TFL 52 - Management Plan #5
Timber Supply Analysis Information Package

Presented To

West Fraser

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Acronyms and Abbreviations

BCGW	B. C. Geographic Warehouse
BCLCS	B. C. Land Classification System
BEC	Biogeoclimatic Ecosystem Classification
CMAI	Culmination Mean Annual Increment
DBH	Diameter – Breast Height
DIB	Diameter Inside Bark
FSP	Forest Stewardship Plan
IRM	Integrated Resource Management
MAI	Mean Annual Increment
MDWR	Mule Deer Winter Range
MFLNRO	Ministry of Forests, Lands and Natural Resource Operations
MHA	Minimum Harvest Age
MP	Management Plan
MSYT	Managed Stand Yield Table
NDT	Natural Disturbance Type
NROV	Natural Range of Variation
NSYT	Natural Stand Yield Table
OGMA	Old Growth Management Area
SIA	Site Index Adjustment (J.S. Thrower and Associates Ltd.)
SIBEC	Site Index Estimates by BEC Site Series
TFL	Tree Farm Licence
THLB	Timber Harvesting Land Base
TIPSY	Table Interpolation for Stand Yields
VDYP	Variable Density Yield Prediction
VRI	Vegetation Resources Inventory
WTP	Wildlife Tree Patch

1 Introduction

West Fraser has initiated a timber supply analysis in support of Management Plan #5 for TFL 52; this document (Information Package) has been prepared to describe the data and assumptions to be used in the timber supply analysis that are relevant in determining a sustainable harvest level.

The timber supply analysis in support of Management Plan #4 was completed in 2008, followed by the allowable annual cut (AAC) determination effective April 1st, 2009. The term for that AAC was five years, which would have required a new determination in 2014. With the province-wide extension of AAC terms from five to ten years, the next determination is now due in 2019.

The objective of this Information Package is to provide a summary of the management issues and assumptions for TFL 52 that may have an impact on timber supply. In particular, the potential for the management of non-timber resources to impact timber supply is considered. The summary is based on a review of previous TSR documents, datasets and assumptions and the most recent timber supply analysis.

A number of sensitivity analyses will also be conducted to test the impact of different assumptions on timber supply for the TFLs. All analysis simulations will be completed using Patchworks - a forest estate model developed by Spatial Planning Systems. Upon acceptance by the British Columbia Ministry of Forests, Lands and Natural Resource Operations (MFLNRO) Timber Supply Analyst, the assumptions and methodology provided in the Information Package will be used by West Fraser to prepare and submit a timber supply analysis to the MFLNRO. All analysis results will be provided to the Chief Forester of British Columbia, or her designate, for the allowable cut determination.

1.1 Timber Supply Review

Timber supply is the quantity of timber available for harvest over time. Timber supply is dynamic, not only because trees naturally grow and die, but also because conditions that affect tree growth, and the social and economic factors that affect the availability of trees for harvest, change through time.

Assessing the timber supply involves considering physical, biological, social and economic factors for all forest resource values, not just for timber. Physical factors include the land features of the area under study as well as the physical characteristics of living organisms, especially trees. Biological factors include the growth and development of living organisms. Economic factors include the financial profitability of conducting forest operations, and the broader community and social aspects of managing the forest resource.

Timber supply analysis involves three main steps.

- The first is collecting and preparing information and data. The Ministry of Forests, Lands and Natural Resource Operations (MRLNRO) forest inventory plays a major role in this.
- The second step is using this data along with a timber supply computer model or models to make projections or estimates of possible harvest levels over time. These projections are made using different sets of assumed values or conditions for the factors discussed above.
- The third step is interpreting and reporting results.

The timber supply analysis starts by modelling a Base Case that is consistent with current management practices on the TFL. In addition, a number of sensitivity analyses will also be conducted to test the impact of different assumptions on timber supply for TFL 52. All analysis simulations will be completed using Patchworks – a forest estate model that schedules timber harvesting in a manner that best meets environmental and timber flow objectives.

The Analysis Report will be circulated for Public Review in conjunction with a draft of Management Plan #5 for the TFL. This MP will include a history of the TFL and a summary of the feedback received; the final versions of the Information Package and Analysis Report will be included as Appendices.

Once this second public review process is complete, these documents will be submitted to the Chief Forester to assist in making an AAC determination for the TFL. Once this is complete, the AAC Rationale document will be appended to the finalized version of Management Plan #5

1.2 Information Package

The purpose of the Information Package is to provide a clear description of information sources, assumptions, issues, and any relevant data processing or adjustments related to the land base, growth and yield, and management objectives and practices. The Information Package will act as a foundation document for the timber supply review (TSR), and all other TSR documents, such as the information report, analysis report and TSR binder.

This Information Package has been prepared on behalf of West Fraser as part of the timber supply analysis for Management Plan No. 5 (MP#5) for TFL 52. It provides a summary of the inputs and assumptions made in preparing the timber supply analysis data model.

The data summarized in this document is the most current available and includes inventory and landbase summaries, growth and yield information, and management assumptions for timber and non-timber resources as they relate to timber supply. The Information Package allows the reader to consider the inputs and assumptions to be used in the timber supply analysis. These include:

- The documentation of inventory data and sources;
- Classification of the land base according to each hectare's contribution to management (harvest, resource management for wildlife, etc.);
- Land productivity estimates and prediction of stand growth and timber yield;
- Silviculture and harvesting regimes;
- Action taken to model multi-resource requirements; and
- Timber supply scenarios and sensitivity analyses to be evaluated.

This Information Package will be advertised and made available for public review. The technical approach to modelling will be reviewed with staff from MFLNRO Forest Analysis and Inventory Branch (FAIB) before starting any forest estate modelling. Any necessary changes will be made to the document based on the feedback received. Upon acceptance by MFLNRO Timber Supply Analyst, the assumptions and methodology provided in the Information Package will be used by West Fraser to prepare and submit a timber supply analysis.

This report will be included as Appendix I of the Timber Supply Analysis Report – which will itself be advertised and made available for publics review. Prior to that public review process, the Analysis Report must first be formally accepted by the MFLNRO for use in the AAC determination process.

1.3 History of the AAC

The AAC determination in 2005 for the original TFL 52 Block A was 570,000 m^3/year. Prior to consolidation, the AAC for Block B was 300,000 m^3/year. Following consolidation in 2006 and AAC adjustments to account for woodlot licences, the AAC of TFL 52 was 870,000 m^3/year.

The infestation of Mountain Pine Beetle (Dendroctonus ponderosae) (MPB) reached critical levels throughout the interior of British Columbia over the past few years. The MPB attack included West Fraser's Bowron-Cottonwood Tree Farm Licence (TFL 52) prompting an urgent timber supply review. Timberline Natural Resource Group completed a timber supply analysis in 2007-08 to provide information to the British Columbia Chief Forester to support an uplift to the current AAC in 2009. The uplift, which is a temporary increase in AAC, was required to allow recovery of the dead and at-risk pine volume on the TFL prior to stand break-up and complete loss of merchantable pine volume. Effective April 1, 2009 the Deputy Chief Forester's Rationale for AAC Determination set the cut for TFL 52 at 1,000,000 m^3/year, which includes a partition of up to 500,000 m^3/year for non-pine species. This represented an increase of about 15% from the previous AAC. The current AAC will remain in effect until the next AAC determination.

In April 2011 the area of the TFL was reduced when area was removed by an Instrument #6 under the authority of the Forestry Revitalization Act. The AAC was reduced by 81,986 m^3/year to reflect the land base reduction. The current AAC is 918,014 m^3/year.

1.4 Description of TFL 52

Block A of TFL 52 is located to the east of Quesnel. Block B is northwest of the city. West Fraser was granted Block A of the TFL 52 licence in January 1991. The land base is typified by rolling plateaus in the west, and the Cariboo Mountains in the east. Numerous lakes and rivers are found within the Licence area. Block A contains the headwaters of the Cottonwood, Bowron and Willow Rivers, which all flow directly into the Fraser River. Highway 26 between Quesnel and Bowron Lake Provincial Park provides primary access to Block A. This highway bisects the License into north and south components. Most forest roads into Block A originate from Highway 26. This provides excellent year-round access for both forest management and recreational activities.

Block B of TFL 52 is located northwest of Quesnel along the Fraser River. Similar to Block A the land base is typified by rolling plateaus but includes steep banks leading down to the Fraser River. Western Plywood Ltd. (which later became Weldwood of Canada) was granted the former TFL 5 licence in May 1950. Primary access to Block B is provided by Highway 97 between Quesnel and Hixon for the eastern component. The western side of Block B can be accessed by either Blackwater Road or Tako Road. Due to the long history of forestry activities on Block B, more than 50 years, there is excellent year-round access for both forest management and recreational activities.

The forests of TFL 52 are dominated by interior spruce, lodgepole pine, and Douglas-fir. Other species include subalpine fir, trembling aspen, and cottonwood. Birch, western hemlock, and western redcedar

are found in localized areas. Two biogeoclimatic ecological classification (BEC) zones dominate the land base of TFL 52:

- Sub-boreal spruce (SBS), generally below 1200 metres with cool, snowy winters and warm summers; and
- Engelmann spruce-subalpine fir (ESSF), generally above 1200 metres with long, cold winters and short, cool summers.

The interior cedar-hemlock (ICH) BEC zone is found in a very small area near the eastern boundary of the TFL.

A number of communities are associated with TFL 52. These include Quesnel, Wells, Barkerville, Bowron Lake and Cottonwood. Both Wells and Barkerville are located within the License area. Two popular recreational areas, Bowron Lake Provincial Park and Troll Mountain Ski Resort, share a common boundary with TFL 52.

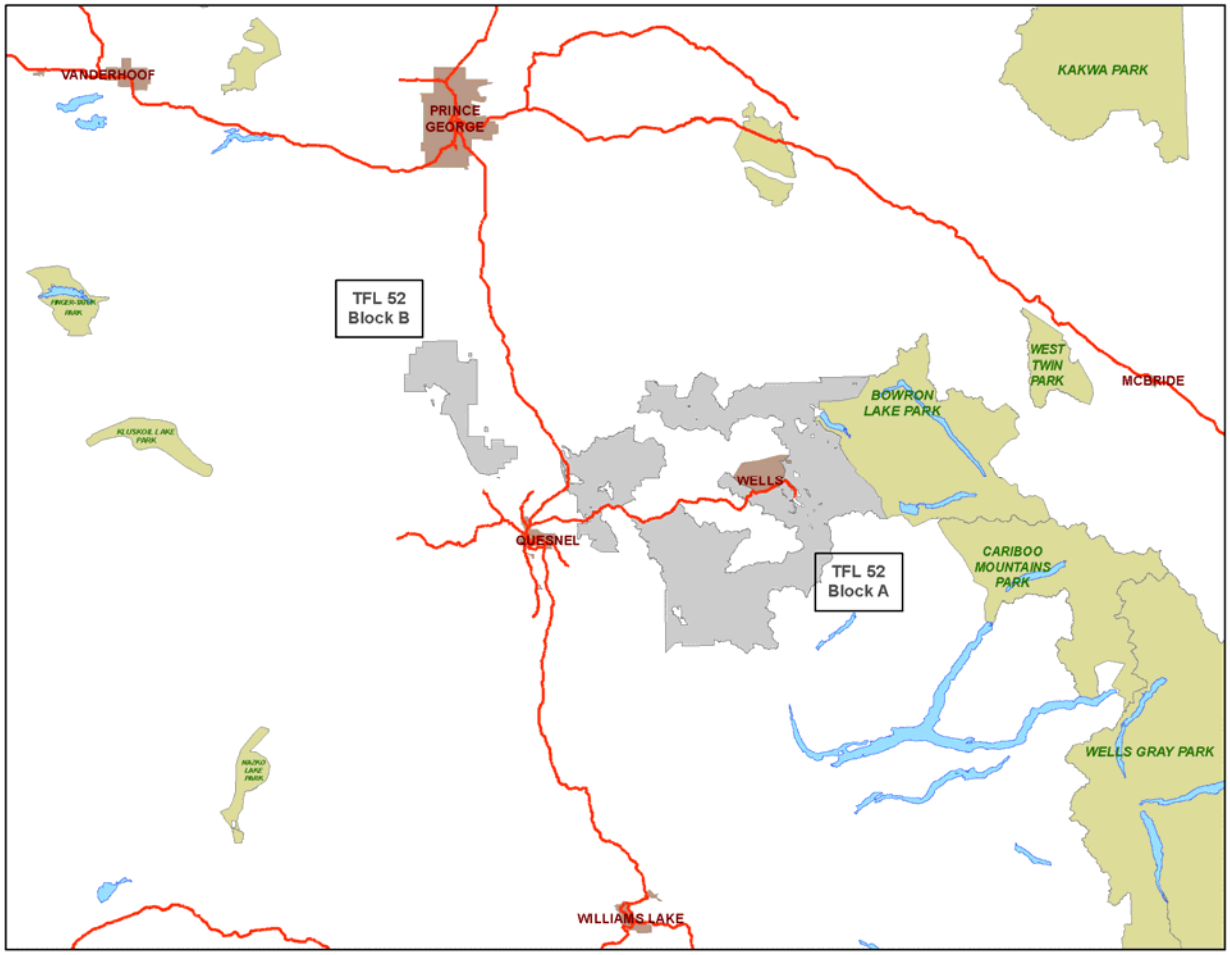

Figure 1.1. Location of TFL 52

1.5 Higher Level Plans

TFL 52 is located within the Cariboo-Chilcotin Land Use Plan (CCLUP) and is managed in accordance with the associated Land Use Order (LUO). This analysis will be consistent with the May 2011 LUO for the CCLUP area for Old Growth Management Areas (OGMAs) and wildlife tree retention targets as holders of an FSP must amend their plans within two years of declaration of the land use order. TFL 52 is also covered by a Government Action Regulation (GAR) Order for Mountain Caribou – Quesnel Highlands Planning Unit that has changed the area to be managed for caribou from the last analysis (new coverage dated December 12, 2009).

1.6 MP#4 Implementation Recommendations

The Chief Forester made several implementation recommendations[1] when setting the AAC in 2009 (see inset). West Fraser has addressed these concerns as follows:

> *In the period following this determination and leading to the subsequent determination, I request that:*
> - *harvesting activities are restricted to those stands in which pine represents 50 percent or more of the stand volume, unless the harvesting activity is required to continue spruce beetle management and/or salvage wind-blown timber;*
> - *MFR and Forest Analysis and Inventory Branch will monitor the species composition of harvested stands and inform me if there is significant harvesting in stands that do not meet these criteria described above;*
> - *MFR staff, in collaboration with Ministry of the Environment and licensee staff continue to monitor impacts to the hydrologic function associated with mountain pine beetle salvage on the TFL;*
> - *the licensee ensure the inventory projections used in the next timber supply review include estimates of dead potential volumes; and*
> - *the licensee review its approach to incorporating Conservation Legacy Areas in its timber supply analysis for the next determination.*
>
> From: Tree Farm Licence 52 – Rationale for AAC Determination. April 1, 2009. p. 28-29

- In the period since the last AAC determination, MPB-impacted stands have been aggressively targeted in short- and medium-term harvest planning.
- The species composition of the harvest from the TFL is routinely tracked.
- P. Beaudry and Associates Ltd. was engaged to assess the hydrological condition of watersheds on the TFL.
- Cruise data may be reviewed and a sensitivity analysis runs to gauge the impact of dead potential volume (in natural stands) on short- and medium-term harvest levels. Alternatively, estimates of dead potential volume compiled by MFLNRO may be used in the sensitivity analysis.

Conservation Legacy Areas (CLA's) were modelled for MP#4, but they will not be required for this analysis. Existing CLA's have been netted out of the THLB (as WTP's), and no future CLA's will be designated. Salvage operations of large cut blocks were completed over five years ago. The pine salvage harvest peaked in 2010 at 62% pine as shown in Table 1.1. Prior to the AAC uplift (early 2000's), a significant amount of pine volume in TFL 52 was harvested but not counted against the AAC

[1] AAC Rationale for TFL 52, March 31, 2009

because 'dry sawlog grade' (i.e. Grade 3) was still in place. West Fraser now manages for patch size distribution by natural disturbance type, according to the Cariboo Chilcotin Land Use Plan (CCLUP) and Regional Biodiversity Conservation Strategy (RBCS). West Fraser maintains an annual seral and patch size distribution analysis.

Table 1.1. Pine Salvage Harvesting Since MP#4

Year	Total Volume (m^3)	Pine Volume (m^3)	Non-Pine Volume (m^3)	Pine Percent
2007	789,108	473,037	316,071	60%
2008	767,599	427,432	340,167	56%
2009	743,566	411,466	332,100	55%
Average	**766,758**	**437,312**	**329,446**	57%
2010	937,908	588,107	349,801	62%
2011	743,515	260,479	483,036	35%
2012	616,950	83,080	533,870	13%
2013	657,893	42,002	615,891	6%
2014	534,638	54,300	480,338	10%
2015	392,600	37,074	355,526	9%
2016	611,279	58,043	553,236	9%
2017 (est.)	600,000	20,000	580,000	3%
Average	**636,848**	**142,886**	**493,962**	22%

1.7 Major Forest Management Issues

The outbreak of Mountain Pine Beetle (Dendroctonus ponderosae) (MPB) has passed though the interior of British Columbia including West Fraser Timber Ltd.'s (WF) Bowron-Cottonwood Tree Farm Licence (TFL 52). The mature pine is dead, and immature pine stands have also suffered significant mortality.

Much of the dead pine volume has been harvested. This was facilitated by an increase in the AAC that was approved in 2009. (An AAC uplift for Block B – the old TFL 5 area – had been previously approved.) The uplift AAC was 1,000,000 cubic metres per year. This was reduced slightly in 2011 in conjunction with the taking for the Cascadia TSA. Very little mature, dead pine remains. It is likely that with this analysis, the short-term harvest will return to (and possibly fall below) historical AAC levels.

Prior to the uplift, the historical AAC for TFL 52 had been approximately 570,000 m^3/year. For TFL 5, it was 123,000 m^3/year. The combined pre-beetle AAC would have been about 693,000 m^3/year. Therefore, the uplift AAC represents an increase of 44% over historical AAC levels.

Not all of the dead pine is currently unmerchantable. The shelf life of dead pine varies across the TFL: eastern pine differs from western pine salvage, for instance. Most of the pine in the harvest is now incidental - it originates in stands of other leading species. In 2016, only 4 of 42 active cutting permits were cruise based (i.e. >35% pine content). In these mixed stands, a larger average piece size and

minority component of pine allows more marginal grade 2 sawlogs to make it to the mill. Essentially, the non-pine component of the block subsidizes the harvesting of dry pine. Over the next 5 years, it is reasonable to expect that some of the pine component will make it to the mill as a sawlog.

2 Current Inventories

This section describes base mapping, forest cover inventory, and other data used in the analysis.

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 ArcGIS™ geographic information system (GIS).

2.2 Forest Cover Inventory

Vegetation Resources Inventory (VRI) data describes the forest inventory for TFL 52.

For Block A, aerial photography was flown in 1997 and the Phase 1 was completed in 2001. NVAF sampling was completed in 2004 and 2007. A preliminary Phase 2 adjustment was compiled in 2006.

For Block B, aerial photography was flown in 2001 and the Phase 1 was completed in 2002. Phase 2 field work was conducted in 2005, and NVAF field work in 2007. No Phase 2 adjustment was ever calculated for Block B as a stand-alone unit.

Phase 2 Net Volume Adjustment Factor (NVAF) adjustments have been made for TFL 52 and the government agency review was completed in March 2009. A subsequent adjustment was completed in January 2011. The later adjustment will be used for this timber supply analysis.

Updates for disturbance have been applied up to January 1, 2014. Harvest blocks from that date to the present are mapped separately and will be incorporated into the spatial resultant that will be used to build the forest estate model input data files.

VRI data does not reflect the standing, merchantable dead volume component of stands. At the time of the determination the Chief Forester will make an adjustment to the AAC level to account for this. Standing dead volume (apart from MPB-impacted pine) will not be considered by the timber supply analysis base case – though it might be examined in a sensitivity analysis.

2.3 Inventory Update

West Fraser updated the forest inventory to January 1, 2014. For this timber supply analysis the inventory has been further updated for disturbances to January 1, 2017 by hardwiring logged blocks (provided by West Fraser) into the forest estate model harvest schedule. For the analysis, recently harvested blocks have been given an age 0 and put on the appropriate managed stand yield curve.

The forest inventory ages, heights and volumes have been projected to January 1, 2014.

2.4 Spatial Data Sources

Many sources of data were compiled to provide input to the previous timber supply analysis for TFL 52. Data was used for two general purposes:

- Netdowns – delineation of the land base into non-productive, non-harvesting, and harvesting components; and

- Landbase classification – the assignment of each stand to a yield curve / analysis unit, and to the resource emphasis areas need to model non-timber resources.

Table 2.1lists the datasets that have been used to create the timber supply analysis resultant for the TFL.

Table 2.1. TFL 52 Data Sources

Description	File	Source	Date
TFL Boundary	*MSYT_2012_BDY.shp*	WF	28-Nov-12
Landscape Units	*RMP_LU_SVW_polygon.shp*	BCGW	29-Jan-13
Cariboo-Chilcotin Land Use Plan Zones	*CCLUP_Zone.shp*	WF	05-May-11
Freshwater Atlas Assessment Watersheds	*FWA_ASS_WS_polygon.shp*	BCGW	29-Jan-13
VRI	*tfl52_vri.shp*	WF	13-Jan-14
Steams	*TRIM_Streams.shp*	WF	05-May-11
Lakes / Rivers	*TRIM_Lakes_and_Rivers.shp*	WF	05-May-11
Wetlands	*TFL52_VRI_SWAMP.shp*	WF	05-May-11
Buffered Riparian Areas	*rip_water (coverage)*	TFIC	
Fish Inventory	*Critical_Fish.shp*	TFIC	05-May-11
Lake Classes	*Lake_Class_SRMP.shp*	WF	05-May-11
Lakeshore Management Zones	*slrp_lmz (gdb)*	WF	05-May-11
Terrestrial Ecosystem Mapping – Block A	*tem_a1*	TFIC	28-Feb-06
Terrestrial Ecosystem Mapping – Block B	*tfl5_ecology(coverage)*	TFIC	28-Feb-06
Biogeoclimatic Subzones – Block A	*TFL52_A_BEC_Subzone_UTM.shp*	WF	05-May-11
Biogeoclimatic Subzones – Block B	*TFL52_B_BEC.shp*	WF	05-May-11
Old Growth Management Areas - Legal - Current	*OGMA_LEG_C_polygon.shp*	BCGW	29-Jan-13
Old Growth Management Areas - Non Legal - Current	*OGMA_NLEG_C_polygon.shp*	BCGW	29-Jan-13
Ungulate Winter Range	*WCP_UWR_SP_polygon.shp*	BCGW	29-Jan-13
Mule Deer Winter Range	*mdwr (coverage)*	MP#4	28-Feb-06
Douglas Fir Management for Mule Deer in the Cariboo Region	*DGLSFRMGMT_polygon.shp*	BCGW	29-Jan-13
MDWR/Moose Block B	*mdwr_moose (gdb)*	MP#4	05-May-11

Description	File	Source	Date
Wildlife Habitat Areas (Mountain Caribou)	*WCP_WHAPLY_polygon.shp*	BCGW	29-Jan-13
Wildlife Tree Patches	*TFL52_WTP_to_March 31, 2011.shp*	WF	05-May-11
Alexander Mackenzie Heritage Trail	*ALX_MCKZ_T_line.shp*	BCGW	29-Jan-13
Recreation Areas (Section 58)	*SEC58_O_PL_polygon.shp*	BCGW	29-Jan-13
Section 58 Recreation Orders - Lines	*R_SEC58_LN_line.shp*	BCGW	29-Jan-13
Tourism Feature Areas for the Cariboo Region	*TRSMRSCRPL_polygon.shp*	BCGW	29-Jan-13
Tourism Feature Sites for the Cariboo Region	*TRSMFTRSCR_point.shp*	BCGW	29-Jan-13
Tourism Feature Trails for the Cariboo Region	*TRSMTRLSCR_line.shp*	BCGW	29-Jan-13
Tourism Reported Operators for the Cariboo Region	*TRSMPRTRSC_polygon.shp*	BCGW	29-Jan-13
Recreation Line	*FTN_REC_LN_line.shp*	BCGW	29-Jan-13
Recreation Points	*REC_SITE_P_point.shp*	BCGW	29-Jan-13
Recreation Polygon	*FTN_REC_PL_polygon.shp*	BCGW	29-Jan-13
Recreational Features Inventory	*REC_INVTRY_polygon.shp*	BCGW	29-Jan-13
Recreational Visual Landscape Inventory	*REC_VLND_polygon.shp*	BCGW	29-Jan-13
Guide Outfitter Areas	*WAAGOA_SVW_polygon.shp*	BCGW	29-Jan-13
Roads	*TFL52_Roads_to_March 31,2011.shp*	WF	05-May-11
Digital Road Atlas (DRA) - Master Partially Attributed Road Data	*DRA_LINESP_line.shp*	BCGW	29-Jan-13
Roads Buffered			20-Oct-14
Terrain Inventory Mapping (TIM) Detailed	*STTRNVNTRP_polygon.shp*	BCGW	29-Jan-13
Operability	mp3_inop	WF	28-Feb-06
Pest Infestation Polygons	*PEST_INFST_polygon.shp*	BCGW	29-Jan-13
Pest Infestation Points	*PST_INF_PN_point.shp*	BCGW	29-Jan-13
Growth and Yield Samples - Active Status	*GRY_PSP_AC_polygon.shp*	BCGW	29-Jan-13

Description	File	Source	Date
Growth and Yield Samples - All Status	*GRY_PSP_AL_polygon.shp*	BCGW	29-Jan-13
Seral Stage Assessment for the Quesnel Forest District	*SRL_ST_DQU_polygon.shp*	BCGW	29-Jan-13
TANTALIS - Municipalities	*TA_MUNICIP_polygon.shp*	BCGW	29-Jan-13
TANTALIS - Parks, Ecological Reserves, and Protected Areas	*TA_PEP_SVW_polygon.shp*	BCGW	29-Jan-13
BC Gazetteer – Named Places	*DRPBCGZTTR_point.shp*	BCGW	29-Jan-13
Fertilization	*TFL_52_Fertilization_2005-14.shp*	WF	05-May-15
Logged - Recent	*TFL52_Harvesting_to_March 31, 2011.shp*	WF	10-May-11
10-year Plan Coverage	*TFL52_10YR_Plan.shp*	WF	UPDATE
Yield Tables	*TFL52_YieldTables.shp*	WF	26-Feb-13

3 Forest Estate Model

3.1 Model Description

Forest estate modelling will be conducted using Patchworks™. Patchworks is a spatially explicit harvest scheduling optimization model developed by Spatial Planning Systems in Ontario (www.spatial.ca). It facilitates the exploration of trade-offs between a broad range of conflicting forest management goals over short or long planning horizons.

On a technical level, Patchworks is a multiple-objective goal-programming model that consists of a GIS interface and a harvest scheduler that runs continuously in the background attempting to balance competing objectives – each of which are assigned penalty weights. Using a simulated annealing algorithm, it produces a solution that maximizes the value of the total objective function. The model has interface that shows – using tables, graphs and maps – real-time progress towards a solution the meets user-specified criteria. Simulation stops when the marginal improvement falls below the specified level.

3.2 Timber Supply Modelling

The model has been formulated using five-year planning periods over a 250-year planning horizon. The model for this analysis will be configured with high weights on the non-timber resource objectives and a lower weight on the harvest flow objective.

4 Timber Supply Options

This section provides an overview of the options that will be evaluated in the timber supply analysis.

The model will be run to find the highest sustainable harvest level and the resulting timber availability and growing stock trends will be summarized and documented. The harvest forecast will be reviewed with West Fraser staff and based on these discussions, additional model runs will be made to examine:

- Alternative initial harvest levels, and comparison to the current AAC;
- Timing and scale of required declines (as needed) to the mid-term harvest rate;
- Timing and scale of opportunities to increase the harvest in the long term; and
- The impact the management for non-timber resource values might have on harvest levels.

This section provides an overview of the options that will be evaluated in the timber supply analysis.

4.1 Base Case

The base case reflects current management performance as of 2016. The analysis will incorporate the following:

- Vegetation resource inventory (VRI) (complete Phase 1 and Phase 2);
- Change Monitoring Inventory (CMI) plots
- Operability mapping that show where timber harvesting is operationally feasible;
- Ecosystem-based analysis units;
- Improved managed stand site productivity estimates;
- Patch size and seral stage modelling for the entire planning horizon;
- Application of current genetic gains to managed stand yields;
- Implementation of the relevant parts of the Cariboo-Chilcotin Land Use Plan (1996).
- Aspects of the Cariboo-Chilcotin Land Use Order (2011) related to seral stage definitions, Old Growth Management Areas, riparian management and moose wetlands.
- Vegetation resources inventory (VRI), updated for disturbance to December 31, 2014;
- Terrestrial ecosystem mapping (TEM);
- Terrain resource inventory mapping (TRIM-II) with enhanced road and stream information;
- Genetic gains from tree improvement;
- Current silviculture regimes;
- Current utilization standards;

- Managed stand site index estimates based on the JS Thrower & Associates reports Potential Site Indices for Major Commercial Tree Species on TFL 52 and Updating Potential Site Index Estimates for Commercial Tree Species on TFL 5;
- Terrain stability mapping (TSM);
- Landscape units and resource development zones (RDZ) as defined by *Cariboo-Chilcotin Land Use Plan* (CCLUP);
- Legally established old growth management areas (OGMAs);
- Updated stand-level biodiversity requirements as specified in
- Regional Biodiversity Conservation Strategy - Update Notes #9 and #12
- Recreational and visually sensitive areas;
- Streams, lakes, wetlands and associated classification;
- Updated caribou habitat areas; and
- Updated management strategy for mule deer.

Recognizing that pine salvage harvesting operations are nearing completion, the initial base case harvest level will be set at the highest non-declining even flow level that can be found. A small allowance will be made for cleaning up the few remaining pine salvage blocks. As managed stands reach a merchantable condition, the harvest will be increased to the long-term sustainable level. Throughout the planning horizon, limits on harvesting will be enforced to ensure that all other (non-timber) resource objectives are met.

4.2 Sensitivity Analysis

Sensitivity analysis provides a measure of the upper and lower bounds of the base case harvest forecast that reflects the uncertainty in the data and/or the management 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 specific variable. This provides a way to gauge the extent to which the base case harvest level and other statistics might change with changes to input data and assumptions.

Table 4.1 lists the sensitivity analyses that will be performed for this analysis. For each scenario the data used and assumptions made will be documented.

Table 4.1. Sensitivity Analysis Runs

Sensitivity
Minimum Harvest Age +/- 10%
Natural Stand Yield Tables +/- 10%
Managed Stand Yield Tables +/- 10%
Regeneration Delay - 0 Years and 4 Years
IRM Constraint Instead of Patch Size Targets

Sensitivity
No Watershed Rate-of-Cut Limits
Watershed HEDA +/- 10%
Increase VQO Classes One Level
Decrease VQO Classes One Level
Reduce Balsam Yield by 10%, 20%, 30%

4.3 Alternative Harvest Flows

Preliminary analysis has shown that – due to the MPB epidemic – it will not be possible to continue the current harvest level once pine salvaging is complete. Due to the circumstances associated with the MPB outbreak, conventional objectives related to harvest flow might not apply in all analysis scenarios. However, wherever possible harvest flow will reflect the following objectives:

- Recover the remaining volume of dead volume prior to loss of merchantability;
- Limit changes in harvest level to less than 10% of the level prior to the reduction; and
- Achieve stability in the long-term harvest level and growing stock profiles.

An alternative harvest flow – with a higher initial harvest level – will also be run. Additional harvest flow patterns will be run if required by MFLNRO.

5 Description of the Land Base

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

5.1 Timber Harvesting Land Base Determination

Table 6.1 presents the results of the land base classification process to identify the productive forest land base (PFLB) timber harvesting land base (THLB). The PFLB excludes non-forested areas and road area from the total TFL area. The THLB further excludes areas that are not suitable for timber production and areas with legally defined boundaries that are reserved for the management of other resource values.

Individual areas may have several classification attributes. For example, stands within riparian reserve boundaries might also be classified as non-commercial. These areas would have been classified on the basis of this latter attribute, prior to the riparian classification. Therefore, in most cases the net reduction will be less than the total area in the classification. The order of the entries in Table 5.1 corresponds to the sequence in which the land base classifications were applied.

Table 5.1. Timber Harvesting Land Base Determination

Land Base Classification	Total Area (ha)	Productive Area (ha)	Area Removed (ha)	Volume Removed (m^3)
Total Land Base	261,468			
Non-Forest	16,315	-	16,315	227,049
Roads	2,977	-	2,465	132,879
Productive Land Base	**242,688**	**242,688**		**38,106,868**
Non-Productive	18,497	1,539	1,539	888
Terrain	6,824	5,757	5,241	1,000,252
Inoperable	3,775	3,539	1,672	381,071
Operable Land Base	**234,236**			**36,724,657**
Riparian Reserve Zone	10,304	6,388	5,883	1,330,912
Riparian Management Zone	15,277	10,874	4,364	829,727
Critical Fish Habitat	5,507	3,973	2,539	558,156
Caribou Habitat	23,417	20,953	18,175	3,195,008
VQO Preservation	338	336	325	87,899
Recreation Features	1,215	1,033	459	83,706
OGMA	24,892	24,321	19,815	5,313,643
WTP	4,535	4,306	3,046	883,216
Low Productivity	20,817	13,218	4,507	611,451
Deciduous	985	749	239	34,328
Timber Harvesting Land Base	**174,884**			**23,796,611**

The total productive area on the TFL is 242,688 hectares and the THLB area is 174,884 hectares.

Table 5.2 summarizes the distribution of area and coniferous volume by 10-year age class for both the productive and net timber harvesting land base.

Table 5.2. Age Class Distribution

Age Class	MFLNRO Age Class	Productive Area (ha)	Productive Volume (m^3)	THLB Area (ha)	THLB Volume (m^3)
0-10	0-19	9,408.1	0	7,936.9	0
10-20	0-19	32,372.5	758	31,401.5	741
20-30	20-39	27,163.5	49,540	26,025.3	47,414
30-40	20-39	19,645.4	227,004	18,808.7	213,722
40-50	40-59	9,143.6	810,616	8,418.6	740,767
50-60	40-59	3,400.4	556,323	2,736.4	459,714
60-70	60-79	3,593.9	492,582	2,754.3	395,461
70-80	60-79	4,325.4	817,534	3,222.8	652,115
80-90	80-99	8,953.6	2,052,942	6,196.8	1,483,412
90-100	80-99	9,105.9	2,010,353	5,619.7	1,447,986
100-110	100-119	11,739.8	2,555,439	6,804.0	1,680,075
110-120	100-119	9,265.2	2,028,474	5,681.7	1,356,505

Age Class	MFLNRO Age Class	Productive Area (ha)	Productive Volume (m^3)	THLB Area (ha)	THLB Volume (m^3)
120-130	120-139	6,748.2	1,688,021	4,033.7	1,098,562
130-140	120-139	9,549.7	2,655,230	5,808.7	1,749,040
140-150	140-249	5,960.3	1,788,765	3,381.8	1,102,788
150-160	140-249	6,901.9	1,788,657	2,877.5	929,212
160-170	140-249	10,228.0	2,658,432	5,090.7	1,521,563
170-180	140-249	6,473.1	1,813,722	3,554.3	1,053,636
180-190	140-249	7,026.6	2,076,403	3,844.3	1,217,132
190-200	140-249	10,656.9	3,174,548	5,998.0	1,913,175
200-210	140-249	7,362.9	2,291,791	4,320.1	1,392,010
210-220	140-249	13,996.5	3,787,309	6,171.9	1,932,155
220-230	140-249	2,077.3	675,426	1,294.5	449,070
230-240	140-249	2,598.2	687,824	956.2	301,355
240-250	140-249	2,011.2	589,728	808.6	272,061
250+	250+	2,979.8	829,446	1,137.4	386,942
Total		**242,687.8**	**38,106,868**	**174,884.3**	**23,796,611**

Figure 5.1 summarizes the productive and net area of the TFL by 10-year age class.

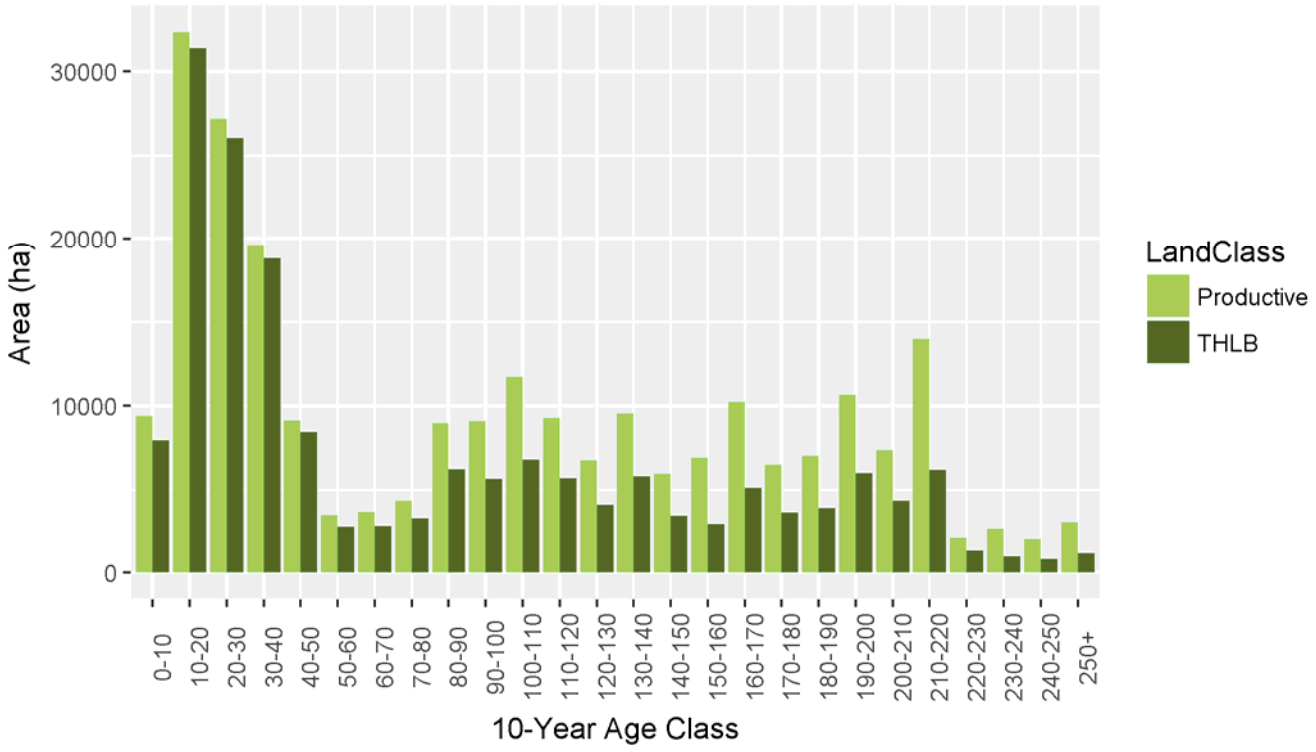

Figure 5.1. Age Class Distribution

Table 5.3 and Figure 5.2 summarize the distribution of area by leading species for both the productive and timber harvesting land base. Some deciduous-leading stands remain in the THLB because they have a previous logging history. Stands that have no leading species in the forest inventory (i.e. recently disturbed) are assigned to the appropriate analysis unit managed stand yield table with an age of zero.

Table 5.3. Leading Species Distribution

Species Code	Productive Area (ha)	THLB (ha)
ACT	954.8	271.4
AT	6,466.9	4,715.7
BL	47,187.0	20,719.6
CW	84.5	67.2
EP	3,160.5	2,607.5
FD	11,816.3	9,977.1
HW	64.1	58.2
PL	47,128.9	38,100.2
SB	1,163.3	489.0
SE	367.6	352.3
SW	14.0	14.0
SX	98,111.1	73,355.9

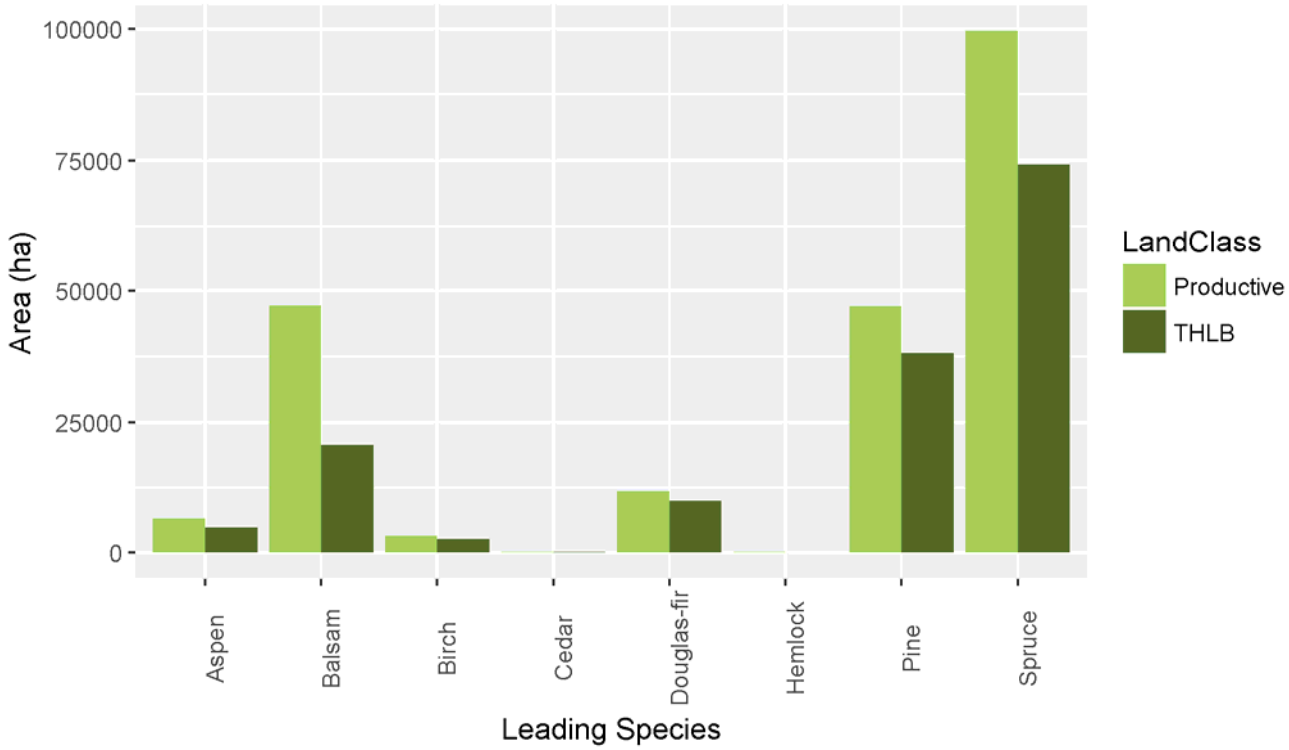

Figure 5.2. Leading Species Distribution

Table 5.4 and Figure 5.3 summarize the site index distribution in 5-metres classes (using VRI site index) for both the productive and timber harvesting land base. Recently disturbed stands are assigned an adjusted site index (see Appendix B).

Table 5.4. Site Index Distribution

Site Index (m)	Productive Area (ha)	Productive Volume (m^3)	THLB Area (ha)	THLB Volume (m^3)
0-5	2,311.1	220,015	0	0
5-10	27,282.3	4,211,136	8,440.1	1,431,980
10-15	57,871.6	10,977,085	37,751.7	6,618,838
15-20	78,276.7	13,233,420	61,636.4	8,803,760
20-25	33,958.0	8,598,904	27,083.7	6,263,573
25-30	2,824.8	651,178	2,366.9	512,067
30+	675.4	215,130	508.7	166,393

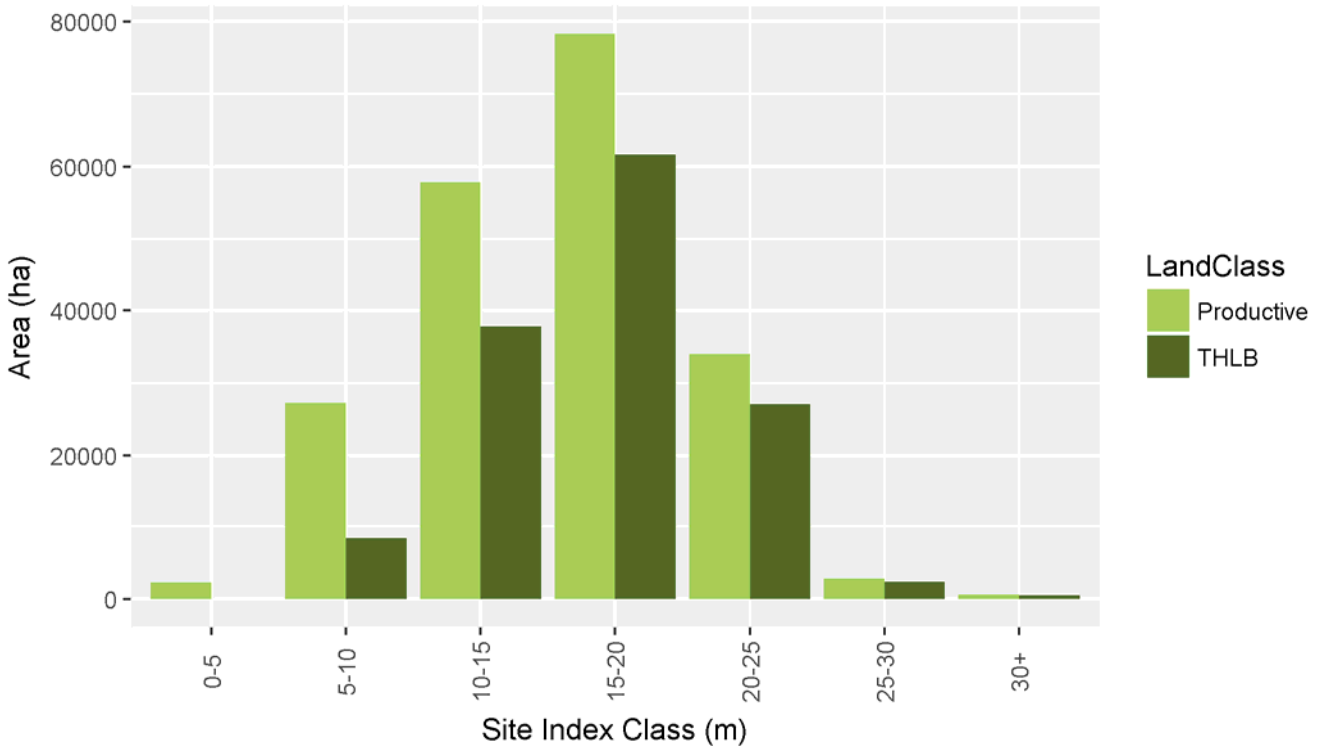

Figure 5.3. Site Index Distribution

5.2 Total Area

The current total area of TFL 52 is 261,468.5 hectares.

5.2.1 Land Base Changes Since MP#4

The area of TFL 52 reported in the previous management plan was 293,495 hectares. The current area of the TFL according to the spatial version of the boundary provided for this analysis is 261,468 hectares – a reduction of 32,027 hectares. Most of this difference is can be accounted for by the Forestry Revitalization Act take back. Four blocks, summarized in the table below, were removed.

Table 5.5. Forestry Revitalization Act Take Back

Deletion Block	Area (ha)
Ahbau	4,208
Little Swift	3,662
Marvin Creek	2,015
Big Valley	21,847
Total	**31,732**

The total area removed was 31,732 hectares as shown in Table 5.5. This difference is slightly lower (295 hectares) than can be confirmed in the spatial data sets. This discrepancy is the result of minor boundary corrections that have been made over the intervening years.

The timber harvesting land base for TFL 52 has been determined through a netdown process using the criteria described in the following sections.

5.3 Open Water

Open water identified in the forest inventory as 'non vegetated water' (based on the BCLCS codes) has been removed from the productive forest land base and from the THLB.

Table 5.6. Open Water Reductions

Description	Gross Area (ha)	Productive Area (ha)	Area Removed (ha)	Volume Removed (m^3)
Open water	1879.5	0.0	1879.5	75.7

5.4 Non-Forest Land

Non-forest areas are identified and removed from the THLB using VRI data. Non-vegetated VRI polygons with no harvesting history are removed. This includes areas classified as 'non-vegetated land' or 'vegetated non-forest' according to the BCLCS.

Table 5.7. Non-Forest Reductions

Description	Gross Area (ha)	Productive Area (ha)	Area Removed (ha)	Volume Removed (m^3)
Non-Vegetated	14900.2	0.0	14900.2	226973.8

5.5 Existing Roads

Forest operations create roads, trails and landings that can reduce the productivity of growing sites, and reduce the area available for growing trees. Reductions to the THLB are made to account for the loss of existing and future productivity associated with these areas. The methodology by which roads, trails and landings constructed during future harvesting operations will be accounted for is described in Section 5.20.

Existing roads have been buffered and the resulting area removed. A buffer width of 20 metres was used for main road and 9 metres was used for all other roads. It should be noted that for main roads – where the cleared right-of-way width is greater than 20 metres – it will in many cases be netted out at a previous step as 'vegetated non-treed'. Table 5.8 summarizes road length by road class. Table 5.9 shows the area and volume removed in road buffers.

Table 5.8. Road Length by Class

Road Class	Buffer Width (m)	Length (km)
MAIN	20	415.1
PUBLIC	20	28.2
BLOCK	9	2,804.8
BRANCH	9	1,229.4
SPUR	9	3.9
HGWY	9	18.3
LONG	9	0.5
NON STATUS	9	0.5
OPER	9	9.9
PRIVATE	9	4.0
TBC	9	0.4
TEMP	9	1.9
UND	9	391.9
WINTER	9	106.2
Total		**5,014.8**

Table 5.9. Road Reductions

Description	Gross Area (ha)	Productive Area (ha)	Area Removed (ha)	Volume Removed (m^3)
Non-Vegetated	2977.3	0.0	2465.2	132879.3

All of the area removals to this point in the netdown process are for non-forested areas. They are not harvestable, and do not contribute to other resource objectives (e.g. wildlife habitat, biodiversity).

5.6 Non-Productive Forest

Stands with no harvesting history that have a crown closure of less than 10% are removed from the timber harvesting land base.

Table 5.10. Non-Productive Forest

Description	Gross Area (ha)	Productive Area (ha)	Area Removed (ha)	Volume Removed (m^3)
Not Treed	18497.4	1539.0	1539.0	887.8

5.7 Unstable Terrain

Terrain stability mapping (TSM) occurred over several years and was completed in 2000. Level 'D' mapping was carried out on the plateau area of Block A, and Level 'C' mapping was completed for the

more mountainous areas. TSM for Block B had been completed while it was still under licence to Weldwood, and the two data sets were merged. Areas of unstable terrain are removed from the THLB. Slope stability class 5 is removed entirely. Only half of the area in slope stability class 4 is netted out.

Table 5.11. Slope Stability Reductions

Description	Gross Area (ha)	Productive Area (ha)	Area Removed (ha)	Volume Removed (m^3)
Slope Stability Class 5	5982.2	4977.0	4852.9	896440.1
Slope Stability Class 4	842.1	780.4	388.0	103812.0

5.8 Operability Issues

Areas classified as 'Inoperable' are removed from the THLB.

An operability assessment was completed for Block A during data preparation for MP#3. Inoperable areas are defined as unsuitable for commercial harvesting due to poor access and/or unstable soils and slopes. The operability mapping exercise included an air photo review of all terrain class IV and V polygons identified in the TSM, combined with local knowledge of ground conditions, past road building and harvesting activities, and forest development plans. This same mapping was used for MP#4, and will be used for this analysis.

Table 5.12. Operability Reductions

Description	Gross Area (ha)	Productive Area (ha)	Area Removed (ha)	Volume Removed (m^3)
Inoperable	3774.7	3538.7	1671.6	381070.8

5.9 Riparian Management Reductions

Areas adjacent to rivers, streams and other wetlands are classified as riparian. These riparian areas are important as thermal cover for fish-bearing streams, habitat for wildlife, and for protection of streambeds from erosion.

Stream and lake classification was completed for Block A prior to MP 3 (and the riparian classification for Block B was updated at this time). This included fish habitat classification. This classification process identified those streams that are important as fish habitat -- S1, S2, S3, and S4 -- and other non-fish bearing streams -- S5, and S6. The critical fish habitat inventory has now been finalized. Wetlands, swamps and lakes were also included in the stream classification. All of this classification work had been completed on the TRIM-II base. In 2014, West Fraser remapped all watercourse locations using LiDAR data. The attribution from the TRIM-II spatial data was conflated onto this new base.

Two buffers were assigned in the GIS database to identify areas adjacent to each stream and wetland:

- *Riparian reserve zone (RRZ)* - the area directly adjacent to the stream which is completely excluded from any harvesting activity, and
- *Riparian management zone (RMZ)* - additional area beyond the *RRZ,* which is partially removed based on FPC basal area retention guidelines.

Management guidelines recommend that a portion of the basal area within the RMZ be maintained. The level of retention ranges from 5% to 100% depending on the riparian category. This approach of reserving the land base equivalent of the basal area percentage has been used in other timber supply analyses to address RMZ requirements. For example, if the requirement is to retain 25% of the basal area, then 25% of the land within the RMZ will be placed in permanent reserve.

During operations there will be variable levels of retention within the RMZ. In some cases the RMZ may be located outside the cutblock. For the timber supply analysis the recommended levels of basal area retention are assumed to reflect average conditions across the TFL.

Current accepted operations on TFL 52 place block boundaries outside S6 streams whenever possible. When S6 streams are encountered within cutblocks only the merchantable timber is removed. Based on these practices there are no reductions for S6 RMZs on TFL 52.

Reserve areas within the RMZ are adjacent to the RRZ or the riparian feature if no RRZ is present. The remainder of the RMZ is then available for harvesting.

Table 5.13. Riparian Management Area Buffer Rules

Riparian Class	Reserve Zone Width (m)	Percent Retention (%)	Management Zone Width (m)	Percent Retention (%)	Effective RMZ Width (m)
Streams:					
S1	50	100	20	50	10
S2	30	100	20	50	10
S3	20	100	20	50	10
S4	-	-	30	25	7.5
S5	-	-	30	25	7.5
Lakes:					
A	10	100	200	100	200
B	10	100	150	90	135
C	10	100	100	80	80
E	10	100	25	50	12.5
Wetlands:					
W1	10	100	40	25	10
W3	-	-	30	25	7.5

Table 5.14. Riparian Reserve Zone Reductions

Description	Gross Area (ha)	Productive Area (ha)	Area Removed (ha)	Volume Removed (m^3)
Lake Class 'A'	0.2	0.2	0.2	93.4
Lake Class 'B'	3.3	3.3	2.9	789.3
Lake Class 'C'	44.9	7.4	7.4	1848.2
Lake Class 'E'	22.6	4.2	4.2	559.3
Wetland Class 'W1'	287.7	212.0	211.0	46147.0
Wetland Class W'5'	98.1	14.6	14.6	6061.6
Stream Class 'S1'	83.3	83.0	73.1	26475.4
Stream Class 'S1-Large'	585.1	151.3	135.6	38978.7
Stream Class 'S2'	3954.5	2191.7	1985.4	482544.0
Stream Class 'S3'	5224.7	3719.8	3448.3	727415.4

Table 5.15. Riparian Management Zone Reductions

Description	Gross Area (ha)	Productive Area (ha)	Area Removed (ha)	Volume Removed (m^3)
Lake Class 'A'	108.0	108.0	99.0	41952.9
Lake Class 'B'	236.2	227.0	207.1	44817.7
Lake Class 'C'	486.8	408.0	383.6	95976.9
Lake Class 'E'	32.2	13.7	9.5	1426.6
Wetland Class 'W1'	600.4	503.5	277.7	58786.9
Wetland Class 'W3'	462.5	248.7	209.4	42626.3
Wetland Class W'5'	106.8	23.1	8.5	2399.2
Stream Class 'S1'	90.8	90.5	6.5	2597.2
Stream Class 'S2'	4393.4	2545.1	304.5	73837.0
Stream Class 'S3'	6070.8	4409.2	618.0	130691.7
Stream Class 'S2'	2665.8	2274.6	2219.9	327590.9
Stream Class 'S3'	23.5	22.7	20.2	7023.3

5.10 Wildlife Habitat – Critical Fish

Critical fish habitat area boundaries are from Land Use Order Objectives for the Cariboo-Chilcotin Land Use Plan, Map 4 (published May 19, 2010 and amended May 24, 2011). Mapped 'Critical Fish Habitat' has been netted out.

Table 5.16. Critical Fish Habitat Reductions

Description	Gross Area (ha)	Productive Area (ha)	Area Removed (ha)	Volume Removed (m^3)
Critical Fish Habitat	5507.2	3972.9	2539.5	558155.8

5.11 Cultural Heritage and Archaeological Resources

An Archaeological Overview Assessment (AOA) for the Quesnel Forest District (including TFL 52) was completed in 1998 and revised in 2009. West Fraser routinely refers to this inventory during their operational planning. Archaeological Impact Assessments (AIA) are performed in areas identified as high potential based on the AOA for the Quesnel Forest District.

Most known archaeological sites are small, and many are found in areas that are already excluded from the THLB for other ecological or environmental reasons. Where they occur on or near a proposed cutblock, they can be preserved through the judicious use and location or these small reserve areas needed to meet stand level retention requirements. With careful operational planning, significant archaeological and cultural sites and features can be protected without having an impact on strategic timber supply.

First Nations consultation occurs during the cutting permit planning process on a site-specific level. Some First Nations (i.e. the Xatśūll First Nation) have provided overview maps to West Fraser to identify potential areas of concern to operational planners.

5.12 Wildlife Habitat – Caribou

Wildlife Habitat Areas (WHA) for Mountain Caribou were established on December 9, 2009 under the authority of the *Government Actions Regulation*. Spatial data was retrieved from the BCGW. Caribou habitat areas designated as 'No Harvest' has been removed.

Table 5.17. Caribou Habitat Reductions

Description	Gross Area (ha)	Productive Area (ha)	Area Removed (ha)	Volume Removed (m^3)
Caribou No-Harvest	23417.0	20953.5	18175.2	3195007.9

5.13 VQO Preservation

Visual Quality Objectives for TFL 52 are established by the Cariboo-Chilcotin Land-Use Plan. The specific polygons and objectives are set out on maps 9a, 9b and 9c which are referenced in the Land Use Order. The supporting spatial data has been downloaded from the BCGW.

Areas with a Visual Quality Objective (VQO) of 'Preservation' are unavailable for harvesting and so are removed from the THLB. Other visually sensitive areas will be modelled with forest cover constraints that will limit the amount of harvesting that may occur during a period of time. Table 5.18 summarizes the area and volume removed from the THLB to address this VQO preservation (VQO-P) area.

Table 5.18. Visual Landscape Reductions

Description	Gross Area (ha)	Productive Area (ha)	Area Removed (ha)	Volume Removed (m^3)
VQO - Preservation	337.6	336.4	325.4	87898.6

5.14 Recreation Sites and Trails

The following recreation sites have been netted out of the timber harvesting landbase:

- Baker Lake
- Crescent Lake
- Eight Mile Lake
- Davey Lake
- Willow 1000 Road Reserve
- Pleasant Valley
- Hush Lake
- Kruger Lake
- Whiskey Flats
- Lightening Creek
- Chisel Lake
- Groundhog Lake
- Victoria Creek
- Atan Lake
- Snowshoe Plateau

The following recreation trails have been buffer by 50 metres each side (100 metres total) and have been netted out:

- Hush Lake Cross-country Ski Recreation Trails
- Jubilee Recreation Trail
- Yanks Peak Recreation Trail
- Yellowhawk Recreation Trail
- Deacon Creek Trails
- Cornish Mountain Recreation Trails

The spatial data source for the sites and trails is the BCGW (*ften_recreation_poly* and *ften_recreation_line* respectively). Only features listed in the FSP have been netted out of the THLB.

Table 5.19. Recreation Feature Reductions

Description	Gross Area (ha)	Productive Area (ha)	Area Removed (ha)	Volume Removed (m^3)
Recreation Sites	87.9	62.5	52.8	12961.1
Recreation Trails	1127.3	970.6	406.2	70744.5

5.15 Old Growth Management Areas

Old growth management areas have been designated on all of TFL 52 as part of the CCLUP. They are intended to be permanent reserves of unique ecosystems present on the landscape. This will help to maintain important components of natural ecological succession that might be compromised in intensively managed forest landscapes.

For the purposes of timber supply analysis OGMAs classified as “permanent” are excluded from the THLB. As a result forest cover constraints typically used to model old forest objectives are no longer required. Mature plus old constraints may still be necessary in certain landscape units. “Transition” OGMAs may be part of the THLB and typically within areas that have a mature plus old constraint applied.

Permanent OGMA’s have been removed. Transitional OGMA’s have been retained in the THLB, and designated as a unique resource emphasis area for modeling purposes.

Table 5.20. Old Growth Management Area Reductions

Description	Gross Area (ha)	Productive Area (ha)	Area Removed (ha)	Volume Removed (m^3)
OGMA’s	24892.0	24321.4	19815.2	5313643.5

5.16 Wildlife Tree Retention

Existing Wildlife Tree patches are mapped (and submitted to RESULTS) and have been removed from the THLB. Existing Conservation Legacy Areas (CLA’s) are also removed at this stage.

Table 5.21. Wildlife Tree Patch Reductions

Description	Gross Area (ha)	Productive Area (ha)	Area Removed (ha)	Volume Removed (m^3)
WTP’s	4535.2	4305.9	3045.6	883216.3

5.17 Low Productivity

Sites may have low productivity either because of inherent site factors (nutrient availability, aspect, excessive moisture, etc.), or because they are incompletely occupied by commercial tree species. Long development periods may enable stands classified as low productivity to achieve merchantable volumes. Sites that are currently occupied by unmerchantable stands may be productive with other species, or following silvicultural treatments.

All stands that have a logging history attribute are not considered in the low site reductions. It is assumed that these sites were capable of producing merchantable timber in the past and should therefore produce merchantable timber in the future.

Young stands (< 30 years old) are assigned a site index (SI50) value in the new VRI. Older stands have been assigned SI50 with VDYPBatch, based on age and height attributes from the VRI. This SI50 estimate is used to evaluate the long-term timber growing potential of the site.

Stands with a VRI site index below 7.5 metres have been removed – unless they have been previously harvested.

Table 5.22. Low Stand Productivity Reductions

Description	Gross Area (ha)	Productive Area (ha)	Area Removed (ha)	Volume Removed (m^3)
Low Productivity	20816.7	13218.0	4506.7	611450.6

5.18 Deciduous Leading Stands

West Fraser harvests a portion of the deciduous profile on Block B (aspen, birch, and very minor amounts of cottonwood) as part of their operations. The remainder of the deciduous inventory is considered non-merchantable under current salvage, market and milling conditions. Therefore this unmerchantable component is excluded from the THLB.

Only a minor component of deciduous is included in the harvest operations on Block A. All naturally established cottonwood-deciduous stands with no previous logging history that will not produce 120 m^3/ha of coniferous volume by age 150 are netted out of the THLB

Cottonwood has limited merchantability and is often found in riparian and moose habitat areas that are reserved from harvesting. All cottonwood-leading stands remaining in the THLB have been labeled as managed stands. All other cottonwood within the THLB occurs as minor amounts (< 10% of stand composition) and is utilized in harvesting operations by West Fraser.

Aspen and birch-leading stands are only harvested incidentally. It is more effective to retain deciduous stands in wildlife zones because deciduous provides valuable habitat in these areas. Table 5.23 summarize the deciduous removals for the land base.

All deciduous-leading stands have been removed if they had no previous harvest history.

Table 5.23. Deciduous Stand Reductions

Description	Gross Area (ha)	Productive Area (ha)	Area Removed (ha)	Volume Removed (m^3)
Deciduous-Leading Stands	984.7	749.5	238.7	34328.5

5.19 Future Wildlife Tree Retention

THLB areas that are not within 250m of mature, productive non-contributing will have a wildlife tree retention net down applied according to FSP Appendix A Table 1.

Stand level biodiversity is addressed in the analysis by reserving wildlife tree patches (WTP). Wildlife tree retention targets (WTR) – by landscape unit and biogeoclimatic unit – are specified in the Cariboo-Chilcotin Land Use Order (Schedule 1). These were the default retention percentages applied to each stand in the THLB. In practice, however, a portion of the WTPs can come from areas already removed from the THLB for other reasons. To account for this in the analysis, THLB stands that lie within 250

metres of productive, mature, non-THLB stands will have no WTR reduction applied – under the assumption that the WTR requirement will be met from adjacent, non-THLB areas.

Mature, non-THLB stands were given a 250-metre buffer to reflect half of the maximum acceptable distance between wildlife tree patches according to the Biodiversity Guidebook. THLB stands that did not fall within these buffers were deemed to require additional wildlife tree retention, so the full LUOR retention reduction was applied. Table 5.24 shows these reductions.

Table 5.24. WTR Target by LU and BEC Zone, Subzone and Variant

LU-BEC	WTR Target (%)	LU-BEC	WTR Target (%)
Abhau-SBSmh	3	Lightning-ESSFwc3	6
Abhau-SBSdw	6	Lightning-ESSFwk1	9
Abhau-SBSmw	6	Lightning-SBSmw	8
Antler-ESSFwc3	2	Lightning-SBSwk1	9
Antler-ESSFwk1	8	Swift-ESSFwc3	3
Antler-SBSwk1	9	Swift-ESSFwk1	8
Big Valley-ESSFwc3	7	Swift-SBSwk1	9
Big Valley-ESSFwk1	8	Umiti-ESSFwc3	4
Big Valley-SBSwk1	9	Umiti-ESSFwk1	10
Bowron-ESSFwc3	3	Umiti-SBSdw1	10
Bowron-ESSFwk1	6	Umiti-SBSmh	10
Bowron-ICHmk3	7	Umiti-SBSmw	10
Bowron-ICHwk4	3	Umiti-SBSwk1	11
Bowron-SBSwk1	4	Victoria-ESSFwc3	5
Indianpoint-ESSFwc3	1	Victoria-ESSFwk1	6
Indianpoint-ESSFwk1	6	Victoria-SBSmw	7
Indianpoint-SBSwk1	6	Victoria-SBSwk1	8
Jack of Clubs-ESSFwc3	5	Willow-ESSFwc3	5
Jack of Clubs-ESSFwk1	6	Willow-ESSFwk1	8
Jack of Clubs-SBSwk1	6	Willow-SBSwk1	9

5.20 Future Roads

All future road development on Block A will be secondary roads with an assumed buffer width on 9 metres. These roads will only be required in areas that are not already roaded. A future road estimation process was completed for TFL 52 as part of MP 3. This study indicated that a reduction of 3.46% to all unlogged areas within the THLB will be required to account for future road development on the Block A.

Future road access on Block B will include a minor addition of block access and cutting permit roads. The main road network is in place for this part of the TFL. Based on a review of future road access completed for MP 4, approximately 40 ha of future roads will be required. This represents a reduction of 0.35% to all unlogged areas of Block B which will be applied during the first harvest of those unlogged areas.

6 Inventory Aggregation

The use of forest cover constraints allows management objectives for non-timber resources to be included in timber supply analysis simulations. For forest level modelling purposes, areas requiring the same management regime, that is having the same forest cover constraints, are assigned to a common land base aggregate. Within each land base aggregate, specific forest cover constraints are implemented. Aggregates defined for each block of the TFL are based on current forest management to address timber and non-timber resources.

Resource emphasis areas (REAs) are aggregates of area with similar non-timber resource concerns. These include visually sensitive areas, wildlife habitat, and general IRM areas. It is possible to assign a stand to more than one REA if overlapping resource objectives exist for that area. Maximum disturbance (based on green-up requirements), minimum mature plus old and old growth forest cover constraints will be assigned to each REA forest cover group to address specific resource needs.

Two levels of REAs will be assigned to the land base to allow modelling of forest cover constraints. These constraints will control the levels of disturbance and mature/old forest within a REA depending on the objectives specified for the non-timber resource. Maximum disturbance (based on green-up height requirements) and/or minimum mature and old growth forest cover objectives will be assigned to each REA forest cover group to address needs of the resource. Areas will be required to meet all overlapping forest cover constraints, or have the ability to meet constraints in the future, before harvesting is allowed to proceed.

With the designation of OGMAs, the forest cover constraints related to old forest will not be modelled. It is assumed that the OGMAs will accommodate the old forest objectives. Mature plus old constraints are required in all landscape units.

To assign yield information, individual stands will be given a reference to both an existing (natural or managed stand) and regeneration (managed stand) yield table. Analysis unit definitions are based on species composition, site productivity, existing stand condition and future management regime. Existing and regeneration yield tables were developed for all stands.

7 Growth and Yield

Yield tables to be used for this analysis have been prepared by Guillaume Thérien. The procedures used to produce these tables are documented in the report 'West Fraser Mill Ltd. – Tree Farm Licence 52 – Yield Table Summary Report' dated May 12, 2014. Both natural and managed stand yield tables were generated. The information in the following two sections is summarized from the Thérien report.

7.1 Natural Stand Yield Tables

Natural stand yield tables were generated using the British Columbia Ministry of Forests, Land, and Natural Resource Operations (MFLNRO) growth model VDYP7, version 7.7a.33, with input from the VRI. The modeling unit for the natural stand yield tables was the intersection between the VRI map/stand and the biogeoclimatic zone polygon. The process is described in detail in Appendix A.

Natural stand yield tables were generated for all stands (other than NSR stands), established before 1980 on Block A or before 1950 on Block B, or at least 30 years of age at reference year.

Yield tables were generated from ages 1 to 250. The output included age, basal area 12.5 cm+ (BA), quadratic mean diameter (QMD) 12.5 cm+, dominant height, volume net of decay, waste, and breakage (Vol) at both 12.5 cm+ and 17.5 cm+. Mean annual increment (MAI) was computed for both 12.5-cm+ and 17.5-cm+ utilization limits.

All natural stand yields are Phase 2 VRI adjusted. The statistical analysis and adjustment process is described in Appendix C.

Table 7.1. Timber Utilization

Leading Species	Minimum DBH (cm)	Stump height (cm)	Minimum top DIB (cm)
Block A:			
Pine	12.5	30.0	10.0
All others	17.5	30.0	10.0
Block B:			
Pine	12.5	30.0	10.0
All others	17.5	30.0	10.0

7.2 Managed Stand Yield Tables

Managed stand yield tables were generated using the MFLNRO growth model BatchTIPSY, version 4.3. Input for these tables was defined in silviculture regimes prepared by West Fraser (Appendix A). The silviculture regimes represent current and expected future managed stand conditions. The modeling unit for the managed stand yield tables was the intersection between the TEM polygon and the polygons from the different SIA projects.

7.2.1 Site Productivity

Site index estimates were obtained from the three SIA projects for Sx, Pl, Bl, and Fd. Not all SIA projects, however, provide complete coverage for all species. In those cases, site index conversion equations (developed by MFLNRO) have been used. Appendix B (TFL 52 Site Index Adjustment Compendium) describes the site index adjustment process in detail.

Unadjusted site index estimates were used in the 2008 SIA project due to a lack of sampling opportunities in two situations: high elevation areas and minor subzones.

Site index in high elevation areas was assigned an estimate based on a TRIM-based elevation model and that estimate was not adjusted.

In minor subzones, site index was assigned by a panel of experts.

7.2.2 Existing Managed Stands

Existing managed stands were defined as any stand containing at least one productive site series that became established after 1979 on Block A or after 1949 on Block B. These cut-off dates are based on a review of information in the history component of the forest inventory and the silviculture records for the TFL that was carried out during the data preparation stage for MP#4.

On TFL 52 Block B, natural stand yield tables were generated for all stands not labeled as NSR and established before 1950. As well, natural stand yield tables were generated for all stands established after 1949, if the inventory age was at least 30 years at reference year. These stands are assumed to be naturally regenerated – e.g. TFL 5 MP 10 Era 1 - Year 1950 -1970.

On TFL 52 Block B, managed stand yield tables were generated for all stands having at least one productive site series, not labeled as NSR, and established after 1949 with an inventory age of less than 30 years at the reference year. These stands are assumed to be planted – e.g. TFL 5 MP 10 Era 2 Year 1971-1986.

Yield tables were first generated from 1 to 250 years by 1-year increment for all silvicultural regimes and site index combinations. There were 5,713 such combinations. These tables were then apportioned at the eco-polygon level based on the site series distribution within the eco-polygon.

Silviculture regimes were developed by West Fraser to describe the conditions of managed stands. These regimes were developed by site series and describe species composition, stand density, and silvicultural treatments. These regimes represent past and current activities that have taken place on TFL 52.

The genetic gains for existing managed stands were divided into two time periods. Stands established prior to 1992 had no genetic gain applied; stands established after 1991 were assigned a weighted genetic gain based on expected gain, usage, and survival rate.

The OAF1 estimate for existing managed stands was localized to TFL 52 by biogeoclimatic subzone using TEM data. A base OAF1 of 7.5% was assumed, and an additional amount was added to account for non-productive areas described within eco-polygons by using the proportion of non-productive site series in each subzone. Resulting OAF1 values fall between 7.5% and 16.9%. The standard MOF OAF2 of 5% was used for all subzones.

No allowance has been made for fertilization, commercial thinning or juvenile spacing in the construction of yield tables for existing managed stands.

7.2.3 Decay, Waste and Breakage for Natural Unmanaged Stands

Decay is assigned to natural stand volumes automatically in VDYP, based on the BEC Zone. These default values will be used when generating natural stand yield tables.

7.2.4 Dead Potential Volume

To date, most of the dead lodgepole pine volume has been harvested. Natural stand yield table (NSYT) pine volume should be considered as live volume only and the adjusted VRI can provide an estimate of remaining dead potential volume on TFL 52.

7.2.5 Deciduous Volume

Standing inventory volumes reported in this document are reduced for any deciduous component. Similarly, for the purposes of modelling, all yield tables are reduced by a percentage reflecting the deciduous component of the stand. This applies only to coniferous leading stands, as all deciduous-leading stands are netted out of the THLB.

7.2.6 Future Managed Stands

Every polygon with at least one productive site series was assigned a future managed stand yield table. Two sets of future managed stand yield tables were generated for each polygon:

1) one for the period 2012-2020; and

2) one for the period 2021 and beyond.

Future managed stand yield tables used the same silviculture regimes as existing managed stand yield tables, except for the expected genetic gains.

Regeneration delay will be dealt with during timber supply modeling, so no regen delay has been assumed in the construction of the yield curves.

7.3 Fertilization

The base yield curves provided do not account for late rotation fertilization that has occurred since 2004. Since a base yield curve had already been prepared for each stand, the decision was made to adjust these curves to show the expected response to fertilization – rather than to generate and independent set of aggregated fertilization curves. The challenge was to accurately estimate this response for each of the base yield curves.

Previous analysis work had shown that the fertilizer response was best correlated to the total volume of pure spruce stands at the time of treatment. Estimates generated for proxy pure spruce stands have to be applied to the stand-level, mixed-species, net volume yield curves that had previously been generated.

Eleanor McWilliams, RPF and Ian Cameron, RPF developed a methodology for accomplishing this – it is described fully in their report in Appendix F of this document. Guillaume Thérien provided the ‘pure-

spruce, total volume' base yield tables for each stand needed to implement this approach. The methodology was applied to all stands for which a fertilization treatment has been recorded.

With the pure spruce total volume tables in hand, and knowing the age of the stand at treatment, Ministry response estimates can be looked up (and interpolated) based on site index and top height. This response is reduced by an 'efficiency factor' of 0.8. This is the factor by which stand growth will increase over the next ten years as a result of the fertilizer treatment. No further additional volume is accrued after ten years, but the gains achieved up to ten years post-treatment are assumed to persist until the stand is harvested.

The curve generated by this method is not used in the forest estate model – it is 'total volume' rather than 'net volume'. Each volume on this total volume curve (post-treatment) is found on the untreated curve. The net volume that occurs at that point is then multiplied by the spruce percentage of the underlying stand (i.e. only spruce responds to treatment). Doing this for each of the ten years following treatment provided the points need to generate a fertilizer treatment net volume curve for each stand that was treated.

The base case does not assume that any fertilization occurs in the future. This might be examined in a sensitivity analysis, in which case a more comprehensive set of fertilization curves would need to be developed.

7.4 Yield Adjustments Based On CMI Remeasurement

West Fraser has established and maintains a set of Change Monitoring Inventory (CMI) plots which can be used to validate the assumptions made about future stand performance. The second remeasurement of these plots – described in Appendix D – was completed shortly after the original managed stand yield tables were completed for this project. Appendix E shows the location of the CMI plots. A comparison of the curves to the CMI field data showed that an adjustment was needed.

In order to bring the managed stand yield curves into line with field observations, and additional regeneration delay was applied. This was done separately for four distinct zones on the TFL: high MPB mortality, natural stands, ESSFwk1 and others. The respective incremental regeneration delays are 10, 10, 0 and 3 years.

This process is described as an Addendum (Section 7) of the yield table report that can be found in Appendix A of this document.

7.5 Yield Curve Summary

The following list consolidates and summarizes information in the previous four sections and shows that steps that are taken to produce a complete set of yield curves for use in the forest estate model.

1) Base yield curves have been provided by Guillaume Therien
   a) For natural and existing managed stands, and future stands
   b) Includes genetic gain eras
   c) Does not include fertilization
   d) No regen delay in curves – apply two years to all stands in forest estate model
2) Adjust for unharvested stands with existing fertilization
   a) calculate the pure spruce volume response

   b) calculate the actual volume response (tvol) based on the spruce percentage of the stand
   c) build the treated tvol curve be adding the increment to the tvol curve for every year starting at (treatment age + 10 years)
   d) use the original tvol/nvol curves as a lookup table to find the nvol that corresponds to the treated tvol.
   e) build the treated nvol curve to use in forest estate model
3) Increase managed stand regen delay based on CMI findings
   a) Plus 10 years in 'high mortality zone' (12 years total)
   b) Plus 10 years in 'natural stands' (12 years total)
   c) Plus 3 years in 'other' stands (not ESSFwk1) (5 years total)
4) Account for pine mortality in stands 100 years and older
   a) reduce pine volumes by 85% immediately
   b) remove remaining 15% of pine after 10 years
5) Reduce yield to account for future wildlife tree patches
   a) Only apply to THLB stands > 250 metres away from mature non-THLB stands
   b) use targets in Table 5.24

8 Integrated Resource Management

8.1 Non-Timber Resource Management

The use of forest cover constraints allows management objectives for non-timber resources to be included in timber supply analysis simulations. For forest level modelling purposes, areas requiring the same management regime, that is having the same forest cover constraints, are assigned to a common land base aggregate. Within each land base aggregate, specific forest cover constraints are implemented. Aggregates are based on current forest management to address timber and non-timber resources.

The analysis will apply forest cover objectives to model wildlife habitat guidelines, hydrologic green-up, and visual quality objectives. Old forest requirements to address biodiversity objectives will not be modelled because OGMAs have now been identified on the TFL.

8.1.1 Visual Quality Objectives

Areas with high viewscape values are managed with harvesting regimes that preserve those values.

Scenic areas objectives are defined in the Cariboo-Chilcotin Land-Use Plan, and shown on map 9a, 9b and 9c

VQO-P is netted out of the THLB. For the other VQO classes, forest cover constraints for visual objectives will be assigned to individual VQO polygons. This will ensure that objectives are maintained for each specific area, and not simply across an entire landscape unit or management unit. The VQO classes modelling in this way are shown in

Table 8.1. Disturbance Limits by Visual Quality Objective and Visual Absorption Capacity

VQO	Maximum Area Disturbed (%) by VAC			Visually Effective Greenup Height (m)
	Low	Medium	High	
Retention	1.1	3	5	3
Partial Retention	5.1	10	15	3
Modification	15.1	20	25	3

Figure 8.1 show those areas of the TFL that are managed for visual landscape objectives (and the small area of VQO – Preservation that has been netted out of the THLB.

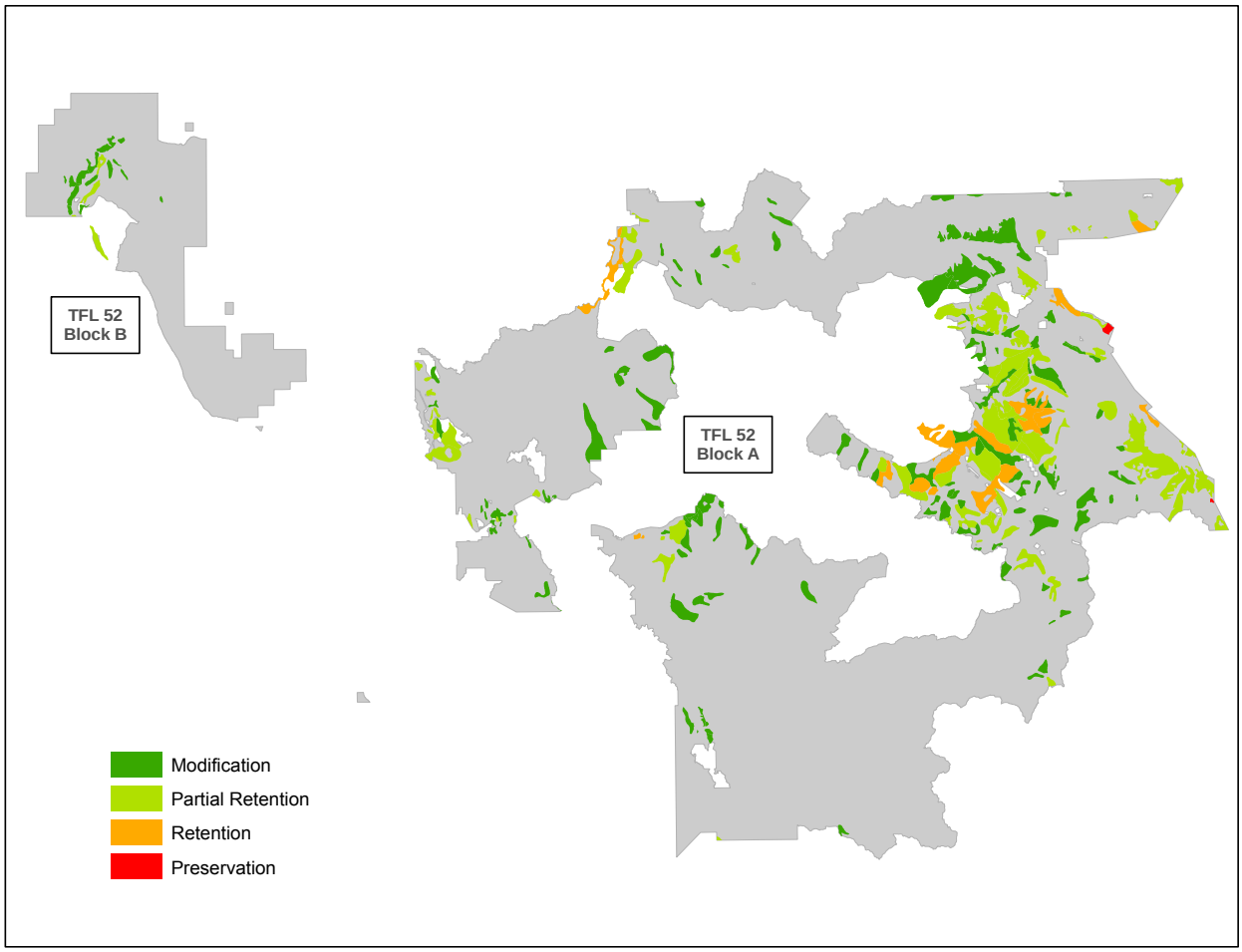

Figure 8.1. Visual Quality Objectives

8.1.2 Wildlife Habitat

8.1.2.1 Caribou Habitat (Mountain)

The GAR Order '*Wildlife Habitat Areas #5-088 to 5-117 – Mountain Caribou – Quesnel Highlands Planning Unit*' [2009] specifies two categories of caribou habitat:

- No harvest – completely excluded from the THLB, no harvesting permitted;
- Modified harvest – partial harvesting on an extended rotation (240 years); and

The combination of these harvesting types allows some access to timber while maintaining caribou habitat. In the eastern caribou areas, wildlife is the primary resource and all other activities must be conducted in ways that do not compromise caribou habitat.

Modified harvest will be by group selection harvesting up to 33% of each stand area on an 80-year cutting cycle.

Ungulate Winter Range Order #U-7-003 designates P-073. This was established by the GAR Order '*Ungulate Winter Range #U-7-003 Mountain Caribou – Upper Fraser, Hart Ranges and Mount Robson*

Planning Units' signed in December, 2009. This is a corridor unit subject to General Wildlife Measure (GWM) 1 of the Order which dictates practices in caribou corridors:

1. At least twenty percent of the productive forest land must be older than 100 years old
2. No more than twenty percent of the productive forest can be less than 3 metres in height
3. maximum of 1/3 of the area in each WHA can be less than 80 years old
4. patch-size constraints not applied

Figure 8.2 shows the distribution of these habitat areas across the TFL.

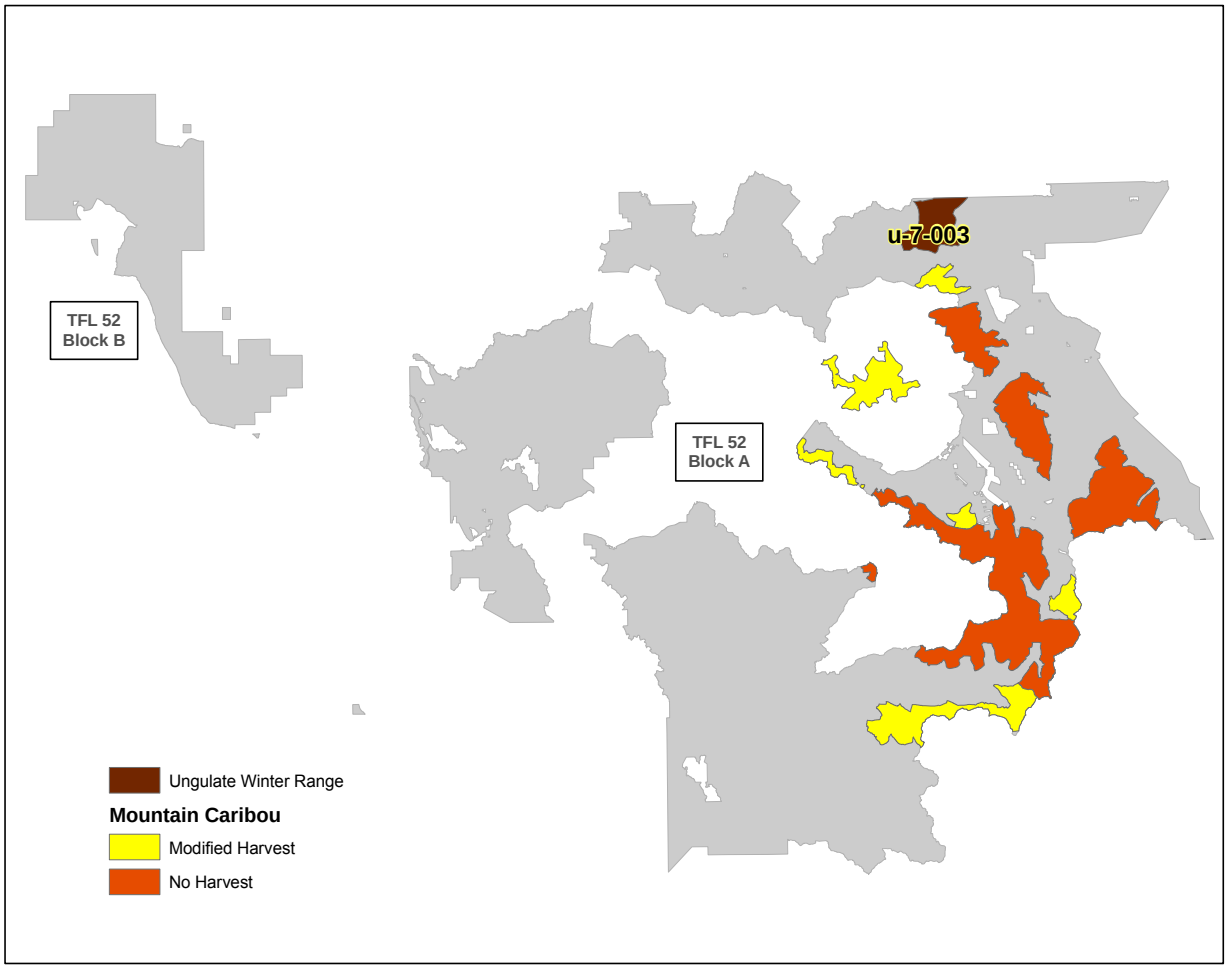

Figure 8.2. Caribou Management Areas

8.1.2.2 Mule Deer Winter Range

The CCLUP requires that MDWR be maintained in a condition that will support the regional population during critical winter conditions. Only one small MDWR polygon (UWR U-5-001) occurs on Block A of the TFL. This was established by the GAR Order '*AMENDED – ORDER #U-5-001, U-5-002, U-5-003 _ Ungulate Winter Ranges Cariboo Chilcotin Land Use Plan, Shallow and Moderate Snowpack'signed* in February, 2007. The modelling approach will be consistent with that taken for the Quesnel TSA analysis. This UWR polygon contains areas that have Stand Structure Class 'Moderate' and 'High'.

For this analysis, the entire polygon will be treated as 'High'. A disturbance constraint will be applied to the productive forest land base: no more than 20% of the area can be less than 40 years of age.

West Fraser completed a Fish, Forest and Wildlife Management Plan for TFL5 (TFL52 Part B) in October of 1995. This plan was requested by the Chief Forester and endorsed by the Ministry of Environment. MDWR was created as part of this plan; therefore no GAR MDWR was designated for this area. This MDWR is reviewed and updated periodically.

The most recent is '*Pellet Transects and Deer Management on TFL 52*' (Keystone, 2008). A copy of this report is provided in Appendix G. This report recommends the following disturbance and retention constraints be enforced on the productive forest land base for each of six planning cells:

(1) maximum 30% younger than 40 years
(2) minimum 30% 40 to 100 years
(3) minimum 40% older than 100 years

These will be implemented in the forest estate model. Figure 8.3 show the location of the planning cells on Block B, and the single UWR polygon on Block A.

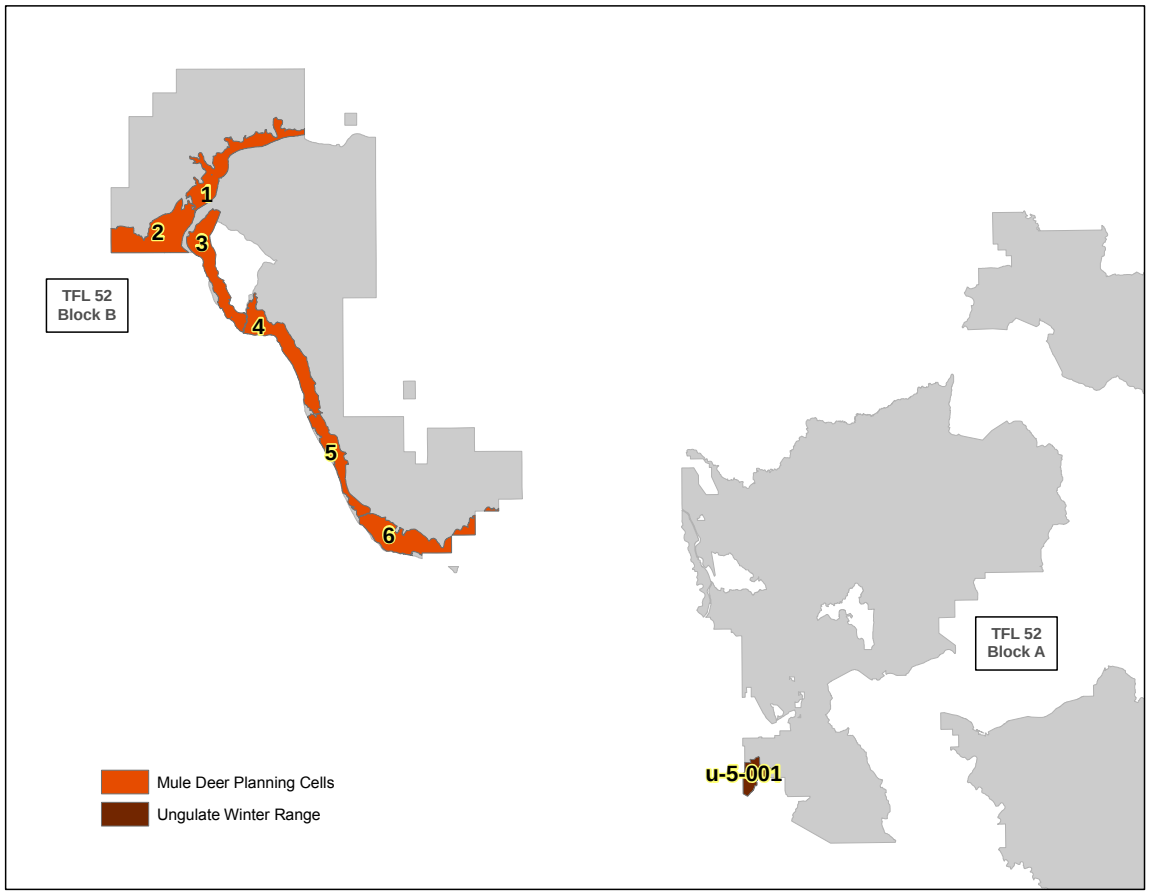

Figure 8.3. Mule Deer Management Areas

8.1.2.3 High-Value Wetlands for Moose

The CCLUP requires that moose winter and calving habitat be managed to minimize disturbance and maximize forage. It identified high value wetlands for moose on TFL 52 – mainly in the east and north. A disturbance constraint will be applied to each of these polygons. No more than half of the riparian management area can be less than 20 years old at any given time. Figure 8.4 show where these wetlands occur.

Figure 8.4. High Value Wetlands for Moose

8.1.2.4 Grizzly Bear Habitat

Management of grizzly habitat is referenced in several of the CCLUP sub-zone objectives. Some grizzly bear habitat occurs on the TFL, but its management is not expected to impact strategic timber supply. This habitat can be managed through operational planning and silvicultural measures. To be sure that this is the case, the amount of harvesting that occurs in grizzly areas will be summarized and reported.

8.1.2.5 Species at Risk

The species at risk having a direct impact on timber supply modeling in the TFL is dealt with previously in this document. Mountain Caribou has an established WHA and associated GWM (see 8.1.2.1). All other species at risk are generally dealt with in managing other values such as riparian retention. Depending on the species, one off reserves may be established following best management practices consistent with the Identified Wildlife Management Strategy (2004) and the FSP. Management for these species will be focused in productive areas outside of the THLB so that impact on strategic timber supply will be minimal. No modelling constraints will be applied.

8.1.3 Landscape Level Biodiversity

Biodiversity is the diversity of plants, animals and other living organisms in all their forms and levels of organisation and includes the diversity of genes, species, and ecosystems as well as the evolutionary and functional processes that link them. The CCLUP (p. 153) requires that landscape level biodiversity be maintained by meeting or exceeding mature+old (M+O) and old forest objectives by NDT-BEC sub-units within landscape units. Old forest is being managed as spatially designated OGMAs, but the M+O forest target is not spatially fixed over time. It is modelled as a retention constraint. This requirement is applied separately to each BEC Zone/Subzone/Variant within each landscape unit.

8.1.3.1 Mature+Old Seral

Old seral is assumed to be met by existing OGMA's; no retention constraint is required. For 'Mature+Old', seral targets are from the FSP are applied. These are shown in Table 8.2.

Table 8.2. Mature + Old Seral Requirements (percentages from FSP)

LU-BEC/NDT	Mature Plus Old (% > years)	LU-BEC/NDT	Mature Plus Old (% > years)
Antler-ESSFwc3-1	36% > 120	Umiti-ESSFwc3-1	36% > 120
Antler-ESSFwk1-1	36% > 120	Umiti-ESSFwk1-1	36% > 120
Antler-SBSwk1-2	31% > 100	Umiti-SBSdw1-3	23% > 100
Big Valley-SBSwk1-2	15% > 100	Umiti-SBSmh-3	23% > 100
Bowron-ICHmk3-2	15% > 100	Umiti-SBSmw-3	23% > 100
Bowron-ICHwk4-1	17% > 100	Umiti-SBSwk1-2	31% > 100
Bowron-SBSwk1-2	15% > 100	Victoria-ESSFwc3-1	54% > 120
Indianpoint-SBSwk1-2	15% > 100	Victoria-ESSFwk1-1	54% > 120
Jack of Clubs-SBSwk1-2	15% > 100	Victoria-SBSmw-3	34% > 100
Lightning-SBSwk1-2	15% > 100	Victoria-SBSwk1-2	46% > 100
Swift-SBSwk1-2	15% > 100	Willow-SBSwk1-2	15% > 100

The CCLUP permits some BEC units to be combined for modelling purposes:

- Umiti SBSmh and SBSdw1 are combined and modeled as single target; and
- Victoria-ESSFwc3 and ESSFwk1 are combined and modeled as single target.

8.1.3.2 Transitional OGMA's

The LUO requires that Transitional OGMA's by temporarily reserved from harvesting. When old forest targets are achieved, these OGMA's become available for harvest (but in no case must they be retained past 2031). For modelling purposes, harvesting will be prohibited for the first three five-year periods.

8.1.4 Stand - Level Biodiversity

The Land Use Objectives for the CCLUP Area has established Wildlife Tree Retention targets. For unharvested stands more than 250 metres from productive forest land outside of the THLB, the existing and future yield curves will be reduced by the required WTR percentage. Stands that fall within 250 metres are assumed to have their WTR requirement satisfied by adjacent (or nearby) stands that are outside of the THLB. Table 5.24 shows the CCLUP-mandated wildlife tree retention targets. Table 8.3 show the percentage of stands in each landscape unit for which future wildlife tree retention is required. It ranges from a low of 2.2% in the Jack of Clubs LU to a high of 37.8% in the Abhau LU. Figure 8.5 show the area of the THLB for which the WTR requirement is met from nearby productive non-THLB areas (cross-hatched).

Table 8.3. Percent of THLB Requiring Wildlife Tree Retention.

Landscape Unit	THLB Requiring WTR (%)
Abhau	37.8%
Antler	8.8%
Big Valley	22.1%
Bowron	14.7%
Indianpoint	28.6%
Jack of Clubs	2.2%
Lightning	17.7%
Swift	14.2%
Umiti	32.3%
Victoria	8.4%
Willow	26.4%

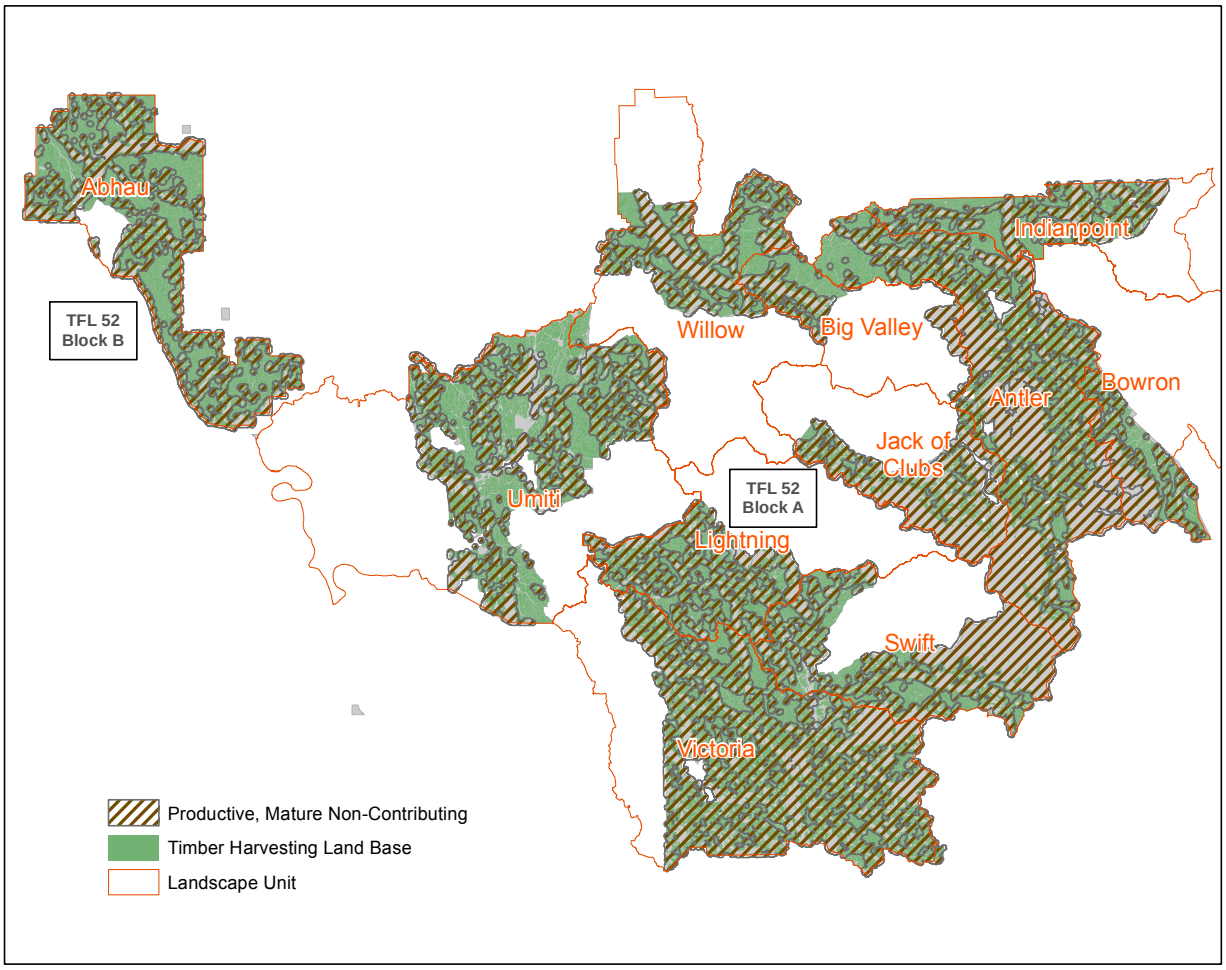

Figure 8.5. Stands Not Requiring Future WTR

8.1.5 Lakeshore Management Zones

The general objective for LMZ's is to maintain or enhance the lake, the riparian reserve zone, the lakeshore management zone, and the surrounding area. In meeting this objective, the CCLUP requires that viewscapes be managed around classified lakes. Each category of lake is managed to an equivalent visual quality objective, as follows:

- model class 'A' as preservation – no harvesting permitted
- model class 'B' as retention – maximum 10% disturbed in a twenty-year period
- model class 'C' as partial retention – maximum 20% disturbed in a twenty-year period
- model class 'E' as modification – maximum 50% disturbed in a twenty-year period

8.1.6 Watershed Management

West Fraser monitors watershed condition using 'hydrologically equivalent disturbed area' or HEDA. They have commissioned reviews of the major watersheds on the TFL by P. Beaudry and Associates. Target conditions are established for each watershed based on its underlying dynamics. These are shown in Table 8.4.

Table 8.4. HEDA Limits by Watershed

Watershed	HEDA Limit
Ahbau Creek	34%
Bendixon Creek	50%
Big Valley Creek	53%
Cantin Creek	0%
Cottonwood River	36%
Cunningham Creek	35%
Deacon Creek	65%
Fontaine Creek	55%
Frye Creek	57%
Jack of Clubs Creek	31%
John Boyd Creek	39%
Lightning Creek	30%
Little Swift River	28%
Middle Willow River	50%
Nelson Kenny Creek	50%
Porter Creek	42%
Pundata Creek	42%
Rond Creek	65%
Slough Creek	46%
Sovereign Creek	28%
Tinsdale Creek	50%
Tregillus Creek	29%
Umiti Creek	35%
Upper Ahbau Creek	37%
Upper McCabe Creek	50%
Upper Swift River	33%
Upper Upper Swift	45%
Victoria Creek	40%
West Creek	35%

After a site is harvested, hydrological recovery occurs as regenerating stands become established. The degree of recovery is estimated base on stand height, as shown in Table 8.5

Table 8.5. HEDA % Based on Stand Height (m)

Stand Height (m)	HEDA (%)
0	1.00
1	1.00
2	0.99
3	0.92
4	0.82
5	0.69
6	0.54
7	0.39
8	0.24
9	0.09
10	0.00

Sites that are disturbed by MPB are treated differently:

- mature stands with at least 70% pine are assigned a HEDA of 50% until harvested; and
- mature stands with between 31% and 70% pine are assigned a HEDA of 30% until harvested.

Figure 8.6 shows the boundaries of the watersheds for which HEDA is managed.

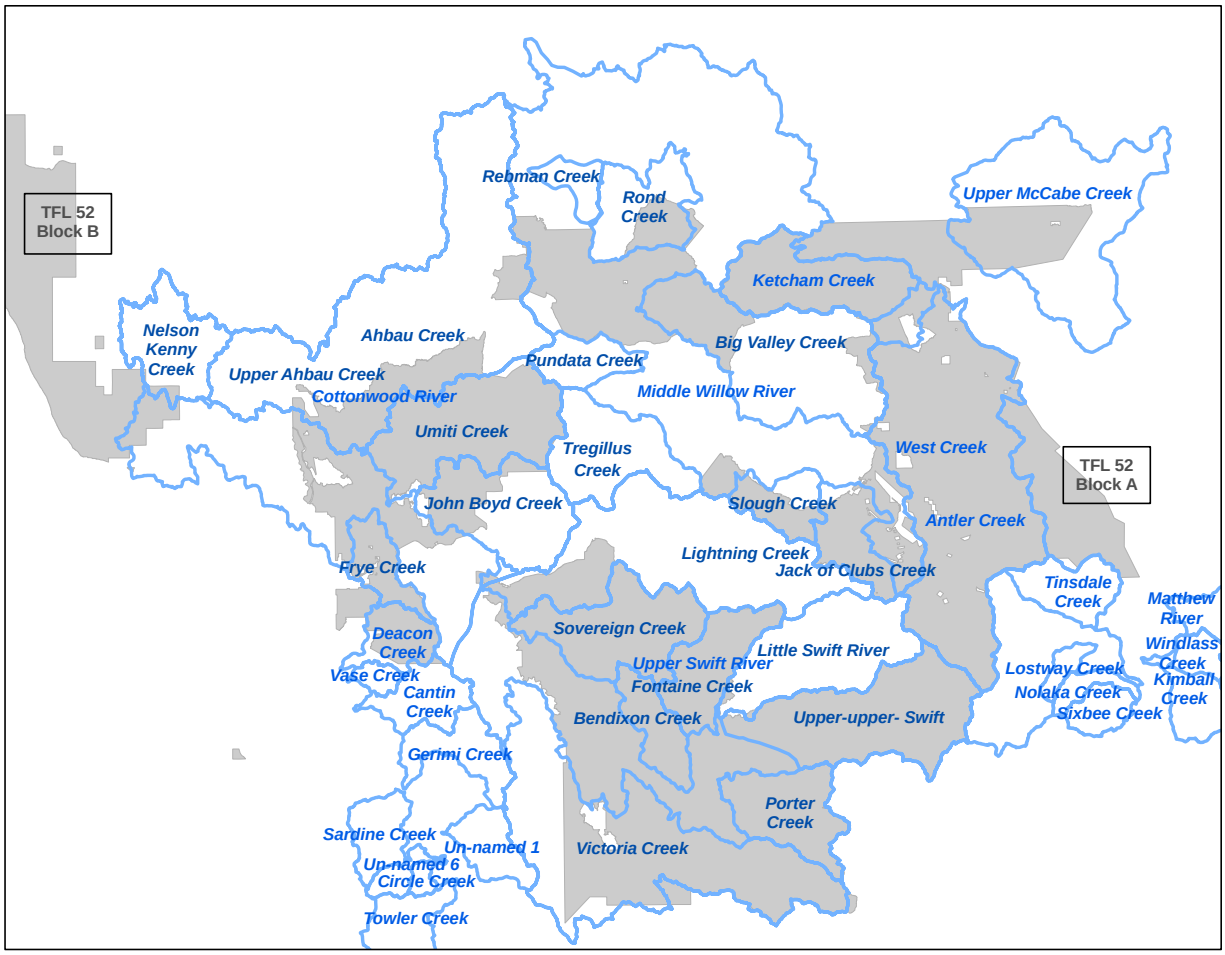

Figure 8.6. HEDA Watershed Boundaries

8.1.7 Backcountry Recreation

The CCLUP has established targets for the amount of area to be managed in backcountry condition in each sub-unit. The CCLUP recreation target for the Quesnel Highland Special Resource Development Zone is to maintain 30 percent of the zone in a backcountry condition. Much of the backcountry requirement of the QHSRDZ area will be met from non-productive areas (alpine meadow, treed swamp, etc.) that will have little or no harvesting over the long-term. No forest cover constraints will be required in the timber supply analysis. The amount of harvesting that occurs in backcountry areas will be summarized and reported.

8.2 Patch Size Distribution

Patch size and seral stage management are principal tools for conserving biodiversity on the landscape. Together they largely determine whether unfragmented areas of mature and older forests will be maintained on the landscape. A patch is a stand of similar-aged forest that differs in age from adjacent patches by more than 20 years.

Patch size distribution on the TFL is managed according to '*Regional Biodiversity Conservation Strategy – Update Note #4 – An Approach for Patch Size Assessments in the Cariboo Forest Region – July 2001*'. Targets are set by natural disturbance type (NDT). That document relied heavily on the Biodiversity Guidebook (1995) for analytical approaches, patch definitions and patch size targets. Each landscape unit is managed separately. Patch size objectives vary by NDT, which is defined based on BEC zone, subzone and variant as shown in Table 8.6.

Table 8.6. BEC Subzone / Variant by NDT

NDT	BEC Subzone / Variant
1	ESSFwc3
	ESSFwcw
	ESSFwk1
	ICHwk4
2	SBSwk1
3	SBSdw1
	SBSdw2
	SBSmh
	SBSmw

The percentage patch-size targets for each NDT are shown in Table 8.7.

Table 8.7. Patch Size Targets (%) by NDT

	Patch Size Class			
NDT	0-40 ha	40-80 ha	80-250 ha	> 250 ha
1	30-40	30-40	20-40	0
2	30-40	30-40	20-40	0
3	20-30	25-40	30-50	0

Only disturbance patches are constrained for this analysis. A disturbance patch is made up of stands 20 years and younger. Creating a range of cutblock sizes is the principal long-term management tool for creating a range of mature and other patch sizes.

No patches greater than 250 hectares are permitted.

One additional patch size limit is applied: individual cutbocks must be at least five hectares in size.

8.3 Timber Harvesting

This section describes the rules that will drive and limit timber harvesting.

8.3.1 Minimum Harvest Age

Minimum harvest ages for all AUs were modelled as the age at which stand volume achieves at least 95% of its culmination mean annual increment (MAI). The 95% culmination age was determined as the youngest age at which the MAI was greater than 95% of the culmination MAI Culmination is defined as the point where volume less decay, waste and breakage is maximized to one decimal place. This is a reasonable approach to avoid excessively high culmination ages resulting from small increases in MAI, but still ensures that the productive capacity of the land base is being utilized.

8.3.2 Harvest Flow Objectives

The harvest flow objective for the base case will be to maximize the harvest over the 250-year planning horizon. With a slight excess of mature/old growing stock, and some remaining dead pine volume (albeit in non-pine leading stands), there may be an opportunity for a small uplift in the short-term. Otherwise, the harvest level is expected to be non-declining across the planning horizon.

In all phases of the analysis, the harvest flow objective will be to achieve stability in the long-term harvest level and growing stock profiles.

Forest cover constraints and biological capacity of the THLB will dictate the long-term harvest level determined in the analysis.

8.3.3 Harvest Rules

Early harvest scheduling for this analysis will be driven by West Fraser's 10-year harvest plan. These 10-year plan blocks will clean up any remaining dead pine. All other pine is assumed to be unrecoverable.

In addition all stands must have a minimum of 120 m^3/ha to be eligible for harvest.

8.3.4 Silviculture Systems

The majority of the harvesting in the analysis will use even-aged clearcut silviculture systems with varying levels of retention. On Block A the caribou "modified harvest" areas will use partial harvest methods as recommended by the CCLUP caribou strategy. Modified harvest will be by group selection harvesting up to 33% of each stand area on an 80-year cutting cycle. This will be modelled by assigning partially harvested stands to the same yield curve at an age where the post-harvest volume will be approximately 67% of the pre-harvest volume.

8.3.5 Pine Shelf Life

The analysis will include a "shelf life" for pine stands older than 35 years that have been attacked by MPB. "Shelf life specifies the time in years that pine trees will remain merchantable after attack. As most MPB impacted pine stands have already been harvested, the approach to modelling shelf life will be simpler than that used in the last timber supply analysis. The following approach will be taken to modelling shelf life:

- All pine stands 36 years and older not included in the ten-year harvest plan will lose the entire pine component of their volume at year ten of the planning horizon;
- Until year ten (i.e. 2024), that pine volume will be considered to be fully merchantable;
- A stand will become unmerchantable if the volume falls below 120 m^3/ha. When this happens, it will regenerate to the same natural stand yield table with a ten-year regeneration delay. The stand will become merchantable when it reaches 95% of its culmination MAI.

MPB mortality has also occurred in stands younger than 36 years. These losses have been accounted for by reviewing the CMI plot data. The details of this adjustment can be found in Section 7.4 and Appendix A.

9 Unsalvaged Losses

Damage to timber caused by fire, wind, insects, diseases and other pests contribute to loss in harvestable volumes. This volume loss is difficult to quantify, although losses to insects and disease that normally occupy stands (endemic losses) are accounted for in empirical yield table 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 (NRLs) are not accounted for in the yield tables.

Given the catastrophic nature of the current MPB outbreak, this has been dealt with as a separate issue in the construction of the yield tables for this analysis.

Table 9.1 summarizes the NRLs for wind and wildfire that will be used for this analysis. These losses will be modelled by adding them to the harvest request in the forest estate model.

Table 9.1. Estimated Non-Recoverable Losses

Loss Agent	Estimated NRL (m^3/year)		
	Block A	Block B	Total TFL 52
Wind damage	1,200	570	1,770
Wildfire	550	150	700
Total	**1,750**	**720**	**2,470**

10 References

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Regional Biodiversity Conservation Strategy - Update Notes

Update Note #9: Strategy for Management of Mature Seral Forest and Salvage of Mountain Pine Beetle-Killed Timber Within TFLs in the Cariboo. 2004

Update Note #12: Stand-Level Retention for Biodiversity. 2005

Appendix A

TFL 52 Yield Table Summary Report

Appendix B

TFL 52 Site Index Adjustment Compendium

Appendix C

TFL 52 VRI Statistical Adjustment Update

Appendix D

Change Monitoring Inventory on TFL 52: Second Remeasurement

Appendix E

CMI Remeasurement Map

Appendix F

Estimating Spruce Fertilizer Response

Appendix G

Pellet Transects and Deer Management on TFL52 Block B