

Morice Timber Supply Area – TSA 20

**Vegetation Resources Inventory
Project Implementation Plan for Volume Audit
Sampling, Young Stand Monitoring and Net
Volume Adjustment Factor Sampling**

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Executive Summary

This Vegetation Resources Inventory (VRI) Project Implementation Plan (VIP) is the planning document that will be used as a guide for the Morice Timber Supply Area (TSA) VRI ground sampling project. The critical work undertaken and recorded in this plan for this TSA includes: deciding the requirements around netting down the land base for Young Stand Monitoring (YSM) and Volume Audit sampling; completing the sample selection for the YSM and Volume Audit and Net Volume Adjustment Factor (NVAF) ground sampling; identifying each sample's location; providing documentation of the sample selection; and confirming details regarding the sampling protocols that will be undertaken.

This Project Implementation Plan has been prepared following the documents:

- *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 (VA) Sampling*
- *A Framework for Implementing Young Stand Growth Monitoring in British Columbia (2012)*

The *Volume Audit Sampling* guideline identifies some standardized items on which to build the VRI ground sampling plan for a management unit. These include:

1. Identifying the populations in the TSA.
2. Establishing the Vegetated Treed (VT) portion of the Morice TSA as the land base for the Volume Audit sample selection.
3. Indicating a sample size of fifty (50) samples in the Volume Audit population.
4. Directing the completion of the Volume Audit sample list development and identification of sample locations within the selected polygons according to the *Vegetation Resources Inventory Sample Selection Procedures for Ground Sampling Version 4.0 DRAFT*.

Young Stand Monitoring will be confined to stands ≥ 15 years and ≤ 50 years. The document *A Framework for Implementing Young Stand Growth Monitoring in British Columbia* outlines details for YSM. The land base for these samples is NOT restricted to the VT. The sample selection for YSM samples is grid based. Based on a 2 km grid provided by Forest Analysis and Inventory Branch (FAIB) staff, a sample list of fifty (50) YSM samples has been developed.

The Volume Audit ground sample selection has been completed based on four strata. The strata were developed after analysing the leading species representation in the Volume Audit population.

- Stratum 1: Pine
- Stratum 2: Balsam
- Stratum 3: Spruce
- Stratum 4: Other

The YSM sample selection involves no pre-stratification.

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1.0 Introduction

The Vegetation Resources Inventory (VRI) is the inventory 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 (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 is ground sampling to verify the accuracy of volumes and some of the key Phase 1 vegetation attributes. It also includes monitoring.

This Project Implementation Plan will provide details to guide the Volume Audit, Net Volume Adjustment Sampling (NVAF) and Young Stand Monitoring (YSM) in the Morice Timber Supply Area (TSA). The YSM samples are being established as long term monitoring plots and are intended to be remeasured at an interval to be determined later.

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 this VRI ground sampling project. It also serves as a guide for those undertaking the project. Specific details include the identification of: sampling population; decisions made in the development of sample lists; sample lists for ground sampling in both the Volume Audit population and for Young Stand Monitoring and NVAF enhancement; VRI plot data collection methodology for both the audit and YSM populations; and deliverables for the ground sampling project.

1.2 Project Land base²

The Morice TSA is located in north-western British Columbia, on the western edge of BC's central interior plateau. The TSA extends from the most northerly tip of Babine Lake in the north to Ootsa and Whitesail Lakes in the south, covering approximately 1.5 million hectares in the Northern Interior Region.

Figure I shows the general location and key geographic features of the Morice TSA.

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

² Text adapted from the Morice TSA AAC Rationale, 2008.

Figure 1. Map of Morice TSA³



The Morice TSA is administered by the Nadina District of the Ministry, located in Burns Lake. The main community in the Morice TSA is Houston, and the remainder of the population lives in smaller communities such as Topley and Granisle, or on the many ranches and farms along the Highway 16 corridor and in the area from Owen Lake to Francois Lake.

Approximately 70 percent of the total TSA being considered as productive forest. Table 1 shows the land base distribution.

³ Map adapted from BC government website:
http://www.for.gov.bc.ca/ftp/hth/external/!publish/web/timber-tenures/TFL-TSA-District-Map_1.pdf

Table 1: Morice TSA Landbase Distribution

Land Classification	Area	% of TSA
Total TSA Area	1,501,703	100
Net-downs	171,707	11.43%
Parks	134,899	8.98%
Private	34,740	2.31%
Indian Reserve	2,068	0.14%
Net Area	1,329,996	88.57%
Non Vegetated	291,212	19.39%
Vegetated	1,038,784	69.18%
Non-treed	180,432	12.02%
Treed	858,352	57.16%

The Morice TSA has a gentle, rolling landscape in the north and east, becoming more mountainous in the southwest. Major rivers include the Bulkley, Morice and Nadina. The overall climate is transitional between coast and interior, with cool summers and cold winters. The biogeoclimatic (BGC) zone variants in the Morice TSA are dominated by subalpine balsam spruce (SBS) forest types, with a significant amount of Engelmann spruce subalpine fir (ESSF) as well as some coastal western hemlock (CWH), boreal alтай fescue alpine (BAFA), mountain hemlock (MH) and coastal mountain heather alpine (CMA). Table 2, below, provides a BGC summary for the TSA.

Table 2: Morice TSA BEC Summary

BCG	Area
SBS mc 2	707,603
ESSFmc	216,865
ESSFmk	137,531
SBS dk	130,035
BAFAun	97,872
CWH ws 2	45,451
ESSFmcp	44,409
SBS wk 3	41,807
ESSFmcp	37,507
ESSFmv 3	25,951
MH mm 2	8,045
MH mmp	6,264
CMA un	1,631
ESSFmvp	727
CMA unp	5
Total	1,501,703

The main tree species are lodgepole pine (PI), subalpine fir (BI), and spruce (Sx, Sw and Sb). The majority of the forests in the TSA are currently mature and old (age class 6+). The Morice TSA has been included in an unprecedented high level of Mountain Pine Beetle infestation in British Columbia.

1.3 State of the Inventory

The most recent photography used in the Morice TSA was flown in 1993, with photo interpretation complete in 1994. The issue of inventory updates raised by the Chief Forester in the 2002 AAC Determination resulted in the follow-up step of continual updates.

In 1997, the Forest Inventory Branch staff completed an Inventory Audit for the Morice TSA to determine the accuracy, consistency and reliability of the current inventory information. The audit results suggested that the inventory was acceptable for the mature component, at that time.

2.0 Ground Sampling Plan

2.1 Sampling objectives

The Strategic Inventory plan for the Morice TSA was prepared for the local stakeholders in 2007. Listed among the business considerations behind this investigation of undertaking inventory projects was the requirement for improved information on the following:

- Mid-term timber supply
- Inventory update (e.g. regarding potentially changing species composition)
- Understory in MPB attacked stands
- Inventory attributes e.g. height, age, site index
- Dead tree volume
- Coarse Woody Debris
- Mountain Pine Beetle (MPB) affected stands – levels of attack, changes to current attributes and volumes
- Problem Forest Types

The forests of the Morice TSA do have more species diversity than many TSA's in the northern interior, but pine still represents more than 40 per cent of the total volume within the Timber Harvesting Land Base (THLB). The Nadina District's strategy to deal with the impacts of the MPB epidemic has been to maximize value recovery of dying and dead pine trees across the TSA. It follows that there is a lot of interest in the mid-term timber supply due to the imminent loss of green pine to the available productive forest.

In terms of the VRI process, the following sampling projects will be undertaken:

1. Volume Audit sampling and NVAF.
2. A monitoring program, following the CMI procedures and standards.

The sampling objective of the Volume Audit and NVAF sampling project is to verify the accuracy of volumes and other key attributes in the inventory. It will provide a statistically valid analysis of the Phase I inventory volumes on the mature population. A sampling error of 15% (net volume) is the target set for the Volume Audit population.

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 (TSR). No sampling error target will be set for the Young Stand Monitoring. The YSM program targets a statistical power and difference between actual and predicted G&Y estimates.

2.2 Target Population

The project uses two separate populations for sampling:

1. 15 to 50 years (Young Stand Monitoring)
2. 51 years and older in the VT (Volume Audit)

Tables 3, 4, 5 and 6 provide land base figures. For the Volume Audit population, figures in Tables 4 and 6 have formed the basis for decisions such as stratification of the population. The Young Stand Monitoring population is not restricted to the Vegetated Treed component of the land base, but is comprised of all stands $\geq 15 \leq 50$. This allows for the inclusion of silviculture openings where the crown closure in the database is less than 10%. These openings are an important portion of the YSM population. The Volume Audit population is > 50 and represents the Vegetated Treed land base.⁴

The exclusions from both the Volume Audit and the YSM land base have included Private land, Parks and Indian Reserves. Community Forests and Woodlots have been retained in the Morice TSA sampling projects' populations.

Table 3: Species Distribution – Morice TSA, Young Stand Monitoring Population, Ages 15-50

Species	Area (ha)	%
Pine	51,152	71%
Spruce	17,232	24%
Balsam	2,566	3%

⁴ 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.

Aspen (Cottonwood, Act)	1,146	2%
Birch	6	0%
Douglas-fir	4	0%
Cedar	1	0%
Total	72,107	100%

Table 4: Species Distribution – Morice TSA Total Vegetated Treed Land base, Volume Audit Population, Ages 51+

Species	Area (ha)	%
Balsam (B,BI,Ba)	295,724	38%
Pine (PI,Pa,Pli)	268,645	34%
Spruce (S,Sx,Sw,Sb)	176,906	23%
A (At,Ac,Act)	38,045	4%
Hemlock (H,Hm,Hw)	9,076	1%
Birch (Ep)	341	0%
Total	788,737	100%

Table 5: Age class Distribution, All Species – Morice TSA, Young Stand Monitoring Population, Ages 15 – 50

Age Class	Ages	Area (ha)	%
1	15-20	6,636	9
2	21-40	59,519	83
3	41-50	5,952	8
Total		72,107	100%

Table 6: Age class Distribution, All Species – Morice TSA Total Vegetated Treed Land base, Volume Audit Population, Ages 51+

Age Class	Ages	Area (ha)	%
3	51-60	4,950	1
4	61-80	52,374	7
5	81-100	90,599	11
6	101-120	70,541	9
7	121-140	82,270	10
8	141-250	384,248	49
9	251+	103,755	13
Total		788,737	100%

In the Morice TSA, the land base in the Young Stand Monitoring population encompasses a total area of 72,107 hectares and the Volume Audit population land base is 788,737 hectares.

2.3 Sample Size

Following the document *Streamlining VRI Ground Sampling Volume Audit Sampling*, a total of 50 ground samples will be established in the Volume Audit population. The Schedule A for this plan identifies that 31 additional samples will be selected as alternates.

The Schedule A also specifies that 50 Young Stand Monitoring samples and a minimum of an additional 100 alternates will be selected for the YSM phase of this project.

2.4 Strata

2.4.1 Ground Sampling

Volume Audit Population

The Volume Audit population has been stratified into species and species groupings as follows:

- Stratum 1: Pine
- Stratum 2: Balsam
- Stratum 3: Spruce
- Stratum 4: Other

The development of these strata was based on species distribution. Each stratum was further divided into 3 sub-strata with equal numbers of polygons, based on volume classes using the 17.5 cm utilization class volume.

Table 7 shows the distribution of ground samples in the Volume Audit population.

Table 7: Distribution of Ground Samples – Volume Audit population

Stratum	Population Area (ha)	% of area	# of Samples	# of hectares represented by each sample	Replacements
Balsam	295,723	37%	19	15,564.37	11
Pine	268,645	34%	17	15,802.65	10
Spruce	176,907	22%	11	16,082.45	7
Other	47,462	6%	3	15,820.67	3
Total	788,737	100%	50		31

Table 8 shows the division of the Volume Audit population stratum into sub-strata based on 3 volume classes.

Table 8: Volume Audit Population in VT - Sample breakdown by Volume Class

Stratum	Sub-stratum	Area	%	Samples	Replacements
Balsam	1	93,255	31.53%	6	3
	2	95,553	32.31%	6	4
	3	106,915	36.15%	7	4
	Total	295,723	100.00%	19	11
Pine	1	83,791	31.19%	5	3
	2	104,346	38.84%	7	4
	3	80,508	29.97%	5	3
	Total	268,645	100.00%	17	10
Spruce	1	49,687	28.09%	3	2
	2	59,768	33.78%	4	2
	3	67,452	38.13%	4	3
	Total	176,907	100.00%	11	7
Other	1	14,769	31.12%	1	1
	2	14,926	31.45%	1	1
	3	17,767	37.43%	1	1
	Total	47,462	100.00%	3	3
Grand Total		788,737		50	31

Appendix D shows how strata and volume class sub-stratum are defined and how samples were distributed among them.

Young Stand Monitoring Population

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

2.4.2 NVAF

For NVAF sampling, the Volume Audit population is divided into two age groups; age 51 to 120 and 121+. In the Morice TSA, the 51 to 120 age group represents 28% of the area and the 121+ population represents 72%. Table 9 (below) shows the distribution of ground samples for NVAF-enhancement by age group.

Table 9: NVAF Ground Sample Distribution by Age Group

Land base	Age Group (years)	NVAF Samples
Volume Audit population	51-120	3
Volume Audit population	121+	5
	Total	8

2.5 Sample Selection

The Standard *VRI Sample Selection Procedures for Ground Sampling* outlines the process for sample selection in detail and Draft Version 4.0 has been used as the guideline for this plan. Documentation of the Sample Selection process followed is included in Appendix D.

2.5.1 Ground Sampling

The initial step was to identify the population of the Morice TSA for the YSM and the Volume Audit population land base. Appendix D details the process of identifying the population areas, developing strata and sub-strata for the Volume Audit population, and how samples were distributed within these.

A sample list was developed for each of the two populations. The lists contain the initial samples and replacement samples available in the likely event that some of the initial samples are rejected in the field. There are 50 initial samples and 31 replacement samples in the Volume Audit population (51+). For Young Stand Monitoring (15-50), 50 initial and 127 replacement samples are identified.

For the Volume Audit population, sample polygons were selected according to procedures outlined in *Vegetation Resources Inventory –Draft Version 4.0 - Sample Selection Procedures for Ground Sampling*-Section 3.0. That is by “probability proportional to size with replacement” (PPSWR). Sample points were located randomly within the sample polygon using ARCMAP 10 GIS techniques and random numbers generated by Excel. Sample locations were reviewed against recent Landsat imagery. One alternate sample fell in recent cutover and this was replaced (see details in the Sample Selection Report).

Where there is a need to replace a sample in the field, the replacement should be from the same stratum or strata and sub-stratum.

The Young Stand Monitoring sample selection was grid based. A grid size providing a minimum of 150 sample points in the YSM population was required. For the Morice TSA a 2 km grid met this requirement. The 50 YSM samples were selected by dividing the total number of available samples (grid points that fell in the population) by 50 and then selecting every nth sample as one to be sampled. The

remainder of the grid points provides the 'alternate' sample locations. This selection is outlined in Appendix D.

The sample lists are provided in Appendix A.

2.5.2 NVAF

The NVAF samples are a subset of the VRI sample selection in the Volume Audit population. Ministry staff has been involved in initial decisions related to the NVAF sample selection. Based on their direction, a list of 8 samples has been derived from the final ground sample list, following Section 3.4 of the *Draft VRI Sample Selection Procedures for Ground Sampling*.

The samples that are to be enhanced to the NVAF standard are identified in this Project Implementation Plan. The details of NVAF sample selection and the complete NVAF profile can be found in Appendix C.

Enhancement of auxiliary plots will be completed at the time of the establishment of the ground samples according to the *NVAF Sampling Standards and Procedures*.

2.6 Sample Type

The protocols developed for the ground sampling enable forest managers to select from several options to collect timber and ecology data, dependent on their objectives. The ground samples established for the Morice TSA project in the Volume Audit population will be completed by certified VRI Timber contractors following 'Timber Emphasis' procedures. It has not yet been determined if Coarse Woody Debris (CWD) data will be collected at each sample.

The sampling design for the 50 samples in the Young Stand Monitoring will basically follow the Change Monitoring (CMI) Procedures and Quality Assurance (QA) Standard. Since the Morice TSA YSM project is a pilot study, any changes or additions to the CMI Procedures will be clearly outlined.

3.0 Project Implementation

3.1 Sample Packages

Sample packages will be prepared by the Ministry for all samples selected in this Morice TSA Project Implementation Plan for both Volume Audit and YSM sampling. They will include tools that support the field crews in their efforts to navigate to, and establish each sample in the correct location. They will be prepared according to the document *Guidelines for Preparing a Project Implementation Plan for Ground Sampling and Net Volume Adjustment Factor Sampling*.

3.2 Standards

The current edition of the Vegetation Resources Inventory Ground Sampling Standards and Procedures and the Change Monitoring Inventory Standards and Procedures will be followed to complete this project. The Standards relevant to this project are listed in this document, following the Bibliography. 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 each Standard.

3.3 Sample List

A complete sample list is provided in Appendix A. A description of how samples were distributed across the population is included in Appendix D.

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.

3.5 Project Analysis

Statistical analysis projects will be conducted on both the Volume Audit and the YSM data collected. Specific analysis procedures are still being determined.

Bibliography

1. British Columbia Ministry of Forests, Resources Inventory Branch. February, 1998. Morice TSA Inventory Audit. (Fieldwork completed in 1997.)
2. British Columbia Ministry of Forests & Range. Forest Analysis & Inventory Branch. February 1, 2008. Morice Timber Supply Area – Rationale for Allowable Annual Cut (AAC) Determination. Jim Snetsinger, Chief Forester, Victoria.
3. British Columbia Ministry of Forests & Range. Forest Analysis & Inventory Branch, June, 2007. Urgent timber supply review for the Morice Timber Supply Area – Public Discussion Paper. Victoria.
4. British Columbia Ministry of Forests. Forest Analysis & Inventory Branch. October, 2002. Morice TSA – Rationale for AAC Determination. Larry Pedersen, Chief Forester, Victoria.
5. Ministry of Forests, Lands and Natural Resource Operations website for VRI - <http://www.for.gov.bc.ca/hts/vri/index.html>
6. Ministry of Forests, Lands and Natural Resource Operations, 2012, A Framework for Implementing Young Stand Growth Monitoring in British Columbia.
7. Ministry of Forests, Lands and Natural Resource Operations, 2011, Streamlining VRI Ground Sampling -Volume Audit Sampling.
8. Nona Phillips Forestry Consulting. Cranbrook TSA, TFL18, Mackenzie TSA and TFL53 Vegetation Resources Inventory Project Implementation Plans. February 2011 (Cranbrook), March 2011 (TFL18), June 2011 (Mackenzie) and July 2011 (TFL53)
9. Nona Phillips Forestry Consulting. July 15, 2011 and March 11, 2012 (draft). Kootenay Lake TSA – Vegetation Resource Inventory Project Implementation Plan for Ground Sampling and Net Volume Adjustment Factor Sampling.
10. Timberline Natural Resource Group Ltd. March, 2007. Morice Timber Supply Area Vegetation Resources Inventory Strategic Inventory Plan.
11. Various. Personal Communication with Ministry of Forests, Lands & Natural Resource Operations staff including Chris Mulvihill regarding issues related to the preparation of the Morice 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 Morice TSA VRI Phase II ground sampling and NVAF sampling project 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/index.html#>

Planning:

Preparing a VRI Strategic Inventory Plan (VSIP) for Ground Sampling and Photo Interpretation, January 2005

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, Vegetation Resources Inventory (VRI):

Vegetation Resources Inventory Ground Sampling Procedures Version 4.9, March 2010
Ground Sampling Procedure Appendices Version 4.6, March 2010

Vegetation Resources Inventory Ground Sampling Quality Assurance Procedures and Standards for VRI Ground Sampling Version 3.1, March 2008

Vegetation Resources Inventory Ground Sampling Data Collection Procedures for Inaccessible Samples Version 1.0, March 2003

Ground Sampling, Change Monitoring Inventory (CMI):

National Forest Inventory B.C. Change Monitoring Procedures for Provincial and National Reporting. Version 1.4, March 2005

National Forest Inventory B.C. Change Monitoring Procedures for Provincial and National Reporting Appendices. Version 1.4, March 2005

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

Change Monitoring Inventory Ground Sampling Standards. Version 2.1 May 2007

Net Volume Adjustment Factors (NVAF):

Net Volume Adjustment Factor Sampling Standards and Procedures Version 5.0, April, 2011

VRI – Data Analysis

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

Appendix A

Sample Lists for Morice TSA Ground Samples

Sample List

The following are sample lists for each of the two populations. Each list contains initial samples for data collection and alternate samples in the event that some of the initial samples need to be replaced during the data collection phase.

For the Young Stand Monitoring (ages 15-50) there are 50 initial samples and 127 alternate samples.

For the Volume Audit population (ages 51+) there are 50 initial samples and 31 alternate samples.

Initial sample number 40 in volume class 2 of the Spruce strata was in a recent cutover so it was replaced with the contingency sample.

The shapefiles for each of the populations include all of the data fields from the original supplied VRI database.

In the Volume Audit population, samples can be rejected at the field sampling stage if they are in an unsafe location or in a cutover. When replacing samples they must be from the same stratum and sub-stratum (volume class). The project manager must be consulted if samples are rejected.

For the Young Stand Monitoring samples, *A Framework for Implementing Young Stand Growth Monitoring in British Columbia* should be referenced if there is any consideration of rejecting a sample.

Below is a description of the strata, for reference.

Volume Audit Population Strata Definition

Strata	Leading Species
1	Balsam
2	Pine
3	Spruce
4	Other

Volume Audit Samples Initial Samples are numbered 1 to 50 and alternate samples are numbers A1 to A31.

Samp	Strata	Sub Strat	MAP_ID	Polygon	UTM	Sp1	S1 %	Sp2	S2 %	Sp 3	S3 %	Age	Height	Basal Area	Vol/ha	Stems/ha
1	B	1	093L003	401	09U 598079 5987341	BL	60	PA	40		0	200	13.4	18	35	952
2	B	1	093L045	101	09U 618792 6035341	B	70	S	30		0	239	19.5	24	88	829
3	B	1	093E056	71	09U 635073 5937685	BL	100		0		0	180	15.7	22	51	968
4	B	1	093E055	159	09U 619633 5930617	BL	70	HM	30		0	200	13.4	19	30	1076
5	B	1	093E094	493	09U 614730 5980029	BL	100		0		0	70	9.8	1	1	50
6	B	1	093E084	247	09U 607865 5967007	BL	100		0		0	270	15.1	14	32	588
7	B	2	093L058	877	09U 659694 6049519	B	80	S	20		0	240	25.0	30	173	611
8	B	2	093E083	144	09U 595211 5967572	B	100		0		0	269	25.8	36	184	671
9	B	2	093K081	647	10U 316237 6077621	B	100		0		0	189	19.5	38	130	1311
10	B	2	093L004	554	09U 615076 5990771	BL	70	PL	20	S	10	80	20.9	29	111	777
11	B	2	093L001	64	09U 578435 5992018	B	100		0		0	339	25.4	37	186	641
12	B	2	093L068	900	09U 665828 6063217	B	90	S	10		0	200	20.5	31	127	985
13	B	3	093K092	711	10U 324498 6087897	BL	80	SW	20		0	241	27.7	38	258	709
14	B	3	093E093	245	09U 600619 5981835	BL	50	PL	30	S	20	220	28.9	46	263	679
15	B	3	093L024	941	09U 615855 6014864	B	90	S	10		0	270	30.6	48	369	751
16	B	3	093L057	256	09U 653122 6043824	B	60	S	40		0	200	25.3	37	242	857
17	B	3	093L056	686	09U 631568 6043706	B	80	S	20		0	177	25.3	39	239	887
18	B	3	093M029	618	09U 674627 6122254	B	70	S	30		0	199	25.2	40	254	965
19	B	3	093L023	852	09U 595009 6016985	B	60	S	40		0	220	31.8	39	343	608
20	P	1	093E088	2548	09U 665682 5974773	PL	40	SW	30	AT	20	60	14.0	20	40	436

21	P	1	093L04 6	528	09U 639956 6037447	PL	60	AT	40		0	120	22.4	28	73	480
22	P	1	093L02 9	2121	09U 671286 6018728	PL	95	SX	5		0	56	11.0	9	4	796
23	P	1	093L01 7	771	09U 655996 6004541	PL	90	S	10		0	120	22.4	38	42	237
24	P	1	093E06 7	9	09U 647720 5951456	PL	100		0		0	65	18.8	14	30	650
25	P	2	093L00 7	347	09U 651159 5988595	PL	100		0		0	85	21.7	35	161	1118
26	P	2	093M03 8	656	09U 664898 6131661	PL	90	AT	10		0	87	21.0	30	129	1140
27	P	2	093L07 9	427	09U 670798 6068943	PL	100		0		0	79	18.8	33	94	1467
28	P	2	093L08 0	173	09U 684324 6071528	PL	100		0		0	79	23.0	40	128	839
29	P	2	093E07 5	545	09U 627408 5955306	PL	100		0		0	220	26.4	45	160	462
30	P	2	093L02 8	746	09U 668904 6019328	PL	71	SX	29		0	206	23.3	35	160	667
31	P	2	093L01 4	523	09U 611740 6000854	PL	60	BL	30	S	10	200	24.5	41	116	537
32	P	3	093N00 1	531	10U 314375 6104375	PL	100		0		0	154	24.8	43	285	1077
33	P	3	093L07 8	406	09U 663256 6069425	PL	90	S	10		0	114	22.5	40	229	1244
34	P	3	093L03 4	539	09U 607772 6025748	PL	60	S	30	B	10	160	25.8	46	196	731
35	P	3	093L01 5	780	09U 628879 5998576	PL	100		0		0	220	24.4	49	247	888
36	P	3	093L08 8	26915655	09U 666149 6083789	PL	80	S	20		0	137	26.4	37	201	523
37	S	1	093L09 8	652	09U 658248 6088063	SB	60	SW	30	PL	10	115	14.1	2	4	162
38	S	1	093L09 8	477	09U 656523 6093200	SB	80	SW	20		0	184	15.4	1	1	67
39	S	1	093K09 1	83	10U 314588 6095341	SB	80	SW	20		0	134	17.0	19	55	842
40	S	2	093K08 2	77	10U 323782 6085220	SW	60	BL	40		0	241	28.3	27	175	462
41	S	2	093E08 6	17	09U 633130 5973994	S	50	PL	30	BL	20	120	27.2	37	203	625
42	S	2	093N00 1	560	10U 313287 6104723	S	70	PL	20	B	10	162	27.9	36	230	628

43	S	2	093K07 2	67927890	10U 321293 6071589	SW	80	BL	20		0	141	26.7	25	173	505
44	S	3	093N01 1	87571844	10U 309628 6112903	S	80	B	20		0	204	34.1	34	291	442
45	S	3	093E08 8	59	09U 660311 5973744	S	50	PL	30	BL	20	140	30.4	45	265	613
46	S	3	093M00 9	603	09U 677397 6109136	S	90	PL	10		0	129	26.7	40	281	920
47	S	3	093L00 8	94803684	09U 664272 5996170	SX	50	PL	40	BL	10	272	29.6	52	396	779
48	O	1	093L05 9	172	09U 678324 6042994	AT	70	S	30		0	70	17.4	28	75	1279
49	O	2	093M03 8	232	09U 664311 6138255	AT	90	PL	10		0	89	19.5	26	88	907
50	O	3	093K07 1	37619460	10U 316304 6074511	AT	60	S	40		0	104	25.1	41	237	905
A1	B	1	093E05 3	48	09U 604610 5935091	B	100		0		0	156	9.4	0	0	23
A2	B	1	093L03 4	84	09U 611226 6019981	B	60	PL	40		0	120	19.7	38	97	899
A3	B	1	093E05 2	39	09U 589980 5934975	B	80	H	20		0	346	16.1	26	90	691
A4	B	2	093E05 5	195	09U 620280 5929542	BL	100		0		0	240	24.0	39	192	811
A5	B	2	093L03 7	50	09U 645298 6020331	B	90	S	10		0	220	21.3	36	157	1020
A6	B	2	093E05 5	53	09U 621983 5939037	BL	100		0		0	250	23.0	38	176	830
A7	B	2	093E08 7	352	09U 654912 5973413	BL	50	S	30	PL	20	196	25.4	32	171	639
A8	B	3	093L02 3	140	09U 603584 6015845	B	80	S	20		0	280	31.5	43	348	657
A9	B	3	093K09 1	43449103	10U 318115 6091080	B	59	PL	21	S	20	219	25.1	39	222	835
A10	B	3	093E05 5	226	09U 620458 5930051	BL	100		0		0	270	28.7	44	280	676
A11	B	3	093M03 0	16392848	09U 679161 6131072	B	60	S	40		0	227	29.7	34	264	604
A12	P	1	093L05 9	856	09U 676535 6049636	PL	60	S	30	AT	10	80	21.0	33	49	524
A13	P	1	093E09 5	784	09U 628914 5976522	PL	100		0		0	200	22.5	44	0	0
A14	P	1	093L07 0	986	09U 690142 6064456	PL	100		0		0	88	21.2	34	55	407

A15	P	2	093L01 4	3	09U 604684 6006469	PL	60	S	30	BL	10	180	24.7	37	141	551
A16	P	2	093E08 7	46748087	09U 657200 5969100	PL	80	S	20		0	150	22.9	20	128	499
A17	P	2	093E09 6	369	09U 633294 5974900	PL	60	S	30	BL	10	120	25.5	40	144	520
A18	P	2	093L06 8	682	09U 659999 6061164	PL	50	B	30	S	20	115	17.5	33	98	1222
A19	P	3	093K08 1	615	10U 313534 6077737	PL	70	S	20	AT	10	149	28.9	34	209	400
A20	P	3	093L08 0	37	09U 682930 6075982	PL	70	BL	30		0	120	25.6	35	248	766
A21	P	3	093M03 8	2525599	09U 659655 6134646	PL	60	S	40		0	187	30.2	46	341	702
A22	S	1	093L06 8	918	09U 667077 6064474	SW	70	S	30		0	200	17.8	18	47	779
A23	S	1	093K09 1	117	10U 315365 6097011	SB	80	SW	20		0	144	20.0	19	80	623
A24	S	2	093L02 7	380	09U 649663 6016704	S	60	B	20	AT	10	150	28.3	35	242	633
A25	S	2	093L00 9	912	09U 670932 5997556	SX	80	PL	15	AT	5	240	34.0	25	197	353
A26	S	3	093L02 8	308	09U 659327 6011101	SX	65	PL	35		0	157	34.1	36	279	402
A27	S	3	093L01 9	101	09U 677543 6000142	SX	70	BL	30		0	262	29.2	42	329	672
A28	S	3	093L03 5	570	09U 621760 6019730	S	60	B	40		0	270	33.8	42	358	543
A29	O	1	093E09 6	74707772	09U 644090 5985086	AT	80	S	20		0	100	22.3	17	81	360
A30	O	2	093E07 4	69	09U 606720 5953827	BL	70	PA	30		0	160	19.9	41	218	887
A31	O	3	093E06 2	127	09U 588135 5943111	H	80	B	20		0	426	24.7	52	305	704

Young Stand Monitoring Samples Initial samples are nos 51 to 100 and alternate samples are nos A51 to A177

Sample	MAP_ID	Polygon	UTM	Sp1	S1%	Sp2	S2%	Sp3	S3%	Age	Height	Basal Area	Vol/ha	Stems/ha
51	093E077	13424016	09U 651582 5961941	PL	100		0		0	31	9.6	5	1	567
52	093E085	95147409	09U 631312 5967095	PL	80	BL	20		0	23	7.8	3	0	360
53	093E087	23327664	09U 653329 5968030	PL	100		0		0	36	11.2	8	3	710
54	093E087	22048473	09U 653244 5970031	PL	100		0		0	30	12.0	8	3	764

55	093E086	35	09U 643151 5971608	PL	70	BL	20	S	10	23	7.8	3	0	347
56	093E083	477	09U 597036 5971653	B	80	H	20		0	50	7.5	0	0	0
57	093E098	228	09U 660825 5980379	BL	50	S	30	PL	20	50	15.9	25	57	2024
58	093E097	89146009	09U 646729 5981786	PL	70	S	10	AT	10	22	9.4	5	1	550
59	093L007	306	09U 644472 5987705	S	40	BL	40	PL	10	30	6.5	0	0	3589
60	093L004	66620673	09U 608363 5988174	PL	95	S	5		0	23	8.8	0	0	1618
61	093L004	182	09U 614281 5990431	S	90	PL	10		0	37	6.6	0	0	1766
62	093L004	57783860	09U 606106 5994093	PL	90	S	10		0	38	15.0	14	13	1151
63	093L005	59834219	09U 624118 5994859	PL	80	S	20		0	22	6.5	0	0	1500
64	093L014	443	09U 615942 5998522	S	70	PL	30		0	38	6.9	0	0	4080
65	093L014	347	09U 607852 6000182	PL	90	S	10		0	25	10.8	7	2	736
66	093L018	6588680	09U 665811 6004654	PL	85	AT	10	SX	5	30	11.3	8	2	617
67	093L016	67609826	09U 641706 6005634	PL	70	AT	20	S	10	21	6.1	0	0	4112
68	093L018	1201	09U 657719 6006315	PL	95	SX	3	AT	2	27	6.8	1	0	175
69	093L017	2	09U 643623 6007721	PL	100		0		0	23	6.8	0	0	1400
70	093L026	38753401	09U 637533 6009467	PL	100		0		0	23	6.8	0	0	10632
71	093L027	412	09U 655547 6010234	PL	100		0		0	25	7.5	0	0	4529
72	093L026	38753401	09U 637362 6013470	PL	100		0		0	23	6.8	0	0	10632
73	093L026	45705901	09U 637277 6015471	PL	80	AT	10	B	10	22	6.5	0	0	0
74	093L027	634	09U 651203 6018070	PL	83	S	17		0	21	7.9	2	0	279
75	093L039	286	09U 671135 6020924	PL	100		0		0	46	5.0	0	0	0
76	093L036	101	09U 638852 6025564	PLI	70	ACT	20	AT	10	29	12.7	8	2	286
77	093L038	502	09U 664788 6028675	PL	80	S	10	BL	10	20	5.7	0	0	2958
78	093L038	19	09U 658698 6030421	PL	90	S	10		0	33	10.2	6	2	627
79	093L046	539	09U 638510 6033570	PL	50	AT	40	S	10	22	8.4	2	0	225
80	093L048	7337927	09U 664447 6036682	AT	60	PL	30	S	10	27	12.2	9	7	842
81	093L056	528	09U 632078 6043322	PL	90	S	5	BL	5	26	7.9	3	0	347
82	093L069	389	09U 673601 6057128	PL	40	BL	40	S	20	34	6.7	0	0	4126
83	093L077	573	09U 651154 6066195	S	70	BL	30		0	25	3.2	0	0	2508
84	093K081	520	10U 309393 6081922	PL	50	BL	20	S	20	33	13.2	16	14	1335
85	093L089	64454872	09U 672488 6083151	PL	70	S	20	BL	10	32	9.9	7	2	658
86	093K081	248	10U 317486 6083581	S	80	BL	10	PL	10	33	5.3	0	0	2733
87	093L089	94547067	09U 676320 6087326	SX	90	BL	10		0	41	12.4	0	0	1082

88	093L098	60448225	09U 654215 6088385	SX	90	PLI	10		0	20	4.0	0	0	2520
89	093L097	39169695	09U 650125 6090215	PL	90	AT	10		0	23	8.8	4	1	453
90	093L097	747	09U 650040 6092216	PL	90	AT	10		0	23	10.4	5	1	543
91	093L100	43421718	09U 685986 6095763	S	90	AT	10		0	33	8.3	4	0	602
92	093M008	717	09U 663795 6098821	PL	100		0		0	24	7.2	0	0	2069
93	093M007	37235601	09U 649697 6100222	S	90	BL	10		0	24	4.2	0	0	1764
94	093M009	1366531	09U 677636 6103426	PLI	60	ACT	20	SX	10	23	12.2	7	4	752
95	093M009	579023	09U 677465 6107430	PLI	30	SX	30	AT	10	20	7.4	0	0	4429
96	093M020	596	09U 685299 6111778	S	100		0		0	25	5.1	0	0	1530
97	093M018	93693491	09U 659105 6114662	S	100		0		0	40	7.5	0	0	0
98	093M019	302	09U 675118 6115350	PL	100		0		0	24	10.4	5	1	578
99	093M020	23945061	09U 681037 6117611	PLI	60	BL	20	SX	10	17	5.9	0	0	3182
100	093M048	92315830	09U 657465 6152691	PL	60	S	40		0	36	7.0	0	0	1100
A51	093E076	19920728	09U 635825 5955257	PL	80	BL	20		0	19	6.1	0	0	3041
A52	093E077	77351653	09U 645747 5957683	PL	90	BL	10		0	30	13.8	11	7	946
A53	093E076	93	09U 643661 5959600	PL	100		0		0	22	6.5	0	0	3000
A54	093E087	407	09U 649496 5963857	PL	100		0		0	36	10.1	6	1	614
A55	093E086	40586373	09U 639403 5965434	PL	80	B	10	S	10	33	13.2	12	8	1117
A56	093E087	77157558	09U 645323 5967690	PL	100		0		0	35	15.1	11	9	877
A57	093E087	1497226	09U 649326 5967860	PL	50	BL	40	S	10	31	12.4	15	11	1330
A58	093E087	10177447	09U 651327 5967945	PL	70	BL	20	S	10	27	10.1	8	2	848
A59	093E087	34387380	09U 655330 5968115	PL	70	S	20	BL	10	35	13.9	17	9	1740
A60	093E087	88818563	09U 647239 5969777	PL	80	BL	20		0	27	9.4	6	1	667
A61	093E088	73699002	09U 661250 5970371	PL	90	S	10		0	39	12.0	10	5	899
A62	093E083	473	09U 595120 5969567	B	90	PL	10		0	50	7.5	0	0	0
A63	093E084	378	09U 613131 5970332	BL	60	PL	40		0	50	9.4	5	3	451
A64	093E088	97279755	09U 665168 5972542	PL	100		0		0	39	12.0	8	4	760
A65	093E088	6529919	09U 667170 5972627	PL	90	AT	10		0	36	13.5	11	3	959
A66	093E088	2582	09U 669087 5974713	AT	70	PL	20	SW	10	35	15.0	18	25	1335
A67	093E098	70763355	09U 660910 5978377	S	60	BL	30	PL	10	27	3.6	0	0	4200
A68	093E098	317	09U 662912 5978462	S	84	BL	13	PL	3	40	7.5	0	0	2133
A69	093E098	492	09U 662827 5980463	PL	93	S	4	BL	3	28	8.6	4	0	432
A70	093E096	464	09U 634720 5981275	PL	70	S	20	BL	10	41	12.6	13	10	1167

A71	093L007	491	09U 654565 5986129	PL	95	S	5		0	31	9.6	6	1	564
A72	093L004	799774	09U 614452 5986428	BL	70	PL	30		0	44	5.4	0	0	2800
A73	093L006	477	09U 642471 5987620	PL	80	S	10	BL	10	28	8.6	4	1	483
A74	093L008	2930	09U 658484 5988300	PL	88	SX	10	AT	2	34	12.0	11	4	847
A75	093L008	345	09U 660485 5988385	PL	98	AT	2		0	29	8.9	5	1	538
A76	093L006	468	09U 640384 5989536	S	64	BL	34	PL	2	30	4.4	0	0	3271
A77	093L007	2513	09U 646389 5989792	PL	50	SW	30	AT	20	26	8.3	3	0	392
A78	093L008	3080	09U 662402 5990471	PL	60	SX	30	AT	5	34	8.8	5	1	516
A79	093L004	91523242	09U 612195 5992347	PL	50	BL	40	S	10	39	12.0	13	12	1224
A80	093L005	156	09U 626204 5992943	PL	100		0		0	22	6.5	0	0	1624
A81	093L004	29	09U 608107 5994178	PL	60	S	40		0	38	15.0	0	0	775
A82	093L004	673	09U 612110 5994349	PL	80	S	20		0	44	13.3	12	10	1051
A83	093L004	1543903	09U 614111 5994434	S	40	B	30	PL	20	33	5.3	0	0	2007
A84	093L015	69195364	09U 626034 5996946	PL	50	BL	30	S	20	21	8.9	4	1	493
A85	093L014	494	09U 607937 5998181	S	60	PL	40		0	28	6.1	0	0	2145
A86	093L014	486	09U 609938 5998266	S	80	BL	10	PL	10	27	5.7	0	0	2034
A87	093L018	87346351	09U 661977 6000480	PL	95	AT	3	SX	1	25	6.2	4	0	1700
A88	093L018	87346351	09U 663979 6000565	PL	95	AT	3	SX	1	25	6.2	4	0	1700
A89	093L019	2289	09U 669899 6002822	PL	80	SX	13	BL	5	50	8.0	4	1	514
A90	093L015	766	09U 623777 6002865	PL	100		0		0	35	13.9	10	7	932
A91	093L016	65538668	09U 641791 6003633	PL	80	S	20		0	24	9.3	4	0	505
A92	093L014	211	09U 615687 6004526	S	60	BL	30	PL	10	24	3.4	0	0	2300
A93	093L015	93410375	09U 627695 6005037	PL	90	AT	10		0	23	8.8	3	0	337
A94	093L017	109	09U 651714 6006060	PL	100		0		0	20	5.7	0	0	1392
A95	093L017	25199404	09U 653716 6006145	PL	50	S	50		0	28	8.6	0	0	1410
A96	093L017	42	09U 655717 6006230	PL	60	S	40		0	28	8.6	4	0	545
A97	093L018	69079814	09U 659721 6006400	PL	88	SX	10	BL	2	27	7.3	28	0	6000
A98	093L016	64970969	09U 641621 6007636	PL	100		0		0	23	6.8	0	0	1400
A99	093L017	40	09U 655632 6008232	PL	100		0		0	26	4.8	0	0	5257
A100	093L018	1205	09U 657634 6008317	PL	85	SX	15		0	27	7.3	23	0	5500
A101	093L026	28462044	09U 635531 6009381	PL	100		0		0	22	6.5	0	0	0
A102	093L026	62352171	09U 641536 6009637	PL	100		0		0	23	6.8	0	0	0
A103	093L027	417	09U 651544 6010063	PL	60	AT	40		0	24	7.2	0	0	5997

A104	093L026	38753401	09U 637447 6011468	PL	100		0		0	23	6.8	0	0	10632
A105	093L026	319	09U 639449 6011553	PL	100		0		0	26	10.2	6	1	712
A106	093L026	311	09U 641451 6011639	PL	100		0		0	26	7.9	3	0	388
A107	093L026	282	09U 641365 6013640	AT	70	PL	30		0	28	12.6	0	0	0
A108	093L027	426	09U 653375 6014152	S	100		0		0	24	4.2	0	0	1384
A109	093L029	2294	09U 675309 6017091	PL	90	SX	10		0	47	8.2	4	0	510
A110	093L026	18066890	09U 633189 6017302	PL	100		0		0	22	8.4	0	0	0
A111	093L026	546	09U 641195 6017643	PL	60	S	40		0	21	7.9	0	0	2173
A112	093L029	2507	09U 675224 6019093	PL	80	SX	20		0	47	10.7	5	3	488
A113	093L036	2313	09U 635105 6019389	PL	98	S	2		0	45	17.2	17	23	1262
A114	093L037	582	09U 655121 6020242	PL	60	S	30	BL	10	31	9.6	6	1	685
A115	093L034	72149643	09U 609000 6020281	BL	40	PLI	40	SX	20	25	2.6	0	0	3165
A116	093L037	770661	09U 646943 6023904	PL	100		0		0	24	7.2	0	0	1357
A117	093L038	501	09U 668877 6026844	PL	95	S	5		0	24	9.3	4	0	274
A118	093L036	380	09U 634763 6027394	S	100		0		0	20	1.9	0	0	1400
A119	093L038	495	09U 656781 6028334	PL	80	S	20		0	23	6.8	0	0	3261
A120	093L038	27283079	09U 668792 6028846	S	60	PL	40		0	25	4.6	0	0	6782
A121	093L036	30	09U 634678 6029396	PL	50	S	50		0	21	6.1	0	0	0
A122	093L038	470	09U 662701 6030592	PL	100		0		0	24	7.2	0	0	2120
A123	093L048	601	09U 660614 6032508	PL	100		0		0	39	15.3	12	8	679
A124	093L046	316	09U 636509 6033485	S	80	B	20		0	40	7.5	0	0	0
A125	093L049	2199	09U 672539 6035022	SW	40	PL	40	AT	20	27	4.5	6	1	702
A126	093L047	43997646	09U 654438 6036255	PL	100		0		0	23	6.8	0	0	2168
A127	093L046	40619570	09U 636252 6039489	SX	80	PLI	10	AT	10	27	8.0	0	0	1200
A128	093L048	815	09U 666278 6040771	PL	99	AT	1		0	18	5.0	0	0	3293
A129	093L056	575	09U 634165 6041406	S	100		0		0	28	3.9	0	0	1393
A130	093L056	528	09U 634080 6043407	PL	90	S	5	BL	5	26	7.9	3	0	347
A131	093L058	521	09U 660102 6044518	PL	70	BL	30		0	43	13.1	14	15	1167
A132	093L068	45	09U 661334 6062619	S	70	BL	10	PL	10	33	6.9	0	0	4840
A133	093L078	578	09U 655243 6064364	B	60	S	40		0	49	6.8	0	0	0
A134	093L078	612	09U 661249 6064621	S	90	PL	10		0	32	6.5	0	0	1871
A135	093K071	30135613	10U 314799 6067651	PLI	80	SX	10	AT	10	25	9.2	5	1	667
A136	093L090	215	09U 688588 6081835	S	80	AT	10	AC	10	35	7.7	2	0	402

A137	093K081	7633742	10U 311395 6081836	BL	60	SX	20	PLI	20	16	1.8	0	0	7743
A138	093K082	49	10U 319402 6081494	S	60	B	20	PL	20	49	25.6	10	5	1147
A139	093L088	61765041	09U 654472 6082380	PL	90	S	10		0	30	9.3	5	1	608
A140	093L089	77124883	09U 674490 6083237	PLI	77	SX	11	BL	9	21	7.0	0	0	2256
A141	093L090	59324690	09U 688503 6083837	PL	40	S	40	AT	20	35	10.9	10	5	1060
A142	093L089	65155985	09U 672402 6085153	SX	45	PLI	21	AT	18	18	2.5	0	0	3520
A143	093K081	7956059	10U 311566 6085840	PLI	60	BL	30	SX	10	15	3.8	0	0	4122
A144	093K081	32286068	10U 315570 6085669	S	80	PL	20		0	32	5.0	0	0	3680
A145	093L100	60117292	09U 688331 6087841	PL	90	S	10		0	34	10.5	8	3	860
A146	093L100	71247355	09U 690333 6087927	PL	70	S	20	AT	10	33	11.7	12	6	1073
A147	093K091	605	10U 317658 6087585	S	100		0		0	22	2.3	0	0	1343
A148	093K091	16788600	10U 313740 6089759	SX	70	BL	20	ACT	10	24	8.0	0	0	2871
A149	093K091	590	10U 317744 6089587	PL	100		0		0	22	8.4	3	0	321
A150	093L098	29169540	09U 666139 6090901	PLI	60	BL	20	SX	10	21	7.0	0	0	2393
A151	093L100	71359584	09U 690161 6091931	BL	50	SX	40	PLI	10	15	1.5	0	0	4440
A152	093K091	29399480	10U 315828 6091675	SX	90	PLI	10		0	18	2.2	0	0	1950
A153	093K091	32270768	10U 315914 6093677	PLI	70	SX	20	BL	10	18	7.3	0	0	5684
A154	093L100	27841673	09U 683984 6095677	S	50	B	30	AC	20	46	13.1	0	0	1029
A155	093L100	78562060	09U 691991 6096021	PL	60	S	20	BL	10	29	11.6	12	6	1213
A156	093M007	36324201	09U 649783 6098220	PLI	90	AT	10		0	24	13.5	4	0	456
A157	093M008	5694287	09U 661793 6098735	S	70	PL	20	B	10	34	5.6	0	0	2186
A158	093M010	820	09U 691820 6100025	PL	90	S	10		0	30	9.3	6	1	697
A159	093N001	6674319	10U 312168 6099854	SX	40	AT	30	BL	30	15	2.5	0	0	4200
A160	093M008	365	09U 663709 6100823	PL	80	S	20		0	28	8.6	4	0	413
A161	093M010	78795619	09U 691734 6102027	PLI	70	SX	20	AT	10	44	16.4	23	41	1530
A162	093M008	95806889	09U 659620 6102653	SW	100		0		0	29	5.1	0	0	9481
A163	093M010	69656523	09U 689646 6103943	PLI	40	ACT	30	SX	20	28	10.5	11	5	1099
A164	093M009	250	09U 677550 6105428	PL	80	S	10	B	10	24	7.2	0	0	2562
A165	093M008	6660225	09U 661364 6108743	PLI	50	SX	30	BL	20	15	4.9	0	0	3000
A166	093M009	602	09U 677379 6109431	PL	100		0		0	24	8.8	4	0	469
A167	093M019	1681315	09U 677293 6111433	PL	100		0		0	26	11.3	6	2	653
A168	093M019	286	09U 677206 6113435	S	70	PL	20	BL	10	26	3.3	0	0	2117
A169	093M020	475	09U 681210 6113607	S	70	PL	20	BL	10	23	3.3	0	0	1968

A170	093M019	53883699	09U 669113 6115092	SX	50	PLI	30	AT	10	26	12.0	0	0	2192
A171	093M019	65023850	09U 671115 6115178	PLI	80	AT	20		0	26	15.5	6	2	597
A172	093M019	78313729	09U 673116 6115264	PL	70	S	30		0	28	12.2	11	4	1040
A173	093M018	83834712	09U 657017 6116577	PLI	90	AT	10		0	22	12.0	3	0	355
A174	093M018	92525346	09U 659019 6116663	PLI	73	SX	14	BL	6	19	6.1	0	0	6108
A175	093M029	41877624	09U 666853 6121011	PL	70	B	20	S	10	39	7.6	3	0	332
A176	093M028	29578839	09U 664765 6122926	PL	80	AT	10	BL	10	23	10.4	6	2	597
A177	093M029	612	09U 674773 6123357	PL	70	S	30		0	40	7.8	2	0	306

Appendix B

Comparison of the Sample Characteristics to the Population

Sample/Population Comparison

The following tables show how the sample distribution compares to the population distribution for leading species, age class, and volume class. Samples and populations compare reasonably close in most cases.

Volume Audit Class Comparison

Age Class	Area	%	Samples	%
3	4,950	1%	2	4%
4	52,374	7%	6	12%
5	90,599	11%	3	6%
6	70,541	9%	6	12%
7	82,270	10%	5	10%
8	384,248	49%	23	46%
9	103,755	13%	5	10%
Total	788,737	100%	50	100%

Volume Audit Height Class Comparison

Height Class	Population Area	%	Samples	%
1	14,912	2%	1	2%
2	174,555	22%	12	24%
3	454,459	58%	31	62%
4	142,156	18%	6	12%
5	2,626	0%	0	0%
6	11	0%	0	0%
7	18	0%	0	0%
Total	788,737	100%	50	100%

Volume Audit Species Distribution

Species	Area	%	Samples	%
B	295,723	37%	19	38%
P	268,645	34%	17	34%
S	176,907	22%	11	22%
AC	38,045	5%	3	6%
H	9,076	1%	0	0%
EP	341	0%	0	0%
Total	788,737	100%	50	100%

Volume Audit Strata Comparison

Strata	Area (ha)	%	Samples	%
Balsam	295,723	37%	19	38%
Pine	268,645	34%	17	34%
Spruce	176,907	22%	11	22%
Other	47,462	6%	3	6%
Total	788,737	100%	50	100%

YSM Audit Class Comparison

Age Class	Area	%	Samples	%
1	6,637	9%	4	8%
2	59,519	83%	42	84%
3	5,952	8%	4	8%
Total	72,107	100%	50	100%

Young Stand Monitoring Height Class Comparison

Height Class	Area	%	Samples	%
1	54,767	76%	39	78%
2	17,161	24%	11	22%
3	161	0%		0%
4	19	0%		0%
Total	72,108	100%	50	100%

Young Stand Monitoring Species Comparison

Species	Area	%	Samples	%
PL	51,152	71%	36	72%
S	17,232	24%	11	22%
B	2,566	3%	2	4%
AC	1,146	2%	1	2%
EP	6	0%		0%
FD	4	0%		0%
CW	1	0%		0%
Total	72,107	100%	50	100%

Appendix C

NVAF Profile - NVAF Sample Selection Process and Methodology for Morice TSA

NVAF Sample Selection

Based on the document outlining the streamlined approach to *VRI Ground Sampling Volume Audit Sampling* and supplementary direction provided by the MFLNRO, 8 of the samples from the Volume Audit population were selected from the original 50 to be completed as part of the Net Volume Adjustment Factor sampling. As specified in the Draft Schedule A of the Invitation to Quote, samples were divided between 2 strata as follows:

Age Group	# of samples
>51≤120	3
>120	5
TOTAL	8

The following 2 tables show how the NVAF samples were chosen. The process was as specified in *Sample Selection Procedures for Ground Sampling Draft Version 4.0* section 3.4. The table of selected VRI samples for each Age Class grouping was sorted by leading species then by volume. The NVAF sample selection interval (K) was determined ($K = (\text{number of VRI samples in the grouping} / \text{number of NVAF samples})$). A random number between 1 and K was generated using Excel and this was the first VRI sample on the sorted list chosen for NVAF sampling. The next NVAF sample was K samples down the list -and so on until all of the NVAF samples were selected.

The following is the NVAF sample list.

NVAF Samples

Sample	Strata	Sub Strat	MAP_ID	Polygon	UTM	Sp 1	S1%	Sp 2	S2%	Sp 3	S3%	Age	Height	Basal Area	Vol/ha	Stems/ha
4	B	1	093E055	159	09U 619633 5930617	BL	70	HM	30		0	200	13.4	19	30	1076
8	B	2	093E083	144	09U 595211 5967572	B	100		0		0	269	25.8	36	184	671
20	P	1	093E088	2548	09U 665682 5974773	PL	40	SW	30	AT	20	60	14.0	20	40	436
26	P	2	093M038	656	09U 664898 6131661	PL	90	AT	10		0	87	21.0	30	129	1140
31	P	2	093L014	523	09U 611740 6000854	PL	60	BL	30	S	10	200	24.5	41	116	537
39	S	1	093K091	83	10U 314588 6095341	SB	80	SW	20		0	134	17.0	19	55	842
40	S	2	093K082	77	10U 323782 6085220	SW	60	BL	40		0	241	28.3	27	175	462
49	O	2	093M038	232	09U 664311 6138255	AT	90	PL	10		0	89	19.5	26	88	907

Appendix D

Sample Selection Process and Methodology for Morice TSA

Sampling Process and Methodology for Morice 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 (MFLNRO or Ministry). This included VRI data which was not clipped to the TSA boundary.

The VRI data was clipped to a shapefile of the TSA boundary which excluded private, parks, and Indian Reserve land. A “repair geometry” was then run on the new file. This file was called “VRI_net”. A new field called “New_area” was added and geometry calculated.

Consistent with the process for the previous TSAs, polygons less than .01ha were eliminated (called this VRI_net_final). The total area of polygons that were less than .01 ha was less than 1 ha.

The following table is a summary of the landbase.

Table 1: Morice TSA Landbase Summary

Land Classification	Area (ha)	% of TSA
Total TSA Area	1,501,703	100
Net-downs	171,707	11.43%
Parks	134,899	8.98%
Private	34,740	2.31%
Indian Reserve	2,068	0.14%
Net Area	1,329,996	88.57%
Non Vegetated	291,212	19.39%
Vegetated	1,038,784	69.17%
Non-treed	180,432	12.02%
Treed	858,352	57.16%

2) Creation of Population Shapefiles

Volume Audit: From the VRI_net_final file VT was selected (called VT_net). From VT_net, projected age greater than or equal to 51 was selected and exported to a new shapefile (called this VT_Mature). The area of the Volume Audit population is 788,737 hectares.

Young Stand Monitoring: From the VRI_net (**not** VT_net), projected age greater than or equal to 15 and less than 51 years was selected and exported to a new shapefile (called this Immature). The area of Volume Audit population is 72,107 hectares. The species distribution within the Young Stand Monitoring population is shown in the table below.

3) Sample Selection for the Volume Audit Population

3.1 Stratification

In order to make decisions about stratification, a summary by leading species was run. This provided the leading species distribution shown below.

Table 2: Volume Audit population Species Distribution

Species	Area	%
B	295,723	37%
P	268,645	34%
S	176,907	22%
AC	38,045	5%
H	9,076	1%
EP	341	0%
Total	788,737	100%

Based on this information, the Ministry staff identified the following strata for the Morice TSA VRI ground sampling project.

Table 3: Volume Audit population Strata Definition

Strata	Leading Species
1	Balsam
2	Pine
3	Spruce
4	Other

Shapefiles were created for each strata.

The number of samples for the Volume Audit and YSM populations was specified by the Ministry in the document *Streamlining VRI Ground Sampling – Volume Audit Sampling*. They specified that there would be 50 initial samples and 31⁵ replacements in the Volume Audit population.

Table 4: Volume Audit population Strata Sample Distribution

Strata	Area (ha)	%	Samples	Replacements
Balsam	295,723	37%	19	11
Pine	268,645	34%	17	10
Spruce	176,907	22%	11	7
Other	47,462	6%	3	3
Total	788,737	100%	50	31

⁵ Normally there are 30m replacement samples but in this case 31 were chosen in order to have 1 in each of the 3 “Other” sub-strata.

3.2) Sub-stratification

For the Volume Audit population sub-stratification was carried out the same way for all 4 strata. The process is described below.

- Exported the attribute table from each of the stratum shapefiles.
- Determined the number of polygons in each stratum (do a “statistics” report on the New_Area field)
- Divided total number of polygons by 3 to determine the number of polygons (approx) that should be in each sub-stratum.
- In these new worksheets, sorted data by total volume
- The “number of polygons per sub-strata” figure determined above was used in the table sorted by volume to find the volume figure that would be used to divide the sub-strata

The table below shows the criteria defining the sub-strata.

Table 5: Sub-Stratification of Volume Audit population:

Strata	No of Poly	Div by 3	Sub Strata	Polygon List no	Vol Criteria
Balsam	15,640	5,213	1	1-5213	≤106.56
			2	5214-10426	>106.56 and ≤200.08
			3	>10426	>200.08
Pine	20,089	6,696	1	1-6696	≤77.9
			2	6697-13392	>77.9 and ≤176.91
			3	>13392	>176.91
Spruce	15,008	5,003	1	1-5003	≤155.57
			2	5004-10006	>155.57 and ≤251.95
			3	>10006	>251.95
Other	3,864	1,288	1	1-1288	≤86.82
			2	1289-2576	>86.82 and ≤161.48
			3	>2576	>161.48

Sample distribution in the Volume Audit population was based on area representation of the sub-strata. The table below shows this distribution.

Table 6: Distribution of Volume Audit population - Samples to Sub-strata

Stratum	Sub-stratum	Area	%	Samples	Replacements
Balsam	1	93,255	31.53%	6	3
	2	95,553	32.31%	6	4

	3	106,915	36.15%	7	4
Total		295,723	100.00%	19	11
Pine	1	83,791	31.19%	5	3
	2	104,346	38.84%	7	4
	3	80,508	29.97%	5	3
Total		268,645	100.00%	17	10
Spruce	1	49,687	28.09%	3	2
	2	59,768	33.78%	4	2
	3	67,452	38.13%	4	3
Total		176,907	100.00%	11	7
Other	1	14,769	31.12%	1	1
	2	14,926	31.45%	1	1
	3	17,767	37.43%	1	1
Total		47,462	100.00%	3	3
Grand Total		788,737		50	31

3.3 Sample Polygon Selection

- An Excel random number spreadsheet was obtained from the Ministry that creates random numbers from a “seed”. Random numbers between 0 and the total area of each sub-stratum were produced for samples and replacement samples in each of the sub-stratum. As well, one extra random number per stratum was produced for a contingency sample in the event that a sample was eliminated during the sample location stage.
- Accumulated area tables were produced for each of the sub-stratum. This was done by selecting for the sub-strata criteria in the strata shapefiles.
- Two new columns were added to the accumulated area table for recording the samples that were chosen (S for selected, R for replacement and C for contingency) and sample number. The accumulated volume table was then sorted by S/R and then by sample number. All other rows were deleted (saved as Samp list full –sub-stratum). Another table was created from this with just mapsheet, polygon, selection, and area columns (called Samp list part-sub-strat). Using the random numbers generated for each sub-stratum, polygons were selected. A polygon was selected from the accumulated area table if the random number was larger than the accumulated area of the polygon immediately preceding it and less than or equal to its accumulated area.
- Initial Sample Polygons were selected first followed by replacement sample polygons then by contingency samples.

Initial sample numbers were numbered 1 to 50 and alternate samples were numbered A1 to A31.

3.4 Location of Samples Within Polygons

For each population, samples were located within selected polygons using an Arcmap 10 GIS program as follows:

- A new shapefile was created for samples with the following fields:

FID_1	Sample_no	Strata	Sub-strat	X	Y

*FID_1 is to link with the Objectid field in the immature VRI shapefile for joining these two files later on.

- The population, 100m grid (obtained from the Ministry), and Landsat shapefiles were displayed on an Arcview map.
- Sample polygons were displayed using the selection tool in the population attribute table.
- Using the tables “Samp list part-sub-strat”, random numbers were generated (with a range between 1 and the total number of dots in the polygon) for each selected polygon using “=Randbetween(1,X)” function in an Excel spreadsheet. The random numbers were recorded in a new column in this spreadsheet.
- The sample was located at the location of the randomly selected dot.
- The location was then checked against the Landsat image and a disturbance shapefile to see if any samples fell in a recent cutover. Initial sample number 40 in volume class 2 of the Spruce strata was in a recent cutover so it was replaced with the contingency sample.
- After sample location was complete for a population, the sample shapefile was joined to the population VRI shapefile so that all veg information would be included in the sample file.

4) Sample selection for Young Stand Monitoring (YSM) Samples

The species distribution of the Young Stand Monitoring population is as shown in the following table.

Table 7: YSM population Species Distribution

Species	Area	%
PL	51,152	71%
S	17,232	24%
B	2,566	3%
AC	1,146	2%
EP	6	0%
FD	4	0%
CW	1	0%
Total	72,107	100%

Direction from the Ministry was to select young stand monitoring (YSM) samples based on a grid provided by them.

The Young Stand Monitoring population was not subdivided into strata or sub-strata. The number of samples was directed to be 50 initial and a minimum of 100 alternates. Trial and error with the grid files provided by the Ministry determined that the 2 kilometre grid yielded 177 points within the Young Stand Monitoring population. This grid was therefore chosen and clipped to the immature population shapefile. The new shapefile was called "Immature_Samples. Consistent with Ministry direction the 177 grid points were divided by the required number of initial samples (50) giving an interval (n) of 3.54. Every "nth" sample was an initial sample. The remaining samples (127) were alternates.

Initial samples were numbered 51 to 100 and alternates were numbered A51 to A177.

Two new fields were added to the attribute table for Immature_Sample. One was called FID2 to allow joining the VRI attributes to the sample table. The other was for sample numbers. UTM coordinates were calculated for each sample and joined to sample shapefile.

The VRI attributes were then joined to the sample shapefile. From this the sample lists were developed.