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**Teal Cedar Products Ltd.**  
**Tree Farm Licence 46**  
**Vegetation Resources Inventory Phase II**  
**Project Implementation Plan**  
**Updated for the NVAF program only**

*Version 3.2*

*Prepared for*

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FIA Project: 6577001

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## 1. INTRODUCTION

### 1.1 TERMS OF REFERENCE

Teal Cedar Products Limited (Teal) contracted J.S. Thrower & Associates Ltd. (JST) to prepare the Vegetation Resources Inventory (VRI) Phase II Project Implementation Plan (VPIP) for Tree Farm Licence (TFL) 46. The JST team who prepared the VPIP included Hamish Robertson, *RPF* (project manager), Guillaume Thérien, *PhD* (biometrician), Alec Orr-Ewing, *RFT* (technical advisor), and Darryl Klassen, *BNRSc* (Geographic Information System analyst). Doug Reeve, *RFT* of Madrone Environmental Services Ltd. is Teal's Forest Investment Account (FIA) coordinator and is the client contact for this initiative.

It has been recognized that the original VPIP document is over two years old and changes to company names and personnel have occurred. Therefore, since this document is the last record of the implementation of the TFL 46 VRI Phase II program the only updates will be the addition of the NVAF sampling plan.

### 1.2 BACKGROUND

The VRI is the Ministry of Forests and Range's (MOFR) forest inventory standard on public lands in BC. Where possible, forest licensees must use the VRI standard in their data package submission for Timber Supply Review (TSR).

The VRI is a four-step process (Figure 1):

1. Phase I (unadjusted inventory data<sup>1</sup>) – Estimates of polygon attributes are derived for the target population from photo-interpretation.
2. Phase II (ground sample data) – Measurements are taken from randomly located ground samples in the target population.
3. Net Volume Adjustment Factor (NVAF) sampling – Random trees are selected for stem-analysis, from the Phase II samples, to develop adjustment ratios that correct taper and decay estimation bias.

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<sup>1</sup> A glossary of terms is provided in Appendix I.

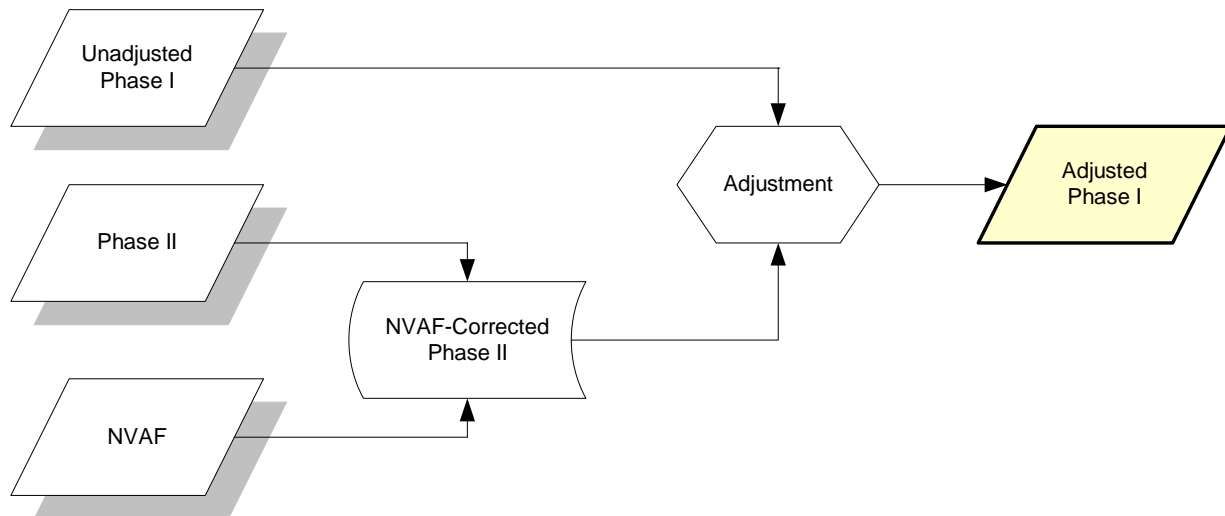


Figure 1. VRI flow-chart.

4. Adjustment Phase – The Phase I estimates are adjusted using the NVAF-corrected Phase II ground samples to provide an adjusted unbiased estimate of forest inventory attributes. The final product is an adjusted VRI database.

Inventory Resources Co-operative (IRC) completed the TFL 46 Phase I between October 27, 2005 and March 11, 2006. Over 98% of the TFL was inventoried using 2002 photos. The photo-interpretation was updated for depletion to January 1, 2005. The next steps in the VRI program are to complete the Phase II and NVAF field programs before proceeding with the inventory adjustment.

### 1.3 PROJECT OBJECTIVE

The project objective is to:

*Upgrade the TFL 46 forest inventory to MOFR standards for Timber Supply Review (TSR).*

### 1.4 DOCUMENT OBJECTIVE

The VRI Phase II VPIP objective is to:

*Provide details on the implementation of the VRI Phase II program, including definitions of the target population, sampling objectives, program scheduling, and roles and responsibilities.*

The intent is that MoFR will review and approve the proposed Phase II sampling program. Teal will update this VPIP with the proposed NVAF methods prior to the NVAF program commencing.

### 1.5 TFL 46 LANDBASE

TFL 46 is located on southern Vancouver Island, west of Cowichan Lake in the South Island Forest District (Figure 2). TFL 46 was transferred from TFL Forest Ltd. to Teal in 2004. The TFL went through several boundary changes following the transfer, with some boundaries not yet finalized. For the purpose of the Phase II VPIP, the TFL area includes the long-term land base of the TFL in addition to the area included in the timber re-allocation program currently underway (for a total of 78,347 ha<sup>2</sup>).

<sup>2</sup> The TFL 46 area for the last Timber Supply Review (effective September 1, 2003) was 83,545 ha.

TFL 46 is located in the Coastal Western Hemlock (CWH) and Mountain Hemlock (MH) biogeoclimatic zones (Table 1). The main species are Douglas-fir (Fdc) and western hemlock (Hw) in the younger stands, and Hw and redcedar (Cw) in the older stands (Table 2).

Table 1. TFL 46 subzone distribution.

Subzone	Area (ha)	(%)
CWHvm1	43,136	55%
CWHvm2	13,492	17%
CWHmm1	12,727	16%
CWHmm2	2,682	3%
CWHxm1	2,609	3%
CWHxm2	2,585	3%
MHmm1	1,015	1%
CWHvh1	100	0%
<i>Total</i>	<i>78,347</i>	

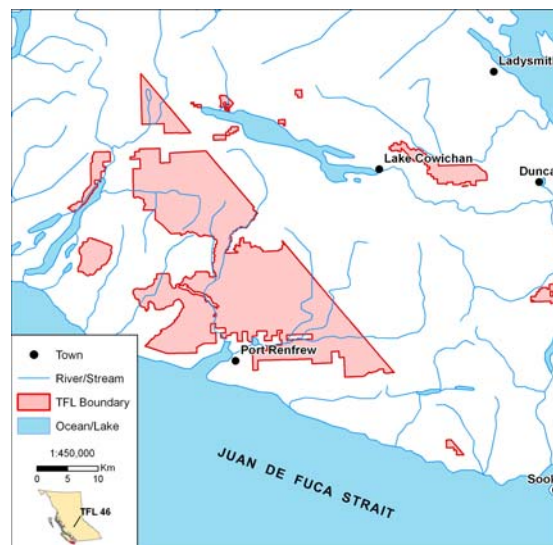


Figure 2. TFL 46 location on southern Vancouver Island.

Table 2. Species and age class distribution on TFL 46.

Leading Species	MOFR Age Class									Total Area	
	1	2	3	4	5	6	7	8	9	(ha)	(%)
Douglas-fir (Fdc)	1,878	11,161	12,860	2,790	372	192	15	510	889	30,667	39
Western Hemlock (Hw)	6,116	7,267	4,025	1,081	486	509	222	5,523	4,411	29,640	38
Western Redcedar (Cw)	1,192	244	36	20	5		9	704	4,066	6,276	8
Amabilis Fir (Ba)	463	286	149	62	7	2	32	1,589	445	3,034	4
Red Alder (Dr)	76	669	1,166	422	122					2,455	3
Hemlock (H)		88				39	2	282	454	865	1
Yellow Cypress (Yc)	12					1		32	337	382	0
Sitka Spruce (Ss)		4	35	38	88	15		32	6	218	0
Broadleaf Maple (Mb)		42	35		10					87	0
Lodgepole Pine (Pl)			16	16						32	0
Grand Fir (Bg)			14							14	0
No species										4,678	6
<i>Total (ha)</i>	<i>9,737</i>	<i>19,759</i>	<i>18,335</i>	<i>4,429</i>	<i>1,088</i>	<i>759</i>	<i>281</i>	<i>8,672</i>	<i>10,608</i>	<i>78,347</i>	
<i>(%)</i>	<i>12</i>	<i>25</i>	<i>23</i>	<i>6</i>	<i>1</i>	<i>1</i>	<i>0</i>	<i>11</i>	<i>14</i>		

## 2. GROUND SAMPLING PLAN

### 2.1 SAMPLING OBJECTIVES

The objective of the VRI Phase II ground sampling program is to:

*Estimate the average net merchantable volume in the target population with a sampling error of  $\pm 10\%$  at a 95% confidence level.*

The objective of the NVAF component is to:

*Estimate the ratio true net merchantable volume / net factored ground sample volume in the target population with a sampling error of  $\pm 10\%$  at a 95% confidence level.*

### 2.2 TARGET POPULATION

The target population for the VRI Phase II was defined as all TFL 46 operable polygons where the main layer is treed and established before 1977. A polygon was considered operable if at least 50% of its area was operable. The main layer was defined as the layer with the largest basal area. A layer was considered treed if the leading species was present with a minimum crown closure of 10%. The total area of the target population was 52,537 ha (Table 3; 67% of the total landbase). Forest cover polygons were either entirely included or excluded from the target population; no polygon was partially included.

Table 3. Phase II target population net down.

Land Class	Area (ha)	(%)
Total Landbase	78,347	
Inoperable	3,545	5
Operable	74,802	95
Non-treed	8,825	11
Treed	65,977	84
0-29 years	13,340	17
30+ years	52,537	67

### 2.3 STRATIFICATION

#### 2.3.1 Ground Sampling

We expect that the adjustment ratios and variability will be different between second-growth and old-growth stands.

Therefore, the target population was stratified by age class using two age groups (30-80 years, 81+ years). Each stratum was sub-stratified based on species group to ensure a good distribution of the ground samples across the range of possible values. Three sub-strata were used: Fdc, hemlock, and other species (Table 4).

Table 4. Stratum and sub-stratum distribution within the target population.

Age	Fdc		Hemlock		Others		Total	
	(ha)	(%)	(ha)	(%)	(ha)	(%)	(ha)	(%)
30-80 yrs	24,175	46	7,638	15	2,481	5	34,293	65
81 yrs+	1,877	4	10,069	19	6,297	12	18,244	35
<i>Total</i>	<i>26,052</i>	<i>50</i>	<i>17,707</i>	<i>34</i>	<i>8,777</i>	<i>17</i>	<i>52,537</i>	<i>100</i>

#### 2.3.2 NVAF

The NVAF strata do not have to be the same as the ground sampling strata.<sup>3</sup> Thus, the stratification for NVAF purposes was based on maturity classes, rather than age class and species group. Two maturity classes were used: immature (30-120 years, 51% of the target population total inventory volume) and

<sup>3</sup> Ministry of Forests – Forest Analysis and Inventory Branch. 2006. Vegetation Resources Inventory Guidelines for Preparing a Project Implementation Plan for Ground Sampling and Net Volume Adjustment Factor Sampling Version 2.0. Victoria BC. p. 8.



mature (121+ years, 49% of the target population total inventory volume). This maturity-based stratification was selected because it has been used in most previous NVAF projects and corresponds to variability observed among maturity classes.

## 2.4 SAMPLE SIZE

### 2.4.1 Ground Sampling

The sample size is set at 120 plots. Assuming a coefficient of variation between predicted and ground volume of 55%<sup>4</sup>, a sample size of 120 plots should be adequate to meet the target sampling error. The sample was split into two batches of 90 and 30 plots, respectively.

Table 5. Sample size distribution by stratum and sub-stratum.

Stratum	Sub-Stratum	Area (ha)	(%)	Sample Size	(%)	Area (ha)/Plot
30-80	Fdc	24,175	70	56	71	432
	H	7,638	22	17	22	449
	Others	2,481	7	6	8	413
	Total	34,293	100	79	100	434
81+	Fdc	1,877	10	4	10	469
	H	10,069	55	23	56	438
	Others	6,297	35	14	34	450
	Total	18,244	100	41	100	445

The sample size was distributed proportionally to area within each sub-stratum for each

batch. Therefore, each plot represents approximately the same area (about 440 ha/plot).<sup>5</sup>

### 2.4.2 NVAF

Twenty-five plots were selected for NVAF enhancement (eight immature and 17 mature). These NVAF-enhanced ground samples will provide the tree matrix from which NVAF trees will be selected for destructive sampling.

The sample size (number of trees) conforms to the minimum required by the MOFR. The selection strata and sample sizes are identified in Table 6. The allocation by species within the selection strata is based on the species proportions calculated from the ground samples from the Phase II plots.

Teal has identified that there are some perceived issues related to taper in immature Hw. Although the destructive sampling cannot specifically modify taper equations due to the small sample sizes, it can help identify, through analyses, whether there are significant differences between the true taper of these trees when compared to the results of the taper equations. The sample size of the dead trees was reduced to 10 which differs from the 25 outlined in the original sample plan. This new sample allocation of 10 dead trees and 90 live trees coincides with the changes made to NVAF standards in 2007.

A separate stratum for immature Hw was created to isolate the trees of interest and help identify the presence of a taper issue. The remaining trees available from the dead strata were added to this stratum which allows Teal to do some exploratory analysis. Proportional to volume, the immature Hw stratum is over sampled, however this allows more confidence in the data when doing analysis.

<sup>4</sup> The CV of 55% was selected based on CV observed in previous VRI projects in coastal BC (TFL 6, TFL 25 Block 1, TFL 25 Block 2&3, Kingcome Timber Supply Area, and TFL 37).

<sup>5</sup> The area represented by each plot will likely change before the inventory statistical adjustment due to upcoming depletion updates.

The sample sizes for the remaining strata are large enough for analysis and are proportional to the volume distributions. The new strata and their associated sample sizes are as follows:

1. Dead (10 trees)
2. Immature-H (25 trees)
3. Immature-Other (15 trees)
4. Mature-H (27 trees)
5. Mature-Other (23 trees)

For this project, one hundred (100) trees were selected following the NVAF tree selection standard methodology (Table 6). Only eight Immature Phase II plots were enhanced based on the original sample size. In Table 6 it can be seen that the Immature - H stratum has proportionally more sample trees based on the volume. Four (4) non-enhanced samples were used specifically to increase the pool of immature trees in an attempt to reduce the number of trees taken from any one enhanced plot. These plots

were chosen at random from all immature non-enhanced samples. The trees chosen from these plots will require enhancement prior to destructive sampling and this will be completed on the same visit as the destructive sampling. The sample size within each stratum was assigned based on consultation with the MOFR, on estimates of net merchantable volume, and expert knowledge about the variability within the stratum. An NVAF-certified crew will be hired to complete the destructive sampling by the end of the 2008 field season. The crew will complete the sampling using the current standards at the time of sampling.<sup>6</sup>

The NVAF will follow the MoFR VRI standards and will involve five steps:<sup>7</sup>

1. Create a tree matrix using data from the enhanced Phase II plots.
2. Select sample trees from the tree matrix.
3. Complete stem analysis of the sample trees.
4. Complete a third-party audit of the sample trees.

<sup>6</sup> The MOFR will be amending the NVAF standards document in the 2008/2009 fiscal as part of their regular annual change management cycle. This will replace the current standards and all sampling and analysis will conform to this version when it becomes available.

<sup>7</sup> NVAF sampling standards can be found at <http://www.for.gov.bc.ca/hts/vri/standards>.

Table 6. NVAF sample distribution.

Species Group	Net Merch Volume			No. Trees		
	Spp	% Total	% Group	Tree s	% Total	% Group
Dead	Hw	46%	46%	5	50%	50%
	Fd	18%	18%	1	10%	10%
	Ba	12%	12%	1	10%	10%
	Cw	11%	11%	1	10%	10%
	Other	13%	13%	2	20%	20%
	<b>Total</b>	<b>100%</b>	<b>100%</b>	<b>10</b>	<b>100%</b>	<b>100%</b>
Immature - H	HW	12%	100%	25	28%	100%
	<b>Total</b>	<b>12%</b>	<b>100%</b>	<b>25</b>	<b>28%</b>	<b>100%</b>
Immature - Other	Fd	12%	55%	8	9%	53%
	Dr	5%	23%	3	4%	20%
	Ss	3%	14%	2	2%	13%
	Other	2%	10%	2	2%	13%
	<b>Total</b>	<b>22%</b>	<b>100%</b>	<b>15</b>	<b>17%</b>	<b>100%</b>
Mature - H	Hm	1%	3%	3	3%	11%
	Hw	34%	97%	24	27%	89%
	<b>Total</b>	<b>35%</b>	<b>100%</b>	<b>27</b>	<b>30%</b>	<b>100%</b>
Mature - Others	Ba	11%	39%	9	10%	39%
	Cw	10%	25%	6	7%	26%
	Fd	6%	25%	5	6%	22%
	Yc	4%	11%	3	3%	13%
	Other	0%	0%	0	0%	0%
	<b>Total</b>	<b>31%</b>	<b>100%</b>	<b>23</b>	<b>26%</b>	<b>100%</b>
<b>Total</b>	<b>100%</b>	<b>100%</b>	<b>3</b>	<b>30%</b>	<b>30%</b>	

5. Analyze the data to develop net volume adjustment factors.

Teal will hire a third party auditor to audit approximately<sup>8</sup> 10% of all trees following the NVAF quality assurance standards.<sup>9</sup> A tree matrix was created using the trees with DBH greater than 12.5 cm from the Phase II NVAF enhanced plots. The sample size for each stratum was determined. The trees were sorted by species group and DBH and the samples were selected systematically using a random start. A list of the specific trees to be sampled can be found in Appendix V.

## **2.5 SAMPLE SELECTION**

### **2.5.1 Ground Sampling**

Ground sampling plot locations were selected using the probability proportional to size with replacement (PPSWR) method as defined in the MOFR standards. The selected sample was representative of the population for height, age, and net merchantable volume (Appendix II).

### **2.5.2 NVAF**

The ground sampling clusters selected for NVAF enhancement were systematically selected with a random start from a list sorted by leading species and diameter. The trees were selected using a random start.

## **2.6 SAMPLING APPROACH**

Teal's proposed approach is to utilize all of their FIA focused funding and any FIA funds that become available later in the fiscal year to complete as much of the Phase II program as possible within this fiscal year. The TFL 46 field season is perhaps the longest in BC, and the intent is to extend the field program to fully utilize this opportunity. Teal believes that a minimum of 80 to 90 plots can be installed with their current FIA allocation, but the goal is to try to complete their entire Phase II program this year.

It is likely that the NVAF program will be implemented in the 2007-08 fiscal year. This program will be initiated once the NVAF tree matrix has been built, the sample trees have been selected from the tree matrix, and the NVAF sample plan approved by the MOFR. The NVAF program should be completed before the end of the 2007-08 fiscal year.

An independent third party will be hired to complete the audit on approximately 10% of the Phase II samples and approximately 10% of the trees undergoing destructive sampling.

## **2.7 SAMPLE TYPE**

The sample type for this project will be timber emphasis plots (type Q). Thus, data on VRI plot cards 1, 2, 3, 8, 9, 10, and 11 will be collected, unless handheld data loggers and TIMVEG software is used.

## **2.8 ANALYSIS AND STATISTICAL ADJUSTMENT**

Two analyses will be completed through this project. A preliminary analysis will be completed after the first batch of 90 plots is installed. If the preliminary analysis demonstrates that more plots are needed,

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<sup>8</sup> A minimum of 10% of all NVAF sampled trees will be audited.

<sup>9</sup> The NVAF quality assurance standards are described in the NVAF sampling standards, chapter 10.

the second batch of plots will be established. A complete analysis and statistical adjustment will be completed once all plots for the project are installed (either after 90 or 120 plots).

The NVAF analysis will be completed using the VRI standard model based approach as outlined in the most current Net Volume Adjustment Factor Sampling Standards at the time.<sup>6</sup>

### 3. PROJECT IMPLEMENTATION

#### 3.1 SCHEDULE

It is possible that both the Phase II ground sampling and NVAF sampling components of the VRI program could be completed in the 2006/2007 fiscal year. The tendering process to select ground sampling crews will start as soon as the MOFR approves the VPIP.

At the end of the Phase II program, the NVAF sample list will be selected, the NVAF crew selected, and this version of the VPIP updated to reflect the final methods for the NVAF program. Should there be sufficient funding, the NVAF destructive sampling could occur early in the New Year, but the most likely scenario is that it will be completed in the next fiscal. All deliverables will be sent to the MOFR at the end of each fiscal year.

The project activities will be implemented as follows (Figure 3):

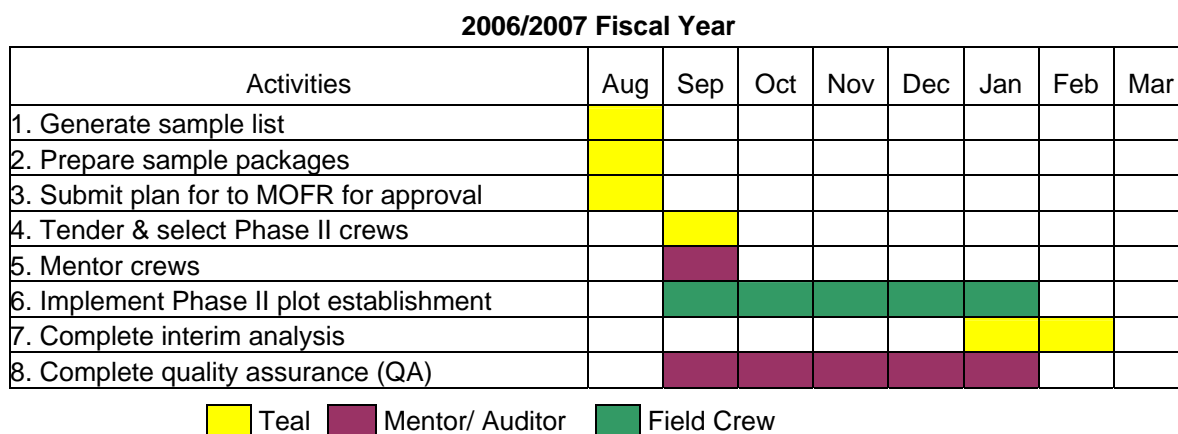


Figure 3. Proposed VRI Phase II implementation schedule for the 2006/2007 fiscal year.

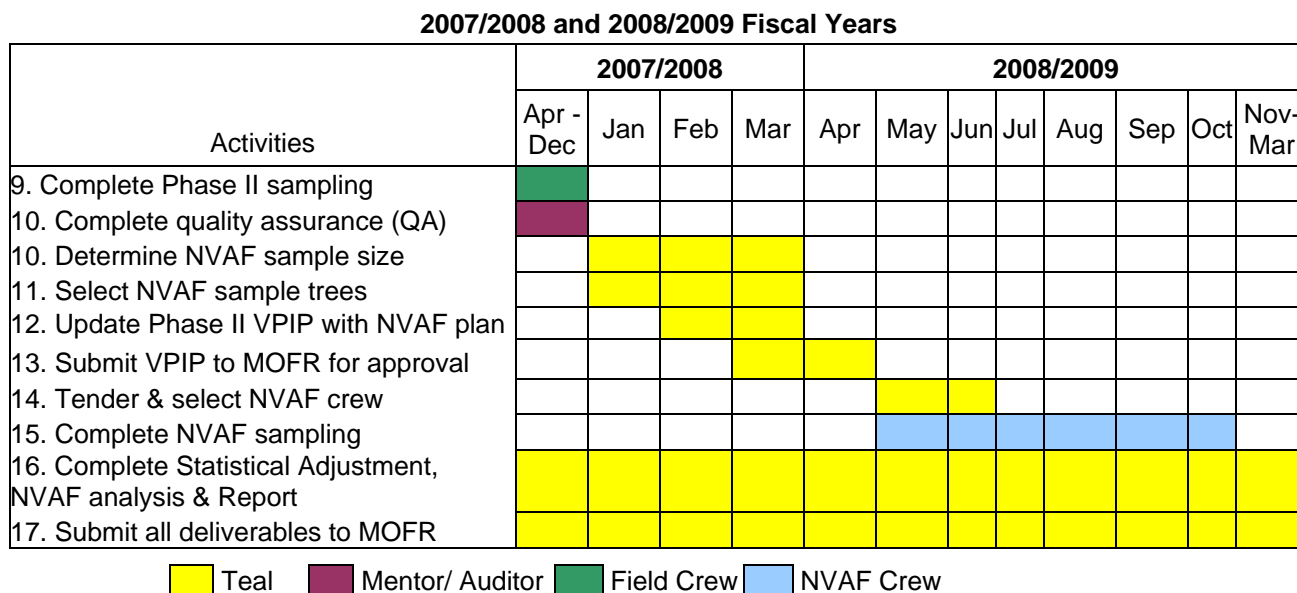


Figure 4. Proposed VRI Phase II and NVAF implementation schedule for the 2007/2008 and 2008/2009 fiscal year.

### 3.2 SAMPLE PACKAGES

The JST GIS department will prepare the sample packages for the TFL 46 VRI Phase II. The sample package for each plot will include:

1. Overview maps showing target polygon location (approximately 1:100,000).
2. 1:20,000 forest cover maps with all features and sample locations identified
3. 11x17" or 8x11" 1:10,000 forest cover maps with label
4. 1:10,000 ortho photo with sample and polygon linework (thin lines)
5. If suitable orthos are not available, then aerial photo pair including a laser copy of the document photos;

### 3.3 STANDARDS

The following standards and procedures will be used for this VRI Phase II project:

1. Ministry of Forests – Forest Analysis and Inventory Branch. 2002. Vegetation Resources Inventory Sample Selection Procedures for Ground Sampling. Version 3.3. Victoria BC. 26 pp. ([http://ilmbwww.gov.bc.ca/risc/pubs/teveg/vri\\_sample\\_selection\\_2k2/sample\\_selection\\_vri\\_dec\\_fi\\_nal.pdf](http://ilmbwww.gov.bc.ca/risc/pubs/teveg/vri_sample_selection_2k2/sample_selection_vri_dec_fi_nal.pdf) )
2. Ministry of Forests – Forest Analysis and Inventory Branch. 2004. Vegetation Resources Inventory Ground Sampling Procedures. Version 4.5. Victoria BC. 213 pp. ([http://ilmbwww.gov.bc.ca/risc/pubs/teveg/vri\\_gs\\_2k4/vri\\_gs\\_2k4.pdf](http://ilmbwww.gov.bc.ca/risc/pubs/teveg/vri_gs_2k4/vri_gs_2k4.pdf))
3. Ministry of Forests – Forest Analysis and Inventory Branch. 2003. Vegetation Resources Inventory Ground Sampling Data Collection Procedures for Inaccessible Plots. Version 1.0. Victoria BC. 24 pp. ([http://ilmbwww.gov.bc.ca/risc/pubs/teveg/vri\\_data\\_collection\\_procedures2k3/vri\\_data\\_collection\\_procedures\\_2k3.pdf](http://ilmbwww.gov.bc.ca/risc/pubs/teveg/vri_data_collection_procedures2k3/vri_data_collection_procedures_2k3.pdf))
4. Ministry of Forests – Forest Analysis and Inventory Branch. 2006. Vegetation Resources Inventory Data Collection Standards for VRI Ground Sampling. Version 2.1. Victoria BC. 11 pp. ([http://ilmbwww.gov.bc.ca/risc/pubs/teveg/vri\\_data\\_collect\\_stand\\_2k6/vri\\_data\\_collect\\_stand\\_2k6.pdf](http://ilmbwww.gov.bc.ca/risc/pubs/teveg/vri_data_collect_stand_2k6/vri_data_collect_stand_2k6.pdf))
5. Ministry of Forests – Forest Analysis and Inventory Branch. 2004. Vegetation Resources Inventory Quality Assurance Procedures for VRI Ground Sampling. Version 3.0. Victoria BC. 11 pp. ([http://ilmbwww.gov.bc.ca/risc/pubs/teveg/vri\\_qa\\_gs\\_2k4/vri\\_qa\\_gs\\_2k4.pdf](http://ilmbwww.gov.bc.ca/risc/pubs/teveg/vri_qa_gs_2k4/vri_qa_gs_2k4.pdf))
6. Ministry of Forests – Forest Analysis and Inventory Branch. 2006. Net Volume Adjustment Factor Sampling Standards and Procedures Version 4.1. Victoria BC. 83 pp. ([http://ilmbwww.gov.bc.ca/risc/pubs/teveg/nvaf\\_2k6/nvaf\\_2k6.pdf](http://ilmbwww.gov.bc.ca/risc/pubs/teveg/nvaf_2k6/nvaf_2k6.pdf))

### 3.4 ROLES AND RESPONSIBILITIES

The *MOFR VRI Section Manager* will:

- Sign-off the approval of the VPIP

Teal's *Project Coordinator* will:

- Sign-off the approval of the VPIP
- Coordinate the project.
- Select the field contractors and auditor/mentor.

- Liaise with MOFR.
- Ensure selected samples are valid.
- Monitor and communicate project progress.
- Ensure all contractors are qualified and certified, and manage fieldwork contracts.
- Monitor the budget.
- Ensure the sample packages are assembled and complete.
- Oversee ground-sampling activities.
- Ensure QA is complete.
- Assist in coordinating technical expertise where required.
- Complete interim and final analyses and statistical adjustment
- Provide MOFR with all project deliverables, according to standards and timelines agreed with the MOFR.

The *Fieldwork Contractors* will:

- Complete field sampling.
- Conduct internal quality control.
- Enter the sampled data.

The *Mentor/Auditor* will:

- Complete QA work for approximately 10% of the VRI samples.
- Enter and validate the sample data.
- Prepare the QA report.

### 3.5 SAMPLE LIST

The sample list is presented in Appendix III. If a plot cannot be established because the location has been logged or for safety reasons, an alternate plot location will be discussed with Regional Resource Inventory Forester and selected according to MOFR standards.

### 3.6 DELIVERABLES

The deliverables for the project include:

1. The VPIP
2. A digital copy of the map of the target population
3. A digital copy of the target population database
4. Sample list modifications (if any),
5. The sample packages,
6. The plot cards,
7. The ground sampling field data in a digital format accepted by the MOFR,<sup>10</sup>
8. The NVAF destructive sampling data in a digital format accepted by the MOFR,
9. A copy of the quality assurance report for each of the Phase II and NVAF programs,
10. Statistical adjustment and final report.

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<sup>10</sup> Phase II and NVAF field sampling data will be submitted to the licensee and MOFR at the conclusion of each fiscal year.

### 3.7 COSTS

The estimated cost to implement the Phase II ground sampling and NVAF field programs will be approximately \$343,000 including data entry, audit, helicopter, and analysis and reporting costs (Table 7). This estimate should be refined once the ground sampling bids become known and the access costs for each plot location are clarified following the sample package development stage.

Table 7. Expected budget for the TFL 46 VRI Phase II and NVAF program.

VRI Phase II and NVAF	Cost	%
Project management	\$10,000	3
Field sampling (including helicopter)	\$210,000	61
NVAF sampling	\$80,000	23
Mentoring & QA	\$23,000	7
Analyses, Statistical Adjustment, Report	\$20,000	6
<i>Total</i>	<i>\$343,000</i>	



#### 4. SIGN-OFF SHEET

It is the intention of the proponent to implement the TFL 46 Vegetation Resources Inventory Phase II Ground Sampling Plan (VPIP) as described. As a key stakeholder in the inventory, Ministry of Forest and Range (MOFR) VRI staff has been consulted throughout the development of this plan.

\_\_\_\_\_  
Proponent Name: Doug Reeve

\_\_\_\_\_  
Date:

Title: FIA Coordinator

Company: Teal Cedar Products Ltd.

Location: Surrey

I have reviewed the TFL 46 Vegetation Resources Inventory Phase II Ground Sampling Plan. I will be advising Pricewaterhouse Coopers that the work proposed in this plan meets Vegetation Resources Inventory standards and MOFR business needs.

\_\_\_\_\_  
Manager Name: Jon Vivian

\_\_\_\_\_  
Date:

Manager

Vegetation Resources Inventory Section

Forest Analysis and Inventory Branch

Ministry of Forests and Range

## APPENDIX I – GLOSSARY OF TERMS

### **Ground Sampling**

VRI ground sampling (Phase I) is the field measurement of timber, ecology, range, and/or coarse woody debris values at one or more locations within each sample polygon. To accommodate the wide variety of resources, various types and sizes of sampling units (e.g., fixed and variable plots, transects) are used to make the measurements.

### **Landcover Classification**

The BC Landcover Classification Scheme (BCLCS) was designed specifically to meet the requirements of the VRI, in addition to providing general information useful for “global vegetation accounting” and “integrated resource management”. The BCLCS is hierarchical and reflects the current state of the landcover (e.g., presence or absence of vegetation, type and density of vegetation) and such fixed characteristics as landscape position (i.e., wetland, upland, alpine). There are two main classes of polygons: Vegetated and Non-Vegetated.

### **Net Volume Adjustment Factor (NVAF) Sampling**

NVAF sampling provides factors to adjust net tree volume estimated from net factoring and taper equations. The adjustment accounts for hidden decay and possible taper equation bias. NVAF sampling involves detailed stem analysis of sample trees, calculation of actual net volume, and calculation of the ratio between actual net volume and estimated net volume (where estimate net volume is obtained from net factoring and taper equations).

### **Photo-Interpretation (Phase I)**

Photo-interpretation (Phase I) involves the subjective delineation of polygons and the photo estimation of attributes for all polygons in an inventory unit. Medium scale aerial photographs (1:15,000) are most often used in the photo-interpreted estimates inventory. However, if the existing photo-based inventory is acceptable, the database can be translated into VRI format and upgraded to include the additional VRI attributes.

### **Post-Stratification**

Post-stratification involves the division of an inventory unit into mutually exclusive sub-populations (strata) *after* ground sampling has been completed. Samples that fall in each post-stratum are analyzed separately and the results are applied to the corresponding population post-strata.

### **Pre-Stratification**

Pre-stratification involves the division of an inventory unit into mutually exclusive sub-populations (strata) *before* ground sampling to provide estimates for specific areas, or to increase the confidence in the overall estimates by considering the special characteristics of each stratum.

### **Sample Size**

The sample size for an inventory is the minimum number of ground samples to be established in an inventory unit to meet specified target precision or cost. Calculation of a theoretical target sample size requires an estimate of the CV of the key attributes of interest under the proposed sampling procedures and a statement of the precision desired in these attributes.

The formal process for determining sample size for an inventory unit is to anticipate the results (e.g., target sampling error for timber volume) and then determine the approximate sample size corresponding to this desired result. This process would, for example, involve the following steps:

1. Set the target accuracy for the overall inventory unit accuracy to  $E$  for timber volume (i.e., the sampling error, or half the confidence interval associated with a given probability, e.g.,  $\pm 15\%$  at the 95% probability level). The number of samples should be adequate to meet the target precision.
2. Estimate the population coefficient of variation ( $CV_{\text{sample}}$ ) of the attribute of interest based on a small sample. This  $CV_{\text{sample}}$  is defined as a relative measure of the average difference between a polygon ground measurement (assumed the true value) and its corresponding estimate from the inventory.
3. The following formula would then be used to estimate sample size:

$$n = \left[ \frac{t * CV_{\text{sample}}}{E} \right]^2$$

where  $t$  is the “ $t$ -value” associated with a given probability and degrees of freedom, and  $CV_{\text{sample}}$  is a sample-based estimate of the population CV.

The sample size calculations suggested here are general guidelines, not exact requirements. The sample size used in practice is usually a trade-off between the calculated sample size and the expected cost, timing, credibility, flexibility, and comparability of the inventory. The size of the population is usually large enough that it does not affect sample size. The calculated sample size may be increased arbitrarily to allow for post-stratification, increased credibility, more flexibility, and a better starting point for growth projections.

### **Statistical Adjustment**

Statistical adjustment (or analysis) is the process of adjusting the values of the photo-interpreted estimates variables using the ground sampling observations. For each sampled polygon, the ground observations are compared to the photo-estimated values to develop an adjustment factor. This factor is then applied to all polygons in the photo-interpreted estimates database to produce the final adjusted database.

### **Sub-unit**

The term sub-unit describes the inventory unit within a management unit. A sub-unit may be defined by a specific geographic area (e.g., operable landbase) or stand type (e.g., problem forest types) within the management unit.

### **Target Population**

The target population is the unit from which the samples are chosen. For management inventories, the inventory unit is a TSA, TFL or other geographic area or specific attribute set, depending upon the sampling objectives.

### **Target sampling error**

Target sampling error expresses the desired accuracy of the attribute of interest (e.g., timber volume). It is usually expressed as a percentage value at a given probability level (e.g.,  $\pm 15$  at the 95% probability level). This means that 95% of the time we are confident that the volume estimates are within 15% of the

actual volume. Target sampling error is used to calculate the minimum sample size for subsequent ground sampling; see **Sample Size**.

### **Vegetation Resources Inventory (VRI)**

The VRI is an improved vegetation inventory process for assessing the quantity and quality of BC's vegetation resources. The VRI process is designed to include a flexible set of sampling procedures for collecting vegetation resource information. The VRI is essentially a toolbox of procedures, which include:

- BC Landcover classification scheme (BCLCS).
- *Photo-interpreted estimates (Phase I)*: the delineation of polygons from aerial photography and the estimation of resource attributes.
- *Ground sampling (Phase II)*: the establishment of plot clusters in selected polygons to measure timber, ecological, and/or range attributes. The data are used for the adjustment of the photo-interpreted estimates for all polygons in an inventory unit or management unit.
- *NVAF Sampling*: Stem analysis sampling of individual trees for net volume adjustment.
- *WPV Sampling*: Intensive sampling of selected polygons to determine the error between the estimated attribute values and the "true" attribute values.
- *Change Monitoring Inventory (CMI)*.

The VRI can be deployed over the entire province (provincial VRI) measuring timber and non-timber resources, or over a large management unit (management VRI) measuring selected resources in specific portions of the landbase. The VRI sampling process produces spatial and non-spatial databases that can be used in multiple resource management applications including timber, ecosystem, and wildlife habitat management.

**APPENDIX II – LANDBASE AND SAMPLE COMPARISONS**

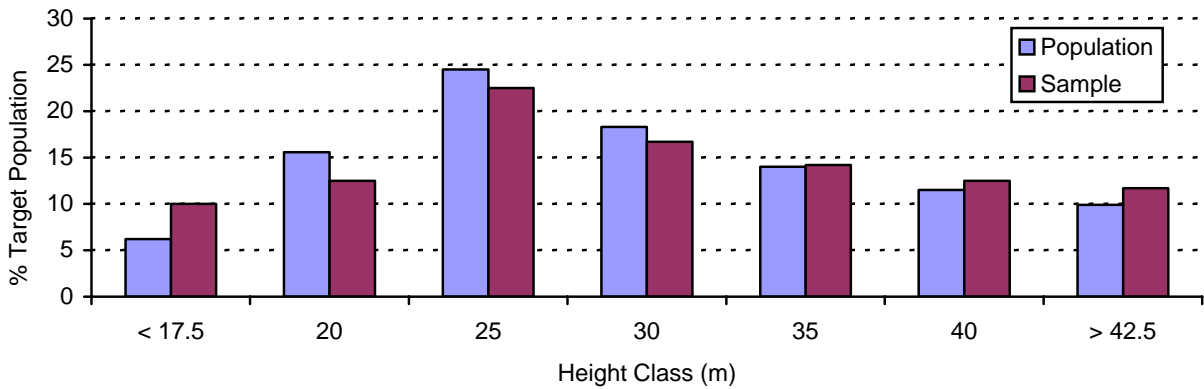


Figure 5. Height distribution in the population and the sample.

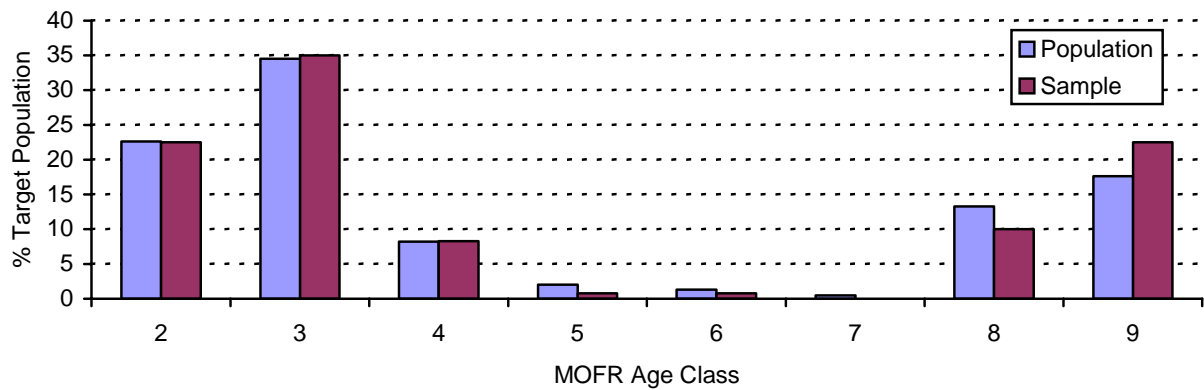


Figure 6. Age distribution in the population and the sample.

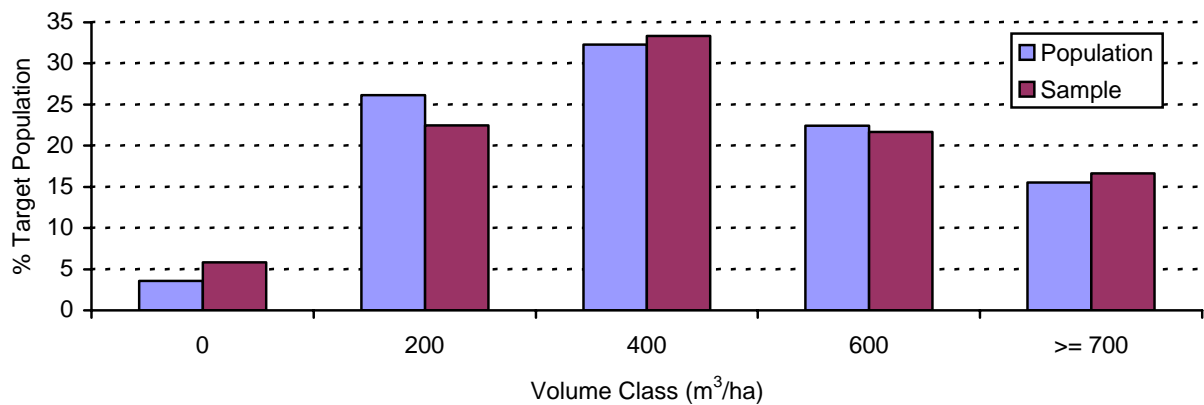


Figure 7. Net merchantable volume distribution in the population and the sample.

## APPENDIX III – SAMPLE LIST

Table 8. Sample list for the TFL 46 VRI Phase II (first batch).

Plot No.	Stratum	Sub-Stratum	NVAF Stratum	Enhanced	UTM			Mapsheet	Polygon
					Zone	Northing	Easting		
2	Second-growth	Fdc	Immature	No	10	395491.9	5400728	092C078	549
4	Second-growth	H	Immature	No	10	385390.2	5409822	092C088	507
5	Second-growth	Fdc	Immature	No	10	384593.5	5422028	092C098	61
6	Old-growth	Others	Mature	No	10	412597.4	5380175	092C060	176
7	Second-growth	Fdc	Immature	No	10	383113.9	5412709	092C088	125
8	Second-growth	Fdc	Immature	No	10	392775.7	5405029	092C078	164
10	Old-growth	Others	Mature	Yes	10	394361	5390201	092C068	254
11	Second-growth	Fdc	Immature	No	10	435096.1	5407966	092B081	158
12	Old-growth	H	Mature	Yes	10	383627.5	5420371	092C098	56
13	Second-growth	Fdc	Immature	No	10	424597.4	5412194	092C090	23
14	Second-growth	Fdc	Immature	Yes	10	385690.9	5419588	092C098	135
15	Second-growth	H	Immature	No	10	389339.8	5418540	092C098	215
17	Second-growth	H	Immature	No	10	416263.6	5382018	092C060	75
18	Second-growth	Fdc	Immature	No	10	397048.4	5399766	092C078	570
20	Second-growth	H	Immature	No	10	393052.7	5399631	092C078	515
22	Second-growth	Fdc	Immature	No	10	393230	5401519	092C078	507
23	Second-growth	Others	Immature	No	10	397266.7	5419611	092C098	313
24	Old-growth	H	Mature	Yes	10	401496.1	5391504	092C069	322
25	Second-growth	Fdc	Immature	No	10	406371.9	5388809	092C069	598
26	Old-growth	Fdc	Mature	Yes	10	381904.1	5409965	092C087	199
27	Second-growth	Fdc	Immature	No	10	416148.9	5376837	092C060	377
28	Second-growth	Fdc	Immature	No	10	375702.2	5412014	092C087	20
29	Second-growth	Fdc	Immature	No	10	392693.2	5383587	092C058	85
31	Second-growth	Fdc	Immature	Yes	10	395194.4	5398346	092C078	615
32	Second-growth	Fdc	Immature	No	10	398038.9	5402020	092C079	147
33	Second-growth	Others	Immature	No	10	432802	5362486	092B041	31
36	Old-growth	Others	Mature	Yes	10	401716.9	5389599	092C069	317
38	Second-growth	Fdc	Immature	No	10	388750.6	5411480	092C088	231
39	Second-growth	Fdc	Immature	No	10	397310	5415817	092C088	109
41	Second-growth	H	Immature	No	10	425286.3	5411966	092C090	40
42	Old-growth	H	Mature	No	10	386968.2	5389906	092C068	174
44	Second-growth	Fdc	Immature	No	10	431448.7	5409016	092B081	78
45	Old-growth	Others	Mature	No	10	404806.5	5391966	092C069	117
47	Second-growth	H	Immature	No	10	419230.6	5376610	092C060	313
48	Old-growth	H	Mature	Yes	10	402473.5	5386177	092C069	798
51	Second-growth	Fdc	Immature	No	10	404244	5387999	092C069	614
52	Old-growth	Fdc	Mature	Yes	10	404971.8	5393555	092C069	150
54	Second-growth	Fdc	Immature	No	10	398082.8	5405509	092C079	36
55	Second-growth	H	Immature	No	10	398403.3	5403601	092C079	126
56	Old-growth	H	Mature	Yes	10	419210	5376112	092C060	348
58	Old-growth	H	Mature	No	10	422586.2	5375773	092C060	343
59	Old-growth	H	Mature	Yes	10	409994.1	5387164	092C069	531
60	Second-growth	Fdc	Immature	No	10	417827.6	5381255	092C060	102
61	Second-growth	Fdc	Immature	No	10	408703.9	5387317	092C069	550
62	Second-growth	Others	Immature	No	10	412476.4	5382075	092C060	40
63	Second-growth	H	Immature	No	10	414762	5381880	092C060	144
64	Old-growth	H	Mature	Yes	10	387571.3	5399756	092C078	442
65	Second-growth	Fdc	Immature	No	10	375175.7	5411337	092C087	86
66	Old-growth	H	Immature	No	10	394736.1	5387194	092C068	301
67	Old-growth	Others	Mature	No	10	392272.4	5400062	092C078	492
68	Second-growth	Fdc	Immature	No	10	381802.1	5407475	092C087	215
69	Old-growth	H	Mature	No	10	388539.6	5403906	092C078	83

Plot No.	Stratum	Sub-Stratum	NVAF Stratum	Enhanced	UTM			Mapsheet	Polygon
					Zone	Northing	Easting		
70	Second-growth	Fdc	Immature	Yes	10	403756.4	5393106	092C069	124
71	Old-growth	H	Mature	No	10	382139.8	5388907	092C068	488
73	Second-growth	Fdc	Immature	No	10	430979.8	5407339	092B081	117
74	Second-growth	Fdc	Immature	Yes	10	392847.3	5382484	092C058	102
77	Second-growth	Fdc	Immature	No	10	407950.8	5393232	092C069	211
78	Second-growth	Fdc	Immature	No	10	389772.7	5409642	092C088	440
79	Second-growth	H	Immature	Yes	10	390188.9	5407630	092C088	754
80	Old-growth	Others	Mature	Yes	10	392654.6	5392366	092C068	43
81	Second-growth	Fdc	Immature	No	10	385892.7	5422074	092C098	322
82	Second-growth	Fdc	Immature	No	10	393999.5	5405677	092C078	177
83	Old-growth	Fdc	Mature	No	10	410126.5	5387956	092C069	525
85	Second-growth	Fdc	Immature	No	10	393292.8	5407901	092C088	824
86	Second-growth	Fdc	Immature	No	10	399038.3	5394796	092C069	34
87	Second-growth	Fdc	Immature	No	10	436133.4	5406526	092B081	236
88	Old-growth	H	Mature	Yes	10	389712.8	5405754	092C078	108
90	Second-growth	Fdc	Immature	No	10	401672.3	5378831	092C059	414
92	Old-growth	H	Mature	Yes	10	401584.5	5388807	092C069	667
93	Second-growth	H	Immature	Yes	10	402984.7	5384062	092C069	1016
94	Old-growth	Others	Mature	Yes	10	404008	5387111	092C069	623
95	Old-growth	Others	Mature	No	10	388485.4	5385555	092C068	499
96	Old-growth	H	Mature	No	10	397065.2	5407447	092C088	882
99	Second-growth	Fdc	Immature	Yes	10	408970.6	5384114	092C069	966
101	Second-growth	H	Immature	No	10	408165.9	5383948	092C069	971
102	Second-growth	Fdc	Immature	No	10	395969.3	5400209	092C078	556
103	Old-growth	Others	Mature	Yes	10	402340.8	5395059	092C079	252
104	Old-growth	Others	Mature	Yes	10	402819.2	5392147	092C069	109
105	Old-growth	H	Immature	No	10	393819.7	5383092	092C058	97
106	Second-growth	Fdc	Immature	No	10	387786.9	5419602	092C098	193
107	Old-growth	H	Mature	No	10	399578	5386097	092C069	757
108	Old-growth	H	Mature	Yes	10	401091.9	5386533	092C069	772
110	Second-growth	H	Immature	No	10	387695.5	5419805	092C098	174
111	Second-growth	Others	Immature	No	10	404802.5	5382192	092C059	137
112	Old-growth	Others	Mature	No	10	410805.4	5380249	092C059	307
114	Second-growth	Fdc	Immature	No	10	372929.7	5397861	092C077	34
117	Second-growth	Fdc	Immature	No	10	407087.2	5384391	092C069	985
118	Second-growth	Fdc	Immature	No	10	385223	5417911	092C098	257
119	Second-growth	H	Immature	Yes	10	400848.9	5383053	092C059	63
120	Second-growth	Fdc	Immature	No	10	438548.4	5407024	092B081	208

Table 9. Sample list for the TFL 46 VRI Phase II (second batch).

Plot No.	Stratum	Sub-Stratum	NVAF Stratum	Enhanced	UTM			Mapsheet	Polygon
					Zone	Northing	Easting		
1	Second-growth	Fdc	Immature	No	10	406514.5	5385013	092C069	868
3	Old-growth	H	Mature	No	10	389820.6	5386498	092C068	521
9	Second-growth	H	Immature	No	10	390950.1	5411589	092C088	252
16	Old-growth	H	Mature	No	10	405989.1	5391618	092C069	387
19	Old-growth	H	Mature	No	10	410125.9	5378283	092C059	483
21	Second-growth	Fdc	Immature	No	10	432257.9	5406887	092B081	122
30	Second-growth	Others	Immature	No	10	396960.7	5385507	092C069	739
34	Second-growth	Fdc	Immature	No	10	399014.3	5401481	092C079	151
35	Second-growth	Fdc	Immature	No	10	393843.9	5401893	092C078	257
37	Second-growth	Fdc	Immature	No	10	391021.1	5410888	092C088	413
40	Old-growth	H	Mature	No	10	390908.7	5391141	092C068	215
43	Second-growth	H	Immature	No	10	387535	5411031	092C088	476
46	Second-growth	Fdc	Immature	No	10	388512.1	5408098	092C088	730
49	Second-growth	Fdc	Immature	No	10	395212.1	5396350	092C078	585
50	Old-growth	Fdc	Mature	No	10	382613.5	5410235	092C088	563
53	Old-growth	Others	Mature	No	10	383239.1	5388962	092C068	130
57	Old-growth	Others	Mature	No	10	390400.7	5381188	092C058	244
72	Second-growth	Fdc	Immature	No	10	384138.6	5413365	092C088	135
75	Old-growth	Others	Mature	No	10	389186.2	5405077	092C078	92
76	Second-growth	H	Immature	No	10	418558.6	5377236	092C060	286
84	Second-growth	Fdc	Immature	No	10	446701.8	5387332	092B062	108
89	Second-growth	Fdc	Immature	No	10	433540	5406534	092B081	256
91	Second-growth	Others	Immature	No	10	428398.7	5410041	092B081	37
97	Second-growth	H	Immature	No	10	398587.7	5383844	092C059	9
98	Second-growth	Fdc	Immature	No	10	392333.7	5401556	092C078	289
100	Second-growth	Fdc	Immature	No	10	375057.7	5408449	092C087	139
109	Second-growth	Fdc	Immature	No	10	419163.5	5379803	092C060	89
113	Old-growth	H	Mature	No	10	383314.3	5388360	092C068	479
115	Second-growth	Fdc	Immature	No	10	413275.5	5386928	092C070	30
116	Old-growth	H	Mature	No	10	397392.6	5408132	092C089	59



## APPENDIX IV – ADDITIONS TO STANDARD VRI METHODS

In order to provide data that better meets Teal's inventory needs, additional field data is being collected beyond provincial VRI standards. The intent is that this data may aid future plot remeasurements. The additions to current VRI methods include:

- Recording the distance plot centre-tree on auxiliary plots.
- Recording borderline trees that are outside the prism plot.

### **Recording the distance plot centre-tree on auxiliary plots**

Tree distances are only recorded on the Integrated Plot Centre (IPC). We propose recording this attribute on all auxiliary plots to increase the information on tree distances.

### **Recording borderline trees outside the prism plot**

Recording borderline trees will decrease the likelihood of missing a tree. In the current system, trees are dropped from compilation if the tree was mistakenly recorded as in tree, but it is impossible to know if missed trees should have been included.

### APPENDIX V – NVAF SAMPLE TREE LIST

Note: Plot 56 is located in an ecological reserve and trees will not be destructively sampled in this plot.  
Seven new trees were selected using the next tree after the one that is being dropped from the original sorted list.

Sample No	Species group	Cluster ID	Plot	Tree No	Spp	Live/Dead	DBH (cm)	Age (Yrs)	Maturity
92	Dead-B	4571-0092-NO1	S	6	BA	Dead	54.2	254	Mature
10	Dead-C	4571-0010-NO1	W	7	CW	Dead	42.5	304	Mature
48	Dead-F	4571-0048-NO1	S	3	FD	Dead	96.9	264	Mature
26	Dead-H	4571-0026-NO1	E	6	HW	Dead	51.0	301	Mature
59	Dead-H	4571-0059-NO1	S	3	HW	Dead	69.9	254	Mature
64	Dead-H	4571-0064-NO1	N	4	HW	Dead	94.0	304	Mature
64	Dead-H	4571-0064-NO1	N	5	HW	Dead	113.0	304	Mature
108	Dead-H	4571-0108-NO1	E	1	HW	Dead	84.0	254	Mature
26	Dead-O	4571-0026-NO1	N	4	XC	Dead	48.7	301	Mature
<del>56</del>	<del>Dead-O</del>	<del>4571-0056-NO1</del>	<del>N</del>	<del>4</del>	<del>PW</del>	<del>Dead</del>	<del>52.6</del>	<del>254</del>	<del>Mature</del>
31	Immature-D	4571-0031-NO1	W	2	DR	Live	17.4	44	Immature
31	Immature-D	4571-0031-NO1	W	3	DR	Live	25.1	44	Immature
70	Immature-D	4571-0070-NO1	E	5	DR	Live	12.7	34	Immature
18	Immature-F	4571-0018-QO1	W	5	FD	Live	20.2	44	Immature
31	Immature-F	4571-0031-NO1	N	1	FD	Live	30.8	44	Immature
79	Immature-F	4571-0079-NO1	S	1	FD	Live	47.3	39	Immature
79	Immature-F	4571-0079-NO1	S	4	FD	Live	42.0	39	Immature
99	Immature-F	4571-0099-NO1	W	2	FD	Live	36.9	74	Immature
114	Immature-F	4571-0114-QO1	E	4	FD	Live	27.2	41	Immature
114	Immature-F	4571-0114-QO1	S	3	FD	Live	33.6	41	Immature
119	Immature-F	4571-0119-NO1	S	4	FD	Live	61.5	54	Immature
7	Immature-H	4571-0007-QO1	E	2	HW	Live	38.1	39	Immature
7	Immature-H	4571-0007-QO1	E	3	HW	Live	32.7	39	Immature
7	Immature-H	4571-0007-QO1	N	3	HW	Live	30.3	39	Immature
7	Immature-H	4571-0007-QO1	N	6	HW	Live	24.8	39	Immature
7	Immature-H	4571-0007-QO1	S	7	HW	Live	41.3	39	Immature
7	Immature-H	4571-0007-QO1	W	1	HW	Live	29.0	39	Immature
7	Immature-H	4571-0007-QO1	W	5	HW	Live	43.1	39	Immature
14	Immature-H	4571-0014-NO1	N	2	HW	Live	17.5	44	Immature
31	Immature-H	4571-0031-NO1	N	3	HW	Live	39.3	44	Immature
47	Immature-H	4571-0047-QO1	E	1	HW	Live	16.2	39	Immature
47	Immature-H	4571-0047-QO1	N	1	HW	Live	24.6	39	Immature
47	Immature-H	4571-0047-QO1	N	4	HW	Live	26.0	39	Immature
47	Immature-H	4571-0047-QO1	N	5	HW	Live	14.0	39	Immature
47	Immature-H	4571-0047-QO1	N	6	HW	Live	25.0	39	Immature
70	Immature-H	4571-0070-NO1	N	1	HW	Live	26.5	34	Immature
70	Immature-H	4571-0070-NO1	S	4	HW	Live	15.8	34	Immature
70	Immature-H	4571-0070-NO1	S	6	HW	Live	21.8	34	Immature
70	Immature-H	4571-0070-NO1	S	7	HW	Live	23.2	34	Immature
79	Immature-H	4571-0079-NO1	N	1	HW	Live	35.0	39	Immature
79	Immature-H	4571-0079-NO1	N	4	HW	Live	55.5	39	Immature
79	Immature-H	4571-0079-NO1	W	3	HW	Live	48.6	39	Immature

Sample No	Species group	Cluster ID	Plot	Tree No	Spp	Live/Dead	DBH (cm)	Age (Yrs)	Maturity
93	Immature-H	4571-0093-NO1	W	3	HW	Live	51.1	34	Immature
99	Immature-H	4571-0099-NO1	W	3	HW	Live	31.5	74	Immature
114	Immature-H	4571-0114-QO1	S	2	HW	Live	28.9	41	Immature
119	Immature-H	4571-0119-NO1	S	3	HW	Live	58.4	54	Immature
70	Immature-O	4571-0070-NO1	W	7	CW	Live	87.5	34	Immature
79	Immature-O	4571-0079-NO1	N	5	BA	Live	42.8	39	Immature
99	Immature-S	4571-0099-NO1	S	2	SS	Live	74.3	74	Immature
99	Immature-S	4571-0099-NO1	W	4	SS	Live	63.8	74	Immature
10	Mature-H	4571-0010-NO1	S	3	HW	Live	28.0	304	Mature
24	Mature-H	4571-0024-NO1	W	3	HW	Live	33.7	244	Mature
26	Mature-H	4571-0026-NO1	E	7	HW	Live	94.6	301	Mature
26	Mature-H	4571-0026-NO1	E	8	HW	Live	86.4	301	Mature
36	Mature-H	4571-0036-NO1	S	4	HW	Live	110.0	254	Mature
48	Mature-H	4571-0048-NO1	W	3	HW	Live	73.2	264	Mature
48	Mature-H	4571-0048-NO1	W	6	HW	Live	71.5	264	Mature
52	Mature-H	4571-0052-NO1	E	1	HW	Live	18.0	234	Mature
52	Mature-H	4571-0052-NO1	E	5	HW	Live	60.0	234	Mature
52	Mature-H	4571-0052-NO1	N	1	HW	Live	76.2	234	Mature
52	Mature-H	4571-0052-NO1	S	1	HW	Live	68.5	234	Mature
56	Mature-H	4571-0056-NO1	E	4	HM	Live	84.9	254	Mature
56	Mature-H	4571-0056-NO1	N	4	HW	Live	401.4	254	Mature
56	Mature-H	4571-0056-NO1	N	6	HM	Live	22.2	254	Mature
56	Mature-H	4571-0056-NO1	W	2	HW	Live	100	254	Mature
56	Mature-H	4571-0056-NO1	W	3	HW	Live	107.4	254	Mature
56	Mature-H	4571-0056-NO1	W	4	HM	Live	58.9	254	Mature
59	Mature-H	4571-0059-NO1	S	5	HW	Live	48.5	254	Mature
64	Mature-H	4571-0064-NO1	N	3	HW	Live	79.0	304	Mature
92	Mature-H	4571-0092-NO1	W	6	HW	Live	121.7	254	Mature
108	Mature-H	4571-0108-NO1	E	2	HW	Live	93.2	254	Mature
108	Mature-H	4571-0108-NO1	E	3	HW	Live	82.0	254	Mature
108	Mature-H	4571-0108-NO1	N	5	HW	Live	88.3	254	Mature
108	Mature-H	4571-0108-NO1	S	2	HW	Live	77.0	254	Mature
122	Mature-H	4571-0122-NO1	N	2	HW	Live	116.5	254	Mature
123	Mature-H	4571-0123-NO1	S	4	HW	Live	66.0	304	Mature
123	Mature-H	4571-0123-NO1	W	8	HW	Live	51.5	304	Mature
10	Mature-O	4571-0010-NO1	E	4	YC	Live	99.3	304	Mature
10	Mature-O	4571-0010-NO1	N	6	CW	Live	57.3	304	Mature
10	Mature-O	4571-0010-NO1	W	10	BA	Live	46.4	304	Mature
10	Mature-O	4571-0010-NO1	W	13	YC	Live	72.7	304	Mature
24	Mature-O	4571-0024-NO1	E	4	FD	Live	85.0	244	Mature
24	Mature-O	4571-0024-NO1	S	4	BA	Live	13.8	244	Mature
36	Mature-O	4571-0036-NO1	E	4	BA	Live	57.5	254	Mature
48	Mature-O	4571-0048-NO1	E	4	FD	Live	121.6	264	Mature
52	Mature-O	4571-0052-NO1	E	2	FD	Live	63.6	234	Mature
52	Mature-O	4571-0052-NO1	E	4	FD	Live	97.5	234	Mature
52	Mature-O	4571-0052-NO1	W	3	YC	Live	48.7	234	Mature
59	Mature-O	4571-0059-NO1	N	7	CW	Live	39.5	254	Mature

Sample No	Species group	Cluster ID	Plot	Tree No	Spp	Live/Dead	DBH (cm)	Age (Yrs)	Maturity
59	Mature-O	4571-0059-NO1	S	2	CW	Live	71.0	254	Mature
64	Mature-O	4571-0064-NO1	S	1	FD	Live	155.0	304	Mature
80	Mature-O	4571-0080-NO1	E	1	BA	Live	109.0	184	Mature
88	Mature-O	4571-0088-NO1	E	3	CW	Live	98.0	304	Mature
88	Mature-O	4571-0088-NO1	N	6	CW	Live	161.0	304	Mature
92	Mature-O	4571-0092-NO1	E	5	BA	Live	39.1	254	Mature
92	Mature-O	4571-0092-NO1	N	2	BA	Live	86.9	254	Mature
92	Mature-O	4571-0092-NO1	S	2	BA	Live	78.8	254	Mature
122	Mature-O	4571-0122-NO1	W	4	BA	Live	19.6	254	Mature
123	Mature-O	4571-0123-NO1	W	4	BA	Live	62.9	304	Mature
123	Mature-O	4571-0123-NO1	W	6	BA	Live	32.8	304	Mature
24	Dead-O	4571-0024-NO1	S	5	PW	Dead	60.1	244	Mature
92	Mature-H	4571-0092-NO1	N	1	HM	Live	23.5	254	Mature
92	Mature-H	4571-0092-NO1	E	1	HM	Live	77.8	254	Mature
36	Mature-H	4571-0036-NO1	E	6	HM	Live	95.6	254	Mature
64	Mature-H	4571-0064-NO1	N	7	HW	Live	100.3	304	Mature
64	Mature-H	4571-0064-NO1	E	1	HW	Live	102.7	304	Mature
64	Mature-H	4571-0064-NO1	W	5	HW	Live	107.4	304	Mature

Shading indicates trees which will require NVAF enhancement prior to destructive sampling.