Timber Supply Analysis Information Package
For Tree Farm Licence #38

International Forest Products Ltd.
Management Plan #8

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Final Version

June, 1997

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1. Introduction

This Information Package has been prepared as a source document prior to the completion of the Timber Supply Analysis for Management Plan #8 for TFL 38. It serves as a summary of the inputs and assumptions made in preparing for the timber supply analysis. Included are inventory and landbase summaries, growth and yield information and management assumptions for timber and non-timber resources related to timber supply. It follows the suggested format of the Timber Supply Analysis Information Package for Tree Farm Licences (Version 1.0 August, 1993).

Two options have been identified in the Statement of Management Objectives, Options and Procedures (SMOOP). Specifically these are:

- Current Management Strategies; and
- Enhanced Forestry: the latitude to affect short and long-term timber supply.

These options will be reviewed and evaluated, and an AAC will be selected and submitted for acceptance by the Chief Forester.

1.1 Process

Following acceptance, this report will be included as an appendix to the timber supply report.

1.2 Growth and Yield

1.2.1 Mature stands (age > 140)

Existing mature stands (age classes 8,9) are assigned average volumes based on a set of inventory plots established by Weldwood of Canada. A total of 920 plots were established; 718 between 1979-1980, and an additional 202 in 1992. These plots were established for the purpose of determining standing inventory, and were distributed randomly across the TFL. A subset of 742 of these plots are located within the operable landbase and were therefore selected for this analysis. The plot data was compiled using 17.5 cm utilization. Average volumes/hectare calculated for each mature analysis unit. In the analysis, stands are assumed to maintain these existing volumes until harvest, at which time they will be reassigned to the appropriate managed yield curve. These averages were also used to assign standing volumes to all mature forest stands .

1.2.2 Yield curves for thrifty unmanaged stands (age 31-140)

Natural stand yield curves for the timber supply analysis were developed using the batch version of the Ministry of Forests (MoF) program VDYP (Variable Density Yield Prediction Version 6.4a). VDYP was also used to assign standing volumes to all thrifty forest stands.

1.2.3 Regeneration yield curves (age $\leq$ 30)

Managed stand yield curves were developed using the MoF program WinTIPSY (A Table Interpolation Program for Stand Yields Version 1.3).

VDYP and TIPSY yield curves will be submitted for review to the appropriate offices of the MoF.

2. Options

The following is a brief overview of each option, as described in the SMOOP:

1. Current Management Strategies

This option reflects current management performance based on the date of commencement for the preparation of Management Plan #8. The analysis will incorporate:

- updated inventory database;
- current management regimes;
- new definition of operability;
- new definitions of environmentally sensitive areas;
- new definitions of wildlife management zones;
- new recreation features inventory;
- new visual landscape features inventory and analysis;
- evaluation of low emphasis biodiversity requirements in mid and old seral stages;
- definition of merchantable stands;
- utilization of alder/cottonwood types;
- definition of utilization standards;
- definition of non-recoverable losses (NRLs);
- definition of minimum harvest ages; and
- definition of silvicultural standards.

2. Enhanced Forestry

These analyses focus on the latitude to affect short and long-term timber supply through opportunities in enhanced silviculture, protection, operability and different silviculture systems on all, or portions of the TFL. Analyses may also be performed to investigate the impacts on timber supply related to various management zoning strategies and different levels of forest activities targeted at enhancing the timber supply.

The opportunities have been grouped into three categories:

1. Currently implementable

- yield increases from genetically improved planting stock

2. Feasible pending verification

- higher yields from existing mature stands
- higher yields from managed stands
- commercial thinning opportunities
- increased access to ESAs and buffers through non-conventional harvesting

3. Require development prior to implementation

- fertilization gains

Only the first category will be addressed quantitatively in terms of timber supply impacts.

These opportunities, in combination with some of the current management strategies, represent a package of incremental activities which have a positive impact on timber supply. Management Plan #8 will develop a collective strategy for an Enhanced Forestry Program to show how these opportunities can be realized.

In addition, as other opportunities become apparent, they will be evaluated and incorporated into the management strategy as they are determined to be operationally feasible.

2.1 Sensitivity Analysis

Sensitivity analysis provides a measure of the upper and lower bounds of a "base case" harvest forecast that reflect the uncertainty of assumptions made in the base case. The magnitude of the increase and decrease in the sensitivity variable reflects the degree of uncertainty surrounding the assumption associated with that given variable. By developing and testing a number of sensitivity analyses, it is possible to determine which variables most affect results.

To allow meaningful comparison of sensitivity analyses, they are usually performed using a "base case" option (i.e. current performance) and varying only the assumption being tested (i.e. all other assumptions remain the same as in the current management (base case) option).

Each scenario will be fully documented with respect to the data and assumptions employed.

Table 1 summarizes the sensitivity issues each option is intended to address. The sensitivity levels included in this table are starting levels only, and may be altered depending upon the results of the analyses.

Table 1. Options and sensitivity levels

Option Title	Issue to be Tested	Sensitivity Levels
1. Current Management	1. harvest age 2. existing yield (VDYP vs. AVL) 3. site index 4. regen delay 5. forest cover - maximum disturbance - green-up - old growth retention 6. operability 7. road allowance 8. Biodiversity options	+/- 10 years +17% see Appendix 1 -1 year +/- x% depending on zone +/- 3 years +/- 10% +/- 5% across all classes 7% present roads 5% future roads intermediate emphasis in LU 3
2. Enhanced Forestry	9. enhanced plantation development based on genetic gain expectations	Douglas fir + 5% Cedar + 3% Hemlock + 5%

Additional concerns regarding uncertainty surrounding specific assumptions may arise during the analysis phase. These will be assessed through sensitivity analysis and included in the final timber supply report.

3. Forest Estate Model

The Forest Service Simulator (FSSIM) Projection Model.

Type: Simulation

Description: The model uses a pseudo-geographic inventory based on zones and groups to implement forest cover constraints on harvesting. Non-contributing inventory in refuges such as environmentally sensitive areas and inoperable areas can be included to better model forest structure and disturbance levels. Silviculture can be used to ameliorate the effects of forest cover constraints by:

- Improving the growth of immature and regenerating stands;
- Reducing regeneration delays; and
- Bringing non-productive areas into production.

FSSIM will be used to determine harvest schedules which incorporate all integrated resource management considerations.

4. Inventory Aggregation

In order to reduce the complexity of the forest description for the purposes of timber supply simulation, considerable aggregation of individual forest stands is necessary. However, it is critical that this aggregation not obscure either biological differences in forest stand productivity, or differences in management objectives and prescriptions. Management differences are recognized by grouping stands into landscape units and management zones on the basis of similarity of management objectives. Biological similarity is captured by grouping stands into analysis units on the basis of similar species and site productivity.

4.1 Landscape Units

For planning purposes, TFL 38 has been subdivided into three broad landscape units:

1. Ashlu and Squamish sub-units;
2. Elaho_South and Sims sub-units; and
3. Elaho_North and Clendenning sub-units.

4.2 Management Zones

The landbase has also been segregated into resource management zones (RMZs) to facilitate the application of management criteria. These include:

1. Partial Retention Visual Quality (PR_VQO) < 40% slope;
2. Partial Retention Visual Quality (PR_VQO) ≥ 40% slope;
3. Modification Visual Quality (Mod_VQO) < 40% slope;
4. Modification Visual Quality (Mod_VQO) ≥ 40% slope;
5. Moose Habitat;
6. Mountain Goat Habitat;
7. General Management Resource Management Zone (GM-RMZ); and
8. Enhanced Forestry Resource Management Zone (EF-RMZ).

Visual quality (VQO) zones are defined based on proposed "scenic areas" defined in Management Plan #8. These proposed areas are derived from the full landscape inventory completed in 1995 and approved by the MoF in 1995. In preparing for MP #8, the inventory was reviewed in the context of "Managing Scenic Values in TFL 38 Consistent with Forest Practices Code Impact Objectives". Subsequent to the review, Interfor has identified two areas for consideration and management as scenic areas as defined under Section 1 of the Operational Planning Requirements.

The moose habitat zone is based on a winter habitat survey in 1995. The mountain goat zone is based on winter track counts in 1994. The general management RMZ is a designation which places emphasis on maintaining a full range of existing values. General provisions of integrated resource management and the Forest Practices Code (FPC) will apply. The enhanced forestry RMZ designation places emphasis on maximizing timber volume and quality through intensive forest management, including increased research, innovation, investment and certainty of access. Key fish and wildlife habitats, community watersheds and other user opportunities will be maintained in accordance with the FPC.

These zones are created to address concerns not accounted for through withdrawals in the netdown process. ESA reductions account for protection of values such as recreation and soils. Therefore, separate zonation is not required. Zones are summarized in Tables 2 (a,b).

Table 2 (a). Resource emphasis zones - gross productive area (ha)

LU #	Sub-unit	PR VQO <40%	PR VQO ≥40%	Mod VQO <40%	Mod VQO ≥40%	Moose	Goat	GM RMZ	EF RMZ	Total
1	Ashlu	126	389	155	521	0	383	2979	4575	9128
	Squamish	10	45	495	1994	0	1255	7825	8997	20621
	Subtotal	136	434	650	2515	0	1638	10804	13572	29749
2	Elaho_South	224	119	936	2185	620	840	348	5714	10986
	Sims	2	1	461	597	368	437	1764	0	3630
	Subtotal	226	120	1397	2782	988	1277	2112	5714	14616
3	Clendenning	674	22	182	211	104	77	3420	0	4690
	Elaho_North	0	0	133	174	501	0	10860	0	11668
	Subtotal	674	22	315	385	605	77	14281	0	16359
Total		1036	576	2362	5682	1593	2992	27196	19286	60723

Table 2 (b). Resource emphasis zones - net harvestable area (ha)

LU #	Sub-unit	PR VQO <40%	PR VQO >40%	Mod VQO <40%	Mod VQO >40%	Moose	Goat	IRM general	IRM enhanced	Total
1	Ashlu	91	184	131	285	0	199	1912	2805	5607
	Squamish	6	19	315	1211	0	694	5944	5839	14028
	Subtotal	97	203	446	1496	0	893	7856	8644	19635
2	Elaho_South	133	63	563	979	397	329	280	3670	6414
	Sims	0	0	17	81	36	279	959	0	1372
	Subtotal	133	63	580	1060	433	608	1239	3670	7786
3	Clendenning	0	0	1	0	0	0	24	0	25
	Elaho_North	0	0	2	2	389	0	8305	0	8698
	Subtotal	0	0	3	2	389	0	8329	0	8723
Total		230	266	1029	2558	822	1501	17424	12314	36144

Note: **As only an insignificant amount of operable area (< 10 hectares) was identified as Retention VQO, this area was grouped with Partial Retention for analysis purposes.**

4.3 Analysis Units

To capture biological similarities, the inventory data has been aggregated on the basis of inventory type group and site index range. Site index is derived using currently accepted site index curves. This stratification is independent of any subsequent site index adjustments (see Appendix 1). Table 3 provides a summary of the site index distribution by species.

Table 3. Distribution of area(hectares) by 5-metre site index class

Species	5	10	15	20	25	30	35+	Total
Douglas fir	860	84	901	4090	4733	696	0	11364
Cedar	0	113	1034	1765	758	106	0	3776
Hemlock/Cedar	123	989	1030	247	0	0	0	2389
Hemlock/Balsam	92	4170	2871	409	0	41	0	7583
Balsam	207	5049	2977	243	1518	418	0	10412
Hardwood	60	18	83	43	284	70	62	620
Total	1342	10423	8896	6797	7293	1331	62	36144

With the exception of hardwood, each species group was split into three site categories (poor, medium, good), on the basis of these distributions. These groupings were further subdivided into three maturity classes (immature, thrifty and mature) to facilitate allowance for old-growth site index biases.

In some cases, the aggregation scheme resulted in only minor areas within individual analysis units. Usually this was due to the subdivision by maturity, necessary in order to apply the appropriate yield forecasting methodology described in Section 1.2. The following additional aggregations were made to simplify yield curve development:

immature	HECP+HECM+HEBP+HEBM+BALP+BALM	=	HEBM
immature	HECG+HEBG+BALG	=	HEBG
thrifty	CEDP+CEDM+CEDG	=	CEDM
thrifty	HECP+HECM+HEBP+HEBM+BALP+BALM	=	HEBM
thrifty	HECG+HEBG+BALG	=	HEBG

Results are summarized in Table 4.

Table 4. Analysis units

Analysis Unit			Net Area (ha) (by age)				Inventory Variables Used	
#	Name	Description	immature (age 1-30)	thrifty (31-140)	mature (141+)	Total	Inventory Type Group	Site Index range
1	FIRP	Douglas Fir - poor	1511	1177	1303	3991	1-8	<20
2	FIRM	Douglas Fir - medium	2304	1117	3285	6706	1-8	20-27.9
3	FIRG	Douglas Fir - good	406	173	87	666	108	>27.9
4	CEDP	Cedar - poor	122		984	1106	9-11	<18
5	CEDM	Cedar - medium	618	79	1711	2408	9-11	18-23.9
6	CEDG	Cedar - good	92		170	262	9-11	>23.9
7	HECP	Hemlock/Cedar - poor			661	661	12,14	<11
8	HECM	Hemlock/Cedar - medium			1394	1394	12,14	11-16.9
9	HECG	Hemlock/Cedar - good			192	192	12,14	>16.9
10	HEBP	Hemlock/Balsam - poor			2744	2744	13,15,16,17	<11
11	HEBM	Hemlock/Balsam - med.	268	407	4173	4848	13,15,16,17	11-16.9
12	HEBG	Hemlock/Balsam - good	2164	268	124	2556	13,15,16,17	>16.9
13	BALP	Balsam - poor			3318	3318	18-34	<11
14	BALM	Balsam - medium			4474	4474	18-34	11-16.9
15	BALG	Balsam - good			198	198	18-34	>16.9
99	HARD	Hardwood		620		620	35+	all
Total			7485	3841	24818	36144		

The following sections document the assumptions and inputs for each management option. Assumptions and inputs common to several options are reported in the first of the options in which they occur.

5. Current Management Strategies

5.1 Operable Landbase Determination

5.1.1 Netdown Protocol

This section summarizes the steps used to identify the net operable landbase within the gross landbase for the licence. Land may be removed for three principle reasons:

- it is unproductive for forest management purposes;
- it is and will remain inoperable under the assumptions of the analysis, or it will become inoperable or unproductive during the period addressed by the analysis; and/or
- it is scheduled to be withdrawn for other uses.

Land may also be added to the operable landbase:

- by management activities which improve productivity or operability; and/or
- by the acquisition of productive forest land.

The net operable landbase for TFL 38 is determined by applying the following reductions, in descending order, to the gross landbase:

1. Reduction for non-forest and non-productive (lakes, swamps, rock, alpine, etc.). All land classified as non-forest or non-productive (type identity 6 or 8) is excluded.
2. Reduction for new protected areas. Areas designated protected in the Lower Mainland Protected Areas Strategy (LMPAS) are removed.
3. Reduction for inoperable. All land classified as inoperable (OPER = I) based on the new operability classification is excluded.
4. Reduction for non-commercial. Land classified as NCBr (type identity = 5) is excluded.
5. Reduction for existing roads, trails and landings. A reduction is applied to all operable stands age 40 and less, to represent existing roads on TFL 38. Section 5.9 provides details on this reduction.
6. Reduction for riparian zones. A reduction is applied to account for buffers around watercourses, including streams, lakes, swamps and wetlands. Section 5.18 provides a summary of rules for this reduction.
7. Reduction for environmentally sensitive areas (ESAs). All lands classified as ESA1 or ESA2 are reduced by percentages reflecting the ESA type. Section 5.5 outlines the removals of area under each ESA1 and ESA2 category.

8. Reduction for deciduous species. Deciduous leading stands (inventory type groups 35 - 42) are included in the landbase. However, in developing standing inventory estimates and yield curves for existing stands, the deciduous volume component of all stands is removed. Section 5.7 outlines the deduction for deciduous species.

9. Reduction for NSR. All land classified as NSR (type identity = 4 or 9) is excluded. This land is added back into the future landbase once regeneration objectives have been met.

10. Reductions for future roads. A reduction for future roads will be made by applying the 4 percent calculated reduction for current roads to all stands currently older than age 40. These reductions will be made in the timber supply simulation after the current volumes have been harvested.

After all reductions and exclusions have been applied to the landbase, NSR lands are added back to the landbase and future roads are removed to give the net long-term harvestable landbase for TFL 38. Tables 5 (a,b) itemize the steps in the determination of the net long-term landbase.

Table 5 (a). Long-term harvestable landbase determination - breakdown by tenure

Classification	Productive Area (ha)[1]	Net Area (ha)			Coniferous Volume (1000s m^3)
		Schedule A	Schedule B	Total	
Total landbase	60723	222	218394	218616	27436
Non-productive	0	43	157850	157893	3360
Total Productive	**60723**	**179**	**60544**	**60723**	**24076**
Reductions to Productive					
Protected	6406	0	6406	6406	2990
Inoperable	14801	15	12618	12633	5411
Non-commercial	8	0	8	8	0
Existing Roads	481	2	454	456	17
Water Buffers	2615	49	1546	1595	472
ESA-1	5306	5	2182	2187	983
ESA-2	35308	0	829	829	363
NSR	655	0	465	465	0
Total Reductions		71	24508	24579	10236
Reduced landbase		**108**	**36036**	**36144**	**13840**
Future Additions/Reductions					
Roads, trails, landings		-3	-1065	-1068	
NSR		0	465	465	
Net long-term landbase		**105**	**35436**	**35541**	

[1] total productive area in each classification. Overlapping classifications reduce area deducted.

Table 5 (b). Long-term harvestable landbase determination - breakdown by landscape unit

Classification	Net Area (ha)			
	LU # 1	LU # 2	LU # 3	Total
Total landbase	91662	55580	71374	218616
Non-productive: stocking class 1	441	155	110	706
stocking class 2	3517	1379	2259	7155
other	57955	39430	52647	150032
Total Productive	29749	14616	16358	60723
Reductions to Productive				
Protected	0	1302	5104	6406
Inoperable	7051	3796	1786	12633
Marginal	0	0	0	0
Non-commercial	2	6	0	8
Existing Roads	349	94	13	456
Water Buffers	926	513	156	1595
ESA-1	1086	698	403	2187
ESA-2	416	300	113	829
Deciduous	0	0	0	0
NSR	284	122	59	465
Total Reductions	10114	6831	7634	24579
Reduced landbase	19635	7785	8724	36144
Future Additions/Reductions				
Roads, trails, landings	-580	-230	-258	-1068
NSR	284	122	59	465
Net long-term landbase	19339	7677	8525	35541

Table 5 (b) also indicates a further subdivision of the non-productive component of the TFL. Stands which are classified as alpine (AF) or non-productive (NP) but which have forest cover attributes and stocking class 1 or 2 potentially can contribute to forest level biodiversity. The purpose in showing these areas is to indicate this potential. While not incorporated into the biodiversity calculations, these components provide a margin of safety around the biodiversity numbers. A total of 7 861 hectares fall into these categories.

5.2 Inventory Status

5.2.1 Current Inventory

The present forest inventory for TFL 38 was prepared by Weldwood in 1981. In 1987 an inventory of second growth stands over 10 years of age was completed and integrated into the mylar base.

In 1993 the mylar base was transferred to a 1988 orthophoto map base made to photo control from the Ministry of the Environment, Lands and Parks TRIM format (NAD 83). Forest attributes were added to make the database compatible with current Ministry of Forests standards and the inventory was converted to a GIS ARC/INFO digital format.

The planimetric base, including forest cover, was also updated to 1994 1:15,000 colour photography. This project updated both altered geographic features, such as meandering rivers, and photogrammetrically unverified harvest block boundaries. Indistinct areas in the original orthophotography were also upgraded.

The inventory and planimetric base have been updated annually for harvesting, road construction, reforestation, silvicultural treatments and TFL area amendments. Most recent updating of inventory records occurred in 1997, and incorporated updates to the end of 1996.

Due to the nature of the original forest attributes, this forest inventory has become incompatible, in some respects, with the current MoF data model. In 1993, the present TFL 38 inventory was modified to facilitate the use of the original forest inventory data for timber supply analysis, for preparation of digital maps with MoF style labels, and for translation of TFL 38 inventory data into compatible Intergraph design files. The following modifications were made:

- The addition of crown closure estimated from TRIM based orthophotos or 1:15 000 scale aerial photos;
- The addition of stand height from recent silviculture records on disturbed areas, and
- The estimation of stand age and stand height from age, height and site classes referenced to the leading species in the original site curves.

Inventories of recreation, landscape, ESAs, wildlife and fisheries were completed for TFL 38 in 1995-96. In addition, new operability classifications were completed in 1996. All new inventories have been submitted to the MoF for approval, and all have been digitally captured and entered into a GIS database linked to graphic files.

The licence contains both net operable land and inoperable land. The current inventory consists of timber on both land classes. Timber on the inoperable land is not available for harvesting under the assumptions of this option. Productive inoperable forest land will contribute to forest cover requirements for non-timber resources.

5.2.1.1 Inventory Summaries

Tables 6 and 7 summarize the distribution of area and volume by age class for total productive, operable and net operable components of the TFL 38 inventory. In all cases, land classified as NSR is not included in the summaries; only forested area is included. Also, only coniferous volume is reported.

Table 6. Area by age class

Age Range	Productive Area (ha)		
	Total[1]	Operable	Net Current[2]
0	663	541	0
1-20	6620	6413	5597
21-40	4752	4458	3848
41-60	1884	1171	1023
61-80	875	231	184
81-100	481	168	138
101-120	480	248	187
121-140	626	273	215
141-250	2829	1386	1165
251+	41513	26794	23787
Total	**60723**	**41683**	**36144**

(1) Excludes non-productive and non-commercial types

(2) Excludes current NSR

Table 7. Coniferous volume by age class

Age Range	Coniferous Volume (1000 m^3)		
	Total[1]	Operable	Net Operable
0	0	0	0
1-20	0	0	0
21-40	434	422	372
41-60	238	191	175
61-80	77	19	17
81-100	47	20	16
101-120	119	58	44
121-140	175	94	76
141-250	1490	719	613
251+	21495	14151	12527
Total	**24075**	**15674**	**13840**

Tables 6 and 7 can also be provided in digital form, broken down by analysis unit, zone and 10 year age class. ASCII files will be included with the yield analysis submission.

5.3 Inaccessible

The purpose of this section is to describe the criteria that are used in defining inaccessible areas. Throughout this report and the subsequent timber supply analysis, operability will be used synonymously with accessibility. Both physical and economic operability using helicopter, cable and ground systems were considered in determining the current operability lines. Problem forest conditions, including low site stands, were removed in this classification. Four operability categories are included in the current operability mapping:

- Conventional;
- Helicopter;
- Marginal Stands; and
- Inoperable.

A description of these categories can be found in Section 5.19.2. This operability mapping is under MoF review with final approval pending. With the exception of the Inoperable category, all operability classes are included in the net operable landbase. None of the area classified as inoperable (I) may contribute to the timber supply for this option. However, forested inoperable area may contribute to forest cover requirements for non-timber resources such as wildlife, visual quality and critical watersheds.

5.4 Non-Commercial Cover

As indicated in Table 5, only 8 hectares of area were removed as non-commercial cover (TypeID = 5).

5.5 Environmentally Sensitive Areas (ESAs)

ESAs (Environmentally Sensitive Areas) are mapped land units that have special management requirements. In the context of timber supply analysis, management constraints are assumed to reduce the area available for harvesting in ESAs. Generally, ESA1 areas are more severely constrained than ESA2 areas. The reduction amount depends on the severity of the constraint and on the category of ESA. ESAs were determined and submitted to the MoF during 1996. Mapping procedures were completed according to MoF standards. ESA categories of high and moderate sensitivity have been assessed for:

- terrain and slope stability, including snow avalanching; and
- recreation.

A complete summary of areas classified as ESA on TFL 38 is presented in Tables 8 and 9. This table includes the net area in each category. This represents the residual area remaining in the net timber producing landbase after the netdown process, reflecting the fact that in some cases only a percentage of the total ESA area is removed from the landbase. The area reductions applied to the operable landbase to account for operational constraints to harvesting in environmentally sensitive areas are also listed in Table 8. Table 9 provides a summary of the ESA hectares removed at each step.

Table 8. Distribution of area by ESA category

ESA Category	ESA Description	Landscape Unit	Productive Area (ha) Total	Operable	Net	Reduction %	ha
Es1	Soils	1	1869	1166	109	90	993
		2	1118	753	74	90	664
		3	856	479	44	90	403
		Total	3843	2398	227		2060
Er1	Recreation	1	638	252	10	90	93
		2	452	230	4	90	33
		3	373	3	0	90	0
		Total	1463	485	14		126
E1 Total		**1**	**2507**	**1418**	**119**		**1086**
		2	**1570**	**983**	**78**		**697**
		3	**1229**	**482**	**44**		**403**
		Total	**5306**	**2883**	**241**		**2186**
Es2	Soils	1	5455	4236	3706	10	416
		2	4068	3069	2629	10	300
		3	1479	1150	1002	10	114
		Total	11002	8455	7337		830
Er2	Recreation	1	12387	9719	8927	0	0
		2	2673	1844	1672	0	0
		3	9246	4370	4292	0	0
		Total	24306	15933	14891		0
E2 Total		**1**	**17842**	**13955**	**12633**		**416**
		2	**6741**	**4913**	**4301**		**300**
		3	**10725**	**5520**	**5294**		**114**
		Total	**35308**	**24388**	**22228**		**830**
E1 + E2		**1**	**20349**	**15373**	**12752**		**1502**
		2	**8311**	**5896**	**4379**		**997**
		3	**11954**	**6002**	**5338**		**517**
		Total	**40614**	**27271**	**22469**		**3016**

Table 9. Reductions applied by ESA category

Classification	Net Area (ha) ESA-1				ESA-2				Total			
Landscape Unit	1	2	3	Total	1	2	3	Total	1	2	3	Total
Total landbase	32828	11330	20958	65116	42234	27911	42456	112601	75062	39241	63414	177717
Non-productive	30321	9759	19730	59810	24392	21170	31730	77292	129775	30929	51460	137102
Total Productive	2506	1571	1228	5305	17842	6741	10725	35308	20348	8312	11953	40615
Reductions												
Protected	0	74	641	715	0	816	4145	4961	0	890	4786	5676
Inoperable	1088	514	106	1708	3887	1011	1061	5959	4975	1525	1167	7667
Marginal	0	0	0	0	0	0	0	0	0	0	0	0
Non-Commercial	0	1	0	1	0	3	0	3	0	4	0	4
Existing Roads	13	8	0	21	237	38	1	276	250	46	1	297
Water Buffers	199	200	34	433	510	194	91	795	709	394	125	1228
ESA-1	1086	697	403	2186	0	0	0	0	1086	697	403	2186
ESA-2	0	0	0	0	416	300	114	830	416	300	114	830
Deciduous	0	0	0	0	0	0	0	0	0	0	0	0
NSR	1	0	0	1	159	78	20	257	160	78	20	258
Total Reductions	2387	1494	1184	5065	5209	2440	5432	13081	7596	3934	6616	18146
Reduced landbase	**119**	**77**	**44**	**240**	**12633**	**4301**	**5293**	**22227**	**12752**	**4378**	**5337**	**22469**

Reductions are listed in the order in which they are applied to ESAs in the operable component of the landbase. Inoperable areas are completely excluded from the landbase prior to ESA deductions. ESA2 areas are less critical for special management purposes, therefore a smaller reduction is applied to these areas. Areas that fall under ESA1 and ESA2 categories will only have the ESA1 reduction assigned. It is assumed that ESA1 constraints address ESA2 constraints for similar management purpose. Similarly, within an ESA category, areas that have several ESA designations are reduced only once.

The net area figures in Table 8 represent the residual area left in the timber producing landbase at the end of the netdown process, while the area reductions represent the area actually removed for ESAs during the netdown process (see Table 5). The latter therefore exclude operable ESA already removed in earlier steps in the netdown process. Of the 40 614 hectares of area in ESAs, 3 016 hectares are taken out due to the ESA reductions listed, and 15 129 hectares are netted out in other netdown steps. This leaves a balance of 22 469 hectares of ESAs in the net timber producing landbase.

5.5.1 Terrain Netdowns

Recently, terrain attribute data has been collected in TFL 38 as part of a Ministry of Forests research program into landslide activity in the Coast Mountains. This data records terrain types and attributes for logged terrain which is about 6 to 15 years old, as well as landslide presence or absence. A preliminary review of this information has shown that much of the logged terrain does not have clearcut (open slope) landslides. Terrain types with specific attributes associated with the absence of landslides were categorized, and correlated with similar terrain in other parts of the TFL which have yet to be logged.

Recent air-photos were used to determine landslide activity in other areas of TFL 38 and the terrain types and attributes associated with those landslides. Netdowns for terrain of these types in unlogged areas of the TFL were estimated, based on FPC harvesting standards. Estimates of landslide occurrence for Class IV and V terrain were then determined on a per hectare basis, using polygon areas from the terrain map information contained in the GIS database of TFL 38.

Based on the above, the netdown factors for Es1 and Es2 areas were established at 90% and 10% respectively.

During final development of the procedure for determining the netdown factors, discussions were held with Research Geomorphologists at the Ministry of Forests, Nanaimo. These discussions confirmed that the approach used to determine the netdown factors is consistent with previous approaches (such as the procedure used for MB TFL 44), as well as the strengths and limitations of the terrain attribute data.

5.5.2 Recreation Netdowns

As indicated in Table 8, there is no landbase netdown factor applied to the Er2 classification. This is consistent with the approach taken in the TSR#1 analysis of the Soo TSA. Of the 24 306 hectares in this classification, 9 415 hectares (39%) are netted out for other purposes. An additional 1 703 hectares are classified into RM zones 1-6. The balance of the area (13188 hectares) is assigned to the general management RMZ. This is consistent with the mitigation strategy contained in the "Recommendations for Finalizing the Protected Areas Strategy in the Lower Mainland" (August, 1996). These recommendations were accepted by the provincial government in October, 1996.

5.6 Low Productivity Sites

Sites may have low productivity either because of inherent site factors (nutrient availability, exposure, excessive moisture, etc.), or because they are incompletely occupied by commercial tree species. In the case of TFL 38, these areas are included in the Inoperable category. Therefore, no separate reduction is required.

5.7 Deciduous

For the purposes of this analysis only the coniferous (softwood) component of the forest is considered commercial. The deciduous (hardwood) component of the forest can occur as relatively minor components of stands of mixed coniferous/deciduous species, and as predominately deciduous stands. The inventory is organized by Inventory Type Group. Groups 35-40 have a deciduous species leading, and have only a small proportion of coniferous trees. These types are grouped together as deciduous, and assigned to a separate analysis unit (see Table 4). Following harvest, 50% of the deciduous component is assigned to a managed softwood yield curve. The remaining 50% is assumed to revert to cottonwood. Table 10 summarizes the inventory of deciduous stands.

The 973 hectares in Table 10 represent total deciduous area classified as operable. In contrast, the 620 hectares of net area excludes operable area removed in the netdown process. For all existing and future stand types, volumes assigned exclude deciduous volume.

Table 10. Deciduous inventory components

Inventory Type Group	Landscape Unit	Productive Area (ha) Total	Operable	Net
35	1	61	58	36
	2	109	76	56
	3	5	0	0
	Total	197	134	92
36	1	401	203	137
	2	230	160	82
	3	62	0	0
	Total	698	368	219
37	1	81	57	44
	2	61	60	45
	3	0	0	0
	Total	142	117	89
38	1	417	229	132
	2	125	84	52
	3	0	0	0
	Total	520	313	183
39	1	63	22	15
	2	4	4	4
	3	0	0	0
	Total	67	26	19
40	1	37	20	17
	2	0	0	0
	3	0	0	0
	Total	28	13	17
Total	1	1060	589	382
	2	529	384	238
	3	67	0	0
	Total	1656	973	620

5.8 Unmerchantable Stands

Unmerchantable stands are classified as inoperable in the TFL 38 inventory. Therefore, all commercial stands in the net operable landbase are considered to be merchantable.

5.9 Roads, Trails and Landings

5.9.1 Reduction for Existing Roads, Trails and Landings

Forest operations create roads, trails and landings which can reduce the productivity of growing sites, and reduce the area available for growing trees. Existing roads, trails and landings are too small to be identified as polygons in the digital inventory files. In general, the timber for which roads, trails and landings have already been constructed has been logged. Therefore, there are changes in available growing area and productivity for future stands due to road building disturbance. For this reason the area of currently regenerating stands (those with a history of logging) is adjusted.

5.9.1.1 Classified Roads

All existing roads are in the GIS database for TFL 38 as line features. These line features are classified according to the categories listed in Table 11. An average width, based on the permanently non-productive component of the road right-of-way, is assigned to each road class to allow the area in roads to be calculated. A summary of existing roads in the database is currently being prepared and will be presented in Table 11.

Table 11. Existing classified road area summary

Road Description	Road Measurements		
	Length (km)	Width (m)	Area (ha)
1 lane (overgrown)	140	5	70
1 lane rough	56	8	45
1 lane gravel	270	8	217
2 lane gravel	124	10	124
Total	585		456

The lengths represent the segments of roads passing through operable TFL 38 polygons. The widths represent the expected permanent net loss in productive growing space. Based on this, a total of 456 hectares were removed from the operable landbase. The majority (85%) of the roads pass through stands which are less than 41 years of age, and which comprise a total of 11 411 hectares. Therefore, a road reduction of 4% was applied to all operable polygons less than age 41.

5.9.1.2 Unclassified Roads Trails and Landings

All existing roads, trails and landings are included in the classified category.

5.9.2 Future Roads, Trails and Landings

Upon harvesting, a component of each stand is placed into a category that will remain in a roaded state for perpetuity. Generally these stands will provide harvest volume on the first entry but not on further entries. The area contributing to the long term sustainable harvest is net of this amount.

In FSSIM, a factor of 4% will be applied to reduce the area of each unroaded forest class (currently greater than age 40) the first time it is harvested. Given the anticipated increase in non-conventional systems such as helicopter, the actual future road allowance is expected to be lower.

5.10 Site Degradation

No allowance is being made for site degradation, beyond the road allowances discussed above. Site degradation is not generally associated with cable logging systems and helicopter operations, which are the predominant harvesting methods employed in TFL 38.

5.11 Area Additions

In the timber supply analysis, the current NSR area listed in Table 5 will be added back into the timber producing landbase in the first decade of the simulation, as it is assumed that it will be regenerated within 2 years. This approach is detailed in Section 5.14.3.

5.12 Growth and Yield

For the analysis of TFL 38, the approach to stand yield forecasting is based on the current maturity of each stand, and the level of silviculture treatment which has been applied.

1. Existing mature stands (> age 140) are assigned average volumes based on inventory plots established by Weldwood of Canada (see Section 1.2.1). Average volumes/hectare were calculated for each mature analysis unit. Stands are assumed to maintain these existing volumes until harvest, at which time they will be reassigned to the appropriate managed yield curve..
2. Existing stands between ages 31-140 are grown on curves developed using the batch version of the MoF program VDYP Version 6.4a.
3. For existing, managed stands (less than or equal to age 30) and all future regeneration, yield curves were prepared using the MoF WinTIPSY Version 1.3.

All yield curves have been submitted for review to the appropriate MoF Branches.

5.12.1 Source of Site Index Data

Site index is derived using currently accepted site index curves. However, it is recognized by MoF Research Branch staff that the adjusted values are very low, relative to values measured in other coastal areas. This issue will be addressed through sensitivity analysis, as documented in Appendix 1.

Site indices for analysis units are derived as the area-weighted average of the polygons in each analysis unit.

5.12.2 Source of Crown Closure Data

The source of crown closure data for stands greater than age 30 is documented in Section 5.2.1.

Coastal default values are being utilized for all stands less than or equal to age 30. These values are taken from the VDYP User Guide Version 4.5 (July 1993), and are summarized in Table 12.

Table 12. Coastal default crown closure values

Leading Species	Average TSA Value (%)
Douglas Fir	61
Cedar	60
Hemlock	61
Balsam	57
Spruce	50

5.12.3 Utilization Levels

Table 13 documents the utilization level by species that will be used in the development of the yield tables. The indicated level is the utilization level applied operationally. The firmwood standard is equal to 50% (percent of gross log volume in sound fibre). Logs are rejected if the firmwood is less than 50%.

Table 13. Utilization levels

Stand Types	Utilization		
	Minimum DBH (cm)	Stump Height (cm)	Top DIB (cm)
existing natural	17.5	30	15
managed	12.5	30	10

5.13 Volume Deductions

Volume deductions can be made by: 1) removing unmerchantable stands from the working forest, or 2) reducing the volume that can be expected from harvesting them. The first method is used for stand types which are unmerchantable. As indicated in Section 5.3, all stands considered to be unmerchantable were removed in the operability classification. The second method is used where a component of a stand is unmerchantable but the remainder of the stand is large enough, and of good enough quality, to be merchantable. For the purposes of this analysis, all stand volumes are reduced by the amount represented by the deciduous component of the stand. Similarly, yield curve volumes are net of deciduous.

5.13.1 Decay, Waste and Breakage

Volume estimates are net of decay, waste and breakage. Ministry of Forests Forest Inventory Zone 'B' loss factors were used for the entire TFL. Existing natural stands greater than 30 years of age will be grown during the analysis on yield curves developed with VDYP batch Version 6.4a. Loss factors are those specified for TFL 38.

Decay, waste and breakage are accounted for in TIPSY yield forecasts through the application of operational adjustment factors (OAFs). These are described in the next section.

5.13.2 Operational Adjustment Factors

5.13.2.1 VDYP

Operational adjustment factors (OAFs) are not developed for VDYP forecasts. These are inherent in the forecasts based on the decay, waste and breakage for the assigned FIZ and TFL. In addition, crown closure defines gaps in the forest canopy.

5.13.2.2 TIPSY

With TIPSY two OAFs are defined:

OAF1 - represents stand holes

OAF2 - represents losses towards maturity (including decay, waste and breakage)

An OAF1 value of 15% and an OAF2 value of 5% were used in developing all managed yield curves.

Species mixes for managed stand are based on input from Interfor operational staff. These are summarized in Table 14. The site indices and operational adjustment factors used to develop the final TIPSY curves for the base case analysis are also summarized in Table 14.

Table 14. Summary of parameters for TIPSY yield curves - base case

Analysis Unit	Site Index			Leading species	Second species	OAF1	OAF2
	1-30	31-140	141+				
FIRP	14.7	13.7	16.3	fir - 80	ced - 20	15	5
FIRM	26.9	26.8	23.1	fir - 80	ced - 20	15	5
FIRG	31.3	32.0	29.9	fir - 80	ced - 20	15	5
CEDP	14.6		15.2	ced - 80	hem - 20	15	5
CEDM	22.8	18.3	19.8	ced - 70	fir - 30	15	5
CEDG	28.7		26.2	ced - 70	fir - 30	15	5
HECP			9.3	ced - 60	hem - 40	15	5
HECM			14.1	hem - 100		15	5
HECG			19.4	hem - 70	ced - 30	15	5
HEBP			10.1	hem - 100		15	5
HEBM	12.5	10.8	13.8	hem - 70	ced - 30	15	5
HEBG	24.0	21.7	19.6	hem - 70	ced - 30	15	5
BALP			9.8	hem - 100		15	5
BALM			13.9	hem - 100		15	5
BALG			19.7	hem - 100		15	5
HARD			19.2	ced - 70	hem - 30	15	5

5.13.3 Modelling of Standing Timber Volumes

Plot-based average volume lines (AVLs) were used to provide volume estimates for each stand over age 140 in the inventory file. Similarly, Version 6.4a of VDYP Batch was used for each stand between ages 31-140. Loss factors specific to TFL 38 are used for converting gross to net volumes. All stand volumes reported are net of deciduous species.

5.13.4 Yield Table Development

5.13.4.1 Existing Mature Stand Yield Tables

Average volume lines for existing mature stands (age 141+) were developed using the inventory plot data described in Section 1.2.1. The methods used were:

1. Each plot was assigned an analysis unit (AU) based on species mix and site index.
2. For each AU, volume/basal area ratios were computed for each measured (M) plot.
3. Volumes were determined for count (C) plots using the volume/basal area ratios.
4. Average volumes were computed for each AU based on all plots (M and C).

The results are summarized in Table 15.

Table 15. Average volumes for mature types

Analysis Unit	Current Net Ha	Vol/BA Ratio	Conv + Heli plots	Conv + Heli AVL	Marginal plots	Marginal AVL	Combined plots	Combined AVL	VDYP	Difference (%)
1	1303	7.81	23	532			23	532	398	-25
2	3285	8.31	45	625			45	635	703	+11
3	87	8.94	5	868			5	868	1090	+26
4	984	7.11	37	527	1	549	38	528	567	+7
5	1711	6.72	56	601			56	601	778	+29
6	170	8.13	3	1263			3	1263	1001	-21
7	661	8.19	8	411	9	347	17	377	331	-12
8	1394	7.09	51	454			51	454	597	+31
9	192	6.87	17	521			17	520	792	+52
10	2744	7.23	66	395	12	439	78	402	435	+8
11	4173	7.56	139	467	3	389	142	466	665	+43
12	124	8.84	32	662			32	662	906	+37
13	3318	8.13	38	488	33	588	71	535	502	+94
14	4474	8.43	154	553	42	650	158	556	722	+30
15	198	9.45	4	560	2	1206	6	775	862	+11
Total	24818		678		64		742	530	618	+17

A comparison of the area-weighted average AVL and VDYP results indicates that the VDYP yields are on average 17% higher than AVL figures. While the AVL figures are being adopted for this analysis, a sensitivity analysis will be performed to test the impact of a 17% increase in existing mature yields.

All existing mature stands are assumed to have reached minimum harvest age.

5.13.4.1 Existing Thrifty Stand Yield Tables

Yield tables for existing thrifty stands (age 31-140) were developed with the MoF program VDYP Version 6.4a. In this analysis, inventory type group and site index range have been used to define analysis units. The methods used to generate base yield tables were:

1. Each polygon in the net land base has been assigned to an analysis unit on the basis of inventory type group and site index. Analysis units are defined in Table 4.
2. Area-weighted average site index, crown closure and species composition attributes have been extracted for each analysis unit. Coastal default crown closure percents were employed for stands less than age 30.
3. These attributes, in addition to decay, waste and breakage associated with FIZ and TFL 38 are used to drive VDYP. All VDYP yield tables have been compiled to the utilization levels listed in Table 13. Table 16 summarizes the VDYP attributes.

Table 16. VDYP Inputs for existing (natural) stand yield curves - thrifty

Analysis Unit	Site Index (m) @ 50	Crown Closure	Species Composition (%) species 1	species 2	species 3	species 4
FIRP	13.7	38	fir - 66	hem - 18	ced - 14	bal - 2
FIRM	26.8	26	fir - 70	hem - 15	ced - 11	bal - 4
FIRG	32.0	25	fir - 58	hem - 21	ced - 21	
CEDM	18.3	50	ced - 53	hem - 35	bal - 6	cot- 6
HEBM	10.8	48	bal - 48	hem - 39	fir - 9	pin - 4
HEBG	21.7	44	bal - 47	hem - 38	ced - 9	fir - 6
HARD	19.2	57	ald - 47	cot - 42	ced - 7	fir - 4

Note: Outputs from VDYP that will be used in modelling the existing natural forest (age 31+) are presented in Appendix 2.

A summary of culmination values derived from VDYP is presented in Table 17.

Table 17. Culmination values for VDYP stand yield curves - thrifty

Analysis Unit	Culmination Values Age	m3/ha	DBH (cm)	MAI (m^3/ha/yr)	Minimum Harvest Age
FIRP	110	196	29.1	1.8	150[1]
FIRM	70	418	33.8	6.0	70
FIRG	70	516	36.1	7.4	70
CEDM	90	304	32.4	3.4	90
HEBM	150	212	29.7	1.4	180[1]
HEBG	100	699	33.9	7.0	100

[1] Age when 250 m3/ha is achieved

Culmination age was determined at the point when mean annual increment (MAI) maximized to one decimal place (i.e. further increases in MAI would be less that .05 m^3/ha/year). This is a reasonable approach to avoid excessively high harvest ages resulting from small increases in MAI. Culmination MAI was then determined at this age, based on volume/ha including waste and breakage. In the base case, these ages will be used as the minimum harvesting ages for existing thrifty stands, with the exception of those stands which have not reached a minimum volume of 250 m3/ha (FIRP and HEBM). In these cases, minimum harvest age was determined as the age when this volume will be achieved.

It should also be recognized that the application of cover constraints in particular zones may delay stand entry well beyond these minimum ages. This will result in realized long term harvest levels which will be lower than the theoretical Long Run Sustained Yield (LRSY), which is based on harvesting all stands at MAI culmination age. Sensitivity will be tested with 10 year increases and decreases in minimum harvest age to show the effects of changes in harvest age on harvest levels.

5.13.4.3 Future (Managed) Stand Yield Tables

In the analysis, managed future stands will be grown on yield curves developed using the MoF model WinTIPSY Version 1.3. In addition to future stands, all existing managed stands (less than 31 years old) will be modelled on managed yield curves from the outset of the planning horizon. Stands less than 31 years have been managed since establishment.

TIPSY incorporates the following inputs to derive a yield curve for each analysis unit:

Species:	species mix expected in post-harvest treated stand - Table 14 [1]
Initial density:	plantations: 1 000 trees per hectare (all harvested areas will be replanted)
Treatments:	none
Site index and OAFs:	as described in Table 14
Regeneration delay:	plantations - 2 years (delays are incorporated in forest level analysis)

[1] Species mixes are based on input from Interfor staff.

Culmination of MAI is used as the base case for minimum harvest age with the exception of those stands which have not reached a minimum volume of 250 m3/ha. In these cases, minimum harvest age was determined as the age when this volume will be achieved. Sensitivity will be run with 10 year increases and decreases in minimum harvest age to show the effects of changes in harvest age on harvest levels. Culmination values are presented in Tables 18 (a,b).

Table 18 (a). Culmination values for planted stand yield curves - mature

Analysis Unit	Base case					Adjusted site indices[1]				
	Age	m^3/ha	DBH (cm)	MAI m^3/ha/yr	Minimum Harv. Age	Age	m^3/ha	DBH (cm)	MAI m^3/ha/yr	Minimum Harv. Age
FIRP	90	212	23.6	2.4	110[2]	100	336	27.4	3.4	100
FIRM	90	485	31.1	5.4	90	80	534	32.3	6.7	80
FIRG	80	733	36.9	9.2	80	70	780	37.9	11.1	70
CEDP	130	425	29.7	3.3	130	130	425	29.7	3.3	130
CEDM	100	500	31.4	5.0	100	100	500	31.4	5.0	100
CEDG	90	801	37.6	8.9	90	90	801	37.6	8.9	90
HECP	140	166	22.2	1.2	210[2]	120	319	26.8	2.7	120
HECM	140	430	28.6	3.1	140	110	723	33.7	6.6	110
HECG	110	623	32.6	5.7	110	90	887	37.5	9.9	90
HEBP	130	176	22.4	1.4	170[2]	130	439	28.7	3.4	130
HEBM	130	361	27.5	2.8	130	110	688	33.8	6.3	110
HEBG	110	636	32.8	5.8	110	90	918	38.1	10.2	90
BALP	140	191	22.9	1.4	180[2]	140	329	26.5	2.4	140
BALM	140	417	28.3	3.0	140	130	644	32.5	5.0	130
BALG	120	714	33.6	6.0	120	100	846	36.0	8.5	100
HARD	110	601	33.0	5.5	110	n/a				

[1] See Appendix 1 for background on SI adjustments.
[2] Age when 250 m3/ha is achieved.

Table 18 (b). Culmination values for planted stand yield curves - thrifty and immature

Analysis Unit	thrifty					immature				
	Age	m^3/ha	DBH (cm)	MAI m^3/ha/yr	Minimum Harv. Age	Age	m^3/ha	DBH (cm)	MAI m^3/ha/yr	Minimum Harv. Age
FIRP	110	173	22.2	1.6	170[1]	100	187	22.7	1.9	140[1]
FIRM	80	582	33.4	7.3	80	90	665	35.4	7.4	90
FIRG	80	837	39.3	10.5	80	80	803	38.5	10.0	80
CEDP	n/a	n/a	n/a	n/a	n/a	120	354	28.0	3.0	120
CEDM	120	510	31.7	4.3	120	90	599	33.5	6.7	90
CEDG	n/a	n/a	n/a	n/a	n/a	80	846	38.5	10.6	80
HEBM	140	218	23.8	1.6	160[1]	150	338	27.0	2.3	150
HEBG	100	699	33.9	7.0	100	100	850	36.8	8.5	100

[1] Age when 250 m3/ha is achieved.

Outputs from TIPSY are presented in Appendix 3 of this data package.

5.14 Silviculture

The purpose of this section is to document the silviculture management regimes that are applied on the TFL and how these regimes are reflected in the analysis.

5.14.1 Silviculture Management Regimes

This section describes how existing analysis units are regenerated after harvesting (i.e. to which analysis unit each stand is regenerated). In the analysis of TFL 38, 80 percent of the area harvested will be planted after harvesting, with appropriate regeneration delays. The remaining 20 percent is expected to regenerate naturally, and will require fill planting and/or spacing to achieve managed stand yield objectives. Regeneration delays are not inherent in the yield curves, but are assigned in the forest estate modelling. The following regeneration delays will be incorporated into the timber supply analyses:

existing NSR: 2 years

new plantations: 2 years

No regeneration problem types were identified and included in the ESA netdown process. The 2 year delay for planted stands is used to account for any regeneration establishment problems. Sensitivity analyses will be performed to measure the impact of changing this delay.

5.14.2 Immature Managed Stands

All stands with a current age less than 31 will be assigned to managed stand yield curves, reflecting the silviculture history of the licence. Stands older than 30 years will be assigned to VDYP curves.

5.14.3 Current and Backlog Non-stocked Areas (NSR)

Non-stocked areas are defined as land that originally contained operable timber, were harvested and have not yet regenerated to commercial species. For every stand scheduled for harvest there is a target period for regeneration following harvest. Land that fails to

regenerate during this period is considered backlog. Under the Silviculture Regulations, land is not allowed to become backlog. It must be planted within the regeneration delay period if it has not regenerated naturally before that. Land that has been harvested recently, for which the regeneration delay period has not yet expired, is current NSR. Current NSR is part of the working forest and is expected to be regenerated on schedule. In the case of TFL 38, all NSR is considered to be current. For analysis purposes NSR area will be distributed among medium site analysis units, based on the area distribution of existing stands. Table 19 summarizes the projected distribution of NSR among the regeneration analysis units.

Table 19. Distribution of current NSR (net operable ha) by analysis unit

Analysis Unit	LU # 1		LU # 2		LU # 3	
	percent	hectares	percent	hectares	percent	hectares
FIRM	42	119	37	45	6	4
CEDM	8	23	20	24	9	5
HEBM	50	142	43	53	85	50
Total	100	284	100	122	100	59

5.15 Area Rehabilitation

No areas have been identified for rehabilitation and inclusion in the long-term land base.

5.16 Protection

5.16.1 Non-recoverable Losses (Unsalvaged losses)

Fire, insects, disease and other natural factors can cause catastrophic losses of whole stands of trees. Where losses occur in merchantable stands some of the dead or dying timber may be salvageable. When modelling the timber supply, the unsalvaged losses are added to the desired harvest forecast and then subtracted from the forecast upon completion of the modelling exercise. In the case of TFL 38, 20 year fire history records indicate an annual average burned area of 28 hectares over the entire TFL 38 landbase. This was converted to a volume reduction as follows:

gross burned area	x	net/total area[1]	=	net area loss	x	average vol/ha[2]	=	net loss (TFL 38)
28	x	.16	=	4.5	x	530	=	2385

(1) 35541 ha / 218616 ha (see Table 5)

(2) average mature volume/ha (see Table 15)

No figures on losses to insects are available for TFL 38. However, figures for the SOO TSA (TSR#1) indicate an annual expected loss of 4000 cubic metres on the net SOO TSA landbase of 196371 hectares. This was extrapolated to TFL 38 as follows:

Soo TSA loss	x	net area ratio (1)	=	net loss (TFL 38)
4000	x	.33	=	1320

(1) 35541 / 106371

The total expected loss is therefore 3 705 m^3 per year.

5.17 Integrated Resource Management

5.17.1 Non-Timber Resource Inventories

This section documents the status of all non-timber resource inventories. Approximate dates of completion and approvals are presented in Table 20.

Table 20. Non-Timber resource inventory status

Inventory Category	Date of Completion	Date of Approval
Landscape	1995 (original) modified in 1997	1995 modifications pending
Recreation	1995	1995
Operability	1996	pending
Wildlife	1995	completed with MoE involvement
ESA - soils	underway	

5.17.2 Forest Cover Requirements

Forest cover constraints are intended to meet specific forest cover requirements by limiting the disturbance in an area, and/or maintaining sufficient proportions of older age classes. FSSIM maintains two constraint categories:

1. A green-up constraint

   The total extent is to be maintained below a specified maximum percentage. The maximum is the upper limit. The level of disturbance may be below this maximum, but may not exceed it. The disturbance class contains the area in stands that are younger than a specified maximum age. The effect of a disturbance class constraint is to ensure that at no time will harvesting increase the area in stands younger than the maximum age above the maximum percentage permitted.

2. An old-growth constraint

   The total extent is to be maintained above a specified minimum percentage. This class contains the area in stands that are older than the specified minimum age. The effect of this constraint is to ensure that at no time will harvesting decrease the area in stands older than the minimum age below the minimum percentage permitted.

In FSSIM, multiple overlapping constraints can be applied to accommodate both RMZ-specific requirements such as green-up and thermal cover constraints, as well as landscape level biodiversity (seral stage) objectives. Both levels of constraints will be employed in the TFL 38 analysis.

5.17.3 VQO Disturbance Requirements - Rationale

Table 21 summarizes the percent denudation range for each VQO, as listed in the "Procedures for Factoring Recreation Resources in Timber Supply Analyses".

Table 21. Percent denudation range for each VQO

VQO	% denudation range for use in timber supply analyses
Retention	1-5
Partial Retention	6-15
Modification	16-25

The Lower Mainland Protected Areas RPAC recommended that, to the extent possible within the ranges permitted in the Forest Practices Code, VQO parameters should be relaxed. Therefore, base case percent denudation percentages will be the maximum values for each VQO category. In the timber analysis, these maximums will be determined base on the contribution of the entire productive forest area within each VQO RMZ.

VQO forest cover constraints will be modelled within each landscape unit / VQO zone combination. While more constraining than aggregating VQOs across landscape units, this approach has been adopted to improve the dispersion of the operable forest within the VQO unit (i.e. the smaller, more spatially contiguous VQO units will have a more homogeneous mix of operable and inoperable components).

5.17.4 Green-up Requirements - Rationale

Green-up ages will be determined based on green-up height requirements of 3 metres in the IRM zones, and 3–6 metres in VQO zones. Using the average site indices developed for each analysis unit, weighted average green-up ages were calculated for each management zone based on height over age relationships generated using FREDDIE. These were computed for both base case and adjusted site indices. The results are summarized in Table 22.

Table 22. Site index based green-up ages

Zone	base case		adjusted site indices	
	green-up height	green-up age	green-up height	green-up age
1. PR_VQO<40%	3	13	3	13
2. PR_VQO≥40%	6	19	6	19
3. Mod_VQO<40%	3	14	3	13
4. Mod_VQO≥40%	6	22	6	20
5. Moose Habitat	n/a	20	n/a	20
6. Goat Habitat	n/a	20	n/a	20
7. GM_RMZ	3	16	3	13
8. EF_RMZ	3	15	3	14

While no empirical data is available for TFL 38 to compare to these results, it is the consensus of operational staff that the calculated green-up ages are higher than observed operationally. Sensitivity analysis will be performed with green-up ages for the VQO and timber harvesting zones reduced by 3 years.

5.17.5 Landscape level Biodiversity - Rationale

The forest cover requirements used to model landscape biodiversity are based on the Biodiversity Guidebook (September 1995). Table 23 provides a summary of gross productive area by natural disturbance type (NDT), Biogeoclimatic Zone (BEC) and landscape unit (LU).

Table 23. TFL 38 biogeoclimatic zone classification

NDT	BEC	LU #1		LU # 2		LU # 3			
		ha	%	ha	%	ha	%	Total	%
1	CWH	936		0		0		936	
	MH	5598		2747		4595		12940	
	Subtotal	6534	22	2747	19	4595	28	13876	23
2	CWH	22432	75	11581	79	11520	70	45533	75
5	AT	783	3	288	2	243	2	1314	2
Total		29749	100	14616	100	16358	100	60723	100

The base case biodiversity requirements assume that low emphasis biodiversity emphasis objectives as described in the Biodiversity Guidebook will be set for each NDT/BEC/LU combination. All of the productive forest land within each landscape unit will contribute to achieving these biodiversity emphasis requirements. Table 24 shows the base case biodiversity emphasis requirements and a summary showing the current seral stage distribution of the total productive area.

Table 24. Landscape level biodiversity requirements - base case

NDT	BEC	Seral Stage Requirements			Current Level (%)		
			Age	required %	LU # 1	LU # 2	LU # 3
1	CWH	early	< 40	n/a	28	-	-
		mature + old	> 80	> 18	59	-	-
		old	> 250	> 13	41	-	-
	MH	early	< 40	n/a	7	1	0
		mature + old	> 120	> 19	88	98	91
		old	> 250	> 19	85	90	85
2	CWH	early	< 40	n/a	36	22	4
		mature + old	> 80	> 17	58	72	94
		old	> 250	> 9	50	67	85

Note: There is an insignificant amount (39 hectares) of AT in the net harvestable landbase. No specific seral stage requirements exist for this BEC. Its classification is probably the result of mapping inaccuracies in the BEC GIS overlay.

Table 25 summarizes the resource management zone cover requirements for the base case.

Table 25. Forest cover requirements - base case

Management Zone	Disturbance Class			Thermal Retention		Old-growth Retention	
	max. age	min. ht (m)	max. %	min. age	min. %	min. age	min. %
1. PR_VQO < 40%	13	3	15				
2. PR_VQO ≥ 40%	19	6	15				
3. Mod_VQO < 40%	14	3	25				
4. Mod_VQO ≥ 40%	22	6	25				
5. moose	20		30	61	20		
6. mountain goat	20		20	81	20		
7. GM_RMZ	16	3	33				
8. EF_RMZ	15	3	33				

5.17.6 Stand Level Biodiversity - Wildlife Tree Patch (WTP) Requirements

Review of Table 5 (a) indicates that 19 039 ha of productive, protected and inoperable forest surround the gross operable land base. In addition, 4 611 ha are removed from the gross operable land base specifically to further account for water buffers, and environmentally sensitive areas. As there are in excess of 23 650 ha of well distributed area, to satisfy WTP requirements, netted out of the productive and gross operable land base, it is highly likely that up to 100% of WTP requirements will be satisfied in identified areas outside of proposed cutblocks, while achieving the maximum recommended distance between WTPs of 500 metres. Furthermore, as shown in Table 5 (b), non-productive area with forest cover attributes provide an additional 7 861 ha toward achieving wildlife tree patch requirements.

The results of WTP spatial analysis conducted in consideration of the timber supply analysis demonstrated that only approximately 16 ha of operable land base was more than 500 metres away from an already constrained area. This analysis will be documented fully in Management Plan #8.

Based on the above, no yield reductions are required to allow for wildlife tree patches in the harvestable land base.

5.18 Riparian Allowances

Riparian allowances are designed to exclude harvesting from areas immediately adjacent to waterbodies, including streams, lakes, swamps and wetlands.

Stream classification for the TFL 38 timber supply analysis is based on existing information from operational plans, and the expertise of Interfor staff who have worked in the TFL 38 area. The classifications and associated stream buffer widths are summarized in Table 26.

Table 26. Stream buffer widths

Waterbody classification	Buffer (metres) each side of stream
S1	60
S2	40
S3	35[1]
S4	10[2]
S5	10[2]
S6	0

(1) The resultant buffer for S3 should be 30 metres based on the total RMA and the maximum retention. However, due to the uncertainty associated with the operational overview information, the additional 5 metre allowance, for a resultant buffer of 35 metres was made to account for the fact that a portion of the creeks classified as S3 may actually be S2.

(2) Exceed RMA requirements to account for unmapped S4-S5 streams.

To simplify the classification of wetlands and lakes, and to eliminate the need to be concerned for whether wetland complexes are less than or greater than 5 metres, all lakes, swamps and wetlands are buffered 10 metres with a 100% netdown. This adequately accounts for the RMA requirements specified in Table 2, page 24 and Table 3, page 28 of the RMA Guidebook, and the maximum retention level of 25% specified in Table 4 of the RMA Guidebook.

5.19 Timber Harvesting

5.19.1 Minimum Merchantability Standards

Minimum merchantability will be assessed for each yield curve, based on minimum volume, diameter and/or the age at which culmination of mean annual increment is reached. From this assessment, the minimum age required for harvesting will be determined for each analysis unit.

The minimum merchantability characteristics will be presented in Tables 16 to 18. Sensitivity will be run with increases and decreases in minimum harvest age.

5.19.2 Operability

As indicated in Table 20, a new operability assessment was completed in 1996 and is currently pending approval. This operability classification has been incorporated into the digital information used in the analysis of TFL 38. The operability classification was based upon a number of factors including:

- economics;
- physical accessibility;
- environmental concerns; and
- currently available harvesting systems.

The classification identifies four operability categories:

Conventional: This classification forms the basis of operability definition for TFL 38. The majority of the TFL is encompassed by this designation. These areas are both physically and economically accessible to ground-based harvesting systems. Minimum harvestable volumes are approximately 350 - 400 m^3/ha.

Helicopter: These are areas above the physical accessibility line which are available as heli-wood based on guidelines adopted by the Vancouver Region. They normally include areas with a minimum volume of 400 cubic metres/ha. Areas with lower volumes can be included based on ground sampling to ensure viability. The category excludes steep corridors along major stream channels.

Marginal: This classification includes physically accessible stands averaging 250 to 400 cubic metres/hectares.

Inoperable: These areas not considered to be economically accessible for timber harvesting.

The entire classification was meant to delineate a reasonable basis for determination of the annual harvest on TFL 38.

The database has been structured so as to permit the identification of the contribution of each operability class to the overall timber supply for TFL 38. These marginal contributions will be identified in the yield analysis. Table 27 provides a summary of net area by operability class and maturity. In addition, the mature area is broken down by volume class. The volume classes represent strata averages, not individual stand volume estimates, as the volumetric data is based on plot averages.

Table 27. Net area by operability and volume class

Volume Class	Conventional	Helicopter	Marginal	Total
350-399	381	71	209	661
400+	18382	4126	1649	24157
Total Mature	18763	4197	1858	24818
Thrifty	3533	238	70	3841
Immature	7470	15	0	7485
Total	29766	4450	1928	36144

5.19.3 Harvest Methods

Various harvest methods will be employed across TFL 38 in consideration of both harvesting and silvicultural systems. Harvesting systems will primarily involve cable equipment to remove most of the operable timber. The areas currently identified for helicopter logging represent approximately 12% of the operable area, though this percentage is likely to increase as a result of additional constraints being placed on the conventional harvest. The use of different conventional silvicultural systems is evolving from previous large scale clearcuts to current prescriptions that include variations on 'clearcut with reserves' and patchcuts. Cut block size will vary on a site-specific basis, with the average conventional opening to be 25 hectares in size.

5.19.4 Initial Harvest Rate

The initial harvest rate for the analysis is 235 000 cubic metres/year. In addition, an allowance of 3 250 cubic metres must be made for the estimate for non-recoverable losses (see Section 5.16.1).

Net harvest:	235 000 m^3/year
Losses:	3 705 m^3/year
Total harvest + losses:	238 705 m^3/year

As the timber supply analysis is based on the net harvest plus non-recoverable losses, the initial gross harvest level for the current management strategy option is 238 705 m^3/year. This will be rounded to 238 700 m^3/year for input into FSSIM. This gross harvest level will provide a starting point for the analysis. However, as a result of changes in the initial operable landbase, combined with the effect of currently defined cover constraints, this level may subsequently be adjusted up or down to achieve harvest flow objectives over the entire planning horizon.

5.19.5 Harvest Rules

Harvest rules are used by the simulation model to rank stands for harvest. The standard rule is oldest first. With this rule, older stands are queued for harvest ahead of younger stands. Harvest rules interact with forest cover constraints to determine the actual order of harvesting within the model. If a higher ranked stand is in a constrained zone and cannot be harvested then the model will choose the next highest ranked stand that can be harvested.

5.19.6 Harvest Flow Objectives

In all phases of the analysis, the harvest flow will reflect a balance of the following objectives:

- maximize short term levels;
- limit shifts in harvest level to less than 10% of the level prior to the shift;
- do not allow the harvest level to drop below the long-term harvest level;
- achieve a long term stable harvest level; and
- harvest proportionately from each operability class.

Forest cover constraints and biological capacity of the net operable landbase will dictate the harvest level. If opportunities exist to increase the harvest at given points during the 250 year planning horizon, these opportunities will be taken.

6. Enhanced Forestry Option

As stated in Section 2, these analyses will focus on the opportunities to affect short and long-term timber supply through enhanced silviculture, protection, operability and different silviculture systems on all, or portions of the TFL.

The opportunities have been grouped into three categories:

1. Currently implementable
   - yield increases from genetically improved planting stock
2. Feasible pending verification
   - higher yields from existing mature stands
   - higher yields from managed stands
   - commercial thinning opportunities
   - increased access to ESAs and buffers through non-conventional harvesting
3. Require development prior to implementation
   - fertilization gains

Only the first category will be addressed quantitatively in terms of timber supply impacts. Managed stand yield curves will employ the site index adjustments for all species.

These opportunities, in combination with some of the current management strategies, represent a package of incremental activities which have a positive impact on timber supply. Management Plan #8 will develop a collective strategy for an Enhanced Forestry Program to show how these opportunities can be realized.

In addition, as other opportunities become apparent, they will be evaluated and incorporated into the management strategy as they are determined to be operationally feasible.

Timber Supply Analysis Information Package
For Tree Farm Licence #38
Appendices

International Forest Products Ltd.
Management Plan #8

Appendix 1. Site Index Adjustments

The following is a summary of the methodology used by J.S. Thrower and Associates to adjust site indices for the sensitivity analyses.

1. Methods

1.1 Overview

The basis for developing estimates for post-harvest regenerating (PHR) stands in TFL 38 was related to the strength of information available for Douglas-fir (Fd) for the same ecological conditions as in the TFL. The average site index for Fd in PHR stands was estimated from over 200 plots with reliable data from the MoF provincial SIBEC and PSP programs. The average site index for western hemlock (Hw) was estimated using the conversion equation developed by the MoF Research Branch and Gordon Nigh. Site indices for balsam fir (Ba) and western red cedar (Cw) were then estimated as 2. 0 metres lower than for Hw. These are conservative estimates based on our field experience in observing the relationship between the site index of Hw, Ba, and Cw.

No data were available to estimate the site indices for Hw and Ba for the higher elevation areas and thus estimates were derived from the opinions and experience of three expert ecologists with knowledge of the ecological conditions of the area.

1.2 Data Sources

The best source of data to describe the site index is to measure managed stands on the TFL. However, currently there are no survey data available for this area. Therefore, the next best alternative source of information is to base estimates of site index for managed stands in TFL 38 from nearby areas with similar ecological characteristics. The best available information to our knowledge are estimates of average site index from the MoF Provincial SIBEC data base and the Resources Inventory Branch Permanent Sample Plot (PSP) program.

1.3 CWH Biogeoclimatic Zone

1.3.1 Douglas-fir

The most reliable site index data for the CWHms1 and CWHds1 subzones are for Fd for the CWHms1. The Provincial SIBEC database estimates the site index of Fd as 22.5 m (ranked as high reliability), and the provincial PSP database estimates the average for Fd as 23.2 m from 94 plots. These estimates are very consistent and should be highly reliable considering the large number of plots in computing these averages. The arithmetic average of these two estimates is 22.85 m, or rounded to 23 m for Fd in the CWHms1.

For the CWHds1, the estimates are similar but slightly higher. The provincial SIBEC database estimates the average site index for Fd as 23.9 m (ranked as medium reliability), and the provincial PSP database estimates the average as 25.4 m from 118 sample plots. The arithmetic average of these two estimates is 24.65 m for Fd in the CWHds1 (rounded to 25 m). These estimates are consistent with our expectation of the overall average for Fd in these subzones.

1.3.2 Hemlock

There are fewer data available for Hw than for Fd. Therefore, we recommend estimating the average site index for Hw in the CWHms1 and CWHds1 using the site index conversion equations developed by the MoF Research Branch and Gordon Nigh. The basis for the Hw prediction is the strength of the data and the resulting confidence in the Fd estimates. The site index of Hw is closely related to the site index of Fd on average, and thus having a good estimate for one species provides the information to predict the site index of the other. Our field observations are that on average, the site index of Hw is generally lower than Fd growing on the same site by about 2 - 5 m. This is confirmed in the MoF Research Branch conversion equations that predict the average site index of Hw from the site index of Fd as:

$$SI\ (Hw) = -0.432 + 0.899\ SI\ (Fd)$$

This equation predicts the average site index for Hw in the two major subzones in the TFL as:

CWHds1: $SI\ (Hw) = -0.432 + 0.899\ (25) = 22$ m

CWHms1: $SI\ (Hw) = -0.432 + 0.899\ (23) = 20$ m

In both subzones, the estimated average site index for Hw is 3 m lower than for Fd.

1.3.3 Cedar and Balsam

We recommend that the site index for cedar and balsam is related to the site index of Hw. This is based on our field observations that the site index of Ba and Cw is generally slightly lower than Hw. For many sites the site index for Ba is the same and sometime higher than Hw. However, in the range of an average Hw site index of 20-22 m the site index for balsam should be slightly lower. The site index of Cw also varies in relation to Hw and depends on ecological conditions. Thus, in these subzones and in this range of average Hw site index we recommend using a site index for Cw and Ba that is 2.0 m lower than for Hw. This is probably a conservative estimate but reflects the uncertainty of the methods.

1.4 MH Biogeoclimatic Zone

There is very little information on the productivity of managed stands in the MH zone. Thus, estimates for the average site index for Hw and Ba in this area were derived through consultation from three expert ecologists, including Karl Klinka, Bob Green, and Allan Banner (see previous report). These experts suggested the average should be 12 m for Hw and 11 m for Ba in these higher elevation areas on the TFL.

2. Results

2.1 PHR Site Indices

The following summarizes our recommendations for site indices to use in an alternate scenario to the Base Case in the upcoming timber supply analyses for TFL 38.

1. Site indices for Fd were based on reliable estimates for averages in the CWHms1 and CWHds1 from MoF data in the same BGC subzone from the SIBEC and PSP databases.

2. The average site index for Hw was estimated using site index conversion equations developed by the MoF Research Branch and Gordon Nigh. Estimates for Cw and Ba were related to the Hw estimates based on our field experience and observations of these relationships.

3. Estimates for Hw and Ba in the MH were developed through consultation with three expert ecologists.

BGC Subzone	Species	Recommended SI	Weighted Average SI	Correction	Information Source
CWHms1	Fd	23	21.1	1.9	MoF PSP and SIBEC data base
	Hw	20	13.0	7.0	MoF Conversion Equations
	Ba	18	13.0	5.0	Field experience
	Cw	18	17.8	0.2	Field experience
CWHds1	Fd	25	21.6	3.4	MoF PSP and SIBEC data base
	Hw	22	14.8	7.2	MoF Conversion Equations
	Ba	20	16.4	3.6	Field experience
	Cw	20	19.8	0.2	Field experience
MHmm2	Hw	11	10.2	0.8	Expert opinion
	Ba	12	11.1	0.9	Expert opinion

The average values were compared with the weighted average inventory site index for all mature polygons in each BEC / species combination in order to arrive at adjustments. These adjustments were applied to site index values used to determine regeneration in TIPSY yield tables for each currently mature analysis unit. No adjustments were applied to existing VDYP yield estimates, or to regenerating TIPSY yield tables for stands currently in the thrifty and immature analysis units. Adjusted yield curves will not be employed in the base case analysis.

Appendix 2. VDYP Yield Tables

This appendix contains the following information:

1. A listing of the AU_CURVE.IOD file specifying the VDYP input and output parameters.

2. A listing of the VDPARAMS.IN file specifying the parameter values for each analysis unit.

3. A listing of the VDYP.ERR file.

4. A listing of the VDYP.OUT file listing gross and net Volume/ha (17.5 utilization), MAI, and average DBH and height. For each curve the culmination point is flagged(****), which forms the basis for minimum harvest age in the base case.

Appendix 3. TIPSY Yield Tables

This appendix contains the final mixed species TIPSY curves developed for each yield scenario. VOL/HA, MAI and DBH values represent weighted averages developed by combining single species TIPSY runs. For each curve the culmination point is flagged(****), which forms the basis for minimum harvest age in the base case.