Tree Farm Licence 46

Information Package

Management Plan #5

Timber Supply Analysis

May 2009

The Teal-Jones Group

Table of Contents

List of Tables

List of Figures

Appendices

Existing Mature Average Volume Lines
Existing Natural Yield Curves
Existing Managed Yield Curves
Future Yield Curves
Site Index Adjustment Report
VRI Phase II Adjustment Report

1 Introduction

This document provides a summary of the inputs and assumptions made in preparing the timber supply analysis data set and model. Included are inventory and land base summaries, growth and yield information and management assumptions for timber and non-timber resources as they relate to timber supply.

The Information Package allows the reader to consider the inputs and assumptions to be used in the timber supply analysis. These include:

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

The document has been prepared to identify management issues on Tree Farm License (TFL) 46 that are relevant in determining a sustainable harvest level, and has been prepared in accordance with the guidelines set out in the document "*Provincial Guide for the Submission of Timber Supply Analysis Information Packages for Tree Farm Licences*". In addition to describing the scope and broad objectives of the timber supply analysis, this report will serve as a communication instrument in dealing with people and organizations who have an interest in the project, but who will not be involved at a technical level. Upon acceptance by the Ministry of Forests and Range (MFR) Timber Supply Analyst, the assumptions and methodology provided in the Information Package will be used to prepare and submit a timber supply analysis to the MFR.

This Information Package has been prepared in support of the Timber Supply Analysis for Management Plan No. 5 for TFL 46 and will be provided as an Appendix to the Timber Supply Analysis Report.

Figure 1-1shows the location of TFL 46 between Cowichan Lake, Nitinat Lake and Port Renfrew on southern Vancouver Island.

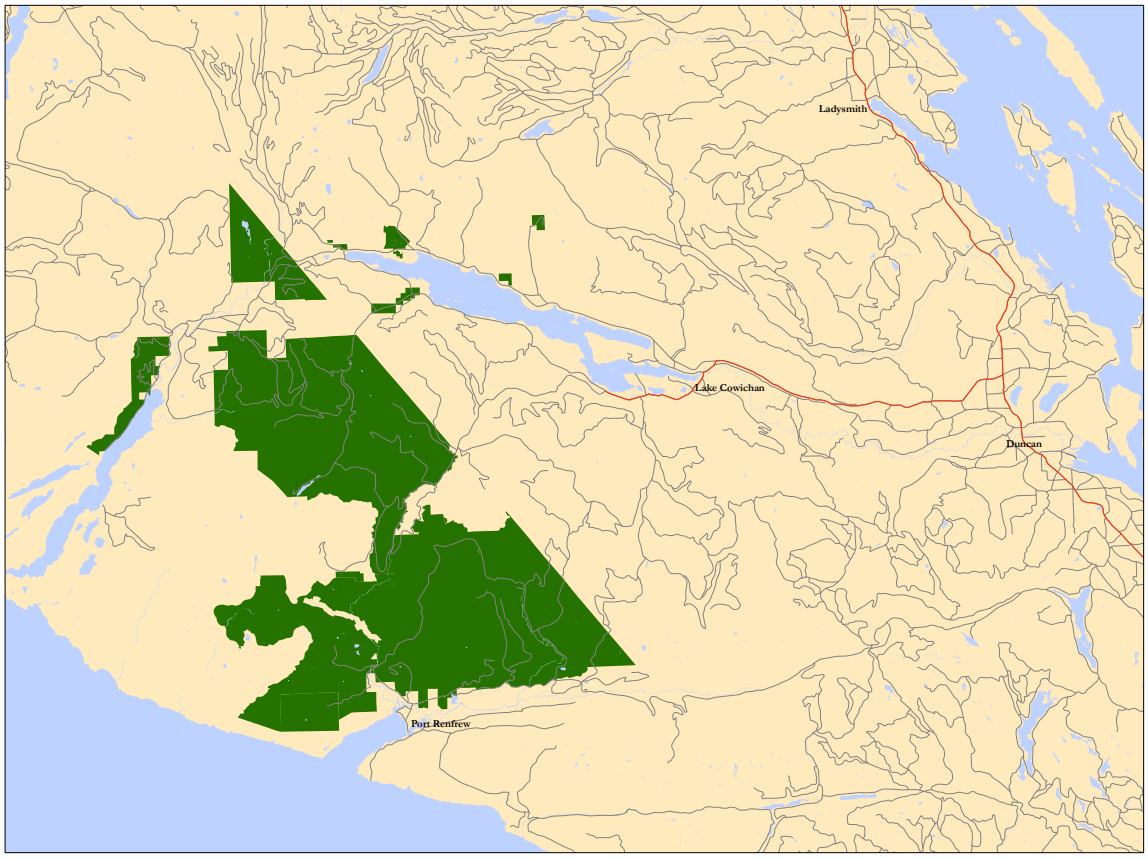

Figure 1-1. Location of TFL46

2 Process

2.1 Overview

The data summarized in this document is the most current available. Any assumptions made for modelling and forecasting purposes are consistent with current forest management practices on the TFL.

The contents of this document will be reviewed with staff from MFR Forest Analysis and Inventory Branch (FAIB) before starting any forest estate modelling.

This report will be included as Appendix I of the Timber Supply Analysis Report.

2.2 Growth and Yield

This section describes the issues, information sources, assumptions, methods, and any relevant processing or adjustments related to growth and yield estimates for existing and future stands. Yield tables for natural stands were developed with the MFR program Variable Density Yield Predictor (VDYP). For old stands, these values were overridden with Average Volume Line (AVL) information taken from the previous forest inventory database. Managed stands used the MFR Table Interpolation Program for Stand Yields (TIPSY) growth and yield model.

Copies of these yield tables can be found in Appendices I through IV.

2.2.1 Site index

Yield curves for the base case scenario in the last timber supply analysis for TFL 46 were based on adjusted site index derived from Terrestrial Ecosystem Mapping (TEM) and a field data collection program. A change in government policy precludes the use of this information for the base case scenario for this analysis. Instead, yield curves based on adjusted site index will be used for one of the sensitivity analysis runs. This issue is discussed further in Section 8.1. The report describing the site index adjustment process[1] can be found in Appendix V.

[1] Second-Growth Site Index Estimates for Douglas-fir, Western Hemlock, Pacific Silver Fir, and Western Redcedar on TFL 46. 2000. J. S. Thrower and Associates Ltd. Consulting Foresters.

3 Timber Supply Forecasts

This section summarizes the harvest forecasts that will be provided. The assumptions pertaining to each option and sensitivity analysis are detailed in later sections.

3.1 Base Case

The base case analysis uses the best available information and assumes that current management practices will be carried on throughout the entire 250 year planning horizon. It is intended to model 'What is?' rather than 'What if?'. Major forest management considerations and issues incorporated into this base case analysis are:

- new Vegetation Resources Inventory (VRI), including the Phase II adjustment;
- minimum harvest ages based on volume and piece size criteria;
- exclusion of harvesting within Old Growth Management Areas, Ungulate Winter Range (UWR), Riparian Reserves Zones (RRZ) and other areas with high habitat or recreational values;
- buffering of all unreclaimed roads in the road inventory to accurately reflect the loss of productive area;
- constraints on harvest rates in order to protect biodiversity and visual values at the landscape level;
- retention of trees to meet stand level biodiversity and riparian requirements; and
- regeneration and silvicultural assumptions that reflect current practices.

It is based on current performance and so provides a reference timber supply forecast against which timber supply implications of different future management options may be measured. The objective of the base case will be to:

- Maintain or increase the current harvest for as long as possible;
- Limit changes in harvest level to less than 10% per decade;
- Balance old growth and second growth harvest to meet industrial requirements; and
- Achieve stability in the long-term harvest level and growing stock profiles.

3.2 Sensitivity Analyses

Sensitivity analysis provides a measure of the upper and lower bounds of the base case harvest forecast that reflects the uncertainty in the data and/or the management assumptions made in the base case. The magnitude of the increase and decrease in the sensitivity variable reflects the degree of uncertainty surrounding the assumption associated with that specific variable. Table 3.1 summarizes the sensitivity analyses that will be performed for this analysis.

Table 3-1. List of Sensitivity Analyses

Issue	Sensitivity Analysis	Level to be Tested
Landbase Uncertainty		
Impact of changes in area available for harvest	Area of THLB	+/- 10%
Stand G/Y Uncertainty		
Inventory volumes not realized at harvest	Existing Stand Volume	+/- 10%
Future stands do not perform as forecast	Future Stand Volume	+/- 10%
Stands become economical to harvest sooner or later than predicted	Minimum Harvest Age	-10 years, +10, +20 years,
Disturbance Limit Uncertainty		
Visual Constraints	Green-up Height	+/- 1 metre
Integrated Resource Management (IRM)	Disturbance Limit	- 5% (20%) + 5% (30%)
Integrated Resource Management (IRM)	Green-up Height	+/- 1 metre
Post-Harvest SI Uncertainty		
VRI does not accurately reflect future site productivity	Use Adjusted Site Index to build yield curves	n/a

3.3 Alternative Harvest Flows

The base case will use a 'Relative Oldest First' harvest rule, subject to a quota on second growth to ensure that the resulting harvest schedule is consistent with current practice. In addition, the following harvest rules will be used to gauge the strategic implications of different harvest queuing options:

- Oldest First
- Highest Volume First
- Minimize Growth Loss

A number of different harvest flows will be explored, based on tradeoffs between short and mid-term harvest levels. In particular, the balance between old growth and second growth harvesting will be varied to gauge the impact on sustainable harvest levels and non-timber resource values.

3.4 Other Options

No other analysis scenarios are anticipated.

4 Forest Estate Model

Timberline's simulation model CASH6 (*Critical Analysis by Simulation of Harvesting*) will be used to develop harvest schedules integrating all resource management considerations. The model uses a geographic approach to land base and inventory organization in order to adhere as closely as possible to the intent of forest cover requirements. Maximum disturbance and minimum thermal and old growth retention forest cover requirements, as well as biodiversity seral stage requirements, can be explicitly implemented if required.

A variable degree of spatial resolution is available depending on inventory formulation and resource emphasis area definitions. Forest stands in refuges such as environmentally sensitive and inoperable areas that do not contribute to the periodic harvest can be included to better model forest structure at the landscape level.

In their current implementation, forest cover objectives require a control area over which to operate. The control area for a constraint set should correspond to a realistic element in the landscape. For example, the requirements associated with visual quality objectives (VQO) are designed to operate on the scene visible from discrete sets of viewpoints. The objective is to identify the "natural" constituency for forest cover constraints. CASH6 contains a hierarchical land base organisation to assist in implementing control areas. Numerous levels of land aggregation are used to define both geographically separate areas and areas of similar management regime. Forest cover constraints can be applied at up to five overlapping levels.

5 Current Forest Cover Inventory

A Vegetation Resources Inventory (VRI) Phase I was completed to MFR standards in 2006. Almost the entire area was covered by aerial photography acquired in 2002. Disturbance updates between 2002 and the year prior to inventory were captured from silvicultural and logging records. All of the area included in the current analysis was covered by this Phase I inventory.

Phase II field sampling was conducted in 2007; ninety sample plots were established. Based on this data, a statistical adjustment of height, age and volume was completed[2]. The results of the adjustment are summarized in Table 5-1. The complete adjustment report can be found in Appendix VI.

Table 5-1. VRI Phase II Adjustment Ratios

	Adjustment Ratio		
	Height	**Age**	**Volume**
Second Growth	0.975	1.084	0.812
Old Growth	0.937	1.078	1.204

Using this information, adjusted height and age were calculated for every stand in the inventory, and these adjusted values were used to derive the inventory site index. VRI site index is one of the primary drivers of the models used to produce stand yield curves.

5.1 Updates

The inventory has been updated for depletion until the end of 2006; growth has been projected to the same date.

[2] Tree Farm Licence 46 - Vegetation Resources Inventory Statistical Adjustment. 2008. Timberline Natural Resource Group.

6 Description of Land Base

This section describes the methodology used to define the productive forest considered to contribute to, and be available for, long-term timber supply from within the total land base of TFL 46.

The Teal Jones Group (Teal) acquired the TFL 46 tenure from TimberWest in May 2004. T0057 (Camper Creek) and A07065 are in the process of being amalgamated into TFL 46, however the transfer in still in process; these areas are considered to be part of the TFL for the purposes of this analysis. Timber Licence T0910 is managed in cooperation with the TFL, but is not part of TFL 46 and is not included in this analysis. Table 6-1 shows how the TFL land base has changed since the last Management Plan.

Table 6-1. Summary of Land Base Changes Since MP #4

	Area(Ha)
TFL 46 Area at MP 4 (net of 7,325 ha Parks)	***83,545***
less:	
Instruments 22, 24, 25	7,167
Forest Revitalization Act Orders	
3(4)21-1 (PFN woodlot (Pixie Lake))	398
3(4)21-2 (Muir Creek)	259
3(4)21-3 (Shawnigan)	974
Proposed Sec 39.1 Takeback Areas	
Rossander (remaining area except 33.3ha of CP41A)	2,291
Hill 60 (remaining area)	3,501
San Juan BCTS (estimated)	10,479
San Juan Woodlot	600
Mapping Error / Boundary Adjustments	(179)
TFL46 Area at MP 5	***58,055***
TO057 Area	1,536
A07065 Area	293
Total Area - Timber Supply Analysis	***59,884***

The above table does not account for deletions under Instrument 26, which removes a 50 metre right-of-way through the TFL for the Pacific Marine Circle Route Highway. Much of the 107 hectares to be removed is identified as non-productive right-of-way in the existing spatial database.

6.1 Timber Harvesting Land Base

This Information Package includes a description of issues, information sources, assumptions, and criteria used to estimate the land base available for timber harvesting, including any relevant data processing or adjustments. Land is classified as either 'Productive' or 'Non-Productive'; the productive landbase is then netted down to determine the Timber Harvesting Land Base (THLB). Figure 6-1 shows the relationship of the total, productive and timber harvesting landbases on TFL 46.

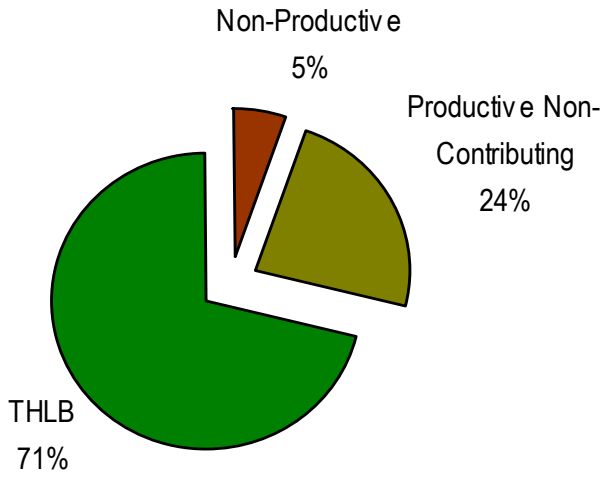

Figure 6-1. Land Base Summary

6.1.1 Timber Harvesting Land Base Determination

This section describes the steps taken to determine the THLB for TFL 46. The THLB for Management Plan #4 was 63,777 hectares. It is smaller now due to the various take-backs that have occurred over the past five years.

The starting landbase for the analysis is all land within the TFL 46 boundary, and all lands in Timber Licence TO057 and Timber Sale Licence A07065. All scheduled take-

back areas will be excluded. These take-back lands will not be included in the base case, or in any sensitivity analyses.

For clarity: Timber License TO910, which is surrounded by TFL 46, will not be included in any of these analyses.

In some cases individual areas may have several classification attributes. For example, stands within riparian reserve boundaries might also be classified as non-commercial. These areas would have been classified on the basis of this latter attribute, prior to the riparian classification. Therefore, in most cases the net reduction will be less than the total area in the classification. Table 6-2 shows the netdown process through which the timber harvesting landbase has been determined. The order of the entries in the table corresponds to the sequence in which the land base classifications were applied.

Table 6-2. Timber Harvesting Land Base Determination

	Total Area (Ha)	Productive Area (Ha)	Net Area Removed (Ha)
Total Area	***59,884***	***56,600***	
less:			
Non-Forest	1,597	-	1,538
Roads	1,785	-	1,746
Total Non-Forest Removed			***3,285***
Productive Forest Land			***56,600***
less:			
Inoperable	2,293	1,683	1,683
Unstable Terrain	6,722	6,284	5,802
Non-Commercial	80	71	71
Low Site	1,392	1,159	743
Community Watersheds	2	2	2
Riparian Reserve Zones	970	847	593
Riparian Management Zones	7,654	7,166	1,345
Environmentally Sensitive Areas	951	588	90
Old Growth Management Areas	6,751	6,211	3,109
Habitat	3,341	3,029	467
Recreation	464	362	186
Total Productive Removed			***14,092***
Timber Harvesting Land Base			***42,508***
Future Roads[3]			***498***
Long-term Landbase			***42,010***

[3] The area of road required to access undeveloped parts of the TFL has been estimated, and an appropriate reduction will be applied to future yield curves to account for this loss of productive landbase.

6.1.2 Age Class Distribution

The age class distribution of the distribution of the productive and THLB landbases is shown in Table 6-3 and Figure 6-2.

Table 6-3. Age Class Distribution

Age Class	Productive Area (Ha)	THLB Area (Ha)
0-9	2,378	2,198
10-19	4,114	3,714
20-29	7,806	6,720
30-39	6,959	6,057
40-49	10,104	8,236
50-59	5,228	4,503
60-69	2,484	2,129
70-79	736	566
80-89	313	237
90-99	224	179
100-109	351	130
110-119	225	133
120-129	131	90
130-139	113	69
140-149	95	29
150-159	169	93
160-249	6,486	3,149
250+	8,683	4,276
Total	**56,600**	**42,508**

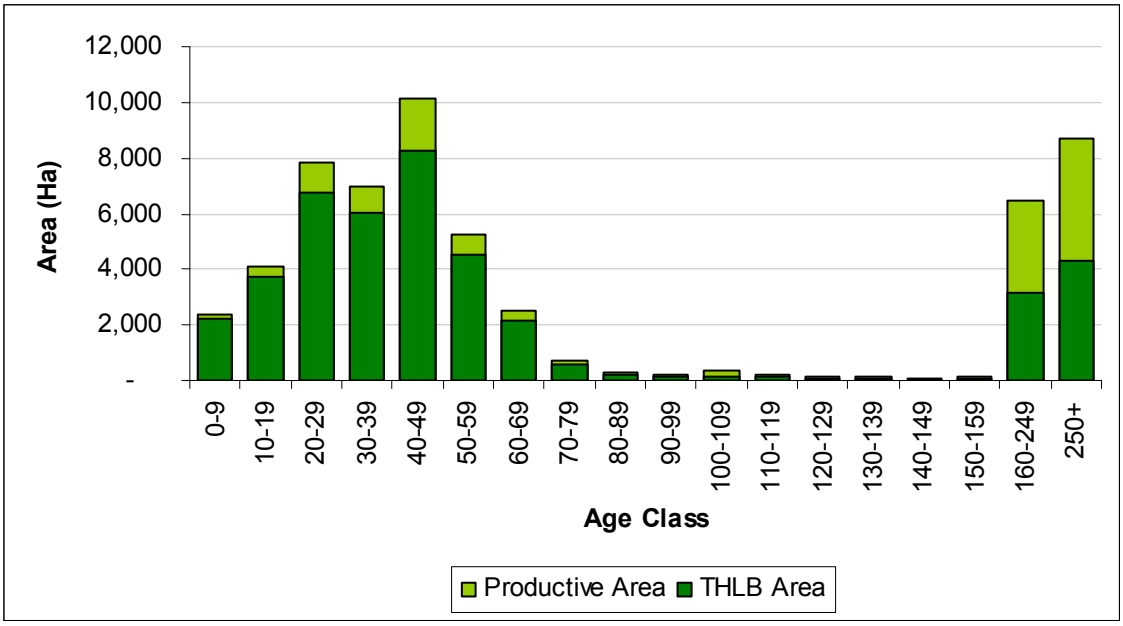

Figure 6-2. Age Class Distribution

Figure 6-3 shows that TFL 46 is comprised mainly of Douglas-fir and hemlock leading stands. Cedar, balsam and deciduous leading stands together comprise just under twenty percent of the productive land in the TFL.

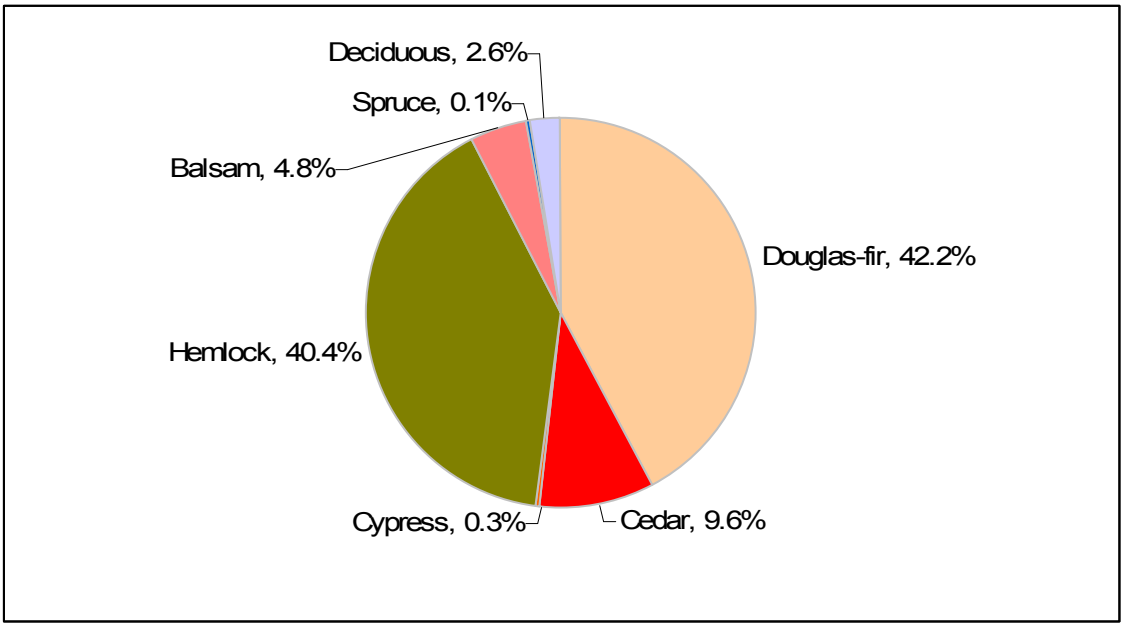

Figure 6-3. Leading Species Distribution

6.2 Total Area

The total area of TFL 46 is 59,884 hectares.

6.3 Non-Forest Area

Non-forest land includes areas in the forest cover that are either non-vegetated (such as lakes, rocks, shrubs that occupy less than 5% of the land, etc.), or are unreported. Non-forest land also includes vegetated areas where less than 10% of the area is occupied by trees. With the exception of recently logged areas classified as bare ground or having little tree cover, all these non-forest areas are considered non-contributing to timber supply and are excluded. This determination was made based on the old forest cover data, using the 'npcode' field. Polygon sizes are smaller than in the VRI, and the classification applies to the entire polygon area. These exclusions are shown in Table 6-4.

Table 6-4. Non-Forest Area

Land Classification	Code	Reduction (%)	Total Area (Ha)	Area Removed (Ha)
Brush	BR	100	3	3
Gravel Pit	GP	100	7	7
Island	IS	100	3	3
Lake	LA	100	137	137
Non Commercial Brush	NCBR	100	5	5
River	RI	100	160	160
Rock	RK	100	329	329
Swamp	SW	100	125	125
Total			769	769

6.4 Non-Productive Area

Non-productive forest areas are portions of the land base that are capable of supporting vegetation, but are considered unsuitable for growing commercial tree species. These areas were also identified from the old forest cover data. Table 6-5 shows the land categories that have been excluded from the THLB.

Table 6-5. Non-Productive Forest Area

Land Classification	Code	Reduction (%)	Total Area (Ha)	Area Removed (Ha)
Non Productive	NP	100	745	745
Non Productive Forested	NPFO	100	1	1
Non Typing Available	NTA	100	23	23
Total			770	770

6.5 Existing Roads, Trails and Landings

Road and landings are considered in three categories - those that:

1) are classified in the VRI;

2) are identified by buffering the roads coverage; and

6.5.1 Classified Roads, Trails and Landings

The VRI land classification system has categories for roads and landings. However, using them for netdown purposes is problematic for two reasons:

1) Most road R/W and landing polygons are too small in size to be captured by the VRI; and

2) The classification often applies to only a portion of the polygon, making it difficult to reconcile with other fully spatial netdowns.

The VRI for TFL 46 shows only 27 hectares in roads and landings, and this area is largely captured through the road buffering process described below. Therefore, no netdown has been applied for classified roads, trails and landings.

6.5.2 Unclassified Roads

The process for identifying unclassified roads is based on the road coverage maintained by Teal. Each road that has not been deactivated has been buffered to a ten metre total width (five metres each side of the centreline) to create a polygon coverage. This area has been removed from the THLB.

Table 6-6. Area in Classified Roads

Classification	Reduction %	Total Area (Ha)	Productive Area (Ha)	Net Area Removed (Ha)
10-metre Road Buffer	100	1,761	0.00	1,746

The area removed is slightly smaller than the total area because some roads pass through non-productive areas previously netted out of the THLB.

6.6 Inoperable / Inaccessible

The current operability map for the TFL was completed in 1993 by an experienced engineer, and reviewed by licencee staff for this project. It identifies large, contiguous areas that are uneconomical to harvest based on a combination of accessibility and timber value, and is considered to be accurate and suitable for strategic planning purposes. Inoperable areas were identified using this mapping. The total area that is considered inoperable or inaccessible is shown in Table 6-7.

Table 6-7. Inoperable Area

Classification	Code	Reduction (%)	Total Area (Ha)	Productive Area (Ha)	Area Removed (Ha)
Inoperable	I	100	2,273	1,683	1,683
Total			2,273	1,683	1,683

Areas with an 'Inoperable' designation that have been previously logged are considered to be operable. The remaining operable landbase has been further classified according to yarding system. This breakdown is shown in Table 6-8.

Table 6-8. Area by Yarding Method

Classification	Total Area (Ha)	Productive Area (Ha)	THLB Area (Ha)
Conventional	52,521	49,999	39,339
Helicopter	3,391	3,318	1,674
Not Classified	1,699	1,600	1,495

A further reduction to the operable land base was made; areas of 'Unstable' terrain were mapped, and these polygons have also been excluded from the THLB. Table 6-9 shows the total and productive area involved, and the impact on THLB.

Table 6-9. Unstable Terrain

Classification	Code	Reduction (%)	Total Area (Ha)	Productive Area (Ha)	Area Removed (Ha)
Unstable Terrain	U	100	6,655	6,284	5,802
Total			6,655	6,284	5,802

6.7 Non-Commercial

Alder-leading stands are considered to be merchantable for this analysis. Stands with a significant non-commercial component (deciduous other than alder – mainly maple) are netted out of the land base. The area excluded is shown in Table 6-10.

Table 6-10. Non-Commercial Area

Leading Species	Code	Reduction (%)	Total Area (Ha)	Productive Area (Ha)	Area Removed (Ha)
Maple	MB	100	80	71	71
Total			80	71	71

6.8 Low Site

Low site stands are not likely to achieve a harvestable volume over a reasonable time horizon. Sites may fall into this category in two ways: they are inherently unproductive due to soil moisture and nutrient regimes (*i.e.* low site index); or the sites might not be fully occupied with commercial tree species. At this stage, the following stand types are netted out of the THLB:

- Coniferous stands that will have a volume of less than 250 m3/ha at 150 years of age; and
- Deciduous stands with a site index less than 15 metres.

This reduction is applied after maple-leading stands have been netted out of the land base as being non-commercial. In order to apply this reduction, stand volume at 150 years of age was forecast using Variable Density Yield Predictor (VDPY). The area that was netted out due to low growing potential is shown in Table 6-11 broken down by leading species.

Table 6-11. Areas With Low Site – By Leading Species

Leading Species	Code	Reduction (%)	Total Area (Ha)	Productive Area (Ha)	Area Removed (Ha)
Balsam	BA	100	106	89	53
Cypress	YC	100	142	90	43
Douglas Fir	FD	100	150	128	104
Red Alder	DR	100	12	11	5
Western Hemlock	HW	100	712	652	399
Western Red Cedar	CW	100	263	190	137
Total			1,385	1,159	743

6.9 Community Watersheds

The only Community Watershed in the TFL is the Malachan, which serves Nitinat Village. Since the FSP states that no 'primary forest activities' will occur, it has been netted out of the THLB. Table 6-12 shows this removal from the THLB.

Table 6-12. Community Watershed

Community Watershed	Code	Reduction (%)	Total Area (Ha)	Productive Area (Ha)	Area Removed (Ha)
Malachan CW	930.013	100	2	2	2
Total			2	2	2

6.10 Riparian Reserve and Management Zones – Streams

The FSP states that FPPR regulations will be followed with respect to riparian buffers. These are listed (for streams) in Table 6-13. Streams have been buffered according to their riparian class and the resulting area has been netted out of the THLB.

Table 6-13. FPPR Riparian Zone for Streams

Riparian Class	Riparian Management Area (metres)	Riparian Reserve Zone (metres)	Riparian Management Zone (metres)
S1-A	100	0	100
S1-B	70	50	20
S2	50	30	20
S3	40	20	20
S4	30	0	30
S5	30	0	30
S6	20	0	20

Table 6-14 shows the Riparian Reserve Zones (RRZ) and Riparian Management Zones (RMZ) that result when these rules are applied to the mapped streams in TFL 46. RRZ's are entirely netted out of the THLB, but only 25% of the area in RMZ's is removed.

Table 6-14. Riparian Reserve and Management Zones – Streams

Riparian Zone	Reduction (%)	Total Area (Ha)	Productive Area (Ha)	Area Removed (Ha)
Stream RRZ	100	898	839	587
Stream RMZ	25	7,533	7,164	1,345
Total		8,430	8,003	1,932

6.11 Riparian Reserve Zones – Lakes and Wetlands

Lakes and wetlands are less common on the TFL than are streams, but the management of riparian areas around these features does have a small impact on the THLB. The FRPA guidelines for riparian management of lakes and wetlands are shown in Table 6-15, and the resulting riparian zones and THLB impacts are shown in Table 6-16.

Table 6-15. FPPR Riparian Zone for Lakes and Wetlands

Riparian Class	Riparian Management Area (metres)	Riparian Reserve Zone (metres)	Riparian Management Zone (metres)
W1	50	10	40
W2	30	10	20
W3	30	0	30
W4	30	0	30
W5	50	10	40
L1-A	0	0	0
L1-B	10	10	0
L2	30	10	20
L3	30	0	30
L4	30	0	30

Table 6-16 Riparian Reserve and Management Zones – Lakes and Wetlands

Riparian Zone	Reduction (%)	Total Area (Ha)	Productive Area (Ha)	Area Removed (Ha)
Lake	100	12	9	7
Wetland	100	2	1	0
Total		14	10	7

6.12 Environmentally Sensitive Areas

Some productive land is classified as environmentally sensitive and/or significantly valuable for other resources. For timber supply analysis purposes, Environmentally Sensitive Areas (ESA's) are identified and delineated through forest cover polygons in the old forest cover data, and are applied as reductions to the THLB. Three categories of ESA's are considered: high value fish habitat, sites with suspected regeneration problems, and avalanche areas. Two ESA classes are recognized within each category: highly sensitive (1) and moderately sensitive (2). Reductions to the THLB due to these ESA's are shown in Table 6-17.

Table 6-17. ESA Areas – By ESA Category

ESA Category	Code	Reduction (%)	Total Area (Ha)	Productive Area (Ha)	Area Removed (Ha)
Regeneration	Ep1	90	189	69	23
Regeneration	Ep2	50	76	49	2
~~Avalanche~~	~~Ea1~~	~~20~~	~~671~~	~~468~~	~~66~~
Fish	Ef2	50	14	1	-
Total			951	588	90

For the last Management Plan, areas of sensitive soils were removed at this stage. That ESA mapping has been replaced by terrain mapping. Areas of unstable terrain were netted out above in conjunction with inoperable areas.

6.13 Old Growth Management Areas

For those Landscape Units covered by the Renfrew Aggregate Landscape Unit Plan, the designated Old Growth Management Areas (OGMA's) will be used for the base case and all sensitivity analyses – landscape-level biodiversity cover constraints based on the Biodiversity Guidebook will not be modelled. The area in OGMA's, by Landscape Unit, is shown in Table 6-18.

Table 6-18. Old Growth Management Area by LU

Landscape Unit	Reduction %	Total Area (Ha)	Productive Area (Ha)	Net Area Removed (Ha)
Caycuse	100	1,274	1,239	608
Gordon	100	2,022	1,957	965
Nitinat	100	60	57	49
San Juan	100	2,481	2,321	1,238
Walbran	100	693	638	249
Total		6,530	6,211	3,109

6.14 Habitat Reductions

Marbled Murrelet and deer are the main species for which habitat areas are managed within the TFL. Since the last Management Plan, many ungulate winter range (UWR) and wildlife habitat areas (WHA) have been identified. One WHA has also been designated for the northern goshawk. Harvesting is prohibited in these areas, so they are netted out of the THLB. The lone WHA for Scouler's Corydalis was recently approved and has also been removed from the THLB.

Reductions for wildlife (and other) habitat are summarized in Table 6-19 and Table 6-20

.

Table 6-19. Ungulate Winter Range

Species	Code	Reduction %	Total Area (Ha)	Productive Area (Ha)	Net Area Removed (Ha)
Ungulate Winter Range	DEER	100	1,167	1,123	204
	ELK	100	52	51	47

Table 6-20. Wildlife Habitat Areas

Species	Code	Reduction %	Total Area (Ha)	Productive Area (Ha)	Net Area Removed (Ha)
Ungulate Winter Range	DEER	100	1,167	1,123	204
	ELK	100	52	51	47
Marbled Murrelet	1-007	100	48	48	-
	1-008	100	4	4	-
	1-097	100	230	229	-
	1-099	100	125	123	0
	1-100	100	605	587	-
	1-101	100	330	318	0
	1-102	100	128	120	45
	1-103	100	171	171	1
Northern Goshawk	Fledgling	100	213	208	141
	Nesting	100	21	20	6
Scouler's Corydalis	Buffer	100	10	10	8
	Core	100	17	16	15

6.15 Cultural Heritage Resource Reductions

Cultural heritage resources can be adequately protected through operational planning measures. When culturally modified trees are found, they will be dealt with through the operational planning process. Consequently, the impact on strategic timber supply is negligible; no area reduction has been applied for this analysis.

6.16 Recreation Reductions

Protection of recreation values on the TFL does not fit into any of the foregoing categories. Two types of netdowns have been applied to protect recreation resources:

1) Features in the Recreation Inventory that were categorized has having 'High' or 'Very High' significance have been removed from the landbase. The exception to this rule is karst features. The Recreation Inventory drew broad polygons around karst features; however Teal staff feel that harvesting operations can be managed in a way that will protect these features without any negative impact on strategic timber supply.

2) Identified recreation sites have been netted out of the THLB.

Table 6-21 shows the total and productive area covered by recreation features, and the THLB impacts of protecting them.

Table 6-21. Recreation Resources

Recreation Feature	Reduction %	Total Area (Ha)	Productive Area (Ha)	Net Area Removed (Ha)
Recreation Inventory	100	417	332	163
CAMPSITE	100	3	2	0
CAVE	100	27	26	23
RECPOINT	100	2	1	-
Total		448	362	186

6.17 Problem Forest Types

No problem forest types have been indentified within TFL 46.

6.18 Future Roads

The portion of the TFL that is currently roaded (could be conventionally harvested from the existing road network) has been delineated by buffering the road network by a distance of 200 metres on each side of the road. This shows that 46,687 hectares of the TFL is currently accessible for conventional harvesting. The area of road needed to accomplish this is 1,761 hectares, or about 3.8% of the roaded landbase. In order to develop a similar level of access on the unroaded portion of the TFL (13,197 hectares), an additional 498 hectares of road will be required. These calculations are summarized in Table 6-22.

Table 6-22. Future Road Requirements

TFL Area (Ha)	59,884
Roaded Area (Ha)	46,687
Existing Road Area (Ha)	1,761
% Roaded in Roads	3.8%
Unroaded Area (Ha)	13,197
Future Roads Required (Ha)	498

For this analysis, these areas will not be removed from the THLB, but rather, a 3.8% reduction will be applied to future stand volumes in unroaded areas to account for this netdown.

6.19 Exclusion of Specific Geographically Defined Areas

No other specific geographically defined areas have been excluded from this analysis.

6.20 Any Other Land Base Exclusions

Wildlife Tree Patches (WTP) are difficult to deal with as a spatial netdown, in spite of the fact that they do result in spatial reserves. Also, the fact that the location of future WTP's cannot be predicted makes them difficult to deal with as a landbase exclusion. They are mentioned here nevertheless, even though they will be modeled as a yield reduction for this analysis.

6.20.1 Wildlife Tree Patches

No existing wildlife tree patches (WTP) are mapped, so they cannot be spatially removed from the THLB. To account for these, and for future WTP requirements, a yield curve reduction will be used.

Stand-level biodiversity is managed operationally through wildlife tree retention to a target of 7%, as set out by the FSP and FPPR. This will be adjusted to account for the WTP requirements that are met by the productive, non-contributing landbase. This consists of the productive areas within: OGMA's, RRZ, UWR and other habitat areas, and within unstable and inoperable areas that have been excluded from the THLB. When these areas are aggregated and buffered to a distance of 250 metres, the resulting coverage is 32,917 hectares in size, or 55% of the TFL. No WTP allowance needs to be made for THLB within this area; that requirement is met from the productive non-contributing landbase. For the remaining 45% of the THLB, a 7% WTP requirement applies. This would amount to an area of 1,340 hectares if it could be applied spatially. Since it cannot, a 3.2% reduction (45% x 7%) will be applied to all existing and future yield curves.

6.21 Area Additions

It is not anticipated that any area will be added to the TFL.

7 Inventory Aggregation

7.1 Management Zones and Multi-Level Objectives

Inventory aggregation allows stands with similar mensurational characteristics and ecological values to be modeled as a single unit, which significantly increases modelling efficiency. This does not preclude the tracking of individual stands for harvest scheduling.

Most TFL 46 resource values other that timber are protected by removing land from the THLB. However, it is still necessary to manage the timing and distribution of harvest within the THLB to adequately address some non-timber resource values. To accomplish this, several management zones have been established (solely for timber supply modelling purposes).

These are shown in Table 7-1.

Table 7-1. Modelling Zones

Zone	Name	Criteria	Rationale
Zone 1	Visual Quality	Polygons classified as 'R' 'PR' or 'M' in the Visual Landscape Inventory (VLI)	Limit denudation to protect visual resources
Zone 3	Watershed Protection	Gordon, Hatton and fisheries sensitive watersheds	Manage Equivalent Clearcut Area to maintain water quality
Zone 3	Goshawk Habitat	Area in Northern Goshawk WHA	Manage seral targets to maintain goshawk foraging habitat
Zone 4	Normal Management	All THLB not in Zone 1	Limit denudation by applying an IRM constraint at the Landscape Unit level as a proxy for adjacency

7.2 Analysis Units

Stands are grouped into analysis units so that individual stand yield curves can be aggregated for modelling purposes. This grouping has been done on the basis of species composition and site index. Table 7-2 shows the THLB area for each of the resulting Analysis Units.

Table 7-2. THLB Area by Analysis Unit

	Area (Hectares)					
	Site Class					
Species Group	**L (SI<20)**		**M (SI 20-30)**		**H (SI>30)**	
Fir	AU#1:	463	AU#2:	3,838	AU#3:	4,562
Fir-Cedar	AU#4:	75	AU#5:	120	AU#6:	30
Fir-Hemlock	AU#7:	919	AU#8:	5,312	AU#9:	4,198
Fir-Alder	AU#10:	20	AU#11:	65	AU#12:	169
Cedar-Conifer Mix	AU#13:	2,657	AU#14:	782	AU#15:	36
Hemlock	AU#16:	3,655	AU#17:	4,971	AU#18:	406
Hemlock-Fir	AU#19:	853	AU#20:	3,391	AU#21:	1,166
Hemlock-Cedar	AU#22:	2,539	AU#23:	1,360	AU#24:	22
Alder	AU#24:	29	AU#26:	581	AU#27:	9
Alder-Conifer Mix	AU#28:	30	AU#29:	216	AU#30:	37

7.3 Detailed Land Base Information Requirements

All resultant spatial datasets, stand and analysis unit yield curves, and forest estate model input files will be made available to the Ministry of Forests and Range upon request.

8 Growth and Yield

8.1 Site Index Assignments

Site Index (SI) is a measure of productivity used during yield analysis. It is an estimate of potential height growth on a site over a fixed period of time, normally 50 years. The productivity of a site largely determines how quickly trees grow and when rotation age and minimum harvest age (MHA), are reached.

The inventory site index from the VRI has been used to develop yield tables for all existing and future stands. This is a change from the last timber supply analysis. In that case, an ecologically-based site index estimate (adjusted site index) was used for stands that regenerated after 1955. The MFR has insisted that this analysis use inventory site index for the base case. The Terrestrial Ecosystem Mapping upon which the adjusted site index estimates were based has not yet been independently assessed for accuracy. A new MFR policy requires that this assessment be completed before ecologically-based site index estimates can be used for a base case analysis. To gauge the impact on timber supply of this change, a sensitivity analysis using adjusted site index will be conducted.

Figure 8-1 shows the site index (VRI) distribution of the THLB, by leading species.

Figure 8-1. Site Index Distribution of the THLB

8.2 Utilization Level

The utilization level defines the maximum height of stumps that may be left on harvested areas and the minimum top diameter (inside bark) and minimum diameter (dbh) of stems

that must be removed from harvested areas. These factors are needed to calculate merchantable stand volume for use in the analysis. The levels used in the analysis reflect current operational practice.

Table 8-1. Utilization Levels

Leading species	Utilization		
	Minimum dbh (cm)	Maximum stump height (cm)	Minimum top dib (cm)
Mature (>200 years of age)	17.5	30.0	15.0
Immature Conifer (<200 years of age)	12.0	30.0	10.0
Alder	12.0	30.0	10.0

8.3 Decay, Waste and Breakage for Unmanaged Stands

Decay, waste and breakage (DWB) factors that are applied to unmanaged stand yield tables to obtain net volume per hectare. These factors are assigned to natural stand volumes automatically in VDYP based on the Public Sustained Yield Unit (PSYU) location. For volume estimates at the 12.0 cm utilization level, net volume cannot be produced directly by VDYP. Gross volume can be output, so these are prorated using the net volume / gross volume ratio taken from the 17.5 cm utilization yield tables.

Licensee experience suggests that hemlock volumes are being underestimated because decay, waste and breakage factors are too high. However, no data is available to support this assumption, so the default PSYU factors have been used in this analysis. A Net Volume Adjustment Factor (NVAF) field program is currently underway and will be completed after the 2009 field season. Better DWB information will be available for the next timber supply analysis.

8.4 Operational Adjustment Factors for Managed Stands

Operational adjustment factors (OAF's) are applied in order to adjust managed stand yields generated by TIPSY to reflect such factors as gaps in stands and decay in trees. The default factors most commonly used are an OAF1 of 15 percent and an OAF2 of 5 percent. OAF1 is a constant percentage reduction to account for openings in stands, distribution of stems, endemic pests and diseases, and other risks to potential yield. OAF2 is an increasing percentage reduction that can be applied to account for decay, waste and breakage. For the last TFL Management Plan (MP) an OAF1 of 15% was applied to account for less than optimal tree distribution, small NP, endemic pests and windfall. An OAF of 5% was used for most existing managed stands.

An adjustment of OAF2 is needed in recognition of the fact that existing and future managed Douglas-fir stands suffer volume losses due to root disease. Laminated and armillaria root diseases are prevalent in the CWHxm subzone/variant. Within TFL 46, 884 hectares of the THLB falls into this ecosystem. The resulting stand volume losses are accounted for in managed stands through revised OAF2 values which are based on work conducted by the Regional Pathologist. 87% of the fir-leading stands were found to suffer a volume reduction that can be modelled by increasing OAF2 by 8.86%. To account for that loss in this analysis, OAF2 has been increased from 5% to 12.7% for existing managed Douglas-fir stands in the CWHxm. This is calculated as follows:

884	ha	(area in CWHxm, Fd-leading less than 50 years old)
87	%	(will experience volume loss)
8.86	%	(additional OAF2 to account for lost volume in these stands)
5	%	(default OAF2 for healthy stands)
12.71	%	(adjusted OAF2 - 5% plus 87% of 8.86%)

8.5 Volume Deductions

No other volume deductions have been applied to the yield curves for biological reasons. However, for timber supply modelling purposes, yield reductions will be applied to account for wildlife tree retention and future roads.

8.6 Yield Table Development

Yield tables are used to forecast the development over time of existing stands, and of future stands that will be established following harvesting.

8.6.1 Base Yield Tables

Separate yield tables have been compiled for each stand identified in the VRI. One of three approaches was taken, depending on the age of the stand:

1. For stands older than 200 years, the average volume lines (AVL's) compiled for the last Management Plan have been used. This is the best available information for these stands, since it is based on substantial field data, and though it is dated, these stands are no longer increasing in volume over time.

2. For stands established before 1955, but younger than 200 years of age, VDYP has been used.

3. For stands established since 1955, TIPSY has been used.

8.6.2 Aggregated Yield Tables

For timber supply modelling purposes, base yield tables have been aggregated into the Analysis Units shown in Table 7-2.

8.7 Yield Tables for Unmanaged Stands

8.7.1 Existing Mature Timber Volumes

The previous forest inventory grouped mature stands greater than 200 years of age into strata based on species composition and volume class. For the last Management Plan, volume estimates, based on field data, were devised for each of these strata. These volumes will be used for this analysis as well. These AVL's are presented in Appendix II.

8.7.2 Yield Tables for Unmanaged Immature Stands

VDYP was used to derive yield curves for each stand between 52 and 200 years of age. These were then aggregated into analysis unit yield tables. These tables are shown in Appendix III.

8.8 Yield Tables for Managed Stands

Any stand that is 52 years of age or younger in 2007 is deemed to be a managed stand and will have a yield predicted using TIPSY. The current species composition and inventory site index is used to develop this yield curve. A planting density of 1000 stems per hectares has been assumed for all existing managed stands.

8.8.1 Silviculture Regimes

The current species composition of each stand will be used to develop its yield curve. The silviculture assumptions used for existing managed stands are shown in Table 8-2.

8.8.2 Regeneration Delay

Regeneration delays of zero years on all sites will be used. A one-year regeneration delay was considered, but was felt to be an overly conservative estimate, since most blocks are planted within one year using one-year old stock – an effective regeneration delay of zero years. The FSP specifies regeneration delays of either three years or six years, depending on the site series, but these are maximum delays for regulatory purposes, and not common operational practice. Rather than factoring regeneration delay into the yield curves, it will be applied – if and where necessary – during the forest estate model runs.

Table 8-2. Silviculture Regimes

AU#	Species Group	THLB Area (Ha)	Avg SI	Leading Species	Second Species	Wght	Estab. Density	Regen Delay
1	Fir	463	17.6	Fd			1000	0
2	Fir	3,838	26.7	Fd	Cw	80/20	1000	0
3	Fir	4,562	33.9	Fd	Cw	80/20	1000	0
4	Fir-Cedar	75	17.9	Fd	Cw	70/30	1000	0
5	Fir-Cedar	120	23.9	Fd	Cw	70/30	1000	0
6	Fir-Cedar	30	32.0	Fd	Cw	70/30	1000	0
7	Fir-Hemlock	919	18.2	Fd	Cw	70/30	1000	0
8	Fir-Hemlock	5,312	26.3	Fd	Cw	70/30	1000	0
9	Fir-Hemlock	4,198	33.4	Fd	Cw	70/30	1000	0
10	Fir-Alder	20	13.0	Fd			1000	0
11	Fir-Alder	65	25.3	Fd	Cw	70/30	1000	0
12	Fir-Alder	169	34.0	Fd	Cw	70/30	1000	0
13	Cedar-Conifer Mix	2,657	17.2	Cw	Fd	80/20	1000	0
14	Cedar-Conifer Mix	782	23.6	Cw	Fd	80/20	1000	0
15	Cedar-Conifer Mix	36	32.7	Cw	Fd	80/20	1000	0
16	Hemlock	3,628	15.9	Cw	Fd	60/40	1000	0
17	Hemlock	4,971	23.8	Cw	Fd	60/40	1000	0
18	Hemlock	406	33.1	Cw	Fd	60/40	1000	0
19	Hemlock-Fir	853	16.6	Fd	Cw	80/20	1000	0
20	Hemlock-Fir	3,391	25.2	Fd	Cw	80/20	1000	0
21	Hemlock-Fir	1,166	32.7	Fd	Cw	80/20	1000	0
22	Hemlock-Cedar	2,539	16.2	Cw	Fd	60/40	1000	0
23	Hemlock-Cedar	1,360	23.0	Cw	Fd	60/40	1000	0
24	Hemlock-Cedar	22	32.0	Cw	Fd	60/40	1000	0
25	Alder	29	19.0	Dr			1000	0
26	Alder	581	25.2	Dr			1000	0
27	Alder	9	37.6	Dr			1000	0
28	Alder-Conifer Mix	30	19.5	Fd	Cw	80/20	1000	0
29	Alder-Conifer Mix	216	24.8	Fd	Cw	80/20	1000	0
30	Alder-Conifer Mix	37	30.9	Fd	Cw	80/20	1000	0

8.8.3 Regeneration Assumptions

While a separate yield curve was developed for each existing stand, future stand yield curves will be developed for each Analysis Unit (AU). All stands in an AU will regenerate to the same yield curve. A total of thirty future yield curves have been developed, and are listed in Table 8-2. The site index used to drive the yield forecast for each AU is the area-weighted average SI (VRI Phase II adjusted height and age) of all of the stands that comprise the AU. All regeneration assumptions are listed in Table 8-2.

8.8.4 Stand Rehabilitation

No active stand rehabilitation is currently undertaken. Alder stands regenerate back to alder stands, but Alder-Confer stands are assumed to be converted to Douglas-fir.

8.8.5 Tree Improvement

Improvements in growth due to the use of genetically improved seed will be modeled during yield curve construction. Table 8-3 shows past performance in planting genetically improved stock on TFL 46. Using this information, genetic gain factors of 7.2 and 3.8 percent for Douglas-fir and Western Redcedar have been calculated and used in the construction of future managed stand yield tables.

8.9 Silviculture History

8.9.1 Existing Managed Immature

Any stand regenerated after 1955 is assumed to be managed. Yield estimates are derived using TIPSY. Operational adjustment factors have been used to account for stand openings and for factors that cause sub-optimum growth. These factors are discussed in Section 8.4.

8.9.2 Backlog and Current Non-Stocked Areas

NSR areas originally contained operable timber, were harvested, and have not yet regenerated to commercial species. Current NSR is part of the working forest and is expected to be regenerated on schedule. No backlog NSR exists on TFL 46.

Table 8-3. Tree Improvement History

Douglas-fir Seedlings				Western Red Cedar Seedlings			
2005							
	A		**B**		**A**		**B**
Planting Season	Seedlings (x1000)	Gain	Seedlings (x1000)	Planting Season	Seedlings (x1000)	Gain	Seedlings (x1000)
2006-Summer	111.5	4%		2006-Summer	73.0	5%	106.5
2007-Spring	261.0	9%		2007-Spring	94.4	5%	-
	372.5	8%			167.4	5%	
2006							
	A		**B**		**A**		**B**
Planting Season	Seedlings (x1000)	Gain	Seedlings (x1000)	Planting Season	Seedlings (x1000)	Gain	Seedlings (x1000)
2007-Summer	150.0	7%		2007-Summer	24.0	4%	156.0
2008-Spring	120.0	7%		2008-Spring	120.0	4%	-
	270.0	7%			144.0	4%	
2007							
	A		**B**		**A**		**B**
Planting Season	Seedlings (x1000)	Gain	Seedlings (x1000)	Planting Season	Seedlings (x1000)	Gain	Seedlings (x1000)
2008-Summer	120.0	7%		2008-Summer	50.0	2%	122.0
2009-Spring	150.0	7%		2009-Spring	70.0	2%	-
	270.0	7%			120.0	2%	

9 Protection

9.1 Unsalvaged Losses

Unsalvaged losses are rare on TFL 46. Fire is uncommon and no major insect pests exist. Laminated root rot is a minor problem with Douglas-fir in some areas, but will be accounted for in this analysis through yield curve reductions. Windthrow is a periodic problem, but blowdown volumes are harvested wherever possible.

A one percent allowance for non-recoverable loss of timber was incorporated into the MP 3 timber supply analysis. Given the licencee's recent performance in recovering blowdown volumes, a zero percent allowance for unsalvaged losses will be used for this analysis.

10 Integrated Resource Management

10.1 Forest Resource Inventories

The following inventories are maintained by the licencee, and along with administrative and ecological boundary information obtained from both Teal and the MFR, form the foundation of the spatial database that has been built for this timber supply analysis.

Table 10-1. Resource Inventories

Inventory	Standard / Source	Mapped At	Date Completed
Vegetation Resources Inventory	Vegetation Resources Inventory	1:20,000	2006
Plantation (Ep)	Al Chatterton	1:20,000	1993
Avalanche (Ea)	Al Chatterton	1:20,000	1993
Terrestrial Ecosystem Mapping (TEM)	TEM / Bob Green	1:20,000	1995
Ungulate Winter Range (UWR)	MOE	1:20,000	2003
WHA – Marbled Murrelet	MOE	1:20,000	2005
WHA – Scouler's Corydalis	MOE	1:20,000	2009
Visual Landscape Inventory	RRL Consultants	1:20,000	1999
Recreation Features Inventory (RFI)	RIC Standards / RRL Consultants	1:20,000	2000
OGMA	LUP Planning Process – Renfrew Aggregate LU Plan	1:20,000	2006
Operability	TimberWest	1:20,000	1993

10.2 Non-Timber Forest Resource Management

The document to this point has been primarily focussed on approaches to modelling the timber resource. This section describes the methods that will be used to forecast the future availability of non-timber resources.

10.2.1 Forest Cover Requirements

The rate of harvesting can be limited in order to achieve an age class distribution target by applying forest cover constraints when the forest estate model is run. Cover constraints typically work by capping the amount of area that can be moved to a young age class (i.e. harvested), or by insisting that a minimum amount of old timber exist at all times. Each has the effect of limiting the rate of harvest within the area to which it is applied. Many cover constraints can be enforced within a given model run, and each may apply to all or only to a specified portion of the landbase. Cover constraints will be applied in this analysis to model visual resources, watersheds and landscape level biodiversity. A cover constraint will also be applied at the landscape unit level as an alternative to modelling strict spatial adjacency rules.

10.2.2 Visual Resources

The visual landscape inventory indentifies known scenic areas in TFL 46. Visually sensitive areas are summarized by Recommended Visual Quality Class (RVQC) in Table 10-2. Visual quality will be maintained by limiting the rate of cut for each visually sensitive polygon according to the limits in Table 10-2.

Table 10-2. Maximum Disturbance by RVQC

RVQC	Area (Ha)	Disturbance Limit	Green Up Height
M	4,454	25%	5 m
PR	5,191	15%	6 m
R	164	5%	7 m
Total	9,809		

10.2.3 Recreation Resources

Important recreational resources have been netted out of the THLB. Any remaining recreational values will be managed through the operational planning process. No cover constraints are required.

10.2.4 Wildlife

Most wildlife habitat is managed through a system of reserves and netdowns, so no forest cover constraints are required. The exception is the foraging portion of the goshawk WHA. Disturbance and retention cover constraints will be applied to this area in order to achieve a desired age class distribution. No more than 20% of the area will be permitted to be less than 20 years of age, and at least 20% of the area must be greater than 80 years of age.

10.2.5 Adjacent Cutblock Green-Up

An Integrated Resource Management (IRM) constraint will be applied in order to model cutblock adjacency and green-up. This constraint will be enforced separately for each landscape unit, and will apply to the THLB only. It restricts the proportion of the THLB that is less than three metres in height to less than 25%. This constraint will approximate a four-pass harvesting approach in each LU, without requiring that a spatial total chance plan be defined.

10.2.6 Biodiversity

10.2.6.1 Landscape Level Biodiversity

Biodiversity planning is modelled through the explicit delineation of OGMA's for all landscape units (LU's) with approved Landscape Unit Plans. This covers all LU's except the Cowichan. For the Cowichan LU, the old seral constraints shown in Table 10-3 will be applied:

Table 10-3. Old Seral Targets for the Cowichan LU

Natural Disturbance Type	Biogeo-climatic Zone	Age of Old Forest	Percent Old Forest Retention in Low Biodiversity Emphasis	Productive Area (Ha)	Net Area (Ha)
1	CWH	>250 years	>13	204	187
2	CWH	>250 years	>9	534	364

Seral stage requirements are established at the BEC variant level. All of the productive forest within each LU/BEC contributes to the old growth seral stage requirement.

10.2.6.2 Wildlife Tree Retention

Wildlife tree retention will be dealt with as a yield curve reduction (see Section 6.20.1). No cover constraint is required.

10.2.6.3 Course Woody Debris

There is no need to model future supplies of course woody debris

10.2.6.4 Objectives for Patch Size Distribution

No patch size modelling will be conducted.

10.2.6.5 Objectives for Connectivity

No effort has been made to model connectivity between old seral patches and high value habitat areas.

10.2.6.6 Watersheds

A significant portion of the TFL falls within Fisheries-Sensitive Watersheds, as shown in Table 10-4:

Table 10-4. Area of Fisheries-Sensitive Watersheds

Watershed	Name	Total Area (Ha)	Productive Area (Ha)	Net Area (Ha)
f-1-004	Gordon River	16,536	15,771	11,653
f-1-005	Hatton Creek	1,938	1,887	1,198
f-1-006	Hemmingsen Creek	5,562	5,293	3,708
Total		24,037	22,952	16,559

The licensee commits to managing fisheries-sensitive watersheds in a manner that sustains and protects aquatic habitat. To model this at a strategic level, each fisheries sensitive watershed will be monitored against an equivalent clearcut area (ECA) target of 20%. In order to model this, full hydrological recovery will be assumed when a stand reaches nine metres in height. For each watershed, the average age to achieve that height will be calculated using regenerated stand yield curves. From this, percent hydrological green up per year will be calculated and compared to forest cover constraint of 20% ECA.

The Klanawa watershed overlaps the TFL by only 8 hectares. Although is classified as fisheries-sensitive, the area involved it too small to apply a cover constraint. Any rate-of-cut issues in this watershed will be dealt with through the operational planning process.

The only Community Watershed within the TFL (the Malachan, only two hectares) was dealt with through a netdown.

10.2.6.7 Riparian Management Zones

Riparian areas – both reserve zones and management zones – have been netted out of the THLB. RRZ's have been entirely removed, and twenty-five percent of RMZ's have been removed. No additional constraints are necessary.

10.2.6.8 Higher Level Plans

TFL 46 will be managed in accordance with the Vancouver Island Land Use Plan (VILUP).

10.2.6.9 Any Other Resource Emphasis

No other resource issues apply to TFL 46.

10.3 Timber Harvesting

10.3.1 Minimum Harvest Age

The minimum harvestable age (MHA) is the criterion that forest stands within an analysis unit must meet to be eligible for harvest. In most cases, economic factors will dictate the threshold beyond which stands are available for harvest. For the purpose of timber supply modelling, these characteristics are often expressed in terms of volume per hectare and/or average diameter. Culmination age, the age at which mean annual increment (MAI) reaches a maximum, or some proportion thereof can also be used as the threshold for minimum harvestable age. In timber supply modelling the age at which the minimum threshold is attained is called the "minimum harvestable age" (MHA). These are minimum criteria – not rotation ages or the actual ages at which the stands will be harvested. Some stands may be harvested at the minimum thresholds to meet forest-level objectives; however, other stands may not be harvested until well past the age for "optimal" timber production due to management objectives for other resource values

MHA is established for each analysis unit. An AU is first harvestable when it meets all three of the following criteria:

- Minimum volume per hectare of 300 m3/hectare;
- Minimum QMD of 25 centimetres; and
- Within 90% of maximum MAI.

The MHA that results when these criteria are applied to each analysis unit are shown in Table 10-5 to Table 10-7.

10.3.2 Operability

Inoperable area has been netted out of the THLB. The remaining area is considered to be more or less equally available over the entire planning horizon, so no additional harvest scheduling constraints or quotas are needed.

Table 10-5. Minimum Harvest Age (MHA) – Existing Natural Stands

AU#	Species Group	Site Class	Minimum Harvest Age
1	Fir	L	105
2	Fir	M	55
3	Fir	H	42
4	Fir-Cedar	L	125
5	Fir-Cedar	M	106
6	Fir-Cedar	H	
7	Fir-Hemlock	L	98
8	Fir-Hemlock	M	52
9	Fir-Hemlock	H	40
10	Fir-Alder	L	150
11	Fir-Alder	M	94
12	Fir-Alder	H	55
13	Cedar-Conifer Mix	L	100
14	Cedar-Conifer Mix	M	72
15	Cedar-Conifer Mix	H	47
16	Hemlock	L	104
17	Hemlock	M	52
18	Hemlock	H	38
19	Hemlock-Fir	L	107
20	Hemlock-Fir	M	48
21	Hemlock-Fir	H	37
22	Hemlock-Cedar	L	110
23	Hemlock-Cedar	M	62
24	Hemlock-Cedar	H	
25	Alder	L	
26	Alder	M	105
27	Alder	H	38
28	Alder-Conifer Mix	L	78
29	Alder-Conifer Mix	M	49
30	Alder-Conifer Mix	H	

Table 10-6. Minimum Harvest Age (MHA) – Existing Managed Stands

AU#	Species Group	Site Class	Minimum Harvest Age
1	Fir	L	112
2	Fir	M	55
3	Fir	H	45
4	Fir-Cedar	L	95
5	Fir-Cedar	M	62
6	Fir-Cedar	H	49
7	Fir-Hemlock	L	103
8	Fir-Hemlock	M	58
9	Fir-Hemlock	H	47
10	Fir-Alder	L	150
11	Fir-Alder	M	54
12	Fir-Alder	H	39
13	Cedar-Conifer Mix	L	68
14	Cedar-Conifer Mix	M	59
15	Cedar-Conifer Mix	H	47
16	Hemlock	L	79
17	Hemlock	M	63
18	Hemlock	H	44
19	Hemlock-Fir	L	75
20	Hemlock-Fir	M	57
21	Hemlock-Fir	H	45
22	Hemlock-Cedar	L	73
23	Hemlock-Cedar	M	65
24	Hemlock-Cedar	H	48
25	Alder	L	76
26	Alder	M	46
27	Alder	H	31
28	Alder-Conifer Mix	L	
29	Alder-Conifer Mix	M	62
30	Alder-Conifer Mix	H	33

Table 10-7. Minimum Harvest Age (MHA) – Future Managed Stands

AU#	Species Group	Site Class	Minimum Harvest Age
1	Fir	L	108
2	Fir	M	50
3	Fir	H	43
4	Fir-Cedar	L	88
5	Fir-Cedar	M	57
6	Fir-Cedar	H	48
7	Fir-Hemlock	L	85
8	Fir-Hemlock	M	51
9	Fir-Hemlock	H	44
10	Fir-Alder	L	150
11	Fir-Alder	M	55
12	Fir-Alder	H	44
13	Cedar-Conifer Mix	L	78
14	Cedar-Conifer Mix	M	61
15	Cedar-Conifer Mix	H	49
16	Hemlock	L	98
17	Hemlock	M	59
18	Hemlock	H	47
19	Hemlock-Fir	L	111
20	Hemlock-Fir	M	55
21	Hemlock-Fir	H	44
22	Hemlock-Cedar	L	95
23	Hemlock-Cedar	M	60
24	Hemlock-Cedar	H	50
25	Alder	L	77
26	Alder	M	62
27	Alder	H	26
28	Alder-Conifer Mix	L	77
29	Alder-Conifer Mix	M	55
30	Alder-Conifer Mix	H	48

10.3.3 Initial Harvest Rate

For the base case, the initial harvest rate will be set at 367,363 m3/year. This represents the AAC level set at the last determination, prorated for area that has since been removed from the TFL.

10.3.4 Harvest Rules

Harvest rules are used by the simulation model to rank stands for harvest. A common approach is to harvest oldest first. With this rule, older stands are queued for harvest ahead of younger stands. Harvest rules interact with forest cover constraints to determine the actual order of harvesting within the model. If a higher ranked stand is in a constrained zone and cannot be harvested, then the model will choose the next highest ranked stand that can be harvested. 'Relative oldest first' harvests those stands that are farthest past their rotation age (culmination MAI), and would be the best rule to use for TFL 46, which has a significant component of second growth timber on a range of sites.

10.3.5 Harvest Profile

A harvest quota will be enforced to ensure that a sufficient volume of second growth timber is harvested in each period. This level will be set in consultation with Teal staff.

10.3.6 Silviculture Systems

Silvicultural practices in TFL 46 need to be considered as a prelude to developing yield curves. Clearcutting is the silvicultural system most commonly employed in the TFL. Variable retention silviculture and commercial thinning have been applied on the TFL in the past, but are no longer current practice and will not be considered during this analysis.

Trees are retained when necessary to meet riparian or wildlife habitat objectives. Reductions to account for wildlife tree and other retention will be applied when the forest estate model is run, rather than directly on the yield curves. All yield curves have been built assuming even-aged management of all stands. Any retention that is left is assumed to be permanently lost to harvesting; no second pass volume is taken.

10.3.7 Harvest Flow Objectives

The harvest flow objectives for this analysis will be:

1) To find the highest even flow timber harvest level that can be achieved while meeting all other resource objectives.

2) If the current harvest level cannot be sustained, to maintain the current level for as long as possible and then step down to the long term level in a series of orderly steps that do not exceed 10% of the initial harvest level in each decade.

3) To provide a balanced flow of old growth and second growth timber in each decade until the available old growth timber has been exhausted.

10.4 Other

All forest management issues – for both timber and non-timber resources – have been dealt with in the preceding sections. No other concerns exist.

11 Glossary

AAC	Allowable Annual Cut
BEC	Biogeoclimatic Ecosystem Classification
CASH6	Critical Analysis by Simulation of Harvesting
ESA	Environmentally Sensitive Area
FPPR	Forest Planning and Practices Regulation
FSP	Forest Stewardship Plan
GIS	Geographic Information System
IP	Information Package
IRM	Integrated Resource Management
IRM	Integrated Resource Management
LU	Landscape Unit
MHA	Minimum Harvestable Age
MFR	Ministry of Forests and Range
MP	Management Plan
NSR	Not Satisfactory Restocked
OAF	Operational Adjustment Factor
OGMA	Old Growth management Area
PSYU	Public Sustained Yield Unit
QMD	Quadratic Mean Diameter
RFI	Recreation Features Inventory
RMZ	Riparian Management Zone
RRZ	Riparian Reserve Zone
RVQC	Recommended Visual Quality Class

SI	Site Index
SRMZ	Special Resource Management Zone
THLB	Timber Harvesting Land Base
TIPSY	Table Interpolation Program for Stand Yields
TL	Timber Licence
UWR	Ungulate Winter Range
VDYP	Variable Density Yield Prediction
VILUP	Vancouver Island Land Use Plan
VLI	Visual Landscape Inventory
VQO	Visual Quality Objective
VRI	Vegetative Resources Inventory
WHA	Wildlife Habitat Area

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Appendices

Appendix I

Existing Mature Average Volume Lines

Appendix II

Existing Natural Yield Curves

Appendix III

Existing Managed Yield Curves

Appendix IV

Future Yield Curves

Appendix V

Site Index Adjustment Report

Appendix VI

VRI Phase II Adjustment Report