DUNKLEY LUMBER LTD.
TREE FARM LICENCE #53
NAVER

Timber Supply Analysis Information Package
in support of
Management Plan # 4

Version 1

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1.0 INTRODUCTION

This Information Package was prepared to fulfill the timber supply analysis requirements in support of Management Plan #4 for TFL 53. The format follows the Ministry of Forest's Provincial Guide for the Submission of Timber Supply Analysis Information Packages for Tree Farm Licence Version 4 March 2001. This document contains the assumptions and modeling procedures that will be used in the timber supply analysis for Tree Farm Licence (TFL) #53.

The purpose of the Timber Supply Analysis Information Package (IP) 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 allowable annual cut (AAC), and how these are applied in the timber supply analysis;
- To provide a means for communication between licensee, Forest Service and BC Environment staff;
- To provide Forest Service staff with the opportunity to review data and information that will be used in the timber supply analysis before it is initiated;
- To ensure that all relevant information is accounted for in the analysis to a standard acceptable to Forest Service staff;
- To reduce the risk of having analysis rejected because input assumptions and analysis methods were not agreed upon in advance.

2.0 PROCESS

This Information Package follows the legislated requirements to complete and submit an information package in support of a timber supply analysis that must be completed as part of a TFL Management Plan. This information package is due to be submitted by August 31, 2003 to the Ministry of Forests (MOF) for approval. The MOF typically has 3 months to review the information and provide feedback to Dunkley Lumber Ltd. Upon the acceptance of the Information Package, a timber supply analysis will be completed and submitted under a separate cover. Changes to the IP resulting from the MOF feedback will be included in an updated IP that will be appended to the timber supply analysis report.

2.1 Growth and Yield

Natural stand growth and yield information was determined through "Batch" version 6.6d of VDYP. Managed stand growth and yield information was calculated through Batch TIPSY version 3.0b. This information has been submitted to the appropriate MOF Branches to facilitate the review process. The yield tables are included in this document in Appendix I and II.

2.2 Missing Data/Uncompleted Tables

There are no missing or uncompleted tables.

3.0 TIMBER SUPPLY FORECASTS/OPTIONS/SENSITIVITY ANALYSES

The purpose of this section is to summarize the harvest forecasts that will be provided. The set of assumptions pertaining to each sensitivity analysis is covered in Section 11.

3.1 Base Case

The Base Case will identify the short and long-term harvest level based on the current level of integrated resource management, harvesting, silviculture performance and pest management practices. The assumptions include current directions from the Prince George Forest District Manager related to achieving biodiversity requirements, acceptable viewshed management, and riparian reserve and management zone requirements.

Changes in management practices, concerns, inventories and forest health issues, which have occurred during the course of Management Plan #3, will now be incorporated into the Base Case scenario for Management Plan #4. These changes are detailed in Table 1.

An immediate overriding health issue is currently facing the TFL. A mountain pine beetle (MPB) infestation is seriously threatening to overwhelm the mature and thrifty pine growing stock within the TFL. The origin of the problem exists not so much within the boundaries of the TFL, but in the migration of MPB from severely infested areas adjacent to TFL #53. Dunkley's primary forest health management objective at this time is to conduct control/salvage harvesting on as much of the mountain pine beetle (MPB) attacked stands on the TFL as possible. In addition, the health of mature spruce stands is a continuing concern, and exclusive attention to MPB sanitation would place the spruce inventory at peril. Dunkley's management actions to safeguard the existing pine growing stock by attempting to reduce the intensity of the infestation, is reflected in the information provided in this information package and in the modeling methodology.

Table 1 Base Case Timber Supply Analysis

Issue	Action / Comments
Utilization Standards	No change from MP #3.
Silviculture	No change from MP #3.
Site Index	Many of the Balsam IU stands and plantations with an incorrect site index identified in the MP #3 analysis, were field visited during the term of MP #3. The site index was corrected through the field survey process.
Legislated FPC Requirements	No change from MP #3, however as a result of the MPB infestation, adjacency constraints are not applied to the TFL for the first 7 years of the harvest simulation.
Sensitive Areas with approved VQO's.	New line work for VQOs was completed and submitted to the MOF in December 2002. No changes to scenic areas or approved VQOs have been made known as a result of this submission. As a result the scenic information made known during the term of MP #3 will be used in the Base Case. The procedure for factoring VQOs in the timber supply analysis remains unchanged from MP #3.
Roads	Updated road width measurements and road length calculations were carried out during the term of MP #3. The road buffer areas were updated.
Wetlands	A wetland classification was completed using a GIS. Wetland buffers have been updated to reflect current management.
Fertilization	Although Dunkley has completed approximately 1000 ha of forest stand fertilization, the results are pending the confirmation of predicted managed stand yields and have not been incorporated into the Base Case analysis at this time.
Deciduous Stands	The natural succession of deciduous leading stands with a coniferous component are modeled as per MP #3. Yields from deciduous stands will not be reduced as in MP #3. Data shows that natural succession leads to coniferous leading stands over time. Type group 41 (deciduous-coniferous) stands have been included in the THLB. A partition harvest of deciduous-conifer stands will be reinstated in 2013 in the timber supply analysis.
Balsam Residual Stands	A partitioned cut to address balsam IU stands is not modeled for the first 10 years in the Base Case. MP #2 established a partitioned cut to facilitate the rehabilitation of IU logged areas. The AAC Uplift for the MPB epidemic removed this partition temporarily. A partition for IU stands will be modeled beginning again in 2013.
Mountain Pine Beetle Epidemic	The TFL is faced with a MPB epidemic. The epidemic is modeled through the mortality of infested pine stands and harvest priority of infested stands. All stands were risk rated for susceptibility of attack. The infestation rate is then calculated based upon the current AAC and beetle management strategy.
Regeneration Delay	Regeneration delay for managed stands is 1 year. Regeneration delay for unsalvaged MPB infested stands is assumed to be 10 years from the time of mortality.
Shelf Life	The shelf life of MPB infested pine trees is 2 years. If mortality results in less than 140m3/ha in the residual stand, then the stand is deemed uneconomical for harvest.
Ingress	Volume ingress for MPB infested stands was not modeled.
MPB Yield Tables	Yield tables for MPB infested stands that are harvested before the end of the shelf life period are unchanged from the VDYP predicted tables. After the shelf life period, yield tables have the pine component removed. Where the residual stand has >140m3/ha at 100 years the stand remains merchantable. Stands with <140m3/ha at age 100 regenerate after 10 years.
Harvest Priority	A priority was placed on harvesting MPB infested stands before the end of the shelf life period. This was followed by a priority on high risk and medium risk stands.
Harvest Rule	A random harvest rule was used in the simulation.

3.2 Sensitivity Analysis

Uncertainty around the data and assumptions used in the Base Case are investigated using sensitivity analysis. Usually only one assumption is varied for each sensitivity analysis (harvest forecast). These forecasts are also used to provide input into the management direction for the TFL. Details on all scenarios are provided in Section 11.

3.2.1 Sensitivity – MOF Standard Sensitivity Analysis

The following scenarios will be completed in the timber supply analysis. These scenarios are designed to assess the implications of uncertainties surrounding inventories, yield estimates and management assumptions. The following sensitivity analyses are all build on the Base Case scenario.

Table 2 Standard Sensitivity Analysis

Issue	Scenario	Comments
Land Base	2.1 Model the impact of increasing the THLB by 5 percent.	Test the impacts regarding uncertainty with inventory information.
	2.2 Model the impact of decreasing the THLB by 5 percent.	
Natural Stand Yield Estimates	2.3 Model the impact of increasing unmanaged stand yields by 10 percent.	Test the implications of under or over estimating empirical stand yields.
	2.4 Model the impact of decreasing unmanaged stand yields by 10 percent.	
Minimum Harvest Age	2.5 Model the impact of using Culmination Age as the minimum harvest age for unmanaged stands.	Test the implications of varying the minimum harvest age.
	2.6 Increase the minimum harvest ages by 5 years.	
	2.7 Decrease the minimum harvest ages by 5 years.	
Forest Cover Constraints	2.8 Model the impact of increasing IRM zone forest cover constraints by 10 percent.	Test the impacts of forest cover constraints.
	2.9 Model the impact of reducing IRM zone forest cover constraints by 10 percent.	
Biodiversity	2.10 Model for the mature plus old seral stage and just show the results.	Test the impacts of the suggested objectives in the biodiversity guidebook.
	2.11 Model the old seral stage targets if full BDG values are applied at all times.	
Managed Stand Yield Estimates	2.12 Model the impact of increasing managed stand yields by 10 percent.	Test the implications of under or over estimating managed stand yields.
	2.13 Model the impact of decreasing managed stand yields by 10 percent.	
Alternative Harvest Flows	2.14 Test the impact of alternative harvest flows.	Assess the variation in harvest flow patterns (See Section 3.3).

3.2.2 Non-Standard Sensitivity Analysis

Table 3 describes the non-standard sensitivity analyses that Dunkley will review during the Timber Supply Analysis.

Table 3 Non-Standard Sensitivity Analysis

Issue	Scenario #	Scenario	Comment
Mountain Pine Beetle	3.1	Model catastrophic depletion of MPB populations (i.e., a cold weather event will decimate populations this fall and management returns to normal.	This would be the MP #4 Base Case, if not for the MPB epidemic.
	3.2	Model a 5 year shelf life.	Sensitivity of shelf life.
	3.3	Model 75 percent mortality for all pine stands.	Uncertainty about the intensity of the epidemic.
	3.4	Model 100 percent mortality of all high risk pine stands and 50 percent mortality in the medium risk stands.	
	3.5	Reduce minimum merchantable volume to 100 m^3/ha.	Uncertainty in future timber values
OGMAs	3.6	Model no harvest in potential OGMAs and low biodiversity emphasis	Test impact of potential OGMAs

3.2.3 Alternative Harvest Flows over Time

One of the requirements of Section 8 of the Forest Act is that the Chief Forester considers the short and long-term implications to British Columbia of alternative rates of timber harvesting from an area.

Several issues must be considered in developing the Base Case harvest flow. For example, where harvest levels are declining, the rate of decline from the current harvest level should be controlled to avoid large and abrupt future harvest shortfalls and the long-term level should be stable.

However, there are many possible harvest flows with different decline rates, different starting harvest levels, and potential tradeoffs between short and long-term forecasts. Several alternative flow forecasts will enable the Chief Forester to assess short, medium, and long-term tradeoffs in the Base Case analysis.

In timber supply analysis various harvest flows (short, medium or long-term) are sometimes possible without compromising long-term sustainable harvest flows. In this analysis, the short-term harvest level will be increased to the maximum level possible to limit non-recoverable losses of mature merchantable lodgepole pine due to the MPB. This will be followed with a sudden decline to the mid-term sustainable harvest flow. Depending on the outcome of the base harvest forecast, alternative rates of decline, or period prior to decline, will be explored. A flat line to step-up harvest flow will also be produced.

4.0 MODEL

Dunkley proposes to use the FSSIM Version 3.0 forest estate model for this timber supply analysis. This is also the model used in the timber supply analysis for MP #3 and for the recent analysis in support of the AAC uplift to help deal with the MPB epidemic. The model was developed by the MOF's Timber Supply Branch.

5.0 CURRENT FOREST COVER INVENTORY

The forest inventory conforms to Ministry of Forest's standards. The current forest cover is based on a TFL specific inventory completed by Dunkley during the term of MP # 1. The photography for this inventory was taken in 1991. The inventory on the TFL occurred shortly thereafter and inventory updates for logging disturbance are an annual ongoing occurrence. Dunkley Lumber Ltd. is relatively comfortable with the accuracy of the inventory (i.e., species, age, height, stocking) for timber supply analysis purposes.

An inventory audit of forest stands within TFL #53 was completed by the MOF in February 1998. The audit compared existing volumes versus inventory volumes (predicted in VDYP) in forest stands. The audit showed that there is no significant difference between the audit volume and the inventory volume for the TFL as a whole.

Although the forest cover inventory has not changed since MP #3, new information has been added to address management issues on the TFL. The site index of 'unmanaged' balsam IU stands has been changed to reflect the SIBEC project completed for the TFL. Errors that occurred in the site index for some plantations identified in MP #3 were also updated through field surveys.

The forest cover inventory was updated for disturbances and inventory attributes. The inventory was projected to January 2003. The custodian of the data, Chartwell Consultants Ltd. in Vancouver, conducted this update.

5.1 Vegetation Resource Inventory

The 1991 inventory has a planned term of twenty years. The accuracy of the inventory is maintained through timely and consistent updates to reflect forest management activities. The TFL also has completed a Terrestrial Ecosystem Inventory. For these reasons, a Vegetation Resource Inventory is not scheduled during the term of Management Plan #4.

6.0 DESCRIPTION OF THE LAND BASE

6.1 Timber Harvesting Land Base

6.1.1 Timber Harvesting Land Base Determination

The purpose of Table 4 is to summarize the area reductions made to the total area of the TFL, to arrive at the land base that is available for timber harvesting. The reductions and additions are listed in the order in which they are applied. Each reduction and addition is described in more detail in the appropriate sections that follow. A comparison of gross area reductions between MP #3 and MP #4 is provided. Dunkley has performed sufficient due diligence to ensure that any discrepancies can be accounted for with regard to the inventory for the TFL. Significant changes in gross area numbers between MP #3 and MP #4 are explained in the specific category descriptions.

Table 4 Timber Harvesting Land Base Determination

Classification	Gross Area (ha) [1]		Net Area (ha) [2]	Volume (m^3)
	MP #3	MP #4		
Total Area (incl. Water)	**87,660.7**	**87,692.6**	**87,692.6**	
Less:				
Non-Forest & Non Productive Forest & Non Commercial Cover	6,673.3	6,785.9	6,785.9	
Existing Roads	1,184.9	889.6	841.9	
Existing Landings	252.0	247.2	226.3	
Potentially Productive Area	79,637.2	79,838.5	79,838.5	
Reductions to Productive Area:				
Low Productivity Sites	967.4	1,286.7	821.3	92,211.3
ESA's (Plantability)	1,272.8	1,283.1	674.4	13,711.0
ESA's (Steep Slopes)	611.7	0.0	0.0	0.0
Recreation sites	213.4	213.4	160.9	37,660.6
Stream Riparian Reserves and Management Zones	4,435.0	4,448.8	3,401.6	761,934.1
Wetland Reserves and Mgmt Zones	299.3	1,409.7	1,117.1	261,764.9
Lakeshore Reserves and Mgmt Zones	417.4	455.8	269.6	60,058.6
Problem Forest Types	5,729.1	4,585.4	3,614.8	483,917.5
Terrain Stability	0	4,262.4	444.1	110,250.0
Wildlife	0	693.5	690.3	149,712.3
Total Net Reductions to Productive Forest	**9,494.9**	**11,194.1**	**11,194.1**	**1,971,220.3**
Initial Timber Harvesting Land Base	**70,142.3**	**68,644.4**	**68,644.4**	
Losses to Future Roads			748.2	
Future Timber Harvesting Land Base			**67,896.2**	

1. The gross areas described in these two columns are NOT ADDITIVE. They represent the gross area in each area classification. Overlap exists between the classifications resulting in the sum of the classifications exceeding the gross area for the TFL. These columns are for comparative information purposes only.
2. The Net Area described in this column is additive. The areas listed describe the net down process followed to determine the timber harvesting land base. Double counting does NOT occur.

6.1.2 Age Class Distribution

The age class distribution for the TFL has been included as Table 5 below.

Table 5 Age Class Distribution

Age Class Range (Years)	Productive Area (ha)	Timber Harvesting Land Base Area (ha)
0	1,009.7	599.1
1-20	16,210.3	15,465.8
21-40	10,326.0	9,565.8
41-80	13,375.6	11,628.6
81-100	10,758.6	9,616.6
101-120	3,870.8	2,594.9
121-140	2,267.1	674.9
141-250	21,752.6	18,317.8
251+	267.8	180.9
Total	**79,838.5**	**68,644.4**

6.2 Total Area

The total area of Tree Farm Licence #53 including fresh water is 87,692.6 hectares. The slight increase from the area in MP #3 is due to a re-digitized TFL boundary.

6.3 Non-Forest Area

Non-forest includes fresh water, snow, ice, rock, alpine, classified roads, camps, etc. The area for these items was derived from the TFL forest inventory file. Type I.D. # 5 and #6 was used to identify these areas. Details are provided in Table 6. Non-forest area has increased slightly over the term of MP #3. This increase is due to forest inventory updates for mining disturbance and gravel pit development.

Table 6 Non-Forest Area

Description	Total Area (ha)
Rock	6.4
Clay Bank	2.8
Lake	1,740.9
Gravel Bar	47.7
River	66.2
Swamp	2,887.8
Mine	84.5
Clearing	15.3
Urban (incl. Classified Roads and Private Land)	96.5
Total Non Forest Area	**4,948.1**

6.4 Non-Productive Forest

The non-productive forest is classified in the inventory and has a total area of 780.0 ha. Non-productive forests do not contribute to landscape biodiversity objectives.

6.5 Inoperable/Inaccessible

There are no areas within the TFL that are currently inoperable / inaccessible because of terrain. Economic viability is addressed in merchantability reductions, through problem forest types (Section 6.13) and low site deductions (Section 6.7).

6.6 Non-Commercial Cover

The purpose of Table 7 is to specify the amount of non-commercial cover area that exists within TFL #53. Timber production on these areas is considered to be unlikely. This area does not contribute to forest cover biodiversity objectives. There is a slight increase in the non-commercial cover area due to survey update information on backlog NSR areas.

Table 7 Non-Commercial Cover Area

Description	Total Area (ha)
Alpine Forest	26.5
NP Brush	694.0
Non-Commercial Cover	337.3
Total	**1,057.8**

6.7 Low Productivity Sites

Table 8 documents the area that is not suitable for harvest due to its low timber growing potential. Low site is one of two methods used in this analysis to identify unmerchantable stands of forests. The issue surrounding the accuracy of using a site index to predict the future productivity of a mature or over-mature stand of trees accounts for the low site index values used in Table 8.

Table 8 Low Site Index

Leading Timber Type	Site Index (Upper Limit of Exclusion)	Total Area (ha)	Reduction Area (ha)	Volume (m^3) Removed	Average vol\ha Removed
Fir	8.8	0.0	0.0	0.0	0.0
Balsam	7.8	387.8	362.8	27,624.6	76.2
Spruce	7.5	525.9	287.7	46,677.2	162.3
Spruce / Pine	7.5	203.6	83.9	16,833.3	200.6
Spruce / Deciduous	7.5	0.0	0.0	0.0	0.0
Pine	7.8	94.9	42.2	0	0.0
Pine / Spruce	7.8	67.8	38.0	1068.3	28.1
Pine / Deciduous	7.8	0.0	0.0	0.0	0.0
Deciduous Leading	7.5	6.7	6.7	7.8	1.2
Total		**1,286.7**	**821.3**	**92,211.3**	

Note: The site index upper limits of exclusion are unchanged from MP #3. The increase in gross area excluded for low site index is a result of: 1) surveys undertaken by Dunkley on plantations with previously incorrect site indices; 2) surveys of balsam IU st ands, and 3) updates to the VDYP site indices as a result of changes to the projected age and projected height of each stand.

6.8 Environmentally Sensitive Areas and Recreational Sites

Environmentally sensitive areas (ESAs) require special treatment when harvesting. Some ESAs may not be harvested at all, since they represent areas having concerns which may adversely impact non-timber resources or regeneration. Recreation sites were digitized from maps of the gazetted sites. Table 9 details the ESAs appearing in TFL #53. Note that in MP #3 a reduction was made to ESAs with a steep slope. The current analysis does not utilize this ESA designation in the THLB net-down. Steep slopes are accounted for using terrain stability mapping that was completed by Dunkley and factored into this analysis (See Section 6.16).

Table 9 Area Reductions for ESAs

ESA Category	ESA Description [1]	Gross Area (ha)	% Reduction	Net Area Reduction (ha)
Es1	Steep slopes – high	595.9	0	0.0
Es2	Steep slopes – mod	493.5	0	0.0
Ep1	Plantability – high	1,201.1	100	592.7
Ep2	Plantability – mod	703.3	0	0.0
Esp1	Slope/Plantability – high	82.0	100	81.7
Esp2	Slope/Plantability – mod	36.7	0	0.0
Epr1	Plantability/Rec - high	0.2	0	0.0
Total ESAs		**3,112.7**	**-**	**674.4**

Note: The gross area of ESAs with high plantability concerns is 1,283.1 ha. Areas with high slope concerns were addressed in the terrain stability coverage.

The reductions for recreation sites remain unchanged from MP #3. A total of 213.4 ha were removed from the productive forest land base for recreation sites. Additional details about the recreation sites are available in Section 10.2.3.

6.9 Riparian Reserves and Management Zones - Streams, Lakes and Wetlands

Reconnaissance fish and fish habitat inventory has been completed for the TFL watershed stream reaches. The work was submitted and approved by the Ministry of Environment. This inventory includes stream classifications for a sample of stream reaches on the TFL.

Stream classifications, assigned through the inventory, were summarized to assign a riparian reserve zone (RRZ) and a riparian management zone (RMZ) according to the Operational and Site Planning Regulation (OSPR) of the Forest Practices Code. Streams which were assigned a classification that existed in a digital coverage in time for this timber supply analysis were buffered according to the OSPR riparian reserve zone width. For the remaining streams that did not yet have a digital classification, a weighted average RRZ width was determined. Management Zone widths were applied using the same methodology. The legislated RMZ width was factored for percent retention by stream class, as derived from summarizing the prescribed retention in silviculture prescriptions. This data is included in Appendix III.

Table 10 Riparian Reserve Zones

Location	Riparian Class	Stream Length [1] (m)	Riparian Reserve Width (m)	Riparian Management Zone width (m)	Percent Excluded Area in RMZs	RMZ Prorated Width (m)	Total Buffer Width per side (m)	Total Area Removed (ha)
Classified Streams	S2	10,678	30	20	60.0	12.0	42.0	496.1
	S3	57,356	20	20	49.0	9.8	29.8	
	S4	28,463	0	30	31.0	9.3	9.3	
	S5	0	0	30	100.0	30.0	30.0	
	S6	28,416	0	20	19.0	3.8	3.8	
	NVC	16,412	0	0	0.0	0.0	0.0	
	NVC-w	840	0	0	0.0	0.0	0.0	
Unclassified Steams		1,253,468	9	-	-	8.0	17.0	3,952.7
Total All Streams		**1,395,633**						**4,448.8**

1. Note that the calculation of stream lengths includes the line work on both sides of double line streams and rivers. It is very difficult to measure, through GIS, a non-existent centre line. As a result, the total length is overestimated slightly.

Many of the stream reaches within the TFL have been classified; however, this information was not available as a complete digital coverage in time for this analysis. The stream lengths provided are the lengths from the completed digital coverage, which is available. Stream reaches without a specific classification assigned had a weighted average buffer width applied. This approach is consistent with the methodology used in MP #3.

6.9.1 Lakeshore Reserves

The forested reserve area around lakes and wetlands was derived through GIS buffering using Prince George Forest District classifications. Management zones were identified using the same methodology as was used for streams, with the zone width factored by percent retention by class. The rationale was derived from summarizing the prescribed retention in silviculture prescriptions.

Two lake classes occur in the TFL, Class A and Class C. An average legislated (FPC) reserve width of 10 metres was buffered around both classes of lakes. District policy, on the other hand, has increased the reserve width around Class A and C lakes. According to this policy, a 200 metre reserve width is required around Class A lakes (190 metre beyond Code requirements) and a 30-metre reserve around Class C lakes (20 metres beyond Code requirements).

A management zone also exists beyond these reserves. To simplify the modeling of management zones, the management area was multiplied by the percent retention to derive an equivalent reserve reduction. This reduction was calculated to be 17.5 metres (e.g. 50m x 35%) beyond the 200 metre reserve zone for Class A lakes and 24.5 metres (e.g. 70m x 35%) beyond the 30 metre reserve around Class C lakes. Details about the lakeshore reserves are provided in Table 11.

Table 11 Lakeshore Reserves

Location (e.g., zone)	Class	Riparian Reserve Zone Width (m)	Riparian Management Zone		Buffer Width (m)	Riparian Reserve Zone (ha)	Riparian Mgmt Zone (ha)	Net Reduction (ha)
			Width (m)	% Retention				
Stony Lake	A	200	50	35.0	217.5	138.4	131.2	269.6
All other lakes > 5 ha's	C	30	70	35.0	54.5			

6.9.2 Wetland Reserves

Wetland classifications were determined using a GIS. Complex wetlands were also calculated using a GIS to buffer wetlands, thereby to determine which wetlands were within the proximity of others. Wetlands have a management zone around them of varying widths and stem retention.

Dunkley has calculated the stem volume retention in various wetland management zones. Details of the effect of these zones on the operable land base are provided in Table 12.

Table 12 Wetland Reserves

Class	Gross Wetland Area (ha)	Riparian Reserve Zone		Riparian Management Zone			Total Buffer Width (m)	Gross Area Reserved (ha)	Net Area Reduction (ha)
		Width (m)	% Retention	Width (m)	% Stem Retention	Equivalent Distance Retention (m)			
n/a	177.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
W1	1,098.9	10.0	100.0	40.0	37.0	14.8	24.8	1,409.7	1,117.1
W3	777.4	0.0	0.0	30.0	40.0	12.0	12.0		
W5	833.6	10.0	100.0	40.0	32.0	12.8	22.8		
All	2,887.8	-	-	-	-	-	-		

The RMZ retention around wetlands has increased significantly during the term of MP #3. The RMZ retention maintains habitat values associated with the wetlands. The change in management has resulted in a large increase in the land base deduction for wetland RMZs as compared to MP #3.

6.10 Wildlife Habitat Reductions

Modeling implications for wildlife management are intertwined with many of the biodiversity, adjacency and IRM assumptions used in the Base Case. Stand level area reductions for riparian areas and other excluded forested land base will contribute to wildlife habitat. Landscape level assumptions, although not current management, are included in the Base Case. This addresses the maintenance of old and mature forest habitat across the TFL. Adjacency and green-up are modeled by restricting the amount of young forest below a given height (3.0 m in the IRM zone). Wildlife tree patch deductions are also factored into the analysis. There are no known wildlife habitat features that require area specific deductions on the TFL

The AAC Rationale for MP #3 suggested that a 1 percent reduction to the THLB was appropriate for unknown wildlife values. This percent reduction was applied in the net down logic to account for additional unknown wildlife concerns. This accounts for anticipated, but not current, wildlife habitat deductions such as ungulate winter range, and identified wildlife management strategies.

6.11 Cultural Heritage Resource Reductions

Cultural heritage features have been identified through the archaeological impact assessments carried out as part of OSPR requirements. When these features have required some level of retention as part of the management prescription they are accounted for in riparian reserves or wildlife tree patches. As a result, there was no decrease in the timber harvesting land base specifically attributed to cultural heritage resources.

6.12 Other Sensitive Site Reductions

There are no known “other sensitive sites” on TFL #53.

6.13 Problem Forest Types

Problem forest types are stands which are physically operable and exceed low site criteria. These stands are excluded from the timber harvesting land base at the present time due to the stands being too old, too short, and/or having too small a diameter. Although many of these stands may be harvested in part, they are not specifically targeted for harvesting at the present time. Changes in timber value, timber availability, and sawmill requirements may change Dunkley’s perception of the value of these stands in the future.

Table 13 documents the areas that are currently considered to be problem forest types. The land base deductions are described according to inventory file attributes.

The problem forest type stands are the same as those excluded in MP # 2 and # 3 and were selected based on field inspections of representative stands. The Age/Height/Stocking number codes are standard Inventory Branch label codes. Definitions for these codes are provided in Table 14.

Table 13 Problem Forest Types

Species	Inventory Type Group	Characteristics			
		Age/Height/Stocking	Reduction Percent	Total Area (ha)	Net Area Reduction (ha)
F	1 - 8	age class 7 and height class = 2 and stocking class = 2	100	0.0	0.0
C, H	9 - 17	all	100	0.0	0.0
B, BH	18 - 19	age class 6 & height class = 2, or age class 6 & stocking class = 2	100	1,243.2	1,040.1
BS	20	age class 6 and height class = 2	100	1,533.9	1,307.4
S	21 - 26	age class 7 and height class = 2 and stocking class = 2	100	250.0	0.9
Pl	28 - 31	age class 5 and height class = 2 and stocking class 2	100	182.4	9.1
Cot, At,Dec	35 - 39,42	all	100	1,084.1	983.4
Bi	40	all	100	291.8	273.9
			Total	**4,585.4**	**3,614.8**

Table 14 Age, Height, Stocking Definitions

Age Class		Height Class		Stocking Class		
#	Age (years)	#	Height (m)	Class #		Definition
5	81 - 100	1	0 - 10.4	0		immature
6	101 - 120	2	10.5 - 19.4	1		mature & > 76 stems/ha, 27.5+ cm dbh
7	121 - 140	3	19.5 - 28.4	2		mature & < 76 stems/ha, 27.5+ cm dbh
8	141 - 250	4	28.5 - 37.4	Sub-div. of 2	3	mature Pl>=311 stems/ha, 17.5+cm dbh and 50% of stems 7.5+ cm dbh are 12.5+ cm dbh
9	251+	5	37.5 - 46.4		4	mature Pl <311/ha, 15.5+cm dbh or >=311/ha, 17.5+ cm dbh and <50% stems 7.5+ cm are 12.5+ cm dbh

6.14 Roads, Trails and Landings

Roads, trails and landings exist on the inventory files as either lines passing through forest cover polygons, or if the road and right-of-way is sufficiently large, as polygons themselves. If a road and right-of-way exists as a polygon on the inventory file, it is deemed a classified road. If a road passes through the middle of a polygon, it is deemed an unclassified road. Reductions to the timber harvesting land base must account for both of these descriptions.

6.14.1 Classified Roads, Trails and Landings

Roads which have a right-of-way identified on the inventory file by a break in the forest cover polygons are excluded in the net down as non-forest and were removed in Section 6.3 "Non-Forest Area". These areas are usually classified as either "urban" or "clearing".

6.14.2 Previously Unclassified Roads, Trails and Landings

Roads, trails and landings passing through the center of a forest stand polygon can only be identified on the forest cover files as 'strings' without any associated area. To ensure that the road width and right-of-way area which exists around these 'strings' are identified and removed from the THLB and from the contributing to biodiversity and forest cover requirements, a GIS was used to buffer the area around the different classes of road. Prior to buffering these strings, the files were updated to incorporate new and deactivated roads. Field measurements to determine the average width of road classes was carried out by Dunkley Lumber in 1993 and updated in June 2003. Using these measurements the right-of-way widths shown in Table 15 were determined.

Table 15 Right-of-Way Widths

Feature	Deduction Width
Forest Service Roads	16.5 m[1]
Road Permits (seasonal and maintained)	13.7 m[2]
On-block Roads	4.3 m[3]
Landings	0.24 ha\landing [4]

Notes:

1. The entire road right-of-way was included as a deduction as it was assumed that this area would remain cleared for safety reasons (measured 2003).
2. The area of the right-of-way brushed for line-of-sight was deducted from the net land base (measured 2003).
3. The road width included unplanted portions of the block such as ditches and cuts and fills which were deemed non-productive (measured 1993).
4. Landing area included the non-reforested portions of the landing (measured 1993).

For this timber supply analysis, deduction widths were applied to the lengths of road, by road class, using a GIS database to determine an area reduction. This area reduction was converted to non-forest area and does not contribute to biodiversity or forest cover constraints

The road system in the GIS database has been updated to include permanent road deactivation. Permanently deactivated roads that have been planted are not included in the deductions for roads, trails and landings. Table 16 summarizes the area removed for current roads, trails and landings.

The reduction in road area as compared to MP #3 is explained by updated road information. The length of road on the TFL is now tracked spatially through a GIS rather than being calculated from a sample map sheet. The road clearing widths were also updated, to reflect the current management practices of road construction and line-of-sight brushing.

Table 16 Previously Unclassified Roads, Trails and Landings

Location	Road Class	Buffer Width (m)	Road Length (km)	Total Area [2] (ha)	Net Area Reduction (ha)
All	FSR	16.5	138.0	227.7	841.9
	Primary Operational	13.7	235.02	321.9	
	On-block	4.3	790.6	340.0	
	Landings [1]	n/a	n/a	247.2	226.3

Notes: 1 Represents 1,050 landings.
2 The total area in roads was excluded from the "Total Productive TFL Forest Area" in the Timber Supply Analysis.

6.14.3 Future Roads, Trails and Landings

This reduction is applied as a percent reduction against all stands that will be disturbed in the future. It will apply to stands greater than 35 years of age. The 35-year cut off was derived to account for the fact that stands less than 35 years of age are likely plantations which already have a road system developed to access them. History records contain harvesting which dates back 45 years. A 10-year time buffer was applied to account for additional roads through previously harvested areas. The net result is a conservative estimate since 10 years of harvested area will have both a current road deduction and a future road deduction.

The calculation for future roads, trails and landings are based upon the calculations used in MP #3. The data is adjusted to reflect current management. It is not anticipated that future construction of Forest Service Roads will occur on the TFL.

Table 17 Calculation for Future Roads, Trails and Landings

Feature	MP#3
Operational Roads	0.42%
On-Block Roads	0.83%[1]
Landings	0.0%[2]
Subtotal	**1.25%**
Permanent Road Deactivation	(0.16)[3]
Future Reductions	**1.09%**

1. It was calculated that on-block roads developed for roadside logging have approximately 30% more length of road than is required for a landing road system.
2. Landings are no longer constructed under our current harvesting system.
3. 1996, 1997 data show that 12.5% of roads constructed for current logging are permanently deactivated. This applies to both operational and on-block roads.

6.15 Terrain Stability

A reduction for terrain stability mapping was not carried out in MP #3. Mapping of terrain stability was completed within the TFL during the term of MP #2, but field verification was not completed in time for inclusion for the MP #3 analysis. Terrain stability has been utilized in this analysis. A total area of 4,262.4 hectares exists in terrain stability classes IV and V. A portion of the total area of each polygon with these classifications was removed from the THLB using the same methodology as riparian management zone deductions. The percent reduction is based on an analysis of Silviculture Prescription retention in these areas. Table 18 describes the area in the classifications, the gross percent reduction to each polygon and the net area reduction to the THLB.

Table 18 Terrain Stability

Terrain Stability Class	Gross Area (ha)	Percent Reduction	Gross Area Reduction (ha)	Net Area Reduction (ha)
IV	3,179.6	25	794.9	397.9
V	1,082.8	21	227.4	46.2
Total	4,262.4	-	1022.3	444.1

6.16 Exclusion of Specific Geographically Defined Area

There are no exclusions of "specific geographically defined areas" beyond those already discussed for TFL #53.

6.17 Any Other Land base Exclusions

There are no "other land base exclusions" beyond those already discussed for TFL #53.

6.18 Area Additions

There are no special area additions to the TFL land base.

Items to note are:

NSR was not excluded from the THLB and then later added back. The NSR that is in the THLB is net of reductions for ESAs, riparian reserves, roads, etc.

Current NSR is a company obligation and treated under silviculture prescriptions. NSR with logging history after 1987 was considered current NSR. Given the performance on treating NSR to-date, it is appropriate that the NSR stands are a component of the Base Case addition to the THLB. Current NSR is added back to managed stand analysis units based upon the site index and the existing species component. Current NSR was assumed to be treated within 1 year. Table 32 in Section 8.9.2 describes the area that gets added to managed stand yield tables.

Backlog NSR was differentiated from current NSR by year of logging. NSR resulting from pre 1987 logging is considered backlog NSR. Backlog NSR has been treated extensively by Dunkley over the term of the past 3 management plans. FRBC/FIA funding was utilized to reduce backlog NSR. Some backlog NSR remains in the TFL. Most of this is not scheduled for treatment in consideration of other resource values on the areas. The backlog NSR area will be grown under its own unmanaged stand yield

table utilizing current species, stocking and site index levels. Table 32 in Section 8.9.2 describes the NSR area which gets added to unmanaged stand analysis units.

During the term of MP #3, Balsam Intermediate Utilization (IU) stands had their site index updated to reflect actual site productivity. As a result, relatively few Balsam IU stands were lost in the low site index or the problem forest type net down. Area may still have been lost in other net downs (e.g. riparian and roads). Total net area in Balsam IU stands is 1,707.9 hectares (total gross IU area is 1,930.3 hectares). Balsam IU stands were identified during the term of MP #2 used the FRDA IU survey area summary. The AAC was adjusted to 4,100 m3 per year for the term of MP #3. The adjustment to the AAC in March 2003 as a result of the MPB epidemic resulted in a suspension of the partition for Balsam IU stands. For modeling purposes, this partition will be reinstated commencing 2013.

The gross area of deciduous leading stands on the TFL totals 3,022.4 ha. Within this area, 1,646.5 ha is Type Group 41 which has deciduous as the leading species and conifer as a major secondary species. After other land base deductions 1,508.4 ha of this gross area is included in the THLB.

7.0 INVENTORY AGGREGATION

The TFL land base was divided into numerous spatially explicit and implicit tracts of land. Divisions occurred on several levels based upon inventory coverage's that were intersected with the forest cover. Items include:

- Biogeoclimatic Zone
- Visual Quality
- Riparian Buffers
- Road Buffers
- Potential Old Growth Management Areas
- Short-Term MPB Susceptibility
- Terrain Stability
- Stand Age Category
- Analysis Unit (based upon species and site quality)

Zones were created based upon many of the attributes listed above. The zones were grouped according to:

1. Biogeoclimatic zone (for seral stage biodiversity constraints)
2. Similar visual quality objective (for green up constraints)
3. Old-growth management areas (for reporting purposes only at this point in time)
4. Short-term MPB susceptibility (to facilitate analysis unit transfers from at-risk to attacked status)

Zones were coded to provide a discrete description of each zone. Table 19 provides the code used to spatially identify a zone of timber. Each column in a string of characters describes an attribute, specific to the location that an analysis unit is found in.

Table 19 Zone definition

1-4	5	6	7
Biogeoclimatic Ecosystem Classification	Visual Quality Condition	Old Growth Management Areas	Stand Susceptibility Index to MPB

Attributes associate to each column in the zone definition string are identified as follows:

BEC:	*Ewc3 = ESSFwc3; Ewk1 = ESSF wk1; Sdw1 = SBSdw1; Smk1 = SBSmk1, Smw1 = SBSmw1; Swk1 = SBSwk1*
VQC:	*R = retention, P = partial retention, M = modification, X = maximum modification, N = not visually sensitive*
OGMA:	*1 = Existing; 2 = Recruiting; 0 = not applicable*
SSI:	*N = not applicable, L = low, M = moderate, H = high*

7.1 Management Zones and Multi-Level Objectives (Groups)

The analysis for TFL #53 contains the zones and groups shown in Tables 20 to 23. Each of the zones was created for a specific modeling reason.

- Biogeoclimatic Ecosystem Classification zones were identified for the purpose of modeling forest cover constraints as per the biodiversity guidebook.
- Visually sensitive zones were created to ensure visual quality objectives and adjacency constraints across the land base are maintained.
- Potential OGMA zones were created for reporting purposes and sensitivity analysis.
- Stand susceptibility zones were created for short term modeling of the mountain pine beetle epidemic.

Table 20 BEC Zones

BEC	Area (ha)			
	Gross	**Productive Area**	**THLB.**	**Rationale**
ESSF wc3	25.2	24.9	24.9	Created for modeling FPC Biodiversity Guidebook old growth constraints
ESSF wk1	14,076.2	13,534.7	12,470.5	
SBS dw1	2,670.1	2,503.1	1,927.4	
SBS mk1	26,447.9	24,231.3	19,749.8	
SBS mw1	17,677.6	16,024.3	13,720.8	
SBS wk1	26,795.6	23,520.2	20,751.0	
Total	**87,692.6**	**79,838.5**	**68,644.4**	

Table 21 Visually Sensitive Areas and IRM Zones

Visual Quality Class	Area (ha)			
	Gross	**Productive Area**	**THLB.**	**Rationale**
Retention	58.5	53.2	31.1	Model forest cover in visually sensitive areas
Partial Retention	1,283.2	1,245.8	1,074.9	
Modification	1,889.5	1,839.6	1,683.4	
Maximum Modification	87.0	84.8	84.7	
Non Visually Sensitive (IRM zone)	84,374.4	76,615.1	65,770.3	
Total	**87,692.6**	**79,838.5**	**68,644.4**	

The area of visually sensitive polygons reflects the known visual quality objectives made known by the District Manager on February 7, 2000. The areas are slightly different than the recommended visual quality classes modeled in MP #3.

Table 22 Potential Old Growth Management Area

OGMA	Area (ha)			
	Gross	Productive Area	THLB.	Rationale
Existing	2,669.1	2,622.1	779.5	Sensitivity analysis and reporting purposes
Recruitment	53.7	53.2	44.6	
Outside OGMA	84,969.8	77,163.2	67,820.3	
Total	**87,692.6**	**79,838.5**	**68,644.4**	

Table 23 Stand Susceptibility to MPB

SSI	THLB. (ha)	Gross THLB Volume (m3)	Non Pine Volume (m3)	Pine Volume (m3)
Not applicable	27,956.4	5,525,882.1	5,525,684.5	197.6
Low	16,416.0	82,230.9	46,673.3	35,557.6
Moderate	9,698.8	2,970,830.1	2,615,878.9	354,951.2
High	14,573.2	4,759,837.5	1,531,833.9	3,228,003.6
Total	**68,644.4**	**13,338,780.6**	**9,720,070.6**	**3,618,710.0**

7.2 Analysis Units

Analysis Units (AUs) are the basic building blocks around which inventory data and other information is assembled for use in forest estate planning models. They represent the general level of aggregation, or detail at which a timber supply analysis is carried out. The areas shown in the following table exclude area adjustments made for NSR.

Table 24 Analysis Units

Analysis Unit (#)	Analysis Unit (Name and Site Quality)	Total Area (ha)	Variable used to define Analysis Unit	
			Type Group	Site index
1	Fir	1,232.3	1, 4, 5, 8	8.8
2	Balsam Good	3,371.0	18, 20	13.0
3	Balsam Medium	2,437.9	18, 20	7.8 & < 13.0
4	Balsam IU	1,707.9	18, 20	All
5	Spruce Good	14,861.5	21, 22, 24	16.0
6	Spruce Medium	12,348.5	21, 22, 24	7.5 & < 16.0
7	Spruce/Pine Good	7,337.6	25	16.0
8	Spruce/Pine Medium	2,386.7	25	7.5 & < 16.0
9	Spruce/Decid Good	2,242.0	26	18.0
10	Spruce/Decid Medium	797.6	26	7.5 & < 18.0
11	Pine Good	4,800.1	28	20.0
12	Pine Medium	2,291.2	28	7.8 & < 20.0
13	Pine/Spruce Good	7,899.7	29, 30	17.0
14	Pine/Spruce Medium	1,746.6	29, 30	7.8 & < 17.0
15	Pine/Deciduous	1,166.8	31	7.8
16	Aspen Conifer	1,508.4	41	7.5
17	Backlog NSR	508.7	All	
18	Excluded forested area pine leading	1,890.9	28-31	0.0
19	Excluded forest area not pine leading	9,302.8	1-27, 32-42	0.0
0	Non-Forest	7,854.4	-	-
	TFL Total Area (ha)	**87,692.6**	-	-

The site index divisions used are different from those used in MP #3. This was done to avoid analysis units representing very little area in the analysis.

7.3 Detailed Land Base Information Requirements

A detailed digital ASCII file of the inventory for the TFL, created after the determination of the timber harvesting land base, will be made available to the MOF's Timber Supply "Audit" Forester upon request.

8.0 GROWTH AND YIELD

The yield curves have been forwarded to Resources Inventory and Research Branch staff for their review and acceptance.

8.1 Site Index Assignments

Site indices for existing unmanaged stands were assigned using the MOF's Variable Density Yie ld Prediction Model, batch version 6.6d.

Site indices for existing managed stands were assigned using an adjusted site index based upon a BEC Classification for TFL #53. Site indices are based upon the biogeoclimatic zone, subzone and site series of each stand or portion of each stand. Biogeoclimatic information was loaded into a GIS and intersected with the forest cover layer. The table used to derive site index by site series and subzone is provided in Appendix IV.

8.2 Utilization Levels

Utilization will be modeled to the utilization standards indicated in Table 25.

Table 25 Utilization Levels

Species	Utilization				
	Minimum Dbh (cm)		Maximum Stump Height (cm)	Minimum Top dib (cm)	Firmwood Standard (%)
	Unmanaged Stands	Plantations			
Spruce	17.5	12.5	30.0	10.0	50
Balsam	17.5	n/a	30.0	10.0	50
Douglas-fir	17.5	12.5	30.0	10.0	50
Lodgepole Pine	12.5	12.5	30.0	10.0	50
Aspen	17.5	12.5	30.0	10.0	50

Unmanaged stand utilization levels are consistent with the TFL licence document. Managed stands will be harvested to a minimum dbh of 12.5 cm. Stump height and top diameter will remain the same. This reflects that the uniformity of managed stands will allow a more consistent utilization standard. It is a strategy appropriate for the TFL where the timber supply is forecast to be most restricted in the future when plantations are reaching a merchantable age. Dunkley is also in the process of updating the Dunkley

sawmill to efficiently handle small tree sizes.

8.3 Decay Waste and Breakage for Unmanaged Stands

The current inventory file no longer has the original P.S.Y.U. designations as an overlay to the digital database. To obtain net volumes per hectare, Ministry of Forests' decay, waste and breakage factors provided in the Variable Density Yield Prediction Model (VDYP) for Forest Inventory Zone (FIZ) I and Public Sustained Yield Unit (PSYU) 476 (Naver) were used.

8.4 Operational Adjustment Factors for Managed Stands

Operational adjustment factors for managed stands remain unchanged from MP #3 where they were derived using field procedures detailed in the Ministry of Forest publication on assessing OAF1 in the field:

OAF 1 Project Report 1 MOF BC, FRBC September 1997, and

OAF 1 Project Report 2 MOF BC, FRBC January 1998.

Technical details on the survey performed on TFL #53 are provided in Appendix V. The OAF 1 Project Report 2 is required to extrapolate the results provided in Appendix V against the Estimate of OAF 1 tables appended to Report 2. Table 26 shows the results of Dunkley's project involving an overview of stocking gaps and OAF 1 estimates for TIPSY. Note that a 6% adjustment factor was applied to the calculated OAF 1 for Spruce and a 7% adjustment factor for Pine. This adjustment was applied to account for unforeseen and/or unaccounted for events such as blister rust, root rot, weevil etc.

Table 26 Operational Adjustment Factors for Managed Stands

Species		Df	Sw	Pl	Bl
OAF 1	Calculated	15	6	3	15
	Adjustment	0	6	7	0
	Applied to TIPSY	15	12	10	15
OAF 2		5	5	5	5

8.5 Volume Reductions

In addition to the volume deductions described in Section 8.3 and 8.4 a wildlife tree patch deduction has been added. To address internal wildlife tree patch retention, a 4% OAF was applied to existing unmanaged and managed stands in the FSSIM model. This was done to mimic the area/volume lost as a result of leaving WTPs in each cut block harvested. The percent reduction for WTPs was derived from a review of silviculture prescriptions, which indicated that an average of 4% of the merchantable area within a block was reserves as a WTP.

The Draft Inventory Audit Results: Overview T.F.L #53 February 1998 indicated that there is no significant difference between the audit volume and the inventory volume for all sample polygons. The aggressive salvage of stands infested with MPB and of wind throw damaged stands assist in ensuring that only endemic amounts of stand volume are not recovered from mature stands.

8.6 Yield Table Development

8.6.1 Aggregated Yield Tables

Yield tables will be aggregated so that unmanaged and managed curves exist for each analysis unit. Aggregation was done using the VDYP site index for all of the stands in the THLB separated into AUs. There will be no 'zone specific' yield curves.

8.7 Yield Tables for Unmanaged Stands

Yield tables for unmanaged stands were generated using the Variable Density Yield Prediction (VDYP) 'batch' model, version 4.5.

Separate curves were not produced for unmanaged mature stands versus unmanaged immature stands. A temporary yield curve was created for each forest polygon in the THLB. The yield curves were then grouped by analysis unit and area-weighted to provide one curve for each analysis unit. All of the net area in each analysis unit was used in the generation of the curves. The same sets of curves are applied to each zone within TFL #53.

Tabular summaries for each analysis unit are included with this report. Please refer to Appendix I

8.7.1 Existing Mature Timber Volumes

Existing mature volumes have not been distinguished differently from existing unmanaged immature volumes. They are assumed to grow on the same VDYP

generated yield curve.

8.7.2 Yield Tables for Unmanaged Immature Stands

Existing unmanaged immature stands will be assumed to grow on the same VDYP curve that is representative of older stands.

8.7.3 Existing Timber Volume Check

To verify that significant error did not occur in the aggregation of polygons into analysis units, the total volume of the current inventory (i.e., THLB.) using VDYP polygon specific volumes was compared to the total volume of the current inventory (i.e., THLB.) using analysis unit volumes. The relationship between inventory volumes and VDYP predicted table volumes is reasonably accurate across the whole TFL, with some discrepancies between analysis units. Table 27 provides details.

Table 27 Total TFL Volume (unmanaged stands only)

AU	Description	Total Poly volume (m3)	Total VDYP Vol (m3)	Percent difference
1	Fir	350,362.0	344,391.2	1.7
2	Bl good	198,138.0	160,882.1	18.8
3	Bl med/poor	324,611.1	358,292.9	-10.4
4	Bl IU	229,402.7	208,401.0	9.2
5	Sw g	3,218,525.6	3,095,687.8	3.8
6	Sw m/p	2,429,646.0	2,376,870.0	2.2
7	SwPl g	1,776,466.1	1,683,139.7	5.2
8	SwPl m	335,655.8	330,496.0	1.5
9	SwDec g	287,805.9	259,140.6	9.9
10	SwDec m/p	28,903.6	22,054.7	23.7
11	Pl g	1,263,926.3	1,295,725.5	-2.5
12	Pl m	363,689.1	355,266.9	2.3
13	PlSw g	1,637,364.2	1,638,870.3	-0.1
14	PlSw m	77,676.1	79,730.3	-2.6
15	PlDec	152,472.6	151,703.6	0.5
16	AtCon	196,022.0	168,857.3	13.9
17	Backlog NSR	0.0	3,319.1	0
	Total	**12,870,667.2**	**12,532,829.2**	**2.6249**

Volume calculations were performed as follows:

1. Total polygon volume = (all polygons in the THLB by AU. (inventory volume/ha 'multiplied by' net THLB polygon area))
2. Total VDYP volumes: all analysis units (all age classes (analysis unit area in age class 1 'multiplied by' VDYP estimated volume @ age class 1))

8.8 Yield Tables for Managed Stands

Managed stand yield tables were created using the Batch Table Interpolation Program for Stand Yields (Version 3.0b) for all coniferous species. Aspen-conifer stands will regenerate to pine-spruce stands following seral succession and harvesting.

Two levels of TIPSY curves were created. Stands harvested between 1973 and 1997 form the first set. After assessing areas harvested between 1972 and 1982 it was determined that 1973 would be the starting point. Stands harvested prior to 1972 were predominantly harvested using intermediate utilization standards and were thought to be better represented by unmanaged stand yield tables.

Stands harvested between 1972 and 1982 were assessed for stocking density, brush levels, crop tree performance and silviculture treatments. Using these criteria, each opening was then categorized as being a natural stand or a managed stand (see Appendix VI). For the openings harvested between 1972 and 1982, a total of 765 hectares were determined to be better represented by natural stand growth and yield. In 1972, a total of 940 hectares were harvested. By including 1972 harvesting in the natural stand growth and yield curves, those openings harvested between 1972 and 1982 that are best represented by natural stand growth and yield are accounted for in the timber supply analysis. Using 1973 as a cut-off year rather than the individual stands simplifies the yield table creation.

Stands harvested between 1982 and 1997 have benefited from restocking and free growing requirements. These openings are represented by managed stand yield tables.

Stands harvested in 1998 and into the future will incorporate the genetically improved seed used in Dunkley's reforestation program. Between 1993 and 1997 approximately 20% of all seedlings planted are from improved seed. Dunkley has also purchased Class A seed from the Vernon Seed Orchard Company. We intend to use improved seed for all spruce planted in the year 2000 and beyond. The seed lots purchased from the VSOC have a genetic worth of 18%. Regeneration yields for areas harvested on or after 1998 will incorporate this genetic worth value. 1998 is used as the starting period for this treatment to incorporate past performance in using improved seed.

Table 28 Regenerated Yield Tables

Logging History	Regenerated yield curve	Rationale
Prior to 1972	VDYP	IU Logging
1973 - 1997	TIPSY	Basic Silviculture
1998 +	TIPSY + (genetic gain)	Plant Genetically Improved Sw Seed

8.8.1 Silviculture Management Regimes

The mature and over-mature stands in TFL #53 are predominantly spruce, spruce-balsam and spruce-lodgepole pine. Clearcutting will generally be the prescribed harvesting system for these timber types.

Site indices for the regenerated stands are derived using the area-weighted site series/subzone/site index combination. See Appendix IV. The change in site index, by analysis unit, going from the area-weighted VDYP site index to the area-weighted Biogeoclimatic Ecosystem Classification (BEC) site index is shown in Table 31. Species, site index, treatment and planting density were input into the Batch TIPSY model as per the information shown in Table 21. OAF1 was applied as per the rationale in Section 8.4. OAF 2 is assumed to be 5% as suggested in the TIPSY operations manual. A managed stand yield table was created for each polygon having THLB area. The 5,000 plus yield tables were then area weighted to derive one managed stand yield table for each Analysis Unit.

8.8.1.1 Aggregated Yield Tables

All of the forest polygons comprising the THLB within TFL #53 were aggregated into analysis units based on site index and species. The yield curves are a representation of the entire TFL. Aggregation was not done on a zonal basis. Table 29 shows two columns for site index. The first is the area-weighted site index based on the BEC system. The second column is the area-weighted site index as a function of VDYP. It is important to note that the analysis units were NOT re-aggregated based on the BEC site index classification. The polygons originally allocated based on species and VDYP site index breaks remained in these analysis units. The area-weighted BEC site index is the resultant site index based on the subzone and site series for the polygons in each AU.

8.8.2 Regeneration Delay

Regeneration delay by analysis unit is shown in Table 29. The regeneration delay was not applied as an input into the TIPSY model in the creation of the managed stand yield tables. The values shown in Table 29 were applied directly into the FSSIM model.

8.8.3 Regeneration Assumptions and Species Conversion

Table 29 describes the regeneration assumptions used to create managed stand yield tables. The BEC site index will be used for the creation of managed stands. As indicated in Table 28, two sets of managed stand curves are representative for the TFL. The first set applies to stands harvested between 1973 and 1997. The second set applies to all stands harvested after 1997.

Table 29 documents the TFL management strategy of adding a pine component to stands where it is ecologically appropriate. The conversion of balsam IU stands to spruce is also reflected. The natural succession of deciduous leading stands with a coniferous component to coniferous leading stands is an ecological fact and is modeled in the Base Case. Appendix VII contains the natural succession rationale.

Douglas-fir strategies are designed to maintain the species as a component of the stands where it occurs. Douglas-fir is normally a minor component of our current harvesting volume. Where established, Douglas-fir leave trees serve a dual function of maintaining biodiversity and providing a natural seed source. This is supplemented by planting a component of Douglas-fir where ecologically appropriate (approximately 10,000 seedlings per year or 1-2% of trees planted). Douglas-fir as a minor stand component, is not reflected in the regeneration assumptions.

If Douglas-fir is the leading component of the stand, it is modeled to be reforested to a leading Douglas-fir stand. Douglas-fir leading stands are a very small component of the TFL and harvesting of these stands is rare.

Table 29 Regeneration Assumptions

Unmanaged AU	Planted Species and Percent [5]	Planting Density [1]	Regeneration Type [7]	Site Index [2]			OAF 1 [3]	Regen Delay [4]
				SIBEC		VDYP		
				Pre 98	Post 98			
1	Df 60 Sw 20 Pl 20	1,600	P	20.4	20.2	21.3	15	1
2	Sw 85 Pl 10 Bl 5	1,600	P95% N5%	n/a	17.6	15.8	12	1
3	Sw 75 Pl 20 B5	1,600	P95% N5%	n/a	17.2	11.4	12	1
4	Sw 95 B5	1,600	P95% N5%	n/a	18.3	13.4	12	1
5	Sw 100	1,600	P	19.0	18.9	19.0	12	1
6	Sw 90 Pl 10	1,600	P	18.3	17.8	13.4	12	1
7	Sw 70 Pl 30	1,600	P	19.0	19.5	20.1	12	1
8	Sw 75 Pl 25	1,600	P	18.9	19.0	14.2	12	1
9	Sw 60 Pl 40	1,600	P	19.4	19.7	20.2	12	1
10	Sw 60 Pl 40	1,600	P	19.1	19.3	15.5	12	1
11	Pl 86 Sw 14	1,600	P	20.6	20.8	22.6	10	1
12	Pl 86 Sw 14	1,600	P	20.1	20.0	16.6	10	1
13	Pl 86 Sw 14	1,600	P	20.8	20.9	21.4	10	1
14	Pl 86 Sw 14	1,600	P	19.7	19.7	15.3	10	1
15	Pl 80 Sw 20	1,600	P	20.7	21.0	20.3	10	1
16	Pl 80 Sw 20	1,600	P	22.2	19.6	19.5	10	1
17	Sw 90 Pl 10	1,600	P	n/a	18.2	16.2	12	1

Notes:
1 Initial density reflects mortality after planting approximat ely 1,800 – 2,000 seedlings per hectare.
2 This is the area-weighted site index calculated using the SIBEC generated site index.
3 OAF 1 values were derived from OAF surveys conducted on TFL plantations and adjusted for insects and disease damage. See Section 8.4
4 Regeneration Delay is consistent with an average regeneration delay from the commencement of harvesting a block until planting is completed. From 1998 to 2002 this delay averaged less then 12 months.
5 The Sw component of all post 1998 managed stands was given a genetic gain of 18% . Pre-1998 managed stands did not receive the genetic increase.
6 All yield tables were produced using TIPSY Batch version 3.0b.
7 Used the regen.dat file to revert 5% back to natural stand AU.

8.8.4 Stand Rehabilitation

Specif ic stand rehabilitation activities, beyond the harvesting of balsam IU stands and deciduous coniferous stands are not carried out in the TFL. The superior growing sites and site qualities within the TFL result in very few problem forest types. Deciduous stands, though less desirable as a commercial species, are important for maintaining a level of biodiversity and wildlife habitat. They represent a very small component of the TFL.

8.9 Genetic Improvement

Dunkley has used class A seed for all spruce seedlings planted after 1998. The seed is purchased from VSOC. Pine class A seed is not available in sufficient quantity to meet Dunkleys seed needs.

Table 30 Genetic Worth

Species	Seedlot Number	Genetic worth	
		1st Generation	2nd Generation
White Spruce	60118	18%	
	60119	18%	
	60269	19%	
	61038	18%	

8.10 Silviculture History

8.10.1 Existing Managed Immature

All stands harvested after 1973 are growing on managed stand yield information. The purpose of Table 31 is to document, for each analysis unit, the area of existing managed second growth stands within the TFL

Managed stands are accounted for in the analysis by doubling the initial number of current analysis units. Therefore, the first 17 analysis units will represent unmanaged stands growing on the VDYP curve. The next 17 analysis units (101-117) are the older managed stands and analysis units 201-217 are current and future managed stands. Table 31 shows the area in current managed stands.

When harvesting occurs, unmanaged stands will regenerate to TIPSY + genetic gain (i.e., AU 1 converts to AU 201). Similarly, when existing managed stands are harvested, they also convert to TIPSY + genetic gain (i.e., AU 101 converts to AU 201). The site indexes for these managed stands were generated using the area-weighted BEC classification based on the subzone and site series of each plantation polygon. The area-weighted site indexes for existing and managed stands are shown in Table 29.

Table 31 Immature Management History

Current AU/ Species		Net Area - Natural (ha) by Age			Net Area - Planted (ha) by Age			Total Net Area (ha)
		1-10	11-20	21-30	1-10	11-20	21-30	
1	Fir	-	-	-	6.7	15.6	0.0	22.3
2	Balsam G	11.9	365.2	713.3	-	-	-	1,090.4
3	Balsam M	0.0	45.1	1.1	-	-	-	46.2
4	Balsam IU	0.0	0.0	56.4	-	-	-	56.4
5	Spruce G	-	-	-	580.8	2,738.9	2,730.2	6,049.9
6	Spruce M	-	-	-	225.6	2,830.8	1,825.1	4,881.5
7	Spruce/Pine G	-	-	-	542.5	709.7	904.2	2,156.4
8	Spruce/Pine M	-	-	-	140.6	797.2	524.3	1,462.1
9	Spruce/Decid G	-	-	-	16.3	660.3	466.8	1,143.4
10	Spruce/Decid M	-	-	-	343.7	298.8	0.0	642.5
11	Pine G	-	-	-	220.9	404.4	117.5	742.8
12	Pine M	-	-	-	179.5	368.2	106.4	654.1
13	Pine/Spruce G	-	-	-	1,891.9	667.5	542.0	3,101.4
14	Pine/Spruce M	-	-	-	465.0	707.5	270.3	1,442.8
15	Pine/Deciduous	-	-	-	146.6	216.4	195.9	558.9
16	Aspen Conifer	-	-	-	33.5	258.4	119.5	411.4
Total		**11.9**	**410.3**	**770.8**	**4,793.6**	**10,673.7**	**7,802.2**	**24,462.5**

8.10.2 Backlog and Current NSR

Backlog NSR is any area that was denuded prior to 1987 and is not fully stocked. All other NSR is current NSR. NSR is included in the analysis by allocating the area according to its current species and site index. Current NSR was added back to analysis units 201-216. Backlog NSR was grouped into one analysis unit (i.e. 17) and this area was grown along an unmanaged yield curve representative of poor stocking and crown closure. The area in current and backlog NSR is shown in Table 32.

Table 32 Backlog and Current NSR

Not Sufficiently Regenerated	Backlog Area (ha)		Current Area (ha)		Total Area (ha)	
	Gross	Net	Gross	Net	Gross	Net
Total	**567.3**	**508.7**	**629.7**	**568.1**	**1,197.0**	**1,076.8**

Over the past 10 years backlog NSR has been reduced from 2,540.0 hectares to 567.3 hectares. These areas have been treated with a combination of mechanical and chemical site preparation followed by planting. Surveys also identify NSR areas that have regenerated naturally through time. Most of the remaining backlog NSR is

not treatable due to either location or the advanced stand age that makes it uneconomic to convert these areas to a managed stand. The best management practice maybe to let the remaining stands grow as they have been and harvest them when sufficient merchantable volume exists to warrant treatment.

9.0 PROTECTION

9.1 Unsalvaged Non-Recoverable Losses (NRL's)

In the Data Package for MP # 3, an NRL number based on the best information available at the time was applied to the TFL. This NRL was 678 m3/year and representative of approximately 2 hectares per year.

A review of disturbance history on the TFL's inventory file was completed to re-calculate NRLs that have occurred on the TFL over the past 11 years. This disturbance history summary is provided in Table 33. The NRL figured proposed for use in this analysis is 597 m3/year. See Table 33 for details.

Table 33 Non Recoverable Losses

NRL Type	Portion of stand affected (%)	Average Volume / hectare (m3/ha)	Prod Forest Area (ha)	THLB (ha)	NRL (m3
Burn	100	241.0	1.1	1.1	258.8
Insect	80	143.7	1.6	1.6	181.5
Insect	80	159.4	3.9	3.9	494.4
Insect	10	365.2	4.8	4.8	177.2
Insect	30	448.0	2.8	2.8	371.1
Wind	100	149.0	5.9	1.1	165.8
Wind	80	80.3	1.9	1.9	123.6
Wind	90	167.4	1.9	1.9	282.6
Wind	100	172.0	2.2	0.0	0.0
Wind	80	221.5	3.3	3.3	588.2
Wind	70	351.0	4.1	3.8	940.3
Wind	80	383.8	4.3	4.3	1,307.1
Wind	30	425.8	3.2	3.2	405.5
Wind	70	461.9	3.9	3.9	1,268.1
Total NRLs 1992 – 2003					6,564.2
Annual NRLs (divide by 11)					**596.7**

Dunkley Lumber Ltd. makes an outstanding effort each year to minimize NRLs. The 2 hectares per year reflects measured NRLs based on disturbance history, and is representative of current performance. NRLs created by the mountain pine beetle epidemic will not be treated by a reduction in the gross annual harvest level. This epidemic will produce extraordinary NRLs that are not representative of yearly

occurrences. NRLs resulting from the MPB epidemic will be modeled by reverting unsalvaged MPB infested stands to unmanaged stand yield tables after a 10 year regeneration delay (See Section 9.2 for more information.) and by reducing the yield tables to reflect pine mortality.

9.2 Mountain Pine Beetle Epidemic

From 1999 to 2002, a mountain pine beetle (MPB) epidemic has been rapidly escalating in central British Columbia including TFL #53. The origin of the problem exists not so much within the boundaries of the TFL, but in the migration of MPB from severely infested areas adjacent to TFL #53. Aerial and ground forest health surveys are conducted annually within the tree farm. The August 2003 aerial survey results show that the beetle population has continued to expand on the TFL this year.

Dunkley's primary forest health management objective at this time is to conduct control/salvage harvesting on as much of the mountain pine beetle (MPB) attacked stands on the TFL as possible. In addition, the health of mature spruce stands is a continuing concern, and exclusive attention to MPB sanitation would place the spruce inventory at peril. An annual trap tree and wind-throw salvage program is conducted to keep spruce bark beetles at low levels. It is also necessary to maintain a harvest component of larger, primarily spruce sawlogs from the TFL, to meet mill requirements and to maintain critical markets developed world-wide.

Up until 2002, TFL harvesting and sanitation commitments have been met with the AAC of 239,500 m^3 per year, established in 1998. However, in 2002 the AAC was no longer sufficient to meet forest health concerns, primarily the MPB objective. As a result an AAC uplift was applied for and granted at 500,000 m3 per year effective June 2003. The AAC uplift will remain in effect until the next regularly scheduled AAC determination in December 2004.

To model the timber supply dynamics of the mountain pine beetle epidemic 4 steps were taken:

The first step was to risk-rate each polygon on the inventory file for susceptibility of attack by MPB. Details on this risk rating are provided in Appendix VIII.

Second, the amount of area/volume of pine at risk was calculated and, using the current AAC of 500,000, the percent infestation rate was predicted by applying historic information.

The third step was to determine the rate of infestation over the next 5-10 year period. Historic information was collected on the current rate of infestation across the TFL and then extrapolated to predict the future rate of mortality across the stands at risk. See Section 9.2.2 for more detail.

Fourth, the analysis units were adjusted to reflect the depletion of the pine volume as a

result of the MPB epidemic. This was done through the transfer of analysis units from at risk, to attacked but salvageable, to either managed stands as a result of harvesting, or unmanaged stands as a result of not being able to salvage the stand prior to the expiration of the shelf-life period.

Table 34 Mountain Pine Beetle Facts and Predictions

Year	MPB Volume (m3)			Proportion of Total Remaining "Pine at Risk" after Harvest [6]	Harvest Volume (Attacked & Incidental Healthy) [4] (m3)	After Sanitation Beetle Expansion Rate [5] (%)	Total Pl Volume Attacked by MPB [8] (m3)	Rate of Attack (applied to FSSIM) [7]
	Surveyed Green Attack [1]	Missed Green Attack [2]	Total Pine Attacked after Sanitation [3]					
1999	0	501	501	0.01%				
2000	1,847	4,145	5,992	0.17%	28,006	11.96		
2001	11,554	5,648	17,202	0.48%	27,002	2.87		
2002	75,169	27,336	102,505	2.86%	113,033	4.86		
2003			249,525	5.24%	263,000	5.00	512,525	**11%**
2004			473,338	9.94%	400,000	3.50	873,338	**18%**
2005			546,675	11.49%	400,000	2.00	946,675	**20%**
2006			693,350	14.57%	400,000	2.00	1,093,350	**23%**
2007			917,365	19.27%	400,000	1.90	1,317,365	**28%**
Volume in High Risk Stands [9] (m3)			4,743,253					
Current Available Harvest directed at MPB [10] (m3/year)			400,000					

Notes:

1. *"Surveyed Green-attack"* is historic information acquired through extensive beetle probes.
2. *"Missed Green-Attack"* is red-attack that appears the year following a sanitation program and is surveyed the following year. The 2002 value 27,336m^3 is based on the 2003 detailed aerial survey
3. *"Total Pine Attacked after Sanitation"* is the sum of surveyed green-attacked pine volume and the missed green-attacked pine volume. Numbers from 2003 forward are predicted using the previous years attack volume multiplied by the "After Sanitation Beetle Expansion Rate" and with the "Sanitation Harvest Volume" subtracted
4. *"Harvest Volume"* is the extent of the salvage program Dunkley can carry out. Values shown are based upon the TFL's current AAC and future harvest direction. Historic values include incidental healthy volume.
5. *"After Sanitation Beetle Expansion Rate"* is the ratio of the total volume attacked from one year to the next. The values from 2003 forward are estimates based upon professional extrapolation of historic population dynamics in and around the TFL.
6. *"Proportion of Total Pine Volume at Risk"* is "Total Pine Attacked after Sanitation" divided by the "Total Pine Volume at Risk". These numbers are the pine volume at risk after sanitation efforts
7. *"Rate of Attack"* is the proportion of pine at risk that is infected by green attack each year. These numbers are used to transfer pine at risk analysis units to green-attack analysis units in the forest estate model. Calculated by (the sum of the Pine Attacked after Sanitation + the Sanitation Volume) divided by the Total Pine at Risk
8. *"Total Pine Volume Attacked and salvaged"* is the sum of Total Pine Attacked plus the annual Sanitation Volume from 2003 onward. This volume includes other species that are present in the stands where salvage harvesting occurs .
9. *"Total Pine at Risk"* was determined by risk rating the stands in the TFL and is the total volume in all high risk stands.
10. *"Current Available harvest directed at the MPB"* is the sum of Dunkley's AAC within the TFL (500,000m^3) which includes the BCTS AAC within the TFL (28,620m^3) less 100,000 m3/year directed to other species (sanitation of spruce beetle and incidental volume)
11. *Shaded cells* are estimates based upon a continuing expansion of the MPB population on the TFL without a catastrophic mortality event.

Within Table 34 we have attempted to convey several important points:

- The leading edge of the central interior MPB epidemic hit the TFL boundary in 2000. By 2002, the edge of the epidemic had expanded into the TFL resulting in low to moderate attack levels (1-20%). The severity of attack on the TFL is expected to rise before declining as the full force of the infestation engulfs the TFL. This is reflected in the slight rise and slow decline in the beetle expansion rate.

- Over the past 3 years, red and associated green-attacked volume has been salvaged within the bounds of the AAC, and thus some measure of control has been achieved by the current AAC.

- Although aggressive sanitation operations are carried out annually across the TFL, some green-attack volume is missed due to difficulties inherent with identifying green-attacked trees that are not associated with red-attack. Additional green attack was left on the TFL in 2002 when the AAC was insufficient to address all of the identified attack. In 2003 the level of attack may exceed the capacity of the sawmill to process all of the infested trees.

- Although Dunkley has aggressively managed internal populations, management practices adjacent to the TFL appear to be less aggressive. Unfortunately this will lead to high rates of migration over the next 3-4 years.

- Within the THLB of the TFL, the current pine volume at risk in moderate and high risk stands is estimated to be 3,583,000 cubic meters. Presently, lodgepole pine constitutes approximately 27 percent of the TFL's merchantable growing stock.

10.0 INTEGRATED RESOURCE MANAGEMENT

10.1 Forest Resource Inventories

Since the submission of MP#3 several of the inventories for TFL #53 have changed or have been updated and improved. Table 35 provides an account of these inventories and their current status.

Table 35 Forest Resources Inventory Status

Forest Resource Inventory	Standard	Date Completed	Date Approved	Approved By	Status
Forest Cover	MOF	February 1993	June 1993	Regional Inventory Forester	Updated Annually
Landscape	MOF	November 1998 December 2002	December 1998	District Manager	Approved Submitted
Recreation	MOF	April 2003	-	-	Submitted
Stream-Naver Watershed	RIC	April 2001	April 2001	-	Approved
Stream-Ahbau, Willow Watershed	RIC	November 1998	September 1999	-	Approved
Terrestrial Ecosystem Mapping including SIBEC	RIC	March 1999	April 2002	-	Approved
Terrain Stability	Level D	July 1995	-	N/A	N/A

10.2 Non-Timber Forest Resource Management

10.2.1 Forest Cover Requirements

For the Base Case analysis, forest cover requirements are used to model visual quality objectives, landscape level biodiversity and cut block adjacency.

10.2.1.1 Green-Up

Age to green-up can impact harvest-scheduling opportunities based on minimum green-up height requirements as identified in the *Forest Practices Code of British Columbia Act* (as outlined in the *Operational Planning*

Regulation Section 68). The age to green-up is an important operational scheduling parameter and a key element in timber supply analysis. Green-up is used as a measure of tree height and site occupancy to meet visual, hydrological, wildlife or other objectives. Achievement of green-up height is required before adjacent areas may be harvested. Green-up in this analysis was determined using height-age curves (e.g., site tools) to approximate the age at which green-up heights are achieved. Specifically, years to green-up in all management zones was calculated using the area-weighted regeneration assumptions (Table 29) for each analysis unit as applied to TIPSY.

10.2.2 Visual Resources

For the Base Case scenario, direction regarding the modeling of the visual landscape was provided by the District Manager. The Base Case includes known visual quality objectives based on the 1998 Visual Landscape Inventory. The scenic areas will be modeled using the maximum percent alteration for forest cover requirements, rather then using the Visual Absorption Capacity ratings weighted by areas to refine percentages. The rationale for this is that with the implementation of the Forest Practices Code, all new harvesting proposed in visually sensitive areas has to be planned using the principles of visual landscape design. In addition, we continue to take further actions that effectively address visual landscape management. These include:

- Block layout consistent with visual landscape design and biodiversity requirements which soften block appearance;
- The initial minimum target density on the TFL is 1,800 sph. This density exceeds that of the Regional well-stocked stand target of 1,200 sph. Road and trail deactivation, grass seeding and an acute awareness of dispersed site disturbance have reduced site disturbance well below levels considered normal when VAC denudation percentages were calculated.
- Our site preparation methods now emphasize minimal disturbance of the duff in order to maintain a more natural look to the blocks. Broadcast burning has been eliminated and raw planting is common. This minimizes exposed rock and soil;
- A natural, mixed look to our plantations which avoids monocultures, and improves visual characteristics;
- The increased planting of pine, where ecologically appropriate, results in bushier trees at a younger age. We utilize this treatment in visually sensitive areas as part of our visual management strategy;

These actions demonstrate our commitment to managing the visual resource. To reflect these practices, the high end of the range of denudation value in a VQO category will be used in the Base Case of the timber supply analysis, rather than the VAC area-weighting, in order to mitigate impacts on timber supply. Visually effective green-up (VEG) is based on the slope calculations presented in Appendix IX.

Table 36 Visual Resources

VQO	Productive [1] (ha)	THLB(ha)	Green-up height (m)	Green-up Age (years)	Allowable denudation (%)
Retention	53.2	31.1	4.4	19	5
Partial Retention	1,245.8	1,074.9	4.4	19	15
Modification	1,839.6	1,683.4	5.0	21	25
Maximum Modification	84.8	84.7	4.8	20	33
Total	**3,223.4**	**2,874.1**			

Note 1. The total area of the productive forest contributes to forest cover constraints in VQOs.

10.2.3 Recreation Resources

The following recreation sites have been removed from the timber harvesting land base:

Naver Creek
Ahbau Lake
Genevieve Lake
Stony Lake
Teapot Lake

10.2.4 Wildlife

10.2.4.1 Ungulate Winter Range

There are no winter range concerns to be addressed. Potential ungulate winter range is addressed by the 1% wildlife reduction described in section 6.10.

10.2.4.2 Identified Wildlife

There no identified wildlife management strategies on the TFL. Area deductions for wildlife are described in Section 6.10.

10.2.5 Adjacent Cut blocks

Cut block adjacency is reflected through a maximum of 33% of the area less than 3 metres in height for the IRM Zone. This was applied after the short term modeling for MPB where adjacency was not implemented for the first 7 years.

Table 37 Forest Cover Requirements in IRM Areas

IRM	Productive (ha)	THLB(ha)	Green-up height (m)	Green-up Age (years)	Allowable denudation (%)
IRM	76,615.1	65,770.3	3	15	33

Productive forest area outside the THLB is not used in modeling adjacency Forest cover requirements are not applied for the first 7 years of the harvest simulation period, as Dunkley endeavors to reduce the intensity of the MPB epidemic.

10.2.6 Biodiversity

10.2.6.1 Landscape Level Biodiversity

As per the methodology used in the MP #3 analysis, landscape level biodiversity is modeled across TFL #53. Old growth representation is managed at the Biogeoclimatic Ecosystem Classification (BEC) variant level. Potential old growth management areas (OGMAs) will not be applied in the Base Case. Biodiversity emphasis has not been formalized across the TFL. In lieu of this, a weighted biodiversity emphasis option (BEO) of 45 percent low biodiversity, 45 percent medium and 10 percent high will be modeled in the Base Case., and this will be factored into the analysis over a 140 year period. The non-contributing land base will be included in the analysis as AUs #18 and #19. The area in the non-contributing land base will contribute to achieving biodiversity targets. Mortality of the non-contributing land base will not be modeled in the Base Case. Refer to Tables 38 and 39 for specific details. Appendix X provides the calculations for determining the old seral biodiversity targets.

Table 38 Forest Cover Requirements – Biodiversity

BEC	NDT	Area (ha)		BEO	Old Age (yrs)	Old Seral Constraint (% of Productive)		
		Productive	THLB			1st rotation	2nd rotation	3rd rotation
ESSF wc3	2[1]	24.9	24.9	45/45/10	250	6.7	8.0	9.4
ESSF wk1	2	13,534.7	12,470.5	45/45/10	250	6.7	8.0	9.4
SBS dw1	3	2,503.1	1,927.4	45/45/10	140	8.2	9.8	11.5
SBS mk1	3	24,231.3	19,749.8	45/45/10	140	8.2	9.8	11.5
SBS mw1	3	16,024.3	13,720.8	45/45/ 10	140	8.2	9.8	11.5
SBS wk1	2	23,520.2	20,751.0	45/45/10	250	6.7	8.0	9.4

1. The ESSF in TFL 53 is managed as NDT 2 as it occurs in transitional patches that are ecologically similar to NDT2.

Table 39 Landscape -Level Biodiversity Constraints

	Early Seral Stage	Mature + Old Seral Stage	Old Seral Stage
NDT 2,3			
Base case	Off	Off	On
Sensitivity	Turn on and just show results	Turn on and just show results	On

10.2.6.1.1 Wildlife Tree Retention

Wildlife tree patch retention is modeled through a reduction in the yield tables to reflect the average 4% of the THLB that is left in the cut block at the time of harvesting operations. This 4% area reduction will be modeled as a 4% OAF in the FSSIM model. Refer to Section 8.5 and Appendix XII for details and rationale.

10.2.6.1.2 Coarse Woody Debris

Coarse woody debris is not explicitly modeled in the timber supply analysis. The yield tables used in the analysis only include volume of timber that exceeds the minimum utilization standards

10.2.6.2 Objectives for Patch Size Distribution

Objectives for patch size distributions have not been legally established in TFL #53. Patch sizes will not be modeled in the Base Case.

10.2.6.3 Objectives for Connectivity

There are no forest ecosystem networks established for TFL #53. The impact of potential OGMAs will be tested in sensitivity analysis.

10.2.6.4 Watersheds

Community watersheds have not been formally established in the vicinity of TFL #53. Watershed concerns are managed through the maintenance of riparian reserves zones and riparian management zones. This has been addressed through a timber harvesting land base reduction.

10.2.6.5 Higher Level Plans

The Prince George LRMP was approved on January 25, 1999. At this time there are no modeling implications from the LRMP.

10.3 Timber Harvesting

Harvest methods are generally feller buncher/grapple skidder on the majority of the timber types scheduled for harvesting during the term of MP #4. Hand felling/line skidding occurs on a site specific basis as required.

As sensitive sites (e.g., for stream protection or steep slopes) are identified, logging methods are selected to best suit the site. Logging methods will continue to be prescribed on a site specific basis and carried out so as to minimize soil disturbance, soil compaction and other environmental concerns.

Dunkley will continue to use and develop innovative harvesting systems to address site specific concerns. Consistent with the highly productive sites on the TFL, minimum volume requirements are not a factor in determining logging systems, but rather the harvesting system is chosen that best meet the site specific objectives. Examples of site specific harvest methods are:

- helicopter logging of windthrow to meet VQOs,
- helicopter logging of wind throw throughout the TFL to minimize site disturbance and damage to existing plantations,
- cable yarding throughout the TFL to minimize soil disturbance on steep ground and,
- horse logging in the highway viewshed to meet VQOs through understory retention.

10.3.1 Minimum Harvest Age Derivation

Minimum harvestable ages are simply minimum criteria. While harvesting may occur in stands at the minimum harvest age in order to meet forest level objectives (e.g., maintaining overall harvest levels for a short period of time or avoiding large inter-decadal changes in harvest levels), most stands will not be harvested until well past the minimum timber production ages because of other resource values taking precedence.

On TFL #53 the minimum harvest age is set as follows:

- Analysis units with high or moderate risk of attack by MPB will have their MHA set to 60 years.

- Unmanaged analysis units with low or no risk of attack by MPB will have their MHA set to the regional priority cutting age.

- Managed stands will be harvested at their regional priority cutting age. This is consistent with the management strategies designed to maximize fibre production on the second growth stands. Full site occupancy, maximizing mean annual increment (MAI) and culmination age harvesting will help to

achieve our forest management, economic opportunity and employment objectives.

- Operationally, the cutting priority on TFL #53 focuses on removing the oldest eligible stands, after meeting the needs of integrated resource management. On a more stand specific basis, cutting priority is highest on blowdown, insect attacked or fire damaged stands. To date, Forest Development Plans have placed priorities on harvesting stands affected by blowdown or mountain pine beetle pest damage. Table 40 shows the minimum cutting age by analysis unit.

- With the increase in the MPB epidemic the cutting priority has shifted in large part to MPB infested stands. This includes stands as young as sixty years old. A small portion of the AAC is also directed to windthrow salvage. that typically occurs in older spruce stands. A small portion of the AAC is also directed towards healthy older spruce stands. These are harvested to achieve the log profile needed to effectively run the sawmill and to meet customer demand. When the MPB epidemic subsides harvesting will return to a relative oldest first priority.

Table 40 Minimum Merchantability Standards

Current AU/ Species		Minimum Cutting Age [6]		Culmination					
		Age (years)	Volume (m3/ha)	Unmanaged Stands [1]		Existing Managed Stands [2]		Future Managed Stands	
				Age	Volume [3]	Age	Volume [4]	Age	Volume [5]
1	Fir	111	346	101	318	95	362	95	356
2	Bl G	121	253	111	233			85	415
3	Bl M	121	155	151	200			85	405
4	Bl IU	121	205	141	240			85	437
5	Sw G	101	312	101	312	85	407	75	403
6	Sw M	101	177	141	258	85	385	85	421
7	Sw/Pl G	101	351	111	388	85	407	75	421
8	Sw/Pl M	101	187	141	303	85	405	75	406
9	Sw/Dec G	101	310	101	310	95	452	75	427
10	Sw/Dec M	101	260	121	324	85	409	75	415
11	Pine G	81	331	71	293	55	296	55	301
12	Pine M	81	213	101	271	65	334	65	330
13	Pl/Sw G	81	292	71	258	55	301	55	305
14	Pl/Sw M	81	168	101	216	65	323	65	323
15	Pl/Dec	81	239	81	239	55	299	55	307
16	At Conifer	101	207	101	207	55	342	65	319
17	Backlog NSR	101	151	111	166	n/a		85	433

Notes:

1. Culmination age and volume for unmanaged stands is not used inthe Base Case. The Regional Priority Cutting Age is used in place of culmination age for the Base Case. Culmination age for unmanaged stands will be used in sensitivity analysis.
2. Existing managed stands from standard seedlings and seed-stock. Site index based on BEC data and generated through Batch TIPSY 3.0.
3. C.U. 12.5+ cm dbh all species
4. Volume shown includes the predicted genetic gain in volume from superior spruce seedlots.
5. Minimum cutting age applies to all unmanaged stands. The cutting ages show are the regional priority cutting age set by the Prince George Regional Office.
6. Moderate and high risk AUs have a short-term minimum harvest age of 60 years applied to these stands as they become infested by MPB. After the infestation and their shelf life period, if the stand still retains greater than 140 m3/ha, the AUs minimum harvest age reverts to regional priority cutting age.

10.3.2 Operability

The majority of harvesting on the TFL takes place with conventional, ground-based equipment. This reflects the generally favorable operating conditions in the area. Non-conventional methods such as overhead cable systems and helicopter logging are used as required, to harvest steeper ground or to meet terrain stability requirements. Horse logging is being utilized on a small scale to demonstrate the ability to carry out partial cuts, commercial thinning and to meet visual quality objectives through shelterwood cutting.

Utilizing any and all of these systems where applicable has resulted in there being no physically inoperable areas within the TFL

Ecological operability has been addressed through reductions to the productive forest land base via environmentally sensitive areas. A list of these areas is provided in Table 9.

Economic operability has been estimated using a combination of the age/height/stocking attributes of a forest stand, and an indication of site quality. Although these areas are excluded at this time from the timber harvesting land base, this does not preclude Dunkley's harvesting within them some time in the future. Estimates of future market conditions are typically difficult to predict.

10.3.3 Initial Harvest Rate

The initial harvest flow pattern is a short-term 500,000 m3/year to address the MPB epidemic. This will fall to the maximum mid-term harvest level supportable by the residual merchantable mature growing stock remaining in the TFL after the epidemic has passed. The harvest flow will then climb back to the long-term harvest level supported by future managed plantations.

The long-term harvest level is the highest level that can be attained for the long-term with a stable (flat line) total inventory.

10.3.4 Harvest Rules

In general terms, harvesting priorities take into account forest profile considerations, forest health conditions, hydrologic considerations, wildlife and environmental issues. However, the principal emphasis will be placed on maximizing growth potential from the productive forest land base.

After 40 years of harvesting, the cutting priority on TFL #53 focuses on removing the oldest eligible stands, after meeting the needs of integrated resource management.

On a more immediate basis, cutting priority is highest on blowdown, insect attacked or fire damaged stands, thus reflecting a "random" nature. To date, Forest Development Plans have placed highest priorities on harvesting stands affected by blowdown or pest damage, and stands with a high risk of blowdown or declining rates of growth. Consequently, Forest Development Plans may have variations which may not always reflect the complete profile of the existing mature inventory. The relative oldest first harvest rule is an appropriate modeling input for the harvest profile; however, for the short term MPB epidemic a random harvest would be most appropriate. After the epidemic, the priority will be shifted to older stands first.

The harvest rule followed while running the FSSIM model will be "random" for the Base Case.

Harvest priorities will be applies as follows:

- Highest priority on MPB attacked stands for the first 5 years,
- Second highest priority on infested stands during their 2 year shelf life,
- After the epidemic, a priority will be placed on harvesting pine leading stands >140 years age, spruce stands > 180 years, balsam stands > 180 and fir stands greater than 150 years.

10.3.5 Harvest Profile

Several harvest profile rules will be modeled in this analysis with respect to deciduous and Balsam IU stands.

- The amount of Balsam IU stands logged will be set at 4,100m3/year commencing in 10 years. (Commencement in 10 years versus 5 years provides additional time to salvaged MPB attacked stands during their shelf life).
- Deciduous leading stands will targeted at 2,000 m3/year commencing in 10 years.
- Non-pine leading stands will have a target volume harvest of less than 100,000 m3/year for the first 10 years of the simulation period.

10.3.6 Silviculture Systems

Clearcutting is the system of choice on the TFL. Partial cutting is not currently being prescribed to any significant extent.

In the Base Case it is appropriate to model only clearcut silviculture systems, as this is the vast majority of the TFL harvesting. This also reduces the uncertainty involved with modeling the growth and yield of partial cutting / commercial

thinning in the Base Case.

10.3.7 10.3.7 Harvest Flow Objectives

Guidance in developing harvest flow objectives is taken from the current economic and social objectives of the Crown expressed by the Minister of Forests in a letter to the Chief Forester in 1994. He emphasized the importance of the continued availability of good forest jobs and to the long-term stability of communities that rely on forests. He stated that any decreases in allowable cut at this time should be no larger than necessary to avoid compromising long-run sustained yield. In this analysis, a harvest flow that best attempts to address forest health concerns will be determined. The short-term harvest level will then be increased just enough minimize predicted non-recoverable losses to the MPB.

Table 41 Harvest Flow Objectives

Harvest flow objectives for the Base Case
1. Reduce non-recoverable losses as a result of the MPB
2. Maximize the mid term harvest level
3. Maximize the long-term harvest level

10.0 OPTION ASSUMPTIONS

The options and sensitivity analysis which will be assessed in the Timber Supply Analysis Report are summarized in Table 42 and Table 43. A brief description of how each scenario will be modeled is included in these tables.

Table 42 Summary of Standard Sensitivity Scenarios

Scenario #	Description
2.1	Model the impact of increasing the timber harvesting land base by 5%. The THLB will be increased 5% by converting area from the NCLB. Yield tables as per the Base Case will be used.
2.2	Model the impact of decreasing the THLB by 5%.
2.3	Model the impact of increasing unmanaged stand yields by 10%. This will be done by increasing the yield tables by a factor of 1.1.
2.4	Model the impact of decreasing unmanaged stand yields by 10%.
2.5	Model the impact of using Culmination Age as the minimum harvest age for unmanaged stands. See Table 46 for the culmination harvest ages.
2.6	Increase minimum harvest ages by 5 years. Accomplished by resetting the MHA in the OAF.dat file.
2.7	Decrease minimum harvest ages by 5 years.
2.8	Model the impact of increasing IRM zone forest cover constraints by 10%. The IRM zone will have the maximum 33% less then green up changed to 36%.
2.9	Model the impact of reducing IRM zone forest cover constraints by 10%. A maximum 30% < green up target will be used.
2.10	Model for mature plus old seral stage and show the results. See Table 40. Full mature plus old seral targets will be applied at time 0. The values used will be as per the FPC biodiversity guidebook.
2.11	Model old seral stage targets if full BDG values are applied at all times. The values in Table 38 under 3rd rotation will be applied at time 0.
2.12	Model the impact of increasing managed stand yields by 10%. All managed stand yield tables will have the OAF.dat file adjustment applied.
2.13	Model the impact of decreasing managed stand yields by 10%. As per scenario 2.13.
2.14	Test the impact of alternative harvest flows. Initial harvest flows of 600,000 and 700,000 m3/year for 7 years will be applied.

Table 43 Summary of Non-Standard Sensitivity Scenarios

Scenario #	Description
3.1	Model catastrophic depletion of MPB populations (i.e., a cold weather event will decimate populations this fall and management returns to normal.
3.2	Model a 5 year shelf life. Modeled through a modification in the transfer.dat file.
3.3	Model 75 percent mortality for all pine stands. This includes the mortality of pine in low risk stands.
3.4	Model 100 percent mortality of all high risk pine stands and 50 percent mortality in the medium risk stands.
3.5	Reduce minimum merchantable volume to 100 m^3/ha. In the Base Case 140 cubic metres was used as the minimum economic volume that must be in the residual timber after the MPB Pine depletion. If this much volume remained in the residual stand, the yield table continued to grow along a reduced VAC. If the minimum economic target was not there, the AU was assumed to regenerate after a 10 year delay.
3.6	Model no harvest in potential OGMAs and low biodiversity emphasis in the remainder of the TFL (factored in over 3 rotations).

Information Package
Appendix I

Natural Stand Yield Tables

Existing Species Distribution by Analysis Unit

The following table describes the species component of existing unmanaged stand analysis units based on the area-weighted inventory label in the Forest Inventory and Planning (FIP) file for TFL #53.

Analysis Unit / Species		Existing Percent Species Component in Unmanaged (Natural) Stands							
		Spruce	Pine	Balsam	Douglas fir	Aspen	Birch	Cottonwood	Total %
1	Fir	17	20	1	55	6	1		100
2	Bl G	44	3	53					100
3	Bl M	23	2	62	13				100
4	Bl IU	17	1	79			1	2	100
5	Sw G	80	3	15	2				100
6	Sw M	77	2	20		1			100
7	Sw/Pl G	60	26	5	4	4	1		100
8	Sw/Pl M	68	24	8					100
9	Sw/Dec G	60	8	7		19	5	1	100
10	Sw/Dec M	35	7	23		19	6	10	100
11	Pine G	2	97		1				100
12	Pine M	3	96			1			100
13	Pl/Sw G	24	67	1	5	3			100
14	Pl/Sw M	21	64	10	4	1			100
15	Pl/Dec	5	64		3	19	6	3	100
16	At Conifer	16	15	4		61	3	1	100
17	Backlog NSR	27	10	63					100

Unmanaged Stand Yield Tables 1-10

Age	1 F	2 B g	3 B m	4 B iu	5 S g	6 S m	7 S/P g	8 S/P m	9 S/D g	10 S/D m
5	0	0	0	0	0	0	0	0	0	0
15	0	0	0	0	0	0	0	0	0	0
25	1	1	0	0	0	0	0	0	0	0
35	35	14	0	4	2	0	3	0	3	0
45	85	43	7	24	35	2	43	1	41	5
55	134	78	23	50	96	15	107	14	101	31
65	180	115	46	80	150	46	167	50	157	72
75	223	145	71	108	198	81	221	89	208	116
85	263	172	92	132	239	115	268	128	252	154
95	299	197	111	154	274	145	311	165	290	189
105	330	220	129	175	304	173	348	199	323	219
115	357	241	145	194	329	197	381	230	350	246
125	382	261	161	212	352	220	410	259	373	269
135	403	281	177	230	372	240	434	285	391	288
145	422	299	192	247	389	258	454	308	407	305
155	438	317	206	264	404	274	469	327	420	317
165	452	334	219	279	416	289	482	343	429	326
175	464	349	232	294	428	302	493	358	437	334
185	475	364	245	308	438	314	501	370	444	341
195	485	378	256	322	446	325	508	381	450	348
205	494	392	268	335	454	335	516	391	456	353
215	504	404	279	347	461	344	523	401	461	359
225	512	417	289	359	468	352	529	410	465	363
235	521	429	300	371	474	360	534	418	470	368
245	529	440	309	382	479	367	539	426	473	372
255	533	446	315	388	483	372	543	432	476	375
265	533	448	317	389	486	377	547	438	479	378
275	533	449	318	390	489	381	550	443	481	380
285	533	451	319	391	491	384	553	448	483	382
295	533	452	321	392	494	387	556	452	485	384

Unmanaged Stand Yield Tables 11 - 19

Age	11 Pl g	12 Pl m	13 P/S g	14 P/S m	15 P/D	16 At/Con	17 Backlog	18 NCLB Pl	19 NCLB other
5	0	0	0	0	0	0	0	0	0
15	0	0	0	0	0	0	0	0	0
25	25	0	15	1	6	0	0	9	0
35	100	34	82	13	52	5	7	54	3
45	166	81	143	52	104	34	30	100	18
55	221	123	193	90	149	70	57	143	45
65	269	161	236	123	188	106	83	180	75
75	309	195	273	152	221	139	104	212	105
85	346	225	305	178	250	168	124	241	132
95	381	255	335	203	277	194	141	268	157
105	412	281	361	225	301	215	157	293	178
115	442	306	385	245	322	231	172	315	198
125	469	330	407	263	342	244	185	336	216
135	491	349	425	279	356	253	199	353	231
145	505	362	437	291	366	261	211	366	245
155	515	372	447	300	374	267	222	375	258
165	521	378	453	307	378	270	232	381	269
175	524	381	457	311	380	273	240	384	279
185	522	381	457	313	379	275	249	385	288
195	520	380	458	315	379	276	256	385	296
205	522	383	460	318	380	278	264	388	304
215	524	385	463	322	382	280	272	391	311
225	527	388	466	325	384	282	278	394	318
235	529	390	469	328	386	283	285	396	325
245	532	393	472	331	388	285	291	399	331
255	535	395	474	333	389	286	295	401	335
265	537	397	477	335	391	286	296	404	338
275	539	399	479	337	392	287	297	406	340
285	541	401	480	339	394	288	298	407	342
295	543	403	482	340	395	288	299	409	344

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Appendix II

Managed Stand Yield Tables

Post -1998 Managed Stand Yield Tables 201-209

Age	201 F	202 B g	203 B m	204 B iu	205 S g	206 S m	207 S/P g	208 S/P m	209 S/D g
10	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	1	0	1
30	17	4	3	1	8	7	25	9	28
40	71	36	29	12	75	51	111	53	120
50	145	103	78	45	178	121	214	124	223
60	216	180	135	98	276	196	303	198	312
70	276	254	193	160	360	265	375	268	384
80	324	316	246	220	420	321	424	321	433
90	365	366	293	273	461	367	457	365	466
100	395	406	329	319	488	402	480	400	488
110	418	435	358	358	507	429	494	426	503
120	435	457	384	391	519	450	504	445	513
130	447	472	403	416	524	463	509	457	518
140	455	484	419	436	527	474	512	468	520
150	463	491	432	450	529	482	514	474	522
160	466	497	441	463	530	488	515	480	522
170	470	502	449	471	530	494	516	485	523
180	473	504	455	479	528	498	516	488	523
190	475	506	458	485	527	501	516	490	523
200	477	506	462	488	525	501	516	492	523
210	478	506	464	492	524	503	516	492	522
220	479	506	466	493	524	503	516	492	522
230	480	505	468	495	522	503	516	493	522
240	481	504	469	494	521	503	515	492	522
250	481	503	469	495	521	503	515	491	522
260	482	503	470	494	520	503	515	491	522
270	482	502	470	493	520	502	515	491	522
280	482	502	469	491	519	501	515	489	522
290	482	501	467	489	518	500	514	489	522
300	482	501	467	489	518	500	514	489	522

Post 1998 -Managed Stand Yield Tables 210-217

Age	210 S/D m	211 Pl g	212 Pl m	213 P/S g	214 P/S m	215 P/D	216 At/Con	217 Backlog
0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0
20	0	20	5	14	4	9	8	0
30	7	117	48	96	42	78	64	6
40	49	224	119	197	106	173	149	48
50	122	311	190	281	173	257	227	123
60	198	377	250	347	232	325	292	207
70	267	424	297	394	279	375	340	284
80	322	456	335	429	316	412	377	343
90	366	478	365	454	348	440	406	391
100	401	491	388	471	372	461	428	429
110	425	499	406	484	391	475	444	456
120	443	503	419	492	403	485	457	474
130	456	505	430	496	414	490	466	486
140	464	507	439	499	423	493	471	494
150	471	508	444	501	429	496	476	500
160	476	508	449	502	434	498	480	504
170	480	509	453	503	438	499	482	508
180	483	509	456	504	443	500	483	511
190	484	509	458	504	445	500	484	512
200	485	509	459	504	446	501	485	512
210	484	509	460	504	447	500	485	512
220	484	509	461	504	448	501	486	511
230	483	509	461	504	449	501	486	510
240	482	509	461	504	449	500	485	509
250	482	509	461	504	449	501	485	507
260	481	509	461	504	450	500	485	507
270	481	509	460	504	449	501	484	506
280	480	509	460	504	449	501	484	505
290	478	509	460	503	449	501	483	504
300	478	509	460	503	449	501	483	504

Pre 1998 -Managed Stand Yield Tables 101-116

age	101	105	106	107	108	109	110	111	112	113	114	115	116
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
20	0	0	0	0	0	0	0	9	5	10	3	10	20
30	28	4	1	4	3	6	4	89	77	93	69	92	124
40	85	61	48	61	58	69	62	186	171	191	161	188	229
50	155	149	130	149	146	161	152	263	249	268	236	266	313
60	210	235	216	235	233	247	237	328	311	334	298	332	371
70	258	308	287	308	304	324	311	369	356	374	347	373	416
80	301	384	358	384	379	395	385	403	389	411	377	409	454
90	342	430	411	430	430	437	433	433	418	441	406	437	483
100	382	460	445	460	458	466	460	458	441	462	430	460	497
110	416	480	470	480	480	488	483	475	460	482	447	480	508
120	446	500	486	500	496	503	499	486	476	490	462	489	508
130	469	511	502	511	510	517	512	491	483	496	475	493	508
140	491	520	512	520	518	526	521	498	486	500	481	499	508
150	509	528	518	528	527	527	528	501	490	500	483	499	508
160	526	525	524	525	525	525	526	501	494	500	488	499	508
170	543	522	522	522	523	523	524	501	494	500	491	499	508
180	556	522	521	522	521	525	522	501	494	500	492	499	508
190	570	522	519	522	523	523	523	501	494	500	492	499	508
200	583	520	517	520	519	523	519	501	494	500	492	499	508
210	594	518	516	518	519	520	518	501	494	500	492	499	508
220	604	517	516	517	519	517	519	501	494	500	492	499	508
230	613	514	515	514	515	516	515	501	494	500	492	499	508
240	617	512	512	512	512	512	513	501	494	500	492	499	508
250	623	509	510	509	509	509	510	501	494	500	492	499	508
260	631	506	506	506	507	508	506	501	494	500	492	499	508
270	636	505	504	505	505	505	504	501	494	500	492	499	508
280	644	501	500	501	502	505	504	501	494	500	492	499	508
290	647	500	498	500	501	505	504	501	494	500	492	499	508
300	647	500	498	500	501	505	504	501	494	500	492	499	508

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Appendix III

Buffering RMZ widths around Streams and Lakes

TFL #53 Calculation of Riparian Widths

Summarize percentage of classified streams by Stream Class

This would include NCD and NVC which is not in the Silviculture Prescription summary

Apply an actual deduction by class for classified streams by class

Apply an average deduction for the remaining unclassified streams

Calculation of Riparian Reserve Zone Width for Unclassified Streams

Stream Class	Stream Length (m)	Riparian Reserve Width (m)	RRZ % Excluded	RRZ Prorate	Prorated RRZ Width (m)
S1	4700	50	100	3%	1.5
S2	9000	30	100	6%	1.7
S3	51200	20	92	32%	5.9
S4	43830	0	100	27%	0.0
S5	0	0	100	0%	0.0
S6	51550	0	100	32%	0.0
NCD/NVC	0	0	0	0%	0.0
	160280			100%	9.0

Calculation of Riparian Management Zone Width for Unclassified Streams

Stream Class	Stream Length (m)	Riparian Management Width (m)	RMZ % Excluded	RMZ Prorate	Prorated RMZ Width (m)
S1	4700	20	76	0.03	0.4
S2	9000	20	60	0.06	0.7
S3	51200	20	49	0.32	3.1
S4	43830	30	31	0.27	2.5
S5	0	30	100	0.00	0.0
S6	51550	20	19	0.32	1.2
NCD/NVC	0	0	0	0.00	0.0
	160280			100%	8.0

Reserve zone for classified streams

Stream Class	Riparian Reserve Width (m)	Riparian Management Width (m)	RMZ % Excluded	RMZ Prorated width	Total Buffer for classified streams	
S1	50	20	76	15.2	65.2	
S2	30	20	60	12	42	
S3	20	20	49	9.8	29.8	
S4	0	30	31	9.3	9.3	
S5	0	30	100	30	30	
S6	0	20	19	3.8	3.8	
NCD/NVC	0	0	0	0	0	

If stream is not classified buffer width = 17 metres

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Appendix IV

SIBEC Table used to Calculate Site Indices for Managed Stands

Adjusted site index estimates by site series for TFL 53

Site series	SBS mw				SBSmk1				SBSdw1				SBSwk1				ESSFwk1			
	Sx	Pl	Bl	Fd	Sx	Pl	Bl	Fd	Sx	Pl	Bl	Fd	Sx	Pl	Bl	Fd	Sx	Pl	Bl	Fd
01	20	22	19	21	19	21	18	20	18	20	17	19	20	21	19	20	16	18	16	18
02	10	13	10	13	10	12	10	12	10	12	10	12	10	12	10	12	12	13	12	13
03	13	15	13	15	12	13	12	13	13	15	13	15	13	15	13	15	15	17	15	17
04	16	19	16	18	16	18	16	18	16	18	16	18	17	19	16	18	17	19	16	18
05	18	20	17	19	18	20	17	19	17	19	16	18	19	21	18	20	19	19	18	18
06	21	23	20	22	15	16	15	16	20	22	19	21	18	20	17	19	12	14	12	14
07	22	24	21	23	21	22	20	21	19	21	18	20	22	24	21	23	16	17	16	17
08	24	26	22	25	24	15	22	24	22	24	21	23	24	26	22	25	6	7	7	7
09	17	17	16	17	16	16	16	16	17	17	16	17	18	18	17	18	19	19	18	18
10	10	10	10	10	10	10	10	10					24	25	22	24				
11													10	10	10	10				
12													15	16	15	16				

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Appendix V

Rationale used in the Calculation of OAF 1

Rationale used in the Calculation of OAF 1

Operational adjustment factors for managed stands were derived using field procedures detailed in the recent Ministry of Forest publication on assessing OAF.1 in the field:

OAF 1 Project Report 1 MOF BC, FRBC September 1997, and
OAF. 1 Project Report 2 MOF BC, FRBC January 1998.

The OAF. 1 Project Report 2 is required to extrapolate the results shown in Table A against the estimate of OAF. 1 tables appended to the Report 2.

No sample information was collected for Douglas fir, Balsam, or aspen leading stands. In these areas, the provincial average OAF 1 of 15% will be used.

Dunkley feels that the results from this survey along with the additional adjustment factor are more than reasonable for several reasons:

- The higher planting densities which occur on TFL #53, single tree mortality does not create a hole in the OAF survey. The same is not true using regional stocking standards.
- Excessive weevil and rusts are factored into the OAF Survey results in that measured trees must meet crop tree criteria.
- The OAF results are applied to managed stands only. Poorer performing plantations are modeled as natural stands. Stand density and holes in stocking were a factor in categorizing a stand as natural or managed. Since only the 'best' natural stands are modeled through TIPSY, the calculated OAF 1 is reasonable.

Table A: OAF 1 Summary of Field Data

Map-Sheet	Poly	Open-ing #	Area (ha)	Species	Site Index	TPH	Year Log	Distance Between Plots (m)	Group	Occupy	Un-occupy	PEP	Z Value	OAF 1
93G.029	1135	16	61	Pl(At)	21.0	1968	58-70	78.1	2	81	7	8	5	4
93G.039	1521	14	56	Sw(BlCtAt Pl)	14.0	1150	72	74.8	1	88	5	5	3	
93G.039	1069	64	11	Pl	21.0	1309	87	23.0	4	98	0	0	0	0
93G.039	62	60	39	Pl	22.0		70-71	62.4	2	89	7	7	4	4
93G.039	318	32	15	PlSw(At)	22.0	4400	84	38.7	4	84	2	2	0	0
93G.040	1039	22	86	SwBl(Pl)	20.0	2085	83	92.7	3	79	14	15	12	10
93G.040	34	32	70	Sw(Bl)	24.0	2629	79-82	83.7	1	88	8	8	5	4
93G.040	79	40	118	SwBl(CtAt)		2784	82	108.6	3	not surveyed				
93G.050	1612	13	55	Sw(BlPl)	20.0	2500	73-76	74.2	1	83	9	10	7	6
93G.041	1187	6	44	Sw(AtBlPl)	20.0	2350	83	66.3	3	82	4	5	3	2
93G.041	282	5	32	PlSw(BlAt)	24.0	1344	72	57.0	2	80	3	4	1	1
93G.048	27	16	42	Pl(AtBlSw)	21.5	6028	84	64.1	4	85	7	8	5	4

Preferred and acceptable species are Sw, Pl, Bl
Minimum tree height = 20 cm
surrounding canopy
PEP = Percent Empty Plots
Roads are not part of the polygon.

Critical distance = 2.7 m
Countable tree > = 20% of height of

TPH = Trees Per Hectare
Landings are not part of the polygon.

Opening #	Leading Species	Area	% of total Area	OAF. 1	Area- weighted OAF. 1
93G.029 16	Pine	61	0.305	4	1.220
93G.039 64		11	0.055	0	0.000
93G.039 60		39	0.195	4	0.780
93G.039 32		15	0.075	0	0.000
93G.041 5		32	0.160	1	0.160
93G.048 16		42	0.210	4	0.840
Total Pine Leading Stands		200	1.000		3.000
93G.039 14	Spruce	56	0.180	2	0.360
93G.040 22		86	0.277	10	2.765
93G.040 32		70	0.225	4	0.900
93G.050 13		55	0.177	6	1.061
93G.041 6		44	0.141	2	0.283
Total Spruce Leading Stands		311	1.000		5.370

No sample information was collected for Douglas-fir, Balsam, or aspen leading stands. In these areas, the Provincial average OAF. 1 of 15% will be used.

Addendum
Concerns were expressed by the MOF Research Branch that the OAF. 1 survey did not adequately assess losses to stand productivity due to pathogens (e.g. blister rust). To address these concerns and to model the growth of managed stands with a conservative factor, an additional factor was applied to the results shown above. The net result is a 10% OAF. 1 for leading Pine stands and a 12% OAF. 1 for leading Spruce stands.

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Appendix VI

Determination of the Start Year for Managed Stand Yields

Harvest Summary

Determination of Managed Stand Yield Table Starting Point

Year	Opening	Area (ha)	Managed Stand Performance	Natural Stand Performance
1972	G38-005	67	67	
	G39-012	85	85	
	G39-014	60	60	
	G39-017	10	10	
	G49-016	94	94	
	H41-005	63	63	
	H41-016	186	186	
	H41-019	269	269	
	H41-015	106	106	
	Subtotal	940	940	0
1973	G39-055	74	74	
	G40-011	60	60	
	G49-018	47	47	
	G49-020	64	64	
	G49-021	36		36
	G49-028	100	100	
	G50-013	107	107	
	H41-008	87	87	
	H41-011	63	63	
	H41-014	65	65	
	H41-031	32	32	
	Subtotal	735	699	36
1974	G39-046	36		36
	G40-013	73	73	
	G40-026	84	84	
	G40-027	60	60	
	G50-026	55	55	
	H41-041	84	84	
	G39-051	169		169
	Subtotal	561	356	205
1975	G39-033	67	67	
	G40-019	99	99	
	G40-023	136	136	
	G40-031	73	73	
	G49-017	76	76	
	G49-023	63		63
	G49-024	35		35
	G50-010	67		67
	H41-002	68	68	
	G49-025	65	65	
	G29-006	58	58	
	Subtotal	807	642	167

Year	Opening	Area (ha)	Managed Stand Performance	Natural Stand Performance
1976	G40-015	72	72	
	G40-017	58	58	
	G40-021	86	86	
	G40-022	91	91	
	G40-033	62	62	
	G49-015	88		88
	H41-003	45	45	
	H41-004	25	25	
	H41-010	45	45	
	H41-012	40	40	
	H41-037	75	75	
	G39-042	53	53	
	H41-001	76	76	
	H41-007	89	89	
	Subtotal	905	817	88
1977	G29-013	88	88	
	G30-002	64	64	
	G39-048	89		89
	G39-049	48		48
	G40-028	66	66	
	G50-006	154	154	
	G50-008	87	87	
	G50-031	93	93	
	G50-007	110	110	
	G50-036	61	61	
	Subtotal	860	723	137
1978	G39-017	59	59	
	G48-014	134		134
	G48-014	11	11	
	G48-015	27	27	
	Subtotal	231	97	134
1979	G29-014	55	55	
	G39-006	81	81	
	G39-010	65		65
	G39-011	63	63	
	G39-044	28		28
	G39-022	76		76
	G50-021	75	75	
	G40-018	106	106	
	G39-015	51	51	
	G40-032	152	152	
	G50-011	107	107	
	Subtotal	859	690	169

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Appendix VII

Rationale for Seral Succession

Rationale for Seral Succession

Based on PSP data obtained for TFL #53, type group 41 (At Con.) has the potential to add to timber supply volume based on mixed stand succession. Two graphs based on PSP data clearly show the succession change from type group (TG) 41 to 26.

PSP data was summarized to obtain basal area (BA) and whole stem volume using Schumacher' equation. BA was calculated for each tree in each plot where a deciduous component was found. BA was summed by species and within the plot to calculate BA per ha.

Whole stem volume was calculated based on tree height, diameter and age. Age was not taken on every tree in each plot; therefore the layer age was used when determining the coefficients to use for the volume equation. Individual tree volumes were then added to create a total by species and total by installation. The species volumes were then transformed into species percent by volume within each plot. Of the 14 plots that were TG 41, 64% shifted species to a spruce dominated TG. The remaining plots stayed as TG 41. Each of the plots used had four measures including 1970 or 1971, 1980 or 1981, 1991 and 2001.

TG 26 in the 2001 measurement year (Figure 1) was plotted to show the species percent change over time. This TG shows a shift in species from At leading to Sw leading. In 2001 measure SW is the top line and At is the next line down.

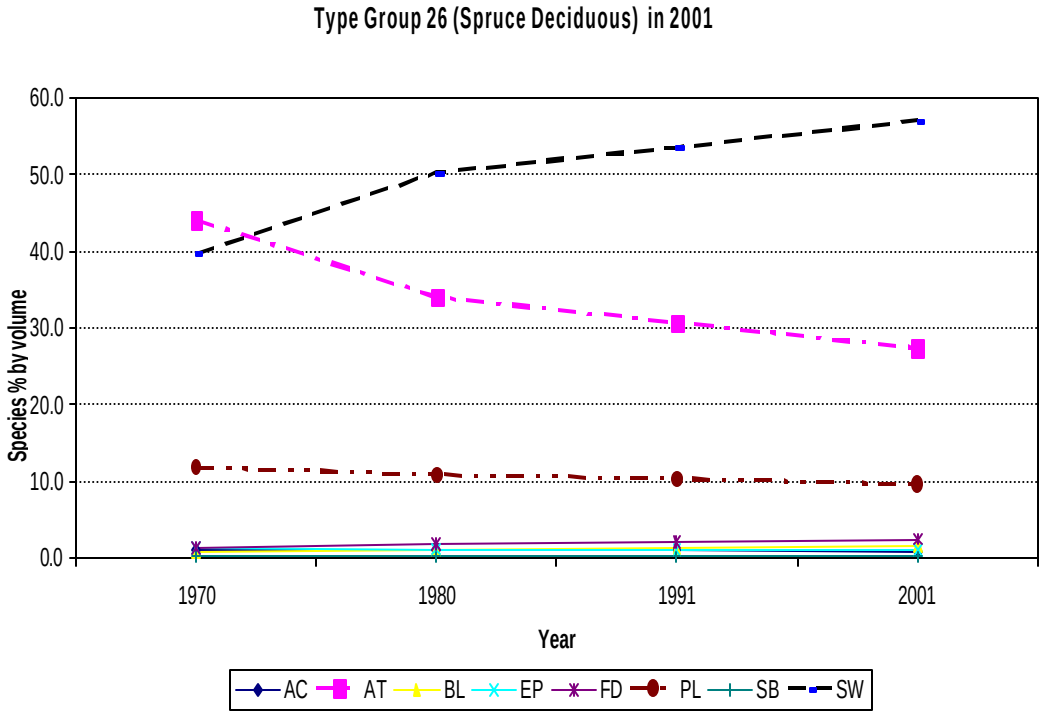

Figure 1. TG 26 in 2001

Based on the shift from TG 41 to 26, TG 41 in 1970 and 1971 measures were plotted to ascertain the how the species percents by volume changed (Figure 2).

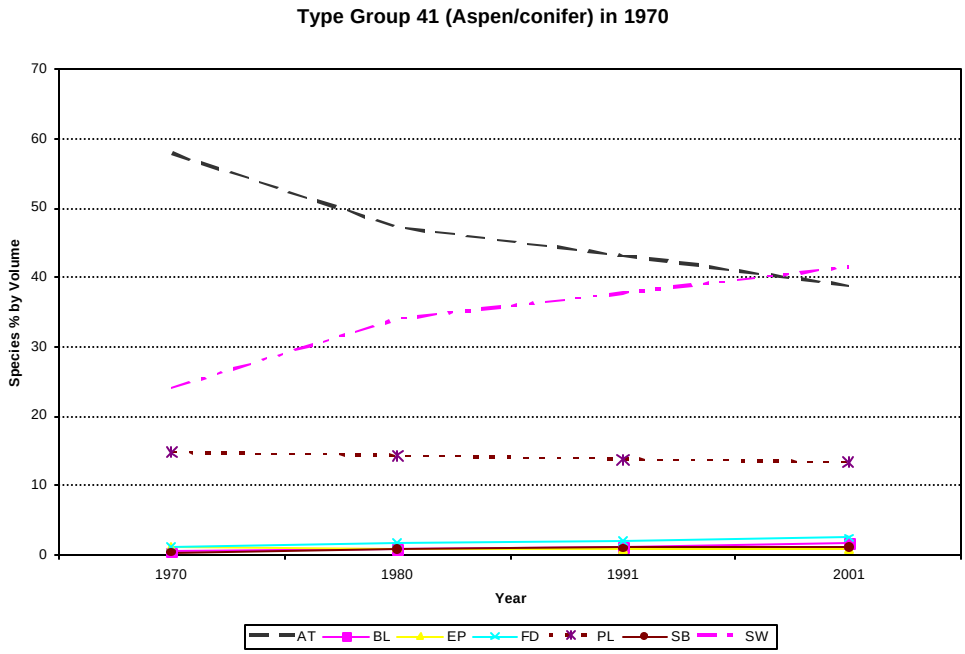

Figure 2. TG 41 in 1970

These two graphs mirror each other showing the succession change. From the PSP data the shift from TG 41 to 26 took place when the layer age was between 50 and 60 years old. The mixedwood plots that did not change (e.g., stayed in TG 41), had an initially lower conifer species percent volume (<10%) than those that shifted to spruce leading (>25%).

The PSP data set obtained does not have stands older than 90 years, where it may be possible to determine when, or if the stands with less than 10 percent conifer volume eventually shift to a coniferous leading component.

Whole tree volume was plotted over tree age (Figure 3) for the plots that changed from TG41 to 26. This graph shows the potential volume that could be achieved from the stands.

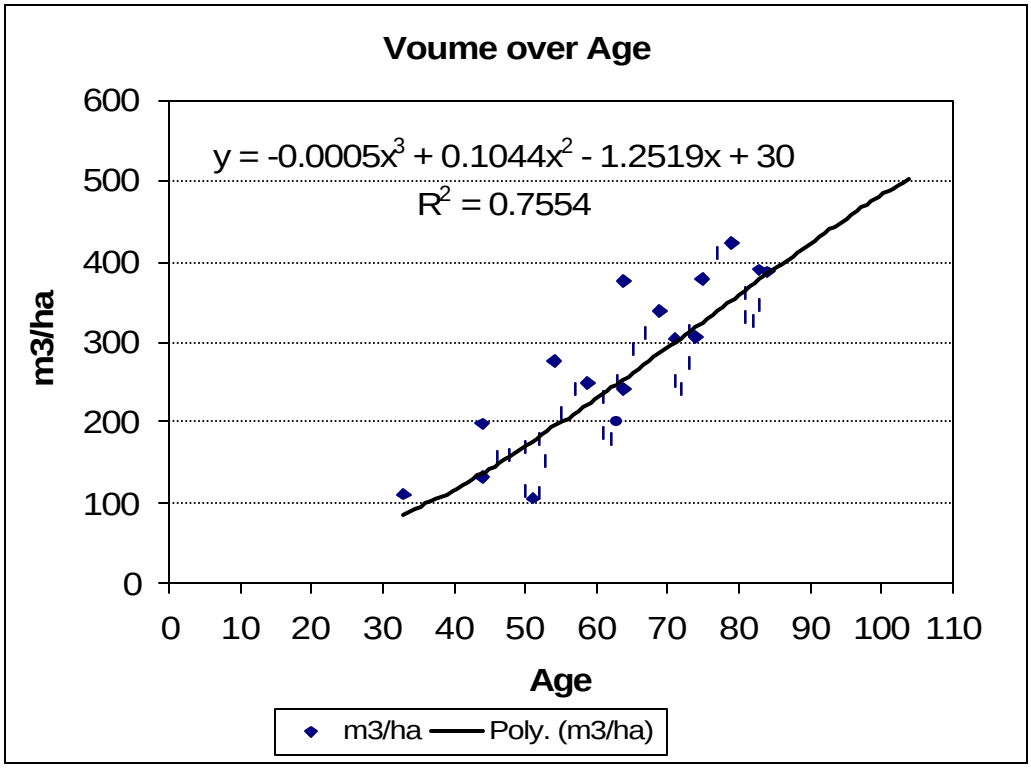

Figure 3. Whole tree volume over age type groups that shifted to spruce leading.

This graph has not separated out plots by site index.

As a result of this analysis, the area in TFL #53 that is currently aspen–conifer was included in the THLB. These stands were assumed to grow along the unmanaged stand yield table (without a reduction in volume as was applied in MP#3). A minimum harvest age of 101 years will allow considerable succession to occur. These mixed-wood stands will convert after harvesting to managed conifer leading stands.

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Appendix VIII

Methodology for Risk Rating Stands for MPB Susceptibility

Beetle Risk Determination

The risk of attack by mountain pine beetle was determined using the following table.

Stand susceptibility	Age	Percent pine
High	>60	>= 30%
Moderate	>60	>1% and < 30%
Low	<60	> 1 percent
Not applicable	all	0 percent

All polygons in the TFL were risk rated based upon these criteria. The polygons were then grouped into zones for further analysis.

The base case assumed 100 percent mortality in all high and moderate risk stands. Sensitivity analysis will address reduced mortality in these stands.

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Appendix IX

VEG Height Slope Calculation Procedure

Area-Weighted Tree Heights in VQO areas.

The rationale for calculating tree heights was obtained from the MOF manual: Procedures for Factoring Visual Resources into Timber Supply Analysis (March 1998). The procedure used in this analysis involved merging the TRIM information with VQO polygons to derive the average slope class within each VQO polygon. The slope classes were then area-weighted by polygon and VQO class to derive an average slope for each VQO zone. The slope classes were applied to the following table to derive minimum height.

Slope Class %	0-5	6-10	11-15	16-20	21-25	26-30	31-35	36-45	46-50	51-55	56-60	61+
Tree Height	3.0	3.5	4.0	4.5	5.0	5.5	6.0	6.5	7.0	7.5	8.0	8.5

Specific calculations were done by computer. The logic followed was:

- Slope polygons were created from TRIM DEM data.
- Slope polygons were then intersected with Recreation, Biogeoclimatic, Natural Disturbance Types, TFL project boundary, Forest Cover, and VQO polygons from the Base Case Scenario.
- Slope values were compared to a look-up table containing Slope value ranges, and Tree Heights.
- Tree Heights were then assigned accordingly to each record with a slope value.
- Records not assigned a VQO value or an Inventory Type group number, were purged.
- A record field was populated with the product of the area * tree height.
- The data was then summarized by VQO categories, area * tree height product, and area, to a new table.
- A new field was populated with the area * tree height product / sum area.
- The new field contains the weighted tree height values.

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Appendix X

Biodiversity Calculations

Factoring Biodiversity into the Timber Supply Analysis

Seral Stage Constraints are factored into the analysis over a 140 year period. Direction for this is provided by Timber Supply Branch. The calculations are based on Appendix C Incorporating Biodiversity and Landscape Units into the Timber Supply Review, found in the Provincial Guide for the Submission of Timber Supply Analysis Information Packages for Tree Farm Licences Version 3 February 1998. Thirty-three percent of the percent area target for old growth must occur immediately (or no harvesting is allowed in the area within the group). Similarly, sixty-six percent of the old growth requirement must be met by age 70 through in-growth, and one hundred percent must be met 140 years from present.

The following calculations were used to derive the seral stage stages for the Groups found in Table 32 of the IP. The seral stage targets were obtained from the Forest Practices Code Biodiversity Guidebook (September 1995).

NDT 2 SBS wk1 and ESSF wk1 and ESSF wc3

Low % =	9		Intermediate % =	9	High % =	13
Time 0	13	x	0.10		1.3	
	9	x	0.45		4.05	
	9	x	0.33	x 0.45	1.3365	
				total =	6.6865	
Time 70	13	x	0.10		1.3	
	9	x	0.45		4.05	
	9	x	0.66	x 0.45	2.673	
				total =	8.023	
Time 140	13	x	0.10		1.3	
	9	x	0.45		4.05	
	9	x	0.45		4.05	
				total =	9.4	

Note: The ESSF in TFL 53 is managed as NDT 2 as it occurs in transitional patches that are ecologically similar to NDT2.

NDT 3 SBS dw, mk1, mw

Low % =	11	Intermediate % =		11	High % =	16
Time 0	16	x	0.10		1.6	
	11	x	0.45		4.95	
	11	x	0.33	x 0.45	1.6335	
				total =	8.1835	
Time 70	16	x	0.10		1.6	
	11	x	0.45		4.95	
	11	x	0.66	x 0.45	3.267	
				total =	9.817	
Time 140	16	x	0.10		1.6	
	11	x	0.45		4.95	
	11	x	0.45		4.95	
				total =	11.5	

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Appendix XI

Rationale for the Area in WTPs

Rationale for Modeling Wildlife Tree Patches

A review of silviculture prescriptions and MLSIS submissions from blocks harvested on TFL #53 after the implementation of the FPC was undertaken. This resulted in the determination that averages of 4% of the merchantable stems in each cut block were being reserved as Wildlife Tree Patches (WTPs). Additional area was reserved through riparian reserves, coarse woody debris and unmerchantable forest types. Dunkley forecasts that they may be able to remove these trees when they return to harvest the plantation they created around these WTPs, 80 years from the initial time of harvest. These patches would then be removed and replaced with WTPs from the growing plantation. However, rather than model this dynamic with respect to WTPs, the yield curves were reduced to account for the 4% area that was left in WTPs.