TFL 5
Change Monitoring Inventory
Sample Plan

Prepared for

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Quesnel, B.C.

Project: WWQ-036

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Weldwood

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1. INTRODUCTION

1.1 BACKGROUND

Weldwood of Canada Ltd. (Weldwood) is implementing a Change Monitoring Inventory (CMI) program in a continued effort to improve management of the forest resources of Tree Farm License (TFL) 5. Weldwood has developed a sustainable forest management (SFM) plan for TFL 5 which includes a requirement for a monitoring program to ensure the productive capability of the landbase is maintained. The CMI program will help track growth and yield (G&Y) attributes for the SFM plan, ensure that up-to-date G&Y information is included in each Management Plan, and provide information for other internal management functions such as fiber allocation.

1.2 GOALS & OBJECTIVES

Weldwood's overall goal for the CMI program on TFL 5 is to monitor and track the change in key G&Y attributes including volume, mean annual increment, site index, top height, and species composition in young managed stands. This goal includes the tracking of SFM indicators should the harvest level change in the future.

The CMI program is designed to detect practically significant differences[1] between actual and predicted changes in key attributes – the program is not designed to explain why potential difference may exist. In other words, the CMI program functions as an early warning system to detect differences that may impact forest management on the TFL.

The volume in most PHR stands is projected to be higher than natural stands on the same sites. This increased projected yield exerts upward pressure on forecasted timber supply, thus it is important that the G&Y of these stands is closely monitored to ensure this increased growth is achieved on the landbase. The need to closely monitor these stands will likely decrease over time as we develop more experience with PHR stands.

The specific objective of this CMI sample plan is to:

1. *Develop a flexible sample design that meets Weldwood's corporate goal for the CMI program and can be modified to address potential future objectives.*

1.3 TERMS OF REFERENCE

J.S. Thrower & Associates Ltd (JST) completed this Change Monitoring Inventory (CMI) sample plan for Weldwood on TFL 5. Allan Johnsrude, *RPF* is the project leader for Weldwood, René de Jong, *RPF* (JST) is the project manager, Jim Thrower, *RPF*, PhD is the project advisor, and Mike Ciccotelli, is coordinating the field sampling activities.

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[1] Practically significant differences (as opposed to statistically significant differences) are defined as ones large enough to impact management decisions. Timber supply (and other) sensitivity analyses can help determine practically significant differences.

2. SAMPLE DESIGN

2.1 TARGET POPULATION

The target population is defined as all conifer leading post-harvest-regenerated (PHR) stands in the TFL that are between 15 and 39 years of age (19% of the entire landbase).[2] The minimum age of 15 years restricts sampling to stands that generally have merchantable volume present. The maximum age covers the majority of stands in the population of interest that are of post-harvest origin. The following forest cover polygons were excluded from the target population:

- Inventory polygons outside the productive forested land base (PFLB).[3]
- Deciduous leading polygons. These stands are considered outside the target population for Weldwood's monitoring objectives.[4]
- Permanent roads. This includes mainlines, and mainline right-of-ways, and in-block permanent access structures.

2.2 SAMPLE POPULATION

CMI plots will be located in the target population systematically on a 1.0 km grid over the TFL. Plots located systematically on a grid theoretically include the same conditions as random locations, but are more convenient since all plot locations are known once the grid size is defined. Due to budget constraints not all samples within the population can be established in 2003, therefore, plots will be randomly selected from the grid points.

An office review will confirm whether any grid point should be excluded from the sample population. Potential reasons include grid points located on a permanent road such as a mainline, mainline right-of-way, or in-block permanent access structure.[5] Additional grid points will only be excluded at the field stage if a new permanent road has subsequently been established that was not identified on the ortho-image. No exclusion will be made for plots that fall within a riparian management area.[6]

2.3 SAMPLE SIZE

The sample size is determined by the grid spacing and the area targeted for sampling. The two main criteria influencing the choice of grid is the sample size achieved in the target population today, and how the sample size increases over time as the target population area expands (i.e., natural stands are harvested, regenerated, and subsequently included in the target population).

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[2] Spatial coverages for TFL 5 were received from Guohu Li, GIS Manager, Weldwood of Canada Ltd, September 1, 2003, and included the most recent coverages for forest cover, roads, ortho-images, and ecosystem mapping. Stand age is based on the inventory label 'PRJAGE' which has been updated in the forest cover files to the year 2002.

[3] Non-forest area exclusions are defined as polygons with the attribute PRJ_TYPEID = 0, 5 or 6.

[4] Management objectives for young decidous leading PHR stands are expected to follow conversion to conifer leading wherever possible. Older decidous leading stands are not considered in the population of interest by Weldwood as part of its monitoring objectives. This was agreed to with Allan Johnsrude at our meeting September 22, 2003.

[5] Two grid points on mainlines have been excluded at the office stage. These grid points are identified in Appendix I.

[6] While these areas represent the current state of these older PHR stands, the need for their inclusion may change in the future, as current management practice is to exclude the RRZ, and portions of the RMZ from the net area to be reforested.

The 1.0 km grid[7] results in 59 grid points in PHR stands. However, budget limitations permit only 30 plots to be established in 2003. Therefore, we randomly selected 30 plots from the 59 grid points, resulting in a sampling frequency of 51% (Appendix I). Applying this sampling frequency to future plots results in a recruitment rate of approximately 10 plots in each subsequent five-year period. Alternatives considered in deciding the appropriate grid size are in Appendix VI.

2.4 PLOT DESIGN

The plot design is based on the Ministry of Sustainable Resource Management (MSRM) CMI standards[8] (Figure 1). The main plot is 400 m^2 (11.28 m radius) where all trees greater than 4 cm diameter at breast-height (DBH) are measured and tagged. Trees between 4 cm and 9 cm were measured and tagged in the small-tree plot (100 m^2, 5.64 m radius), and all trees taller than 30 cm but less than 4 cm DBH were measured and tallied by species in the regeneration plot (19.6 m^2, 2.50 m radius).

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2.50 m Regeneration plot

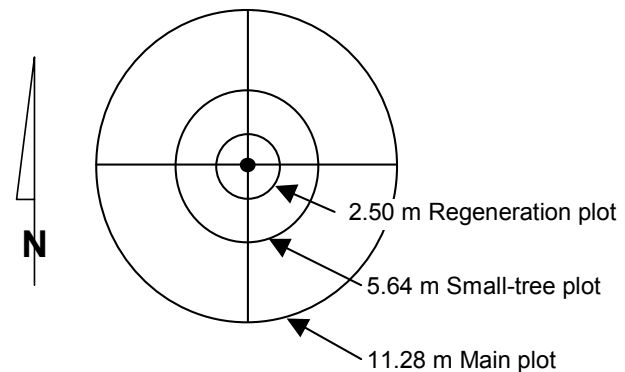5.64 m Small-tree plot

11.28 m Main plot

Figure 1. CMI sample plot.

2.5 REMEASUREMENT PERIOD

We recommend a five-year re-measurement period to coincide with the five-year management plan cycle. Re-measurement every five years will provide new information to check the PHR yield curves for each subsequent timber supply analysis. The re-measurement period can be lengthened after more comfort is gained in G&Y estimates for PHR stands.

2.6 PLOT MEASUREMENTS

2.6.1 Modification from Standards

While the majority of MSRM CMI standard field procedures[8] will be used for this project, the following modifications from the standards will been made:

- No information is collected on range data.
- No information is collected on ecology data, other than a visual estimate of the biogeoclimatic site series as well as site features at pin location are recorded on the Ecology Header (EP) card.
- For timber attributes, potential site trees from all species are sampled from each quad in the 11.28 m radius main plot, and includes provision of stepping down the DBH list if the largest tree is deemed an unsuitable site tree.
- Blue tree tags are affixed at breast rather than at stump height as recommended in the CMI protocol. This simplifies installation and re-measurement without making the plot unduly visible.
- Coarse woody debris sampling methods follow the previous year's 2002 CMI standards.

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[7] Possible grid sizes included 0.5 km, 1.0 km, 1.5 km, 2.0 km, and 2.5 km grid sizes. The 1.0 km grid was agreed to with Allan Johnsrude at our meeting September 22, 2003, following discussion of sample sizes and future recruitment rates using the different grid size options.

[8] Ministry of Sustainable Resource Management National Forest Inventory – BC Change Monitoring Procedures for Provincial and National Reporting March 31, 2003. Ver. 1.3. http://srmwww.gov.bc.ca/risc/pubs/teveg/cmi2k3/cmi_ground_2k3.pdf

- Grid points that fall on a permanent road (mainline, cleared mainline right-of-way, in-block road) will be excluded from the sample list and noted.
- If a portion of a plot falls outside the target population (eg., permanent road, or an old growth stand), then all trees outside the target population will also be measured and tagged as per CMI standards. In addition, these trees will be identified as being outside the target population. Separate site tree data will be collected from both portions of the quad. A drawing of the plot will be used to estimate the target population boundary line, and will be based on the 1:5,000 sample package maps.

Modifications to MSRM CMI standard field procedures are summarized in Appendix II.

2.6.2 Top Height Tree
The age of the largest diameter tree, regardless of species in the 5.64 m radius plot is measured. This tree is the top height tree in the MSRM CMI standards and is identified as the "T" tree.

2.6.3 Site Trees
Leading and second species are not determined prior to selecting site trees. Instead, the age of the largest diameter, dominant or co-dominant tree of all species in each quad is measured. This ensures that data for the leading and second species are collected, and also provides data to examine site index relationships with other species.[9]

If the largest diameter tree of a given species (coded as "S" tree) is not suitable for height and age, then the next largest diameter tree suitable for height and age will be selected (and coded as "O" tree). The variance to step down the DBH list provides extra data to ensure we do not leave a plot without having a potential site tree. If a site tree is between 4 cm and 9 cm DBH outside the small-tree plot but inside the main plot, this site tree will be tagged and the height will be recorded in the site tree section on Card 10.

If a plot overlaps with an adjacent mature / old growth stand, site trees will be sampled from both the older stand outside the target population, as well as the PHR stand inside the target population.[10] In these instances, the procedure to step down the DBH list only applies to the PHR stand inside the target population.

2.6.4 Coarse Woody Debris
Coarse Woody Debris (CWD) sampling methods follow the 2002 CMI standards[11] where CWD measurements are taken from two 24 m transects. We have chosen not to apply the additional detail from the 2003 CMI standards which include small woody debris measurements from longer transects. Stump data will be collected from the 2.50 m radius small plot, as this is considered integral to CWD sampling.[12]

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[9] This supports the need to localize site index conversion equations, an issue previously raised by MSRM in other related projects.

[10] Although we are interested primarily with PHR stands, suitable site trees originating from adjacent older stands outside the target population should also be measured (email from V. Sundstrom, MSRM, October 2, 2003).

[11] Ministry of Sustainable Resource Management Change Monitoring Inventory – Ground sampling procedures for the provincial CMI program. March 29, 2002. Ver. 1.2.

[12] From conversation with V. Sundstrom, MSRM, October 2, 2003.

2.7 DATA MANAGEMENT

Data will be entered after field sampling is complete using the most recent version of VIDE (the MSRM data entry software for VRI and CMI). We will then compile the data using the MSRM CMI data compiler.

2.8 ANALYSIS & INTERPRETATION

Data analysis is not included as part of this project, however, we will submit an establishment report that describes the sample design, plot installation methods, and some basic summaries of the measurements.

2.9 FUTURE MODIFICATIONS

Future modifications to the CMI program may include:

1) **Establishing linkages with other programs**

   Accommodate the extension of the CMI program to incorporate plot establishment in mature stands and possibly have links to Vegetation Resources Inventory (VRI) Phase II ground sampling.

   Provide a link with silviculture surveys designed to monitor the first 15 years of post-harvest.

2) **Utilizing previously collected CMI data**

   Enable opportunities to utilize other previously collected CMI data from similar sites to increase statistical confidence (eg., the CMI project recently completed on the adjacent TFL 52).

3) **Decreasing sample intensity**

   Sampling intensity can be decreased in the future as more plots are located in PHR stands. The number of plots in the CMI program will increase as more natural stands are harvested, regenerated, and reach 15 years of age. At some point in the future, the cost of the program may become too high and Weldwood may want to reduce costs. This can be done by randomly dropping some plots in older PHR stands where the comfort on predicting stand yield is higher.

4) **Increasing measurement period**

   The 5-year measurement period is convenient because it corresponds to the MP schedule. However, this period could change if the MP cycle changes, if a higher level of comfort is developed in PHR yield estimates, or if Weldwood wants to decrease the cost of the program. The advantage of an increased measurement period is lower costs, however, the disadvantage is that less information can be obtained from the data, and linking previous measurements will be more complicated.

5) **Eliminating grid points no longer considered to represent current management practices**

   The current sample list includes stands harvested under varying historical standards, some of which may not be acceptable under the current Forest Practices Code. For example, some grid points that occur in PHR stands within the riparian reserve zone may be considered for possible exclusion, since current legislation removes these areas from the THLB.

6) **Growth and yield model development**

   Data from the CMI plots could be used to assist in the development of G&Y models. However, the current CMI sample size is likely too small, and using CMI data to develop G&Y models may compromise the independence of the monitoring data from the information that it is to check. Thus, we suggest that each future modelling need be evaluated separately as to whether or not it is appropriate to use the CMI data for model development.

7) Adding other information

New tree measurements can be added to the CMI program at any time in the future. For example, measurements of branch size, tree taper, or wood quality could be included in the next measurement cycle. This would provide the same representative sample, but change estimates could not be computed until two or more measurements of the same attribute were taken. Future additions could also include more detailed ecological descriptions.

3. SCHEDULE

The initial establishment of 30 CMI plots will be completed in the fall 2003. A detailed establishment report will be written after the field work is complete and submitted prior to the end of March 31, 2004.

2003 / 2004 Activities	Sep	Oct	Nov	Dec	Jan	Feb	Mar
1. Approved sample plan	■						
2. Prepare sample packages	■						
3. Conduct field sampling		■	■				
4. Conduct mentoring and quality assurance		■	■				
5. Validate and compile data				■	■		
6. Conduct analysis and prepare reports						■	■

4. ROLES AND RESPONSIBILITIES

4.1 WELDWOOD

Weldwood will:

- Coordinate the project.
- Monitor project budget and progress, and communicate with the MSRM.
- Approve the CMI sample plan.
- Ensure quality control is complete.
- Assist in coordinating technical expertise where required.

4.2 QUALITY ASSURANCE/MENTORING CONTRACTOR

An independent third party contractor will:

- Conduct quality assurance of the fieldwork.

4.3 J.S. THROWER & ASSOCIATES LTD.

JST will:

- Prepare the sample plan.
- Select the plot locations.
- Transfer plot locations from GIS to air photos.
- Prepare sample packages and ensure the sample packages are assembled and complete.
- Mentor field crews at the beginning of the fieldwork.
- Complete fieldwork.
- Complete internal quality control of fieldwork.
- Enter data.
- Complete quality control on data entry.
- Compile data.
- Check data after initial compilation.
- Analyze data.
- Complete establishment report.

APPENDIX I – TFL 5 CMI SAMPLE LIST

Table 1. Sample list of CMI plots, including up to 40 possible samples, sorted in random order. Shaded cells refer to those grid points excluded from sampling, the IPC being on a permanent access road or within a cleared road right of way.

Sort List	Plot number	UTM Easting	UTM Northing	Mapsheet number	Polygon number	Leading species	Second species	Third species	Age (yrs)	Height (m)	Merch volume (m³/ha)	Harvest Year	Accept Plot	Access (Q = Quad)	Comments
1	Plot-520-5892	520,000	5,892,000	093G017	320	PL	AT	FD	15	4.4	0	1986	Y	-	-
2	Plot-530-5893	530,000	5,893,000	093G018	77	SX	PL	FD	27	5.5	0	1984	Y	-	-
3	Plot-508-5913	508,000	5,913,000	093G036	405	SX	FD	EP	31	14.7	18.1	1962	Y	Q	-
4	Plot-520-5894	520,000	5,894,000	093G017	70	FD	SX	PL	15	4.5	0	1983	Y	-	Between M/L ROW and 50 yr Bl patch.
5	Plot-527-5893	527,000	5,893,000	093G018	76	PL	SX	EP	18	9	0	1983	Y	-	-
6	Plot-508-5912	508,000	5,912,000	093G036	496	FD	SX	EP	29	9.2	2.7	1973	Y	Q	-
7	Plot-516-5910	516,000	5,910,000	093G037	495	AT	BL	PL	31	19.8	17.7	1973	Y	-	Potentially in RRZ, on block boundary.
8	Plot-519-5910	519,000	5,910,000	093G037	467	SX	FD	PL	26	4.7	0	1973	Y	Q	In creek
9	Plot-505-5916	505,000	5,916,000	093G036	122	SX	FD	AT	27	5.1	0	1972	Y	-	-
10	Plot-503-5911	503,000	5,911,000	093G036	686	FD	PL		20	6	0	1982	Y	-	-
11	Plot-505-5914	505,000	5,914,000	093G036	241	FD	SX	AT	31	12.5	41.5	1972	Y	-	-
12	Plot-527-5892	527,000	5,892,000	093G018	121	FD	SX	PL	26	8.1	0	1959	Y	-	-
13	Plot-507-5915	507,000	5,915,000	093G036	203	PL	FD	FD	21	11.1	4.2	1985	Y	-	-
14	Plot-515-5917	515,000	5,917,000	093G047	95	FD	SX	PL	16	4.2	0	1982	Y	-	-
15	Plot-507-5911	507,000	5,911,000	093G036	699	FD	SX	EP	33	11.4	37.6	1962	Y	-	-
16	Plot-518-5908	518,000	5,908,000	093G037	648	SX	FD	PL	30	6.3	0	1971	Y	Q	-
17	Plot-509-5914	509,000	5,914,000	093G036	234	SX	FD	EP	36	13.4	56.9	1969	Y	-	On block boundary
18	Plot-506-5912	506,000	5,912,000	093G036	524	BL	SX	FD	30	5.7	2.4	1966	N	-	On M/L
19	Plot-521-5895	521,000	5,895,000	093G027	634	SX	PL	FD	16	1.6	0	1984	Y	-	Adjacent to inblock road / landing
20	Plot-506-5915	506,000	5,915,000	093G036	166	SX	FD	AT	27	5.1	0	1975	Y	-	-
21	Plot-505-5913	505,000	5,913,000	093G036	384	FD	SX	BL	26	8.6	2.2	1972	Y	-	-
22	Plot-513-5912	513,000	5,912,000	093G036	536	SX	FD	PL	22	3	0.1	1975	Y	Q	-
23	Plot-504-5912	504,000	5,912,000	093G036	395	FD	SX	AT	31	16.6	60.3	1970	Y	-	Adjacent to inblock road
24	Plot-529-5893	529,000	5,893,000	093G018	71	PL	SX	AT	16	5.2	0	1984	Y	-	-
25	Plot-510-5915	510,000	5,915,000	093G036	201	SX	FD	EP	36	13.4	56.9	1969	Y	-	-
26	Plot-505-5909	505,000	5,909,000	093G036	952	FD	SX	EP	36	10.6	19.2	1965	Y	-	-
27	Plot-510-5916	510,000	5,916,000	093G036	103	FD	SX	PL	20	4.9	0	1974	Y	-	-
28	Plot-518-5913	518,000	5,913,000	093G037	245	SX	EP	FD	17	1.8	0	1962	Y	-	On block boundary
29	Plot-520-5911	520,000	5,911,000	093G037	381	PL	FD	SX	25	9.3	0.9	1975	Y	Q	-
30	Plot-507-5914	507,000	5,914,000	093G036	320	SX	EP	FD	39	12.5	38.4	1963	Y	-	-

Sort List	Plot number	UTM Easting	UTM Northing	Mapsheet number	Polygon number	Leading species	Second species	Third species	Age (yrs)	Height (m)	Merch volume (m³/ha)	Harvest Year	Accept Plot (Q = Quad)	Access	Comments
31	Plot-506-5913	506,000	5,913,000	093G036	415	FD	SX	AT	35	12.4	55.6	1967	Y	-		On M/L right of way, on block boundary
32	Plot-512-5916	512,000	5,916,000	093G036	102	FD	SX	PL	30	10.2	17.4	1973	Y	-		On block boundary
33	Plot-510-5909	510,000	5,909,000	093G036	909	SX	FD	PL	21	3.2	0.1	1978	Y	-		-
34	Plot-514-5902	514,000	5,902,000	093G027	312	FD	SX	AT	15	3.5	0	1984	Y	-		-
35	Plot-520-5909	520,000	5,909,000	093G037	533	FD	SX	PL	20	6	0	1979	Y	Q		-
36	Plot-520-5910	520,000	5,910,000	093G037	470	FD	SX	EP	26	7	0	1972	Y	Q		-
37	Plot-522-5892	522,000	5,892,000	093G017	297	PL	SX	FD	16	4.9	0	1985	Y	-		-
38	Plot-508-5915	508,000	5,915,000	093G036	214	SX	FD	PL	21	5.2	0	1979	Y	-		On block boundary, adjacent to At patch
39	Plot-511-5911	511,000	5,911,000	093G036	653	FD	SX	AT	39	13.6	61.6	1969	Y	Q		In creek
40	Plot-510-5911	510,000	5,911,000	093G036	693	FD	PL	SX	15	3.7	0	1985	N	-		On M/L right of way

APPENDIX II – SAMPLING METHODS VARIANCE FROM CMI STANDARDS

Attribute	MOF CMI Standard[13]	TFL 5 CMI
Plot Establishment		
Tree tags	Affixed at stump height	Tags will be nailed at breast height. Tagging sector (1-8) will be recorded in column S1 of Card 8.
Plot boundary overlaps with adjacent polygon outside target population (eg., mature / old growth stand, permanent road)	No provision other than to sample all trees as per CMI standards, regardless if managed or old growth.	Trees outside the target population will be identified in column S2 of card 8 (I=in, O=out). If a tree outside target population is identified as the site tree, then also sample an equivalent PHR site tree from within the target population (see tree msmts below). Map portion of plot outside target population using map drawing on CL card. Reference boundary line using 1:5,000 ortho image with forest cover polygons overlaid.
Plot Measurements		
Range data	Collected	Not collected
Ecology data	Collected	Only visual estimation of site series from the 11.28 m radius plot. No other eco data collected.
Tree Measurements		
Top height tree	Selected from 5.64 m radius plot	Selected from 5.64 m radius plot. Record as 'T' tree.
Leading / second species	Determined as those species with largest and second largest basal area from 5.64 m radius plot. L and S trees sampled from within each 11.28 m radius plot.	Not pre-determined. Instead, potential site trees are measured from each species in each 11.28 m radius quad. Record as 'S' tree. Where plot boundary overlaps with adjacent stand outside target population and the 'S' tree is determined outside the target population, then two 'S' trees are measured (one from the stand outside target population and one from PHR stand inside target population).
Non-largest DBH trees (leading and second species)	Not measured	Potential site trees are measured from the next largest DBH tree of each conifer species in each 11.28 m quad, if the largest DBH tree is unsuitable for site index. Record as 'O' tree. Where plot boundary overlaps with adjacent mature / old growth stand, do not sample 'O' tree from the adjacent older stand.
Stump / CWD Measurements		
Stumps	Collected from 2.54m radius plot.	Collected from 2.50 m radius plot.
CWD	Sampled from two 30m transects extending from the IPC (includes CWD and SWD)	Sampled from two 24 m transects extending from the IPC, for CWD only. SWD is not sampled. (note, this is consistent with the previous 2002 CMI standards[14]).

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[13] Ministry of Sustainable Resource Management National Forest Inventory – BC Change Monitoring Procedures for Provincial and National Reporting March 31, 2003. Ver. 1.3. http://srmwww.gov.bc.ca/risc/pubs/teveg/cmi2k3/cmi_ground_2k3.pdf

[14] Ministry of Sustainable Resource Management Change Monitoring Inventory – Ground sampling procedures for the provincial CMI program. March 29, 2002. Ver. 1.2.

APPENDIX III – TFL 5 LANDBASE

Weldwood's TFL 5 covers approximately 35,000 ha, of which 33,000 ha (95%) are productive (Table 2). Douglas-fir (Fd), interior spruce (Sx), and lodgepole pine (Pl) account for 85% of all leading species in the productive forest of the TFL (Table 3). Approximately 41% of the area is covered by stands up to 40 years of age, while 28% of the area is 121 years and older.

Table 2. TFL 5 Area distribution.

Landbase	Area (ha)	(%)
Entire Landbase	34,640	100
Non-Forest, non-producitve	1,680	5
Productive Forest	32,960	95

Table 3. TFL 5 Area distribution by leading species and age class.[15]

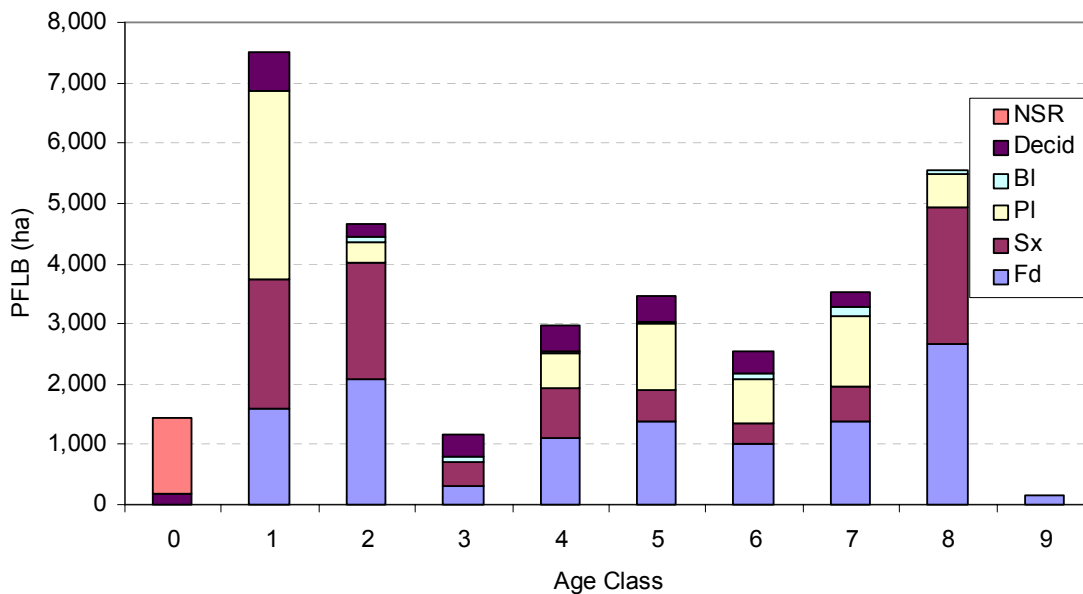| Spp	Age Class 0	1	2	3	4	5	6	7	8	9	Total (ha)	(%)
Fd		1,602	2,085	319	1,111	1,378	1,011	1,368	2,667	141	11,683	35%
Sx		2,145	1,929	374	811	537	343	579	2,266		8,984	27%
Pl		3,119	351	25	588	1,081	737	1,183	548		7,632	23%
Bl		6	81	71	32	24	97	163	58		533	2%
Decid	188	631	219	371	421	456	359	229			2,876	9%
NSR	1,250										1,250	4%
Total	1,438	7,504	4,665	1,160	2,964	3,476	2,549	3,522	5,539	141	32,957	100%
%	*4%*	*23%*	*14%*	*4%*	*9%*	*11%*	*8%*	*11%*	*17%*	*0%*	*100%*	

Figure 2. PFLB area distribution by leading species and age class.

[15] Age class attributes are projected in the inventory filie to the year 2002.

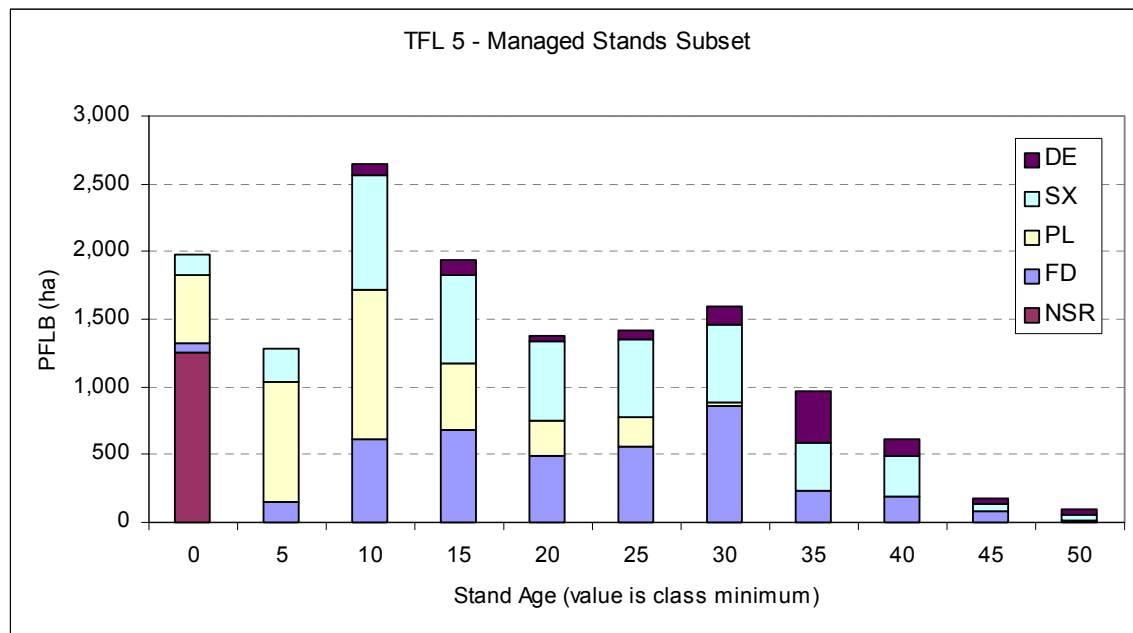## APPENDIX IV – AREA DISTRIBUTION BY AGE AND LEADING SPECIES

Figure 3. Area distribution by stand age.

Table 4. Species distribution by age class (ha).

Age class	Leading Species						Total	%
	NSR	Fdi	Pl	Sx	Decid	Bl		
0 – 4	1,250	70	503	160			1,982	14%
5 – 9		147	886	247			1,279	9%
10 – 14		614	1,100	856	83		2,652	19%
15 - 19		680	491	662	106	6	1,939	14%
20 – 24		493	257	590	43	1	1,382	10%
25 – 29		565	210	582	62	2	1,418	10%
30 – 34		861	24	580	127	48	1,591	11%
35 - 39		230	0	357	380	31	968	7%
40 – 44		197		300	121	29	619	4%
45 – 49		88		47	48	0	183	1%
50 – 54		12	7	35	47	41	101	1%
Total	1,250	3,956	3,477	4,416	1,017	158	14,273	100%
%	9%	28%	24%	31%	7%	1%	100%	

APPENDIX V – STAND HISTORY AREA DISTRIBUTION

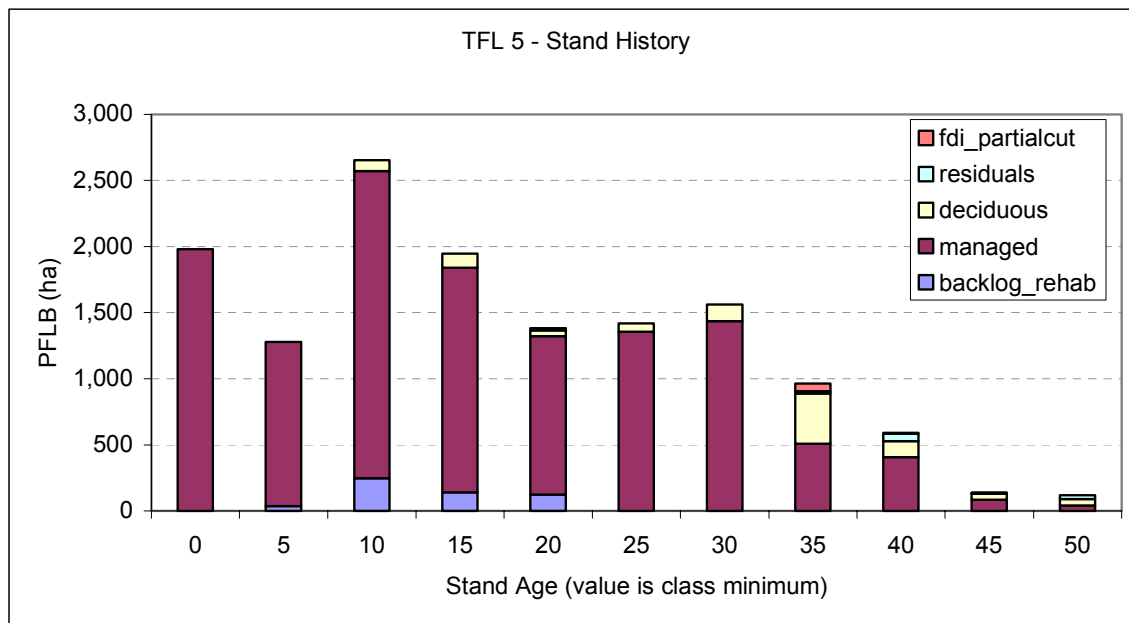Figure 4. Stand history by age class for the PFLB.

Table 5. Stand history distribution by age class (ha).

Age class	Stand history						Total	%
	Managed	Backlog Rehab	Decid	Overstory Residuals	Natural	Fdi Partial cut		
0 – 4	1,982						1,982	14%
5 – 9	1,243	36					1,279	9%
10 – 14	2,324	246	83				2,652	19%
15 - 19	1,698	142	106				1,946	14%
20 – 24	1,201	122	43	17			1,383	10%
25 – 29	1,356		62	2			1,420	10%
30 – 34	1,435		127		78		1,639	11%
35 - 39	509		380	18	36	55	998	7%
40 – 44	406		121	56	56	8	648	5%
45 – 49	85		48	4	45	2	183	1%
50 – 54	43		47	30	23		142	1%
Total	*12,282*	*546*	*1,017*	*126*	*237*	*65*	*14,273*	*100%*
%	*86%*	*4%*	*7%*	*1%*	*2%*	*0%*	*100%*	

APPENDIX VI – CMI ALTERNATE SAMPLING OPTIONS

The top table summarize the different establishment sample sizes by varying the grid establishment size between 500m (0.5km) and 2,500m (2.5km). The bottom table summarizes the impact using the 1,000m grid (1.0km) that different age ranges to define the sample population have on sampling frequency and future recruitment rates in the next five and ten year periods. Shaded rows identify the option selected for this project.

Grid size	sample size 15-29 yrs	sample size 15-34 yrs	sample size 15-39 yrs	sample size 15-44 yrs	sample size 15-49 yrs	sample size 15-54 yrs	annual area harvest @300m3/ha)	grid ha / plot	estimated recruitment / yr	estimated recruitment / 5 yrs	sample grid recruitment 10-14 yrs
500	176	229	252	273	275	278	400	25	16	80	107
1000	37	52	59	67	68	69	400	100	4	20	25
1500	20	24	26	30	30	31	400	225	2	9	11
2000	12	18	18	20	20	20	400	400	1	5	7
2500	7	9	10	12	12	12	400	625	1	3	6

Grid	sample population age range	2003 grid sample population	2003 adjusted sample size	sample frequency to achieve adjusted sample size	annual adjusted recruitment rate	2003 total field costs	2008 recruitment sample size	2008 estab costs	2008 remeas costs	2008 total field costs	2013 recruitment sample size	2013 estab costs	2013 remeas costs	2013 tota field costs
1000	15-29	37	30	81%	3.2	57,000	16	30,800	28,500	59,300	16	30,800	43,900	74,700
1000	15-34	52	30	58%	2.3	57,000	12	21,900	28,500	50,400	12	21,900	39,500	61,400
1000	15-39	59	30	51%	2.0	57,000	10	19,300	28,500	47,800	10	19,300	38,200	57,500
1000	15-44	67	30	45%	1.8	57,000	9	17,000	28,500	45,500	9	17,000	37,000	54,000
1000	15-49	68	30	44%	1.8	57,000	9	16,800	28,500	45,300	9	16,800	36,900	53,700