SPRINGER CREEK
FOREST PRODUCTS LTD.

Tree Farm Licence 3

Timber Supply Analysis Report

Information Package

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1 Introduction

Springer Creek Forest Products Ltd. (SCFP) is responsible for preparing a timber supply analysis for Tree Farm License #3 (TFL3) showing the long-term strategic timber supply for the land base. In 2002, the Chief Forester postponed the allowable annual cut (AAC) determination till 2008 under Section 8(3.1) of the Forest Act. This Information Package documents the procedures, assumptions, data and the timber supply model used in the analysis for the Chief Forester's AAC determination. Forest Ecosystem Solutions Ltd. (FESL) has been retained to prepare the information package and conduct the timber supply analysis on behalf of SCFP. The document follows the general format of the *Provincial Guide for the Submission of Timber Supply Information Packages for Tree Farm Licences, Version 4 (B.C. Ministry of Forests, 2000b)*.

The purpose of this Timber Supply Analysis Information Package is to:

- provide a detailed account of the factors related to timber supply that the Chief Forester must consider under Section 8 of the Forest Act when determining an AAC and how these will be applied in the timber supply analysis;
- provide a means for communication between SCFP, the Ministry of Forests and Range (MoFR), the Ministry of Environment (MoE), First Nations groups and the general public;
- provide First Nations groups, the general public and Ministry staff with the opportunity to review data assumptions and information that will be used in the timber supply analysis before it is initiated;
- ensure that all relevant information and factors are accounted for in the Analysis to a standard acceptable to the Ministry of Forest and Range, and;
- reduce the risk of having analyses rejected because input assumptions and analysis methods were not agreed upon in advance.

For this analysis, relevant information from SCFP's resource inventories, the Provincial Land and Resource Data Warehouse (LRDW), or the Provincial Agencies have been used. Where appropriate, resource GIS coverages specific to the assumptions in this analysis have been compiled, using source data from SCFP or the Province.

The baseline forest inventory data used for this analysis is the Vegetation Resources Inventory (VRI), projected for growth to January 1, 2006. Where necessary, inventory attributes not found in the VRI but retained in the Forest Inventory Planning (FIP) data have been included if the FIP data attributes are the most current information available (e.g. environmentally sensitive areas).

Appropriate yield tables to project stand volumes are generated with Variable Density Yield Prediction (VDYP) batch version 6.6d, for inventory stands >20 years of age. The Table Interpolation Program for Stand Yields (TIPSY), batch version 4.1 has been used to generate yield tables for existing stands ≤20 years of age and for all future managed stands.

The data summarized in this Information Package, retains the VRI forest inventory polygon labels as well as the unique identities of the various source data, thereby allowing all attributes to be spatially and temporally referenced. The timber supply model Forest Simulation Optimization System (FSOS) will be used to determine an achievable harvest level for TFL3 over a 250-year planning horizon.

The management assumptions described in this Information Package will be used to guide the compilation of the timber supply analysis. Sensitivity analyses of alternative management assumptions will be evaluated to determine their influence on timber flow levels. All sensitivity analyses and the base case timber supply projection will be submitted to the Chief Forester for determination of the allowable annual cut.

2 Process

The original expiry date for Management Plan #9 was June 30, 2003, which was extended to December 1st, 2003. In August 2002, the previous licensee (Slocan Forest Products) was exempted from the requirement to complete a timber supply analysis for TFL3 during the term of Management Plan #10. In August 2002, the Chief Forester postponed the AAC determination until 2008, under Section 8(3.1) of the *Forest Act*.

This timber supply analysis is directed by the following key documents:

- Proposed Management Plan #10 for TFL3 (Slocan Forest Products, 2003)
- Springer Creek Forest Products Ltd. 2006 Forest Stewardship Plan for Tree Farm Licence #3 and FLA20192 (Springer Creek Forest Products Ltd. 2006)
- *Forest and Range Practices Act*
- *Forest Planning and Practices Regulations*
    - Notices established under *FPPR* s.7(2)
        - *Notice – Indicators of the amount, distribution, and attributes of wildlife habitat required for the survival of species at risk in the Arrow Boundary Forest District* - December 30, 2004
- *Kootenay-Boundary Higher Level Plan Order* - effective October 26, 2002 (Government of B.C., 2002)
    - Approved variances (to date, none of the approved variances impact TFL3)
- Orders established under the *Government Actions Regulation*
    - Order established under *GAR* s.9(2) and s.12(1)
        - *Order establishing Ungulate Winter Range #U-4-001 West Kootenay (Arrow TSA, Kootenay Lake TSA, Revelstoke TSA, TFL3, TFL23)* - Feb 7, 2007
    - Order established under *GAR* s.7(1)
        - *Order for the establishment of Visual Quality Objectives and Scenic Areas for the Arrow Boundary District* - Dec 31, 2005
- TFL3 Rationale for Allowable Annual Cut Determination (B.C. Ministry of Forests, 1998a)
- Appendix 1 -Tree Farm Licence 3 Management Plan #9 Information Package (Sterling Wood Group, 1998)
- *Forest Practices Code*
- Biodiversity Guidebook (Government of B.C., 1995a)
- Landscape Unit Planning Guidebook (Government of B.C., 2000a)
    - Amendment to S. 3.2 Planning for Stand Structure - Wildlife Tree Retention
- Riparian Management Area Guidebook (Government of B.C., 1995b)
- Green-up Guidebook, 2nd edition (Government of B.C., 1999)

- A complete list of information sources is provided in Section 12.

2.1 Growth and Yield

The growth and yield data has been generated using the following models:

- Variable Density Yield Projection (VDYP), batch version 6.6d, for stands >20 years
- Table Interpolated Projected Stand Yields (TIPSY), batch version 4.1, for existing stands ≤20 years and for all future managed stands.

2.2 Data Preparation

A spatial GIS resultant database incorporating relevant attributes from the various resource inventory files was created, with each polygon assigned a unique identification number. The resultant database is used to derive the modelling database that also considers the management assumptions used to derive the Timber Harvesting Land Base (THLB).

Spatial information was received in various formats (shapefiles, ArcExport files and coverages) and translated into ARCINFO. All data is controlled to the North American Datum (NAD) 83 base. The VRI data (projected to January 01, 2006) was used for the forest attribute information. The VRI contained the latest depletion data, therefore only current (since 2006) harvest units were added to the dataset. The resultant was processed throughout the overlay procedure to remove sliver polygons from the data set. Particular attributes had their boundaries locked in place to preserve areas. Private areas, road and riparian buffers, hydro right of way and VRI unclassified areas were all preserved, with the minimum polygon size set at 0.1 ha. The final polygon manipulation was performed at 0.07 ha after locking private land boundaries as well as road and riparian buffers.

The data reported is only as reliable as the source databases. Although the data is believed to be accurate and the best information available, there are instances where GIS coverages require minor manipulation in order to approximate a best fit. Throughout the overlay processes, resource coverages are clipped to the area of interest and an exact match is not always possible, particularly along administrative boundaries. Though values are likely a very close approximation of the actual landscape, caution should always be used when viewing geographic data results.

Table 1 below documents the source of the resource inventories used for this Information Package. Approximate dates of completion are also provided.

Table 1: Data sources (continued on following page).

Forest Resource Inventory	Data Source	Date Completed/Updated	Date Approved	Approved By
DRAFT Old Growth Management Areas (OGMAs)	ILMB/SCFP	October 2006		SCFP
KBHLP - Connectivity Corridors	ILMB	April 2005	2002	ILMB
KBHLP - Enhanced Resource Development Zones	ILMB/LRDW	January 2007	2002	ILMB
KBHLP - Resource Management Zones	ILMB/LRDW	January 2007	2002	ILMB
KBHLP - Biodiversity Emphasis Option	ILMB/LRDW	January 2007	2002	ILMB
Biogeoclimatic Ecosystem Classification	MoFR-Res. Br.	November 2006		
Domestic Watershed Boundaries	ILMB	May 2005		
Landscape Units Boundaries	ILMB	June 2005		
2005-6 Logged Areas	SCFP	August 2006		SCFP
Scenic Areas/VQO Coverage	MoFR	February 2006		ABFD
Vegetation Resource Inventory	SCFP	March 2006:, projected to Jan 1 2006	March 2006	MoFR
Ungulate Winter Range Planning Cells	MoE	September 2006		
Ungulate Winter Range Forage Units	MoE	September 2006		
Aspect	SCFP/FESL	October 2002		
TSIL B Terrain Mapping	SCFP/FESL	October 2002		
TSIL D Terrain Mapping	SCFP/FESL	October 2002		
TSIL C Terrain Mapping	SCFP	March 2006		
Operability	SCFP	1996	1996	ABFD

Forest Resource Inventory	Data Source	Date Completed/Updated	Date Approved	Approved By
Private Lot Boundaries	SCFP	2004		SCFP
SBFEP Activity Areas	SCFP/FESL	October 2002		
Hydro Lines	SCFP/FESL	October 2002		
Goshawk Nests	SCFP/FESL	2001		
Cultural Heritage Inventories	Ministry of Tourism Archaeology branch	2000	January 2007	
Recreation Features Inventory	SCFP	1998		SCFP
Roads	SCFP	January 2006		SCFP
Wildlife Tree Patches	SCFP	January 2007		SCFP
Proposed Blocks	SCFP	November 2006		SCFP
Recreation Polygons	SCFP/ LRDW	January 2007		SCFP
Environmentally Sensitive Areas (from 1997 FIP Data)	SCFP/FESL	2002		
Silviculture Layer	SCFP	April 2007		
Classified Streams	SCFP	December 2001		
FRPA Riparian Buffers	FESL	March 2007	2007	SCFP
FPC Riparian Buffers	FESL	March 2007	2007	SCFP
Annual Forest Health Flight Data	MoFR/SCFP	2005 2006 2007		
Seed Planning Units/Zones	LRDW	October 2007		
Average Slope	FESL	August 2007		

[1] ILMB & LRDW denotes the Integrated Land Management Bureau's Land and Resource Data Warehouse; SCFP is Springer Creek Forest Products; ABFD is the Arrow Boundary Forest District; and MoFR is the Ministry of Forests and Range. Coverages from Forest Ecosystem Solutions Ltd. (FESL) are created using source coverages supplied by SCFP, LRDW and/or basemap TRIM data for this analysis.

3 Timber Supply and Sensitivity Analyses

3.1 Scenarios

The analysis scenarios that will be modelled using the timber supply model FSOS are listed in Table 2. These scenario options will help assess the implications of various management decisions.

Table 2: Scenarios.

Scenarios	Description
Total THLB Potential	Determines the maximum biological potential of the THLB within the preferred flow parameters. Barriers to timber flow are removed.
Base Case Scenario	Applies current biodiversity, adjacency and seral strategies to determine an initial volume flow.
Proposed Scenarios	Developed based on an understanding of sensitivity analyses and the base case – see *Categories* in Table 3.

3.2 Base Case

The base case scenario reflects current management activities, and provides a standard against which other management options can be compared. The base case will include:

- Management practices consistent with historical operations, with emphasis on the last 5 years;
- Implementation of the *Forest and Range Practices Act* (FRPA) and associated regulations current to July 2007;
- Incorporation of the *Kootenay Boundary Higher Level Plan Order* dated October 26, 2002 (Government of B.C., 2002) and associated variances current to July 2007;
- Orders established under the *Government Actions Regulation* prior to July 2007;
- Current Forest Stewardship Plans for TFL3;
- Approved Landscape Units to address landscape level biodiversity;
- DRAFT Old Growth Management Areas (OGMAs) as accepted by the Arrow Boundary Forest District and Springer Creek Forest Products Ltd.;

- Current utilization standards;
- Incremental silviculture on demonstrated sites and basic silviculture on all other sites;
- Consideration for sensitive areas based on recent inventories, including wildlife, terrain and recreation;
- Natural disturbance in the non-harvestable land base;
- Special management in domestic watersheds, and;
- Consideration for forest health and uneconomic forest stands.

3.3 Sensitivity Analyses

Sensitivity analyses are used to assess issues that have some degree of uncertainty associated with them. For the base case scenario, sensitivity analyses have been grouped into the following categories:

- Land base Alterations;
- Growth and Yield;
- Forest cover constraints and patch management;
- Management options, and;
- Modelling rules.

Sensitivity analyses for the base case are shown in Table 3.

Table 3: Sensitivity analyses.

Category	Sensitivity Analysis	Sensitivity Magnitude
Land base alterations	Adjust Timber Harvesting Land Base	+/-10%
	Remove areas classified as 'Alternate' operability without previous logging history.	
	Exclude permanently deactivated roads from the THLB	
Growth and Yield	Adjust SI for managed stands	+/-10%, +/-2.5 m
	Apply SIBEC SI for managed stands	SIBEC SI
	Apply OGSI derived SI for managed stands	After harvesting existing stands >140 years.
	Adjust existing stand volumes	+/-10%
	Adjust regenerated stand volumes	+/-10%
	Apply Armillaria OAFs to Douglas-fir in ICH zone	Low, Moderate, High
	Adjust genetic gain to 2008-2018 Forest Genetic Council Forecast	See Table 40 for values.
Forest Cover and Patch Size Targeting	Apply an iterative patch/seral management strategy with the FSOS optimization model	
	Apply green-up rules instead of patch targets in visually non-sensitive areas	Max 25% at 2.5 m in areas outside ERDZ-T, 0 m in ERDZ-T
	Adjust green-up in visually sensitive areas	+/-1.5 m
	Adjust VQO disturbance percent in visually sensitive areas based on Visual Absorption Capacity (Low, Moderate or High)	Apply maximum limits Apply minimum limits
Management Options	Remove DRAFT OGMAs and manage to old seral targets	Examine impacts of applying connectivity corridors
	Remove DRAFT OGMAS and manage to old seral targets & model Valhalla Park contribution in Hoder LU	Examine impacts of applying connectivity corridors
	Apply a partitioned harvest volume in "Alternate" operability areas	
	Apply Provincial Mountain Pine Beetle forecasts to pine component of stands	Provincial chip, sawlog and average loss curves.
	Productive capacity of land base	No forest cover constraints applied
Modelling Rules	Prioritize Pine leading stands for harvest	Apply Provincial average loss curves
	Harvest flow alternatives - uneven flow and alternative flows to base case	
	Change harvest priority rule from relative first to absolute oldest first	Use Oldest first rule
	Alternative minimum harvest ages – minimum volume, 95% Max MAI	Min. Volume +/-10 years Age at 95% of Max MAI

4 Forest Estate Model

Landscape Design Model - *FSOS*

Model Name: FSOS

Model Developer: Guoliang Liu, PhD

Model Development: Forest Ecosystem Solutions Ltd. (formerly as Hugh Hamilton Ltd) and UBC

Model Type: Time Step Simulation and Simulated Annealing Modules

Description:

FSOS (Forest Simulation Optimization System) uses C++ programming language and can be run with Windows operating systems. The model interfaces directly with Microsoft Access for data management. The Ministry of Forests has reviewed the model and found that it projects reasonable results when compared with FSSIM.

FSOS uses dynamic optimization to schedule harvest units based on 1) patch and seral objectives defined by non-timber (e.g. old-growth, biodiversity, visuals, habitat, watershed, etc.) resource values and 2) timber management objectives (e.g. even flow, volume levels, opening size distribution, species quotas). Harvest levels and approximate operational cutblock shape and size over the planning horizon are an output of the model. Modelling of strict adjacency and seral constraints is accomplished using simulation modelling. The data structure is identical for both optimization and simulation models, which prevents extensive data loading procedures when switching between approaches.

FSOS uses the multiple resultant polygons created by GIS overlay as the basic model unit, allowing great flexibility in creating a variety of potential harvest unit configurations by amalgamating these resultant polygons. Amalgamation of the harvest units through time creates early seral openings and mature and old growth patches consistent with planned patch management strategies as may be defined by higher level plans. Managing for specific patch size distributions within each seral class is also inherent within the model framework and is an effective way to meet long-term biodiversity objectives.

High weightings can be applied to relatively important resource objectives or objectives which are difficult to achieve. The objective function (evaluation equation) provides the means to evaluate the relative success between differing solutions. The model calculates a penalty based on the deviation of a given solution from target values for each iteration. Optimal solutions achieve targets quickly for highly-weighted parameters in order to minimize the total penalty over the planning horizon. With optimization, constraints can be violated. As all resource values are tracked throughout the planning horizon, where and when this occurs is part of the model output.

The initial inventory data represents the gross land base, which includes both non-forested and forested areas. Forested areas are comprised of the timber harvesting land base or the non-harvestable land base. The non-harvestable land base contributes to reserve areas and to the achievement of non-timber objectives. From GIS overlays, the land base is divided into resultant polygons, each with a unique set of attributes. Treatments are applied to each polygon based on these attributes. Treatments can be defined by analysis unit, forest type, forest age, silviculture treatment, user allocation, site index, non-timber resource objectives or any other parameter.

FSOS uses individual stand ages to project the current age structure of stands in the analysis area. As stands age, they move into and out of age classes established as a basis for meeting target objectives. For example, age classes may be established as <40 years, 41-140 years, 141-250 years, and >250 years.

Generally, FSOS runs utilize 5-year periods, as the output is intended to be operationally applicable and reflect 5-year management plan objectives, but 1, 10 or 20 year periods are easily assigned. The middle of the period (year 3 for 5-year periods) is used for reporting.

The planning horizon length can vary as required. FSOS can produce spatially and temporally explicit plans over 20 years or for multiple rotations. A unique feature of FSOS is its ability to integrate strategic, tactical and operational planning phases into one process. Analysis runs include harvest timing and location for each period, as well as long-term, sustainable harvest levels.

An example of the harvest rules that are used in FSOS are:

- minimum stand age before a stand can be harvested;
- maximum stand age, at which the stand is scheduled for cutting within a certain number of years;
- green-up period required before adjacent harvest units can be harvested, and;
- prioritize species types for harvest

All possible regeneration alternatives can be incorporated into the model. Complex harvest systems (i.e. partial cutting) and silviculture treatments are incorporated by adjusting growth curves or harvesting percentages of the block at specified intervals. FSOS can also account for re-entry delays. FSOS can apply multiple regeneration assumptions by randomly following the identified percentages.

The road area is non-contributing to forest cover. Road area will only be returned to the timber harvesting land base if the road is scheduled to be permanently rehabilitated.

The reporting functions of FSOS are extensive. The data for each period is easily accessible for any analysis unit, zone, polygon, landscape unit, etc. and gives an overview of the forest state at any point in time. Species compositions, age structure, patch distribution, harvest scheduling, and many other variables are tracked and reported by period. Reporting functions are highly effective for the direct comparison of different sensitivity analysis scenarios. FSOS is linked directly to the ArcView environment for the easy production of high-quality map production.

Cover targets are usually applied by age as a surrogate for height, although height may be used for early seral targets. All forest cover targets can be achieved by using patch and age class distribution indicators, and targets may be prioritized if desired. Age class distribution targets can be set as minimums, maximums, or within a range of desired levels. Targets may be incrementally adjusted over the length of a projection, such as when applying a 2/3 old seral target drawdown for the first rotation with the expectation that the full targets will be met by the end of the third rotation.

Updates to the land base can easily be applied through two methods; either by adjusting the attributes in the model database tables or by adjusting the modelling database in the GIS environment and subsequently reloading the model.

5 Forest Inventory

5.1 Vegetation Resources Inventory

All spatial information was received in UTM and MDB format and translated into ARCINFO. All data is controlled to the North American Datum (NAD) 83 base.

The current vegetation resources inventory (VRI) information is based on a re-inventory project that was completed in 2004 and subsequently statistically adjusted in April 2005. Inventory adjustments were based on 2001 Phase II sampling and 2004 Net Volume Adjustment Factor (NVAF) sampling. The procedures for these adjustments are found in *TFL3 Documentation of Analysis for Vegetation Resources Inventory Statistical Adjustment and Net Volume Adjustment Factor Development - Addendum* (Jahraus and Associates Consulting Inc. and Churlish Consulting Ltd., 2005) The adjusted population was limited to polygons classified as Vegetated Treed (VT) that were greater than 20 years of age. Adjustments were made to age, height & volume only.

The Phase II work is based on 90 ground samples established in the summer of 2001 and the 2004 NVAF work is based on the destructive sampling of 58 trees.

In March 2006, the VRI coverage was updated for harvesting and re-projected to 2006.

All work was done through the assistance of Forest Investment Account funding and with the involvement and support of the Ministry of Forests and Range (MoFR).

5.1.1 Changes to the Vegetation Resources Inventory

Minor adjustments were made to the VRI to address border discrepancies with the Arrow TSA and the two private land parcels within the TFL borders. A total 246 ha of VRI polygons were classified as Unreported in the BCLCS Level 1 category.

When the private land coverage was compared with the unclassified polygons in the VRI, approximately 91 ha were unclassified in the VRI that were bordering the boundaries of the two private land parcels. The line work of these polygons were retained in the GIS resultant for transparency purposes, however the forest cover attributes of the contiguous polygon were assumed for these areas.

A further 155 ha were unreported in the VRI due to border discrepancies with the Arrow TSA. Upon review of the Arrow TSA inventory, a similar situation was found. To address the problem the unclassified polygons were assigned the attributes of their neighbouring polygons, while preserving the line work and identifying the polygons in the database.

After constructing the GIS resultant, a 37.4 ha parcel in the south east portion of the TFL was found to be missing outside the boundary. This area was joined to the GIS resultant, however the forest inventory attributes of this area were not available for the analysis.

Some modifications were made to the inventory to accurately reflect the current state of TFL3:

- Cutblocks logged subsequent to the inventory compilation (2006) were updated to an average age of one year and were assigned inventory attributes corresponding to the regeneration assumptions for their respective analysis unit.

- There were discrepancies between the inventory attributes of several polygons and the disturbance reported in the history file. Significantly, the projected ages of polygons with a logging history were up to 200 years older than the implied age estimated from the date of logging. Often these polygons were small areas, likely managed for stand level retention purposes. For the purposes of this analysis, both the inventory age and the logging history status were retained, assuming that the harvested and retained areas were considered a total area under prescription.
- Inconsistencies were found between the history table in the VRI and the Ministry compiled flat file that relates stand attribute with history information for each VRI polygon. Approximately 870 ha within the TFL were impacted, of which 831 ha were in the Crown Forested Land Base. Discrepancies in the VRI logging history were attributed to two primary factors:
    1. inconsistencies in the rank of tree layers in the Layer table found in the VRI access database, and;
    2. multiple layers being reported in the History table, both reflecting the same activity.

    The rank of polygon tree layers with missing history data was investigated. For the purpose of this analysis, the layer ranking was reassigned for consistency when the disturbance age and layer age differed by no more than 20 years. Inventory volumes of modified layer rank stands were not re-projected in VDYP, however the polygon attributes of the re-ranked layers were used for the netdown criteria, analysis unit assignments and in the yield table development. The identity of modified layer rank stands was retained in the database.

6 Description of the Land Base

6.1 Timber Harvesting Land Base Determination

The Timber Harvesting Land Base (THLB) is determined through a netdown process in which areas that are ineligible for harvest are sequentially removed from the total land base. Once an area has been removed, it cannot be deducted further along in the process. For this reason, the gross area of reduction factors (e.g. total non-contributing area) is often greater than the net area removed. This is a result of overlapping resource issues. Portions of the land base that are reserved from harvest can still contribute to non-timber and biodiversity objectives.

The netdown table shows the priority in which attribute reductions are removed from the total land base. Areas not managed by SCFP (private land), polygons that are non-forested and roads or utility corridors, are removed first in order to determine the total productive forest land. Since a polygon can only be removed once, the attributes with the highest reduction components are removed first, beginning with areas that are completely deferred from the THLB. For clarity purposes, the percent removed is shown with the topic in Table 4.

Table 4 summarizes the netdown procedure. The gross area of the TFL (including fresh water) is 79,111 ha, of which the total productive forest land is equivalent to the Crown Forested Land Base (CFLB) at 58,997 ha. The current THLB is 27,587 ha, and the long-term THLB is 26,214 ha. The remainder of this section is dedicated to a detailed description of each reduction.

Table 4: Timber Harvesting Land Base determination.

Topic and % Removed	Total Area (ha)	Productive Area (ha)	Total Non - Contributing Area (ha)	Net Area Removed (ha)
TOTAL AREA	***79,111***			
Area not managed by SCFP	574		574	574
Non-typed areas in the inventory	37		37	37
Non-Vegetated	4,066		4,066	4,060
Non-Productive	14,661		14,661	14,604
Existing Roads and Trails	905		905	831
Hydro Line Corridors	338		338	7
TOTAL PRODUCTIVE FOREST LAND	*58,997*			
Inoperable 100%	39,109	21,679	39,109	21,679
Steep slope >90 pct 100%	510	168	510	18
Non-Merchantable Age >140yrs 100%	8,481	4,898	8,481	696
Low Site Productivity Age 20 - 140yrs 100%	14,435	8,291	14,435	1,161
Low Site Productivity Age ≤20yrs	0	0	0	0
Low Site Growth Potential Previously Logged 100%	34	33	34	33
Problem Forest Types - Deciduous Stands 100%	941	759	941	50
Problem Forest Types: ITG18 >250yrs 100%	0	0	0	0
Problem Forest Types: ITG19 >250yrs 100%	0	0	0	0
Riparian Buffers 100%	3,639	2,403	3,639	1,803
DRAFT Old Growth Management Areas 100%	4,481	3,293	4,481	1,672
Goshawk Nests 100%	25	24	25	19
AREAS COMPLETELY DEFERRED FROM THLB				*27,131*
ESA - High Avalanche Sensitivity 90%	302	260	299	26
Unstable Terrain TSIL-B,C & ES1s 80%	1,025	837	980	177
Problem Forest Types: ITG12 >140yrs 80%	229	224	211	73
Unstable Terrain TSIL-D 60%	7,197	3,512	7,004	289
Problem Forest Types: ITG11 >140yrs 60%	580	556	432	211
ESA - High Regeneration Sensitivity 50%	11,905	11,161	11,316	561
Problem Forest Types: ITG13-17 >140yrs 40%	2,443	2,386	1,640	511
Problem Forest Types: ITG18 141-250yrs 30%	3,141	1,372	3,122	8
Problem Forest Types: ITG20 >140yrs 20%	5,269	4,138	4,774	119
Potentially Unstable Terrain TSIL-B,C 13%	4,323	3,970	2,055	299
Potentially Unstable Terrain TSIL-D, ES2s 10%	29,199	20,451	21,824	755
ESA - Moderate Regeneration Sensitivity 10%	2,098	2,009	1,459	31
Problem Forest Types: ITG19 141-250yrs 10%	23	21	4	2
Archaeological Sites <5%	17	3	17	0
AREAS PARTIALLY DEFERRED FROM THLB				*3,062*
Existing Landings			110	110
Wildlife Tree Retention Areas			1,106	1,106
TOTAL NETDOWN LAND				*1,217*
TOTAL PRODUCTIVE LAND BASE REDUCTIONS				*31,410*
CURRENT TIMBER HARVESTING LAND BASE	***27,587***			
Future Road Area			1,135	1,135
Future Landings			237	237
FUTURE THLB	***26,214***			

6.2 Non-ownership

Two areas of private land are located in the Little Slocan Valley. These lands, which are 415 ha and 159 ha in size, are not managed under TFL3 and are removed from the timber harvesting land base.

6.3 Non-typed Land

A 37.4 ha parcel in the south east portion of the TFL was identified after constructing the GIS resultant. This area was joined to the GIS resultant but forest inventory attributes of this area were not available for the analysis.

6.4 Non-forest

All areas without logging history that were designated by the BC Land Classification Scheme (BCLCS) as non-vegetated (BCLCS Level 1 = N) are removed from the THLB as non-forest. The types of non-forest areas in TFL3 are given in Table 5.

Table 5: Non-forested types in TFL3.

Non Forest Descriptor	Total Area (ha)
Alpine bedrock	25.6
Alpine lake	0.1
Alpine snow cover	3.6
Alpine talus	256.1
Upland bedrock	346.7
Upland exposed soil	6.2
Upland talus	2957.0
Lake	362.6
Mudflat	0.6
River	90.0
Snow cover	17.3
Total Area	**4,066**

6.5 Non-productive Forest

The non-productive forest is difficult to determine with the BCLCS where management activities have occurred. The BCLCS Levels 1 and 2 define polygons as vegetated - treed (VT) or vegetated - non-treed (VN). The VN descriptor in the BCLCS may include productive immature and current not-sufficiently-restocked (NSR) lands that may potentially contribute to the productive land base. Areas may have been classified as VN simply because they are recently harvested areas not yet regenerated, or they are regenerated stands that due to their early stage of development, are classified under BCLCS Level 4 as Shrub Low. To reduce the chance of removing harvested areas, VN lands with a previous logging history were not removed when classified as VN. To reduce the risk of removing unidentified recently harvested and/or regenerated areas, further delineation of the VN stands were made on the basis of site index[1], stand age, the BCLCS Level 3 classifications, and tree pattern. VN stands with a site index of 0, or with a site index >0 and an age >20, were removed from the productive land base. VN polygons classified under BCLCS Level 3 as being wetland or alpine were also removed, as were VN polygons with very few to a sporadic tree cover pattern, classified in the VRI inventory as having a cover pattern ≤4. VN polygons with more than 50% of the area classified as non-vegetated due to land or water features (i.e. rivers, bedrock) were also removed.

Under the BCLCS, VT polygons may have as little as 5% of the productive area covered with trees. VT polygons are further categorized by their proportion of non-vegetated land or water. For this analysis, VT polygons that were more than 50% non-vegetated (due to either land or water attributes combined) were removed from the land base, provided they did not have a previous logging history.

Approximately 14,182 ha of VN polygons met at least one of these criteria, of which 14,125 ha of VN polygons were removed after consideration of previous deductions. Any vegetated polygon in the Interior Mountain-heather Alpine (IMA) biogeoclimatic zone was removed, including 22 ha of VT polygons. Approximately 457 ha of VT polygons with more than 50% of their area non-vegetated were removed from the THLB after consideration of previous deductions. All removed VT polygons were classified as having sparse tree coverage under BCLCS Level 5. In total, 14,604 ha were removed from the land base for non-productivity after consideration of previous deductions.

6.6 Existing Roads and Trails

Roads within TFL3 are not accounted for within the forest inventory. A buffer was applied to road line work in GIS to account for the degraded[2] right-of-way road width of existing roads. Degraded road buffer widths vary depending on road class, and are shown below in Table 6. Road buffer widths are based on the findings of an operational road width survey conducted on TFL3.

[1] Site index is an estimate of the site productivity for tree growth. Site index is estimated using the average height of site trees (the largest diameter trees free of damaging agents in a site index plot) at a reference age. The reference or base age for site index in the VRI is breast height age 50 years.

[2] Degraded road width refers to the road right-of-way area that would normally be expected to sustain productive forest in the absence of roads.

Table 6: Existing roads in TFL3.

Road Type	Degraded right-of-way width[1] (m)	Operable Length (km)
Mainline	17	67.2
Branch	18	228.3
Spur	14	218.1
Trail	8	65.9
Total Length		**579.4**

[1]Degraded width refers to the road right-of-way area that would normally be expected to sustain productive forest in the absence of roads. The buffer used in GIS was half this width on either side of the road line feature.

After applying the right-of-way widths in GIS as buffers to the road lines and accounting for road intersections and endpoints, the gross area occupied by road openings under the GIS road buffers is 905 ha. Approximately 13 ha of these road openings in TFL3 are found within the boundaries of the private land parcels with the remainder inside the Crown owned portion of the TFL. After consideration of previous reductions, 831 ha were removed from the THLB for existing roads and trails, as shown in Table 7.

Table 7: Area removed for existing roads and trails.

Road Type	Gross Area (ha)	Area removed (ha)
Mainlines, branches, spurs, trails	905	831
Road area removed		**831**

Roads are both seasonally and permanently deactivated in TFL3. While seasonally deactivated roads contribute to the road network and remain unproductive for growing trees, permanently deactivated roads and machine trails are assumed to contribute to the productive growing space after rehabilitation, and were not removed from the THLB. To date, nearly 247 km are identified in the roads inventory as being permanently deactivated, as shown in Table 8. To address uncertainties around the road deactivation estimate, a sensitivity analysis is planned to examine the impacts on timber supply of not removing the deactivated roads and trails from the THLB.

Table 8: Permanently deactivated roads and trails in TFL3.

Road Type	Recovered width (m)	Operable Length (km)
Branch	18	19.2
Forwarding Trails	14	2.3
Spurs	14	125.0
Trails	8	100.3
Total Permanent Deactivation (km)		**246.8**

6.7 Hydro Line Corridors

Approximately 338 ha of hydro line corridors are found in TFL3. While hydro line corridors may provide access and opportunities for non-timber forest products, due to the brushing treatments they are generally not suitable for the production of commercial timber. After consideration of previous deductions, approximately 7 ha were removed from the land base due to hydro lines.

6.8 Inoperable

The operability line for TFL3 is based on the 1996 operability classification used in Management Plan #9. The detailed methodology for the operability determination is given in the report *Operability Line Report for Tree Farm License 3, Slocan Forest Products Ltd.* (Hugh Hamilton Limited and Atticus Resource Consulting Ltd., 1996). The gross area by operability class for the TFL is summarized in Table 9. After consideration of previous deductions, 21,679 ha were removed from the THLB due to operability. The inoperable classification was ignored for the 354 ha of inoperable areas with prior harvesting activities.

Table 9: Operability class.

Operability Class	Gross Area (ha)
Alternate	3,526
Operable	35,996
Unclassified	156
Total Operable	**39,648**
Total Inoperable	39,462
Inoperable with Harvesting history	(354)
Net Inoperable	**39,109**

6.9 Steep Slope

Consistent with current practice, slopes greater than 90% are generally not harvested, even though they may be classed as operable in the 1996 operability determination. There are 510 ha in TFL3 with a slope >90%, of which 169 ha are considered forested land. Land base removals for steep slope areas amounted to 18 ha.

6.10 Non-merchantable Forest

Based on operational experience in TFL3, minimum merchantable volumes are 150 m^3/ha for slopes less than or equal to 40% and 225 m^3/ha where slopes are greater than 40%. Stands older than 140 years with VDYP[3] projected volumes currently below these standards are excluded from the harvestable land base.

[3] The Ministry of Forest and Range's yield projection model Variable Density Yield Projection Batch version 6.2d (VDYP) was used to project the inventory volumes of all stands > 20 years of age. Volumes were projected and evaluated for each individual polygon that contained VDYP input parameters (species, site index, crown closure).

The total non-merchantable areas by species group and slope class and the net area removed from the THLB after consideration of previous reductions are shown in Table 10. Polygons with a history of logging were not removed at this stage.

Managed stand yield tables[4] are not available for stands with a site index <5 m, therefore stands older than 140 years with a site index <5 m were also removed at this point. There are only 15 ha of these stands and all were spruce leading types in low slope areas. After consideration of previous reductions 12 ha of the spruce leading stands with a site index <5 m were removed from the THLB.

Table 10: Criteria and netdown reductions for non-merchantable stands >140 years.

Slope Class	Species Group	Non-merchantable Area (ha)	Minimum Volume at >140 years	Area Removed
≤40%	Balsam	2,072	150	36
	Cedar	12	150	12
	Deciduous	29	150	20
	Fir_Pine[1]	5	150	1
	Hemlock	23	150	18
	Larch	29	150	29
	Lodgepole	19	150	0
	Spruce	239	150	24
	Total			**139**
>40%	Balsam	3,893	225	82
	Cedar	36	225	23
	Deciduous	3	225	2
	Fir_Pine[1]	212	225	86
	Hemlock	45	225	33
	Larch	125	225	115
	Lodgepole	57	225	0
	Spruce	1,683	225	216
	Total			**557**
Total Area Removed				**696**

[1]The Fir_Pine species group is predominantly Douglas-fir (Fd) with minor components of ponderosa pine (Py) and western white pine (Pw)

[4] The Ministry of Forest and Range's growth model *Table Interpolated Stand Yields* version 4.1 (TIPSY) base age 50 site index lower bound is 5 m for spruce, Douglas-fir and pine, and 10 m for cedar and hemlock types.

6.11 Low Site Productivity

Existing stands aged 21 to 140 years that currently did not meet the minimum volume requirements and were not projected in VDYP[5] to meet the minimum volume by 140 years of age were removed from the THLB.

Table 11 shows the total non-merchantable area by species group and slope class, and the area removed from the THLB, after consideration of previous reductions. Polygons with a history of logging were not considered in this reduction. Although the minimum site index of 5 metres was also applied to stands aged 21 to 140 years, no stands were removed in this age group solely due to the low site criteria.

Table 11: Criteria and netdown reductions for non-merchantable stands 21 to 140 years.

Slope Class	Species Group	Non-merchantable Area (ha)	Minimum Volume at >140 years	Area Removed (ha)
≤40%	Balsam	3,096	150	82
	Cedar	0	150	0
	Deciduous	543	150	314
	Fir_Pine[1]	140	150	59
	Hemlock	2	150	0
	Larch	2	150	0
	Lodgepole	37	150	32
	Spruce	112	150	2
	Total			**489**
>40%	Balsam	8,212	225	279
	Cedar	3	225	0
	Deciduous	313	225	174
	Fir_Pine[1]	1,118	225	144
	Hemlock	7	225	0
	Larch	128	225	44
	Lodgepole	113	225	14
	Spruce	607	225	16
	Total			**672**
Total Area Removed				1,161

[1]The Fir_Pine species group is predominantly Douglas-fir (Fd) with minor components of ponderosa pine (Py) and western white pine (Pw)

[5] VDYP projections were made for each polygon using inventory stand attributes. Stands aged <50 years use species specific provincial average crown closure values, weighted by the species proportion for each polygon.

Stands aged ≤20 years without logging history that were not capable of producing the minimum merchantable volumes by 140 years of age were also evaluated. Batch TIPSY was used to determine the minimum site index to produce the minimum merchantable volume by species type and BEC group combination, using the initial densities and species distributions derived for the managed stand yield tables. The criteria of 150 m^3/ha for low slopes and 225 m^3/ha for slopes >40% were used to determine the minimum site indices shown in Table 12 . Existing deciduous types were converted to conifer species as discussed in the regeneration assumptions presented in Section 8.7. Where available, site index conversion equations were used with species conversions[6] (see Section 8.7.3 for further discussion on conversions) and the associated minimum inventory site index is shown in Table 12. No stands ≤20 years of age were classified under these criteria.

Table 12: Criteria for low site productivity of stands ≤20 years.

Slope	Species Group	BEC Zone	Minimum Inventory SI_{50} (m)
<=40%	Balsam	--	8.5
	Cedar	--	12.0
	Deciduous	--	11.7
	Fir_Pine[1]	--	12.1
	Hemlock	--	8.2
	Larch	--	11.5
	Lodgepole	ICH	10.5
	Lodgepole	ESSF	9.6
	Spruce	ESSF	8.0
	Spruce	ICH	8.4
>40%	Balsam	--	10.1
	Cedar	--	14.0
	Deciduous	--	13.7
	Fir_Pine[1]	--	14.2
	Hemlock	--	10.6
	Larch	--	13.6
	Lodgepole	ICH	13.0
	Lodgepole	ESSF	11.5
	Spruce	ESSF	9.9
	Spruce	ICH	10.6

[1]The Fir_Pine species group is predominantly Douglas-fir (Fd) with minor components of ponderosa pine (Py) and western white pine (Pw)

[6] The Ministry of Forest and Range's site index conversion model *Site Tools* version 3.3 was to convert inventory site indices to the site index of the leading regenerated species. TIPSY automatically converts site indexes for stands with multiple species, if the conversion equations are available in the growth model.

Areas with harvest history were retained in the THLB and were excluded from the minimum volume and managed stand site productivity criteria discussed above. Due to other resource management objectives, areas not suitable for harvest may have been spatially identified as being under a cutting permit, but consist of retention areas that are relatively unproductive for growing timber. Previously harvested areas with a site index <5 m were removed from the THLB. Table 13 shows the gross area and the 33 ha of area removed, by species group, after consideration of previous deductions. Although all species types had the minimum site criteria applied to previously harvested areas, only balsam and cedar types had areas of very low productivity.

Table 13: Criteria and area removed for very low site productivity on previously harvested stands.

Slope Class	Species Group	Very Low Productivity Gross Area (ha)	Minimum Site Index	Area Removed (ha)
All	Balsam	16	5	16
	Cedar	18	5	17
Total Area Removed				**33**

6.12 Problem Forest Types

Problem forest types (PFTs) are stands that are physically operable and exceed low site criteria yet are not currently utilized or have marginal merchantability. PFTs are identified by combinations of inventory type group (ITG) and age class. Deciduous and coniferous PFTs are accounted for separately in this analysis.

6.12.1 Deciduous Problem Forest Types

All deciduous-leading stands without prior logging history are excluded from the THLB. Minor deciduous components of conifer-leading stands have been accounted for by volume reductions to yield curves. Table 14 provides a summary of the deciduous stand type exclusions by inventory type group and leading species.

Table 14: Areas removed for Deciduous-Leading Stands.

Inventory Type Group	Primary Species[1]	Gross Area (ha)	Area removed (ha)
35	Ac	77	42
36	Ac	72	0
40	Ep	664	8
41	At	39	0
42	At	88	0
Total Area Removed			**50**

[1] balsam poplar (Ac), birch (Ep), trembling aspen (At)

6.12.2 Coniferous Problem Forest Types

Under the Management Plan #9 timber supply analysis for TSR II, problem forest type (PFT) deductions were based on the criteria used in the 1994 TSR 1 analysis for the Arrow TSA. In the 1998 AAC Determination for TFL3 (B.C. Ministry of Forests, 1998a), the Chief Forester suggested the licensee review the problem forest type deductions in time for the next analysis. SCFP has conducted a review of recent logging over the last 10 years in PFTs and has made revisions to the netdown deductions by inventory type group and age. Details of these deductions and the areas removed for coniferous PFTs are presented in Table 15. Across all inventory type groups and age categories, a total of 924 ha were removed from the THLB due to problem forest types, after consideration of previous deductions.

Table 15: Areas removed for Coniferous Problem Forest Types.

Inventory Type Group	Species Types[1]	Age (years)	% Area Removed	Gross Area (ha)	Area removed (ha)
11	Cw/H	>140	60	580	211
12	H	>140	80	229	73
13	H/Fd	>140	40	455	113
14	H/Cw	>140	40	1,393	265
15	H/B	>140	40	139	51
16	H/S	>140	40	456	83
17	H/Decid	>140	40	0	0
18	B	141-250	30	3,141	8
19	B/H	141-250	10	23	2
18	B	>250	100	0	0
19	B/H	>250	100	0	0
20	B/S	>140	20	5,269	119
Total Area Removed[2]					**924**

[1] Species types: western redcedar (Cw), western hemlock (H), Douglas-fir(Fd), Balsam(B), Interior spruce (S), deciduous species include aspen and birch (decid)
[2]Numbers may not add up exactly due to rounding

6.13 Environmentally Sensitive Areas and Terrain Stability

Environmentally sensitive area (ESA) classification identifies polygons that have either high (ESA1) or moderate (ESA2) sensitivity to disturbance or to management activities. Sensitivity is defined as either having a risk of damage or being of high value for other resources. Sensitivity attributes are soil disturbance (s), avalanche hazard (a), forest regeneration (p), recreation (r), and wildlife (w). Some ESAs are conditionally available for harvest, based on an assessment at the operational level. Area reductions are applied to ESA polygons based on the expected rate that ESA areas are reserved from harvest. Where more than one type of sensitive area is assigned to a polygon, the more restrictive reduction applies.

6.13.1 Unstable Terrain and Sensitive Soils

Terrain stability assessment and the ESA soil sensitivity rating both identify areas of potentially sensitive or unstable soils. SCFP has completed Terrain Survey Intensity (TSIL) Level D terrain stability assessments for portions of TFL3. This analysis identified the necessity for a more detailed TSIL B assessment of 4,056 ha in the Airy/Tindale Watersheds, located in the Southeast portion of the TFL. Since 2003, 11,548 ha of the TFL were assessed at the TSIL C level. Terrain stability assessments are more current than the ESA soil sensitivity rating and are considered to be more reliable.

The *Sensitive Soil Data and Netdown Review for TFL3 Management Plan #10* (Slocan Forest Products Ltd., 2002) provided a rationale of the netdown criteria for sensitive soils. Where polygons are classified according to both Terrain Stability Assessment and ESA soil sensitivity classification, all TSIL B, C and D classifications override the ESA system. Where the TSIL classifications overlap, the more precise classification is used. The ESA soil sensitivity rating is used where no TSIL B, C or D rating is given. Table 16 shows the reductions for unstable terrain and sensitive soils.

Table 16: Deductions for unstable terrain and sensitive soils.

TSIL	Terrain Class	Description	% area removed[1]	Gross Area	Area Removed (ha)
B, C	IV	Potentially unstable	13%	4,323	299
	V	Actively unstable	80%	639	167
D	P	Potentially unstable[2]	10%	29,159	754
	U	Actively unstable[3]	60%	7,197	289
ESA[4]	E2s	Moderate soil sensitivity	10%	40	1
	E1s	High soil sensitivity	80%	385	9
Total Area Removed[5]					**1,520**

[1] Source: *Sensitive Soil Data and Netdown Review for TFL3 Management Plan #10*
[2] Includes P, P/S and P/U ratings
[3] Includes U and U/P ratings.
[4] TSIL B over-rides C which over-rides D which over-rides the ESA ratings when they overlap.
[5] Numbers may not add up exactly due to rounding

6.13.2 Other ESA Reductions

ESA reductions for avalanche and regeneration are presented in Table 17. There are no moderate avalanche hazard risk areas in TFL3. Wildlife ESAs are not used in this analysis since Ungulate Winter Range and landscape connectivity will be modelled as forest cover requirements (see Section 10).

Recreation ESAs and inventory polygons were also not used in this netdown assumption. There are several areas of recreation use in TFL3, including recreation sites at Grizzly Creek and Upper Little Slocan Lake, trails to popular rock climbing areas, Mulvey Basin and the Drinnon Lake, and a high elevation commercial ski lodge near McKean Lake.

SCFP actively works to incorporate recreation needs in the planning and operational process, and as such will continue to consider recreational interests at the operational level.

Table 17: Area removed for other Environmentally Sensitive Areas.

ESA Type	ESA Description	Reduction %	Gross Area (ha)	Net Area Removed (ha)
Ea1	High avalanche hazard	90%	302	26
Ea2	Moderate avalanche hazard	50%	0	0
Ep1	High risk of forest regeneration failure	50%	11,905	561
Ep2	Moderate risk of forest regeneration failure	10%	2,098	31
Total Area Removed[1]				**619**

[1]Numbers may not add up exactly due to rounding

6.14 Riparian Reserves and Management Zones

Buffers were created in GIS to extract the riparian reserve zones (RRZs) and riparian management zones (RMZs). The RRZ buffer widths and the RMZ retention levels are consistent with and reflect current practice on TFL3. As suggested in the *Riparian Management Area Guidebook (*Government of B.C., 1995b) and consistent with Section 5.2.4 of the *2006 Forest Stewardship Plan for Tree Farm Licence #3 and FLA2019* (Springer Creek Forest Products Ltd., 2006), a minimum 25% retention was assumed for all lake and wetland RMZs.

To simplify the analysis, the RMZ buffer applies full retention even though RMZs may be managed through partial cutting. This adjusted RMZ buffer width is equivalent to the basal area retention required for a given riparian class. The total riparian buffer width to be excluded from the harvestable land base is a combination of the RRZ and the adjusted RMZ buffer. Where buffers of different riparian management areas overlap, the larger buffer takes precedence. Riparian reserve and management zones covered 3,639 ha of the TFL or 2,403 ha of the productive land base. After consideration of previous removals, the THLB is reduced by 1,803 ha for riparian management areas.

6.14.1 Classified Streams

Riparian management area buffer widths for classified streams are shown in Table 18. There are nearly 688 km of classified streams in TFL3.

Table 18: Classified stream Riparian Management Area buffers.

Stream Class	RMZ Width (m)	RMZ Basal Area Target Retention %	RMZ Buffer (m)	RRZ Buffer (m)	Total RMA Buffer (m)	Length (km)
S1(>100 m)	100	50%	50	0	50	0
S1(<100 m)	20	50%	10	50	60	95.5
S2	20	50%	10	30	40	141.1
S3	20	50%	10	20	30	25.4
S4	30	25%	7.5	0	7.5	8.7
S5	30	25%	7.5	0	7.5	176.6
S6	20	5%	1	0	1	240.6
Total Classified Stream Length						**687.9**

6.14.2 Unclassified Streams

There are 1138.4 km of unclassified streams in the TFL3 inventory. For modelling purposes, the average RMZ width (26.7 m) and average basal area retention requirements (18 %) of the S4-S6 streams was used to estimate an average buffer width of 4.8 m for the unclassified streams. Consistent with the S4-S6 streams, no RRZ buffer widths were assumed. Approximately 28% of the gross area of stream buffers is attributed to unclassified streams, although stream nodes would reduce this proportion.

6.14.3 Lakes and Wetlands

Using the BC Land Classification Scheme in the VRI, a GIS exercise was used to define lakes and wetland areas >1 ha in size. The combined polygon area of the wetland or lake feature was used to determine the appropriate riparian class. Wetlands in the W1 and W3 category were further analysed in GIS by their proximity to other wetlands for inclusion in the W5 classification. No W5 wetlands were determined from the VRI inventory.

Current practice by SCFP is to manage Upper and Lower Little Slocan Lakes with a 30 m RRZ and a 70 m RMZ with 25% retention.

Table 19 and shows the calculated RMA riparian buffers for lakes and wetlands, while Table 20 shows the gross area of features as shown in the inventory. TFL3 is comprised of nearly 336 ha of lakes, and approximately 170 ha are wetlands greater than 1 ha in size.

Table 19: Lake and wetland Riparian Management Area buffers.

Category	Riparian Class	RMZ Width (m)	RMZ BA Retention %	RMZ Buffer (m)	RRZ Buffer (m)	Total RMA Riparian Buffer (m)
Lakes	Upper & Lower Little Slocan[1]	70	25%	17.5	30	47.5
	L1	0	25%	0	10	10
	L2	20	25%	5	10	15
	L3	30	25%	7.5	0	7.5
	L4	30	25%	7.5	0	7.5
Wetlands	W1	40	25%	10	10	20
	W2	20	25%	5	10	15
	W3	30	25%	7.5	0	7.5
	W4	30	25%	7.5	0	7.5
	W5	40	25%	10	10	20

[1]Buffer widths on Upper and Lower Little Slocan Lake reflect current practices

Table 20: Lake and wetland gross area by Riparian Class.

Category	Riparian Class	Gross Area (ha)[1]
Lakes	L1	248.5
	L2	0
	L3	87.0
	L4	0
Gross Lake Area		**335.5**
Wetlands	W1	154.9
	W2	0
	W3	14.7
	W4	0
	W5	0
Gross Wetland Area		**169.6**

. [1]Gross area is the total area of the lake or wetland polygons in the VRI inventory in the TFL. Assigned riparian buffers are not included in the area

6.15 Wildlife Habitat Removals

6.15.1 Goshawks

Two goshawk stick nests were identified in TFL3. Current operational practice is to refrain from harvesting within a 200 m radius buffer around indentified nests. If the nests remain inactive during the next 5-10 years, removal of these buffers may be considered during the next timber supply review. The total area of the buffers is 25 ha, and the net area removed is 19 ha.

6.15.2 Ungulate Winter Range

In February 2007, Ungulate Winter Range #U-4-001 was established through an Order established under the *Government Actions Regulation* (Government of B.C., 2007). Area reductions are not made to the THLB as this area is managed through forest cover retention requirements, as discussed in Section 10.2.5.

6.15.3 Wildlife Habitat Areas

The following species at risk have been identified through the notice *Indicators of the Amount, Distribution and Attributes of Wildlife Habitat Required for the Survival of Species at Risk in the Arrow Boundary Forest District (*Government of B.C., 2004)*:*

- Coeur d'Alene Salamander (*Plethodon idahoensis*),
- Flammulated Owl (*Otus flammeolus*),
- Interior Western Screech-Owl (*Otus kennicottii macfarlanei*)

At this time, there are no Wildlife Habitat Areas established within TFL3.

6.16 DRAFT Old Growth Management Areas

Approximately 4,481 ha of draft old growth management areas (OGMAs) have been established within the boundaries of TFL3. While these areas have yet to be formally approved, SCFP has agreed to the OGMAs and plan their operational activities accordingly. Table 21 shows the total area and the area removed from the THLB, by landscape unit.

Table 21: DRAFT Old Growth Management Areas by landscape unit.

Landscape Unit	LU Code	Gross Area[1] (ha)	Area Removed[1] (ha)
Hoder	N517	647	310
Koch	N516	3,390	996
Perry	N514	445	367
Total Area Removed			**1,672**

[1]Numbers may not add up exactly due to rounding

6.17 Cultural Heritage Areas

Small cultural heritage areas were identified from the resource inventories at Archaeological Information Services and their locations were rated into the GIS resultant to maintain the integrity of their specific location. While the areas are small (<1 ha in total), approximately 17 ha of inventory resultant polygons were impacted. After consideration of previous removals, less than 1 ha was removed from the THLB for cultural heritage reasons.

6.18 Not-Satisfactorily Restocked Conditions

The backlog NSR areas identified under the 1998 timber supply review have been restocked and/or reclassified in the inventory. The 279 ha of harvest units identified as current NSR are assigned an age of 1 year in the inventory file for modelling purposes to reflect their recently regenerated status. SCFP is committed to prompt stand reestablishment of harvested areas, having an average regeneration delay of 1.75 years.

6.19 Existing Landings

Spatial data on landings is incomplete for TFL3, therefore a non-spatial reduction for existing landings was used for this analysis. SCFP has determined landings are on average, 0.1 ha in size and occupy 1.25% of the harvest unit's net area to be restocked without consideration of Wildlife Tree Retention areas. For this analysis, the 8,837 ha of THLB polygons identified with a history of logging were uniformly reduced by 1.25% to account for current landings, after all previous deferrals are accounted for. This results in an area reduction of 110 hectares attributable to existing landings.

6.20 Wildlife Tree Retention

After accounting for full and partial deferrals and existing landings, an additional reduction is applied to the THLB to account for areas retained for wildlife tree retention. Wildlife tree retention (WTR) estimates were made in consideration of the *Forest Planning and Practices Regulation*[7] Sections 66(1) and (2), and the procedures outlined in Section 3.2 and Appendix 3 of the *Landscape Unit Planning Guide* (Government of B.C. 2000a).

For this analysis, WTR areas were calculated as 7% of the subtotalled THLB area immediately prior to the WTR area deduction. WTR retention is assumed to be distributed proportionally between the THLB and the Crown forested portion of the non harvestable land base (NHLB). To reflect a landscape distribution in the modelling, these proportions are determined at the landscape unit and BEC subzone level, in a manner similar to Section 3.2 of the *Landscape Unit Planning Guide*.

[7] 66. (1) If an agreement holder completes harvesting in one or more cutblocks during any 12 month period beginning on April 1 of any calendar year, the holder must ensure that, at the end of that 12 month period, the total area covered by wildlife tree retention areas that relate to the cutblocks is a minimum of 7% of the total area of the cutblocks. (2) An agreement holder who harvests timber in a cutblock must ensure that, at the completion of harvesting, the total amount of wildlife tree retention areas that relates to the cutblock is a minimum of 3.5% of the cutblock. (3) For the purposes of subsection (1) and (2), a wildlife tree retention area may relate to more than one cutblock if all of the cutblocks that relate to the wildlife tree retention area collectively meet the applicable requirements of this section.

Table 22 shows the logic used to determine the 7% estimate for WTR in TFL3. In total, 1,106 ha have been retained for WTP areas using this approach, or 3.8% of the THLB[8] on average.

Table 22: Wildlife tree retention area calculations.

Col 1	Col 2	Col 3	Col 4	Col 5	Col 6	Col 7	Col 8	Col 9	Col 10	Col 11	Col 12	Col 13
Landscape Unit	**Zone**	**Subzone**	**Non-forest (ha)**	**CFLB (ha)**	**THLB (ha)**	**Percent THLB (%)** Col6/Col5	**WTR Min (%)**	**NHLB (%)** Col 8 - Col 10	**THLB (%)** Col 7 x Col 8	**NHLB WTR (ha)** Col 9 x Col 6	**THLB WTR (ha)** Col 10 x Col 6	**Total WTR (ha)** Col 11 + Col 12
HODER	ESSF	wc	2,690	8,316	3,397	41	7	4.1	2.9	141	97	238
HODER	ESSF	wcp	2,643	532	0	0	7	7.0	0.0	0	0	0
HODER	ICH	dw	712	1,904	1,138	60	7	2.8	4.2	32	48	80
HODER	ICH	mw	868	4,918	3,049	62	7	2.7	4.3	81	132	213
HODER	IMA	un	327	0	0	0	7	0.0	0.0	0	0	0
KOCH	ESSF	wc	5,715	22,634	8,135	36	7	4.5	2.5	365	205	569
KOCH	ESSF	wcp	4,708	1,456	4	0	7	7.0	0.0	0	0	0
KOCH	ICH	dw	273	2,194	1,752	80	7	1.4	5.6	25	98	123
KOCH	ICH	mw	1,102	11,468	8,087	71	7	2.1	4.9	167	399	566
KOCH	IMA	un	483	0	0	0	7	0.0	0.0	0	0	0
PERRY	ESSF	wc	107	1,807	954	53	7	3.3	3.7	32	35	67
PERRY	ICH	dw	450	1,738	1,168	67	7	2.3	4.7	27	55	82
PERRY	ICH	mw	108	1,919	1,010	53	7	3.3	3.7	34	37	71
n/a			37	0	0	0	7	0.0	0.0	0	0	0
Total WTR Area[1]										904	**1,106**	2,009

[1]Numbers may not add up exactly due to rounding

6.21 Future Roads, Trails, and Landings

6.21.1 Future Roads and Trails

To estimate future access requirements, the existing road (and/or trail) density in the accessible (i.e. conventionally operable) portion of the THLB is extrapolated to the accessible, but non-roaded portion of the THLB.

[8] Without removing the 1,106 ha of wildlife tree retention areas, the THLB area is 28,693 ha.

Future road and trail requirements were estimated from the existing road density with a spatial analysis in GIS. All existing active or seasonally deactivated roads and trails had a 400 m buffer applied in GIS to the road line, resulting in a 200 m buffer on either side of the road line. Areas within the 200 m average yarding distance buffer on either side of the road line were assumed to be currently accessible. Accessible areas are shown as the roaded THLB in Table 23. In total, 11,167 ha of the THLB were estimated to be accessible using this approach. The ratio of the existing road network area (885 ha) over the accessible portion of the THLB was calculated (7.9%) and this factor was used as a multiplier for determining the future road area (1,136 ha) to be applied to the non-roaded but conventionally operable portion of the THLB (14,319 ha).

Table 23: Procedure for determining the area removed for future roads and trails.

Col 1	Col 2	Col 3	Col 4	Col 5	Col 6	Col 7	Col 8	Col 9	Col 10
Existing THLB	**Alternate Operability Area (ha)**	**Conventional Operability Area (ha)**	**Roaded THLB Area (ha)**	**Non-Roaded Conventional THLB Area (ha)**	**Existing Road Area (ha)**	**Existing Road (%)** Col6/Col4	**Future Road (%)** Col 7	**Future Road Area (ha)** Col8 x Col5	**Future Road % of Existing THLB** Col9/Col1
27,587	2,101	25,486	11,167	14,319	885	7.9	7.9	1,135	4.1

Future road deductions were applied only to the non-roaded conventionally operable portion of the THLB. Future roads reduce the existing THLB by 4.1%, on average.

6.21.2 Future Landings

Future landings are estimated to reduce the net area to be restocked by 1.3%, after all WTR areas and future roads are removed. Future landing deductions were applied to the 18,263 ha of conventional and alternate operability polygons in the THLB, identified in the inventory as without prior logging history.

7 Inventory Aggregation

Inventory aggregation is a process of simplifying the landscape into similar units. It identifies management zones or resource emphasis areas for the application of unique forest cover and spatial structure requirements. It is also used for the application of growth and yield information. The aggregation must recognize both the similarities and differences in forest stand productivity as well as management objectives and prescriptions. This section describes the criteria and rationale behind the aggregation.

7.1 Management Zones and Multi-Level Objectives

Multiple resource issues may be present on the same forest area. For example, a domestic watershed management zone may also have areas that are visually sensitive and require an old growth objective. FSOS can accommodate multiple overlapping resource layers, and therefore does not require that these layers be aggregated into mutually exclusive management zones. A description of the overlapping resource management zones is provided in Section 10.

7.2 Analysis Units

Stands with similar biological characteristics were aggregated into larger homogenous units called analysis units (AUs) for management prescriptions and objectives. Site index and leading species were the dominant criteria for determining the AUs, although the spruce and lodgepole pine inventory type groups were further delineated by BEC zone. Table 24 describes each of the 31 AUs and their respective areas within the THLB.

7.2.1 Rationale for Analysis Unit Criteria

Leading Species (Inventory Type Group)

Leading species is the primary criteria for creating the analysis units. Some species were aggregated into the same analysis unit, either because they form a leading component in a very small area of TFL3 or because the yield curves used in TIPSY are the same as the predominant species group in the AU (e.g. Pw or Py with the Fd type).

Biogeoclimatic Zone

Separate analysis units were given to spruce and lodgepole pine stands in the ICH and the ESSF because silviculture assumptions for these species are substantially different between these two BEC zones.

Table 24: Analysis Unit descriptions.

Species Group	BEC	ITG	Site Class	AU Description	Inventory Site Index Limits	THLB Area (ha)
Spruce	ICH	21-26	Low	Spruce_ICH_Low	<13.0	264
			Poor	Spruce_ICH_Poor	13.0 - 16.9	666
			Medium	Spruce_ICH_Med	17 - 20.9	662
			High	Spruce_ICH_High	>=21.0	184
Spruce	ESSF	21-26	Low	Spruce_ESSF_Low	<9.0	848
			Poor	Spruce_ESSF_Poor	9.0 - 12.9	2,197
			Medium	Spruce_ESSF_Med	13.0 - 16.9	2,189
			High	Spruce_ESSF_High	>=17.0	1,372
Balsam	All	18 - 20	Low	Balsam_Low	<11.0	783
			Poor	Balsam_Poor	11.0 - 13.9	1,139
			Medium	Balsam_Med	14.0 - 17.9	966
			High	Balsam_High	>=18.0	143
Cedar	All	9 - 11	Poor	Cedar_Poor	<=15.9	446
			Medium	Cedar_Med	16.0 - 18.9	327
			High	Cedar_High	>=19.0	223
Fir_Pine	All	1 - 8, 27, 32	Poor	Fir_Pine_Poor	<=15.9	977
			Medium	Fir_Pine_Med	16.0 - 19.9	3,126
			High	Fir_Pine_High	>=20	1,045
Hemlock	All	12 - 17	Poor	Hemlock_Poor	<14.0	1,020
			Medium	Hemlock_Med	14.0 - 18.9	2,192
			High	Hemlock_High	>=19.0	267
Larch	All	33 - 34	Poor	Larch_Poor	<14.0	293
			Medium	Larch_Med	14.0 - 19.9	2,970
			High	Larch_High	>=20	584
Lodgepole	ICH	28 - 31	Medium	Lodgepole_ICH_Med	<18.0	654
			High	Lodgepole_ICH_High	>=18.0	443
Lodgepole	ESSF	28 - 31	Poor	Lodgepole_ESSF_Poor	<14.0	152
			Medium	Lodgepole_ESSF_Med	14.0 - 16.9	937
			High	Lodgepole_ESSF_High	>=17	328
Deciduous[1]	All	>=35	Medium	DecidLarch_Med	<19.0	53
			High	DecidLarch_High	>=19.0	138
Total Area						27,587

[1] Deciduous leading stand types are excluded from the THLB except areas identified in the inventory with prior logging history. All stand volumes in yield curves are net of deciduous species.

Site Productivity

Potential site productivity, quantified by site index[9], is an input attribute for VDYP and TIPSY. Analysis units were further delineated by stratifying each leading species group into site classes (poor, medium and high) to reduce the variability of site productivity within analysis units. Site classes were defined on a species-specific basis using the distribution of VRI inventory site indices in the timber harvesting land base. A clustering algorithm was developed to report the site index range, mean site index and the coefficient of variation within site classes. Generally, the productive land base was stratified according to the site index distribution of the species groups. Inventory site index value thresholds were truncated to the integer for AU classification purposes only while actual inventory site indices were used in the growth and yield models.

In the inventory there are spruce and balsam stands with a relatively low site index, that either have history of logging or currently have a merchantable volume of timber. To avoid biasing the more productive site classes in these species groups, spruce and balsam inventory type groups were further stratified into low sites. Lodgepole pine leading stands in the ICH zone were only grouped into two site classes as the range of site index values in the ICH zone was relatively narrow for this inventory type.

7.2.2 Natural Stand Analysis Units 1-31

In 2004, a Phase 2 inventory adjustment was conducted on the TFL and the heights, ages and volumes of stands older than 20 years in the VRI inventory were statistically adjusted. In light of the Phase 2 adjustment work, VDYP projected inventory volumes are being used in this analysis for all stands >20 years of age. Based on the harvest and planting history in the VRI, harvesting has occurred in TFL3 since 1950[10]. Stands >20 years and <57 years of age have likely been managed on the TFL. To reflect the lower age bound of the Phase 2 sampling, all stands older than 20 years use inventory volumes derived from the VDYP projection model and the associated Phase 2 adjustments in the inventory, and are referred to as 'natural' stands for this analysis. The natural VDYP projected stands comprise 23,915 ha, or approximately 87% of the THLB.

Analysis units 1-31 are the existing natural stands within TFL3. Table 25 shows the inventory average species composition, site index, crown closure, and the volume adjustment factor[11] reported for these analysis units on an area-weighted basis. Each AU yield table attribute in Table 25 is an average of the area weighted individual polygon attributes by AU. Since Batch VDYP (ver. 6.6d) applies a default crown closure[12] to stands <50 years of age regardless of the inventory values, the average adjusted crown closure value is also shown.

[9] Site index is an estimate of the site productivity for tree growth. Site index is estimated using the average height of site trees (the largest diameter trees free of damaging agents in a site index plot) at a reference age. The reference or base age for site index in the VRI is breast height age 50 years.

[10] Tree Farm Licence 3 was first granted to Passmore Lumber Co. Ltd. in 1950 (Slocan Forest Products Ltd., 2003)

[11] Volume adjustment factors were derived from the Phase II inventory adjustment in Jahraus and Associates Consulting Inc. and Churlish Consulting Ltd., (2005).

[12] See Appendix D of the *VDYP Batch Application User Guide version 6.6d*, (B.C. Ministry of Forests, 1999).

Table 25: Analysis Units and area weighted stand attributes of natural VDYP projected stands >20 years of age in the THLB.

AU Description	AU	THLB Area (ha)	Site Index	CC	Adjusted CC	Volume Adjust Factor	Species Composition (%)								
							S	B	C	F	H	L	P	E	A
Spruce_ICH_Low	1	196	10.9	42	45	0.986	**55**	22	6	3	10	3	1	0	0
Spruce_ICH_Poor	2	505	14.9	29	48	0.989	**55**	16	10	3	9	3	2	1	1
Spruce_ICH_Med	3	522	18.9	40	53	0.990	**52**	16	8	3	10	3	6	0	2
Spruce_ICH_High	4	108	22.2	54	56	0.980	**50**	9	15	3	17	4	2	2	0
Spruce_ESSF_Low	5	842	7.7	46	46	0.982	**60**	34	0	0	4	1	1	0	0
Spruce_ESSF_Poor	6	2,167	10.8	45	46	0.982	**65**	30	1	0	1	1	2	0	0
Spruce_ESSF_Med	7	1,779	14.9	30	46	0.989	**68**	23	3	1	3	1	2	0	0
Spruce_ESSF_High	8	883	19.1	42	51	0.989	**61**	22	5	1	5	1	4	0	0
Balsam_Low	9	513	8.7	14	22	1.035	35	**57**	4	0	4	0	1	0	0
Balsam_Poor	10	1,047	12.4	39	46	1.073	27	**65**	1	0	3	1	2	0	0
Balsam_Med	11	875	15.4	24	45	1.026	26	**62**	2	1	3	3	4	0	0
Balsam_High	12	131	19.7	23	38	1.021	24	**63**	5	0	8	0	0	0	0
Cedar_Poor	13	432	14.2	32	49	1.035	14	10	**48**	6	17	2	2	0	0
Cedar_Med	14	280	17.4	37	53	1.038	8	8	**46**	9	20	5	2	2	0
Cedar_High	15	209	19.5	39	55	1.033	6	4	**49**	14	13	5	3	5	0
Fir_Pine_Poor	16	865	14.5	48	51	1.259	6	2	9	**56**	6	10	9	1	0
Fir_Pine_Med	17	2,689	18.1	58	59	1.264	3	0	7	**57**	6	15	7	3	1
Fir_Pine_High	18	728	21.2	59	61	1.270	0	2	8	**62**	4	9	10	2	1
Hemlock_Poor	19	994	12.1	54	54	1.040	7	6	14	4	**60**	5	3	0	0
Hemlock_Med	20	2,185	16.5	55	59	1.039	8	5	19	6	**54**	6	2	0	0
Hemlock_High	21	267	21.2	58	58	1.053	6	1	21	6	**53**	4	3	5	0
Larch_Poor	22	293	12.7	56	56	1.270	9	9	2	8	4	**59**	9	0	0
Larch_Med	23	2,923	17.5	66	66	1.271	3	2	5	17	7	**57**	7	1	1
Larch_High	24	335	20.9	63	63	1.270	1	0	6	16	6	**63**	5	3	1
Lodgepole_ICH_Med	25	597	15.6	61	61	1.275	5	2	0	14	1	13	**65**	0	1
Lodgepole_ICH_High	26	164	19.5	53	56	1.272	6	3	2	15	4	9	**60**	0	1
Lodgepole_ESSF_Poor	27	140	12.5	50	51	1.264	15	15	1	1	0	5	**63**	0	0
Lodgepole_ESSF_Med	28	876	15.4	62	62	1.276	8	8	0	5	1	5	**73**	0	0
Lodgepole_ESSF_High	29	224	18.1	47	55	1.250	8	10	1	3	0	7	**70**	0	0
DecidLarch_Med	30	47	16.2	13	54	1.215	3	0	14	25	13	0	4	**41**	0
DecidLarch_High	31	99	20.2	30	55	1.270	1	0	24	14	17	0	3	**39**	1

7.2.3 Existing Managed Stand Analysis Units

All stands less than or equal to 20 years of age are considered managed stand analysis units. Managed stands were separated into two categories: existing managed and existing managed with Class A seed applied. All managed stand AUs follow the same stratification by species, site index and BEC zone described in Table 24.

Existing Managed Stand AUs 101-131

Managed stands >10 and ≤20 years were projected with TIPSY and are shown as AU 101 to 131 in Table 26. Due to their establishment age, the use of Class A seed was not modelled on managed stands >10 years of age. Table 26 shows the area weighted inventory attributes of the managed stand AUs for stands >10 and ≤20 years of age. These stands comprise 1,743 ha, or 6% of the THLB.

Table 26: Analysis Units and weighted inventory stand attributes of existing managed stands >10 and ≤20 years of age in the THLB.

AU Description	AU	THLB Area (ha)	Site Index	Inventory Species Composition (%)								
				S	B	C	F	H	L	P	E	A
Spruce_ICH_Low	101	68	10.1	95	0	0	0	0	0	0	0	5
Spruce_ICH_Poor	102	134	15	69	6	6	2	7	2	3	0	5
Spruce_ICH_Med	103	52	18.8	82	3	4	0	7	0	4	0	0
Spruce_ICH_High	104	0										
Spruce_ESSF_Low	105	0										
Spruce_ESSF_Poor	106	19	10	78	0	5	0	16	0	0	0	0
Spruce_ESSF_Med	107	304	15	79	16	3	0	0	0	1	0	0
Spruce_ESSF_High	108	126	18.5	84	15	1	0	0	0	0	0	0
Balsam_Low	109	165	7.7	25	75	0	0	0	0	0	0	0
Balsam_Poor	110	76	12.1	31	59	6	0	5	0	0	0	0
Balsam_Med	111	91	15.2	31	65	3	0	0	0	0	0	0
Balsam_High	112	0										
Cedar_Poor	113	14	8.9	14	5	46	3	31	0	3	0	0
Cedar_Med	114	39	16.8	0	0	44	24	24	0	3	2	2
Cedar_High	115	0										
Fir_Pine_Poor	116	93	13.4	1	0	2	75	2	9	7	2	2
Fir_Pine_Med	117	311	16.9	0	0	7	72	5	0	12	2	2
Fir_Pine_High	118	89	20.2	0	0	7	62	3	9	8	9	2
Hemlock_Poor	119	26	10.7	0	6	34	0	56	0	4	0	0
Hemlock_Med	120	7	15.2	0	0	26	18	46	10	0	0	0
Hemlock_High	121	0										
Larch_Poor	122	0										
Larch_Med	123	9	16	0	0	11	36	0	46	7	0	0
Larch_High	124	31	20.7	0	0	13	13	7	42	5	20	1
Lodgepole_ICH_Med	125	25	16	25	2	2	9	2	0	60	0	0
Lodgepole_ICH_High	126	28	22.6	1	2	2	15	2	2	60	2	13
Lodgepole_ESSF_Poor	127	0										
Lodgepole_ESSF_Med	128	10	15.8	19	2	2	0	6	0	69	0	0
Lodgepole_ESSF_High	129	10	20	10	30	0	0	0	0	60	0	0
Deciduous_Med	130	0										
Deciduous_High	131	17	20	2	0	8	28	0	5	8	40	8

Existing Managed Stand AUs 201-231 – Class A Seed

Yields for managed stands were further stratified by age to model the use of Class A seed. Class A seed is not modelled on managed stands established prior to 1996. The area weighted inventory attributes of the managed Stands ≤10 years of age are shown as AU 201 to 231 in Table 27. These stands comprise 1,929 ha, or 7% of the THLB.

Table 27: Analysis Units and weighted inventory stand attributes of managed stands ≤10 years of age in the THLB.

AU Description	AU	THLB Area (ha)	Site Index	Inventory Species Composition (%)								
				S	B	C	F	H	L	P	E	A
Spruce_ICH_Low	201	0										
Spruce_ICH_Poor	202	28	14.9	79	2	0	9	9	0	1	0	0
Spruce_ICH_Med	203	88	18	65	14	4	0	1	4	13	0	0
Spruce_ICH_High	204	76	22.1	66	10	1	6	1	4	12	0	0
Spruce_ESSF_Low	205	7	8.4	70	25	0	0	0	0	5	0	0
Spruce_ESSF_Poor	206	10	12	77	19	0	0	0	0	3	0	0
Spruce_ESSF_Med	207	106	14.4	64	19	0	1	0	2	14	0	0
Spruce_ESSF_High	208	362	18.4	76	11	2	0	0	0	10	0	0
Balsam_Low	209	105	9.8	29	67	0	2	0	1	2	0	0
Balsam_Poor	210	16	13.3	30	44	17	0	9	0	0	0	0
Balsam_Med	211	1	15.6	30	30	0	0	0	20	20	0	0
Balsam_High	212	12	24	30	70	0	0	0	0	0	0	0
Cedar_Poor	213	0										
Cedar_Med	214	8	18	20	20	50	0	10	0	0	0	0
Cedar_High	215	14	19.6	5	1	94	0	0	0	0	0	0
Fir_Pine_Poor	216	19	15	0	0	10	40	0	20	30	0	0
Fir_Pine_Med	217	126	17.3	6	0	5	48	4	19	12	0	6
Fir_Pine_High	218	228	21.8	2	1	3	43	0	16	28	5	2
Hemlock_Poor	219	0										
Hemlock_Med	220	0.2	15.7	20	0	0	0	75	5	0	0	0
Hemlock_High	221	0										
Larch_Poor	222	0										
Larch_Med	223	38	17.7	9	0	13	17	0	50	11	0	0
Larch_High	224	218	21.5	3	0	6	15	1	39	22	1	13
Lodgepole_ICH_Med	225	32	16.3	12	7	10	14	4	1	52	0	0
Lodgepole_ICH_High	226	251	22	7	1	2	14	1	13	58	2	2
Lodgepole_ESSF_Poor	227	12	12.6	6	15	0	0	0	0	80	0	0
Lodgepole_ESSF_Med	228	50	15.9	13	14	0	4	0	0	68	0	0
Lodgepole_ESSF_High	229	93	19.8	26	8	2	1	0	2	61	0	0
DecidLarch_Med	230	6	18	0	0	0	10	0	0	20	30	40
DecidLarch_High	231	22	20.3	2	0	12	7	3	16	18	31	12

7.3 Age Class Distribution

A summary of the distribution of area and inventory volumes by age class are given in Table 28. A detailed summary of areas and volumes by analysis unit is shown in Table 29 and Table 30.

Table 28: Existing Age class distribution by Area and Volume.

Age Class (years)	Area (ha)		Total Inventory Conifer Volume[1] (m^3)	
	THLB	NHLB[2]	THLB	NHLB[2]
1 to 20	3,672	435	0	0
21 to 40	3,149	475	9,614	1,515
41 to 60	1,661	670	106,306	28,626
61 to 80	2,916	3,390	550,277	341,805
81 to 100	5,931	5,516	1,379,599	840,483
101 to 120	1,874	2,803	567,437	455,046
121 to 140	1,442	4,742	419,955	559,505
141 to 250	4,293	10,102	1,407,214	2,153,063
>250	2,648	3,167	946,410	1,145,376
Total	27,587	31,300	5,386,810	5,525,419

[1] The non-merchantable deciduous volume component of all inventory polygons is excluded

[2] The productive Crown forest component of the area outside the THLB.

Table 29: THLB age class distribution by Analysis Unit area.

AU Description	THLB Area (ha) by Age Class (years)									
	<20	21 - 40	41 - 60	61 - 80	81 - 100	101 - 120	121 - 140	141 - 250	>250	Total
Spruce_ICH_Low	68	2	19	0	0	0	0	90	85	264
Spruce_ICH_Poor	161	237	38	9	15	42	35	60	70	666
Spruce_ICH_Med	140	132	54	95	140	39	28	34	0	662
Spruce_ICH_High	76	8	0	32	0	10	23	13	22	184
Spruce_ESSF_Low	7	0	0	0	0	0	0	245	596	848
Spruce_ESSF_Poor	30	4	9	0	6	9	19	1,158	962	2,197
Spruce_ESSF_Med	410	671	24	54	137	157	30	453	254	2,189
Spruce_ESSF_High	489	198	38	273	183	36	27	126	2	1,372
Balsam_Low	270	54	242	49	0	1	95	72	0	783
Balsam_Poor	92	45	234	23	22	73	263	386	0	1,139
Balsam_Med	91	457	50	13	83	93	120	59	0	966
Balsam_High	12	51	58	18	0	0	4	0	0	143
Cedar_Poor	14	204	29	15	30	11	1	42	101	446
Cedar_Med	47	147	10	23	27	13	0	45	16	327
Cedar_High	14	115	3	8	63	4	17	0	0	223
Fir_Pine_Poor	112	100	2	39	221	50	40	365	47	977
Fir_Pine_Med	437	123	158	341	1,352	332	122	261	0	3,126
Fir_Pine_High	317	32	0	237	138	284	37	0	0	1,045
Hemlock_Poor	26	54	23	51	58	23	150	283	351	1,020
Hemlock_Med	7	242	527	458	513	128	166	134	17	2,192
Hemlock_High	0	67	94	48	28	15	15	0	0	267
Larch_Poor	0	0	0	6	76	17	36	93	66	293
Larch_Med	46	0	13	721	1,605	252	96	177	60	2,970
Larch_High	249	0	0	116	177	32	10	0	0	584
Lodgepole_ICH_Med	57	0	13	114	319	123	8	20	0	654
Lodgepole_ICH_High	279	10	8	76	33	25	11	0	0	443
Lodgepole_ESSF_Poor	12	5	0	3	34	9	11	78	0	152
Lodgepole_ESSF_Med	60	0	13	53	550	97	65	100	0	937
Lodgepole_ESSF_High	104	47	0	42	122	0	13	0	0	328
DecidLarch_Med[1]	6	46	0	0	0	0	0	0	0	53
DecidLarch_High[1]	39	99	0	0	0	0	0	0	0	138
Total	3,672	3,149	1,661	2,916	5,931	1,874	1,442	4,293	2,648	27,587

[1] All deciduous stands without previous harvest history are removed from the THLB – deciduous stand types with previous harvest history are relatively young (<40 years).

Table 30: THLB age class distribution by Analysis Unit total volume[1] (000 m^3).

AU Description	THLB Volume[1] (000 m^3) by Age Class (years)									
	<20	21 -40	41 - 60	61 - 80	81 - 100	101 -120	121 -140	141 - 250	>250	Total[1]
Spruce_ICH_Low	0	0	0	0	0	0	0	27	30	57
Spruce_ICH_Poor	0	0	1	1	3	10	12	23	29	80
Spruce_ICH_Med	0	0	2	19	34	10	10	16	0	90
Spruce_ICH_High	0	0	0	8	0	4	9	6	13	40
Spruce_ESSF_Low	0	0	0	0	0	0	0	61	164	225
Spruce_ESSF_Poor	0	0	0	0	1	1	4	330	328	665
Spruce_ESSF_Med	0	0	0	7	25	35	10	158	101	336
Spruce_ESSF_High	0	0	4	52	47	10	10	58	1	181
Balsam_Low	0	0	0	0	0	0	3	13	0	16
Balsam_Poor	0	0	3	1	3	13	59	102	0	181
Balsam_Med	0	0	5	2	15	21	34	22	0	99
Balsam_High	0	0	9	5	0	0	2	0	0	15
Cedar_Poor	0	0	1	2	6	2	0	14	47	73
Cedar_Med	0	5	1	5	6	5	0	21	10	52
Cedar_High	0	1	0	2	17	1	7	0	0	28
Fir_Pine_Poor	0	0	0	4	37	11	12	137	19	220
Fir_Pine_Med	0	0	13	60	344	103	43	104	0	668
Fir_Pine_High	0	0	0	60	44	121	12	0	0	238
Hemlock_Poor	0	0	0	4	11	6	49	109	158	337
Hemlock_Med	0	2	50	90	145	41	58	59	10	456
Hemlock_High	0	0	13	12	10	6	7	0	0	47
Larch_Poor	0	0	0	0	9	4	8	24	21	66
Larch_Med	0	0	1	123	335	70	31	55	15	631
Larch_High	0	0	0	29	37	14	4	0	0	84
Lodgepole_ICH_Med	0	0	1	21	70	37	2	7	0	139
Lodgepole_ICH_High	0	0	2	22	9	11	4	0	0	48
Lodgepole_ESSF_Poor	0	0	0	0	5	2	3	24	0	35
Lodgepole_ESSF_Med	0	0	1	11	132	28	20	36	0	228
Lodgepole_ESSF_High	0	1	0	10	36	0	6	0	0	53
DecidLarch_Med[2]	0	0	0	0	0	0	0	0	0	0
DecidLarch_High[2]	0	0	0	0	0	0	0	0	0	0
Total	0	10	106	550	1,380	567	420	1,407	946	5,387

[1] The non-merchantable deciduous volume component of all inventory polygons is excluded

[2] All deciduous stands without previous harvest history are removed from the THLB – deciduous stand types with previous harvest history are relatively young (<40 years) and accordingly have low coniferous volumes.

7.4 Existing Timber Volume Check

An existing inventory volume check was preformed to ensure that errors were not made in the yield table aggregations. Table 31 shows the VRI inventory volumes compared with the aggregated natural stand yields produced with BatchVDYP. Both the inventory and aggregated AU yield volumes are net of non-merchantable deciduous species. Overall, the yield table volumes are 0.4% higher than the inventory volumes.

Table 31: Existing timber volume check of VDYP projected inventory stands >20 years of age.

Species Group	BEC	THLB Inventory[1] Volume (m^3)	THLB Aggregated AU Yield[1] Volume (m^3)	Ratio of THLB AU Yield Volume over Inventory Volume (%)
Spruce	ICH	266,733	267,646	100.3%
Spruce	ESSF	1,407,033	1,414,718	100.5%
Balsam	ALL	311,200	304,648	97.9%
Cedar	ALL	152,996	148,424	97.0%
Fir_Pine	ALL	1,125,918	1,113,131	98.9%
Hemlock	ALL	839,621	846,276	100.8%
Larch	ALL	781,130	804,377	103.0%
Lodgepole	ICH	186,900	188,044	100.6%
Lodgepole	ESSF	315,049	320,094	101.6%
Deciduous	ALL	215	302	140.6%[2]
Total		5,386,795	5,407,659	100.4%

[1] Both inventory and the aggregated AU yield volumes are net of the non-merchantable deciduous species

[2] Deciduous species groups are highly variable due to the relatively small area

8 Growth and Yield

This section outlines the procedures and assumptions used to develop the yield tables that will be included in the timber supply analysis and the volume information that is reported in this information package. New additions to the growth and yield information consist of the following:

- Species conversion equations
- Genetic seedling improvement
- 10-year planting history

8.1 Site Index

The VRI inventory site index was used in generating the yield curves. While it is recognized that the inventory site indices derived from mature or decadent stands may be an underestimate of the actual growth potential, the VRI site indices are the best information available for use in the base case.

In 2001, the previous Licensee of TFL3 commissioned a Predictive Ecosystem Mapping (PEM) project[13]. A subsequent accuracy assessment report for the PEM project[14] showed the PEM data did not meet the minimum acceptable standards for use in a timber supply analysis base case, as described in the *Protocol for Accuracy Assessment of Ecosystem Maps*, *Tech.Rpt. 011* (Meidinger, 2003b).[15]

Alternate site index estimates for managed stands will be reviewed to address uncertainties to timber flow attributed to site productivity. Applying the PEM values, old growth derived site index (OGSI) estimates (Nigh, 1998; Nussbaum, 1998) and arbitrary metre and percentage adjustments to the VRI site indices will be examined through sensitivity analyses.

8.1.1 Site Curves

Table 32 describes the source of the site curves utilized in BatchVDYP, version 6.6d and BatchTIPSY, version 4.1. VDYP curves for interior species use those compiled in *Site Index Curves and Tables for British Columbia – Interior Species* (Thrower *et al.* 1994). BatchTIPSY version 4.1 uses more recent site productivity references[16]. Table 32 shows the site curve reference by species for the respective growth and yield models.

[13] See JMJ Holdings and Ecologic Research. 2001. *TFL3 Predictive ecosystem mapping year two final project report*. Prepared for Slocan Forest Products Ltd., Slocan.

[14] See JMJ Holdings. 2003. *Tree Farm Licence 3 predictive ecosystem mapping accuracy assessment report*. Prepared for Slocan Forest Products Ltd., Slocan.

[15] The minimum accuracy standards for PEM data to be used in a base casetimber supply analyis are shown in Appendix D of *Protocol for accuracy assessment of ecosystem maps, Tech.Rpt. 011 (*Meidinger, 2003b). The values presented in Table 7 of *Tree Farm Licence 3 Predictive ecosystem mapping accuracy assessment report* (JMJ Hodlings, 2003) do not meet the minimum accuracy standards for use in the timber supply analysis base case.

[16] Detailed notes on the curve references used TIPSY ver. 4.1 are shown in the WinTipsy species selection dialogue box.

Table 32: Source of Site Index equations used in the yield models.

Model	Species	Code	Site Curve Reference
VDYP	Balsam	Bl	Kurucz (1982)
	Douglas-fir	Fdi	Thrower and Goudie (1991)
	Lodgepole pine	Pli	Goudie (1984)
	Paper birch	Ep	Alberta Forest Service (1985)
	Ponderosa pine	Py	Hann and Scrivani (1987)
	Trembling aspen	At	Alberta Forest Service (1985)
	Western hemlock	Hw	Wiley (1978)
	Western larch	Lw	Milner (1989)
	Western redcedar	Cw	Kurucz (1985)
	Western white pine	Pw	Curtis *et al.* (1990)
	White spruce	Sw	Goudie (1984)
TIPSY	Balsam	Bl	Chen and Klinka (2000)
	Douglas-fir	Fdi	Thrower and Goudie (1992)
	Engelmann Spruce	Se	Chen and Klinka (2000)
	Lodgepole pine	Pl	Thrower and Associates (1994)
	Ponderosa pine	Py	Nigh (2002)
	Western hemlock	Hwi	Nigh (1998)
	Western larch	Lw	Brisco, Klinka and Nigh (2002)
	Western redcedar	Cw	Nigh (2000)
	Western white pine	Pw	Curtis, Diaz and Clendenen (1990)
	White Spruce (Hybrid spruce)	Sw/Sx	Goudie (1984)

8.2 Utilization Levels

Table 33 shows the minimum diameters at breast height, minimum top diameters (inside bark) and the stump heights that are used in the development of the yield tables.

Table 33: Utilization levels.

Leading Species	Utilization standard		
	Min DBH (cm)	Stump Height (cm)	Top DIB (cm)
Lodgepole pine	12.5	30	10
All other commercial species	17.5	30	10

8.3 Decay, Waste and Breakage

VDYP generated volumes for both current polygon volume and yield table development, are net of decay, waste, and breakage (DWB) using forest inventory zone (FIZ) G and loss factors for Special Cruise 303. Default decay waste and breakage factors were also applied to all managed stand yield tables generated with TIPSY.

8.4 Operational Adjustment Factors

TIPSY uses operational adjustment factors (OAFs) to reduce the gross volumes of regenerated stands. There are two OAFs applied in TIPSY. OAF 1 allows for yield reductions associated with non-productive areas in the stand and uneven spacing of crop trees (clumping). OAF 2 allows for volume losses due to maturity and endemic and random loss not attributable to DWB factors. In the construction of the managed stand yield tables, OAF 1 is 15% and OAF 2 is 5% for all analysis units other than spruce leading stands. Where stands are spruce leading by more than 50% the OAF 2 is 10% to approximate volume losses due to spruce weevil. A similar OAF adjustment was applied in TSR II.

Recent work has been done by the Province and the Canadian Forest Service in quantifying volume losses due to Armillaria root rot. The Interior Cedar Hemlock (ICH) zone is more heavily impacted by Armillaria root rot than other ecological zones in B.C (B.C. Forest Service, 1995). Armillaria is known to exist on the TFL and has been recorded as an incidence on recent silviculture surveys, however due to the below ground and often hidden symptoms of the disease the volume loss has not been quantified explicitly to date. A 2004 study (Stearns-Smith *et al.*, 2004) in the Arrow TSA analysed the impacts of different levels of Armillaria root rot infections on timber supply in the Douglas-fir stands in the ICH. Growth losses were estimated to be 30 ±10% and corresponding volume losses were projected with TASS and incorporated into TIPSY as custom OAFs. As a result of that study, the current version of TIPSY (ver. 4.1) now incorporates Armillaria root rot OAFs although these OAFs are only applied to the Douglas-fir component of stands found within the ICH zone. Given the uncertainty of volume losses to timber supply in the TFL, sensitivity analyses will be conducted using the three levels of ICH Douglas-fir root rot OAFs in TIPSY.

8.5 Volume Reductions

The deciduous[17] volume in mixed stands is excluded from the merchantable volume for all existing stand analysis units that are projected with VDYP. Stands were projected in VDYP using the VRI inventory species proportions, density, productivity and volume adjustment attributes, after which the deciduous volume component was removed. Broadleaf deciduous species were not included in the managed stand yield tables projected with TIPSY.

Overall, the deciduous volume excluded from the THLB is less than 1 % of the growing stock on TFL3. Deciduous volume reduction was calculated separately for each analysis unit, and is summarized in Table 34.

[17] Larch is a commercial species and is not removed as a deciduous species component.

Table 34: Volume reductions for the deciduous species component of stands in the THLB.

AU Description	Gross THLB Volume (m^3)	Adjusted THLB Volume[1, 2] (m^3)	THLB Deciduous Volume[2] (m^3)	THLB Deciduous Volume[2] Component (%)
Spruce_ICH_Low	57,092	57,092	0	0.0
Spruce_ICH_Poor	80,588	79,669	919	1.1
Spruce_ICH_Med	90,943	90,027	916	1.0
Spruce_ICH_High	40,394	39,946	448	1.1
Spruce_ESSF_Low	225,112	225,112	0	0.0
Spruce_ESSF_Poor	665,193	665,193	0	0.0
Spruce_ESSF_Med	335,663	335,663	0	0.0
Spruce_ESSF_High	181,078	181,068	10	0.0
Balsam_Low	15,960	15,960	0	0.0
Balsam_Poor	181,333	181,333	0	0.0
Balsam_Med	99,121	99,121	0	0.0
Balsam_High	14,789	14,789	0	0.0
Cedar_Poor	73,327	73,177	150	0.2
Cedar_Med	52,917	52,044	873	1.7
Cedar_High	28,969	27,776	1,193	4.1
Fir_Pine_Poor	220,922	220,192	729	0.3
Fir_Pine_Med	681,421	667,851	13,569	2.0
Fir_Pine_High	242,475	237,878	4,597	1.9
Hemlock_Poor	336,936	336,500	436	0.1
Hemlock_Med	459,628	455,661	3,967	0.9
Hemlock_High	47,829	47,464	365	0.8
Larch_Poor	66,335	66,335	0	0.0
Larch_Med	637,895	630,562	7,332	1.2
Larch_High	86,064	84,231	1,833	2.1
Lodgepole_ICH_Med	140,148	139,038	1,110	0.8
Lodgepole_ICH_High	48,129	47,862	267	0.6
Lodgepole_ESSF_Poor	34,605	34,605	0	0.0
Lodgepole_ESSF_Med	227,860	227,860	0	0.0
Lodgepole_ESSF_High	52,588	52,585	3	0.0
DecidLarch_Med[3]	27	7	20	73.8
DecidLarch_High[3]	349	208	141	40.3
Total	5,425,686	5,386,810	38,876	0.7

[1] Adjusted inventory volumes are net of deciduous species.

[2] Larch is a commercial species and is not removed as a deciduous species component.

[3] Deciduous stands without previous harvest history are removed from the THLB – deciduous stand types with harvest history are relatively young (<40 years) and have low coniferous volumes.

8.6 Yields for Natural Stands

Since the 2004 Phase 2 inventory adjustment was applied to stands >20 years of age, the inventory volumes projected with VDYP were used for these stands, as discussed in Section 7.2.2. While Table 25 above shows average inventory attributes for AUs 1 to 31, the yield tables for this analysis were derived by projecting each inventory polygon individually in BatchVDYP, and averaging (weighted by polygon area) the projected stand attributes for each year, by AU. This method retained the inherent variability of the stand attributes when the analysis unit average yields were compiled.

Batch VDYP (ver. 6.6d) applies a default crown closure value[18] to stands <50 years of age regardless of the inventory values. The default crown closure values are shown above in Table 25.

8.6.1 Yield Adjustments for Natural Stands

In 2005, an adjustment was made to TFL3 inventory age, height, and volume based on 90 VRI Phase II ground samples established in the 2001 field season, and the 2004 Net Volume Adjustment Factor work that used destructive sampling of 58 trees.

The methodology for these adjustments follow the Fraser Protocol for statistical adjustment of inventories, and is discussed in *TFL3 Documentation of Analysis for Vegetation Resources Inventory Statistical Adjustment and Net Volume Adjustment Factor Development – Addendum (*Jahraus and Associates Consulting Inc. and Churlish Consulting Ltd., 2005). The adjusted population was limited to Vegetated Treed (VT) polygons ≥20 years of age.

The general approach taken for the inventory adjustment followed the following steps:

1. Height and age adjustment factors are derived from a comparison of ground and photo observations for each polygon. Inventory height and age of each polygon are multiplied by these factors.
2. A new “attribute-adjusted” inventory volume is calculated using Batch VDYP version 6.6d, where the adjusted height and age are the basis for site index.
3. A volume adjustment factor is calculated from the ratio of ground volume to attribute-adjusted inventory volume for the ground sampled polygons.
4. The volume adjustment factor is applied to all inventory polygons.

Table 35 shows the ratio of means adjustment factors as they were applied to height, age and net volume in the VRI inventory.

[18] See Appendix D of the *VDYP batch application user guide version 6.6d* (B.C. Ministry of Forests, 1999).

Table 35: Height, age and volume adjustment factors applied in the VRI inventory for vegetated treed stands >20 years of age.

Inventory Leading Species Stratum	Height Adjustment Ratio of Means	Age Adjustment Ratio of Means	"Attribute-Adjusted" Volume Adjustment Ratio of Means
Fir, Pine, Larch, Deciduous	0.905	1.032	1.265
Cedar, Hemlock	0.965	1.034	1.041
Balsam <121 years	1.053	1.300	1.026
Balsam >120 years	0.960	0.844	1.105
Spruce	0.974	1.081	0.977

Source: Table 2 in *TFL3 Documentation of Analysis for Vegetation Resources Inventory Statistical Adjustment and Net Volume Adjustment Factor Development - Addendum*.

8.7 Yields for Managed Stands

Yields for stands <20 years of age are projected with BatchTIPSY. Managed stand yield table input parameters were compiled from planting history data since 1995, and the weighted species proportions and planting densities were derived for each of the Analysis Units based on past performance.

Managed stand yield tables are projected for each inventory polygon individually using the input assumptions shown in Table 36. BatchTipsy projected stand yield attributes were averaged (weighted by polygon area) for each year, by managed stand AU[19].

Yields of the managed stand AUs reflect the productivity of the area identified within each AU, by management status[20].

8.7.1 Silviculture Management Regimes

All silviculture strategies in TFL3 assume even-aged management with reserves. Generally, partial harvesting is not conducted on the TFL; therefore no partial harvest yield curves were developed.

8.7.2 Regeneration Assumptions

Table 36 provides the detailed information used to create the managed TIPSY yield curves. The species distributions follow current regeneration practices in the TFL, on average, as the regeneration assumptions were based on past performance. Species compositions and initial density estimates from planting and regeneration surveys for cutblocks harvested since 1995 were analysed. After overlaying the cutblock openings on the inventory, area weighted estimates of species proportions and planting densities were determined for each inventory

[19] As discussed in Section 7.2.3, AUs for existing managed stands are differentiated by their age and the corresponding use of Class A seed. – existing managed (AU 101-131) and existing managed with Class A seed (AU 201-231)

[20] Management status refers to natural stands (AU 1 to 31), existing managed, (AU 101-131) existing managed with Class A seed applied (AU 201 to 231), and future managed (AU 301 to 331).

species group. Lodgepole pine and spruce stands were further stratified by BEC zone. The area weighted results of these estimates are shown in Table 36.

Table 36: Managed stand yield table assumptions as applied in TIPSY.

AU Description	Density	Net Factor	Regen Type	Regen Delay	Util	OAF1	OAF2	SX[1]	FDI	LW[1]	PL	PW[1]	PY[1]	CW
Spruce_ICH_Low	1,276	DWB	P	2	17.5	0.85	0.90	69	9	7	14			1
Spruce_ICH_Poor	1,276	DWB	P	2	17.5	0.85	0.90	69	9	7	14			1
Spruce_ICH_Med	1,276	DWB	P	2	17.5	0.85	0.90	69	9	7	14			1
Spruce_ICH_High	1,276	DWB	P	2	17.5	0.85	0.90	69	9	7	14			1
Spruce_ESSF_Low	1,318	DWB	P	2	17.5	0.85	0.90	89		1	10			
Spruce_ESSF_Poor	1,318	DWB	P	2	17.5	0.85	0.90	89		1	10			
Spruce_ESSF_Med	1,318	DWB	P	2	17.5	0.85	0.90	89		1	10			
Spruce_ESSF_High	1,318	DWB	P	2	17.5	0.85	0.90	89		1	10			
Balsam_Low	1,436	DWB	P	2	17.5	0.85	0.90	95			5			
Balsam_Poor	1,436	DWB	P	2	17.5	0.85	0.90	95			5			
Balsam_Med	1,436	DWB	P	2	17.5	0.85	0.90	95			5			
Balsam_High	1,436	DWB	P	2	17.5	0.85	0.90	95			5			
Cedar_Poor	1,231	DWB	P	2	17.5	0.85	0.95	7	80	2	10	1		
Cedar_Med	1,231	DWB	P	2	17.5	0.85	0.95	7	80	2	10	1		
Cedar_High	1,231	DWB	P	2	17.5	0.85	0.95	7	80	2	10	1		
Fir_Pine_Poor	1,384	DWB	P	2	17.5	0.85	0.95	3	63	18	12		4	
Fir_Pine_Med	1,384	DWB	P	2	17.5	0.85	0.95	3	63	18	12		4	
Fir_Pine_High	1,384	DWB	P	2	17.5	0.85	0.95	3	63	18	12		4	
Hemlock_Poor	1,078	DWB	P	2	17.5	0.85	0.95	11	53	17	18	1		
Hemlock_Med	1,078	DWB	P	2	17.5	0.85	0.95	11	53	17	18	1		
Hemlock_High	1,078	DWB	P	2	17.5	0.85	0.95	11	53	17	18	1		
Larch_Poor	1,414	DWB	P	2	17.5	0.85	0.95	12	21	39	25	3		
Larch_Med	1,414	DWB	P	2	17.5	0.85	0.95	12	21	39	25	3		
Larch_High	1,414	DWB	P	2	17.5	0.85	0.95	12	21	39	25	3		
Lodgepole_ICH_Med	1,469	DWB	P	2	12.5	0.85	0.95	7	29	17	45	2		
Lodgepole_ICH_High	1,469	DWB	P	2	12.5	0.85	0.95	7	29	17	45	2		
Lodgepole_ESSF_Poor	1,533	DWB	P	2	17.5	0.85	0.95	50	1	3	46			
Lodgepole_ESSF_Med	1,533	DWB	P	2	17.5	0.85	0.95	50	1	3	46			
Lodgepole_ESSF_High	1,533	DWB	P	2	17.5	0.85	0.95	50	1	3	46			
DecidLarch_Med	1,321	DWB	P	2	17.5	0.85	0.95	10	20	37	25		8	
DecidLarch_High	1,321	DWB	P	2	17.5	0.85	0.95	10	20	37	25		8	

[1]With TIPSY Volumes, white spruce is a proxy for hybrid spruce, and Douglas-fir is a proxy for larch, western white and ponderosa pine

Current practice is to regenerate all harvested areas in TFL3 with planted stock. The average regeneration delay is 1.75 years. The default seedling heights in TIPSY were used as they were representative of the heights of planted stock used in the TFL. Generally, spacing is not conducted on the TFL and is not planned for future managed stands. Class A seed use was assumed for stands ≤10 years of age and on all future managed stands. The assumptions regarding Class A seed use are discussed below in Section 8.8.1.

Post planting survey data was also compiled that showed varying levels of natural regeneration infill along with the planted stock. Discussions were had with Analysis Branch about the impact of natural regeneration on yields. Courtesy of the Stand Development Modelling group at the Ministry of Forests and Range, TASS runs were made to model the impacts of natural regeneration infill in addition to the planting density estimates shown in Table 36. Significant volume impacts at 100 years of age were not found across a representative range of infill densities and site indices for all Analysis Unit species groups due to the influence of natural regeneration (Di Lucca, 2008).

8.7.3 Species and Site Index Conversions

Existing balsam, hemlock, western redcedar, lodgepole pine in the ESSF zone and the conifer component of deciduous leading stands will be converted to the future managed stand species shown in Table 37. Where regenerated species differ from the leading species in the inventory, the inventory site index is converted to an equivalent site index of the leading regenerated species. BatchTIPSY uses the leading species as the reference species and internally assigns converted site indices to the other species within the stand where conversion equations are available. Where species conversions occured between the leading species found in the existing inventory and managed stand yields projected with BatchTIPSY, the Ministry of Forest and Range's Site Tools ver. 3.3 was used with the equations shown in Table 37.

Species conversion equations do not exist in Site Tools or in the yield models for interior varieties of western redcedar or for the deciduous species. Inventory site indices are not adjusted when cedar-leading AUs are converted to Douglas-fir leading stands.

Table 37: Site index conversion equations.

AU Description	Inventory SI Species	Conversion Equation	Future Managed Stand SI Species
Balsam	Bl	-1.953+(1.163*site_index)	Sx
Lodgepole_ESSF	Pl	-2.14+(1.09*site_index)	Sx
Hemlock	Hw	4.56+(0.887*site_index)	Fd
Cedar	Cw	n/a	Fd
DeciduousLarch	Ac, Ep, At, Act	n/a	Lw

8.8 Yields for Future Managed Stands

Future managed yields use the same silviculture regime assumptions as the existing managed stands shown in Table 36. All existing stands are assumed to regenerate to future managed stand AUs (series 301 to 331). Yields of the future managed stand AUs reflect the productivity of the area identified within each AU description, regardless of management status.[21]

[21] Management status refers to natural stands (au 1 to 31), existing managed, (au 101-131) existing managed with Class A seed applied (au 201 to 231), and future managed (au 301 to 331).

8.8.1 Genetic Gain Allowances

As a result of an on-going tree improvement program, a rational volume increase is expected for stands regenerating from genetically-improved stock. Data was obtained from the MoFR Seed Planning and Registry (SPAR) to provide empirical estimates of the genetic worth (GW) and the proportion of Class A seed planted by seed planning unit on TFL3 (McAuley, 2007). Table 38 shows the SPAR data of the improved seed use in TFL3 since 2001.

Table 38: Seed Planning and Registry data for TFL3.

Year	Species	Zone	Elev Unit	Seedling (000's)s	GW	Class A	Class B+	Class B	Total	Percent Improved A&B+ (%)	Percent Improved Class A (%)	Percent Improved Class B (%)
2001	LW	NE	Low	248.0	2	248.0	0.0	130.0	378.0	66	66	34
2001	PLI	NE	Low	363.4	2	321.0	42.4	35.0	398.4	91	81	9
2001	SX	NE	High	649.4	11	649.4	0.0	0.0	649.4	100	100	0
2001	SX	NE	Mid	416.0	22	416.0	0.0	0.0	416.0	100	100	0
2002	LW	NE	Low	250.0	2	250.0	0.0	100.0	350.0	71	71	29
2002	PLI	NE	Low	310.0	5	235.0	75.0	0.0	310.0	100	76	0
2002	SX	NE	High	270.0	4	270.0	0.0	80.0	350.0	77	77	23
2002	SX	NE	Low	35.0	2	35.0	0.0	0.0	35.0	100	100	0
2002	SX	NE	Mid	127.0	3	127.0	0.0	0.0	127.0	100	100	0
2003	LW	NE	Low	110.0	24	110.0	0.0	20.0	130.0	85	85	15
2003	PLI	NE	Low	300.0	6	300.0	0.0	40.0	340.0	88	88	12
2003	SX	NE	High	207.0	7	207.0	0.0	0.0	207.0	100	100	0
2003	SX	NE	Mid	60.0	4	60.0	0.0	0.0	60.0	100	100	0
2004	LW	NE	Low	300.0	20	300.0	0.0	0.0	300.0	100	100	0
2004	PLI	NE	Low	300.0	7	300.0	0.0	0.0	300.0	100	100	0
2004	SX	NE	High	200.0	12	200.0	0.0	0.0	200.0	100	100	0
2004	SX	NE	Low	20.0	5	20.0	0.0	0.0	20.0	100	100	0
2004	SX	NE	Mid	220.0	11	220.0	0.0	0.0	220.0	100	100	0
2005	LW	NE	Low	370.0	29	370.0	0.0	0.0	370.0	100	100	0
2005	PLI	NE	Low	205.0	16	200.0	5.0	127.0	332.0	62	60	38
2005	SX	NE	High	380.0	6	380.0	0.0	0.0	380.0	100	100	0
2005	SX	NE	Low	29.0	5	29.0	0.0	0.0	29.0	100	100	0
2005	SX	NE	Mid	200.0	2	200.0	0.0	0.0	200.0	100	100	0
2006	LW	NE	Low	91.0	32	91.0	0.0	0.0	91.0	100	100	0
2006	PLI	NE	Low	75.0	7	70.0	5.0	80.0	155.0	48	45	52
2006	SX	NE	High	390.0	11	390.0	0.0	0.0	390.0	100	100	0
2006	SX	NE	Low	0.0	0	0.0	0.0	21.0	21.0	0	0	100
2006	SX	NE	Mid	215.0	14	215.0	0.0	0.0	215.0	100	100	0
2007	LW	NE	Low	200.0	32	200.0	0.0	0.0	200.0	100	100	0
2007	PLI	NE	Low	69.1	7	69.1	0.0	0.0	69.1	100	100	0
2007	SX	NE	High	500.0	7	500.0	0.0	0.0	500.0	100	100	0
2007	SX	NE	Mid	190.0	8	190.0	0.0	0.0	190.0	100	100	0

Source: Seed Planning and Registry system data supplied by L. McAuley, Seed Policy and Planning Officer

A proportionally weighted GW factor was determined from the values in Table 38 to provide a single GW estimate and the proportion of Class A seed for each species across all elevation bands for each year. The average GW and average percent Class A seed was determined from the annual weighted values to produce the overall average GW and average proportion of Class A seed shown in Table 39. The overall average GW estimate was weighted by the proportion of Class A seed to provide the proportional GW estimate shown in Table 39 for use in TIPSY. The proportional GW was applied to the respective species in the future managed and existing managed stands ≤10 years of age, regardless of the species composition in the AU.

Table 39: Average Genetic Worth as applied in TIPSY.

Species	Mean GW	Mean Class A Seed (%)	Proportional GW
Lw	19	86.3	16
Pl	7	78.5	5
Sx	10	97.6	10

The Forest Genetic Council expects genetic gains to improve over the next 10 years (Forest Genetics Council of B.C., 2007). Given the uncertainty of future gains, a sensitivity analysis will be conducted based on the 2018 forecasts shown in Table 40.

Table 40: Forest Genetics Council Genetic Gain Forecast to 2018.

Species	Seed Zone	SPU	Elevation Band (m)	Forecast Seed Avail 2007[1]	Forecast Genetic Gain 2007	Forecast Seed Avail 2018[1]	Forecast Genetic Gain 2018	SPAR Inventory 2007[2] (M)
Sx	NE	LOW	1 - 800	0.1M (9%)	20%	2.2M (200%)	26%	Use MID
Sx	NE	MID	800 – 1500	6.5M (141%)	11%	8.2M (178%)	15%	10.1M
Sx	NE	HIGH	1500 – 1900	6.7M (126%)	12%	7.3M (149%)	14%	3.1M
Lw	NE	LOW	700 – 1400	4.1M (132%)	29%	4.0M (129%)	32%	2.4M
Fdi	NE	LOW	400 – 1000	0.4M (17%)	25%	3.0M (125%)	25%	1.37M
Fdi	NE	HIGH	1000 – 1600	0.4M (12%)	29%	4.3M (126%)	32%	0.02M
Pli	NE	LOW	700 - 1400	3.7M (106%)	10%	8.6M (246%)	16%	8.01M
Pw	KQ	LOW	500 - 1400	1.0M (50%)	R65	2.7M (135%)	R65+	1.9M

[1] Annual orchard seed production estimates; Percent of SPU Seed Use based on 5 year historical average (see brackets); Cumulative SPAR seed inventory not considered; Seed also for use in transition (overlap) zones.

[2] Based on Lot Search report Nov 9, 2007. All Owners. Total (RES + SUR)

Source: *Forest Genetic Council Business Plan 2007/2008* (Forest Genetics Council of B.C., 2007).

8.9 Yield Estimates in the Non-Harvestable Land Base

Stands in the non-harvestable land base (NHLB) were identified by the same AU description as those found in the THLB, although they were grouped into separate analysis units from the THLB. All AU numbering for the NHLB follow the same format as the THLB but the number series is >1000 (e.g. 1001 to 1031 for natural stands >20 years). Separate yield tables were derived for stands in the NHLB using the same criteria as the THLB, although the area weighting was based on the forested portion of the non-harvestable land base.

9 Protection

9.1 Unsalvageable Losses

Unsalvageable losses represent natural disturbance events that are non-recoverable and result in a decrease in the productive harvest volume of the TFL. Generally, endemic losses such as the spruce weevil or Armillaria root rot are accounted for through operational adjustment factors in managed stands (see Section 8.4 above) or the existing inventory sampling. For this analysis, unsalvageable losses focus on epidemic losses, such as fire, windthrow or other disturbance events.

Estimates of the average annual unsalvageable volume losses are given in Table 41, based on local knowledge and recent surveys since the last determination. The non-recoverable loss volume will be removed from projected harvest levels in the analysis.

Table 41: Non-recoverable loss volume.

Loss Type	Annual Volume Loss (m^3)
Fire	211
Mountain Pine Beetle[2] (epidemic)	2,398
Spruce bark beetle	3
Douglas-fir bark beetle	0
Windthrow[1]	0
Total	**2,612**

[1] Windthrow mainly occurs inside cutblock boundaries in relation to Wildlife Tree Retention (WTR) areas. Volume has already been excluded through WTR area reductions.

[2] Current epidemic loss – Ministry of Forests and Range projections are for the pine beetle kill volume to decline to 0 after year 2020 (Source: B.C. Ministry of Forests and Range. 2008a. Excel spreadsheet: *BCMPB.v4.NoMgmtSummaryOfKill.PineUnits.xls.* Website for the Provincial-Level Projection of the Current Mountain Pine Beetle Outbreak. www.for.gov.bc.ca/hre/bcmpb/Year4.htm)

Unsalvageable losses have not been a major volume loss within TFL3 in the past. Historically, fire has been shown as the major loss but generally represents very few hectares on an annualized basis. Windthrow has not been a significant disturbance in the TFL, although a minor component of windthrow has been found to occur primarily within cutblocks around wildlife tree retention (WTR) boundaries. As windthown WTR trees were retained for habitat in the first place, historical practice has been to leave windthrown WTR trees for coarse woody debris. As there has already been an area-based netdown for WTR areas, no specific accounting is made for windthrown trees on harvest volume in Table 41.

Historically, epidemic disease has not been a significant loss factor, and losses to bark beetles for species other than pine have been relatively minor. Current estimate however, is an annual unsalvageable loss of nearly 2,400 m^3 per year attributable to the mountain pine beetle epidemic. These numbers are based on the findings from the pest survey flights in recent years and are the best estimates available.

Sensitivity analyses will examine the impacts of the mountain pine beetle epidemic on timber supply within TFL3, including the loss of the pine component within mixed species stands. Beetle impacts are based on the current Provincial mountain pine beetle projections. It is expected that the non-recoverable losses attributed to mountain pine beetle in Table 41 will decline over the length of the planning horizon once the beetle infested pine is dead.

9.1.1 Determining the Non-Recoverable Loss Volumes

The area and volume of stands adversely impacted by mountain pine beetle, spruce bark beetle and fire is shown in Table 42. Damaged stands in the TFL that were classified as being under Very Severe[22] attack in the forest health flights from 2005, 2006 and 2007[23] were identified. To approximate the non-recoverable volume, impacted stands were assessed for their proximity to existing roads. Fire impacted stands were considered non-recoverable if they were more than 200 m from the existing road network, while beetle killed stands had a 500 m buffer applied. The average stand volume was estimated from the inventory and the annual unsalvageable volume was calculated.

Table 42: Summary of unsalvageable loss calculations for fire, mountain pine beetle (IBM) and spruce bark beetle (IBS).

Pest/Incidence	3-year total impacted THLB area (ha)[1]	3-year impacted THLB area outside of road buffers (ha)[2]	% Area Unsalvageable (based on 3-year data)	Average annual Attacked Area (ha)[3]	Average Annual Unsalvageable Area (ha)	Average vol/ha[4]	Annual Unsalvageable Volume (m^3)
Fire	30.24	3.24	11%	10.08	1.08	195	211
IBM – Pine	240.00	50.00	21%	54.29	11.31	212	2,398
IBS - Spruce	8.09	0.09	1%	1.80	0.02	174	3

[1] THLB area was calculated by multiplying polygon area by % thlb (thlb/cflb) and by the mid-point of severity red attack percent (V=0.75)

[2] 500 metre buffers were used for pine & spruce beetle polygons & 200 metre buffers for fire polygons.

[3] Areas in the original 3-year summary were netted down to acknowledge the average impacted species component of the inventory.

[4] Average volumes per hectare are based on the area weighted AU inventory volumes.

[22] Only forest health polygons classified as *Very Severe* were considered in the assessment of unsalvageable losses for mountain pine beetle (IBM) and spruce bark beetle (IBS) According to the MoFR forest health information, *Very Severe* is considered greater than 50% of trees in the polygon with red attack.

[23] Three years of Provincial Annual Forest Health Flight Data data (fhf_poly.shp for 2005 to 2007) was reviewed against the resultant data set derived for this analysis.

9.2 Provincial Mountain Pine Beetle Projection

Since 2004, the Ministry of Forests and Range, Research Branch has been forecasting the current mountain pine beetle outbreak. Mountain pine beetle attack assumptions for the TFL3 analysis are based on the spatial Year 5 BCMPB results (BCMPB) for the provincial level projection of the attack (Walton *et al.,* 2008). The section briefly describes the BCMPB data and how it was incorporated into the analysis.

9.2.1 Year 5 BCMPB Data

The Year 5 BCMPB data was provided as a raster with 16 ha grid resolution. The Provincial model assumes there is no harvesting after 2007 when forecasting the annual beetle spread and impact and the cumulative percent pine killed in each 16 ha grid cell. The projection proceeds until 2026, by which time most of the susceptible pine volume is killed. The BCMPB data includes some of the input data such as age, inventory type group, total and pine volume and overall susceptibility to mountain pine beetle for each grid cell.

The two main challenges in converting the Provincial BCMPB forecast are incorporating the grid data into the TFL3 resultant and converting the percent killed into percent volume lost using shelf life curves.

Incorporating Grid Data into the TFL3 Resultant

Beetle attack chronosequence in the BCMPB projection occurs in susceptible grid cells. Simply overlaying or rating the grid data onto the resultant may not be sufficient since it may orphan otherwise susceptible polygons that occur in non-susceptible grid cells. Alternatively, pine could be killed in non-susceptible stands.

The TFL inventory polygons were classified as susceptible or non-susceptible using the same criteria used to classify the Provincial grid (some component of pine that is >60 years of age). Susceptible polygons were assigned the attack sequence of the nearest susceptible grid cell, using a tolerance of 2 grid cell widths (800 m) from the cell centre. This process is illustrated in Figure 1.

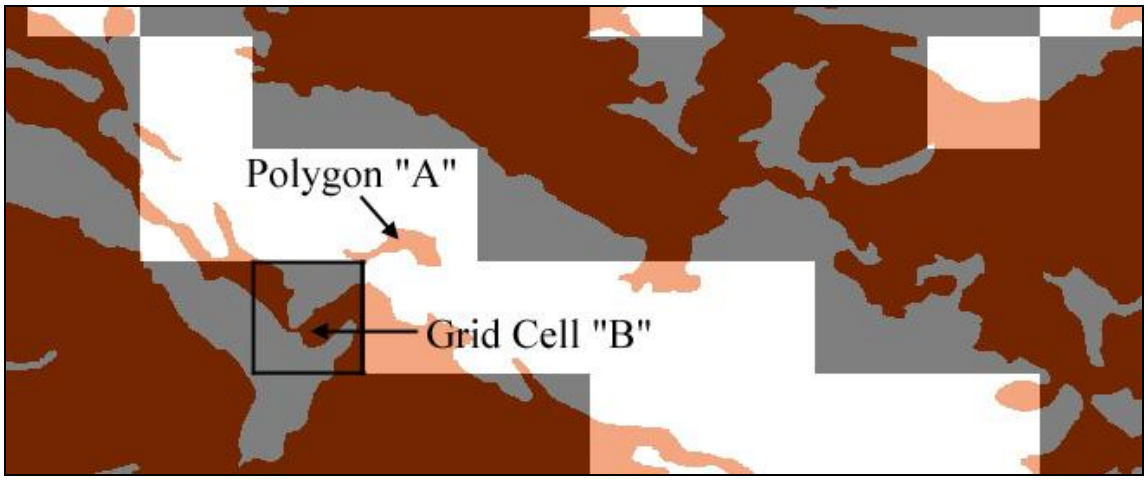

Figure 1: Susceptible grid cells are shown in dark gray: susceptible resultant polygons are shown in red. Polygon "A" is in a non-susceptible grid cell, but is assigned the attack sequence of grid cell "B." since it is within 2 grid cell widths (800 m) from the grid cell "B" centre.

Converting Percent Killed to Percent Volume Lost Using Shelf Life Curves

Once the BCMPB grid attributes were assigned to susceptible resultant polygons, each polygon had:

- An attack chronosequence of % pine volume killed (from BCMPB), and;
- A shelf life curve that varies depending on general climate categories (Dry, Moist, and Wet BEC subzones; also from BCMPB).

Recent data collection and analysis have provided more accurate shelf-life estimates then the initial pine beetle analyses. The Year 3 BCMPB analysis (Eng *et al.*, 2006) updated the Year 2 BCMPB assumptions based on the shelf-life information provided in Lewis and Hartley (2005). The Year 3 assumptions provided two sets of shelf-life curves based on sawlog (lumber) and chip (pulp, OSB, fuel, etc.) forest products for both wet and dry sites (Figure 2). Shelf-life curves for moist sites were an average of the dry and wet sites, and the shelf life curves were applied as appropriate for dry, moist, and wet BEC subzones.

For TFL3, shelf life curves for lumber and chips use the values from the Year 3 BCMPB analysis (Eng *et al.*, 2006), as shown in Figure 2. An average shelf life curve was also developed using interpolated values between the chip and sawlog shelf life curves.

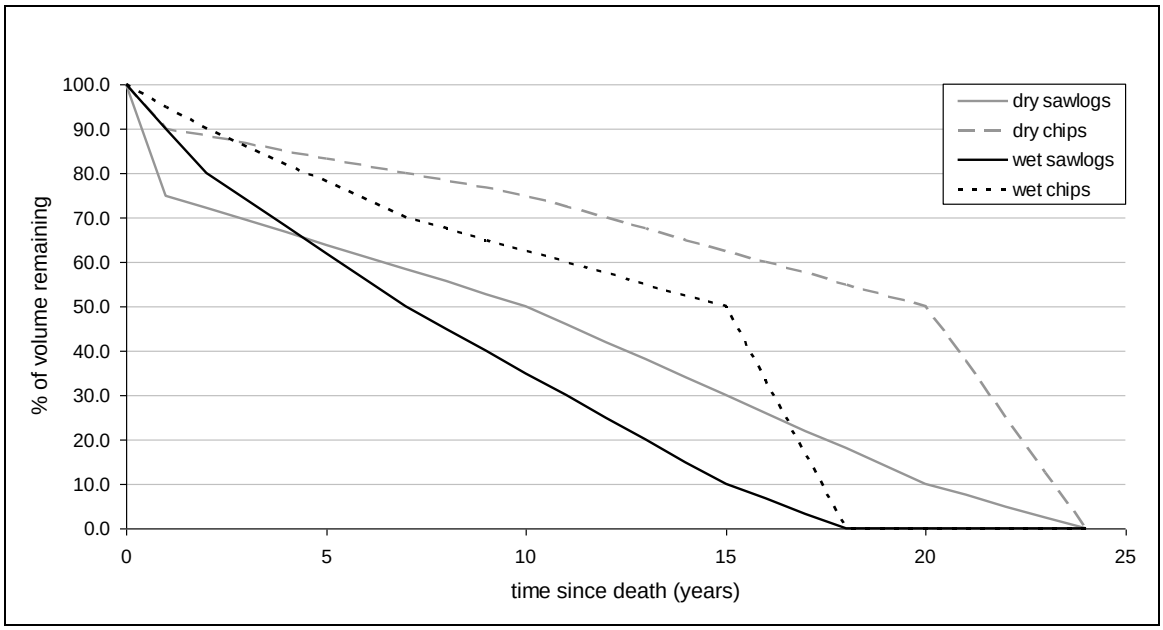

Figure 2: Shelf life curves for dry and wet subzones (Source: Eng *et al.* 2006; concept from Lewis and Hartley, 2005).

9.2.2 Loss Curves, Stand Break-up and Regeneration Delay

The attack chronosequence and severity from Year 5 BCMPB (Walton *et al*. 2008) and the shelf life curves were combined to produce loss curves for each grid cell representing the percent of pine removed from the available timber supply over time. Pine volume killed by mountain pine beetle at some period in the Year 5 BCMPB chronosequence was decayed along shelf life curves from the year of mortality. One or more (if a grid cell was attacked over multiple years) loss curves were proportionately summed to produce an overall loss curve for each grid cell.

Loss curves were developed for using shelf lives for sawlogs, chips and an average of these two products. A clustering algorithm was used to combine the individual grid cell loss curves into ten generalized volume loss curves for use in the timber supply model for the three product categories (lumber, chips and the average).

The generalized volume loss curves for each attack cluster, based on the average of chips and lumber shelf life, are shown in Figure 3. For comparison purposes, the volume loss curves in Figure 3 assume 100% pine, however the analysis units and corresponding loss vary in their proportion of pine. Loss curves were only applied to the pine component of stands susceptible to mountain pine beetle, defined has being within 800 m of an impacted grid cell, having some component of pine within the AU and a current stand age older than 60 years.

Analysis units comprised of >60% pine and found on Clusters 1, 3, 6, 8 and 9 in Figure 3 were assumed to break-up and regenerate to their existing yield curves with a 10 year regeneration delay. Actual age of break-up was dependent upon the proportion of pine within the AU species composition and was assumed to be when the total stand volume (all species, including pine) was reduced below a 35% threshold. The volume losses depicted in Figure 3 are applied to the pine component of the susceptible stands. The yield of stands harvested prior to break-up reflect the loss curve impacts at the time of harvest.

Stands with less than 60% pine, or stands on the lighter attacked Clusters 2, 4, 5, 7 or 10, were assumed to continue to grow as mature stands but with reduced pine volumes.

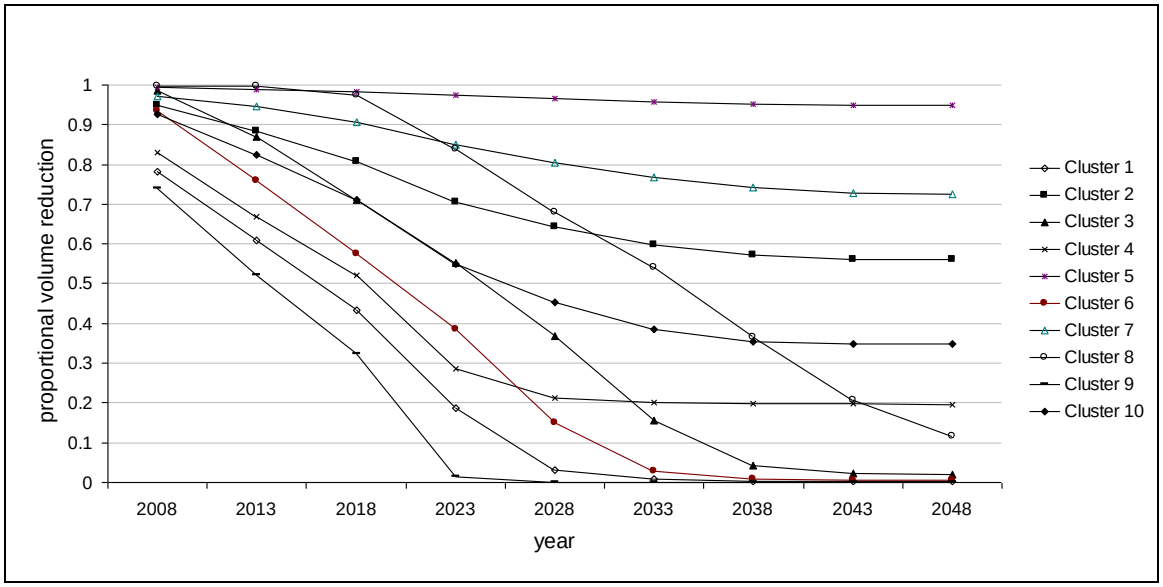

Figure 3: TFL3 generalized volume loss curves (assuming 100% pine and an average of chips and lumber shelf life) for each attack cluster. Losses are applied to the pine component of the stand only. Initial proportional volume reductions <1 indicate stands were attacked prior to 2008 and have since decayed along the shelf life projection.

9.2.3 Proportion of TFL3 Impacted by Mountain Pine Beetle

The 2008 forecast outbreak data was obtained for TFL3 and the proportion of susceptible pine (the pine component of all stands >60 years within 800 m of a pine beetle cell) relative to the total THLB component of the inventory is shown in Table 43. Susceptible pine THLB area is shown when stands are within 800 m of an attacked pine beetle cell.

Table 43: Proportion of pine stands susceptible to mountain pine beetle in TFL3.

AU #	AU Description	THLB Area (ha)	Susceptible. Pine THLB Area (ha)	Total Pine Inventory Volume - all ages (m^3)	Susceptible Pine Inventory Volume (m^3)	Total Inventory Volume (m^3)	Susceptible Pine as % of Total Inventory Volume
1	Spruce_ICH_Low	264	118	702	493	57,092	1%
2	Spruce_ICH_Poor	666	164	1,195	805	79,669	1%
3	Spruce_ICH_Med	662	262	5,807	4,115	90,027	5%
4	Spruce_ICH_High	184	81	675	550	39,946	1%
5	Spruce_ESSF_Low	848	384	3,264	1,509	225,112	1%
6	Spruce_ESSF_Poor	2,197	996	12,971	5,970	665,193	1%
7	Spruce_ESSF_Med	2,189	541	5,438	2,525	335,663	1%
8	Spruce_ESSF_High	1,372	492	7,388	5,022	181,068	3%
9	Balsam_Low	783	67	112	38	15,960	0%
10	Balsam_Poor	1,139	374	4,279	2,035	181,333	1%
11	Balsam_Med	966	262	3,747	2,516	99,121	3%
12	Balsam_High	143	0	0	0	14,789	0%
13	Cedar_Poor	446	165	1,515	1,188	73,177	2%
14	Cedar_Med	327	104	937	717	52,044	1%
15	Cedar_High	223	92	808	782	27,776	3%
16	Fir_Pine_Poor	977	711	20,104	18,835	220,192	9%
17	Fir_Pine_Med	3,126	2,105	49,688	42,741	667,851	6%
18	Fir_Pine_High	1,045	683	25,691	25,377	237,878	11%
19	Hemlock_Poor	1,020	789	9,624	8,212	336,500	2%
20	Hemlock_Med	2,192	1,208	10,116	7,463	455,661	2%
21	Hemlock_High	267	99	1,671	1,148	47,464	2%
22	Larch_Poor	293	279	5,638	5,279	66,335	8%
23	Larch_Med	2,970	2,749	43,257	40,512	630,562	6%
24	Larch_High	584	311	4,574	4,334	84,231	5%
25	Lodgepole_ICH_Med	654	583	90,681	89,622	139,038	64%
26	Lodgepole_ICH_High	443	145	29,023	27,864	47,862	58%
27	Lodgepole_ESSF_Poor	152	128	21,846	20,304	34,605	59%
28	Lodgepole_ESSF_Med	937	857	165,723	163,877	227,860	72%
29	Lodgepole_ESSF_High	328	177	37,067	36,551	52,585	70%
30	DecidLarch_Med	53	0	1	0	7	0%
31	DecidLarch_High	138	0	10	0	208	0%
Total		27,587	14,926	563,550	520,384	5,386,810	10%[1]

[1] Overall THLB area weighted average susceptible percent of pine for the TFL.

10 Integrated Resource Management

The purpose of this section is to provide details on how the modelling methodology will integrate non-timber resource values with timber objectives.

10.1 Management Zones

Management zones are geographically referenced areas that require unique management considerations. Areas requiring the same management regime or the same forest cover requirements are grouped into management zones. Table 44 lists the management zones for TFL3 and the criteria used to define these zones.

Table 44: Management zones (continued on following page).

Management Zone	Criteria Used to Delineate Zone	Rationale/Comment
Landscape Units: Perry – N514 Hoder – N516 Koch – N517	Spatially defined using Provincial inventory data.	Legally established in *KBHLP Order* (Government of B.C., 2002) Objective 1, Map 1.1. Perry and Hoder are partially within the boundaries of TFL3. Forest cover objectives are managed for the area inside TFL3.
BEC Variants: ESSFwc 1 ESSFwc 4 ESSFwcp ICH dw 1 ICH mw 2 IMA un	Spatially defined BEC zones to the variant level using Provincial inventory data. NDT types are based on BEC variant.	*KBHLP Order* (Government of B.C., 2002) Objective 2 specifies that representation of mature and old forest is to be achieved at the variant level, by natural disturbance type.
Connectivity Corridor	Corridor areas are spatially identified using Provincial inventory data. Slopes ≤80% determined from TRIM data.	Legally established in *KBHLP Order* Objective 5, (Government of B.C., 2002). Ensures that forest cover objectives are represented within areas of the TFL that are important for wildlife dispersal on slopes ≤80%.
Ungulate Winter Range	Spatially defined UWR polygons from Provincial inventory data for UWR-4-001	Established under *Government Actions Regulations* S.9(2) and S.12(1) on Feb 07, 2007 (Government of B.C., 2007). Management requirements are designed to maintain the quality of shelter cover.
Visual Quality Objectives: Retention Partial Retention Modification	Spatially defined from provincial inventory data accompanying the *Order for the Establishment of Visual Quality Objectives and Scenic Areas for the Arrow Boundary District* (Government of B.C., 2005).	Legally established objectives for VQOs in *KBHLP Order* (Government of B.C., 2002) Objective 2(9). Established to conserve the quality of views from major waterways, highways, and communities. Specific VQO polygons are identified and established under the *Government Actions Regulations* S.7(1) as the *Order for the establishment of Visual Quality Objectives and Scenic Areas for the Arrow Boundary District* (Government of B.C., 2005).
OGMAs	Spatially identified from Provincial inventory data of DRAFT Old Growth Management Areas.	DRAFT OGMAS are not formally established but SCFP has agreed to the OGMAs and plan their operational activities accordingly.

Management Zone	Criteria Used to Delineate Zone	Rationale/Comment
Alternate Operability Areas	Spatially identified from the 1996 Operability classification for TFL3.	Used to examine the impacts of a partitioned harvest in areas classified as 'alternate' operability in a sensitivity analysis.
Enhanced Resource Development Zones – Timber	Spatially identified from Provincial inventory data. The area of the TFL that is outside the connectivity corridor, domestic watersheds and visual quality zones	Legally established in *KBHLP Order* Objective 7, (Government of B.C., 2002). and shown as Map 7.1 as part of this Order.
Domestic Watersheds: Class 1 Class 2 Class 3	Spatially identified domestic watershed polygons from Regional data.	Consumptive use stream objectives are legally established in *KBHLP Order* Objective 2(6) (Government of B.C., 2002). Boundaries of the watersheds are delineated by the height of land and the boundary of TFL3. Established to reduce the impacts of forest development on streams licensed for human consumption.
Valhalla Provincial Park	Spatially defined using Provincial inventory data.	Outside the TFL boundary, but inside the Hoder LU. Will be used in a sensitivity analysis to consider the park contribution to old seral targets for the Hoder LU. Not used in the base case.

10.2 Forest Cover Requirements

The timber supply analysis will account for forest cover objectives at the landscape level. Forest cover management aims to protect biodiversity, identified wildlife habitat, domestic water use, and visual quality by specifying target height and age distributions. The primary source of direction for forest cover management in TFL3 is the *Kootenay Boundary Higher Level Plan Order* (Government of B.C. 2002). Summaries of the forest cover targets are shown in Table 45.

Table 45: Summary of forest cover targets.

Resource	Criteria	Cover Requirement	Applied to:	
			Zone	Cover Type
Patch Size Distribution.	Desired patch size and % of LU area ≤20 years of age.	Early seral patch size distribution by BEC Variant within each Landscape Unit.	Landscape Unit	Crown forested area
ERDZ-T Zones	Green-up height	Stand reestablishment.	Enhanced Resource Development Zones – Timber unencumbered by other IRM issues.	THLB
Visual Resources Management	% denudation and visually effective green-up	No more than a specified percentage of each visual quality polygon can be less than the visually effective green-up height.	VQO polygons	Crown forested area
Landscape Level Biodiversity	Old seral cover	A specified percentage of each BEC variant must be greater than the designated old seral age. DRAFT OGMAs expected to meet target requirements in the base case.	BEC variants by Landscape Unit	Crown forested area
	Mature + old seral cover	A specified percentage of each variant must be greater than the designated mature seral age. DRAFT OGMAs are expected to meet old seral component of requirements in base case	NDT 3 BEC variants in Perry Landscape Unit	Crown forested area
Consumptive water	Equivalent clearcut area (ECA)	ECA of each domestic watershed should be less than a specified percentage.	Class 1, 2, and 3 Domestic watersheds	Crown forested area
Ungulate Winter Range	Seral cover	Depending on BEC, 30 or 40% of the UWR management unit in TFL3 must be greater than the minimum age by management unit. No more than 40% of UWR management unit area can be <20 years old	UWR Management Units	Crown forested area excluding broadleaf stands.
Connectivity Corridors	Mature + Old seral cover	Desired spatial location of old and mature+old seral cover requirements appropriate to each BEC variant and LU. OGMAs are assumed to meet old seral requirements in base case.	Connectivity corridor	Forested area with slope <80%

10.2.1 Adjacency and Cutblock Green-up

The *Kootenay Boundary Higher Level Plan Order* (*KBHLP Order)* specifies the green-up height for all areas other than community watersheds, visually sensitive areas and Enhanced Resource Development Zones – Timber (ERDZ-T) to be 2.5 metres. The green-up requirement for ERDZ-Ts is the successful regeneration of cutblocks. There are no community watersheds in TFL3. Special green-up requirements apply to visual resource objectives, and are discussed in section 10.2.2.

Current practice on the TFL is to emulate natural disturbance patterns to the extent practicable. The *Forest Planning and Practices Regulation* (FPPR) S 64 limits the size of cutblock openings to 40 ha in the Arrow Boundary Forest District, except for salvage, or where cutblock openings are designed with the structural and temporal distribution consistent with natural disturbance.[24]

To emulate natural disturbance, the early seral patch size areas and distributions shown in Table 46 are used as management objectives for each of the natural disturbance types within the Landscape Units. In practice, only early seral patches (stand age ≤20 years) are monitored for patch area distribution.

Table 46: Early seral patch size distribution targets.

NDT	Patch Size Area		Percent of Seral Stage by Landscape Unit		
	Minimum (ha)	Maximum (ha)	Minimum %	Maximum %	Midpoint %
1 or 2	0	40	30	40	35
1 or 2	41	80	30	40	35
1 or 2	81	250	20	40	30
3	0	40	20	30	25
3	41	80	25	40	35
3	81	250	30	50	40

Source: *Landscape Unit Planning Guide (Government of B.C. 2000a)* and *TFL3 Proposed Management Plan #10* (Slocan Forest Products, 2003)

Generally, current practice on the TFL is to use a 100 m distance between similar seral stage openings for grouping into patches. Sensitivity analysis will examine appropriate opening distances for patches when reporting the model output, with consideration to the 100 m opening distances generally used in practice.

The impacts of applying a 2.5 m green-up height to all areas other than community watersheds, visually sensitive areas and ERDZ-T zones will also be explored through sensitivity analysis. Consistent with the TSR 2 analysis, the green-up sensitivity will assume a maximum allowable disturbance of 25% within each LU.

[24] *FPPR*, S. 64 (4) The maximum 40 ha cutblock size limit does not apply when no part of net area to be reforested is >2 tree lengths from the block boundary or a reserve area >0.25 ha in size. If reserve areas are <0.25 ha, then the net area to be reforested can not be >1 tree length from the reserve area.

10.2.2 Visual Resources

The December 2005, the *Order for the Establishment of Visual Quality Objectives and Scenic Areas for the Arrow Boundary District* (Government of B.C., 2005) was established as the basis for visual quality management in TFL3. The forest cover percent denudation and visually effective green-up are determined separately for each visually sensitive area.

Percent Denudation

The B.C. Ministry of Forests (1998b) document *Procedures for Factoring Visual Resources into Timber Supply Analyses (*the *Procedures)* specifies planimetric percent denudation ranges for each visual quality class. The percent denudation ranges were based on a planimetric to perspective (P2P) ratio of 2.0, meaning that for each hectare disturbed in perspective view, 2.0 hectares can be disturbed in plan view. In 2003 the *Procedures* were revised in the *Bulletin – Modelling Visuals in TSRIII* (B.C. Ministry of Forests, 2003; referred to here as the *Bulletin*). The *Bulletin* outlines the process for using ground slope to estimate a P2P ratio in order to provide a more accurate calculation of the area that may be harvested while maintaining visual quality objectives.

For this analysis, the average slope in 10% class groups was determined from TRIM data for each hectare. Using the average slope class, each hectare was assigned a P2P ratio as shown in Table 47, and an area-weighted average P2P ratio was determined for each visual polygon.

Table 47: Predicted P2P ratios (with 95% confidence limits) for slopes 0% to 70%.

Slope	0%	10%	20%	30%	40%	50%	60%	70+%
P2P Ratio	4.68	3.77	3.04	2.45	1.98	1.6	1.29	1.04

Source: *Bulletin - Modelling Visuals in TSR III*.

The Visual Absorption Capacity (VAC) was used to refine the percent denudation range to a single value for each visual polygon shown in Table 48. Also shown in are the weighted P2P ratios, the respective percent denudation for each visual polygon and the maximum area that may be below the visually effective green-up (VEG) height. Clearcutting is the silviculture system assumed for all visual quality analyses, and percent denudation applies to the Crown Forested Land Base.

Table 48: Calculation of percent denudation for each visually sensitive area, based on visual absorption capacity (VAC).

Visually sensitive area	VAC[1]	EVQO[3]	Percent denudation[4]	Gross Area (ha)	Non-Forested Area (ha)	Crown Forested Area (ha)	Area Weighted P2P Ratio	Maximum denudation (ha)	THLB Area (ha)
128	M	M	12.6%	2	2	0	0.00	0.0	0
131	L	M	7.1%	1	1	0	0.00	0.0	0
383	M[2]	M	12.6%	404	26	378	1.99	95.0	263
386	L	PR	1.6%	5	0	5	3.73	0.3	4
410	M[2]	M	12.6%	416	61	355	1.85	82.6	155
414	L	PR	1.6%	3	0	3	3.30	0.1	1
420	M[2]	M	12.6%	1,993	236	1757	2.16	478.0	1,149
438	H[2]	M	18.0%	132	132	0	0.00	0.0	0
444	M[2]	M	12.6%	293	12	281	1.94	68.7	147
445	M[2]	PR	4.3%	355	85	269	1.74	20.2	100
451	H[2]	M	18.0%	11	8	3	3.29	1.6	0
453	H[2]	M	18.0%	556	348	208	1.84	68.8	42
802A	L	PR	1.6%	0	0	0	2.45	0.0	0
803	M[2]	PR	4.3%	303	7	296	2.34	29.8	252
Total THLB Area									2,113

[1]Visual Absorption Capacity: L=low, M = medium; H= high.

[2]Where VAC was missing from District information, previous TFL3 Visual Inventory VAC information was used.

[3]Recomended Visual Quality Classes: R = retention; PR = partial retention; M = modification; MM = maximum modification – from the *Order for the establishment of Visual Quality Objectives and Scenic Areas for the Arrow Boundary District*

[4]VQO-specific percent denudation figures are taken from Table 3 in the *Bulletin – Modelling Visuals in TSR III.*

Visually Effective Green-up

Percent denudation refers to the proportion of a visually sensitive area that is below the visually effective green-up (VEG) height. As noted in the *Procedures*, VEG height is highly dependent on slope. To account for this effect, the *Procedures* specify VEG tree heights by the slope classes shown in Table 49.

Table 49: Tree height required to meet VEG height by percent slope class for well stocked stands.

Slope (%)	0-5	6-10	11-15	16-20	21-25	26-30	31-35	36-45	46-50	51-55	56-60	60+
Tree Height (m)	3.0	3.5	4.0	4.5	5.0	5.5	6.0	6.5	7.0	7.5	8.0	8.5

Source: Table 4 of *Procedures for Factoring Visual Resources into Timber Supply Analyses*

The VEG heights from Table 49 are interpolated to the slope classes shown in Table 50 for each visually sensitive area. For comparison with other timber supply analyses, the overall area-weighted VEG tree height is 6.9 m. The previous timber supply analysis for TFL3 under Management Plan #9 used a fixed VEG tree height of 5 m for all visually sensitive areas (Sterling Wood Group, 1998). Calculating visually effective green-up based on the slope of visually sensitive areas increases the VEG height by 1.9 m, on average.

Table 50: Calculation of VEG tree height for visually sensitive areas.

Visually Sensitive Area[2]	Area (ha) by slope class[1] (%) and VEG height[1] (m)								Crown Forested Area (ha)	Area Weighted VEG tree height (m)
	0-0.9% 3 m	1-10% 3.25 m	10.1-20% 4.25 m	20.1-30% 5.25 m	30.1-40% 6.25 m	40.1-50% 6.75 m	50.1-60% 7.75 m	60%+ 8.5 m		
128[2]	0	0	0	0	0	0	0	0	0	0.0
131[2]	0	0	0	0	0	0	0	0	0	0.0
383	0	9	11	19	55	123	96	65	378	7.0
386	0	1	3	2	0	0	0	0	5	4.4
410	0	0	7	36	64	62	62	123	355	7.2
414	0	0	1	1	0	0	0	0	3	4.9
420	0	6	74	246	398	494	321	218	1757	6.7
438[2]	0	0	0	0	0	0	0	0	0	0.0
444	0	4	10	19	34	73	81	60	281	7.1
445	0	0	4	5	24	60	116	60	269	7.5
451	0	0	1	1	0	0	0	0	3	4.9
453	0	0	7	23	12	45	58	63	208	7.3
802A[3]	0	0	0	0	0	0	0	0	0	6.3
803	0	8	16	56	53	105	47	12	296	6.4
Overall area-weighted VEG tree height (m)										6.9

[1] Slope class and VEG height are specified in the *Procedures for Factoring Visual Resources into Timber Supply Analyses*

[2] Visually Sensitive Area 128, 131 and 438 have no Crown forested area inside TFL3.

[3] Within TFL3, the Crown forested area of Visually Sensitive Area 802A is 0.3 ha.

For modelling purposes, the timber supply model FSOS defers harvest in visual areas until the area weighted VEG height is beyond the allowable percent denudation for the respective visual polygon.

10.2.3 Biodiversity

The *KBLUP Order (Government of B.C., 2002)* establishes old and mature+old seral cover targets as the current priority for landscape unit biodiversity management. Draft OGMAs have been identified within TFL3, and although they have not been formally established, SCFP has agreed to work around them. In conjunction with the OGMAs, and in accordance with Objective 5(3) of the *KBLUP Order*, SCFP is managing for the mature+old seral targets for the ICHdw subzone in the Perry landscape unit.

Landscape Units

Three landscape units (LUs) have been formally established in TFL3. The Hoder and Koch LUs have a low biodiversity emphasis option (BEO) while the Perry LU has an intermediate biodiversity emphasis option.

Only the Koch landscape unit is located entirely within TFL3. Minor components of the contiguous LUs (Cayuse, Woden, Gladstone and Ladybird) are within the defined TFL boundaries however due to their very small areas, they were spatially incorporated with their neighbour LU in the TFL for the purpose of this analysis. The south-eastern half of Perry LU (N514) is outside the TFL, and the north-eastern half of Hoder LU (N516) is in Valhalla Provincial Park.

Valhalla Park

Where a Tree Farm Licence comprises a portion of a landscape unit, for modelling purposes the LU seral targets are usually applied only to the Tree Farm License area. This approach will be taken for all three landscape units in the base case.

Valhalla Provincial Park is outside the TFL boundaries but within the Hoder LU. Since old seral targets and the periodic seral target monitoring reports are made for the entire LU, the timber supply impacts of accounting for Valhalla Provincial Park's contribution to seral targets in the Hoder LU will be investigated. Stand level inventory data for the park has been obtained and a sensitivity analysis is planned to examine the impacts on timber supply of the park's contribution to biodiversity targets in the Hoder LU.

Connectivity

A regional forest ecosystem connectivity corridor is legally established under *the KBLUP Order* in Objectives 5(3) to 5(6). Only forested slopes ≤80% contribute to the connectivity component in the corridor. The mature+old forest cover targets for landscape level biodiversity must be met for each landscape unit and BEC variant within the connectivity corridor. Old targets should be used to address the connectivity corridor. Under the *KBLUP Order,* Protected Areas must be used first within each BEC variant to reduce the seral target proportions outside the Protected Areas.

Mature and Old Seral Forest Cover Requirements

Forest cover targets for the productive Crown forest in mature and old seral stages are shown in Table 51, as established under Objective 2 in the *KBHLP Order*.

The old growth cover targets in the two low biodiversity emphasis landscape units reflect a two-third drawdown during the first rotation[25] and are expected to be restored to the full target after the third rotation. For this timber supply analysis, the old seral retention targets are

[25] Rotation age is defined as 80 years in *Landscape Unit Planning Guide* (Government of B.C. 2000a).

assumed to have been met with the draft OGMAS. In accordance with *KBHLP Order*, a recruitment strategy will be applied over the timber supply projection to meet the full old seral targets by the end of the third rotation.

Objective 2(2) of the *KBHLP Order* limits the mature+old seral targets to intermediate BEO areas, therefore only the ICHdw subzone within the Perry LU will be modelled in this manner. Nearly 94% of Crown Forested Land Base within the ICHdw1 subzone in the Perry LU is in the connectivity corridor and sloped ≤80%.

Table 51: Seral stage thresholds and minimum area targets from the *KBHLP Order*.

LU Name	LU Code	BEO	BEC Variant	NDT	Lower Age Threshold (years)		Forest Cover Requirement (% Productive Area)		
							Mature + Old Seral	Old Seral	
					Mature[1]	Old		Current[3]	End of 3rd Rotation[2]
Perry	N514	I	ESSFwc1	1	n/a	>250	No mature forest cover requirements	19%	
			ESSFwc4	1		>250		19%	
			ICHmw2	2		>250		9%	
			ICHdw1	3	>100	>140	23%	14%	
Hoder & Koch	N516 & N517	L	ESSFwc1	1	n/a	>250	No mature forest cover requirements	6.3%	19%
			ESSFwc4	1		>250		6.3%	19%
			ICHmw2	2		>250		3%	9%
			ICHdw1	3		>140		4.7%	14%

[1] the mature age definition in the KBHLP Order (Government of B.C. 2002) supersedes the age specified in the *Landscape Unit Planning Guide* (Government of B.C. 2000a)

[2] rotation age is defined as 80 years in *the Landscape Unit Planning Guide* (Government of B.C. 2000a) .

[3] current old seral targets in Low BEO emphasis areas reflect a 2/3 drawdown and are assumed to be met with the DRAFT OGMAs

10.2.4 Domestic Watersheds

Although no community watersheds are located in TFL3, approximately 8.5% of the total area of TFL3 is managed as a Domestic Watershed. Domestic Watersheds are defined in the June, 1997 *Kootenay Boundary Land Use Plan-Implementation Strategy* (KBLUP-IS)[26] as the drainage area above the downstream point of diversion on a stream that is:

- licensed under the *Water Act* for human consumption;
- not classified as a community watershed under the *Forest Practices Code of British Columbia Act*, and;
- not more than 200 km^2 in drainage area.

[26] See the *Kootenay/Boundary Land Use Plan Implementation Strategy, June 1997* (Kootenay Inter-Agency Management Committee, 1997).

Streamside management provisions within Consumptive Use Streams are legally established under Objective 6 of the *KBHLP Order*. Specifically, S5 and S6 stream riparian management zones of the upstream from water intakes are required to have at least a 30 metre (slope distance) management zone with site specific measures to safeguard water used for human consumption. Minimum retention targets within the management zones are consistent with Section 8 of the *Forest Planning and Practices Regulation*.

For this analysis, streams within the domestic watersheds were assigned the riparian zone buffers described in 6.14 and Table 18 to approximate the riparian management zone and stand retention requirements for each stream class. These buffers were excluded from the THLB as a surrogate for the reserve zone and management zone stand retention requirements. Although SCFP operations prescribe site specific retention levels to maintain water quality, no additional buffers were made to S6 and unclassified streams beyond those presented in Section 6.14 for this analysis.

Maximum ECA varies depending on whether the watershed is Class 1 (springs and very small streams), Class 2 (<500 ha), or Class 3 (>500 ha). Class 1 domestic watersheds are an agglomeration of adjacent small streams. The Airy domestic watershed is divided into 7 sub-drainages (Class 3s) to which cover requirements are applied separately. The 1997 KBLUP–IS suggested a maximum ECA of 30% for Class 1 and 2 Domestic Watersheds, and 35% for Class 3.

Subsequent to the KBLUP–IS, the Arrow Forest District used a graduated ECA 'Red Flag' threshold, based on a reduced hydrologic green-up recovery height of 6 metres. This approach was implemented under Management Plan #10 on the understanding that any expert advice from a qualified professional would over-ride these thresholds (Slocan Forest Products Ltd., 2003). For this analysis, the 'Red Flag' ECA thresholds for each of the domestic watersheds shown in Table 52 will be applied in the base case.

Table 52: Forest cover requirements for domestic watersheds in TFL3.

Domestic watershed class	Maximum 'Red Flag' ECA	Watershed Name	Total Area (ha)*	Crown Forest Area (ha)*	THLB Area (ha)
1	15%	Airy-Cowie Face	292	274	237
		Talbot Face	25	23	10
2	20%	Cowie Creek	3	3	2
		Talbot Creek	31	31	10
		Varney Creek	461	450	366
		ZZ Creek (70934)	6	6	2
3	25%	Airy Creek	1,843	1,619	792
3s	25%	Goose Creek 2	9	9	8
		Airy Creek 1	1,016	959	595
		Airy Creek 2	447	364	149
		Airy Creek 3	472	315	163
		Airy Creek 4	775	480	210
		Airy Creek 5	727	372	107
		Airy Creek 6	589	266	105
Total			**6,697**	**5,170**	**2,756**

*Only the portion of the watershed found in TFL3.

The KBLUP-IS recommends a 50-meter upstream buffer at points of diversion (POD) for domestic water use. Although SCFP operations follow this guideline (to 100 m for road construction), it is considered unnecessary to model this requirement for the purposes of timber supply analysis.

10.2.5 Wildlife

No approved Wildlife Habitat Areas are found within TFL3.

Grizzly Bears

Grizzly bear habitat management is legally established in the *KBHLP Order* under Objectives 5(1) and 5(2). The management strategy is maintenance of mature and/or old forests adjacent to avalanche tracks or den sites that are important for grizzly bear habitat.

Mapping of important grizzly bear habitat has not been identified and mapped under Section 5 of the *KBHLP Order*. Grizzly bear habitat management will not be explicitly modelled in this timber supply analysis.

Ungulates

Ungulate winter ranges in TFL3 were formally established on February 7th, 2007 under the *Order establishing Ungulate Winter Range #U-4-001 West Kootenay* (Government of B.C., 2007). The management strategies outlined in the Order are for Mule deer (*Odocoileus hemionius*), White-tailed deer (*Odcoileus virginianus*), Rocky Mountain elk (*Cervus elaphus nelsoni*) and moose (*Alces alces*), although only Mule deer UWRs are located within TFL3.

Stand age will be used as a surrogate for the desired target forest conditions derived from the Crown Forested Land Base. Although crown closure is retained in the inventory and is considered at an operational level, it is not projected in the timber supply analysis. The forest cover targets shown in Table 53 do not apply to broad-leafed[27] stands or to lands not managed by the Crown.

[27] Broadleaf and deciduous leading mixed tree stands as they are defined under the BC Land Classification Scheme in the VRI are excluded from meeting Ungulate Winter Range forest cover requirements (Government of B.C., 2007).

Table 53: Forest cover requirements for Ungulate Winter Range management units.

Ungulate Winter Range Attribute	Priority Ungulate Species	BEC Subzones	Forest Cover Area	Forest Characteristics		Management Units[1]
				Age (yrs)	Evergreen Crown Closure[2]	
Snow Interception Cover	Mule Deer	ICHdw, MSdk	≥30%	≥81	≥40%	177, 186, 195, 198, 199, 367
		ICHmw, ICHwk	≥40%	≥101	≥40%	159, 165, 363, 364, 367
Forage Area	All Species	All subzones	≥10%	≥81	dispersed or patches	Sum of identified forage areas within select MUs
Early Seral	All species	All subzones	≤40%	≤20		177, 186, 195, 198, 199, 367, 159, 165, 363, 364, 367

Source : *Order Establishing Ungulate Winter Range #U-4-001 West Kootenay* (Government of B.C., 2007).

[1] Only units within TFL3 are shown.

[2] Crown closure targets are not modelled in timber supply analysis

10.3 Natural Disturbance in the Non-Harvestable Land Base

Crown forested areas outside of the timber harvesting land base contribute to non-timber objectives through desired forest conditions such as age class structure or the proportion of old forest. An assumption of no disturbance in the non-harvestable land base (NHLB) will likely amount to a disproportionate contribution of old forest conditions from these areas for meeting non-timber objectives.

The document *Modelling Options for Disturbance Outside of the THLB* (B.C. Ministry of Forests, 2004) discusses various options and their associated strengths and weaknesses when applying disturbance in the Crown forested portion of the non-harvestable land base. For this analysis, a procedure similar to *Option 4 - the age reset by variant in forested non-timber harvesting land base*, has been used (B.C. Ministry of Forests, 2004). The parameters used to determine the annual disturbance in the forested portion of the NHLB are shown in Table 54.

The *KBHLP Order* (Government of B.C., 2002) gives the lower age threshold for old seral stands by BEC variant within each landscape unit while the average disturbance event interval by BEC variant comes from the *Landscape Unit Planning Guide* (Government of B.C., 2000a). Using the approach outlined in Appendix 4 of the *Biodiversity Guidebook* (Government of B.C.,1995a), an estimate of the proportion of old forested greater than the old seral stage age threshold is calculated and shown in column 8 of Table 54. An effective rotation age is determined (column 9 of Table 54) using the proportion of old forest and the old seral age threshold. The annual disturbance area for each BEC variant within the landscape unit is estimated by dividing the forested portion of the NHLB by the effective rotation age.

Table 54: Calculation of annual disturbance area estimates for the non-harvestable land base.

Col	Col2	Col3	Col4	Col5	Col6	Col7	Col8	Col9	Col10	Col11
LU Name	**LU Code**	**BEO**	**NDT**	**BEC Variant**	**Old Seral Stage Age[1] (yrs)**	**Average Dist. Return Interval[2] (yrs)**	**Proportion of Old Forest[3] (%)** $\left(\exp\left(-\left[\frac{Col6}{Col7}\right]\right)\right)\times 100$	**Effective Rotation Age (yrs)** $\frac{Col6}{(1-Col8)}$	**Forested NHLB Area (ha)**	**Annual Dist. Area (ha)** $\frac{Col10}{Col9}$
Perry	N514	I	1	ESSFwc1	250	350	49	490	269.1	0.5
			1	ESSFwc4	250	350	49	490	619.6	1.3
			2	ICHmw2	250	200	29	350	946.7	2.7
			3	ICHdw1	140	150	39	231	624.8	2.7
Koch	N517	L	1	ESSFwc1	250	350	49	490	2,426.2	5.0
			1	ESSFwc4	250	350	49	490	12,278.0	25.1
			2	ICHmw2	250	200	29	350	3,780.5	10.8
			3	ICHdw1	140	150	39	231	539.9	2.3
Hoder	N516	L	1	ESSFwc1	250	350	49	490	876.5	1.8
			1	ESSFwc4	250	350	49	490	4,139.3	8.5
			2	ICHmw2	250	200	29	350	2,001.1	5.7
			3	ICHdw1	140	150	39	231	813.5	3.5

[1] From the *KBLHP Order*. [2] From the *Landscape Unit Planning Guide*, Appendix 2. [3] From the *Biodiversity Guidebook*

Disturbance in the NHLB will be modelled by randomly assigning a disturbance period to forested stands within the NHLB, regardless of the stand age or integrated resource management objectives.

11 Timber Harvesting

11.1 Minimum Merchantability Standards

Minimum merchantability standards are regulated in the model by setting a minimum harvestable age for each analysis unit. This minimum age requirement is determined from the amalgamated yield curves as the age where the minimum volume requirement is met.

Current practice on the TFL is to only harvest where the merchantable volume is ≥150 m^3/ha when the slope is ≤40%. Minimum merchantable volume limits are ≥225 m^3/ha when the slope is >40%. A weighted average minimum merchantable volume harvest age was derived for each analysis unit across the two slope categories. These ages and the accompanying minimum volumes will be used in the base case and are shown in Table 55.

A sensitivity analysis will examine the impacts on timber supply of setting the minimum harvest age to the age where 95% of maximum MAI occurs. The harvest ages at 95% of maximum MAI are shown in Table 56.

Harvest queuing rules such as the relative oldest first, and modelling to meet various management objectives through forest cover requirements will likely influence the actual age at harvest, shifting it beyond the minimum values shown in Table 55 and Table 56. The actual age at harvest will be provided in the Timber Supply Analysis report.

Table 55: Minimum harvest age using minimum volume criteria.

Analysis Unit Description	AU	Minimum Merchantable Volume (m^3/ha)				Minimum Harvest Age (yrs)			
		NAT	EM >10yrs	EM ≤10yrs	FM	NAT	EM >10yrs	EM ≤10yrs	FM
		1 to 31	101 to 131	201 to 231	301 to 331	1 to 31	101 to 131	201 to 231	301 to 331
Spruce_ICH_Low	1	197	152	--	187	132	115	--	115
Spruce_ICH_Poor	2	176	168	187	178	88	77	77	75
Spruce_ICH_Med	3	181	191	167	180	71	62	58	57
Spruce_ICH_High	4	187	--	174	184	61	--	46	47
Spruce_ESSF_Low	5	188	--	213	188	184	--	155	156
Spruce_ESSF_Poor	6	183	226	153	184	133	139	86	107
Spruce_ESSF_Med	7	181	162	175	179	93	73	75	73
Spruce_ESSF_High	8	177	167	176	181	69	58	56	55
Balsam_Low[1]	9	175	157	170	170	253	158	117	139
Balsam_Poor	10	180	167	219	180	115	93	90	89
Balsam_Med	11	181	168	230	180	88	70	74	67
Balsam_High	12	170	--	189	168	62	--	38	46
Cedar_Poor[1]	13	205	137	--	205	101	292	--	125
Cedar_Med	14	181	201	218	187	70	88	82	79
Cedar_High	15	199	--	202	205	68	--	68	69
Fir_Pine_Poor	16	209	183	212	206	109	130	113	120
Fir_Pine_Med	17	200	175	195	198	78	81	81	77
Fir_Pine_High	18	195	172	186	191	64	61	55	58
Hemlock_Poor	19	197	165	--	198	101	102	--	97
Hemlock_Med	20	189	211	227	190	69	78	76	64
Hemlock_High	21	181	--	--	183	57	--	--	47
Larch_Poor	22	208	--	--	211	121	--	--	146
Larch_Med	23	196	153	228	197	83	77	78	72
Larch_High	24	201	155	190	194	72	52	51	53
Lodgepole_ICH_Med	25	198	177	213	197	78	74	79	80
Lodgepole_ICH_High	26	179	223	191	186	53	51	46	48
Lodgepole_ESSF_Poor	27	194	--	179	192	99	--	99	104
Lodgepole_ESSF_Med	28	197	225	186	200	73	85	71	77
Lodgepole_ESSF_High	29	187	150	191	193	59	49	52	57
DecidLarch_Med[2]	30	205	--	154	195	150	--	61	80
DecidLarch_High[2]	31	168	155	196	174	80	55	57	54

Volumes and ages are shown by the correpsonding AU series – 1-31 for Natural Inventory >20 years, 101-131 for Existing Managed 11 to 20 years, 201-231 for Existing Managed ≤10 years and 301-331 for all Future Managed stands. Merchantable volumes and ages are weighted averages across the slope classes of ≤40% and >40%

[1] Where minimum volumes are not achieved in the yield projection, the minimum age of maximum volume was used.

[2] All deciduous stands without previous harvest history are removed from the THLB – deciduous stand types with previous harvest history must meet the minimum volume through the conifer component of the stands.

Table 56: Minimum harvest age using age at 95% of maximum MAI.

Analysis Unit Description	AU	Minimum Merchantable Volume (m^3/ha)				Minimum Harvest Age (yrs)			
		NAT	EM >10yrs	EM ≤10yrs	FM	NAT	EM >10yrs	EM ≤10yrs	FM
		1 to 31	101 to 131	201 to 231	301 to 331	1 to 31	101 to131	201 to 231	301 to 331
Spruce_ICH_Low	1	193	201	--	197	130	137	--	119
Spruce_ICH_Poor	2	198	235	241	237	95	93	89	88
Spruce_ICH_Med	3	216	263	259	265	79	74	73	70
Spruce_ICH_High	4	236	--	286	288	70	--	59	59
Spruce_ESSF_Low	5	172	--	216	200	173	--	156	162
Spruce_ESSF_Poor	6	179	226	244	224	131	139	111	120
Spruce_ESSF_Med	7	190	259	259	263	96	94	93	90
Spruce_ESSF_High	8	213	283	286	287	77	76	72	70
Balsam_Low	9	103	184	232	199	153	173	140	152
Balsam_Poor	10	149	244	263	251	98	115	100	107
Balsam_Med	11	160	271	278	275	80	90	82	84
Balsam_High	12	185	--	321	303	66	--	48	61
Cedar_Poor	13	154	79	--	168	80	156	--	107
Cedar_Med	14	196	220	238	224	74	94	87	89
Cedar_High	15	212	--	265	262	71	--	81	81
Fir_Pine_Poor	16	214	155	179	171	111	115	99	104
Fir_Pine_Med	17	268	213	220	235	95	92	88	86
Fir_Pine_High	18	303	277	293	286	85	81	72	74
Hemlock_Poor	19	226	169	--	187	111	104	--	93
Hemlock_Med	20	232	232	236	245	78	83	78	75
Hemlock_High	21	240	--	--	298	68	--	--	62
Larch_Poor	22	211	--	--	148	122	--	--	107
Larch_Med	23	264	199	220	219	101	90	76	77
Larch_High	24	287	264	270	265	91	70	63	64
Lodgepole_ICH_Med	25	201	180	183	175	79	75	70	73
Lodgepole_ICH_High	26	220	254	243	235	61	56	54	56
Lodgepole_ESSF_Poor	27	177	--	208	207	92	--	109	109
Lodgepole_ESSF_Med	28	212	241	245	238	77	89	84	86
Lodgepole_ESSF_High	29	215	276	269	262	65	67	63	68
DecidLarch_Med[1]	30	128	--	227	202	94	--	76	82
DecidLarch_High[1]	31	154	255	261	263	75	73	68	69

Minimum Age is the age where 95% of maximum MAI occurs.

Volumes and Ages are shown by the corresponding AU series – 1-31 for Natural Inventory >20 years, 101-131 for Existing Managed 11 to 20 years, 201-231 for Existing Managed ≤10 years and 301-331 for all Future Managed stands.

[1] All deciduous stands without previous harvest history are removed from the THLB – deciduous stand types with previous harvest history must meet the minimum harvest age using 95% of maximum MAI of the conifer component of the stands.

11.2 Initial Harvest Rate

The initial harvest rate in the base case will be the current AAC, 80,000 m^3 per year net of the estimate for unsalvageable losses discussed in Section 9.1. This harvest level is the current approved AAC that is in effect until July 01, 2008. Sensitivity analyses and other scenarios will explore the impacts of altering the initial harvest rate.

11.3 Operability

All operable areas will be included in the base case, as will areas classified as inoperable that have had previous harvesting history. In the 1998 AAC Rationale, the Chief Forester apportioned a component of the AAC to areas classified as 'alternate' in the 1996 operability classification (B.C. Ministry of Forests., 1998a). The harvest level impacts of partitioning a component of the harvest volume to the alternate operability areas will also be examined through sensitivity analysis.

11.4 Harvest Rules

A 'relative oldest first' rule will be applied in the base case to rank stands for harvest. In this rule, the age of a stand is relative to its minimum harvestable age. Stands that have the greatest positive difference between their actual age and their minimum harvest age are selected for harvest, subject to forest cover requirements.

A sensitivity analysis of altering the 'relative oldest first' rule to an 'oldest-first' rule will be conducted to examine the impacts on timber supply.

11.5 Harvest Profile

The proposed harvest units in the GIS resultant will be fixed for harvest in their intended year when the model runs the timber supply projection. Currently, there are 10 cutting permits under review, comprising 857 ha of cutblocks that SCFP estimates will be harvested by the end of 2008.

The harvest level impacts of prioritizing the pine leading stands will be investigated in the mountain pine beetle sensitivities.

11.6 Harvest Flow Objectives

The harvest flow objective will be to achieve an even flow timber level and a stable growing stock throughout the planning horizon with the base case scenario, while ensuring that the long-term harvest level is appropriately established. If an even flow harvest level of 80,000 m^3 per year results in an unstable growing stock, target levels that project a declining timber flow will be implemented over the planning horizon. If an even flow can be achieved at the current harvest level, a long-range maximum harvest level will be investigated by increasing the initial harvest.

12 Information Sources

B.C. Forest Service. 1995. *Geographic distribution of Armillaria species*. Extension Note RS-015. Nelson Forest Region, B.C. Min. For, Victoria.

B.C. Ministry of Forests. 1998a. *Tree Farm Licence 3, rationale for allowable annual cut determination*. July 1998. B.C. Min. For., Victoria.

B.C. Ministry of Forests. 1998b. *Procedures for factoring visual resources in timber supply analyses*. For. Pract. Br., B.C. Min. For., Victoria.

B.C. Ministry of Forests. 1999. *VDYP batch application user guide version 6.6d*. Resources Inventory Br., B.C. Min. For., Victoria.

B.C. Ministry of Forests. 2000a. *Arrow Timber Supply Area – timber supply analysis report, April 2000*. B.C. Min. For., Victoria.

B.C. Ministry of Forests. 2000b. *Provincial guide for the submission of timber supply analysis information packages for tree farm licences, version 4, December 2000*. B.C. Min. For., Victoria.

B.C. Ministry of Forests. 2003. *Bulletin – Modelling visuals in TSRIII.* For. Pract. Br., B.C. Min. For., Victoria.

B.C. Ministry of Forests. 2004. *Modelling options for disturbance outside of the THLB.* Draft Working Paper dated March 2004. Res. Br., B.C. Min. For., Victoria.

B.C. Ministry of Forests. 2005. *Arrow Timber Supply Area. Rationale for allowable annual cut determination*, *July 2005*. B.C. Min. For., Victoria.

B.C. Ministry of Forests and Range. 2008a. Excel spreadsheet: *BCMPB.v4.NoMgmtSummaryOfKill.PineUnits.xls.* Website for the Provincial-Level Projection of the Current Mountain Pine Beetle Outbreak. www.for.gov.bc.ca/hre/bcmpb/Year4.htm

B.C. Ministry of Forests and Range. 2008b. Excel spreadsheet: *sisuBybgcUnit2008.xls.* Website for the Site Index estimates by Site Series (SIBEC) - second approximation. www.for.gov.bc.ca/hre/sibec/

Cortex Consultants Inc. 2002. *TFL3 silviculture strategy (Type 2)*. Prepared for Slocan Forest Products Ltd., Slocan Division.

Di Lucca, Mario. 2008. Personal communication.

Eng, Marvin, Andrew Fall, Josie Hughes. 2006. *Provincial-Level projection of the current mountain pine beetle outbreak: Documentation of revisions to the model resulting in BCMPB.v3.* Prepared for B.C. Min. For. Range. Victoria

Forest Genetics Council of B.C. 2007. *Forest Genetics Council of BC business plan 2007/2008*.

Government of B.C. 1995a. *Biodiversity guidebook.* For. Pract. Br., B.C. Min. For., Victoria.

Government of B.C. 1995b. *Riparian management area guidebook*. For. Pract. Br., B.C. Min. For., Victoria.

Government of B.C. 1999. *Green-up guidebook, 2nd edition*. For. Pract. Br., B.C. Min. For., Victoria.

Government of B.C. 2000a. *Landscape unit planning guide*. Updated March 2000. For. Pract. Br., B.C. Min. For., Victoria.

Government of B.C. 2000b. *Provincial wildlife tree policy and management recommendation, February 2000*. B.C. Min. For., Victoria.

Government of B.C. 2002. *Kootenay-Boundary Higher Level Plan Order* dated October 26, 2002. Victoria.

Government of B.C. 2004. *Notice – Indicators of the amount, distribution, and attributes of wildlife habitat required for the survival of species at risk in the Arrow Boundary Forest District* dated December 30, 2004. Victoria.

Government of B.C. 2005. *Order for the establishment of Visual Quality Objectives and Scenic Areas for the Arrow Boundary District* dated Dec 31, 2005. Victoria.

Government of B.C. 2007. *Order establishing Ungulate Winter Range #U-4-001 West Kootenay (Arrow TSA, Kootenay Lake TSA, Revelstoke TSA, TFL3, TFL 23)* dated Feb 7, 2007. Victoria.

Hugh Hamilton Limited and Atticus Resource Consulting Ltd. 1996. *Operability line report for Tree Farm License 3, Slocan Forest Products Ltd.* Prepared for Slocan Forest Products Ltd., Slocan.

Jahraus and Associates Consulting Inc. and Churlish Consulting Ltd. 2005. *TFL3 Documentation of analysis for vegetation resources inventory statistical adjustment and net volume adjustment factor development - addendum.* March 2005. Prepared for Canadian Forest Products Ltd., Slocan.

Jahraus and Associates Consulting Inc. 2002. *Tree Farm License 3, Slocan Forest Products Ltd.: Documentation of analysis for vegetation resources inventory statistical adjustment*. Prepared for Slocan Forest Products Ltd., Slocan.

JMJ Holdings and Ecologic Research. 2001. *TFL3 predictive ecosystem mapping year two final project report.* Prepared for Slocan Forest Products., Slocan.

JMJ Holdings Inc. 2003. *Tree Farm Licence 3 predictive ecosystem mapping accuracy assessment report*. Prepared for Slocan Forest Products., Slocan.

Kootenay Inter-Agency Management Committee. 1997. *Kootenay/Boundary Land Use Plan Implementation Strategy, June 1997*.

Lewis, Kathy and Ian Hartley. 2005. *Rate of deterioration, degrade and fall of trees killed by mountain pine beetle: A synthesis of the literature and experiential knowledge*. Mountian pine beetle initiative working paper 2005-14. Can.For. Serv., Victoria.

McAuley, Leslie. 2008. Personal communication.

Meidinger, D. 2003a. *Ecosystem mapping and accuracy and timber supply applications*. July 2003. Res. Br., B.C. Min. For., Victoria.

Meidinger, D. 2003b. *Protocol for accuracy assessment of ecosystem maps*. Technical Report 011. Res. Br., B.C. Min. For., Victoria.

Nigh, G.D. 1994. *Site index conversion equations for mixed species stands*. Research Report 01. B.C. Min. For., Victoria.

Nigh, G.D. 1998. *Site index adjustments for old-growth stands based on veteran trees*. Working paper 36. Res. Br., B.C. Min. For., Victoria.

Nussbaum, Albert. 1998. *Site index adjustments for old-growth stands based on paired plots*. Working paper 37. Res. Br., B.C. Min. For., Victoria.

Slocan Forest Products Ltd. 2002. *Sensitive soil data and netdown review for TFL3 Management Plan #10.* Slocan Forest Products Ltd., Slocan.

Slocan Forest Products Ltd. 2003. *Tree Farm Licence No. 3 (Little Slocan) proposed Management Plan No 10. July 1, 2003 – June 30, 2008*. May, 2003. Slocan Forest Products Ltd., Slocan

Springer Creek Forest Products Ltd. 2006. *2006 Forest stewardship plan for Tree Farm Licence #3 and FLA20192.* Springer Creek Forest Products Ltd., Slocan.

Springer Creek Forest Products Ltd. 2007a. *Patch size analysis map LU: Koch, Hoder, Perry Existing.* Dated October 2007. Springer Creek Forest Products Ltd., Slocan.

Springer Creek Forest Products Ltd. 2007b. *Patch size distribution analysis for Landscape Units: N514, N516, N517 Perry – Hoder – Koch.* October 23, 2007. Springer Creek Forest Products Ltd., Slocan.

Stearns-Smith, S., Neinaber, G., Cruickshank, M., and Nussbaum. A. 2004. *Demonstrating growth and yield adjustments (TIPSY OAFs) for Armillaria root disease in a timber supply analysis*. Report # RO4-008 for B.C. Forest Investment Account Research 2003-04, Victoria.

Sterling Wood Group. 1998. *Tree Farm Licence 3 Management Plan 9 information package*. March 1998. Prepared for Slocan Forest Products Ltd., Slocan.

Thrower, J.S., Nussbaum, A.F., and Di Lucca, C.M. 1994. *Site index curves and tables for British Columbia – interior species. 2nd edition*. Field Guide Insert 6. Res. Br., Land Manage Handb., B.C. Min. For., Victoria.

Timberline Forest Inventory Consultants Ltd. 2004a. *Arrow timber supply analysis report, timber supply review 2003/2004, Arrow Timber Supply Area.* April 2004. Prepared for the Arrow Forest Licence Group.

Timberline Forest Inventory Consultants Ltd. 2004b. *Data package timber supply review 2003/2004 Arrow Timber Supply Area final draft version 3.* February 2004. Prepared for the Arrow Forest Licence Group.

Tozer, R. R. 2001. *Letter to Kathy Howard regarding conditions for the approval of MP #9 for TFL3. October 31, 2001*. Nelson For. Region, B. C. Min. For., Nelson.

Wang, E. and I. Listar. 2000. *Impact of the current and planned seed orchard program on timber flow in the Arrow TSA.* September 2000. Prepared for the Forest Genetics Council of B.C.

Walton, Adrian, Josie Hughes, Marvin Eng, Andrew Fall, Terry Shore, Bill Riel and Peter Hall. 2008. *Provincial-level projection of the current mountain pine beetle outbreak: Update of the infestation projection based on the 2007 Provincial aerial overview of forest health and revisions to the "Model" (BCMPB.v5)*. Prepared for B.C. Min. For. Range. Victoria

Appendix 1 – Maps

Attached separately

Map 1: Timber harvesting land base
Map 2: Operability
Map 3: Roads and Hydro
Map 4: Riparian
Map 5: Ogmas UWR Connectivity Corridor
Map 6: Landscape Units BEC NDT
Map 7: Terrain and Avalanche
Map 8: Domestic Watersheds
Map 9: Recreation Sites & Visuals
Map 10: Problem Forest Types
Map 11: Road Access Buffers
Map 12: Species Distribution
Map 13: Stand Age Class Distribution

Appendix 2 – Yield Tables

Yield curves are shown by the Analysis Unit groups on the following pages.

Spruce ICH Zone AU Yields

Age	Natural Inventory >20 Years				Existing Managed >10 and ≤20 years				Existing Managed ≤10 years				Future Managed			
	Low	Poor	Med	High	Low	Poor	Med	High	Low	Poor	Med	High	Low	Poor	Med	High
	1	2	3	4	101	102	103	104	201	202	203	204	301	302	303	304
0	0	0	0	0	0	0	0	--	--	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	--	--	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	--	--	0	0	0	0	0	0	0
30	0	0	0	0	0	0	3	--	--	0	3	27	0	0	5	26
40	0	1	11	41	0	5	39	--	--	8	40	115	0	9	52	116
50	1	15	68	116	0	34	109	--	--	46	110	210	4	47	129	211
60	8	61	126	181	5	83	178	--	--	101	179	293	19	101	200	295
70	30	106	176	236	22	137	239	--	--	155	241	354	45	155	265	355
80	61	147	220	282	48	181	293	--	--	201	295	396	79	201	316	397
90	92	182	256	318	79	222	333	--	--	245	333	426	113	245	352	427
100	121	213	287	348	111	262	361	--	--	282	361	443	145	281	379	445
110	147	240	314	373	139	292	382	--	--	309	382	454	174	308	399	455
120	171	263	336	394	164	314	400	--	--	329	398	457	200	329	413	457
130	193	286	358	414	187	331	412	--	--	345	410	456	223	344	423	456
140	214	306	376	432	208	343	422	--	--	356	418	454	243	355	427	455
150	233	323	392	447	229	353	424	--	--	365	421	452	260	364	428	452
160	249	339	405	459	245	360	424	--	--	372	420	449	273	371	427	449
170	265	352	417	470	258	367	423	--	--	376	417	445	283	375	423	445
180	278	364	427	479	268	371	420	--	--	380	414	443	291	378	420	443
190	291	375	436	488	276	374	416	--	--	383	410	440	297	380	416	441
200	303	385	444	496	283	377	412	--	--	381	406	440	302	379	410	441
210	314	395	452	504	286	376	407	--	--	376	402	440	305	375	404	441
220	324	404	459	511	290	371	399	--	--	371	396	440	307	371	399	441
230	334	412	466	518	293	366	392	--	--	368	391	440	309	367	393	441
240	343	419	472	524	295	362	386	--	--	363	385	440	309	363	388	441
250	351	426	477	530	296	358	379	--	--	357	380	440	309	357	383	441
260	356	430	480	532	296	353	373	--	--	352	374	440	309	353	381	441
270	361	433	483	535	297	347	368	--	--	347	369	440	307	348	379	441
280	365	436	485	536	296	342	365	--	--	342	364	440	305	342	377	441
290	368	438	487	538	295	337	364	--	--	338	360	440	303	338	376	441
300	372	440	489	540	295	334	363	--	--	335	359	440	301	334	375	441
310	375	442	490	541	295	334	363	--	--	335	359	440	301	334	375	441
320	378	444	492	542	295	334	363	--	--	335	359	440	301	334	375	441
330	380	446	493	543	295	334	363	--	--	335	359	440	301	334	375	441
340	382	447	494	544	295	334	363	--	--	335	359	440	301	334	375	441
350	384	448	495	544	295	334	363	--	--	335	359	440	301	334	375	441

Spruce ESSF Zone, AU Yields

Age	Natural Inventory >20 Years				Existing Managed >10 and ≤20 years				Existing Managed ≤10 years				Future Managed			
	Low	Poor	Med	High	Low	Poor	Med	High	Low	Poor	Med	High	Low	Poor	Med	High
	5	6	7	8	105	106	107	108	205	206	207	208	305	306	307	308
0	0	0	0	0	--	0	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	--	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	--	0	0	0	0	0	0	0	0	0	0	0
30	0	0	0	0	--	0	0	2	0	0	0	4	0	0	0	5
40	0	0	1	14	--	0	4	33	0	0	5	48	0	0	8	56
50	0	1	12	74	--	0	35	106	0	8	36	127	0	3	46	140
60	0	7	56	132	--	3	88	180	1	37	91	205	1	19	105	218
70	2	25	99	182	--	19	147	245	6	80	149	272	4	48	164	287
80	7	55	138	225	--	48	195	305	20	127	198	331	15	86	215	343
90	21	84	172	261	--	82	240	349	46	169	245	369	33	125	263	380
100	40	111	201	291	--	117	286	378	75	205	288	396	56	161	304	405
110	61	135	226	317	--	150	318	398	105	240	321	415	82	194	334	423
120	80	156	249	338	--	177	342	415	135	274	344	428	108	224	356	435
130	100	177	270	359	--	203	360	426	159	299	361	437	132	251	371	443
140	119	196	289	377	--	228	372	434	181	319	374	443	154	274	383	446
150	136	214	305	392	--	254	382	438	203	333	383	443	175	294	392	445
160	153	230	320	406	--	273	389	438	224	344	391	439	196	309	399	441
170	168	244	333	417	--	289	396	433	245	352	395	435	215	321	403	437
180	182	257	345	427	--	301	399	429	262	359	399	430	232	330	406	432
190	196	269	355	436	--	310	401	425	275	363	401	425	246	336	407	428
200	208	281	365	445	--	318	403	420	286	366	400	421	259	342	405	423
210	220	291	374	452	--	323	402	415	293	369	398	417	269	345	401	418
220	231	300	382	459	--	327	397	409	300	370	395	412	277	348	397	413
230	242	309	389	465	--	331	392	404	305	370	391	405	284	350	393	407
240	252	317	396	471	--	333	387	398	308	369	385	400	290	350	388	402
250	261	325	402	476	--	334	383	392	311	368	380	395	294	350	382	397
260	267	330	406	479	--	335	378	386	313	367	376	390	297	349	377	394
270	273	334	409	481	--	336	372	380	315	363	372	385	300	348	371	391
280	278	338	412	483	--	336	366	376	315	357	366	380	301	345	366	388
290	282	341	414	485	--	334	361	372	315	353	360	376	302	343	361	386
300	287	345	417	487	--	333	358	370	315	350	357	375	302	341	358	386
310	291	348	419	488	--	333	358	370	315	350	357	375	302	341	358	386
320	295	350	420	489	--	333	358	370	315	350	357	375	302	341	358	386
330	299	353	422	490	--	333	358	370	315	350	357	375	302	341	358	386
340	302	355	423	491	--	333	358	370	315	350	357	375	302	341	358	386
350	305	357	424	492	--	333	358	370	315	350	357	375	302	341	358	386

Balsam AU Yields

Age	Natural Inventory >20 Years				Existing Managed >10 and ≤20 years				Existing Managed ≤10 years				Future Managed			
	Low	Poor	Med	High	Low	Poor	Med	High	Low	Poor	Med	High	Low	Poor	Med	High
	9	10	11	12	109	110	111	112	209	210	211	212	309	310	311	312
0	0	0	0	0	0	0	0	--	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	--	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	--	0	0	0	1	0	0	0	0
30	0	0	1	17	0	0	0	--	0	0	0	74	0	0	0	20
40	0	4	20	67	0	0	5	--	0	1	16	215	0	1	14	106
50	1	22	57	115	0	4	45	--	0	19	74	343	0	11	66	208
60	5	50	93	159	1	27	106	--	3	67	146	419	3	45	134	295
70	14	83	130	200	5	66	168	--	18	123	207	463	12	92	197	362
80	26	109	160	235	14	111	220	--	48	174	266	486	29	141	253	405
90	39	132	186	263	27	155	271	--	82	219	318	484	51	185	305	431
100	50	153	210	287	43	193	315	--	118	263	353	483	75	225	343	447
110	61	171	231	309	61	228	345	--	151	301	377	477	99	262	368	457
120	71	188	250	327	80	261	366	--	179	331	394	473	124	294	387	459
130	81	206	271	349	99	290	381	--	206	349	406	473	148	319	400	459
140	91	224	290	370	119	313	393	--	232	364	416	473	172	338	409	456
150	101	240	309	390	141	330	401	--	258	374	422	473	195	351	416	453
160	110	256	326	408	161	342	408	--	278	383	426	473	214	361	419	448
170	118	271	342	425	179	352	412	--	295	388	429	473	232	369	421	444
180	126	285	357	442	196	359	414	--	306	393	424	473	247	374	421	440
190	134	298	371	457	210	364	415	--	316	395	419	473	260	378	418	438
200	141	311	385	471	224	368	412	--	324	396	415	473	271	381	414	436
210	148	323	398	485	235	371	407	--	328	396	410	473	280	382	409	433
220	155	335	410	498	245	372	402	--	333	396	404	473	288	383	404	431
230	162	347	422	511	255	373	398	--	337	393	399	473	295	381	399	429
240	169	358	434	523	263	372	393	--	339	387	395	473	301	379	393	427
250	175	368	445	534	270	371	388	--	340	382	390	473	305	377	387	426
260	177	371	447	536	276	369	382	--	340	377	386	473	308	374	383	426
270	178	373	449	537	282	367	377	--	342	373	381	473	311	370	377	426
280	180	375	451	538	287	364	372	--	341	369	372	473	313	365	373	426
290	182	377	452	539	290	359	368	--	338	362	363	473	313	360	368	426
300	183	379	454	540	290	356	364	--	337	358	358	473	313	356	365	426
310	185	380	455	541	290	356	364	--	337	358	358	473	313	356	365	426
320	186	382	457	542	290	356	364	--	337	358	358	473	313	356	365	426
330	187	383	458	542	290	356	364	--	337	358	358	473	313	356	365	426
340	188	385	459	543	290	356	364	--	337	358	358	473	313	356	365	426
350	189	386	460	544	290	356	364	--	337	358	358	473	313	356	365	426

Cedar AU Yields

Age	Natural Inventory >20 Years			Existing Managed >10 and ≤20 years			Existing Managed ≤10 years			Future Managed		
	Poor	Med	High	Poor	Med	High	Poor	Med	High	Poor	Med	High
	13	14	15	113	114	115	213	214	215	313	314	315
0	0	0	0	0	0	--	--	0	0	0	0	0
10	0	0	0	0	0	--	--	0	0	0	0	0
20	0	0	0	0	0	--	--	0	0	0	0	0
30	1	2	9	0	1	--	--	2	6	0	1	5
40	15	46	65	0	9	--	--	20	37	2	15	35
50	53	95	117	2	41	--	--	63	96	13	52	94
60	91	140	164	7	84	--	--	117	157	36	101	156
70	124	181	207	15	131	--	--	167	212	65	148	210
80	154	218	247	23	171	--	--	210	259	96	191	258
90	180	249	281	31	207	--	--	249	304	125	228	302
100	203	276	311	39	240	--	--	285	341	151	261	340
110	223	301	338	47	269	--	--	316	376	174	291	375
120	241	322	361	54	295	--	--	344	404	195	318	405
130	261	347	387	61	317	--	--	370	427	214	342	430
140	280	369	411	68	339	--	--	392	445	231	363	450
150	297	390	433	74	357	--	--	411	460	245	381	467
160	313	409	453	82	373	--	--	425	474	259	397	482
170	328	426	471	88	388	--	--	437	487	270	410	495
180	341	442	489	94	400	--	--	448	498	281	421	505
190	355	457	505	100	409	--	--	458	505	290	430	512
200	368	473	522	105	418	--	--	468	510	299	439	517
210	380	487	538	109	425	--	--	475	515	306	446	521
220	394	505	556	114	431	--	--	480	517	312	451	523
230	409	521	574	118	436	--	--	485	520	317	456	525
240	423	538	591	122	440	--	--	489	522	322	460	526
250	436	553	608	125	443	--	--	493	522	326	463	526
260	439	555	609	129	445	--	--	494	522	328	465	526
270	441	557	610	132	446	--	--	494	522	331	467	526
280	442	558	611	134	448	--	--	494	522	333	468	526
290	444	559	612	137	449	--	--	494	522	334	468	526
300	446	561	613	137	449	--	--	494	522	335	469	526
310	447	562	614	137	449	--	--	494	522	335	469	526
320	448	563	614	137	449	--	--	494	522	335	469	526
330	450	564	615	137	449	--	--	494	522	335	469	526
340	451	565	615	137	449	--	--	494	522	335	469	526
350	452	566	616	137	449	--	--	494	522	335	469	526

Fir Pine AU Yields

Age	Natural Inventory >20 Years			Existing Managed >10 and ≤20 years			Existing Managed ≤10 years			Future Managed		
	Poor	Med	High	Poor	Med	High	Poor	Med	High	Poor	Med	High
	16	17	18	116	117	118	216	217	218	316	317	318
0	0	0	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0
30	0	2	12	0	1	6	0	2	17	0	2	13
40	3	31	61	1	10	41	3	16	74	3	22	64
50	25	75	117	8	41	102	19	54	149	16	66	136
60	57	121	173	24	84	167	50	102	219	42	118	204
70	90	165	227	47	131	221	86	150	281	74	168	263
80	123	208	279	73	171	273	122	191	337	106	211	318
90	154	248	328	99	206	316	154	227	385	136	250	365
100	183	287	373	123	239	357	181	260	425	162	284	406
110	212	323	413	144	268	393	205	290	457	185	315	439
120	237	355	447	165	293	423	227	315	481	206	342	465
130	262	384	481	183	316	446	247	337	499	224	365	486
140	285	411	511	198	336	467	264	356	514	240	385	504
150	304	433	537	211	353	485	278	373	525	254	402	516
160	321	452	560	223	369	499	290	388	533	266	416	525
170	335	468	581	233	382	510	302	400	539	277	428	532
180	349	483	600	243	392	519	311	410	540	286	437	536
190	362	497	618	250	400	524	320	418	541	294	445	538
200	376	511	636	257	408	529	328	425	542	301	451	539
210	388	524	653	263	415	532	334	430	542	307	456	539
220	400	537	669	268	419	535	340	434	542	312	459	539
230	412	549	684	272	422	536	345	437	542	316	461	539
240	423	560	699	275	426	536	349	439	542	320	463	539
250	434	571	713	277	428	536	350	441	542	323	464	539
260	435	572	714	280	429	536	351	442	542	325	465	539
270	436	573	714	281	430	536	351	443	542	326	466	539
280	437	574	715	283	430	536	352	443	542	328	466	539
290	439	575	716	284	431	536	352	443	542	329	466	539
300	440	576	717	285	432	536	352	443	542	329	466	539
310	440	577	718	285	432	536	352	443	542	329	466	539
320	441	578	718	285	432	536	352	443	542	329	466	539
330	442	579	719	285	432	536	352	443	542	329	466	539
340	443	579	719	285	432	536	352	443	542	329	466	539
350	443	580	720	285	432	536	352	443	542	329	466	539

Hemlock AU Yields

Age	Natural Inventory >20 Years			Existing Managed >10 and ≤20 years			Existing Managed ≤10 years			Future Managed		
	Poor	Med	High	Poor	Med	High	Poor	Med	High	Poor	Med	High
	19	20	21	119	120	121	219	220	221	319	320	321
0	0	0	0	0	0	--	--	0		0	0	0
10	0	0	0	0	0	--	--	0		0	0	0
20	0	0	0	0	0	--	--	0		0	0	1
30	0	1	5	0	2	--	--	4		0	8	39
40	1	24	70	5	25	--	--	36		9	48	122
50	9	84	138	22	73	--	--	91		34	108	208
60	41	142	198	46	127	--	--	149		71	168	284
70	82	194	250	75	177	--	--	200		110	221	349
80	124	241	295	105	219	--	--	244		146	267	403
90	161	279	331	133	258	--	--	283		178	307	448
100	194	311	362	160	292	--	--	317		206	343	480
110	223	339	387	184	321	--	--	347		231	374	502
120	249	363	408	204	347	--	--	374		253	399	516
130	276	388	432	222	370	--	--	396		271	420	526
140	299	411	452	238	390	--	--	416		287	437	532
150	320	430	469	252	406	--	--	427		302	450	536
160	338	446	484	264	419	--	--	438		314	461	537
170	353	461	496	274	429	--	--	447		323	469	537
180	367	473	507	283	437	--	--	456		332	475	537
190	380	485	517	291	443	--	--	463		339	479	537
200	393	496	527	297	448	--	--	467		344	481	537
210	405	507	536	302	452	--	--	470		349	483	537
220	416	517	545	306	453	--	--	472		352	484	537
230	427	526	552	308	456	--	--	470		355	484	537
240	438	535	560	310	457	--	--	467		357	484	537
250	448	543	567	312	458	--	--	465		358	484	537
260	453	546	569	313	459	--	--	463		359	484	537
270	459	549	571	314	458	--	--	462		359	483	537
280	463	552	574	315	458	--	--	462		359	483	537
290	467	555	576	315	459	--	--	462		359	483	537
300	471	558	577	315	459	--	--	462		358	483	537
310	475	560	579	315	459	--	--	462		358	483	537
320	478	562	581	315	459	--	--	462		358	483	537
330	481	564	582	315	459	--	--	462		358	483	537
340	484	566	583	315	459	--	--	462		358	483	537
350	486	568	585	315	459	--	--	462		358	483	537

Larch AU Yields

Age	Natural Inventory >20 Years			Existing Managed >10 and ≤20 years			Existing Managed ≤10 years			Future Managed		
	Poor	Med	High	Poor	Med	High	Poor	Med	High	Poor	Med	High
	22	23	24	122	123	124	222	223	224	322	323	324
0	0	0	0	--	0	0	--	0	0	0	0	0
10	0	0	0	--	0	0	--	0	0	0	0	0
20	0	0	0	--	0	0	--	0	0	0	0	0
30	0	1	6	--	1	15	--	3	28	0	4	24
40	1	19	48	--	10	69	--	32	101	1	32	93
50	5	57	95	--	39	140	--	85	182	9	83	172
60	27	99	143	--	80	208	--	143	252	26	138	241
70	57	142	192	--	125	264	--	194	311	52	188	299
80	89	184	239	--	164	313	--	237	361	80	231	348
90	120	223	283	--	199	353	--	274	401	108	267	389
100	150	261	324	--	229	389	--	304	434	133	298	422
110	179	295	363	--	254	417	--	331	458	155	325	447
120	206	327	398	--	276	440	--	353	476	173	347	466
130	231	357	430	--	294	457	--	372	488	190	365	479
140	254	384	460	--	310	469	--	387	498	204	379	490
150	270	401	478	--	324	479	--	399	504	216	390	497
160	281	413	489	--	335	486	--	408	509	226	400	502
170	287	419	495	--	345	491	--	414	512	234	407	505
180	291	423	499	--	353	496	--	419	513	241	411	507
190	294	427	503	--	358	498	--	423	513	246	415	507
200	298	432	506	--	363	499	--	427	513	251	418	507
210	301	436	510	--	366	499	--	429	513	255	419	507
220	304	440	513	--	369	500	--	430	513	258	421	507
230	307	443	517	--	372	500	--	431	513	261	421	507
240	309	446	520	--	375	500	--	431	513	263	422	507
250	311	449	522	--	376	500	--	432	513	265	422	507
260	312	450	523	--	376	500	--	431	513	266	422	507
270	312	451	524	--	375	500	--	430	513	267	421	507
280	313	452	524	--	374	500	--	428	513	268	421	507
290	313	453	524	--	373	500	--	427	513	268	421	507
300	314	453	525	--	373	500	--	426	513	268	421	507
310	314	454	525	--	373	500	--	426	513	268	421	507
320	314	455	526	--	373	500	--	426	513	268	421	507
330	314	455	526	--	373	500	--	426	513	268	421	507
340	314	456	526	--	373	500	--	426	513	268	421	507
350	315	456	527	--	373	500	--	426	513	268	421	507

Lodgepole ICH Zone, AU Yields								
Age	Natural Inventory >20 Years		Existing Managed >10 and ≤20 years		Existing Managed ≤10 years		Future Managed	
	Med	High	Med	High	Med	High	Med	High
	25	26	125	126	225	226	325	326
0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0
20	0	0	0	6	0	7	0	5
30	1	34	7	64	11	67	8	56
40	40	102	38	144	51	146	41	130
50	87	163	84	217	100	217	86	198
60	130	215	126	278	144	278	127	256
70	169	262	163	332	183	330	164	307
80	204	302	196	376	217	372	197	348
90	237	339	225	411	246	406	225	381
100	267	371	251	434	270	430	249	406
110	294	401	271	453	292	449	270	426
120	320	428	289	467	309	463	287	441
130	344	453	305	478	323	474	301	453
140	361	472	316	486	335	482	313	462
150	374	486	326	493	346	484	322	466
160	384	496	335	498	353	485	330	469
170	390	502	342	500	357	485	335	470
180	392	506	348	499	360	485	339	470
190	392	506	354	498	363	485	342	469
200	396	511	355	497	365	485	344	469
210	399	515	354	496	366	485	345	468
220	403	520	352	494	368	484	344	468
230	406	524	350	493	370	484	341	466
240	410	528	348	492	368	483	339	465
250	413	532	346	490	363	482	336	463
260	415	535	345	490	359	482	334	462
270	417	537	343	490	353	481	331	460
280	419	539	342	490	347	481	328	459
290	420	541	340	490	342	481	326	459
300	422	543	339	490	338	481	324	459
310	423	544	339	490	338	481	324	459
320	424	546	339	490	338	481	324	459
330	425	547	339	490	338	481	324	459
340	426	549	339	490	338	481	324	459
350	427	550	339	490	338	481	324	459

Lodgepole ESSF Zone, AU Yields												
Age	Natural Inventory >20 Years			Existing Managed >10 and ≤20 years			Existing Managed ≤10 years			Future Managed		
	Poor	Med	High	Poor	Med	High	Poor	Med	High	Poor	Med	High
	27	28	29	127	128	129	227	228	229	327	328	329
0	0	0	0	--	0	0	0	0	0	0	0	0
10	0	0	0	--	0	0	0	0	0	0	0	0
20	0	0	1	--	0	0	0	0	0	0	0	0
30	2	3	20	--	1	10	0	1	18	0	1	10
40	9	46	84	--	11	75	1	18	90	1	14	64
50	43	97	141	--	51	158	9	66	175	11	57	142
60	80	144	192	--	105	230	35	127	249	37	113	213
70	113	186	236	--	159	294	73	181	310	74	167	273
80	144	223	276	--	204	344	113	227	357	113	213	323
90	172	258	312	--	245	379	151	271	389	149	254	359
100	197	289	344	--	283	404	182	306	413	181	290	385
110	220	318	374	--	311	424	211	330	429	210	317	404
120	242	344	401	--	332	439	238	349	440	236	337	418
130	263	370	427	--	348	449	262	363	446	259	352	427
140	278	388	445	--	361	453	281	375	449	277	364	434
150	291	402	459	--	371	454	295	384	451	292	373	438
160	301	412	469	--	379	455	307	391	451	304	381	440
170	308	419	475	--	386	455	316	397	449	313	387	440
180	312	422	478	--	391	452	323	402	447	321	391	439
190	314	422	477	--	396	448	330	404	444	326	394	437
200	318	425	481	--	398	444	334	402	442	331	395	436
210	322	429	485	--	398	440	337	401	440	335	395	434
220	327	433	489	--	397	436	340	400	439	338	394	431
230	331	437	493	--	396	433	342	399	437	341	392	429
240	334	441	496	--	395	430	343	397	436	343	391	427
250	338	444	500	--	394	427	344	395	435	344	390	425
260	340	446	502	--	392	427	345	394	434	344	388	422
270	342	449	505	--	390	427	345	393	433	343	387	420
280	344	451	507	--	389	427	345	391	432	341	385	418
290	346	452	508	--	386	427	344	390	431	339	383	416
300	347	454	510	--	385	427	343	389	431	338	381	415
310	349	455	512	--	385	427	343	389	431	338	381	415
320	350	457	513	--	385	427	343	389	431	338	381	415
330	351	458	514	--	385	427	343	389	431	338	381	415
340	352	459	516	--	385	427	343	389	431	338	381	415
350	352	459	517	--	385	427	343	389	431	338	381	415

DecidLarch AU Yields								
Age	**Natural Inventory >20 Years**		**Existing Managed >10 and ≤20 years**		**Existing Managed ≤10 years**		**Future Managed**	
	Med	**High**	**Med**	**High**	**Med**	**High**	**Med**	**High**
	30	**31**	**130**	**131**	**230**	**231**	**330**	**331**
0	0	0	--	0	0	0	0	0
10	0	0	--	0	0	0	0	0
20	0	0	--	0	0	0	0	0
30	0	2	--	10	4	17	2	16
40	8	36	--	56	36	75	19	74
50	31	73	--	121	90	149	59	147
60	55	108	--	186	148	215	108	212
70	78	139	--	240	200	271	155	268
80	100	168	--	289	243	320	195	318
90	120	193	--	330	281	362	230	359
100	138	215	--	366	313	396	260	394
110	156	234	--	397	340	423	285	422
120	171	251	--	421	364	445	307	443
130	184	266	--	439	383	460	325	459
140	195	278	--	453	398	472	340	472
150	205	290	--	465	411	480	352	480
160	213	300	--	472	419	485	361	485
170	221	310	--	476	422	488	368	487
180	229	319	--	480	425	489	373	487
190	236	327	--	481	428	489	377	487
200	243	335	--	480	431	488	380	486
210	249	342	--	479	432	487	381	486
220	256	350	--	478	433	487	381	486
230	262	358	--	478	434	486	379	485
240	269	366	--	478	434	485	377	485
250	274	373	--	478	434	485	375	485
260	275	373	--	478	434	485	374	485
270	276	374	--	478	430	485	371	485
280	277	374	--	478	426	485	369	485
290	277	375	--	478	422	485	367	485
300	278	375	--	478	421	485	366	485
310	278	375	--	478	421	485	366	485
320	279	376	--	478	421	485	366	485
330	279	376	--	478	421	485	366	485
340	280	376	--	478	421	485	366	485
350	280	376	--	478	421	485	366	485

Appendix 3 – List of Acronyms

Acronym	Desription
AAC	Allowable Annual Cut
ABFD	Arrow-Boundary Forest District
BCLCS	British Columbia Land Classification Scheme
BEC	Biogeoclimatic Ecosystem Classification
CFLB	Crown Forested Land Base
DBH	Diameter at Breast Height
DWB	Decay, Waste and Breakage
ECA	Equivalent Clearcut Area
ERDZ-T	Enhanced Resource Development Zone – Timber
ESA	Environmentally Sensitive Area
EVQO	Existing Visual Quality Objective
FESL	Forest Ecosystem Solutions Ltd.
FIP	Forest Inventory Planning
FIZ	Forest Inventory Zone
FPPR	Forest Planning and Practices Regulation
FRPA	Forest Range and Practices Act
FSOS	Forest Simulation Optimization System
GAR	Government Actions Regulation
GIS	Geographic Information System
GW	Genetic Worth
IBM	Mountain pine beetle
ILMB	Integrated Land Management Bureau
IRM	Integrated Resource Management
ITG	Inventory Type Group
KBHLP	Kootenay Boundary Higher Level Plan
KBHLP - IS	Kootenay Boundary Higher Level Plan Implementation Strategy
LRDW	Land and Resource Data Warehouse
LU	Landscape Unit
MAI	Mean Annual Increment
MoE	Ministry of Environment
MoFR	Ministry of Forests and Range
NDT	Natural Disturbance Type
NHLB	Non-Harvestable Land Base
NSR	Not-Sufficiently Restocked
NVAF	Net Volume Adjustment Factor
OAF	Operational Adjustment Factor
OGMA	Old Growth Management Areas
OGSI	Old Growth Site Index

Acronym	Desription
PFT	Problem Forest Types
RMA	Riparian Management Area
RMZ	Riparian Management Zone
RRZ	Riparian Reserve Zone
SBS	Spruce Bark Beetle
SCFP	Springer Creek Forest Products Ltd.
SI	Site Index
SPAR	Seed Planning and Registry
TASS	Tree and Stand Simulator
TFL	Tree Farm Licence
THLB	Timber Harvesting Land Base
TIPSY	Table Interpolate Stand Yield
TRIM	Terrain Resource Inventory Mapping
TSA	Timber Supply Area
TSIL	Terrain Survey Intensity
VAC	Visual Absorption Capacity
VDYP	Variable Density Yield Projection
VEG	Visually Effective Greenup
VN	Vegetated – Non-Treed
VQO	Visual Quality Objective
VRI	Vegetation Resources Inventory
VT	Vegetated –Treed
WTR	Wildlife Tree Retention

Appendix 4 – List of Tree Species

Species Code	Common Name	Scientific Name
Conifers		
Bl	subalpine fir (balsam)	*Abies lasiocarpa*
Cw	western redcedar	*Thuja plicata*
Fd	Douglas-fir	*Pseudotsuga menziesii*
Hm	mountain hemlock	*Tsuga mertensiana*
Hw	western hemlock	*Tsuga heterophylla*
Lt	tamarack	*Larix laricina*
Lw	western larch	*Larix occidentalis*
Pa	whitebark pine	*Pinus albicaulis*
Pl	lodgepole pine	*Pinus contorta*
Pw	western white pine	*Pinus monticola*
Py	ponderosa pine	*Pinus ponderosa*
Se	Engelmann spruce	*Picea engelmannii*
Sw	white spruce	*Picea glauca*
Sx	hybrid spruce	*Picea hybrids*
Sxw	hybrid white spruce	*Picea engelmannii x glauca*
Broad-leaved trees		
Act	black cottonwood	*Populus balsamifera ssp. trichocarpa*
Acb	balsam poplar	*Populus balsamifera ssp. balsamifera*
At	trembling aspen	*Populus tremuloides*
Ep	common paper birch	*Betula papyrifera*