Vegetation Resources Inventory
Strategic Inventory Plan
for Tree Farm Licence 23

Prepared for:

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Executive Summary

This Vegetation Resource Inventory (VRI) Strategic Inventory Plan (VSIP) outlines the inventory activities and products needed to address the forest management and inventory issues identified by stakeholders for Tree Farm Licence (TFL) 23. The main forest management issues include timber supply analysis and AAC determination expected in 2009, a reduced TFL landbase due to take-back for the BC Timber Sales (BCTS) program, and upgrading the forest inventory to VRI standards. The forest inventory issues include an inventory based on old (> 20 years) photography, inaccurate polygon attributes (volume, age and height), and an incomplete VRI upgrade (no NVAF sampling or statistical adjustment). The VRI activities to be implemented in the TFL include NVAF sampling, new Phase I, and statistical adjustment of the existing inventory database and the new Phase I. The stakeholders included Pope & Talbot Ltd. and the Ministry of Forests and Range (MOFR) Forest Analysis and Inventory Branch (FAIB).

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INTRODUCTION

This report describes the Vegetation Resource Inventory (VRI) Strategic Inventory Plan (VSIP) for Pope & Talbot Ltd.'s Tree Farm Licence (TFL) 23. It is an update of the TFL 23 component of the Arrow Forest District VSIP that was prepared in 1998 and revised in 1999. This VSIP broadly outlines VRI activities and products needed to address the identified forest management and inventory issues on TFL 23, and it provides a general strategic direction for implementing VRI inventory activities in the TFL. Funding for these inventory activities is not discussed in this VSIP since funding mechanisms may vary from time to time.

This VSIP will be used in the preparation of VRI Project Implementation Plans (VPIPs). The VPIPs are working documents that detail the specific operational activities associated with implementing and documenting the inventory activities identified in the VSIP. For example, an NVAF (Net Volume Adjustment Factor) sampling VPIP will address specific requirements for conducting enhancements of the existing VRI plots and destructive sampling.

The next sections outline the business considerations, the VRI activities to be implemented in the TFL, and the VRI implementation strategy. A glossary of VRI terms of the Ministry of Forests and Range (MOFR) Forest Analysis and Inventory Branch (FAIB) is provided in Appendix I.

BUSINESS CONSIDERATIONS

This section provides some background on the TFL 23 landbase, forest inventory history, and forest management and inventory issues. This information was obtained following discussions with the stakeholders Pope & Talbot Ltd. and the MOFR FAIB (see Appendix II), and review of the following documents:

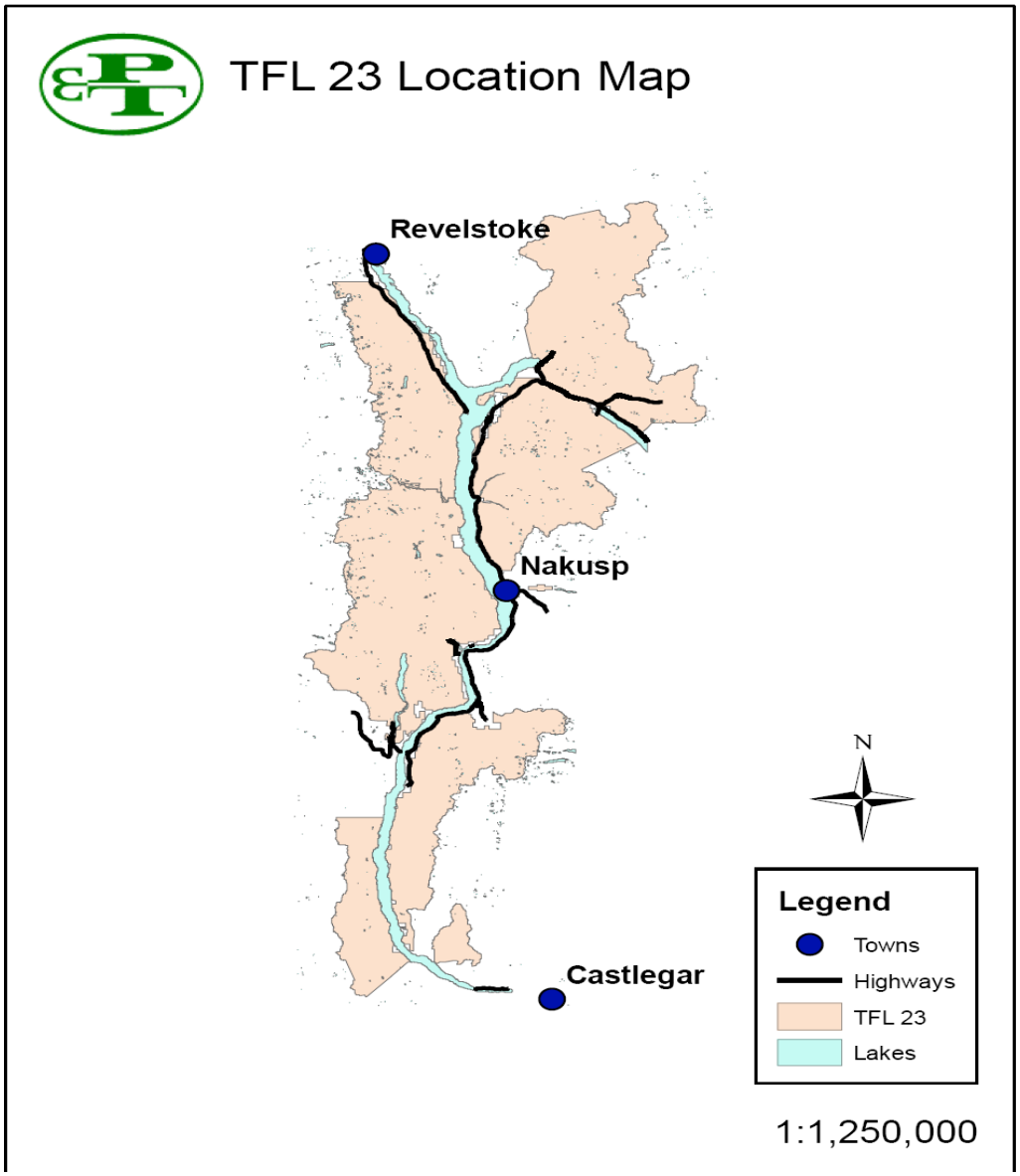
1. *Westar Timber Ltd. Tree Farm License 23 Reinventory Report* (1990)
2. *TFL 23 Inventory Audit* (1996).
3. *Arrow Forest District (Arrow TSA, TFL 3 & TFL 23) Vegetation Resources Inventory Strategic Inventory Plan (*March 15, 1999*).*
4. *TFL 23 Rationale for Allowable Annual Cut (AAC) Determination* (2000)*.*
5. *TFL 23 Ground Sampling and Work Plan for Old Growth Productivity Estimates* (2000).
6. TFL 23 V*egetation Resources Inventory Attribute Adjustment* (May 2002).
7. *Chief Forester Order Respecting an ACC Determination for Tree Farm License No. 23* (October 2002).
8. *VRI Adjustment for TFL 23: Memo from Sterling Wood Group to the Ministry of Sustainable Resource Management and Pope & Talbot (August 7, 2002)*
9. *Request for Quote VSIP and VPIP for TFL 23 (2006)*

Relevant information from these documents was summarized into a discussion paper, *Vegetation Resources Inventory Strategic Inventory Plan for TFL 23 Forest management and Inventory Issues*, prepared for Pope & Talbot Ltd. by Rural Forestry International Ltd. in November 2006. On 23 November 2006 the stakeholders considered this paper and confirmed the TFL landbase, forest management and inventory issues, and the VRI activities to be implemented in the TFL. These issues and activities are described in the following sections.

LANDBASE

TFL 23 is located in the Arrow and Columbia Forest Districts in the southern interior of British Columbia, with a total land base of approximately 556,389 ha (Figure 1).

Figure 1. Map showing location of TFL 23.



The TFL land base also includes the old temporary tenures within the boundaries of the TFL, but does not include minor crown land slivers (< 200 ha) at the boundary of the TFL. Approximately 67% of the TFL area is (timber) productive forest and the remainder is non-productive (alpine areas, non-productive brush, rock, rivers, lakes and swamp. The timber harvesting landbase is approximately 40% of the total TFL landbase (Table 1).

Table 1. TFL 23 landbase

Land type	*Area (ha)*
Productive landbase	371,834
THLB	224,702
Other	147,132
Non-productive landbase	184,555
Total TFL landbase	*556,389*

The TFL lies in the ICH, IDF and ESSF biogeoclimatic zones. The main tree species are Douglas-fir (Fd), western hemlock (Hw), Engelmann spruce, white spruce (Sw), lodgepole pine (Pl), sub-alpine fir (B), western larch (L) and western redcedar (Cw).

FOREST INVENTORY HISTORY

An overview of the recent forest inventory history in TFL 23 is given in Table 2. This includes an inventory in 1974, a partial re-inventory in 1990, an inventory audit in 1995, and VRI ground sampling in 1999/2000.

Table 2. Recent inventory history of TFL 23.

Year	*Stratum*		
	Age class 1	*Age class 2-6*	*Age class 7-9*
1974	Photo interpretation using aerial photos taken over several years and limited ground calls; no ground sampling. Type labels included species composition, age class, height class, and site class.		Photo interpretation using aerial photos taken over several years, and air calls and ground calls; ground sampling using prism plots. Type labels included species composition, age class, height class, stocking class and site class.
1990	No re-inventory; mainly disturbance update, conversion	Re-inventory using new (1987/88)	No re-inventory; mainly disturbance update,

Year	*Stratum*		
	Age class 1	*Age class 2-6*	*Age class 7-9*
	of age-class and height-class attributes to continuous attributes by mid-pointing, and addition of crown closure to the type labels.	photography of approximate scale 1:18000, and air calls and ground calls.	conversion of age-class and height-class attributes to continuous attributes by mid-pointing, and addition of crown closure to the type labels.
1995	Inventory Audit – 50 polygons sampled in mature stands (> 60 yrs) and 20 polygons in immature stands $\leq$ 60yrs).		
1999/2000		VRI ground sampling – 289 ground plot clusters established in 1999/2000. The 1999 samples were in stands 10-80 years old, and the 2000 samples were in stands greater than 80 years old. The sampling in 1999 included site series descriptions (but not to VRI standards).	
2001	NSR strategic planning project that involved using 2001 color photographs.		
2006	A disturbance update was completed.		

The 1995 inventory audit showed that the mature volumes were accurate (ratio of ground volume to map volume = 0.97), and that the site index assignment in immature stands was acceptable. However, the match in the inventory type groups was only 22%, which raises questions about the accuracy of species composition.

The 289 timber emphasis VRI plots established in old-growth and second-growth stands within the TFL were selected systematically from a sorted list, with equal probability and no pre-stratification. These VRI data were used by Sterling Wood Group to check for the biases in polygon attributes including height and age. NVAF sampling and statistical adjustments were not completed as part of this project. As well, no new photo interpretation has been done since the 1990 partial re-inventory.

Site series sampling was done in the TFL during the 1999 VRI sampling (see the report *RTFL 23 ground sampling and work plan for old growth productivity assessment on Tree Farm License 23,* March 2000, by Sterling Wood Group Inc., Victoria, BC). The objective of this sampling was to check the site series labels in the TFL using ground vegetation and soil description. Site series was determined at each IPC of the 164 VRI sample polygons. While the plot location procedures followed those of the VRI ground sampling, the site series data collection followed the "Field Guide Identification and Interpretation for Nelson Region" (see the report *Request for Proposal for Old Growth Productivity Assessment on Tree Farm*

Licence 23, June 2000, by Sterling Wood Group Inc., Victoria, BC). An independent check of the site series labels from a sample of 12 VRI plots determined an error rate of 33%.

FOREST MANAGEMENT ISSUES

The forest management issues that may affect timber supply in TFL 23 were discussed in the 2002 Chief Forester Order respecting an AAC determination. This Order postponed the next AAC determination for TFL 23 to September 1, 2007. These issues, along with the VRI impacts, are listed in Table 3.

Table 3. Forest management issues for TFL 23 and the potential impact of VRI

	Issue	VRI Impact	Remarks
1.	Little harvesting of the portion of the AAC attributable to the "aerial operability" terrain class.	No	
2.	Refinement of site index assignments, to reflect the provincial Old Growth Site Index adjustments.	High	Site index adjustments were completed in 2000 using the VRI data, and this improved the accuracy of polygon site index estimates. Timber supply sensitivity analysis, however, indicated no effect of this adjustment on timber supply over the first 50 years.
3.	Impacts on timber supply of the promulgated the KBLUP (Kootenay-Boundary Land Use Plan) Higher Level Plan Order and the recommendations of the Revelstoke and Area Land Use Planning Minister's Advisory Committee.	No	
4.	Area identified as caribou habitat, the management strategy for it, and the mapping of ungulate winter range have changed.	High	VRI Phase I attributes, such as species composition, crown closure and age, are useful in mapping caribou habitat. The VRI Phase II ecological data would also contribute to ecological mapping and other sustainable forest management initiatives in the TFL.

Pope & Talbot have proposed to the Chief Forester to again extend the AAC determination by two more years, to 2009. No decision has yet been made on this request. The TFL landbase is shrinking. It will be losing approximately 28% of its

timber harvesting landbase to BC Timber Sales. Thus, it is important to have an accurate forest inventory of the remaining landbase.

It was pointed out at the stakeholder's conference call that the caribou management strategy that has been in place since October 23, 2006 (the KBLUP Amendment) is also expected to have a negative effect on the TFL landbase, as more areas may be deferred from harvesting (see *TFL 23 VSIP forest management and inventory issues conference call minutes*, 23 November, 2006). The line work for this is uncertain at this time. While the TFL has done some detailed field assessments already, the VRI Phase I will complement this effort with improved forest cover species composition and crown closure.

Finally, Pope & Talbot would like to complete the upgrade of the TFL inventory to VRI standards, as has been done in other management units in the Arrow Forest District. Full upgrading of the inventory to VRI standards would result in unbiased TFL overall and strata net volumes through Phase II and NVAF sampling and statistical adjustment, and possibly better polygon delineation and description through a new Phase I.

FOREST INVENTORY ISSUES

The TFL 23 forest inventory is relatively old, may be inaccurate and is not fully upgraded to VRI standards. These issues are discussed further below.

Old inventory

The current TFL 23 is the only remaining portion of the former larger TFL 23 without a new inventory. The current inventory database is an update of the re-inventory that was done almost 20 years ago (then age classes 2-6) and 33 years ago (then age classes 7-9). Thus, changes in stand structure attributes such as species composition are uncertain. For example, as pointed out earlier, the inventory audit done nearly 10 years ago that showed a low match (22%) in species composition (inventory type groups) between the existing inventory database and the audit ground data. Note that this low match could also be due the generally inherent difficulty in interpreting the complex stands in this part of the province.

Inaccurate attributes

The inventory may be inaccurate in some strata. An analysis of the 1999/2000 VRI ground sample data by Sterling Wood Group found that the inventory ages and heights in most strata in the current database were biased (Table 4); see the report *TFL 23 vegetation resources inventory attribute adjustment* (May 2002) by Sterling Wood Group.

Table 4. Age and height attribute biases based on the 1999/2000 VRI comparisons. These biases were all statistically significant. (Source: *TFL 23 vegetation resources inventory attribute adjustment,* May 2002, report by Sterling Wood Group.)

Attribute	Stratum (% bias and number of samples in brackets)	
	Under-estimated	Over-estimated
Stand age	• 10-39 yr old stands in ESSF (92%; 19) and ICH (58%; 47) • Older second growth stands of B and Hw in ESSF (26%; 14) • Second growth stands of Fd, Pl, and L in ESSF and ICH (17%; 90)	• > 140 yr old stands in ESSF(32%; 39) & ICH (13%; 25)
Stand height	• 10-39 yr old stands in ESSF (136%; 19) • 10-39 yr old stands in ICH (67%; 47)	• > 140 yr old stands in ESSF (16%; 39)

Sterling Wood Group used in their analysis 256 VRI plots out of the original 289; 33 plots were excluded because they either did not meet the Fraser protocol method of adjustment (30), were considered outliers (2), or was the only suitable deciduous plot (1). A memo from Sterling Wood Group, who conducted the VRI analysis, to the Ministry of Sustainable Resource Management and Pope & Talbot, stated that "… [the] VRI exposed inconsistencies in the forest classification of TFL 23. These inconsistencies resulted in more variation between adjusted ratios for different strata than is usual … Nevertheless stratum specific adjustment ratios will result in adjusted inventory file which is more accurate than the unadjusted file …".

The TFL inventory database was, however, not formally adjusted or changed, although the VRI showed that these attributes were biased for most strata in the existing inventory. The statistical adjustment was not done mainly because of concerns about the adjustment ratios. Residual plots of the adjustment ratios derived by Sterling Wood Group indicated over-estimation in older stands and taller stands, and under-estimation in younger stands and shorter stands, and some of the adjustment ratios were quite large (up to 2.36). Thus, the consensus among MOFR, Pope &Talbot and Sterling Wood Group was not to adjust the age and height attributes in the TFL 23 inventory database (see the *TFL 23 vegetation resources inventory attribute adjustment r*eport, May 2002, by Sterling Wood Group, p. 13).

Finally, anecdotal evidence from cruise and scale comparisons appears to suggest that merchantable volume (sound wood) is over-estimated in western hemlock stands. This is possibly due to biased decay estimates (loss factors) and taper equations when applied to Hw in the TFL. However, there are no independent data to substantiate these observations.

Incomplete VRI upgrade

The TFL inventory is not fully upgraded to VRI standards, thus the full benefits of the VRI explained earlier cannot be achieved. While the VRI timber emphasis ground sampling has been completed in the TFL, the supporting and compulsory NVAF sampling has not been done. As well, as indicated earlier, no statistical adjustment was done. Finally, the ecological (site series) sampling was not done to VRI standards.

Compared to other management units in the Arrow Forest District, it appears that TFL 23 is lagging behind in upgrading their inventory to VRI standards. Since the original Arrow Forest District VSIP (1999):

- TSA: New Phase 1 was completed in 2002; Phase 2 was completed in 2004/2005 with approximately 80 samples; NVAF sampling was completed in 2005; and analysis and adjustment was completed in 2006.
- TFL 3: Phase 1 Retrofit was completed in 2003/2004; Phase 2 was completed in 2001, with 89 samples; and NVAF sampling was completed in 2004.

Completion of the inventory to a common standard among all the units in the district would permit a District roll-up of the inventory, if needed.

VRI ACTIVITES TO IMPLEMENT IN TFL 23

To complete upgrading the TFL inventory to the VRI standard, Pope & Talbot shall implement the following VRI activities:

1. Conduct NVAF sampling to support the VRI ground sampling already completed. These data would also be used to determine the amount of sound wood, and the taper equation bias, in Hw in the TFL.
2. Conduct new Phase I photo interpretation to address the uncertainties in the inventory information raised from the VRI comparisons done by Sterling Wood Group, as discussed in the previous section.
3. Complete a statistical adjustment of the inventory attributes. The statistical adjustment will provide reliable and defendable estimates of overall and strata timber volumes and other attributes.

The NVAF and statistical adjustment shall be done in the net TFL landbase excluding the BCTS area. That is, the BCTS area and the remaining TFL area shall be treated as separate units. If the two units are combined during NVAF sampling and statistical adjustment, and the BCTS area is cut out after the adjustment, the attributes of the remaining TFL landbase would no longer be unbiased. To remove the potential bias, the NVAF samples would still have to be recompiled, and the statistical adjustment made, separately for each unit.

The new Phase I shall be done in the entire TFL landbase, including the BCTS area. No statistical bias will be incurred as in the NVAF sampling when the BCTS area is removed later, since the polygon attributes are estimates to be subsequently adjusted.

Each of these three activities is discussed further below. Products from these VRI activities would provide a more accurate description of the TFL land cover classification and attributes. They would also support forest management activities that rely on accurate forest inventory information, including the timber supply analysis for the next AAC determination in 2009 and caribou habitat mapping (see Table 3).

NVAF SAMPLING

Objective

The objective of NVAF is to provide factors to adjust net tree volume in the VRI plots, which is obtained from net factoring and taper equations. NVAF is required to complete the TFL VRI ground sampling. The adjustment accounts for hidden decay and possible taper equation bias. The 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.

Population

The target population for NVAF sampling is the net TFL Vegetated Treed ($\geq$ 30 years old) landbase, excluding the BCTS area.

Enhancement & remeasurement

A subset (40 locations) of the 289 VRI ground samples established in 1999/2000 (excluding those that fall in the area for BCTS and the non-VT areas), will be enhanced for NVAF. The subset will be selected using a systematic sorted list. The NVAF enhancement will involve the tallying and enhancement of dead trees, the enhancement of the live trees, and the updating of sample location access and stand conditions.

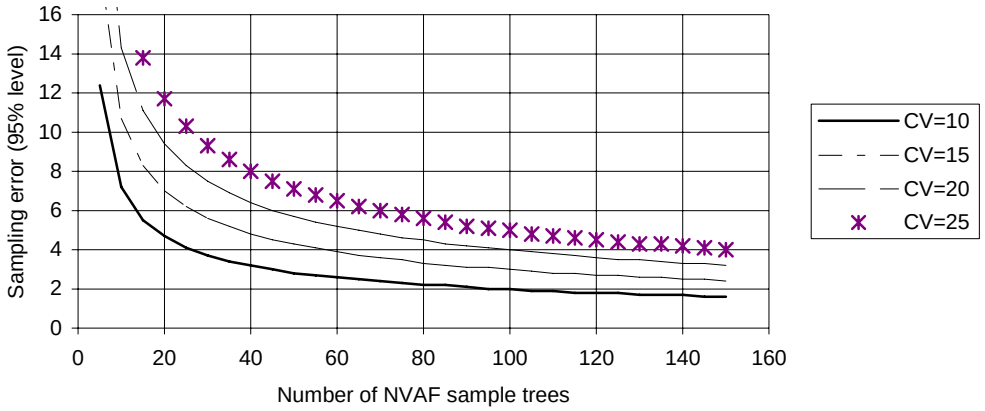
During the enhancement, timber attributes will be remeasured for the entire plot cluster, including the IPC (Integrated Plot Centre). As well additional VRI attributes, including CWD, site series, succession, and ecology, will be collected. The additional data would be entered into the TFL database, to be used support habitat mapping and other sustainable forest management initiatives. The remeasured timber attributes would be used to check the magnitude of the differences in attribute values due to the 6-year age difference in the measurement and enhancement dates. They will also be used to update the attributes of the remaining unmeasured 1999/2000 VRI ground plots.

Tree sample size

Determination of the number of desired sample trees for NVAF requires knowledge of the variability (or coefficient of variation, CV) of the NVAF ratios in the population, and the target sampling error. Using overall CVs of the NVAF ratios in the neighboring management units (TFL 3, TFL 55 and the Arrow Forest

District), which ranged from about 10% to about 20%, the maximum allowable overall sampling error for the NVAF of 7.5% (95% probability) for live trees can be achieved with about 60 sample trees (Figure 2).

Figure 2. Decreasing NVAF sampling error with increasing number of sample trees.



For TFL 23, however, the MOFR FAIB, in consultation with Pope & Talbot, has recommended NVAF sampling of 140 trees (120 live, 20 dead), stratified by polygon maturity and species groups (Table 5).

Table 5. Number of NVAF sample trees for TFL 23

Stratum	Number of NVAF sample trees	
	Minimum	Recommended
Dead trees	20	20
Live trees	80	120
Immature (stand ≤ 120 yrs old)	15	20
Mature (stand > 120 yrs old)	65	100
Western hemlock	40	45
Other species	25	55
Total	*100*	*140*

This larger sample will provide a much lower overall sampling error (< 4% at 95% probability) than the required minimum. It will also allow for derivation of strata NVAFs with acceptable sampling errors (< 15% at 95% probability) for each of the four strata defined in Table 5, i.e., dead, live immature, mature Hw, and other mature other species. The total sample also includes additional 45 sample trees from the Hw stands, to permit the assessment of the accuracy of the taper equations and the amount of sound wood in Hw.

Tree sample selection & analysis
An age-class – species tree matrix will be created using data from the enhanced VRI plots (auxiliary plots). Age-class is defined as either immature (polygon ≤ 120 years old) or mature. Sample tree selection procedures will follow the MOFR standard for NVAF. Complete stem analysis of the sample trees will be done following the MOFR FAIB standards. The data will be analyzed to develop net volume adjustment factors.

To address concerns about the accuracy of net volume estimates in western hemlock stands, the NVAF western hemlock data will be analyzed to detect error trends in the Hw decay estimates and taper equations. It is also for this reason that priority has been given to completing NVAF sampling ahead of a new Phase I. Methods for conducting this non-standard VRI analysis will be developed and implemented by Pope & Talbot in consultation with the MOFR FAIB.

PHASE I PHOTO INTERPRETATION

Objective
The objective of the VRI Phase I is to improve the photo interpreted estimates of attributes, such as age and height, in the TFL. The VRI product is a spatial database consisting of adjusted photo-interpreted estimates.

Population
The target area will be the entire TFL landbase, including the BCTS take-back area. It will also include the old temporary tenures and the minor crown land slivers (< 200 ha) within the boundary of the TFL.

Methodology
The VRI Phase I inventory will involve completion of new delineation and polygon estimates based on new aerial photos to be flown in 2007 -2008. Existing data sources will be documented and used for calibration. These will be augmented by a limited number of air calls and ground calls.

The soft copy technology will be used for attribute estimation. Thus, the scale of the aerial photos will be 1: 20, 000, preferably color photos. The color photos could potentially assist in the identification of species composition, and hence identification of stands to exclude from the THLB (e.g., deciduous stands and non-forest polygons). The four blocks in the TFL, and the strata within these blocks (e.g., those in Table 4), shall be prioritized. The Phase I in the TFL shall be completed over a period of 2-3 years.

VRI STATISTICAL ADJUSTMENT

Objective

The purpose of the statistical adjustment is to obtain overall averages and totals for the TFL that are statistically unbiased, and to adjust the existing and new photo-interpreted estimates.

Population

The population for statistical adjustment is identical to that for NVAF sampling. It is the Vegetated Treed net TFL landbase (> 30years), excluding the BCTS area.

Methodology

Statistical adjustment of the new or existing photo-interpreted estimates using the VRI ground plot observations involves two steps:

1. Statistical estimation of overall TFL totals by strata. These values include totals and averages for continuous attributes such as volume.
2. Statistical adjustment of the individual polygon estimates such that their estimated total for the TFL and strata match those obtained in Step 1.

The existing and the new photo interpreted estimates would be adjusted using data from the 1999/2000 VRI ground plots. Post-stratification criteria for the data should be investigated, possibly using strata different from those used by Sterling Wood Group in their 2000 analysis. The ground plot data would be first adjusted using the NVAF ratios, and to account for the 6-year differences in the measurements. The statistical adjustment would use the current methods approved by the MOFR FAIB.

VRI IMPELEMENTATION STRATEGY

PRIORITIES & SCHEDULING

The order of priority for the identified VRI activities is:

1. NVAF sampling to support the VRI ground sampling already completed. These data would also indicate the amount of decay and taper in Hw.
2. Statistical adjustment of the current Phase I database.
3. New Phase I photo interpretation to address the issues of attribute bias.
4. Statistical adjustment of the new Phase I database.

These four VRI activities could be implemented following the schedule in Figure 4.

Figure 3. VRI activity schedule (2007-2009)

VRI Activities	2007				2008				2009			
	Month											
	1-3	4-6	7-9	10-12	1-3	4-6	7-9	10-12	1-3	4-6	7-9	10-12
NVAF sampling												
Select VRI samples												
Measure VRI samples												
Destructive sampling												
New Phase I												
Acquire photos												
Photo interp.												
Final mapping												
Statistical adjustment												
Current Phase I												
New Phase I												

Note that the first adjustment (existing database) will be necessary for timber supply analysis for AAC determination in 2009). The new Phase I would unlikely be ready for this next AAC determination.

ESTIMATED COSTS

Estimated total cost of upgrading the TFL 23 inventory to VRI standards is approximately $978,667. The breakdown of the estimated cost for the new Phase I photo acquisition and interpretation, NVAF sampling enhancement and destructive sampling, and statistical adjustment, is given in Table 6. The estimated total cost for new Phase I is $727,667, for NVAF is $221,000, and for statistical adjustment (including NVAF analysis and Hw decay/taper analysis) is $30,000.

Table 6. Estimated costs for the proposed VRI activities in TFL 23.

VRI activity	*Number of units*	*Estimated Unit Cost*	*Estimated Total*
Phase I			
Prepare VPIP			$10,000
Phase I	556,389 ha	$1.20/ha	$667,667*
QA Phase I			$50,000
Sub-Total			$727,667
NVAF sampling			
Enhancement and measurement	40 clusters	$2,250/cluster	$90,000
QA enhancements			$9,000
Sample tree selection			$3,000
Destructive sampling	140 trees	$600/tree	$84,000

VRI activity	*Number of units*	*Estimated Unit Cost*	*Estimated Total*
QA destructive sampling			$5,000
Helicopter costs			$30,000
Sub-Total			*$221,000*
VRI Statistical Adjustment			
NVAF analysis & VRI adjustment**			$25,000
Analysis of errors in Hw decay/taper			$5,000
Sub-Total			*$30,000*
Grand Total			***$978,667***

* This total cost can be broken down by activity component: Photo acquisition & scanning (20%), polygon delineation and data transfer (11%), field calibration (air calls and ground calls) (37%), polygon attributes estimation (21%), and final mapping & digital database (11%). The photo acquisition cost was assumed to be approximately $3,000 per map sheet (from C. Mulvihill); the remaining component relative costs were obtained by examining the TFL 46 VPIP (2005) posted on the MOFR website. These component costs will be confirmed when the VPIP for Phase I is prepared.

**This cost is for NVAF analysis and adjustment of the existing database. The cost of statistical adjustment of the new Phase I is not included, as recommended by the stakeholders.

NEXT STEPS

The next steps are:

1. Rural Forestry International Ltd. to prepare a VPIP for NVAF sampling based on this VSIP.
2. Pope & Talbot and the MOFR Forest Analysis and Inventory Branch to approve and signoff this VSIP.
3. Pope & Talbot to submit the NVAF VPIP to FIA or other agency for funding.
4. Pope & Talbot to consider preparing a VPIP for new Phase I photo interpretation based on this VSIP, for submission to FIA or other agency for funding. Pope & Talbot shall contact the MOFR Update Section prior to initiating this VPIP.

These NVAF and Phase I VPIPs will identify inventory activities, priority block areas, detailed costs by year, and roles and responsibilities for implementation. The estimated costs for the VRI statistical adjustment will be included in the VSIPs. The first adjustment will be included in the NVAF VPIP and the second adjustment will be included in the Phase I VPIP.

APPROVAL/SIGNING

I have read and concur with the TFL 23 Strategic Inventory Plan, dated March 5, 2007. It is understood that this is an agreement-in-principle and does not commit the signatories to completing the inventory activities outlined within the plan. Modifications to this plan or more detailed plans need to be reviewed and approved by the signatories.

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Doug Lang
Chief Forester
Pope & Talbot Ltd.

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Jon Vivian
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APPENDIX I: GLOSSARY OF TERMS

Ground Sampling

Ground sampling is the field measurement of timber, ecology, range, and/or coarse woody debris values at one or more locations within each sample polygon. The sample polygons are selected proportional to their area from a sorted list. 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.

Inventory Unit

An inventory unit is the target population from which the samples are chosen. For the provincial VRI, the inventory unit is the Forest District or TFL, which includes the timber harvesting landbase, parks, recreational areas, private, and federal lands. For management inventories, the inventory unit is a subset of the provincial VRI inventory unit that focuses on a geographic area or specific attribute set, depending upon the sampling objectives.

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.

Management VRI

Management VRIs are specialized inventories that provide the detailed information required for specific resource management, i.e., day-to-day forest management. One or more VRI sampling procedures may be used for management inventories. Management inventories may focus on specific resource types (timber, range, ecology), geographic areas (e.g., landscape unit, TFL), attribute sets (e.g., Douglas-fir leading stands, age class 4+). They may use one or more of the following tools (e.g., photo-interpreted estimates, ground sampling, NVAF sampling).

National Forest Inventory (NFI)

The NFI provides information on Canada’s resources across all provinces and allows the Federal Government a consistent framework for reporting on Canada's inventory. The inventory unit for the NFI is the entire country, although it is implemented province-by-province.

Net Volume Adjustment Factor (NVAF) Sampling

NVAF sampling provides factors to adjust net tree volume, which is 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.

Photo-Interpreted Estimates
Photo-interpreted estimates inventory involves the subjective delineation of polygons and the photo estimation of attributes for all polygons in an inventory unit.

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 to improve the precision of the inventory's overall averages and totals.

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.

Provincial VRI
The provincial VRI provides baseline data for provincial inventory reporting, monitoring, and research. All of the sampling procedures from the VRI toolbox are used for this inventory at the Forest District level. The databases generated from each District inventory will be compiled to create the provincial VRI database. The provincial VRI has also been referred to in the past as the District VRI.

Resource-Specific Interpretations
Resource-Specific Interpretations (RSI) use the RIC standard VRI baseline data products (provincial VRI or management inventory), in combination with other data sets and analysis (outside of that required to produce VRI), to produce information to address specific-resource management issues (e.g., TSR review, important ecosystems, important habitats). These interpretations include ecosystem interpretations and habitat interpretations.

Sample Size
The sample size for an inventory is the minimum number of ground samples to be established in an inventory unit to meet the target precision.

Statistical Analysis (Adjustment)
Statistical 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 of a management inventory (i.e., the management inventory target population is a subset of the provincial VRI inventory 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 Forest District.

Target Precision
Target precision expresses the amount of variation in key attributes (e.g., timber volume) desired in the final results. The target precision, usually expressed as the coefficient of variation (CV), is used to calculate the minimum sample size for subsequent ground sampling.

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:

- *Photo-interpreted estimates*: the delineation of polygons from aerial photography and the estimation of resource attributes.
- *Ground sampling*: the establishment of plot clusters in selected polygons to measure timber, ecological, and/or range attributes.
- *NVAF Sampling*: Stem analysis sampling of individual trees for net volume adjustment.
- *Statistical Adjustment*: the adjustment of the photo-interpreted estimates for all polygons in an inventory unit or management unit using the values measured during ground sampling.

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: STAKEHOLDERS AND CONTACTS

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