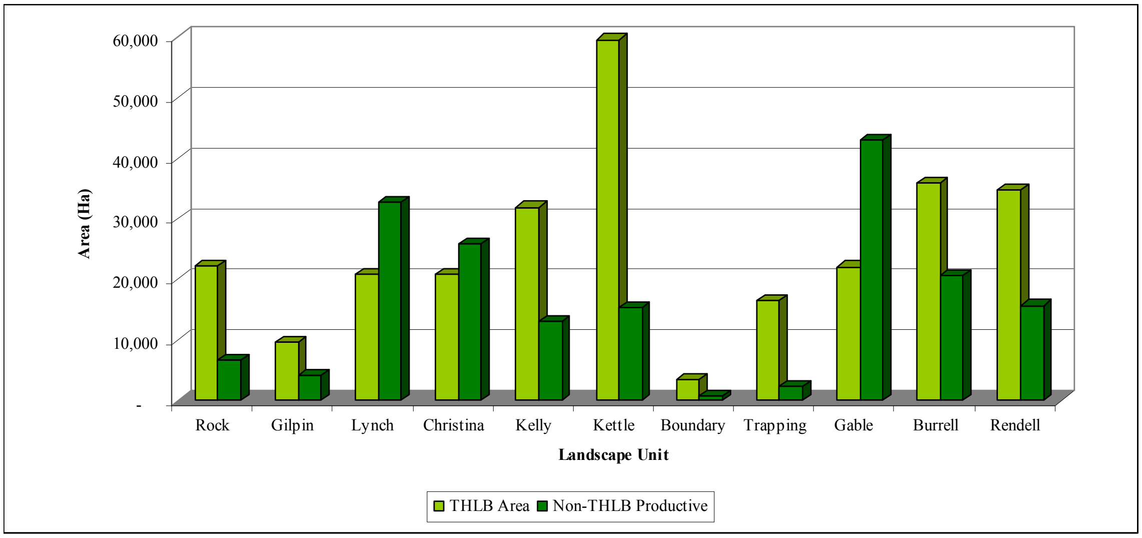

Figure 5.5 Landscape Unit Distribution of the Boundary TSA

5.2.5 Productivity Estimates

Figure 5.6 shows the distribution of site index values for the Boundary TSA. The average inventory site index on the THLB is 16.5.

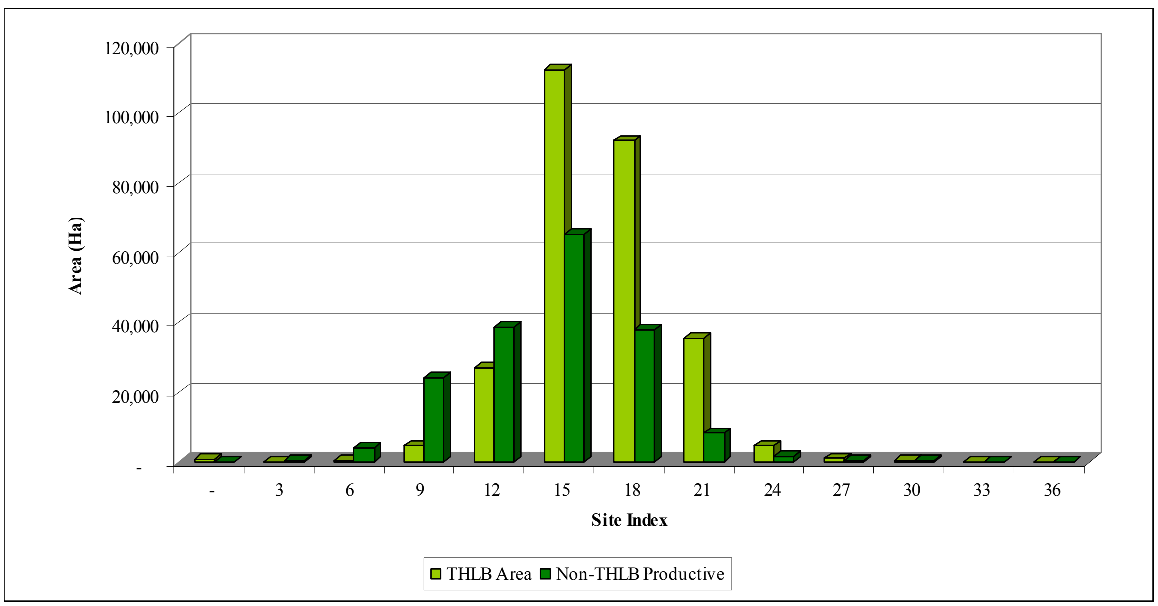

Figure 5.6 Site Index Distribution of the Boundary TSA

6.0 GROWTH AND YIELD

6.1 Analysis Unit Definition

In order to reduce the complexity of the forest description for the purposes of timber supply analysis, 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 land base 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.

Grouping stands into analysis units (AUs) on the basis of similar species composition, site productivity and silviculture regime captures similarities in growth and response to silvicultural treatments.

6.2 Natural Stand AUs and Yields

6.2.1 ClearCut

Analysis units (AUs) are aggregates of stands of similar characteristics and growth and yield responses. In order to precisely capture the value from each stand it is important to keep as much stand level information as possible, which in turn means that there is less opportunity for aggregation. For this analysis a balance was found by rounding certain stand level attributes and then aggregating in cases where the rounded attributes were identical. The rounding process involved:

- Rounding age to the MoFR ageclass;
- Rounding site index to the nearest multiple of 3 (VRI site index);
- Finding the leading species;
- Finding the Pine percentage (grouped by greater or less than 70%); and
- Finding the year a stand became "very severe" MPB affected (from selected years: never/2007/2010/2012/2015/2017/2020).

After this classification process, stands with the same rounded age, rounded site index, leading species, pine percentage classification and very severe year were grouped together in AUs. Figure 6.1 shows an example of the process used.

The year a stand first becomes VS

Ageclass	SI	VS Year	Leading Species	Pine per
8	9	2015	Pine	greater_than_70
8	9	2015	Pine	less_than_70
8	24	2020	Douglas_fir	less_than_70
8	6	0	Spruce/Balsam	less_than_70

Site Index Rounded to 3

Figure 6.1 Analysis Unit definition and Process

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

Natural stands are aggregated into AUs as described in the section above. The aggregation process resulted in 861 natural AUs in the Boundary TSA. The MoFR Variable Density Yield Prediction (VDYP) model (Version 6.6d) was used to develop natural stand yields at the analysis unit level. A yield curve was first generated for each stand using the species composition, crown closure and VRI site index of the stand. These yield curves were then averaged on area-weight to produce one yield curve for each analysis unit. Volumes were calculated net of secondary deciduous species volume contributions. The average inputs to VDYP are not presented because of the large number of natural AUs.

6.2.2 Partial Harvest

Partial harvesting was applied to open range and open forest fire maintained ecosystems. The systems modeled for partial harvests are described below:

- Open range will have only one entry, which will clearcut 98% of the volume (leave a few trees); and
- Open forest will retain 30% of the volume (70% removed) for the first entry with re-entry in 100 years. The volume at re-entry will be determined using 20% of a TIPSY curve (JSThrower, 2001).

The yield curves for patch cut, open forest and open range use VDYP curves for the first rotation and TIPSY curves for subsequent rotations. The yield reductions are modelled using CASH's 'OAF' functionality to reduce volumes.

6.3 Managed Stands AUs and Yields

For this analysis, the same approach as the last analysis was used (Spatial Timber Supply Analysis done by Timberline in 2004). Stands were grouped using the biogeoclimatic ecosystem classification (BEC) system at the site series level. Additional analysis units were required in order to model partial harvests in the fire maintained ecosystems, open forest and open range. This ecological approach to assigning analysis units resulted in a total of 68 managed analysis units. This approach was selected because it integrates more closely with ecologically based productivity estimates. Additionally, many management and silviculture treatment decisions are determined based on the ecological classification of the stand being treated.

Site index estimates produced using the MoFR's site index biogeoclimatic ecological classification (SIBEC) system will be used to model the growth of managed stands where available. SIBEC site index estimates are assigned to a stand based on the leading species and BEC site series classification. For this analysis, the BEC site series information required to use SIBEC was derived from the recently completed PEM project for the Boundary TSA (Timberline, 2002).

The silviculture management regimes within the Boundary TSA were modelled as predominantly using clear cutting followed by planting. Partial retention silviculture systems for the open forest/ open range have been modelled as described in section 6.2.2.

The planting species mixtures and densities were prescribed by the licencees for each ecological zone (see the Spatial Timber Supply Analysis done by Timberline in 2004). Existing and future managed stand yields were developed using MoFR BatchTIPSY (Version 2.1). The planted species composition used as input for TIPSY are presented in Table 6.1.

Table 6.1 TIPSY regeneration composition inputs

AU	Description	SI	Species composition	SPH	OAF 1 and 2		Plant or nat	CMAI age	CMAI
101	MSdm-1-F	16.5	FD 50 PL 40 Lw 10	2200	15	12	N	90	2.24
102	MSdm-1-L	16.9	Lw 50 PL 40 FD 10	2200	15	7	N	110	2.70
103	MSdm-1-P	17.4	PL 70 Lw 20 SW 10	2200	15	10	N	90	2.89
104	MSdm-1-S/B	15.2	SW 50 PL 40 BL 10	2200	15	10	N	110	2.68
105	MSdm-4-F	15.1	FD 50 PL 40 Lw 10	2200	15	12	N	100	1.83
106	MSdm-4-L	16.4	PL 40 Lw 40 FD 20	2200	15	7	N	110	2.42
107	MSdm-4-P	17.0	PL 80 Lw 10 SW 10	2200	15	10	N	90	2.82

AU	Description	SI	Species composition						SPH	OAF 1 and 2		Plant or nat	CMAI age	CMAI
108	MSdm-DA-L	18.1	PL	50	Lw	40	SW	10	2200	15	7	N	100	3.10
109	IDFxh-DP-F	16.7	FD	75	PL	15	PY	10	2200	15	12	N	100	2.13
110	IDFxh-DP-L	17.3	PL	50	FD	50	X	X	1400	15	7	P	80	2.98
111	IDFxh-SP-F	16.9	FD	75	PL	15	PY	10	2200	15	12	N	100	2.20
112	IDFdm-1-F	16.4	FD	50	PL	30	Lw	20	2200	15	12	N	100	2.18
113	IDFdm-1-L	17.2	PL	50	FD	40	Lw	10	1400	15	7	P	80	2.93
114	IDFdm-1-P	17.8	PL	75	FD	15	Lw	10	1600	15	10	P	70	3.40
115	IDFdm-3-F	15.4	FD	75	PL	15	PY	10	2200	15	12	N	110	1.78
116	IDFdm-4-F	15.9	FD	75	PL	15	Lw	10	2200	15	12	N	100	1.89
117	IDFdm-4-L	17.0	PL	60	Lw	20	FD	20	1400	15	7	P	80	2.95
118	IDFdm-4-P	17.2	PL	70	Lw	20	FD	10	1600	15	10	P	80	3.11
119	ICHmw-1-C/H	15.7	PL	50	Lw	30	SW	20	1600	15	10	P	100	2.67
120	ICHmw-1-C/H	16.3	PL	50	Lw	30	SW	20	1600	15	10	P	90	2.84
121	ICHmw-1-F	17.7	PL	50	Lw	30	FD	20	2200	15	12	N	90	2.70
122	ICHmw-1-L	17.3	PL	50	Lw	40	SW	10	1400	15	7	P	90	3.06
123	ICHmw-1-P	17.0	PL	70	Lw	20	SW	10	1600	15	10	P	90	3.13
124	ICHmw-1-S/B	15.5	PL	50	Lw	40	SW	10	1600	15	10	P	100	2.50
125	ICHmw-3-F	15.7	FD	50	PL	30	Lw	20	2200	15	12	N	110	1.97
126	ICHmw-3-L	16.5	PL	50	Lw	40	FD	10	1400	15	7	P	90	2.70
127	ICHmw-3-P	16.7	PL	70	Lw	20	FD	10	1600	15	10	P	80	2.95
128	ICHmw-4-L	18.2	Lw	50	PL	40	FD	10	1400	15	7	P	90	3.29
129	ICHmw-4-P	16.5	PL	70	Lw	20	SW	10	1600	15	10	P	90	2.97
130	ICHmw-4-S/B	17.8	PL	50	SW	40	Lw	10	1600	15	10	P	90	3.57
131	ICHmk-1-C/H	15.1	PL	40	Lw	30	SW	30	1600	15	10	P	110	2.54
132	ICHmk-1-F	17.1	FD	50	PL	30	SW	20	2200	15	12	N	90	2.52
133	ICHmk-1-L	17.9	PL	50	Lw	40	SW	10	1400	15	7	P	90	3.26
134	ICHmk-1-P	17.6	PL	50	FD	40	SW	10	1600	15	10	P	80	3.18
135	ICHmk-1-S/B	15.9	PL	50	SW	40	Lw	10	1600	15	10	P	100	2.93
136	ICHmk-3-F	16.0	FD	50	PL	40	Lw	10	2200	15	12	N	100	2.09
137	ICHmk-3-L	17.2	PL	50	FD	40	SW	10	1400	15	7	P	80	3.03
138	ICHmk-3-P	16.3	PL	70	Lw	20	FD	10	1600	15	10	P	90	2.81
139	ICHmk-4-F	16.4	FD	50	PL	30	Lw	20	2200	15	12	N	100	2.18

AU	Description	SI	Species composition						SPH	OAF 1 and 2		Plant or nat	CMAI age	CMAI
140	ICHmk-4-L	17.3	PL	50	Lw	40	FD	10	1400	15	7	P	80	2.94
141	ICHmk-4-P	17.1	PL	70	Lw	20	FD	10	1600	15	10	P	80	3.09
142	ICHmk-5-L	18.2	Lw	50	FD	40	SW	10	1400	15	7	P	100	3.08
143	ICHmk-5-P	17.5	PL	50	SW	40	Lw	10	1600	15	10	P	90	3.47
144	ICHdw-1-F	17.1	FD	50	PL	30	Lw	20	2200	15	12	N	100	2.36
145	ICHdw-1-L	18.0	PL	50	Lw	40	FD	10	1400	15	7	P	80	3.18
146	ICHdw-1-P	17.4	PL	70	Lw	20	FD	10	1600	15	10	P	80	3.19
147	ESSFwc1-1-P	17.3	PL	50	SW	40	BL	10	1600	15	10	P	90	3.48
148	ESSFwc1-1-S/B	14.2	PL	50	SW	40	BL	10	1600	15	10	P	110	2.41
149	ESSFwc1-2-P	16.6	PL	70	SW	20	BL	10	1600	15	10	P	90	3.17
150	ESSFwc-3-P	16.9	PL	40	SW	40	BL	20	1600	15	10	P	90	3.33
151	ESSFwc-3-S/B	14.9	SW	60	PL	30	BL	10	1600	15	10	P	100	3.00
152	ESSFwc-4-P	16.8	PL	50	SW	40	BL	10	1600	15	10	P	90	3.29
153	ESSFwc-4-S/B	15.6	SW	60	PL	30	BL	10	1600	15	10	P	100	3.23
154	ESSFdc-1-L	16.2	PL	50	SW	40	Lw	10	1400	15	10	P	100	2.94
155	ESSFdc-1-P	16.8	PL	70	SW	30			2200	15	10	N	100	2.85
156	ESSFdc-1-S/B	12.7	PL	50	SW	40	BL	10	1600	15	10	P	130	1.98
157	ESSFdc-2-P	14.9	PL	90	SW	10			2200	15	10	N	100	2.19
158	ESSFdc-3-L	16.0	PL	70	SW	20	Lw	10	2200	15	10	N	100	2.54
159	ESSFdc-3-P	16.0	PL	70	SW	20	Lw	10	2200	15	10	N	100	2.54
160	ESSFdc-3-S/B	12.6	PL	50	SW	40	BL	10	1600	15	10	P	130	1.95
161	ESSFdc-4-P	17.2	SW	50	PL	40	BL	10	1600	15	10	P	90	3.69
162	ESSFdc-4-S/B	13.8	SW	50	PL	40	BL	10	1600	15	10	P	110	2.62
163	PP all	17.5	FD	85	PL	15			2200	15	12	N	90	2.29
164	ESSFwc4-1-P	18.1	SW	80	BL	20			1600	15	10	P	90	4.11
165	ESSFwc4-1-S/B	16.0	SW	80	BL	20			1600	15	10	P	100	3.46
166	ESSFwc4-2-P	16.4	SW	80	BL	20			1600	15	10	P	100	3.58
167	Open forest	16.7	PL	50	Lw	40	FD	10	1600	15	10	P	90	2.74
168	Open range	14.7	PL	51	Lw	41	FD	10	1600	15	10	P	100	2.18

6.3.1 Regeneration Delay

Regeneration delays are deployed separately from yield prediction in the forest level analysis. A regeneration delay of 4 years was used throughout the analysis.

6.3.2 Genetic Gains

The Forest Practices Code requires use of Class A seed from tree improvement programs where it exists. No genetic gains have been modelled in the basecase analysis (they will be include as a sensitivity).

6.3.3 Silviculture History

For growth and yield application, stands are classified into two categories based on their silviculture regime: natural stands and managed stands. Natural stands have no prior silviculture treatments and were regenerated naturally. Managed stands have had previous silviculture treatments and are assumed to be artificially regenerated. All stands less than 30 years old are assumed to be managed.

6.3.4 Backlog and Current Not Satisfactorily Restocked

As per TSR 2, the current NSR was assumed to regenerate with normal managed stand regeneration delays.

6.3.5 Utilization Levels

The utilization levels modeled are listed in Table 6.2. The levels reflect current standards and performance. Note: dbh = diameter breast height, dib = diameter inside bark

Table 6.2 Utilization levels

Leading Species	Minimum dbh (cm)	Maximum stump height (cm)	Minimum top dib (cm)
Pine	12.5	30.0	10.0
All others	17.5	30.0	10.0

6.4 Decay Waste and Breakage – Natural Stands

Decay, waste and breakage (DWB) factors associated with forest inventory zone (E/D) and the appropriate public sustained yield unit (PSYU) (124/170/308/315) were used to model the natural stands.

6.5 Operational Adjustment Factors – Managed Stands

Standard Operational Adjustment Factors (OAF) were used to model managed stands. OAFs were set similar to TSR 2and identical to the KBHLPO Spatial Analysis (See Table 6.1).

6.6 Existing Timber Volume Check

An existing timber volume check was performed in order to ensure that all of the growth and yield inputs were correctly established in the model. The initial volume at time zero calculated by the model was outputted and compared to the current inventory volume from the VRI. The results are shown in Table 6.3.

Table 6.3 Aggregate volume check

	Polygon Volume Derived Using		**Percent Difference**
	Inventory Volume	Yield Table Volume	
THLB Volume (m^3)	31,876,284	33,997,230	6.2

6.7 LRSY

Table 6.3 displays the culmination of Mean Annual Increment (CMAI) values for the current type 2 analysis as well as the 2005 spatial analysis.

Table 6.4 Culmination of Mean Annual Increment (CMAI)

	Natural	**Managed**
2005 Spatial Analysis	2.09	3.35
2008 Type 2	2.03	3.23

7.0 PROTECTION

Expected non-recoverable losses (NRLs) are summarized in Table 7.1. In the analysis, this volume was added to the annual harvest target to reflect total volume depletion. A rounded value of 6,000 m^3/year was used in this analysis.

Table 7.1 Non-Recoverable losses

Catastrophic blowdown	Annual NRL (m^3)
Mountain pine bark beetle	400
Spruce bark beetle	400
Douglas-fir bark beetle	50
Catastrophic blowdown	2,000
Non-catastrophic blowdown (cutblock)	300
Non-catastrophic blowdown (to Forest Service Reserves)	225
Blowdown along other roads, fences, trails and right-a-ways	1,000
Snow damage	300
Wildfires	60
Retention tree mortality	1,250
Total	**5,985**

These values are similar to those used in TSR 2, with slight adjustments made as recommended in the AAC rationale.

8.0 MPB MODELLING

This section details the MPB modeling assumptions. These assumptions only apply during the first 10 years of modeling.

8.1 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 of the stand that is pine. The percent of each grid that is affected is calculated by multiplying the percent pine MPB affected by the percent pine.

To provide consistency in reporting the percent of the stand affected has been classified using the forest health overview (FHO) classification system. This classification system is shown in Table 8.1.

Table 8.1 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 cumulative impact of MPB instead of the annual impact. This was done because the MPB projections rarely showed annual impacts beyond the trace and low classes and because the overall impact is more important for making strategic level decisions.

Figure 8.1 displays the projected MBP infestation spatially in the year 2020 for the Boundary TSA.

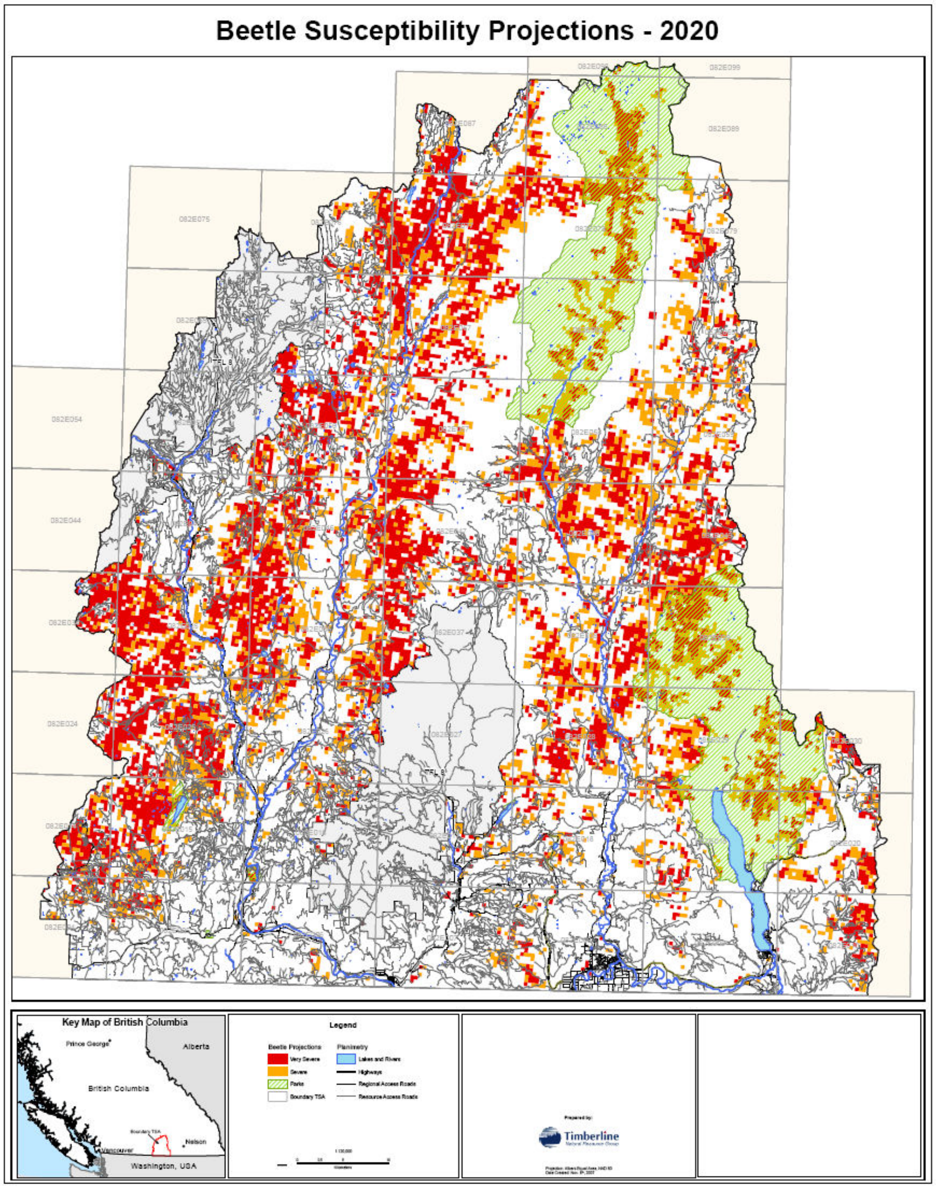

Figure 8.1 2020 MPB Projection Map the Boundary TSA

Figure 8.2 summarizes MPB severity between the years 2007 and 2020. From this projection summary, it can be seen that almost all of the potential infection area is affected by 2010. From this time onwards, the general trend is for already infected stands to become more affected- their severity rating increases from low → moderate → severe → very severe. By the year 2015/2017, this movement towards increasing severity has run its course and all the area is affected to its potential.

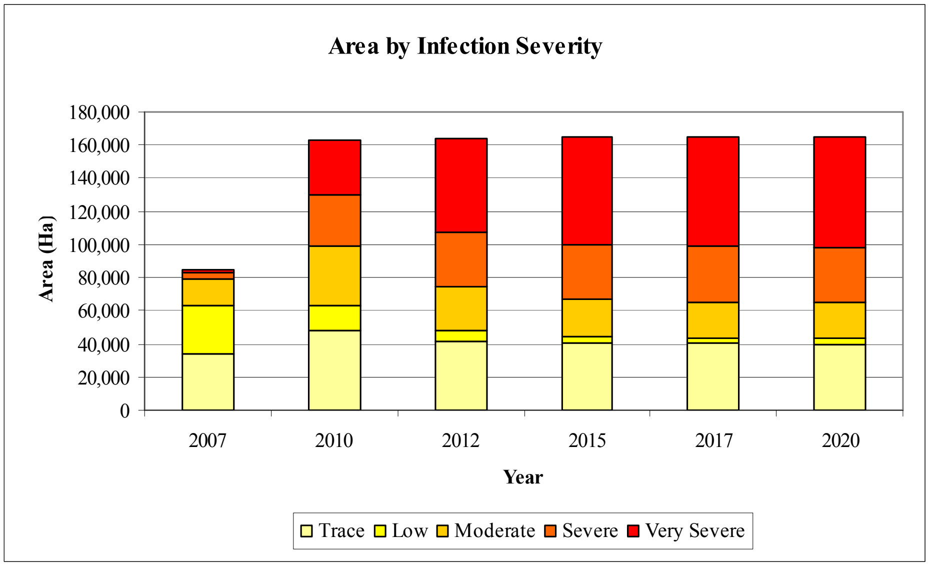

Figure 8.2 Summary of Area by MPB Severity

8.1.1 Shelf Life

Shelf life is defined as the time a stand will remain economically viable to harvest. This time is taken from the year that a stand first becomes "very severely" (over 50%) affected by MPB. Table 8.2 and Figure 8.3 show the percentage of the net stand volume that is considered viable as sawlogs dependent on the years since the stand was over 50% affected by MPB.

Table 8.2 Shelf Life Decay Curve

Years since Affected	Sawlog Percentage	Pulpwood Percentage	Total Percentage
0	100	0	100
1	100	0	100
2	80	20	100
3	74	26	100
4	68	32	100
5	62	35	97
6	56	38	94
7	50	41	91
8	44	44	88
9	38	47	85
10	32	50	82
11	26	53	79
12	20	56	76
13	14	59	73
14	8	62	70
15	2	65	67
16	0	64	64

Years since Affected	Sawlog Percentage	Pulpwood Percentage	Total Percentage
17	0	61	61
18	0	58	58
19	0	55	55
20	0	52	52
21	0	49	49
22	0	46	46
23	0	43	43
24	0	40	40
25	0	37	37
26	0	34	34
27	0	31	31
28	0	28	28
29	0	25	25
30	0	22	22
31	0	19	19
32	0	16	16
33	0	13	13
34	0	10	10
35	0	7	7
36	0	4	4
37	0	1	1
38	0	0	0
39	0	0	0
40	0	0	0

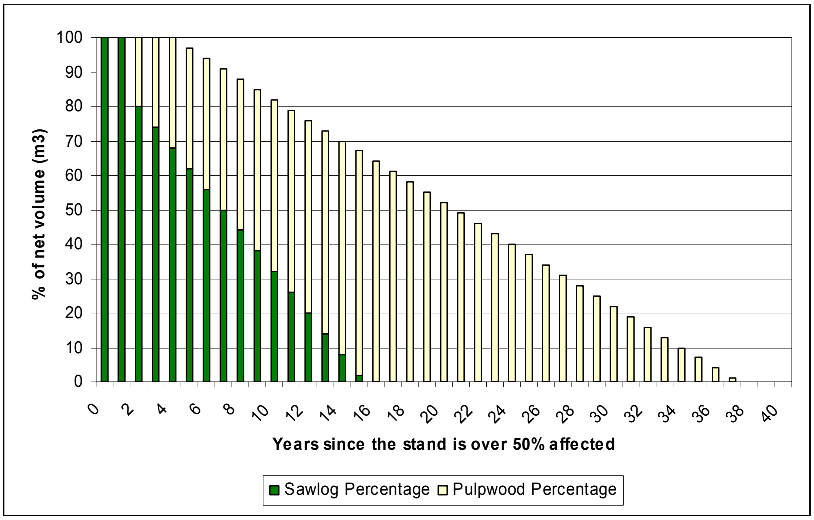

Figure 8.3 Shelf Life decay Curve

The way that this shelf life decay curve was applied to each stand (through analysis unit) is as follows:

- The years since affected was found for each year of the 5 year harvest period.
- The corresponding sawlog percentage was found for each year.
- The sawlog percentage was averaged for the 5 year period.
- The yield curve volume was adjusted by the sawlog percentage for that 5 year period. Since the age of the stand was known, the volume was only adjusted at that stand age.
- The same process was used for the second 5 year period.

8.1.2 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 the area affected by MPB. In these areas it was calculated that there is already 15% retained, therefore in the basecase an additional 5% retention is required on MPB salvaged areas to achieve the 20% retention target. This concept is shown below in Table 8.3.

Table 8.3 Productive Area in MPB VS Affected

Non-THLB Productive Classification	Area (ha)
Riparian	1,049
ESA	6,050
Low Productivity	2,596
Deciduous	400
Problem Fores Type	1,808
OGMA	1,048
Total	12,951
Harvestable	72,574
Percentage of Productive	15%

8.1.3 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 30% of the initial harvest rate during the first 10 years of MPB epidemic. There will be sensitivity analyses completed to test the impact of reducing and increasing the non-pine harvest.

8.1.4 MPB Harvest Queuing

Harvest queuing is the order in which the stands are prioritized for harvest. In the basecase the harvest queuing is controlled for the first 10 years (2007-2017) in the following order:

1. FDP Blocks that are VS MPB affected are queued up for harvest first;
2. FDP Blocks that are not VS affected are queued up second;
3. VS stands affected before or in 2012 are queued third; and
4. VS stands affected from 2013 to 2017 are queued up fourth.

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 and IRM targets are not enforced;
3. Visual requirements are not enforced for targeted stands;
4. Connectivity Corridors are not enforced for targeted stands; and
5. All other landbase requirements are enforced (*e*.g. Caribou and OGMAs).

8.1.5 Unharvested MPB stands

In 2018, MPB affected stands that were harvested regenerate on a managed stand yield curve. Stands that were affected by 2017 and not harvested loose the affected volume according to the rules below. All landbase requirements are restored to normal (*i.e.* Visuals and IRM are turned back on). The schema below (Figure 8.4) shows how the productive landbase is classified into various MPB classes and the reductions that apply to each of these classes.

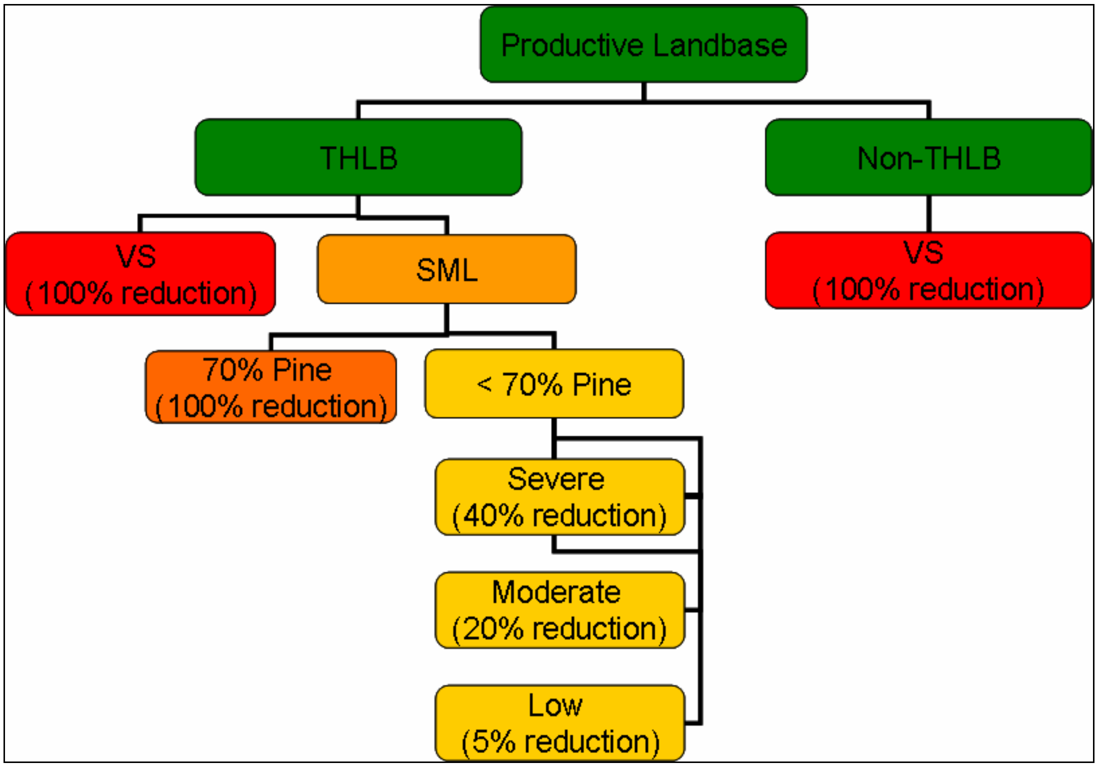

Figure 8.4 MPB Affected Stand Classification and Volume Reduction

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

1. VS MPB affected stands:
    - 15 year regeneration delay;
    - Grow back on a natural stand yield curve.
2. SML MPB affected stands with > 70% pine:
    - 15 year regeneration delay;
    - Grow back on a natural stand yield curve.
3. SML MPB affected stands with < 70% pine:
    - Stands with severe, moderate or low MPB infestation continue growing on the natural stand yield curve with volume reductions according to level of infestation (severe- 40%, moderate - 20% and low - 5%).
4. On non-THLB productive land, pine leading stands that are projected to be very severe impacted by 2017 are all reduced by 100% in 2018.

The visual, IRM, connectivity corridors and disturbances in the non-THLB are returned to normal after 2015.

9.0 RESOURCE MANAGEMENT ZONES

Current forest resource management practices are modelled using forest cover requirements. This section provides a summary of the forest cover objectives.

Unique management characteristics are modelled by grouping areas into resource management zones (RMZs), which are aggregates of area with similar non-timber resource concerns. These include visual sensitivity, wildlife habitat and community watersheds. Maximum disturbance (based on green-up height requirements) and minimum mature and old growth forest cover objectives will be assigned to each RMZ forest cover group to address needs of the resource. RMZs are aggregated within each landscape unit to reflect operational management of the resource. Where RMZ classifications overlap, areas must meet all overlapping forest cover objectives before harvesting. In cases where a retention policy is not met the model will recruit the oldest available stands and allow harvest in areas that are not being recruited.

9.1 Management Zones, Groups, and Objectives

The Boundary TSA supports non-timber resource demands which are expressed in analysis as forest cover objectives. These objectives, as described in this section, are applied to subsets of the landbase and are often overlapping. The resource emphasis zones used in the type 2 analysis are listed in Table 9.1. The zones are overlapping and are, therefore, not additive in area.

Table 9.1 Resource emphasis zones

Policy	Area (ha)		
	THLB	non-THLB Productive	Total Productive
Connectivity Corridors	131,463	62,996	194,459
Watersheds	7,307	2,064	9,371
KBHLPO Mature Requirements	6,847	4,671	11,517
KBHLPO Mature (on connectivity only)	3,573	3,987	7,560
MDWR	22,793	19,479	42,272
Moose	28,980	6,140	35,120
VQO	26,788	11,383	38,171

9.2 Visual Quality Objectives

The visual resource strategy used in the Basecase scenario used landscape level visual polygons with green up height calculated for each polygon according to the MoFR procedure guidelines (MoFR, 1998). Table 9.2 displays the average green-up heights for each quality objective as well as the amount of area affected by visual resource policies.

Table 9.2 Visual Resource Objectives

VQO	Maximum % Under Height	Height (average)	Area (ha)		
			THLB	non-THLB Productive	Total Productive
M	25	5	14,538	4,631	19,170
PR	15	5	11,339	4,915	16,254
VQO	5	6	910	1,837	2,747
Total:			26,788	11,382	38,171

9.3 Wildlife

9.3.1 Mule Deer Winter Range

MDWR requirements come from the Ungulate Winter Range Order (#U-8-008) 2004. Requirements have been determined for each planning cell based on BEC (which determines snowpack). Planning cells that fit several different snowpack categories have one area-weighted average requirement. For example, if a planning cell in the IDFdm is 50% over 1000m (moderate snow pack 15% > 100 years) and 50% below 1000m (shallow snow pack 25% > 100 years) the retention requirement would be 20% > 100 years.

Table 9.3 Ungulate winter range Snowpack by BEC Variant

Snow pack	BEC Variant
Shallow	PP, IDFxh, IDFdw below 1000m
Moderate	ICHdw and MS
	IDFdm1 above 1000m
Deep	ICHmk1, ICHmw2, ESSF

Table 9.4 Ungulate winter range retention and disturbance requirements

MDWR Planning Cell	Retention Requirement		Disturbance Requirement		Area (ha)		
	Minimum Percentage	Age (yrs)	Maximum Percentage	Age (yrs)	THLB	non-THLB Productive	Total Productive
1	21	20	33	113	58	1	59
2	25	20	33	118	374	508	882
3	16	20	33	101	449	355	804
4	22	20	33	111	7	21	28
5	25	20	33	120	24	3	27
6	24	20	33	116	259	98	357
7	27	20	33	120	349	331	680

MDWR Planning Cell	Retention Requirement		Disturbance Requirement		Area (ha)		
	Minimum Percentage	Age (yrs)	Maximum Percentage	Age (yrs)	THLB	non-THLB Productive	Total Productive
8	27	20	33	120	622	433	1,055
9	23	20	33	116	497	342	839
10	30	20	33	120	290	173	463
11	28	20	33	120	1,273	310	1,583
12	28	20	33	120	459	458	917
13	25	20	33	120	181	145	326
14	31	20	33	120	891	329	1,221
15	31	20	33	120	220	50	270
16	32	20	33	120	261	494	755
17	30	20	33	120	326	143	470
18	25	20	33	120	24	8	33
19	32	20	33	120	398	58	456
20	31	20	33	120	374	178	552
21	32	20	33	120	659	386	1,046
22	30	20	33	120	478	185	663
23	27	20	33	120	306	116	422
24	29	20	33	120	379	177	556
25	30	20	33	120	356	73	429
26	28	20	33	120	665	477	1,142
27	28	20	33	120	595	134	729
28	28	20	33	120	360	272	632
29	28	20	33	120	253	450	702
30	29	20	33	120	421	260	680
31	30	20	33	120	150	117	266
32	27	20	33	120	488	199	686
33	28	20	33	120	322	125	447
34	29	20	33	120	279	304	582
35	30	20	33	120	252	457	709
36	29	20	33	120	442	114	556
37	29	20	33	120	299	59	358
38	27	20	33	120	295	96	390
39	30	20	33	120	311	101	412
40	29	20	33	120	16	12	28
41	30	20	33	120	46	95	141
42	33	20	33	120	3	0	3
43	31	20	33	120	113	20	133
44	31	20	33	120	502	92	594
46	25	20	33	120	30	12	42
47	0	20	33	0		0	
48	0	20	33	0		0	
49	0	20	33	0		0	
50	26	20	33	120	313	102	415
51	34	20	33	120	12	1	13

MDWR Planning Cell	Retention Requirement		Disturbance Requirement		Area (ha)		
	Minimum Percentage	Age (yrs)	Maximum Percentage	Age (yrs)	THLB	non-THLB Productive	Total Productive
52	25	20	33	120	28	6	34
53	27	20	33	120	65	60	125
54	30	20	33	120	294	377	671
55	31	20	33	120	277	244	521
56	30	20	33	120	137	177	314
57	29	20	33	120	99	232	331
58	31	20	33	120	242	126	368
59	30	20	33	120	117	342	458
60	32	20	33	120	282	100	383
61	28	20	33	120	352	886	1,237
62	31	20	33	120	287	385	673
63	29	20	33	120	408	245	654
64	28	20	33	120	609	330	940
65	26	20	33	120	735	737	1,472
66	24	20	33	117	275	225	500
67	18	20	33	104	413	79	493
68	20	20	33	107	387	564	951
69	17	20	33	102	421	531	953
70	20	20	33	107	471	289	760
71	18	20	33	107	3	7	10
72	22	20	33	114	21	8	29
73	26	20	33	120	501	297	799
74	30	20	33	120		3,792	3,792
77	33	20	33	120	41	53	94
78	30	20	33	120	47	10	56
79	28	20	33	120	38	94	133
80	25	20	33	120	280	105	384
81	25	20	33	120	132	24	156
82	36	20	33	120	54	14	67
83	35	20	33	120	19	0	19
84	29	20	33	120	0	25	25
85	24	20	33	119	22	22	44
86	19	20	33	109	5	19	24
87	25	20	33	120	17	3	20
88	26	20	33	120	30	194	224
Total:					**22,793**	**19,478**	**42,272**

9.3.2 Moose Winter Range

Moose winter range is legislated in the ungulate winter range order #U-8-007. This order gives disturbance and retention requirements for areas not covered by MDWR (#U-8-008) and deemed to be moose winter range (moose_wr = 'Y'). These requirements are applied by LU and are shown in Table 9.5.

Table 9.5 Moose Winter Range Areas and Requirements

LU	Percent Retention Over Age	Percent Retention Under Height	Area (ha)		
			THLB	non-THLB Productive	Total Productive
1	40% > Age 30	20% > Height 16m	4,039	854	4,893
2	40% > Age 31	20% > Height 16m	1,146	548	1,694
3	40% > Age 32	20% > Height 16m	1,502	291	1,792
4	40% > Age 33	20% > Height 16m	0	0	0
5	40% > Age 34	20% > Height 16m	9,777	3,253	13,030
6	40% > Age 35	20% > Height 16m	5,591	421	6,012
7	40% > Age 36	20% > Height 16m	901	125	1,026
8	40% > Age 37	20% > Height 16m	6,025	649	6,673
9	40% > Age 38	20% > Height 16m	0	0	0

9.4 Integrated Resource Management (IRM)

IRM (adjacency) was not used in this analysis because:

1. Most of the harvest came from MPB stands in the first 10 years. It is assumed that salvage in MPB areas does not follow the standard IRM guidelines; and
2. The spatial adjacency function in CASH was used in areas not affected by MPB for the first 20 years of this analysis.

9.5 Biodiversity

9.5.1 Landscape Level Biodiversity

Within the Boundary TSA, biodiversity is primarily managed through old-seral forest retention. OGMAs will be used directly to meet old growth landscape level biodiversity requirement. See the netdown table for the area in OGMAs. A sensitivity will investigate the impact of using seral requirements instead of spatial OGMAs.

9.5.2 KBHLPO Additional Landscape Level Biodiversity - Mature

The KBHLPO requires that a mature component of the landbase must be maintained for biodiversity objectives. This requirement is only applied to specific landscape units and is applied within connectivity corridors as well to ensure proportional representation. The target LUs, BECs and their biodiversity emphasis option (BEO), and the mature retention requirement are listed in Table 9.6.

Table 9.6 LU-BEC managed for mature biodiversity objectives

LU_BEC	Percent Retention Over given age	BEO	Area (ha)		
			THLB	non-THLB Productive	Total Productive
B10-ESSFwc4_mature	42%>120	High	1,406	1,743	3,149
B11-ESSFdc_mature	34%>140	High	5,441	2,929	8,368
B10-ESSFwc4_mature in connectivity only	42%>120	High	1,353	1,673	3,026
B11-ESSFdc_mature in connectivity only	34%>140	High	2,185	2,350	4,534

9.5.3 Stand Level Biodiversity - Wildlife Tree Retention

Stand level biodiversity has been modelled using a 2.7% reduction as per TSR 2.

9.5.4 Connectivity Corridors

Connectivity Corridors were set up using a bio-connectivity index provided by the MoFR. Retention levels were set based on BEC. Table 9.7 displays the policy and size of each connectivity area

Table 9.7 Connectivity Corridors Area and Requirements

LU-BEC	Percent Retention Over Age	Age (yrs)	Area (ha)		
			THLB	non-THLB Productive	Total Productive
B01-ESSFdc1	4.7	140	184	18	202
B01-ESSFdcp	4.7	140		0	
B01-ESSFdcw	4.7	140	0	4	4
B01-ICHmk1	4.7	140		0	
B01-IDFdm1	6.3	250	3,038	1,305	4,343
B01-IDFxh4	6.3	250	2,010	845	2,855
B01-MSdm1	4.7	140	2,692	936	3,628
B01-MSdm1a	4.7	140	278	12	291
B01-PPdh1	4.3	250	53	41	94
B02-ESSFdc1	4.7	140	98	17	115
B02-ICHdw1	4.7	140	36	18	54
B02-ICHdw2	4.7	140		0	
B02-ICHmk1	4.7	140	3,163	1,020	4,183
B02-ICHmw2	3.0	250	6	3	10
B02-IDFxh4	4.3	250	135	225	361

LU-BEC	Percent Retention Over Age	Age (yrs)	Area (ha)		
			THLB	non-THLB Productive	Total Productive
B02-PPdh1	4.3	250	229	180	409
B03-ESSFdc1	4.7	140	988	518	1,507
B03-ESSFdcw	4.7	140	13	307	320
B03-ICHdw2	4.7	140	3,578	4,361	7,939
B03-ICHmk1	4.7	140	4,382	4,556	8,939
B03-ICHmw2	3.0	250	37	44	81
B03-IDFdm1	4.3	250		0	
B03-IDFxh4	4.3	250	35	14	48
B04-ESSFdc1	4.7	140	2,024	468	2,492
B04-ESSFdcw	4.7	140	51	63	114
B04-ICHdw1	4.7	140	2,625	1,838	4,463
B04-ICHmk1	4.7	140	7,114	1,998	9,112
B04-ICHmw2	3.0	250	5,782	1,447	7,230
B05-ESSFdc1	4.7	140	1,169	342	1,511
B05-ESSFdcw	4.7	140	5	88	93
B05-ICHmk1	4.7	140		0	
B05-IDFdm1	4.3	250	1,558	557	2,115
B05-IDFxh4	4.3	250	287	80	367
B05-MSdm1	4.7	140	5,626	1,468	7,094
B05-MSdm1a	4.7	140	644	233	877
B06-ESSFdc1	4.7	140	4,381	1,336	5,717
B06-ESSFdcw	4.7	140	205	608	812
B06-ICHmk1	4.7	140	2,489	474	2,962
B06-IDFdm1	4.3	250	2,989	1,351	4,340
B06-IDFxh4	4.3	250		0	
B06-MSdm1	4.7	140	12,064	2,003	14,067
B07-ESSFdc1	4.7	140	24	2	26
B07-ESSFdcw	4.7	140	0	1	2
B07-ICHdw2	4.7	140		0	
B07-ICHmk1	4.7	140		0	
B07-ICHmw2	3.0	250	4	0	4
B07-IDFdm1	4.3	250		0	
B07-MSdm1	4.7	140		0	
B08-ESSFdc1	4.7	140	16	7	23
B08-ESSFdcw	4.7	140		3	3
B08-ICHmk1	4.7	140	0	0	0
B08-IDFdm1	4.3	250		0	
B08-MSdm1	4.7	140	6,444	713	7,157
B09-ESSFdc1	4.7	140	2,337	1,145	3,482
B09-ESSFdcw	4.7	140	43	510	553
B09-ESSFwc1	3.0	250	2	0	3
B09-ESSFwc4	3.0	250	5	2	7
B09-ESSFwcw	3.0	250	0	4	4
B09-ICHdw2	4.7	140	5,132	2,081	7,213

LU-BEC	Percent Retention Over Age	Age (yrs)	Area (ha)		
			THLB	non-THLB Productive	Total Productive
B09-ICHmk1	4.7	140	1,859	1,015	2,874
B09-ICHmw2	3.0	250	1,958	594	2,553
B10-ESSFdc1	4.7	140	4,033	2,374	6,408
B10-ESSFdcw	4.7	140	64	474	539
B10-ESSFwc1	3.0	250	1,468	871	2,340
B10-ESSFwc4	4.3	250	1,353	1,673	3,026
B10-ESSFwcw	3.0	250		303	303
B10-ICHdw2	4.7	140	8,253	5,404	13,657
B10-ICHmk1	4.7	140	8,296	4,348	12,644
B10-ICHmw2	3.0	250	11,993	4,674	16,666
B11-ESSFdc1	7.0	140	2,185	2,350	4,535
B11-ESSFdcw	4.7	140	156	1,132	1,288
B11-ESSFwc1	3.0	250	1,941	696	2,637
B11-ESSFwc4	3.0	250	3,211	2,263	5,474
B11-ESSFwcw	3.0	250	119	1,308	1,427
B11-ICHmk1	4.7	140	3	9	12
B11-ICHmw2	3.0	250	597	263	860
B11-MSdm1	4.7	140		0	
Total			131,465	63,003	194,468

9.6 Watersheds

A maximum disturbance level of 30% under a height of 9m was set to areas identified by the MoFR to be Community Watersheds (CWS). Table 9.8 shows the areas associated with each CWS.

Table 9.8 Watershed Areas and Requirements

CWS by LU	Percent Retention Over Height	Height (m)	Area (ha)		
			THLB	non-THLB Productive	Total Productive
CWS_B02	30	9	90	106	196
CWS_B04	30	9	7,216	1,959	9,175
Total			7,307	2,065	9,372

9.7 Grizzly Bear Habitat

Grizzly bear direction in the Boundary TSA is given by the Draft Grizzly Bear Specified Area Order (version February12th, 2008). Strategic aspects of this order will be addressed in sensitivity analysis. For a more thorough write-up, please see the applicable sensitivity section in the analysis report document.

10.0 TIMBER HARVESTING

This section describes all of the assumptions used to model the timber harvesting systems employed in the Boundary TSA.

10.1 Minimum Harvest Age

Minimum harvest ages (MHAs) were determined as the age of stands at which 90% of the culmination mean annual increment (CMAI) is achieved with a minimum volume of 150 m^3/ha. If a stand did not reach a minimum volume of 150 m^3/ha[1], then just the 90% CMAI age was used. Because of the large number of natural stand AUs, individual MHAs will not be displayed here, however the average natural MHA was 89 years and the average managed MHA was 70 years.

10.2 Harvest Systems

This analysis uses a combination of clearcut and partial harvesting. Areas classified as open forest and open range are modelled as using partial harvesting (2% of the THLB). An explanation of how this was modelled is in section 6.2.2 Partial Harvest .

10.3 Disturbing the Non-THLB

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. In reality, there will be some level of natural disturbance within the non-THLB. Because the entire productive landbase is available to fulfill various landbase requirements (i.e. seral requirements, retention requirements and thermal requirements), this can lead to the non-THLB fulfilling an unrealistic portion of forest cover requirements, thereby reducing the impact on the timber harvest landbase. This issue of the non-THLB continuously aging throughout the planning horizon in timber supply analyses is addressed by modelling disturbances in the non-THLB (MoFR, 2003b).

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

1. Impose an annual disturbance to the non-THLB of each BEC zone. The size of the disturbance will be determined from the disturbance frequency in the Biodiversity Guidebook; and

[1] 376 ha THLB did not reach a minimum volume of 150 m^3/ha. This was largely due to a stocking class 2 in the inventory.

2. A seral requirement will be imposed on the non-THLB of each BEC variant, which will force the non-THLB to achieve a seral zone distribution similar to the natural rate of variation (NROV) from the Biodiversity Guidebook.

10.3.1 Impose Annual Disturbance

The area in each BEC zone is summarised and the NDT and disturbance return interval is found from the *Biodiversity Guidebook.* This information allows the annual disturbance to be calculated by BEC. The annual disturbance is 1 % the disturbance interval and the annual disturbance area is this percentage * non-THLB area (as shown in Table 10.1).

Table 10.1 Non-THLB Annual Disturbance

NDT	BEC	Disturbance Interval	Non-THLB Prod Area	Annual Disturbance (%)	Annual Disturbance (ha)
3	ESSFdc	150	36,433	0.67%	243
2	ESSFwc	200	27,447	0.50%	137
3	ICHdw1	150	9,271	0.67%	62
3	ICHdw2	150	17,496	0.67%	117
3	ICHmk1	150	32,017	0.67%	213
2	ICHmw2	200	19,493	0.50%	97
4	IDFdm1	250	10,666	0.40%	43
4	IDFxh4	250	2,722	0.40%	11
3	MSdm1	150	17,666	0.67%	118
4	PPdh1	250	371	0.40%	1

10.3.2 Impose Seral Requirement

The area in each BEC zone is summarised and the NDT and age of mature and old forest is found from the *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 then the input age:

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

Table 10.2 shows the seral stage distribution for the three fire return intervals that occur it the Boundary TSA (150 years, 200 years and 250 years).

Table 10.2 Cumulative age distribution using by mean disturbance interval

Age	150		200		250	
	>	<	>	<	>	<
20	88%	12%	90%	10%	92%	8%
40	77%	23%	82%	18%	85%	15%

Age	150		200		250	
	>	<	>	<	>	<
60	67%	33%	74%	26%	79%	21%
80	59%	41%	67%	33%	73%	27%
100	51%	49%	61%	39%	67%	33%
120	45%	55%	55%	45%	62%	38%
140	39%	61%	50%	50%	57%	43%
160	34%	66%	45%	55%	53%	47%
180	30%	70%	41%	59%	49%	51%
200	26%	74%	37%	63%	45%	55%
220	23%	77%	33%	67%	41%	59%
240	20%	80%	30%	70%	38%	62%
250	19%	81%	29%	71%	37%	63%

Table 10.3 shows the seral zone requirements that will be placed on the BEC zones in order to achieve the desired NROV. The data from Table 10.2 is used to populate the seral requirement percentages, for example: NDT-BEC 3-ESSFdc has a disturbance return interval of 150 years. By looking in the "150 >" column at the mature age of 120 years, the % required to achieve NROV is 45%.

Table 10.3 Annual disturbance and seral requirement for the non-THLB

NDT	BEC	Non-THLB Prod Area	Seral requirements			
			Mature Plus Old		Old	
			%	Age	%	Age
3	ESSFdc	36,433	45%	120	39%	140
2	ESSFwc	27,447	55%	120	29%	250
3	ICHdw1	9,271	51%	100	39%	140
3	ICHdw2	17,496	51%	100	39%	140
3	ICHmk1	32,017	51%	100	39%	140
2	ICHmw2	19,493	61%	100	29%	250
4	IDFdm1	10,666	67%	100	37%	250
4	IDFxh4	2,722	67%	100	37%	250
3	MSdm1	17,666	51%	100	39%	140
4	PPdh1	371	67%	100	37%	250

11.0 FOREST ESTATE MODEL

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 landbase (THLB) can be included to better model forest structure and contribute to forest cover objectives. These may be areas classed as environmentally sensitive or inoperable areas to name a few.

In their current implementation, forest cover objectives require an area over which to operate. The control area for an objective should correspond to a realistic element in the landscape. For example, the requirements associated with visual quality objectives (VQOs) are designed to operate on the scene visible from discrete sets of viewpoints. Disturbance requirements are calculated for each identified VQO polygon as described in section 9.0.

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

Timber supply analysis for the 250-year planning horizon will be carried out using CASH6. In the basecase, a 400-year time from will be modelled to ensure complete understanding of the factors influencing timber supply well into the long term.

11.1 Interpreting Timber Availability

Harvest flow has been the traditional indicator used to evaluate timber supply impacts of various management scenarios however this may not reveal the complete timber supply picture. Another useful indicator is timber availability which is the total volume of merchantable timber that could be harvested in any given period without violating any forest cover requirements. In general, the periods with the least amount of timber available control the resulting harvest flow.

When comparing management scenarios using timber availability profiles the same harvest request is used in both scenarios. In doing so, the differences in the timber availability profiles can be entirely attributed to differences in the management assumptions and not clouded by differences in the modeled harvest. Generally this harvest flow request is the basecase harvest flow unless otherwise specified.

11.2 Defining the Short, Mid and Long Term

In the basecase and all the following sensitivities, unless otherwise mentioned, the expressions short term, mid term and long term will be defined as shown in Table 11.1 below. The 250 year planning horizon is modelled with two 5 year periods at the start and then 24 10 year periods. The short term harvest period is modelled as two 5 year periods and the characteristics of the short term are defined by current practices and the projected MPB infestation. After 10 years, it is assumed that the MPB affected volume is lost and the mid term begins. The availability of timber over time is what dictates how long the mid term lasts before the harvest level can increase to the long term level. In the Boundary TSA, this mid term trough is modelled to last until year 70 (2070).

Table 11.1 Definition of Short, Mid and Long term

Term	Definition		
	Description	**Length**	**Year**
Short	Period of MPB spread and uplift	10yrs	2007-2016
Mid	Period of down fall after MPB death	60yrs	2017-2067
Long	The rest of the modeling horizon	198yrs	2067-2256

12.0 MERCHANTABILITY

Oliver Thomae of *ArbourTech* developed a merchantability model that was applied to inventory information across the landbase. The model assigned values and costs to forested stands based upon inventory attributes. Merchantability is defined as the difference between value and cost. In this analysis, these cost and value tables were imported directly into Patchworks. The following sections outline the input into the cost table and value table.

12.1 Value

The following inventory attributes were used to assign value:

- site index;
- species;
- crown closure;
- stocking; and
- CMAI age.

Based upon site index a general gross product value was assigned to each stand. This value was subsequently adjusted up or down based upon the other inventory attributes. Refer to Oliver Thomae's *Sustainable Forest Management Plan Economic Values Assessment* document for detailed information about the specific dollar and adjustment values by factors.

Value is calculated using the following equation:

Average Product Value = SI Based Product Value × Leading Species Factor × Stocking Factor × Piece Size Affect Factor × Decay & Defect Factor

12.2 Cost

The following inventory attributes were used to assign cost:

- site index;
- species;
- stocking:
- crown closure;
- landbase characteristics determine overhead and maintenance costs
- slope; and
- BEC.

It should be noted that road building/maintenance and hauling (cycle time) costs were incorporated directly into the Patchworks model to make use of its road-building capabilities.

The equation below illustrates how these factors were used to calculate operating costs. Refer to Oliver Thomae's *Sustainable Forest Management Plan Economic Values Assessment* document for further information on how the variables listed in affected total operating costs.

Total Operating Costs = ((Road Development Costs + Basic Silviculture Costs) × Stocking Based Operating Cost Factor x Site Index Based Operating Cost Factor × Stand Age Volume Factor × Decay and Defect Factor) + Yarding Cost + Overhead and Road Maintenance Cost + Terrain Cost Increment + Cycle Time Cost + Species Based Manufacturing Cost

12.3 Age as a dynamic Variable

In previous models, stand age was a static variable that was incorporated as a factor into both the cost and value calculation. In this analysis however we have used age as a variable that changes over time as a stand is harvested or grows older. This modifies the output from Oliver Thomae's merchantability model from a static "merchantability value" to a "merchantability curve". This merchantability curve is much like a volume yield curve and is shown in Figure 12.1. The value and costs shown are in $\$/m^3$.

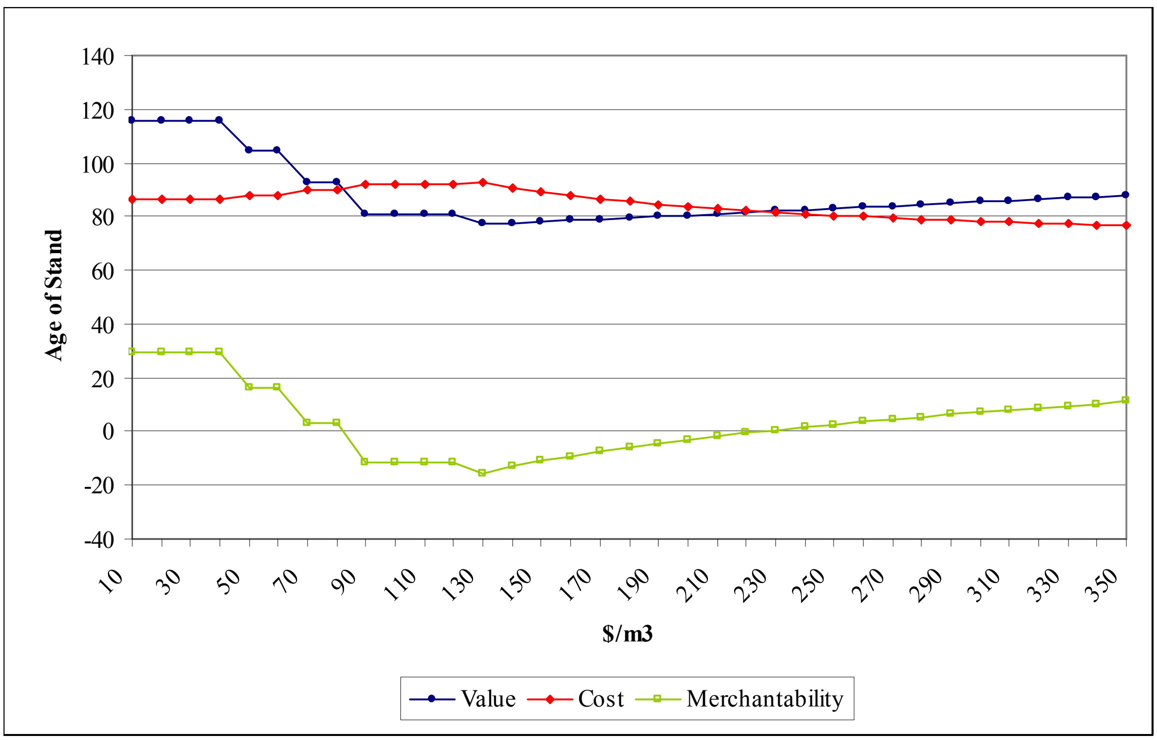

Figure 12.1 Example Merchantability Curve

13.0 PRODUCT OBJECTIVES

Product objectives formed a section in the tender package for this analysis- the objective associated with them was to develop a definition of merchantable and premium logs for each AU in the hope that management regimes can be found to yield a minimum of 10% premium logs.

Forest products vary in quality- the term "quality" being defined as the fitness for a defined end use. The quality of a forest product has a significant influence on value and the definition of "premium". Log grading is used to assess this level of quality and is an important part of the process of converting growing trees into a commodity (James, 2001). In general, logs are graded according to:

- Species;
- Log size; and
- Log quality.

13.1 Log Size

The potential end use and product recovery is in large part determined by each logs' end diameter. Other factors being equal- larger logs will produce more and better quality lumber than smaller diameter logs (MoFR, 2006). Log dimensions are usually quantified by a minimum diameter and length.

13.2 Log Quality

Log quality encompasses many factors such as: fractures and fibre separation; bark seams; sweep, crook and pistol grip; rot hole, char and missing wood; twist (spiral grain); knots (size, types, distribution); grain density and compression wood (MoFR, 2006). In this analysis, we do not have the tools that are required to model many of the specific individual log quality factors mentioned above.

The objective of this section is to develop a definition of merchantable and premium logs for each AU. The definition of premium logs are outlined in Table 13.1 and are dependent on:

- Species; and
- Minimum average stand DBH.

Table 13.1 Definition of Premium and Merchantable Logs

Quality Class	Products	Species	Min av. Stand DBH	Av. Height Corresponding to min DBH (m)
Peeler	Peelers, poles, house-logs and high grade sawlogs	All except deciduous	32.5+	28
Standard profile sawlog	Sawlogs		27.5+	24
Merchantable			12.5/15+	11/12

Below is a report from the B.C. Interior Log Market for the month of January 2007 which shows the volumes and average price by product and species group. This data was considered in the formation of product objectives.

Figure 13.1 B.C. Interior Log Market Prices for January 2007

	Product [1]	Species Group								Total/Avg
		SPF [2]	Df-Larch	Hem-Bal [3]	Cedar [4]	White Pine	Yellow Pine	Deciduous	Other [5]	
Volume (m^3)	Sawlog	2,425,240	86,104	36,628	15,565	47	12,955	23,138	89	2,599,767
	Peelers	122,023	32,826	2,503	-	-	-	2,564	259	160,175
	Poles / House	5,511	318	-	2,473	-	-	-	-	8,302
	Minor Products [6]	1,684	-	-	-	-	-	-	-	1,684
	Pulpwood	120,523	110	3,439	30	-	25	22,143	-	146,270
	Total	2,674,980	119,358	42,570	18,069	47	12,980	47,845	348	2,916,198
Average Price ($/m^3$) [7]	Sawlog	53.13	64.79	53.26	115.37	85.00	50.93	37.17	53.40	53.74
	Peelers	69.98	88.82	55.74	-	-	-	34.38	82.01	73.06
	Poles / House	82.21	100.63	-	174.28	-	-	-	-	110.34
	Minor Products	32.45	-	-	-	-	-	-	-	32.45
	Pulpwood	32.87	28.00	27.43	15.27	-	28.00	36.29	-	33.25
	Wtd. Average	53.04	71.46	51.32	123.26	85.00	50.88	36.61	74.73	53.92

Source: http://www.for.gov.bc.ca/hva/timberp/llsp/interior/1m_Jan07.pdf

Also considered were the following definitions in the scaling manual (MoFR, 2006), which defines premium sawlog, no 4 sawlog, no 2 coastal sawlog and sawlog in terms of length and minimum radius.

The definition of the no.4 sawlog for all coniferous species in the scaling manual specifies that a log must be "5m or more in length and 8 to 18 cm in radius … Whereas the definition of the no.2 sawlog for costal spruce specifies that a log must be "4m more in length and 19 cm more in radius…, Otherwise grad code D,E,F or G, 4m or more in length and 30cm or more in radius…". The definition of premium sawlog in the scaling manual specifies that a log must be "2.5 m or more in length and 10cm or more in radius…" (MoFR, 2006). These definitions were considered and integrate well with the definition of peeler grade quality class of which premium sawlogs are one product.

The definition of sawlog in the scaling manual (MoFR, 2006) specifies that a log must be "2.5 m or more in length and 5cm or more in radius…". This definition was considered and integrates well with the definition of standard profile sawlog.

An illustration of how a yield curve contributes to each quality class is shown in Figure 13.2 below. Once the minimum DBH for a given quality class is reached, 100% of the stand yield is assumed to contribute to that quality class.

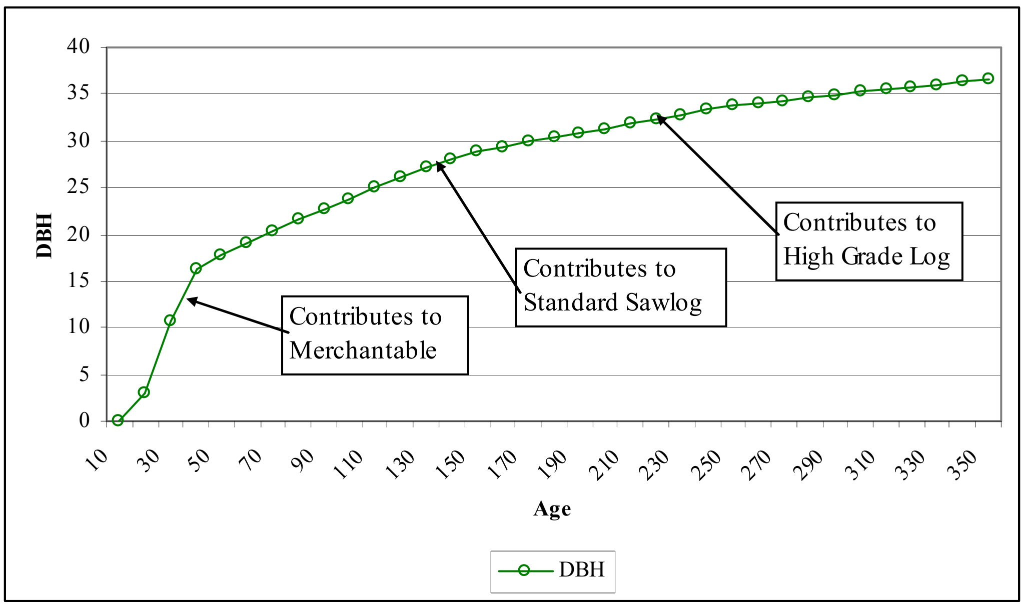

Figure 13.2 Product Objective Contribution for Example Yield Curve

14.0 SENSITIVITY ANALYSIS

Sensitivity analysis provides a measure of the upper and lower bounds of the basecase harvest forecast and reflects the uncertainty of assumptions made in the basecase. Sensitivity analyses have been carried out to look for opportunity to mitigate the mid-term timer supply impact caused by the MPB epidemic. By developing and testing a number of sensitivity issues, it is possible to determine which variables most affect results. This in turn facilitates the management decisions that must be made in the face of uncertainty.

To allow meaningful comparison between sensitivity analyses, each sensitivity is built on the basecase with only the evaluated assumption being altered. All other assumptions remain unchanged. In each analysis, the changes in availability were first assessed, using the basecase harvest level, and imposing the alternative assumption to be tested. Based on the changes in availability, a new harvest level was sought, adhering to the flow policy described earlier in section 3.0. Table 14.1 shows the sensitivity analyses modelled using CASH6, the spatial simulation model[2].

Table 14.1 Summary of Sensitivity Analyses

Sensitivity Analyses	Description
70% MPB **0% MPB** **100% MPB** **40% MPB**	The indicated % of the AAC (700,000m^3/year) is harvesting in MPB affected stands for the first 10 years of the analysis
Max MPB Basecase non MPB Harvest	Maintain non-pine harvest and harvest as many of the MPB affected stands as the model will allow
Max MPB No non MPB Harvest	Harvest as many of the MPB affected stands as the model will allow, with no non-MPB harvest
Genetic Gains	Model impacts of genetic gains (none in Basecase)
Fertilization Sx/Fd	Fertilize 22,772 ha of potential Sx/Fd candidates
90 MAI MHA	Uses 90% MAI for MHA (Basecase also requires a minimum volume of 150m^3/ha)
Plant VS MPB	Aggressively reforest non-harvest very severely affected MPB stands
Harvest V MPB with MHA <= 50 **Harvest Highly Productive Stands First**	Two scenarios used to see if the gains from planting all the MPB VS can be realized from harvesting the highly productive stands
No Partial Harvesting	Tests impact of using clearcut harvest system in currently partially harvested stands
Low BEO Seral Requirements	Retains full seral requirement in low BEO LUs (OGMAs have 1/3rd)
Seral No OGMA	Using aspatial seral requirements in place of OGMAs

[2] Additional analyses will be done in Patchworks, which is a spatial optimization model. This includes grizzly bear, timber merchantability, identified wildlife strategies, ecological representation and further reporting on habitat elements.

Sensitivity Analyses	Description
Plant V SI >= 18 **Plant V SI >= 21**	Analyses to find a productivity threshold to get the best benefit from aggressively reforestation
Grizzly CWD Retention	Leave volume for CWD in berry and riparian areas identified in the GAR order
Grizzly Replant at Low Stocking	Replant identified areas at lower stocking

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