

100 Mile House Timber Supply Area – TSA 23 AND Kamloops Timber Supply Area – TSA 11

Vegetation Resources Inventory Project Implementation Plan for Young Stand Monitoring (YSM) Sampling

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April 21, 2014

Executive Summary

This Vegetation Resources Inventory (VRI) Project Implementation Plan (VPIP) is the planning document that will be used as a guide for establishing VRI Young Stand Monitoring (YSM) samples across the combined 100 Mile House and Kamloops Timber Supply Areas (TSAs). The details recorded in this plan regarding this project include:

- an outline of the land base including the netting down process;
- documentation of the sample selection;
- a listing of all sample locations; and
- confirmation of the sampling protocols for this VRI activity.

This Project Implementation Plan has been prepared following the documents:

- *Vegetation Resources Inventory Sample Selection Procedures for Ground Sampling v4.0 DRAFT*
- *VRI Guidelines for Preparing a Project Implementation Plan for Ground Sampling and Net Volume Adjustment Factor Sampling (Version 3.1)*
- *Streamlining VRI Ground Sampling - Volume Audit Sampling*
- *A Framework for Implementing Young Stand Growth Monitoring in British Columbia (2012)*

The land base used to select the Young Stand Monitoring samples was not restricted to the Vegetated Treed (VT) land base. The YSM samples were selected from the population greater than or equal to 15 years and less than or equal to 50 years. The following exclusions occurred to net down the land base during the sample selection process:

- private land, parks, and federal lands including Indian Reserves and Military Reserve.

A set of seventy (70) samples were selected based on a 5 X 10 km grid provided by the Ministry. There was no stratification of this population during the sample selection.

Table of Contents

1.0 Introduction	1
1.1 Document Objectives	1
1.2 Project Land base	2
1.3 State of the Inventory	4
2.0 Ground Sampling Plan	4
2.1 Sampling Objectives	4
2.2 Target Population	4
2.3 Sample Size	5
2.4 Strata – Young Stand Monitoring Population	5
2.5 YSM Sample Selection	5
2.6 Sample Establishment Methodology	6
3.0 Implementation Plan	6
3.1 Sample Packages	6
3.2 Standards	6
3.3 Sample List	6
3.4 Project Files	6
3.5 Project Analysis	7
Bibliography	7
VRI Standards and Procedures	7
Appendices	
Appendix A: Sample List for YSM Samples	9
Appendix B: Comparison of Sample to the Population	13
Appendix C: Sampling Selection Process and Methodology	14
List of Figures	
Figure 1. Map of Combined 100 Mile House & Kamloops TSAs	3
List of Tables	
Table 1. 100 Mile House & Kamloops TSAs Land Base Summary	2
Table 2. Species Distribution – YSM – Ages 15-50	4
Table 3. Age Class Distribution – All Species	5

1.0 Introduction

The Vegetation Resources Inventory (VRI) is the standard for forest cover inventory in the province of British Columbia (BC). It follows a set of procedures with associated standards, administered by the Ministry of Forests, Lands and Natural Resource Operations (MFLNRO or 'the Ministry'). The VRI was designed to answer two questions: "Where is the resource located?" and "How much of given vegetation resource is within an inventory unit?"¹

The VRI is a photo based, 2-phase program. Phase 1 involves photo interpretation, delineating polygons of homogenous land cover types and providing estimates of the vegetation attributes for each polygon. Phase 2 includes several ground sampling activities. The Volume Audit (VA) activity samples a random subset of polygons to verify the confidence in the accuracy of the Phase 1 volumes as well as some of the other key vegetation attributes. It provided detailed information on tree size and condition. Ground sampling may also include the Young Stand Monitoring (YSM) activity. YSM involves the establishment of long term monitoring plots following the Change Monitoring Inventory (CMI) standard. It is intended that these plots will be remeasured at a fixed interval.

Two separate Project Implementation Plans (VPIPs) have been prepared to outline Phase 2 projects including Volume Audit sampling in 100 Mile House Timber Supply Area (TSA) and Kamloops TSA. Additionally, these plans identified the location of a set of Air Call samples to be completed in each TSA.

This VRI Project Implementation Plan has been prepared to outline the details of establishing a Young Stand Monitoring program in the combined areas of the 100 Mile House and Kamloops TSAs.

1.1 Document Objectives

The objectives of preparing this Project Implementation Plan are two-fold. This document provides a record of the decisions made to develop the Young Stand Monitoring sample list. It also serves as a guide for undertaking this project.

Specific details provided in this VPIP include the identification of:

- decisions made in the development of the sampling population and sample list;
- the sampling population;
- sample list for the YSM establishment locations;
- CMI data collection methodology for the YSM sampling; and
- deliverables for the project.

¹ From the MFLNRO, Forest Analysis & Inventory Branch, Vegetation Resources Inventory website – Overview - <http://www.for.gov.bc.ca/hts/vri/intro/overview.html>

1.2 Project Land base

Both the 100 Mile House TSA and the Kamloops TSA are located in south central British Columbia. These TSAs are administered from the Ministry of Forests, Lands and Natural Resource Operations' ('the Ministry') offices in 100 Mile House and Kamloops respectively. The 100 Mile House TSA boundary coincides with the 100 Mile House Forest District Boundary, which is part of the Cariboo Region. The Kamloops TSA boundary coincides with the Thompson Rivers Forest District boundary, administered from the Ministry office in Kamloops. Together, the two TSAs cover approximately 4 million hectares.

On each TSA, a Phase 1 inventory has recently been completed. The photography was taken following the Mountain Pine Beetle (MPB) epidemic, so it reflects the current state of the forest.

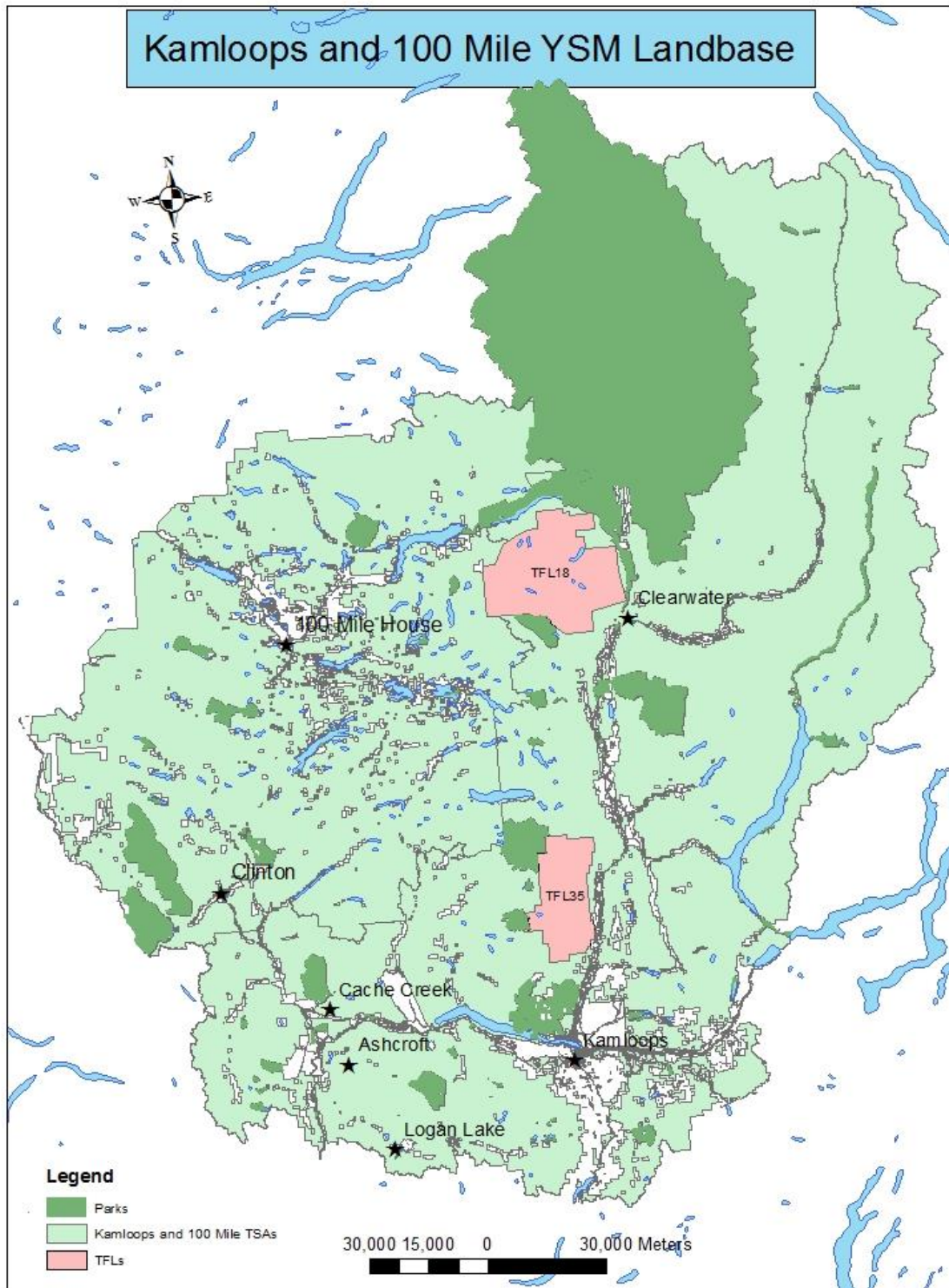
Table 1 show the land base distribution in the entire combined 100 Mile House and Kamloops TSAs.

**Table 1: 100 Mile TSA and Kamloops TSA
Combined Land base Summary**

Land Classification	Area (ha)	% of Proj Area
Total TSA Area	3,891,801	100.00%
Net-downs	1,011,545	25.99%
Parks	677,955	17.42%
Private	294,166	7.56%
Federal	39,424	1.01%
Net Area	2,880,256	74.01%
Non Vegetated	167,505	4.30%
Vegetated	2,712,751	69.70%
Non-Treed	368,263	9.46%
Treed	2,344,488	60.24%

Figure 1 provides an overview map of project area, which is the combined 100 Mile House TSA and Kamloops TSA.

Figure 1. Overview map YSM project area - 100 Mile House and Kamloops TSAs



1.3 State of the Inventory

A Project Implementation Plan was prepared to outline the Phase 1 photo acquisition and photo interpretation in both TSAs. The photos were flown for each TSA in 2011. The photo interpretation projects for both the 100 Mile House TSA and the Kamloops TSA projects were delivered to the Ministry in early 2014.

The inventory files used for this project's sample selection reflect the following updates:

- harvest and reforestation updates current to 2014
- ages projected to 2014

2.0 Ground Sampling Plan

2.1 Sampling objectives

This plan's focus is on the establishment of a Young Stand Monitoring program in the target population of the recently re-inventoried 100 Mile House and Kamloops Timber Supply Areas. The YSM activity follows the Change Monitoring Inventory (CMI) procedures and standards. The primary focus of the YSM program is to check the accuracy of growth and yield (G&Y) predictions of key timber attributes in young stands, to support management unit timber supply review. No sampling error target will be set for the Young Stand Monitoring project. The YSM program targets a statistical power and difference between actual and predicted G&Y estimates.

2.2 Target Population

The area for the Young Stand Monitoring project is not restricted to the Vegetated Treed (VT) land base. It includes all stands ≥ 15 years and ≤ 50 years, excluding private land, parks and federal lands (military reserves and Indian reserves). Community Forests and Woodlots have been retained.

Tables 2 and 3 provide land base figures for the Young Stand Monitoring population.²

Table 2: Species Distribution – Young Stand Monitoring Population - Ages 15-50

Species	Area	%
P	151,366	43%
S	79,169	23%
FD	56,195	16%
BL	36,806	11%

² Numbers related to identifying the sampling population are the result of analytical work completed by Nona Phillips Forestry Consulting, using current data files provided by the Ministry. All work has followed the *VRI Sample Selection Standard* and has been documented in a Sample Selection Report provided to the government.

AT	9,973	3%
CW	6,155	2%
EP	5,776	2%
HW	4,464	1%
LW	81	0%
XH	42	0%
Total	350,027	100%

Table 3: Age class Distribution, All Species – Young Stand Monitoring Population, Ages 15 - 50

Age Class	Area	%
1	68426	20%
2	220194	62%
3	61407	18%
Total	350,027	100%

In summary, based on the target population in the combined 100 Mile House TSA and Kamloops TSA, the land base in the Young Stand Monitoring population is 350,027 hectares.

2.3 Sample Size

The contract *Schedule A* stated that a total of approximately 70 samples would be established in the Young Stand Monitoring population for 100 Mile House and Kamloops TSAs. A series of sampling grids were provided by the Ministry and the results are discussed in section 2.5 below and further detailed in Appendix C.

2.4 Strata – Young Stand Monitoring Population

There is no pre-stratification of the Young Stand Monitoring population.

2.5 Young Stand Monitoring Sample Selection

The initial step in preparing this plan was to define the land base for the YSM sampling population. Appendix C outlines the sample selection process used in planning for undertaking this project. It details the identification of the population areas and the distribution of the YSM samples.

In the combined 100 Mile House and Kamloops TSAs, the Young Stand Monitoring sample selection was grid based. A series of grids were overlaid on the land base and the number of potential samples was identified. The Ministry staff reviewed the

outcome of various grids and it was decided that a 5 X 10 km grid met the sampling list development requirement. Seventy (70) points fell within the YSM population. The YSM samples are numbered 201 to 270.

The sample list for the YSM samples is provided in Appendix A.

2.6 Sample Establishment Methodology

The sampling design for the establishment of the Young Stand Monitoring samples will follow the Change Monitoring (CMI) Procedures and Quality Assurance (QA) Standard. The work will be completed by certified VRI Timber contractors. Any changes or additions to the CMI Procedures will be clearly outlined at the outset of the project.

3.0 Project Implementation

3.1 Sample Packages

Sample packages will be prepared following Ministry direction for all samples selected in this 100 Mile House TSA and Kamloops TSA Project Implementation Plan for Young Stand Monitoring. They will include tools that support the field crews in their efforts to navigate to, and establish each sample in the correct location.

3.2 Standards

When the project is initiated, the participants should access the Forest Analysis and Inventory Branch website to confirm that they are using the latest version of the appropriate Ministry Standards. The website and Standards relevant to this project are listed in this document, following the Bibliography.

3.3 Sample List

A complete sample list for the YSM sampling is provided in Appendix A. A description of how samples were distributed across their population is included in Appendix C.

3.4 Project Files

The original population files used to determine the selection will be provided to, and kept on file by, Forest Analysis and Inventory Branch staff.

3.5 Project Analysis

Statistical analysis projects will be conducted on all of the data collected. Other sampling occurring in the area may be used in the analysis projects as well.

Bibliography

1. BC Ministry of Forests, Lands and Natural Resource Operations website for VRI - www.for.gov.bc.ca/hts/VRI/
2. Ministry of Forests, Lands and Natural Resource Operations. A Framework for Implementing Young Stand Growth Monitoring in British Columbia. 2012.
3. Ministry of Forests, Lands and Natural Resource Operations. Streamlining VRI Ground Sampling -Volume Audit Sampling. 2011.
4. Nona Phillips Forestry Consulting. Cranbrook TSA, TFL18, Mackenzie TSA, TFL53, Kootenay Lake, Morice and Williams Lake TSA Vegetation Resources Inventory Project Implementation Plans. February 2011 (Cranbrook), March 2011 (TFL18), June 2011 (Mackenzie), July 2011 (TFL53), July 2011 and March, 2012 (Kootenay Lake), March 2012 (Morice), March 2013 (Williams Lake), March 2014 (Prince George).
5. Nona Phillips Forestry Consulting. Kamloops TSA and 100 Mile House TSA VRI Project Implementation Plans – Volume Audit Sampling and Air Calls. DRAFT editions, April 2014.
6. Various. Personal Communication with Ministry of Forests, Lands & Natural Resource Operations staff members Chris Mulvihill and Matt Makar regarding issues related to the preparation of the 100 Mile House TSA VPIP.

VRI Standards & Procedures

The list of VRI Standards and Procedures that have been followed in the preparation of this plan and project to date and that must be followed to complete the 100 Mile House TSA VRI ground sampling projects is provided below. The most current edition should be used when this project is undertaken. They will be found at the VRI website:

<http://www.for.gov.bc.ca/hts/VRI/>

Planning and Sample Selection:

Vegetation Resources Inventory Guidelines for Preparing a Project Implementation Plan for Ground Sampling and Net Volume Adjustment Factor Sampling Version 3.1, March 2010

VRI Phase 2 Post-Project Documentation and Deliverables, June, 2007

Vegetation Resources Inventory Sample Selection Procedures for Ground Sampling DRAFT Version 4.0 May 2011

Ground Sampling, Change Monitoring Inventory (CMI):

Change Monitoring Procedures for Provincial Reporting. Version 1.0, June 2012

Change Monitoring Procedures for Provincial Reporting Appendices. Version 1.5, June 2012

Change Monitoring Inventory Ground Sampling Quality Assurance Procedures. Version 1.1, March 2002

Change Monitoring Inventory Ground Sampling Standards. Version 2.2 June 2012

VRI – Data Analysis

VRI Sample Data Analysis Procedures and Standards. Version 1.0, June 2011

Appendix A

Young Stand Monitoring Sample List

The following is the sample list for the 100 Mile House and Kamloops Timber Supply Areas Young Stand Monitoring project. There are 70 samples in this list, numbered 201 to 270.

The shapefiles for this population includes all of the data fields from the originally supplied VRI database.

Kamloops and 100 Mile YSM Sample List

Sample	Mapsheet	POLYGON	Zone	East	North	Sp	Sp%	AGE	Ht	BA	Stems/ha
201	092I038	092I03874089051	10	676632	5583286	PLI	90	18	2.3	0	3933
202	092I055	092I05511551038	10	632591	5605246	PLI	90	15	3.0	0	6000
203	092I066	092I06697876959	10	648009	5614569	PLI	90	22	6.0	12	2000
204	092I064	092I06446307266	10	623045	5615669	FDI	100	42	5.0	1	100
205	092I090	092I09051658605	10	708822	5631880	PLI	40	17	4.9	4	2240
206	092I097	092I09756394563	10	659319	5644090	PLI	100	18	7.0	6	2000
207	092I096	092I09669244434	10	644337	5644752	FDI	90	42	10.0	10	750
208	092I100	092I10022000115	10	704718	5652082	SX	60	42	12.0	14	1250
209	092P008	092P00847270300	10	674746	5653416	SE	70	32	6.0	5	1250
210	092P007	092P00757500392	10	659761	5654079	PLI	60	16	2.0	0	5667
211	092P005	092P00580710388	10	629793	5655398	PLI	90	27	4.0	5	2500
212	092P004	092P00492860568	10	614810	5656054	FDI	90	42	8.0	10	1200
213	092P017	092P01757766262	10	660203	5664071	PLI	90	17	4.0	3	2500
214	092P015	092P01511446251	10	635227	5665170	EP	70	42	12.0	1	50
215	082M012	082M01268572034	11	310917	5669258	FDI	75	27	9.0	17	2300
216	082M011	082M01180201979	11	296033	5671147	FDI	30	22	4.4	8	5258
217	092P019	092P01962552074	10	695615	5672511	FDI	90	22	7.0	1	800
218	092P025	092P02581462110	10	630669	5675378	FDI	100	48	16.0	20	1050
219	092P023	092P02362512422	10	610688	5676253	FDI	80	38	6.0	2	2000
220	082M022	082M02269017804	11	312178	5679183	BL	80	32	8.0	6	850
221	092P029	092P02906538083	10	686066	5682950	BL	60	42	9.0	16	2515
222	092P028	092P02874648052	10	681069	5683171	PLI	90	17	4.0	15	6000
223	092P033	092P03328567943	10	606128	5686462	PLI	90	24	2.3	2	5544
224	092P032	092P03277387993	10	596137	5686898	PLI	75	17	3.0	1	1500
225	092P032	092P03215158198	10	586146	5687331	PLI	100	23	1.7	1	4710
226	082M024	082M02444663827	11	343207	5685320	PLI	45	24	11.0	25	2500
227	092P040	092P04021414042	10	706498	5692056	SE	50	17	1.8	0	4333
228	092P036	092P03669133972	10	646534	5694705	PLI	80	21	7.0	10	2250
229	092P044	092P04490754074	10	616556	5696018	PLI	90	17	2.5	5	3974
230	092P041	092P04185053930	10	581584	5697540	PLI	50	15	2.5	5	5262

231	092O060	092O06001019489	10	567028	5708180	PL	95	33	7.0	7	2200
232	082M045	082M04574405683	11	350697	5704536	BL	70	34	8.0	6	850
233	082M044	082M04416235544	11	340774	5705800	SX	55	32	8.0	10	1200
234	082M044	082M04487525732	11	335812	5706430	SX	40	27	8.0	5	950
235	082M043	082M04356335702	11	330850	5707063	FDI	85	15	3.5	6	1120
236	092P060	092P06092555667	10	702387	5712271	PLI	80	33	6.0	10	1480
237	092P054	092P05493145706	10	617427	5716003	PLI	90	33	10.0	10	1000
238	092P053	092P05305815679	10	602437	5716656	PLI	90	19	3.0	2	5107
239	092P052	092P05245595602	10	592442	5717091	PLI	85	40	8.0	10	1250
240	092P061	092P06156805648	10	577452	5717740	PL	75	33	7.0	10	1850
241	082M053	082M05327601512	11	327151	5717619	SE	70	18	4.5	5	1400
242	092P070	092P07092461589	10	702829	5722268	EP	40	27	11.0	20	1500
243	092P061	092P06185371413	10	582882	5727519	PL	99	26	2.2	1	3907
244	092P061	092P06155301648	10	577885	5727735	PL	75	23	4.0	1	650
245	092P061	092P06129011546	10	572888	5727952	PL	90	20	2.2	3	7180
246	082M064	082M06485207583	11	338340	5726281	FDI	80	37	15.0	15	850
247	082M063	082M06397477481	11	323451	5728176	PLI	75	27	12.0	20	1600
248	082M062	082M06269227455	11	318488	5728809	PLI	70	22	6.0	10	2000
249	082M062	082M06240877583	11	313524	5729439	SX	30	42	14.0	25	1800
250	082M061	082M06179947469	11	303596	5730703	SE	60	46	9.0	10	1000
251	082M061	082M06150967552	11	298632	5731333	BL	80	42	11.0	20	1000
252	082M074	082M07456043194	11	334642	5736840	BL	60	37	12.0	5	750
253	082M085	082M08504739110	11	360724	5743601	SX	50	17	6.0	5	2500
254	082M083	082M08369229218	11	321016	5748662	SX	40	50	14.1	21	1323
255	082M082	082M08209599510	11	311087	5749926	BL	60	37	8.0	10	800
256	092P097	092P09726529154	10	659159	5754241	FDI	40	18	9.0	25	2250
257	082M094	082M09486595270	11	342137	5756061	BL	70	37	12.0	15	900
258	093A003	093A00305585192	10	604608	5766635	PLI	50	33	8.0	15	1200
259	083D004	083D00456321467	11	338440	5766621	PLI	70	22	9.0	3	1500
260	093A007	093A00730830665	10	660034	5774238	SX	95	27	6.0	5	1800
261	093A007	093A00704860837	10	655034	5774456	SE	50	29	9.0	15	1800
262	093A016	093A01670301252	10	650035	5774675	PLI	60	29	5.5	6	2640
263	093A014	093A01463181110	10	615040	5776197	PLI	60	25	5.0	2	800

264	083D014	083D01459287133	11	339706	5776550	SX	60	37	14.0	20	1600
265	083D013	083D01327387123	11	334741	5777184	SX	60	22	7.0	20	2000
266	083D026	083D02605588640	11	367063	5793236	BL	100	27	3.0	1	1200
267	083D034	083D03486805190	11	348474	5805704	BL	85	47	7.0	5	700
268	083D034	083D03455834501	11	343509	5806338	BL	50	37	11.0	10	450
269	083D044	083D04457160727	11	344777	5816269	SX	70	40	18.6	35	600
270	083D056	083D05675646533	11	365908	5823659	BL	80	32	3.0	3	1200

Appendix B

Comparison of the Sample Characteristics to the Population

The following tables show how the sample distribution compares to the population distribution for age class, height class and leading species. Sample and populations compare quite closely.

Age Class Comparison for YSM

Age Class	Area	%	Samples	%
1	68426	20%	17	24%
2	220194	62%	41	59%
3	61407	18%	12	17%
Total	350,027	100%	70	100%

YSM Height Class Comparison

Height Class	Population Area	%	Samples	%
1	272,008	78%	55	79%
2	76,423	22%	15	21%
3	1,558	0%		0%
4	39	0%		0%
Total	350,027	100%	70	100%

YSM Species Comparison

Species	Area	%	Samples	%
PL	151,196	43%	31	44%
S	79,169	23%	15	21%
FD	56,195	16%	11	16%
BL	36,806	11%	11	16%
AT	9,973	3%		0%
CW	6,155	2%		0%
EP	5,776	2%	2	3%
HW	4,464	1%		0%
PY	109	0%		0%
LW	81	0%		0%
PW	61	0%		0%
XH	42	0%		0%
Total	350,027	100%	70	100%

Appendix C

Sample Selection Process and Methodology for the Young Stand Monitoring Project in the combined project area of 100 Mile House TSA and Kamloops TSA

1) Data assembly Process

All the shapefile data was obtained from Chris Mulvihill, the project coordinator with Ministry of Forests, Lands & Natural Resource Operations ('the Ministry'). There was a set of data for each of Kamloops and 100 Mile TSAs. The individual TSA files were netted down in the Volume Audit sample selection process for each of the TSAs. The above individual VRI files were merged to get the VRI base for Young Stand Monitoring (YSM). This file was called 100M_Kamloops_VRI_Merge. To get the YSM population file for this project Proj_Age greater than or equal to 15 and less than 51 selected from the above merged file. This file was called YSM_Pop.

The following table is a summary of the project area.

Table 1: YSM Project Land base Summary

Land Classification	Area (ha)	% of Proj Area
Total TSA Area	3,891,801	100.00%
Net-downs	1,011,545	25.99%
Parks	677,955	17.42%
Private	294,166	7.56%
Federal	39,424	1.01%
Net Area	2,880,256	74.01%
Non Vegetated	167,505	4.30%
Vegetated	2,712,751	69.70%
Non-Treed	368,263	9.46%
Treed	2,344,488	60.24%

2) Sample selection for Young Stand Monitoring Samples

The Young Stand Monitoring population was not subdivided into strata or sub-strata.

The following tables summarize the YSM population for species and age class.

Table 2: Species Summary for YSM

Species	Area	%
PL	151,196	43%
S	79,169	23%
FD	56,195	16%
BL	36,806	11%
AT	9,973	3%
CW	6,155	2%
EP	5,776	2%
HW	4,464	1%
PY	109	0%
LW	81	0%

PW	61	0%
XH	42	0%
Total	350,027	100%

Table 3: Age Class Summary for YSM

Age Class	Area	%
1	68426	20%
2	220194	62%
3	61407	18%
Total	350,027	100%

Direction from the Ministry was to select Young Stand Monitoring samples based on a grid provided by them. Four grids were tested to determine how many samples fell in the population. The following table shows the results.

Table 4: Report of Points Per Grid Yield for YSM

Grid	Points in YSM Population
4X20	45
5X10	70
4X10	90
5X5	143

The Ministry directed that the 5 km by 10 km grid would be used. This totaled 70 samples with no alternates. These were numbered 201 to 270.

The clipped 5X10 km grid was used as the base for the sample shapefile. Two new fields were added to this attribute table. One was called FID2 to allow joining the VRI attributes to the sample table. The other was for sample numbers. UTM coordinates were calculated. The VRI attributes were then joined to the sample shapefile. From this the sample lists were developed.