

TFL 1

Timber Supply Analysis Information Package

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TABLE OF CONTENTS

- 1.0 INTRODUCTION1**
- 2.0 OPTIONS AND SENSITIVITY ANALYSIS1**
- 3.0 ANALYSIS MODEL2**
- 4.0 LANDBASE ASSUMPTIONS4**
 - 4.1 Forest Cover Inventory4
 - 4.2 Timber Harvesting Landbase Determination.....4
- 5.0 FOREST MANAGEMENT ASSUMPTIONS.....9**
 - 5.1 Management Zones9
 - 5.2 Analysis Units11
 - 5.3 Detailed Timber Harvesting Landbase.....11
- 6.0 GROWTH AND YIELD14**
 - 6.1 Yield Table Development14
 - 6.2 Weighted Average Species Composition and Site Index14
 - 6.3 Site Index Assignment15
 - 6.4 Utilization Level15
 - 6.5 Silviculture Management Regimes16
 - 6.6 Regeneration Assumptions17
 - 6.7 Existing Managed Immature18
 - 6.8 Not Satisfactorily Restocked Areas (NSR)19
 - 6.9 Unsalvaged Losses19
- 7.0 INTEGRATED RESOURCE MANAGEMENT.....20**
 - 7.1 Forest Resource Inventories20
 - 7.2 Forest Cover Requirements.....20
 - 7.3 Wildlife Tree Patches22
 - 7.4 Timber Harvesting23
 - 7.5 Operability/ Harvest Methods.....24
 - 7.6 Initial Harvest Rate.....24
 - 7.7 Harvest Rules24
 - 7.8 Harvest Profile25
 - 7.9 Harvest Flow Objectives.....25

LIST OF TABLES

Table 1: Proposed sensitivity analysis	1
Table 2: Timber harvesting landbase determination	4
Table 3: Non-forest areas	5
Table 4: Non-productive forest areas	5
Table 5: Inoperable classes	6
Table 6: Non-commercial areas	6
Table 7: Low site areas	6
Table 8: Excluded deciduous areas	7
Table 9: Problem forest types	7
Table 10: Environmentally sensitive areas	7
Table 11: Alpine Tundra areas	7
Table 12: Reductions for riparian reserves and management zones	8
Table 13: Reductions for specific geographically defined areas	8
Table 14: Reduction for mountain goat winter range	8
Table 15: Reduction for NSR	9
Table 16: TFL 1 Management Zones	10
Table 17: Analysis unit definitions	11
Table 18: THLB area by analysis unit and 10 year age class	12
Table 19: THLB volume by analysis unit and 10 year age class	13
Table 20: Analysis unit attributes	15
Table 21: Utilization levels	15
Table 22: Silviculture management regimes	16
Table 23: Regeneration assumptions	17
Table 24: Immature management history	18
Table 25: NSR distribution	19
Table 26: Resource inventory status	20
Table 27: Green-up cover constraints by management zone	20
Table 28: Old seral stage constraints	21
Table 29: Wildlife Tree Patches	22
Table 30: Minimum harvest age	23
Table 31: Timber harvesting landbase and harvest methods	24
Table 32: Historic harvest profile	25

APPENDICES

Appendix 5-1: Existing and Managed Stand Yields

1.0 INTRODUCTION

This Timber Supply Analysis information package describes calculations of the timber harvesting landbase, analysis methods and input for various long term harvest scenarios for Tree Farm Licence 1 (TFL 1) in support of Management Plan 10. This information represents current forest management within TFL 1.

The main sections in this report are:

1. Options and sensitivity analysis
2. Model features
3. Landbase assumptions
4. Forest management assumptions
5. Growth and Yield
6. Integrated Resource Management

Main sources of information include: 1998 TFL 1 timber supply analysis, the Kalum Land and Resource Management Plan 2002 (LRMP), and the Kalum Timber Supply Area Analysis Report, March 1999.

2.0 OPTIONS AND SENSITIVITY ANALYSIS

The net timber harvesting landbase (THLB) includes conventional and non-conventional operable areas. Basecase management models the silviculture and harvesting systems in current use, existing legislation, and the current strategic planning environment. The management assumptions are therefore structured to be consistent with the Forest Practices Code, the Kalum LRMP, and the defined LRMP management zones. Area reductions and constraints are applied as defined in the next sections.

Sensitivity analysis is done to assess uncertainty in data and assumptions. During the analysis, more issues that require sensitivity analysis may become apparent. Table 1 describes the analyses proposed for the timber supply analysis. Site index adjustment is described in the timber supply analysis report.

Table 1: Proposed sensitivity analysis

Option	Description
I	Unadjusted inventory-see section 4.1
	1. no OGSI adjustment
	2. base OGSI adjustment
II	VRI adjusted inventory- base OGSI adjustment
	1. base
	2. 10% THLB increase
	3. 10% THLB decrease
	4. 10% volume increase
	5. 10% volume decrease
III	VRI adjusted inventory-SI adjustment options
	1. no OGSI adjustment
	2. 5m SI adjustment AUs 4 & 5
	3. 10m SI adjustment AUs 4 & 5
	4. veteran study SI adjustment
IV	Current landbase with MP9 management assumptions, yield curves, and operability

3.0 ANALYSIS MODEL

TREEFARM version 6.5, a forest estate model proprietary to Sterling Wood Group, will be used for this timber supply analysis. TREEFARM simulates the growth, harvesting, and silvicultural treatment of a forest estate on an annual basis, with results summarized by decade.

TREEFARM was first developed in 1979 and has undergone regular additions and upgrades. It has been used for a variety of industrial and government clients since 1984. Its use for tree farm licence allowable cut calculations was approved by the MOF in 1986. The model is written in the programming language 'C'.

The initial inventory data determines the net landbase. The landbase is stratified into analysis units which may be defined by forest type, site, silvicultural treatment, user allocation or resource protection category. TREEFARM can accommodate a large number of analysis units. Each analysis unit is further broken down into age classes.

A feature of TREEFARM is the subdivision of the forest estate according to silvicultural treatment. At all times the unmanaged and untreated, planted, spaced, fertilized, spaced and fertilized and partially cut areas are visible. Initial inventory summaries are also organized in this way.

TREEFARM does not require that inventory age classes be the same width as the time period used in harvest projections. For example, 20-year inventory age classes and five-year time periods are possible. In addition, inventory age classes need not be uniform. For example, an age class sequence of 1-20 years, 21-35 years, 36-80 years, 80-110 years, 111-150 years and 150-200 years will work in TREEFARM. TREEFARM can use up to 30 age classes.

Harvesting rules determine which areas in the present and future forest inventories are candidates for harvest. The harvesting rules influence the harvest schedule but do not specify it. The harvest schedule is specified by the harvesting algorithm in the forest estate model.

The TREEFARM harvesting inputs are:

- the total annual harvest required during each time period;
- the present-day harvest profile by forest type and age class;
- the minimum harvest volume per hectare, stand average diameter (dbh), and age;
- the ranking of forest types in order of preference for harvest;
- the ranking of silvicultural management types in order of preference for harvest;
- forest cover constraints and green-up periods for groupings of analysis units which are specified by the user.

A selected subset of harvesting rules may be determined for any given run.

TREEFARM allows the user to model cover constraints and green-up periods in a variety of ways. At the most detailed level, a separate cover constraint and green-up period for each forest type/silvicultural treatment combination can be identified. For example, natural hemlock stands can have different constraints and green-up periods than planted and spaced hemlock stands. Similarly, constraints can be applied to a group of forest types or silvicultural treatment types, or to different visual quality objectives (VQOs) or other resource zones. In every case the ability is retained to have a range of rotations as long as the overall cover constraint and green-up period for each forest type or zone is satisfied. In other words, both silvicultural programs and cover constraints can be modelled concurrently, and the amount of future harvests can be identified by silvicultural treatment within each resource zone. In addition, future harvest schedules are identified by management zone.

Cover constraints can be applied to a minimum or a maximum age. Examples are: up to 15% of a particular zone or analysis unit can be less than 20 years old; and 20% must be greater than 150 years old. Minimum and maximum age constraints may be applied singly or in combination.

Partial cutting of various kinds may be applied. Examples are: commercial thinning, shelterwood systems, or true all-aged selection cutting. The intensity of removals for a given system may be varied at each cutting cycle. Areas currently not under partial cutting systems may be converted to partial cutting. Using partial cutting systems requires the user to supply the appropriate yield tables.

TREEFARM usually is set to begin with the current harvesting profile. Over time the model departs from the starting profile in a systematic manner as the standing timber inventory changes. Technically any starting harvest profile may be provided to the model. If required a specific harvesting profile can be in force over the entire planning horizon.

TREEFARM includes a powerful three-stage harvesting algorithm. This produces many rotations for different forest type/resource zone combinations. TREEFARM can cut to a fixed profile, cut oldest first or cut to a combination of oldest first and species requirements. In most simulations a mix of all three types of harvest takes place.

For each time period the timber production objective is supplied to the model. When harvesting, TREEFARM will try to reach the objective but if this cannot be done in any time period it will get as close as it can without breaking any of the harvesting rules. Constant, declining, increasing, and fluctuating series of timber production targets are all possible.

A specific desired harvest schedule is reached by running the model, inspecting the results and re-running. This cycle is repeated several times. Maximum even-flow harvests are achieved in the same way.

To qualify for harvest, a stand must reach the given minimum volume, average dbh and age. Even then it cannot be cut if resource zone cover constraints and green-up objectives are not satisfied.

TREEFARM can analyze many different silvicultural treatment regimes. Complete silvicultural programs involving planting, spacing, fertilization, thinning and rehabilitation of not sufficiently restocked (NSR) area can be constructed and included as part of the input file. Each part of the forest estate, treated and untreated, can be reported on separately. The future growing stock and future harvests from untreated areas, plantations, spaced, fertilized, spaced and fertilized areas are reported on specifically. Responses and harvest gains from incremental silviculture show up not only in the total harvest but in the harvest from the treated areas. TREEFARM can show harvest by silvicultural treatment type. The changing nature of the forest estate due to harvesting and silvicultural practices is very clearly shown.

Silvicultural programs can be targeted as analysis unit/site class combinations. For example, the proportion of Douglas-fir areas planted after logging can be different from the proportion of logged hemlock areas which are planted. The forest type regenerated after logging can be different from the forest type which was logged. NSR areas from past logging can be re-claimed during a model run.

Changes to the landbase are included in three ways. The first is by applying net down logic to the inventory file to produce a net landbase in a process completely independent of TREEFARM. Changing the net down logic will change the net landbase. The second is by applying factors such as for accessibility during a model run. The third way is to prepare detailed area summaries of the areas to be added or subtracted. TREEFARM looks for area summaries to be added to or subtracted from the landbase at the beginning of the first six time periods. Given the same input data as the MoF model FSSIM, TREEFARM will produce similar results.

All forest practice code requirements are accommodated either in the timber harvesting landbase determination or by TREEFARM, including: adjacency and green-up; riparian zones; stand and landscape level biodiversity. These items are further discussed in the following sections.

4.0 LANDBASE ASSUMPTIONS

4.1 FOREST COVER INVENTORY

The re-inventory completed in 1992 has attributes projected to December 2001 and silviculture history and labels updated to December 31, 2001. The inventory meets MOF standard inventory specifications. The classification of second growth forest cover types has been updated based on the vegetation resources inventory (VRI) project which involved sample plot establishment in 2001, and final compilation in 2003 (see TFL 1 Vegetation Resources Inventory Adjustment report, available with final timber supply analysis report). This project resulted in age, height, and site index adjustment for forest stands currently aged 30 to 110, and age and height adjustment for stands 10 to 29 years, excluding stands with silviculture plot information. The updated attributes are used in the timber supply analysis for the current stand attributes. As noted, a sensitivity analysis will be run with unadjusted attributes. Site index adjustment is further discussed in the growth and yield section.

4.2 TIMBER HARVESTING LANDBASE DETERMINATION

The following table shows the area reductions applied to determine the net timber harvesting landbase for schedule A and schedule B lands. Landbase reductions are made in the order listed in this table.

Table 2: Timber harvesting landbase determination

DESCRIPTION	Area Schedule A ha	Area Schedule B ha	Total Area ha	Volume Schedule A m ³	Volume Schedule B m ³	Total Volume m ³
Total land base	635	517662	518297	127380	86968768	87096148
Non-forest	92	273951	274042	929	1926847	1927776
Non-productive forest	12	14864	14876	0	656543	656543
Total productive forest	532	228847	229379	126451	84385378	84511829
Less:						
Inoperable	64	118936	119001	25468	48050936	48076404
Non commercial	0	87	87	0	0	0
Low site	0	2950	2950	0	1085624	1085624
Deciduous	28	1430	1459	1741	81544	83285
Non-merchantable	8	1492	1500	1406	326277	327683
ESAs	0	5519	5519	0	2903618	2903618
Alpine Tundra	0	112	112	0	59613	59613
Riparian zones	23	2530	2553	2934	630137	633071
Specific geographically defined area	10	906	915	2448	545123	547571
Goat winter range	0	1102	1102	0	536226	536226
Unclassified roads, trails and landings	5	2054	2059	55	26027	26082
NSR	11	2929	2940	0	0	0
Wildlife tree patch	25	2501	2526	5758	1019253	1025011
Total Current Reduction	176	142547	142723	39810	55554459	55594269
Initial Timber Harvesting Land Base	355	86301	86656	86641	28830919	28917560
Additions:						
NSR	11	2929	2940			
Total Additions	11	2929	2940			
Current Timber Harvesting Land Base	366	89230	89596	86641	28830919	28917560

DESCRIPTION	Area Schedule A ha	Area Schedule B ha	Total Area ha	Volume Schedule A m ³	Volume Schedule B m ³	Total Volume m ³
Future Reductions:						
Future roads, trails, landings	17	3418	3435			
Future Timber Harvesting Land Base	349	85812	86161			

*numbers may not add up exactly due to rounding

Definitions and excluded areas are as follows. Total netdown areas in the following tables may differ slightly due to rounding.

1. Total landbase: the entire area of TFL 1. The 1998 total landbase was 610,691 ha, a difference of 92,394 ha. This area is accounted for by removal of the Nisga'a area from the TFL and a new TFL boundary provided by the MOF since the 1998 analysis.
2. Non-forest: the following non-forest types are 100% excluded from the THLB.

Table 3: Non-forest areas

Description	Total area ha	Area removed in netdown step ha
NTA- no typing available	3904	3904
Classified roads, trails, landings	3887	2005*
Alpine	239581	239581
Alpine forest	13600	13600
Gravel bar	428	428
Gravel pit	3	3
Lakes	1201	1201
Rock	1458	1458
River	5389	5389
Swamp	5248	5248
Urban	1225	1225
Total	275924	274042

*1882 ha of classified road overlaps with other non-forest types

3. Non-productive forest: the following non-productive types are 100% excluded from the THLB.

Table 4: Non-productive forest areas

Description	Total area ha	Area removed in netdown step ha
NP	6447	6426
NPBR	8312	8291
NPBU	160	160
Total	14919	14876

4. Inoperable: The productive forest area is classified into operability classes based on combinations of accessibility, harvesting systems, and merchantable volume. The landbase was reclassified for operability in 2002 with the following inoperable areas 100% excluded from the THLB.

Table 5: Inoperable classes

Class	Total area ha	Total productive area ha	Area removed in netdown step ha
Conventional low volume	11506	11233	11233
Inoperable	393403	107767	107767
Total	404909	119000	119000

Conventional low volume areas were determined in the 2002 total chance planning to be unavailable for harvesting due to insufficient volume at maturity, defined as volume less than 250 m³/ha. Inoperable areas are defined as not suitable for harvesting due to a combination of low volume, very poor quality, or inaccessibility. Inoperable areas do not include alpine forest. Volume per hectare was used only as a general guideline for viability when operability was being determined. Operability designations are also based on local knowledge of site conditions and wood quality.

5. Non-commercial: the following non-commercial types are 100% excluded from the THLB.

Table 6: Non-commercial areas

Description	Total area ha	Total productive area ha	Area removed in netdown step ha
NC	17	17	17
NCBR	458	456	70
Total	475	473	87

6. Low site: the following leading species-fiz-site index combinations are considered not suitable for harvest due to low timber growing potential, and are 100% excluded from the THLB.

Table 7: Low site areas

Leading species	FIZ	Site Index m, age 50	% reduction	Total area ha	Total productive area ha	Area removed in netdown step ha
Balsam	A	<6.5	100	157	36	0
Balsam	J	<6.5	100	5350	1369	21
Cedar	A	<8.5	100	0	0	0
Cedar	J	<9.0	100	47	26	2
Hemlock	A	<7.0	100	2025	653	47
Hemlock	J	<7.5	100	32872	25703	2868
Spruce	A	<3.0	100	0	0	0
Spruce	J	<5.0	100	23	9	5
Pine	A	<8.5	100	0	0	0
Pine	J	<9.5	100	175	115	0
Cottonwood	A	<8.0	100	1	1	0
Cottonwood	J	<7.0	100	8	8	7
Total				40659	27921	2950

Source: Kalum Timber Supply Area Analysis Report, March 1999

7. Deciduous: all deciduous except cottonwood is 100% excluded from the THLB as follows.

Table 8: Excluded deciduous areas

Inventory Type Group	Total area ha	Total productive area ha	Area removed in netdown step ha
37 - 42	2063	2026	1459
Total	2063	2026	1459

8. Non-merchantable: the following problem forest types are 100% excluded from the THLB.

Table 9: Problem forest types

Species	Description	Total area ha	Total productive area ha	Area removed in netdown step ha
All	Age > 100 and height < 22m or age > 60 and crown closure < 25 or age > 100 and volume < 250m ³ /ha	6510	6478	1500
Total		6510	6478	1500

Source: Kalum Timber Supply Area Analysis Report, March 1999

9. Environmentally sensitive areas: ESAs have been evaluated for TFL 1 and are included in the inventory landbase. The ESAs identified for exclusion from the THLB are listed in the following table: Ea-avalanche areas; Es-areas with unstable soils that may deteriorate unacceptably after harvesting; Ep-areas where regeneration will likely be difficult; and Er-areas with high recreation features. ESA categories are either 1-high sensitivity or 2-moderate sensitivity. Percent reductions are based on the March 1999 Kalum Timber Supply Area Analysis Report. Wildlife management areas identified in the LRMP replace the previous Ew designations.

Table 10: Environmentally sensitive areas

ESA Category	% reduction	Total area ha	Total productive area ha	Operable area ha	Area removed in netdown step ha
Ea1	100	158	144	21	21
Ep1	100	42028	31768	2440	1608
Er1	100	0	0	0	0
Es1	50	10809	10097	1961	882
Esa1	100	15	0	0	0
Esp1	100	19616	12666	504	365
Ep2	50	5426	4986	838	257
Es2	30	48631	43826	9070	2323
Esp2	50	1978	1961	138	63
Esr2	30	1	1	0	0
Total		106366*	88115*	14105*	5519

* individual areas do not add up to total area because some areas have both high and moderate ESA classifications.

10. Alpine Tundra: areas in the alpine tundra biogeoclimatic zone are 100% excluded from the THLB.

Table 11: Alpine Tundra areas

Description	Total area ha	Total productive area ha	Area removed in netdown step ha
Alpine Tundra	123923	3870	112
Total	123923	3870	112

11. Riparian zones: riparian reserve and management zones are spatially defined in the TFL 1 inventory. The following reductions are made to the THLB for these zones.

Table 12: Reductions for riparian reserves and management zones

Description	% reduction	Total area ha	Total productive area ha	Area removed in netdown step ha
Reserve Zone	100	20158	9041	1952
Management Zone	10	56644	23596	600
Total		76802	32637	2553

12. Specific geographically defined areas: the Upper Kitsumkalum and the Lakelse River Subzone 1 are identified as no logging zones in the Kalum Land and Resource Management Plan, 2002. These areas are excluded from the THLB as follows.

Table 13: Reductions for specific geographically defined areas

Description	% reduction	Total area ha	Total productive area ha	Area removed in netdown step ha
Upper Kitsumkalum	100	22399	6854	843
Lakelse River Subzone 1	100	172	152	73
Total		22571	7006	915

13. Ungulate Winter Range- Mountain Goat: a no timber harvesting zone has been established by the Kalum LRMP 2002 for goat winter range. Per personal conversation with the biologist that prepared the Mountain Goat Winter Range inventory (Brad Pollard, R.P.Bio), 82% of the identified goat winter range is unavailable for timber harvesting and has been excluded from the THLB as follows.

Table 14: Reduction for mountain goat winter range

Description	% reduction	Total area ha	Total productive area Ha	Area removed in netdown step ha
Goat winter range	82%	17513	10998	1102
Total		17513	10998	1102

14. Unclassified roads, trails, and landings: existing unclassified roads, trails and landings are defined for TFL 1 as 6% of the current productive stands available for harvesting, ≤ 35 years old. This reduction is made in addition to the spatially defined classified roads, trails and landings accounted for in the non-forest reductions. The total reduction is 2059ha.

15. NSR: not satisfactorily restocked areas do not currently contain sufficient stocking of acceptable trees, and are identified in the TFL inventory. These areas are excluded from the initial THLB, and are added back to the current THLB after a specified delay (see section 6.8).

Table 15: Reduction for NSR

Description	% reduction	Total area ha	Total productive area ha	Area removed in netdown step ha
Current NSR	100%	3948	3881	2940
Total		3948	3881	2940

16. WTPs: Wildlife tree patches were calculated using Table A3.1 of the Landscape Unit Planning Guide, March 1999. Draft landscape units and landscape unit objectives are incorporated into the timber supply analysis. Biogeoclimatic subzones with area available for harvest include the CWHws, ICHmc, and MHmm. From Table A3.1, 15 combinations of subzones and landscape units require wildlife tree retention between 1% and 10% of cutblocks. A total area of 7894ha is calculated for WTP requirements, with 32% of the area, 2526 ha, excluded from the THLB.
17. Future roads, trails and landings: reductions are made for future roads, trails and landings after the stands are harvested for the first time by the simulation model. A total area of 3435ha will be deducted from the current THLB as harvesting proceeds. This reduction is applied to stands currently greater than 35 years old, and is 6% of the harvest area.

5.0 FOREST MANAGEMENT ASSUMPTIONS

5.1 MANAGEMENT ZONES

The timber harvesting landbase is divided into management zones based on forest management objectives, consistent with the Kalum Land and Resource Management Plan, 2002. GIS coverages were used to define the following management zones for TFL 1.

Table 16: TFL 1 Management Zones

Management Zone	Characteristics	Productive forest area ha	Timber harvesting landbase ha
General	All areas not assigned to one of the other management zones.	149275	61,664
Lakelse River	LRMP, subzone 1 excluded from the timber harvesting landbase. No subzone 2 within landbase.	152	0
Upper Kitsumkalum	LRMP, excluded from the timber harvesting landbase.	6854	0
Mountain Goat winter range	LRMP, 82% excluded from the timber harvesting landbase.	10998	241
Copper watershed/ Grizzly Bear	LRMP, additional seral stage requirements. Critical grizzly patch habitats accounted for in the timber harvesting landbase determination.	22776	9237
Moose winter range	LRMP, includes Beaver, Nass, Skeena, and isolated primary and secondary zones. No green-up or biodiversity requirements in addition to General Management Zone.	19201	9253
Backcountry recreation	LRMP, no green-up or biodiversity requirements in addition to General Management Zone.	841	133
Miligit Valley	LRMP, within the Upper Copper special management zone. Portion included in the partial retention VQO zone, otherwise no green-up or biodiversity requirements in addition to General Management Zone. Sensitive area accounted for in the timber harvesting landbase determination.	421	175
Retention VQO zone	LRMP, includes 29ha of VQO preservation, and retention area in the Kiteen-Cedar low level pass retention area. Additional green-up constraints.	6200	1610
Partial retention VQO zone	LRMP, additional green-up constraints. Includes partial retention areas identified in the Miligit special management zone and the Kiteen-Cedar low level pass area.	18611	9043

* management zones overlap, therefore total productive forest and THLB areas do not add up to landbase determination totals

5.2 ANALYSIS UNITS

Individual forest stands are grouped into analysis units as defined below. Each analysis unit is associated with existing stands and regenerated stands yield tables. Analysis units are independent of management zones. Site classes are described in section 6.

Table 17: Analysis unit definitions

Analysis Unit	BEC zone	FIZ (for MH stands)	Leading species	Inventory Type Group	Site class	Age class	Current timber harvesting landbase (ha)
1	CWH	n/a	hemlock, cedar	9 – 17	1, 2	All	3331
2	CWH, MH	A	hemlock, cedar	9 – 17	3	1 – 7	14997
3	CWH, MH	A	hemlock, cedar	9 – 17	4	1 – 7	2796
4	CWH, MH	A	hemlock, cedar	9 – 17	3	8, 9	4046
5	CWH, MH	A	hemlock, cedar	9 – 17	4	8, 9	29667
6	CWH, MH	A	balsam	18 - 20	1, 2	All	1602
7	CWH, MH	A	balsam	18 - 20	3	All	6958
8	CWH, MH	A	balsam	18 - 20	4	All	3644
9	CWH	n/a	spruce	21 - 26	1 – 4	All	1246
10	CWH	n/a	pine	28 – 31	2 – 4	All	2577
11	CWH	n/a	cottonwood	35 - 36	2 – 4	All	626
12	ICH, MH	J	hemlock, cedar	9 – 17	2, 3	1 – 7	4511
13	ICH, MH	J	hemlock, cedar	9 – 17	4	1 – 7	775
14	ICH, MH	J	hemlock, cedar	9 – 17	3	8, 9	704
15	ICH, MH, ESSF	J	hemlock, cedar	9 – 17	4	8, 9	6420
16	ICH, MH	J	balsam	18 - 20	2, 3	All	1003
17	ICH, MH, ESSF	J	balsam	18 - 20	4	All	2544
18	ICH, MH	J	spruce	21 – 26	1 – 4	All	375
19	ICH, MH	J	pine	28 – 31	2 – 4	All	1492
20	ICH, MH	J	cottonwood	35 - 36	1 – 4	All	283
Total							89596

5.3 DETAILED TIMBER HARVESTING LANDBASE

The following tables show the THLB area and volume summaries by analysis unit and 10 year age classes.

Table 18: THLB area by analysis unit and 10 year age class

age/ AU	0- 10	11- 20	21- 30	31- 40	41- 50	51- 60	61- 70	71- 80	81- 90	91- 100	101- 110	111- 120	121- 130	131- 140	141- 150	151- 160	161- 170	171- 180	181- 190	191- 200	201- 210	211- 220	221- 230	231- 240	241- 250	>250	total ha	
1	62	769	155	1013	1175	148	0	1	0	7	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	3332	
2	2628	4051	3834	3297	719	46	4	12	26	89	4	242	24	12	0	0	0	0	0	0	0	0	0	0	0	0	14988	
3	348	60	152	1317	725	2	3	6	0	0	0	69	75	39	0	0	0	0	0	0	0	0	0	0	0	0	2795	
4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	122	22	5	0	22	79	0	26	0	351	18	3402	4045	
5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	48	48	59	174	4	73	76	433	22	293	59	28377	29666	
6	66	159	108	433	606	224	5	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1602	
7	2905	1496	672	1059	368	75	0	0	0	1	0	4	0	0	0	0	0	0	0	0	0	0	0	57	0	319	6958	
8	305	580	343	136	0	0	0	0	0	0	0	0	0	0	14	0	0	0	0	1	10	167	0	32	20	2036	3643	
9	155	98	140	512	42	22	0	0	1	0	0	0	0	0	0	1	11	0	0	19	0	101	0	8	1	136	1247	
10	351	512	77	846	678	13	0	0	0	32	6	5	0	0	0	0	0	58	0	0	0	0	0	0	0	0	2578	
11	100	39	54	93	283	12	0	0	4	11	4	0	0	4	0	0	0	0	0	0	0	0	0	21	0	0	625	
12	433	1187	1522	759	6	0	0	0	70	6	162	298	57	0	0	0	0	0	0	0	0	0	0	0	0	0	8	4510
13	177	6	58	275	0	0	0	0	19	1	0	166	55	19	0	0	0	0	0	0	0	0	0	0	0	0	0	776
14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9	0	0	0	0	11	0	0	12	22	0	650	704	
15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	114	177	0	18	26	24	28	205	100	295	344	5088	6419	
16	442	487	63	0	0	0	0	0	0	4	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	4	1004
17	108	288	214	35	0	0	0	0	0	0	0	0	0	4	44	0	0	1	0	223	1	168	0	37	122	1495	2540	
18	0	0	11	231	0	0	0	0	0	0	0	13	3	0	0	8	0	6	0	0	0	78	0	0	0	24	374	
19	158	203	158	317	21	0	0	0	2	56	24	433	34	0	0	0	0	87	0	0	0	0	0	0	0	0	1493	
20	17	43	125	87	0	0	0	0	0	0	8	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	283	
total	8254	9977	7686	10410	4623	541	13	20	122	206	208	1230	251	78	358	256	75	344	52	230	115	1178	135	1116	565	41539	89596	

Table 19: THLB volume by analysis unit and 10 year age class

age/ AU	0- 10	11- 20	21- 30	31- 40	41-50	51-60	61- 70	71- 80	81- 90	91- 100	101- 110	111- 120	121- 130	131- 140	141- 150	151- 160	161- 170	171- 180	181- 190	191- 200	201- 210	211- 220	221- 230	231- 240	241- 250	>250	total volume	
1	0	165	13527	232878	440573	72620	0	402	0	4619	0	0	2427	0	0	0	0	0	0	0	0	0	0	0	0	0	0	767212
2	0	809	58413	270450	125430	16103	1771	4815	14377	46016	2596	120443	11614	5355	0	0	0	0	0	0	0	0	0	0	0	0	0	678192
3	0	0	72	1701	14005	0	190	1200	18	0	0	21469	26437	15792	0	0	0	0	0	0	0	0	0	0	0	0	0	80885
4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	65396	12751	2270	0	12465	50370	0	15858	0	281156	10505	2664887	3115658	
5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20991	22787	25274	84338	1815	34075	38882	205392	10585	159222	30722	16248123	16882206	
6	0	0	8795	85418	213983	102258	2918	630	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	414002
7	0	4	7294	24657	64421	23477	152	0	0	725	0	2839	257	0	0	0	0	0	0	0	0	0	0	45625	0	272545	441997	
8	0	0	6	0	0	0	0	0	0	0	0	10	43	0	6563	0	0	0	0	454	4375	80652	0	15896	10889	1064755	1183644	
9	0	91	769	24492	2916	1342	0	0	446	0	0	32	0	80	9	291	4455	0	0	15855	0	73654	0	8653	925	113440	247451	
10	0	0	720	33326	73178	2663	0	0	0	0	2810	3344	0	0	0	0	0	32569	0	0	0	0	0	0	0	0	0	148611
11	0	0	74	989	34188	2124	0	0	469	2573	1076	0	0	0	1026	0	0	5	0	0	0	0	0	0	6062	0	1	48587
12	0	17	3901	15378	233	26	0	0	40195	2972	66150	116410	20217	0	0	0	0	0	0	0	0	0	0	0	0	0	5647	271146
13	0	0	0	161	0	0	0	0	3933	126	0	49436	18353	6333	0	0	0	0	0	0	0	0	0	0	0	0	0	78343
14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4059	0	0	0	0	0	7160	0	232	6219	14088	0	450713	482471
15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	37027	56887	0	7066	11130	11199	13656	101320	46926	120892	144434	2709004	3259542	
16	0	0	463	0	0	0	0	0	0	1152	0	0	0	0	1869	0	0	0	0	0	0	0	0	0	0	0	2709	6193
17	0	0	0	8	0	0	0	0	0	0	0	0	0	1358	14115	0	0	411	0	11948	474	76336	0	19573	47923	707912	880058	
18	0	0	0	3203	0	0	0	0	0	0	0	4815	1365	0	0	4051	0	1794	0	0	202	39720	0	0	0	12300	67450	
19	0	45	647	6229	0	0	0	0	547	10584	7192	141971	13679	0	0	0	0	22097	0	0	0	0	0	0	0	0	0	202991
20	0	9	477	908	0	0	0	0	0	0	2406	0	0	970	0	0	0	0	0	0	0	0	0	0	0	0	0	4769
total	0	1142	95160	699799	968928	220612	5031	7047	59986	68767	82230	460768	94392	29888	151055	96768	31999	148281	25410	131061	57589	593164	63730	671167	245399	24252036	29261407	

6.0 GROWTH AND YIELD

6.1 YIELD TABLE DEVELOPMENT

Existing stand yield tables and managed stand yield tables are developed for each analysis unit. Separate managed stand yield tables are also developed for analysis units that have spaced areas; these will be developed for the analysis in consultation with licensee and MOF staff. Existing and managed stand yield tables are in Appendix 1.

Existing natural stands:

Volumes for existing natural stands are generated by VDYP (Variable Density Yield Projection) windows version 1.1, core version 6.6d using weighted average species composition and site index, and VDYP default crown closure. Existing natural stands are defined as stands currently ≥ 30 years old, excluding spaced stands. VDYP generated yields are net decay, waste and breakage, using TFL 1 waste and breakage factors. Deciduous volumes except cottonwood are netted out of the stand volumes based on the species composition assigned to each analysis unit.

Upon examination of these yields, concern was raised that the average volume per hectare of old growth stands was higher than expected for the TFL. Based on the extensive consideration given to old growth yields in the previous analysis, old growth existing stand yields were adjusted as follows.

1. 1998 analysis average volume per hectare for stands > 250 years calculated at $464 \text{ m}^3/\text{ha}$. This average applies to the THLB only. This average was considered reasonable, with yields in 1998 adjusted based on audit plot information.
2. 2003 analysis average volume per hectare for THLB >250 years, using yields from step 1 calculated at $493 \text{ m}^3/\text{ha}$.
3. Factor of 0.94 applied to all old growth volumes (>140 years) for all analysis units to create final existing stand yield curves.

Managed stands:

Volumes for existing and future managed stands are generated by WinTIPSY (windows version of the Table Interpolation Program for Stand Yields), version 3.0e using weighted average species composition and site index. For TIPSY yields, all stands are assumed to be natural regeneration with a 6 year regeneration delay incorporated in TIPSY. The operational adjustment factors (OAFs) used to generate yields are OAF1 of 15% to account for incomplete site occupancy, and OAF2 of 5% to represent losses that increase with stand age. Existing managed stands are defined as stands currently < 30 years old and all currently spaced stands. All existing natural stands become managed stands once harvested, except for cottonwood leading stands, for which the existing stand yield curves continue after harvest.

6.2 WEIGHTED AVERAGE SPECIES COMPOSITION AND SITE INDEX

The following table outlines the area weighted species composition and site index used to generate the yield tables. Weights are based on the THLB area for each analysis unit. Adjusted attributes refers to the inventory age, height, and site index resulting from the recent VRI adjustment. Unadjusted attributes refers to the inventory attributes prior to VRI adjustment, and are used in a sensitivity analysis.

Table 20: Analysis unit attributes

Analysis unit	Species composition	Site index BH age 50 adjusted attributes	Site Index BH age 50 unadjusted attributes
1	H ₆₂ B ₃₀ S ₄ C ₃ Ac ₁	27.6	25.0
2	H ₆₃ B ₂₇ C ₄ S ₄ Pl ₂	20.5	20.0
3	H ₆₆ B ₂₃ S ₅ C ₃ Pl ₃	12.4	11.9
4	H ₆₄ B ₂₆ S ₆ C ₄	16.7	16.7
5	H ₇₆ B ₂₂ S ₁ C ₁	11.9	11.9
6	B ₆₁ H ₃₇ C ₁ S ₁	28.1	25.6
7	B ₆₁ H ₃₄ S ₃ C ₂	20.7	20.5
8	B ₆₄ H ₃₄ S ₂	12.1	12.1
9	S ₅₇ H ₂₀ Ac ₈ B ₅ Pl ₄ C ₄ At ₂	16.0	15.5
10	Pl ₇₃ H ₁₈ At ₄ C ₃ S ₂	19.7	18.2
11	Ac ₆₆ D ₁₅ H ₇ S ₆ C ₄ Pl ₂	25.9	25.9
12	H ₆₀ B ₁₈ S ₉ Pl ₅ C ₄ Ac ₄	19.8	19.5
13	H ₆₀ B ₁₄ S ₁₄ Pl ₈ C ₄	13.9	13.3
14	H ₆₂ B ₂₃ C ₁₁ S ₄	17.1	17.1
15	H ₇₅ B ₁₉ S ₂ C ₂ Pl ₂	10.8	10.8
16	B ₆₄ H ₃₄ S ₂	21.4	21.4
17	B ₆₉ H ₂₈ S ₃	11.8	11.8
18	S ₅₄ H ₂₀ Ac ₈ E ₆ C ₅ Pl ₅ B ₂	20.3	20.3
19	Pl ₆₄ H ₁₈ At ₈ B ₅ S ₅	19.3	18.9
20	Ac ₅₀ S ₁₇ H ₁₅ D ₁₁ Pl ₄ C ₃	19.6	19.6

6.3 SITE INDEX ASSIGNMENT

Site index and site class have been assigned to each polygon in the inventory database as follows:

- Stands ≥ 30 years: VDYP Batch version 6.6d breast height age 50 site index
- Stands < 30 years: inventory site index

Four productive site classes are based on site index breast height age 50:

Site class 1:	BH50 SI > 35
Site class 2:	$25 < \text{BH50 SI} \leq 35$
Site class 3:	$15 < \text{BH50 SI} \leq 25$
Site class 4:	$3 < \text{BH50 SI} \leq 15$

6.4 UTILIZATION LEVEL

The following table shows the utilization levels used to calculate merchantable timber volumes.

Table 21: Utilization levels

Species	Minimum dbh cm	Maximum stump height cm	Minimum top dib cm
cottonwood	22.5	30	10
all conifer species	17.5	30	10

6.5 SILVICULTURE MANAGEMENT REGIMES

The following table shows TFL 1 silviculture regime assumptions used for this analysis. Current management practices are natural regeneration and no spacing.

Table 22: Silviculture management regimes

Analysis unit	Existing Stand Leading species	Regen delay	Regen method	Initial density
1	hemlock, cedar	6	natural	4000
2	hemlock, cedar	6	natural	4000
3	hemlock, cedar	6	natural	4000
4	hemlock, cedar	6	natural	4000
5	hemlock, cedar	6	natural	4000
6	balsam	6	natural	4000
7	balsam	6	natural	4000
8	balsam	6	natural	4000
9	spruce	6	natural	4000
10	pine	6	natural	4000
11	cottonwood	6	natural	n/a
12	hemlock, cedar	6	natural	4000
13	hemlock, cedar	6	natural	4000
14	hemlock, cedar	6	natural	4000
15	hemlock, cedar	6	natural	4000
16	balsam	6	natural	4000
17	balsam	6	natural	4000
18	spruce	6	natural	4000
19	pine	6	natural	4000
20	cottonwood	6	natural	n/a

6.6 REGENERATION ASSUMPTIONS

Existing stands regenerate to the following analysis units following harvest. Interior spruce leading stands regenerate to interior balsam stands in proportion to their site productivity. Regeneration is assumed to the same species composition as the existing stands except for AU 18 which regenerates to AUs 16 and 17 as shown.

Table 23: Regeneration assumptions

Existing analysis unit	Regenerated analysis unit	weighting %
1	1	100
2	2	100
3	3	100
4	2	100
5	3	100
6	6	100
7	7	100
8	8	100
9	9	100
10	10	100
11	11	100
12	12	100
13	13	100
14	12	100
15	13	100
16	16	100
17	17	100
18	16	75
18	17	25
19	19	100
20	20	100

6.7 EXISTING MANAGED IMMATURE

The following table identifies the immature management history for each analysis unit, and areas of existing managed second growth stands. NSR is excluded from this table.

Table 24: Immature management history

Analysis unit	Area < 30 years ha	Area spaced ha
1	917	332
2	9320	3243
3	189	175
4	0	0
5	0	0
6	331	292
7	41561	1358
8	1042	81
9	270	26
10	728	458
11	71	0
12	2726	868
13	108	0
14	0	0
15	0	0
16	928	41
17	526	92
18	2	3
19	426	67
20	164	0
total	21908	7035

6.8 NOT SATISFACTORILY RESTOCKED AREAS (NSR)

Currently 2940 ha of NSR is in the THLB. This area is distributed by analysis unit as shown in the following table, based on BEC subzone, FIZ, inventory type group and estimated site index data. NSR is assumed to regenerate over the first 10 year time period in TREEFARM.

Table 25: NSR distribution

Existing analysis unit	Analysis unit regenerated to	NSR area ha
1	1	43
2	2	637
3	3	344
4	2	0
5	3	0
6	6	0
7	7	814
8	8	144
9	9	112
10	10	204
11	11	99
12	12	184
13	13	124
14	12	0
15	13	0
16	16	24
17	17	82
18	75% AU16 and 25% AU 17	26
19	19	88
20	20	17
Total		2940

6.9 UNSALVAGED LOSSES

Unsalvaged losses are volume losses in addition to those accounted for by VDYP decay, waste and breakage, and TIPSY operational adjustment factors, resulting from natural causes such as insects, disease, fire, and blowdown. The annual net unsalvaged loss is deducted from the TREEFARM harvest flow results to determine net harvest volumes. Unsalvaged loss is estimated at 2900 m³/year, which is proportionately consistent by THLB area with the 1999 analysis. Assumptions as stated in 1999 and consistent in 2003 are that there have been no fires in TFL 1 and nearly all losses from blowdown are salvaged. There have been no major losses from insect attacks.

7.0 INTEGRATED RESOURCE MANAGEMENT

7.1 FOREST RESOURCE INVENTORIES

Complete details regarding resource inventories are provided in the Management Plan section 3.0 and appendix 4. The following table summarizes the source and dates of the resource inventories.

Table 26: Resource inventory status

Inventory Type	Standard	Source	Date
Operability	SCI	Woodima	2002
Ecological-BEC	MSRM	MSRM	1996
Terrain	MSRM	Madrone, Timberline	1996-2000
Visual quality objectives	MSRM	LRMP	2002
Streams	MSRM	various	1997-2000
Wildlife-goat, moose, grizzly	MSRM	LRMP	2002
Biodiversity-LUs	MSRM	MSRM	2001

7.2 FOREST COVER REQUIREMENTS

The green-up period after logging is defined during which time the replacement stands are expected to reach a specified height. The following constraints are applied in TREEFARM.

Table 27: Green-up cover constraints by management zone

Management Zone	Green-up height m	Green-up maximum allowable disturbance % area	Application
General			
Moose winter range			
Mountain Goat winter range	3	35	THLB
Backcountry recreation			
Miligit Valley, excluding VQO areas			
Copper Watershed/ Grizzly Bear	5	25	productive landbase
Visual - retention	5	5	productive landbase
Visual - partial retention	5	15	productive landbase
Upper Kitsumkalum			
Lakelse	n/a	n/a	

Landscape biodiversity constraints are applied by landscape unit, biogeoclimatic variant, natural disturbance type, and biodiversity emphasis. Biodiversity emphasis is identified in the inventory database. The following old seral constraints are applied to the productive forest area, consistent with the Landscape Unit Planning Guide. Old seral age is >250 years throughout TFL 1. Constraints are identified only for the landscape unit - BEC combinations which contain area in the timber harvesting landbase.

Table 28: Old seral stage constraints

Landscape Unit	Zone	Subzone	Variant	NDT	BEO	min retention area %
Beaver	CWH	ws	1	2	I	9
Beaver	CWH	ws	2	2	I	9
Beaver	MH	mm	2	1	I	19
Clore	CWH	ws	1	2	I	9
Clore	CWH	ws	2	2	I	9
Clore	CWH	ws	1	2	L	9
Clore	CWH	ws	2	2	L	9
Clore	MH	mm	2	1	I	19
Clore	MH	mm	2	1	L	19
Dasque	CWH	ws	1	2	L	9
Dasque	CWH	ws	2	2	L	9
Dasque	MH	mm	2	1	L	19
Ishkheenickh	CWH	ws	1	2	I	9
Ishkheenickh	CWH	ws	2	2	I	9
Ishkheenickh	MH	mm	1	1	I	19
Kalum	CWH	ws	1	2	I	9
Kalum	CWH	ws	2	2	I	9
Kalum	MH	mm	2	1	I	19
Kiteen	CWH	ws	2	2	I	9
Kiteen	CWH	ws	2	2	L	9
Kiteen	ICH	mc	1	2	I	9
Kiteen	ICH	mc	2	2	I	9
Kiteen	MH	mm	2	1	I	19
Kiteen	MH	mm	2	1	L	19
Kleanza-Treasure	CWH	ws	1	2	I	9
Kleanza-Treasure	CWH	ws	2	2	I	9
Kleanza-Treasure	CWH	ws	1	2	L	9
Kleanza-Treasure	CWH	ws	2	2	L	9
Kleanza-Treasure	MH	mm	2	1	I	19
Kleanza-Treasure	MH	mm	2	1	L	19
Ksedin	CWH	ws	1	2	L	9
Ksedin	CWH	ws	2	2	L	9
Ksedin	MH	mm	2	1	L	19
Lakelse	CWH	ws	1	2	I	9
Lakelse	CWH	ws	2	2	I	9
Lakelse	MH	mm	2	1	I	19
Nass River Kalum	ICH	mc	1	2	H	13
Nass River Kalum	ICH	mc	2	2	H	13
Nelson-Fiddler	CWH	ws	1	2	L	9
Nelson-Fiddler	CWH	ws	2	2	L	9
Nelson-Fiddler	ICH	mc	1	2	L	9
Nelson-Fiddler	ICH	mc	2	2	L	9
Nelson-Fiddler	MH	mm	2	1	L	19
Skeena River Kalum	CWH	ws	1	2	H	13
Skeena River Kalum	CWH	ws	2	2	H	13
Skeena River Kalum	MH	mm	2	1	H	28
Tseax	CWH	ws	1	2	I	9
Tseax	CWH	ws	2	2	I	9
Tseax	ICH	mc	1	2	I	9
Tseax	ICH	mc	2	2	I	9
Tseax	MH	mm	2	1	I	19

The LRMP defines an additional forest cover constraint for grizzly bear management in the Copper watershed portion of the Kleanza-Treasure Landscape Unit. This management zone will have maximum retention of 30% of the productive forest landbase between the ages of 25 and 100 years.

7.3 WILDLIFE TREE PATCHES

Wildlife tree patches were calculated using Table A3.1 of the Landscape Unit Planning Guide, March 1999. Landscape units and landscape unit objectives are incorporated into the timber supply analysis. From Table A3.1, 15 combinations of subzones and landscape units require wildlife tree retention between 1% and 10% of cutblocks as shown in the following table.

A total area of 7894 ha is calculated for WTP requirements, with 32% of the area, 2526 ha, excluded from the timber harvesting landbase as shown in the landbase determination. Reduction % is zero for other landscape units for which BEC zones and subzones are not shown.

Table 29: Wildlife Tree Patches

Landscape Unit	Zone	Subzone	WTP%
Beaver	CWH	ws	6
Clore	CWH	ws	4
Dasque	CWH	ws	7
Kalum	CWH	ws	10
Kiteen	CWH	ws	1
Kiteen	ICH	mc	6
Kleanza-Treasure	CWH	ws	3
Ksedin	CWH	ws	4
Lakelse	CWH	ws	7
Nass River Kalum	ICH	mc	6
Nelson-Fiddler	CWH	ws	9
Nelson-Fiddler	ICH	mc	1
Skeena River Kalum	CWH	ws	5
Tseax	CWH	ws	3
Tseax	ICH	mc	8

7.4 TIMBER HARVESTING

Minimum harvest volume is 300 m³/ha, except for the analysis units that contain the majority of the operable non-conventional volume. These analysis units, for which minimum harvest volume is 350 m³/ha, are 4, 5, 8, and 15.

The minimum ages for natural and managed stands are determined from the yield tables for each analysis unit as the age at which the minimum volume is attained, or 60 years, whichever is greater. Minimum age for cottonwood stands is designated as 60 years consistent with the Kalum Timber Supply Area Analysis Report, March 1999.

Table 30: Minimum harvest age

Analysis unit	existing natural stands		natural regen managed stands no OGSI adjustment	
	minimum harvest age	culmination age	minimum harvest age	culmination age
1	60	68	60	105
2	60	88	71	140
3	125	130	141	190
4	78	102	71	150
5	145	132	141	210
6	60	66	60	100
7	63	94	69	130
8	135	155	149	200
9	77	105	91	140
10	76	109	81	100
11	60	60	60	60
12	71	91	75	120
13	106	130	117	140
14	82	105	75	120
15	146	155	117	180
16	79	100	67	110
17	175	161	141	170
18	88	96	n/a	100
19	104	110	86	100
20	60	81	60	81

7.5 OPERABILITY/ HARVEST METHODS

Operability mapping of TFL 1 was revised and completed in 2002, based on a combination of harvesting systems, accessibility, merchantable volume, and local knowledge of site conditions and wood quality. As shown in the landbase determination, reductions to the timber harvesting landbase are made for:

- conventional low volume areas which are unavailable for harvest due to insufficient volume at maturity, defined as volume less than 250 m³/ha;
- inoperable areas, defined as not suitable for harvesting due to a combination of low volume, very poor quality, or inaccessibility. Inoperable areas do not include alpine forest.

Table 31: Timber harvesting landbase and harvest methods

Analysis unit	Conventional		Non-conventional	
	area (ha)	volume (m ³)	area (ha)	volume (m ³)
1	3329	747709	3	55
2	14933	567467	64	24383
3	2739	73273	57	7504
4	3564	2726503	482	364705
5	27291	15387236	2376	1342614
6	1602	411123	0	3
7	6906	432363	52	14200
8	3300	988626	343	185534
9	1226	233551	19	16232
10	2577	150949	0	0
11	621	48432	6	413
12	4500	259262	6	2971
13	759	40168	16	4969
14	657	446579	52	35521
15	5827	2931137	594	313077
16	995	1812	7	4415
17	2264	756686	281	129849
18	373	67549	1	739
19	1490	195682	2	353
20	283	3919	0	0
total	85237	26470025	4359	2447537

7.6 INITIAL HARVEST RATE

The initial harvest rate will be determined during the timber supply analysis.

7.7 HARVEST RULES

Section 3.0 describes the harvest rules used by TREEFARM in more detail. Preference will be given for harvesting the historic harvest profile, with a secondary preference to harvest oldest stands first.

7.8 HARVEST PROFILE

The historic harvest profile is shown by analysis unit, area weighted for stands currently ≤ 20 years old, including NSR.

Table 32: Historic harvest profile

Analysis unit	% THLB
1	4.5
2/4	36.6
3/5	2.3
6	1.2
7	24.2
8	4.8
9	1.4
10	4.7
11	0.8
12/14	8.9
13/15	1.0
16	4.9
17	2.1
18	0.2
19	2.0
20	0.3
Total	100

7.9 HARVEST FLOW OBJECTIVES

The initial harvest level will be set to maximize the AAC in the short term followed by a maximum decline of 10% in each of the following decades, and to avoid harvest shortfalls below the long term level. The long-term level is defined as the harvest that will maintain total timber growing stock at an even level so that harvesting can continue at a constant level in perpetuity.

APPENDIX 5-1

The following yield tables are included in this Appendix:

- Existing Stands
- Managed Stands – base site productivity
- Managed Stands – sensitivity analyses
- Managed Stands - spaced

Existing Stand Yields

10 year age class	AU age class midpoint	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	25	65	1	0	0	0	60	0	0	14	1	2	1	0	0	0	6	0	0	1	0
4	35	220	77	1	9	0	217	42	0	41	39	43	36	0	7	0	41	0	0	21	14
5	45	351	178	5	95	1	348	147	0	97	110	81	124	4	74	0	115	9	51	72	69
6	55	461	265	55	168	39	459	238	10	167	177	111	204	54	147	3	178	27	127	120	117
7	65	555	341	104	232	87	552	321	65	233	238	133	272	113	212	25	237	53	192	165	155
8	75	634	407	148	288	129	630	388	112	291	294	149	331	167	269	75	286	93	245	205	185
9	85	701	463	187	337	167	695	447	154	342	346	162	380	215	317	121	330	124	289	243	209
10	95	755	511	221	378	199	749	497	192	387	392	173	421	257	357	162	369	151	325	277	230
11	105	801	552	250	414	228	795	541	226	427	435	181	456	294	391	199	404	176	354	307	248
12	115	839	587	277	445	253	834	579	256	462	475	188	486	327	419	232	435	200	378	336	262
13	125	874	619	301	474	276	871	615	285	495	512	190	513	358	446	263	465	222	400	363	275
14	135	881	630	314	485	288	878	629	302	509	519	191	521	373	457	292	477	236	405	368	277
15	145	887	640	326	497	300	884	642	319	522	525	192	528	387	467	299	489	249	409	373	279
16	155	914	665	344	520	318	912	670	342	545	537	194	546	407	487	321	512	267	421	382	285
17	165	938	688	361	540	334	938	696	363	566	546	195	559	425	504	340	534	285	431	389	289
18	175	959	708	377	558	349	961	720	383	585	551	196	571	441	520	357	554	301	440	393	291
19	185	979	726	391	575	362	981	741	402	602	552	196	581	454	533	372	572	316	447	395	294
20	195	996	743	404	591	375	1000	762	419	619	553	197	591	466	545	386	590	331	453	396	296
21	205	1012	758	416	605	387	1017	780	435	634	557	197	600	478	557	400	607	346	459	399	298
22	215	1026	773	428	618	397	1033	797	451	649	562	198	607	490	567	413	623	360	464	403	300
23	225	1039	786	438	631	407	1047	813	465	662	566	199	614	501	576	425	638	373	469	406	302
24	235	1051	797	448	642	416	1060	828	479	675	570	199	621	511	584	437	652	385	474	410	304
25	245	1061	808	457	652	425	1072	842	492	687	573	200	627	520	592	448	665	397	478	413	305
26	255	1070	818	465	661	432	1083	854	504	698	577	200	631	526	597	458	673	405	482	416	307

**Managed Stand Yields- Natural Regeneration
Base site productivity**

	AU	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
10 year age class	age class midpoint																				
		*																			
1	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	25	0	0	0	0	0	0	0	0	0	0	24	0	0	0	0	0	0	0	0	4
4	35	50	2	0	39	3	57	2	0	0	7	66	1	0	2	0	4	0	6	46	
5	45	222	43	0	195	66	236	44	0	6	60	100	34	0	50	7	67	0	48	99	
6	55	390	140	3	354	187	410	147	2	41	136	125	120	5	155	57	183	0	117	141	
7	65	547	251	14	511	304	566	259	9	109	209	143	216	31	265	138	294	5	184	173	
8	75	683	348	43	643	416	709	359	37	190	271	158	300	78	353	221	388	26	245	200	
9	85	821	444	83	772	515	848	460	69	263	323	169	373	139	435	295	470	64	293	222	
10	95	935	526	125	889	600	959	542	111	323	368	178	437	197	505	354	534	111	332	241	
11	105	1035	599	168	986	684	1063	617	151	388	405	185	489	247	567	412	598	161	367	257	
12	115	1130	669	211	1078	764	1165	689	192	448	434	191	538	292	622	463	653	205	393	270	
13	125	1221	736	246	1166	838	1258	759	227	500	464	197	581	330	669	501	700	247	416	283	
14	135	1291	798	279	1246	898	1325	823	260	545	486	202	615	367	713	538	749	285	435	293	
15	145	1353	852	312	1310	952	1384	875	291	585	506	206	649	398	756	574	790	315	454	302	
16	155	1408	898	342	1360	1004	1451	923	318	624	522	207	682	425	794	604	830	344	464	306	
17	165	1464	898	370	1412	1054	1507	966	347	659	535	208	707	448	826	630	862	373	475	309	
18	175	1516	898	396	1463	1100	1553	1011	374	693	548	208	733	467	858	653	897	397	484	312	
19	185	1553	898	424	1509	1142	1596	1050	398	725	561	209	755	484	887	675	928	418	492	314	
20	195	1553	898	445	1544	1185	1632	1087	422	754	561	210	755	501	914	697	956	438	500	316	
21	205	1553	898	463	1574	1216	1669	1122	445	778	561	210	755	518	942	716	956	455	508	319	
22	215	1553	898	481	1607	1243	1669	1153	459	803	561	211	755	533	961	732	956	467	508	321	
23	225	1553	898	498	1634	1267	1669	1183	475	824	561	212	755	544	961	746	956	482	508	323	
24	235	1553	898	511	1660	1289	1669	1207	489	841	561	212	755	554	961	762	956	494	508	324	
25	245	1553	898	525	1660	1312	1669	1222	503	859	561	213	755	564	961	774	956	504	508	326	
26	255	1553	898	538	1660	1330	1669	1241	515	872	561	213	755	572	961	785	956	515	508	327	

* AU 18 regenerates to AU 16 and AU 17 yields per Information Package assumptions

**Managed Stand Yields- Natural Regeneration
Sensitivity analyses**

SI adjustment		AU 4	AU 5	AU 4	AU 5	AU 4	AU 5	AU 14	AU 15	AU 4_ spaced	AU 4_ spaced	AU 4_ spaced	AU 14_ spaced
10 year age class	age class midpoint	none**	none**	5m	5m	10.7m*	12.1m*	none**	none**	10m	5m	10.7m*	3.6m*
1	5	0	0	0	0	0	0	0	0	0	0	0	0
2	15	0	0	0	0	0	0	0	0	0	0	0	0
3	25	0	0	0	0	0	0	0	0	0	0	0	0
4	35	2	0	3	0	47	12	1	0	52	5	61	3
5	45	43	0	62	4	216	117	34	0	188	78	207	63
6	55	140	3	183	45	384	258	120	5	329	180	356	149
7	65	251	14	300	120	540	391	216	31	479	281	510	241
8	75	348	43	411	199	678	513	300	78	614	382	648	323
9	85	444	83	510	272	812	618	373	139	746	478	789	404
10	95	526	125	595	337	930	719	437	197	869	566	912	471
11	105	599	168	680	404	1030	818	489	247	976	652	1021	535
12	115	669	211	760	465	1124	897	538	292	1073	733	1123	592
13	125	736	246	834	513	1216	969	581	330	1168	810	1216	639
14	135	798	279	896	557	1291	1037	615	367	1249	877	1299	690
15	145	852	312	947	603	1352	1102	649	398	1318	935	1365	734
16	155	898	342	1001	643	1410	1163	682	425	1373	991	1423	773
17	165	898	370	1048	681	1464	1221	707	448	1428	1042	1483	809
18	175	898	396	1093	721	1515	1263	733	467	1483	1091	1535	841
19	185	898	424	1133	755	1555	1299	755	484	1529	1136	1576	872
20	195	898	445	1175	787	1593	1334	755	501	1564	1178	1611	900
21	205	898	463	1211	815	1626	1366	755	518	1596	1218	1646	925
22	215	898	481	1237	837	1655	1400	755	533	1626	1244	1676	950
23	225	898	498	1260	860	1686	1431	755	544	1654	1270	1707	950
24	235	898	511	1283	882	1686	1457	755	554	1681	1292	1707	950
25	245	898	525	1303	900	1686	1479	755	564	1681	1315	1707	950
26	255	898	538	1323	917	1686	1498	755	572	1681	1337	1707	950

*based on veteran study equations per Information Package

**AU 4 regenerates to AU2; AU 5 to AU 3; AU 14 to AU 12; AU 15 to AU 13 per Information Package

**Managed Stand Yields- Natural Regeneration
Spaced to 800 stems per hectare**

	AU	1	2	4	6	7	9	12	14	16
10 year age class	age class midpoint									
1	5	0	0	0	0	0	0	0	0	0
2	15	0	0	0	0	0	0	0	0	0
3	25	0	0	0	0	0	0	0	0	0
4	35	65	4	4	71	3	0	2	2	7
5	45	214	57	57	223	58	10	47	47	78
6	55	367	146	146	382	152	56	126	126	171
7	65	517	237	237	532	243	122	208	208	264
8	75	660	324	324	679	333	196	287	287	351
9	85	803	416	416	826	429	266	359	359	430
10	95	925	495	495	945	511	331	424	424	498
11	105	1037	569	569	1060	584	396	478	478	563
12	115	1139	641	641	1164	658	461	533	533	622
13	125	1236	712	712	1262	731	519	578	578	673
14	135	1315	777	777	1336	800	570	620	620	722
15	145	1377	833	833	1401	859	617	657	657	766
16	155	1441	884	884	1469	910	661	690	690	807
17	165	1499	884	884	1529	958	704	723	723	843
18	175	1551	884	884	1577	1003	741	752	752	879
19	185	1588	884	884	1615	1048	781	772	772	910
20	195	1588	884	884	1655	1087	812	772	772	940
21	205	1588	884	884	1692	1123	844	772	772	940
22	215	1588	884	884	1692	1156	874	772	772	940
23	225	1588	884	884	1692	1189	898	772	772	940
24	235	1588	884	884	1692	1212	920	772	772	940
25	245	1588	884	884	1692	1234	940	772	772	940
26	255	1588	884	884	1692	1253	961	772	772	940

AU 4 regenerates to AU 2; AU 14 to AU 12 per Information Package assumptions