

# **Robson Valley Timber Supply Area**

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## **Vegetation Resources Inventory Strategic Inventory Plan**

Nona Phillips Forestry Consulting

March 19, 2007

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# Acknowledgements

This planning process was initiated by Craig Pryor, prior to the shutdown of McBride Forest Industries Ltd. It has been supported by both industry and government Stakeholders including:

Local licensees:

Tony Bild, Lead Proponent, Operations Forester, Valemount Forest Products Ltd.

Ainslie Jackman, Planning Forester, Hauer Bros. Lumber Ltd.

Denise Hogue, Planning Forester, BC Timber Sales, Prince George Business Area

Marc von der Gonna, General Manager, McBride Community Forest Corporation

The Ministry of Forests & Range staff:

Vegetation Resources Inventory expertise:

Forest Analysis and Inventory Branch staff in Victoria

Gary Johansen and Will Smith

and

VRI Inventory staff in the Southern Interior Forest Region, Kamloops

Jim Grace and Matt Makar

Timber Supply Branch, Southern Interior Forest Region, Kamloops

Cheryl Delwisch

Local knowledge from the Headwaters District:

McBride satellite office

Norma Stromberg-Jones, Stewardship forester

Headwater District Office, Clearwater

Elia Ganderski, Compliance and Enforcement Officer

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# Executive Summary

The licensees in the Robson Valley Timber Supply Area (TSA) have recently undergone a Timber Supply Review (TSR) process. In the development of the data package, it became apparent that, utilizing the current knowledge of the land base and taking into consideration the traditional assumptions for TSR, there would be a drop in the Annual Allowable Cut (AAC). Through the Vegetation Resources Inventory (VRI) planning process, the Robson Valley TSA stakeholders' group has investigated forest cover inventory options to provide new and pertinent information on the TSA, both for future TSR and for operational planning. This document provides a record of the decision-making process that has been completed.

The initial step undertaken was to prepare an Issues Paper for the Robson Valley TSA as a background document. This was provided to the Stakeholders in this unit prior to a meeting that occurred on November 21, 2006 in Dunster, B.C. Along with the Issues Paper, this meeting's agenda was designed to:

1. provide background on the Vegetation Resources Inventory process
2. discuss client data needs in the TSA suggested by previous provincial planning processes and by the meeting's participants
3. identify support for forest management that can be provided through completion of a Vegetation Resources Inventory

During this planning process the Stakeholders identified the following information requirements:

1. Better estimates of live and dead volume for all species
2. Better volumes for species through destructive sampling, especially in cedar and hemlock
3. Potential abundance of secondary structure<sup>1</sup>
4. Better estimate of volume for species other than those identified as 'leading' by the forest cover label.
5. Improved current site index estimates.

With a better understanding of the VRI process, the licensee Stakeholders used this meeting as a foundation for a subsequent meeting held on December 15, 2006. Highlights of their discussion are included in Table 2.4 of this plan which outlines local forest management issues and the ability of VRI activities to supply information regarding identified issues. Also, utilizing their increased inventory knowledge gained from the Stakeholders' meeting, a document prepared by the Planning Contractor and an email from the Ministry of Forests & Range (MoFR) Inventory staff, the Licensees have identified the VRI activities that they would like to plan for on this Unit.

Through this VRI Strategic Inventory Plan (VSIP),<sup>1</sup> the Licensees have decided to maintain the current Forest Cover inventory or Phase 1 and proceed with a project that includes Phase 2 Ground Sampling and Net Volume Adjustment Factor (NVAF) destructive sampling.

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<sup>1</sup> Seedlings, saplings, sub-canopy and canopy trees that will likely survive a pine beetle attack (Coates 2006)

This Strategic Plan begins to assess the following:

1. The target population for sampling.
2. Strata for the ground sampling activity
3. Protocol to be followed for the sampling work and additions to it.
4. Net Volume Adjustment Factor destructive sampling including strata.
5. Role of Monitoring.

A VRI Project Implementation Plan (VPIP) for Ground Sampling and NVAF will be prepared based on direction from this VSIP. The VPIP will provide details for the implementation of VRI ground sampling program including strata development decisions for the ground sampling 'cluster' samples and NVAF, sample lists, roles and responsibilities, implementation steps, and estimated costs.

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# **1. Introduction**

## **1.1 Background to the Vegetation Resources Inventory process**

The Vegetation Resources Inventory (VRI) is one of a number of inventories that have been implemented since the 1990's in the province of British Columbia. The Forest Resources Inventory Commission (RIC, 1991) recommended "that the Government of British Columbia undertake a commitment to complete inventories for all renewable forest resource values using standardized compatible systems". The Resources Information Standards Committee (RISC) has evolved as the group who continues to "support the effective, timely and integrated use of land and resource information for planning and decision making by developing and delivering focused, cost-effective, common, provincial standards and procedures for information collection, management and analysis."

The VRI has been the standard for forest cover inventory since 1996. As stated on the Ministry of Forest and Range's (MoFR's) website for the Vegetation Resources Inventory, the VRI was designed to answer two questions:

1. Where is the resource located?
2. How much of a given vegetation resource is within an inventory unit?

Among the strengths of the VRI are its statistically accurate procedures, its re-introduction of a ground sampling phase to adjust the photo interpreted population and its multi-option approach to answering inventory related questions. The value of a VRI is enhanced by following up Phase 1 photo interpretation with a ground sampling program. At a minimum, the ground sampling will provide information on the quality of the photo interpreted inventory and will provide adjustment ratios of attributes referred to in Section 2.6.1 to adjust Phase I.

The VRI process starts with a formalized planning requirement, often lead by a contractor working on behalf of local licensees. This work starts by involving all Stakeholders including licensees and government personnel, informing them of the process, providing options, and finally making decisions on the direction for the inventory. This planning phase is documented in a VRI Strategic Inventory Plan (VSIP). If a project is to be undertaken, one or more detailed plans are prepared. This may include a Project Implementation Plan (VPIP) for Photo Interpretation and/or a VPIP for Ground Sampling and Net Volume Adjustment Factor (NVAF) sampling. These Plans' details should be thorough enough that those undertaking a project can use these documents as a reference.

The constraints on the forest in the Robson Valley Timber Supply Area (TSA) have been emphasized in the current Timber Supply Review (TSR).<sup>2</sup> Among these are Mountain Caribou habitat requirements and Visual Quality Objectives that constrain the landbase. Gathering more data to mitigate the effects of the constraints is a key element behind this licensee initiative.

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<sup>2</sup> AAC Rationale, 2006

## 1.2 Scope and Objectives

The VSIP identifies issues in a TSA and evaluates the effectiveness of the Vegetation Resources Inventory to provide data to answer critical management questions. Various components of the inventory can be selected to address specific issues. This plan provides direction for the undertaking of a VRI project. The VPIP provides more operational details, either emphasizing Phase 1 photo interpretation or Phase 2 ground sampling and Net Volume Adjustment Factor activities.

Nona Phillips Forestry Consulting prepared this report in consultation with the Robson Valley TSA Stakeholders. Included in the Stakeholders' group are the following:

- Valemount Forest Products, Valemount
- Hauer Brothers, Valemount
- McBride Forest Industries Ltd., McBride
- McBride Community Forest, McBride
- BC Timber Sales (BCTS), Prince George Business Area
- Ministry of Environment (MoE) – BC Parks
- MoFR – Forest Analysis and Inventory Branch (FAIB)
  - – Southern Interior Forest Region
  - – Headwaters Forest District, with staff in both the McBride Satellite Office and District Office in Clearwater

A list of attendees to the Stakeholders' Meeting held in Dunster on November 21, 2006 is included in Appendix A. The record of this meeting will be found on the VSIP development file.

## 1.3 Vegetation Resources Inventory Overview

Before deciding the direction for a VRI project, it is important to have familiarity and some understanding of this inventory. There are numerous activities that may be undertaken in combination or in some cases, individually.

The Vegetation Resources Inventory has several components.

### 1. Phase 1 or Photo Interpretation

The Photo Interpretation phase involves estimating vegetation polygon characteristics from aerial photographs.

The key steps involve:

- Delineating the vegetated and non-vegetated land base into polygons based on similar vegetation characteristics
- Field calibration for the photo interpreters
- Attribute estimation, incorporating historical data, field calibration data and the skills of the photo interpreters
- Digital capture of attribute and graphic information to produce forest cover maps

## 2. Phase 2 or Ground Sampling activities

The ground sampling phase provides the information necessary to determine how much of a given attribute is within the inventory area.

There are two parts to this phase.

- i) Establishment of 'cluster' samples randomly across the project area. The data collected at the cluster samples may include the measurement of timber and/or ecology attributes. Net close utilization volume is obtained by call grading and net factoring trees, and breakage loss factors.
- ii) Destructive sampling following the protocols established in the Net Volume Adjustment Factor process is used to correct for errors in the estimation of net tree volume. The NVAF work provides an adjustment factor that is used during sample compilation to produce unbiased estimates of net close utilization tree volume and adjusts the net factor volumes from the plot establishment activity. Net Volume Adjustment Factor destructive sampling has been recognized as a mandatory component of the Phase 2 activity.

## 3. Analysis and Adjustment

- Data analysis is the process of screening, preparing, and comparing compiled ground sample data to the Phase 1 inventory data, to determine the relationships between these data.
- Attribute adjustment is the process of applying the relationship between photo estimation data and ground sampling data to the initial estimates in the photo interpreted database.

## 4. Monitoring plots

Monitoring is not considered part of the Vegetation Resources Inventory "toolkit" but is being added to projects to track changes over time. The following are features of this activity:

- a permanent, remeasurable design that is a statistically based system of monitoring and reporting
- most often includes collecting full VRI ground sampling data, including timber and ecology
- intention is to monitor change over a long term at defined locations with remeasurements at intervals of 5 to 10 years

## 1.4 Vegetation Resources Inventory Overriding Principles

To ensure consistent and effective implementation of the inventory the following principles guide projects across the province:

- Strategic and Project Implementation Plans are produced to provide background on the VRI process, identify the project area and tailor the inventory to the specific needs of the inventory unit as identified by the Stakeholders. Project Implementation Plans identify specific timelines, roles and responsibilities, and deliverables. These plans form a critical part of the record for Vegetation Resources Inventory projects and they have high value in both the short and long term.
- Implementation will follow standards and procedures established by the Resources Information Standards Committee that are available at the website:  
<http://ilmbwww.gov.bc.ca/risc/pubs/teveg/index.htm>

## 1.5 Vegetation Resources Inventory Planning

The MOFR requires that a VSIP be prepared before starting a VRI. This is to ensure that the inventory is tailored to address issues identified in the TSA.

The following outlines the strategic planning process for this TSA:

- Stakeholders identified (specifically local licensees and relevant government personnel, including government licensees, District and BC Timber Sales staff and Regional and Provincial specialists) who are to be included in the planning process and any VRI projects.
- A preliminary Issues Paper was distributed to the Stakeholders to provide background information prior to the meeting.
- A Stakeholders' Meeting was held to provide an opportunity for the attending group to be informed about their current forest cover inventory and the VRI process, and identify management issues relevant to inventory work.
- A copy of the Management Issues section of the Issues Paper and a second discussion paper was circulated to the Stakeholders, to facilitate further internal discussion on inventory initiatives.
- At the same time, the Ministry of Forests Inventory staff from the Southern Interior Forest Region and the Forest Analysis and Inventory Branch met and prepared a summary of their discussion related to the Robson Valley TSA VSIP preparation.
- The Licensee group met for a second time, and reviewed the Management Issues, the second edition of the discussion paper and the government's ideas on proceeding with a VRI project in the Robson Valley TSA.
- The outcome of this meeting led to the development of this VRI Strategic Inventory Plan, containing decisions on the utility of various VRI tools to address TSA issues specific to the Robson Valley.

- This VSIP identified a need for a Phase 2 Ground Sampling project with NVAF. This plan will be followed up with the preparation of a VIP.

## 1.6 Funding

VRI activities, including this planning phase, are being funded by the Licensees, utilizing money from their Forest Investment Account (FIA) allocation. To assist in the decision-making process, approximate costs for VRI work have been developed, based on the application of local project requirements to the experience in other TSAs. These costs will help to determine the feasibility of the work, and the timeframe for an inventory project.

# 2. Business Considerations

## 2.1 Landbase (adapted from the Robson Valley TSA AAC Rationale – August 4, 2006 and Timber Supply Review 3 Draft Analysis Report – October, 2005)

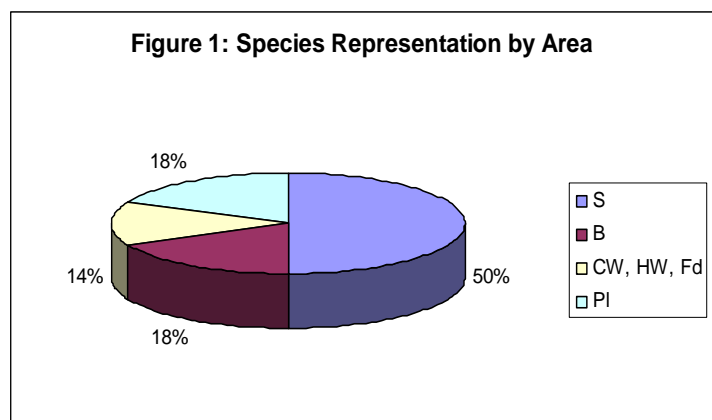
The Robson Valley TSA is located in east central BC between Bowron Lake and Wells Gray Provincial Parks on the west and the Province of Alberta on the east. It comprises approximately 1.46 million hectares of the Headwaters Forest District which is administered from Ministry of Forest and Range office in Clearwater with a field office in McBride. The population of the TSA is 3963 people about half of which live in the two largest communities of McBride and Valemount. The smaller communities of Crescent Spur, Dunster, Tete Jaune Cache, and Albreda are also in the TSA. Mount Robson Provincial Park is located in the TSA. Figure 2 is an overview map of the area.

The terrain is quite variable. The Rocky Mountain Trench runs through the center of the TSA which is a broad valley bottom. Steep rugged ground is found in the Rocky Mountains to the east and the Cariboo and Monashee Mountains to the west.

Of the total area for the TSA, only about 15% is considered available for timber harvesting under current management practices.

There are four biogeoclimatic zones in the TSA including Alpine Tundra, Engelmann Spruce-Subalpine Fir, Interior Cedar-Hemlock, and Sub-boreal Spruce.

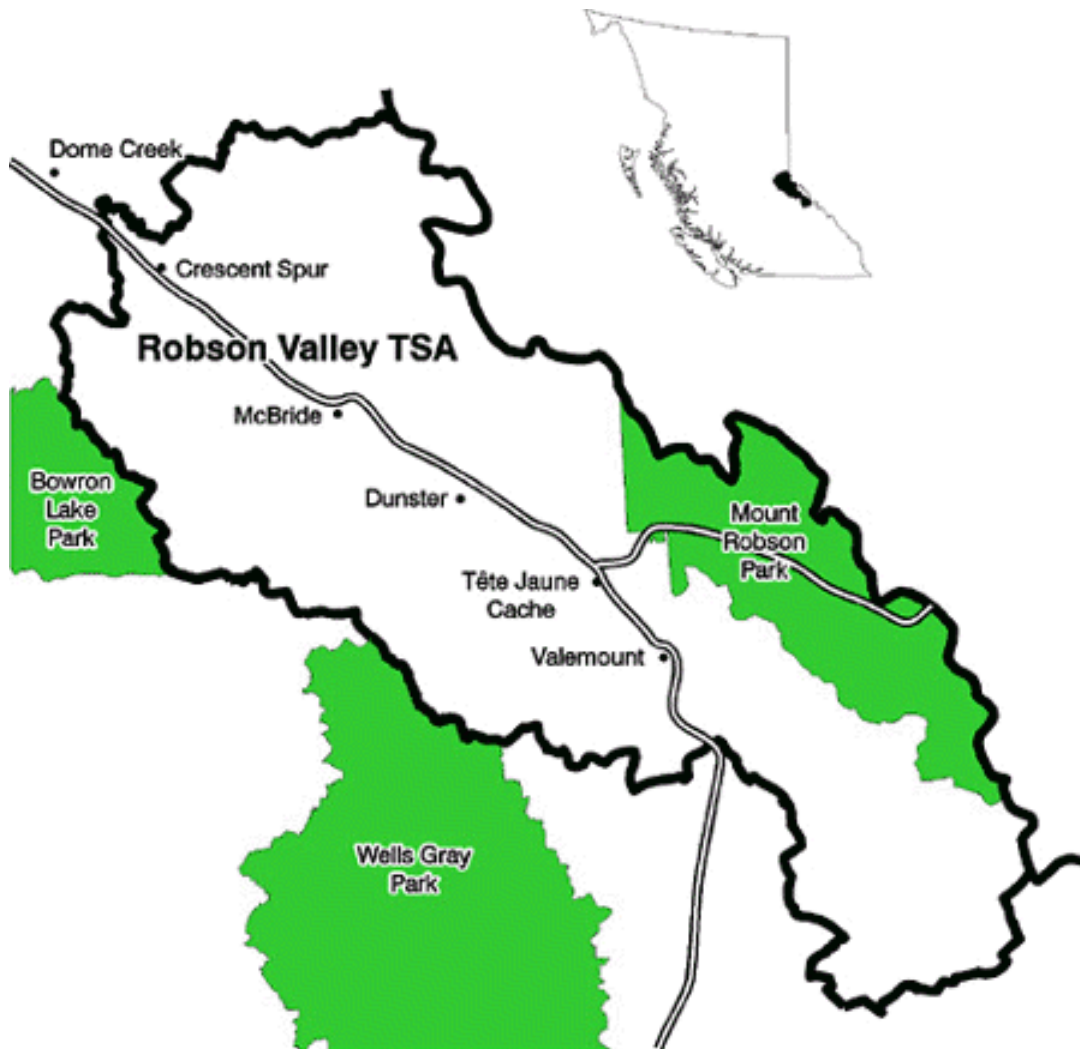
Spruce leading stands predominate the TSA but pine and balsam leading stands are also a significant component. Cedar, hemlock and Douglas-fir leading stands comprise the remainder of the forested landbase. Over 50% of the stands are greater than 140 years of age.



There are no First Nation communities in the TSA but the following four assert territorial interests in the area.

- Lheidli T'enneh Nation
- North Thompson Band (Simpco First Nation)
- Canim Lake Band
- Red Bluff Band

**Figure 2. Robson Valley TSA**



**Table 1. Land Base of the Robson Valley TSA.<sup>3</sup>**

<b>Total TSA Area (hectares)</b>	<b>1,458,000</b>	
<b>Total Area of Mount Robson Provincial Park from the Draft Management Plan, March '07</b>	<b>223,000</b>	
<b>Crown Forest Landbase (outside of Parks &amp; Protected Areas)</b>	<b>Area (ha)</b>	<b>% of CFLB</b>
<b>Total</b>	459,000	
Age 0 - 60	24,000	
Age 61+	435,000	<b>100</b>
Leading Species		
S	217,500	<b>50</b>
PI	73,950	<b>17</b>
BL	73,950	<b>17</b>
Cw,Hw,Fd	60,900	<b>14</b>
Deciduous	8,700	<b>2</b>

## 2.2 Forest Cover Inventory History

The Ministry of Forests completed a forest cover reinventory of the TSA in 1994-95. Mount Robson's inventory is vintage 1974.<sup>4</sup> The most current update year for the Veg files for the Robson Valley TSA in the Land & Resource Data Warehouse (LRDW) is 2002.

Other inventory initiatives discussed in the 2005 Timber Supply Analysis Report were two studies conducted by Research Branch of the Ministry of Forests (MoF) in 1998 on Site index adjustments for old-growth stands. The results showed that the site index adjustment for these stands significantly increased the harvest rate in the medium and long term. Since stands currently older than 140 years comprise over 50% of the Timber Harvesting Land Base (THLB) in the Robson Valley TSA, the issue of site productivity estimation is potentially important here in the mid to long term.

## 2.3 Inventory Audit

The inventory audit that occurred in the Robson Valley TSA in 1998 was part of a provincial program to assess the accuracy of the current forest inventory. For this TSA, in the mature forest there is no statistically significant difference between the average volume for the audit and the inventory. The population of

<sup>3</sup> Rough hectares adapted from DFAM Analysis Table 2 and Figure 3. These areas will be refined during the development of the sampling plan in the VPIP.

<sup>4</sup> Personal communication, Matt Makar, October, 2006.

samples was then stratified to assess the operable forested area. Again, there was no statistically significant difference between the mean audit volume and the mean inventory volume. Audit results for the immature component of the inventory suggest an acceptable level of accuracy for site index assignment in young stands.



## 2.4 Forest Management and Inventory Issues

The following table was discussed both at the November 21 Stakeholders' meeting and again by the licensees on December 15, 2006. Input from these meetings has been included in this 'final' version.

TSA issue	Issue-Licensee Comments	VRI Effectiveness			Remarks on VRI Effectiveness
		Photo-Interpreted Estimates	Ground sampling & NVAF	Monitoring	
Yes	1. Volume of dead wood. -Chief Forester considered dead wood volumes in TSR determination in Robson Valley 2006 AAC Rationale. Used Inventory Audit to provide information for dead wood. Recommended additional inventory plots to provide information. - Licensees may want to focus on non-pine types i.e. more Hw, Cw, BI since other studies in province have focused on pine.	Low	High	Moderate	Licensees agreed that Ground Sampling and NVAF could be effective and priority to provide good information on dead potential volumes.
Yes	2. Volume estimates in Unmanaged stands; -discrepancy between actual and projected volumes - Biggest local issue in age class 8 and 9 high elevation spruce-balsam stands.	Moderate	High		New Phase I can provide more accurate attributes for VDYP to use in deriving volumes. Ground sampling effective in providing good data on actual volumes. This data can then be used to adjust the database.
Yes	3. Errors in inventory attributes: species, species composition, age, height. -Incidents of Hemlock miscalled Fir - Licensees –moderate (local group) to high (BC Timber Sales) priority	Moderate	Moderate		Phase I and Ground sampling may improve individual polygon values and reduce errors in attributes. Further analysis by age and species could also identify trends within the inventory. No process to adjust spp.comp. Photo Interpreted database can be adjusted for numeric attributes only using Ground Sampling.
Yes	4. Problem Forest Types Identification Improve site productivity estimates -Licensees feel this is semi-related to Issue#3. Group feels ground sampling is a high priority for the Cw, Hw in the NW portion of the TSA and also the area around Foster & Buster Creek in the south.	Moderate	High		New Phase I can verify/improve the estimates in these stands. Targeted Ground Sampling in these types will provide good data. Can also target this stratum in analysis. Not a big issue in Robson TSA.
Yes	5. Site index in both managed and unmanaged stands:	Moderate	High	High	Phase I can provide better estimates of height for use in determining Site Index.

TSA issue	Issue-Licensee Comments	VRI Effectiveness			Remarks on VRI Effectiveness
		Photo-Interpreted Estimates	Ground sampling & NVAF	Monitoring	
	-Concern that current SI may underestimate growth rates -Need better estimates in immature stands. -SI adjustments for species -Licensees see this as high priority to offset negative impact of MPB losses.				Ground Sampling can provide data for Site Index based on current stands. Monitoring can provide data, over time. Monitoring may be better suited to targetting young managed stands if interest is in capturing data on potential of the TSA .
Yes-No	6. Landscape-level biodiversity -BC Timber Sales – high priority, utilizing ground sampling to meet FSP commitments -Local Licensees – low priority for either Phase 1 or 2 work	Moderate	Moderate	Moderate	Photo interpretation can provide more detailed information on non-forest attributes. Ground Sampling can provide data on Coarse Woody Debris, Forest Succession and ecology.
Yes	7. Mountain Pine Beetle – Mid term timber issue. - Additional information on existing structure of these stands desirable. -Additional data on future volume coming from the understory i.e. poles, sapling.	Low	Moderate to High	Moderate	New photo interpreted Estimates (Phase I) would be useful after the infestation is finished. Ground Sampling can give good information about current attributes and volumes of MPB stands. To study this in GS project might identify strata that define this part of the population i.e. non-pine stands, pine less than 50%. May wish to modify small tree plot data collection to increased size or additional classes.
Yes	8. Mountain Pine Beetle Shelf Life -Monitor the duration of merchantability of dead timber in beetle attacked areas. -Licensees interested in results from provincial & federal studies	NA	Moderate to High	Moderate to High	MOFR has piloted the collection of shelf life attributes in other VRI and Monitoring projects in 2006/07. Data is to be used to build a shelf life model.
Yes	9. Polygon delineation and species composition in younger age classes. -Licensees feel this is a moderate priority.	High	Moderate		New Photo Interpretation can improve delineation estimates on openings older than those populated by RESULTS. Ground Sampling will provide attribute information for openings age 31+, based on current species labels.
Yes	10. Volumes for Managed stands. -'snapshot' estimates of current volumes for managed stands -concern that current inventory does not present the existing volume accurately.	Moderate	High	High	New Phase I can provide more accurate attributes for VDYP to use in deriving volumes. Ground Sampling will provide very good data on actual volumes. The data can then be used to adjust the database.

TSA issue	Issue-Licensee Comments	VRI Effectiveness			Remarks on VRI Effectiveness
		Photo-Interpreted Estimates	Ground sampling & NVAF	Monitoring	
	-Licensees see this as moderate priority.				Limitations as the current managed stands may not exceed 35 years – ground sampling starts with age 31+
Yes	11. Environmentally Sensitive Areas -Licensees see this as Low priority for VRI work.	Low	Low		ESAs are not part of current Photo Interpretation procedures. Could attempt to mimic i.e. for soil & regen. Using soil moisture, aspect, shrub, mass movements, avalanching.
Yes	12. Decay, waste, and breakage -High priority for ground work locally.	Low	High		NVAF data will provide information on decay and waste. This data could be used to provide information to verify the current loss factors and adjust the photo-estimated inventory. Breakage is not part of the VRI system.
Yes	13. Implications of managing for species at risk i.e. caribou - Low priority, issue being managed elsewhere i.e. SARCO	Moderate	Low		New Phase I can provide finer delineation and specific attributes for non-forest areas. Ground sampling will show general incidence of lichens for caribou (TSA level overview), but not spatial extent.
Yes	14. Ungulate Winter Range, Wildlife management areas -Low priority. UWR already set for Robson TSA.	Moderate	Low		Phase I can provide more detailed information on non-forest attributes.
Yes	15. Cut block adjacency and green-up. -Licensees see this as a low priority.	Low	Low	Moderate	Monitoring can provide information on whether or not regenerated stands are meeting expected green-up.

In summary, the following information is of particular interest to the Stakeholder group and could be derived from the completion of VRI ground sampling and NVAF activities:

- Provide dead wood volume
- Derive more accurate volume in Cedar and Hemlock through destructive sampling
- Improve current site index estimates
- Provide better data on species composition in mixed wood stands
- Improve information on potential future volume of wood coming from the understory

## 2.5 VRI Activities and Products

### 2.5.1 VRI Photo Interpretation

If undertaken, a new photo interpreted inventory would be completed over the entire TSA. The decision to include the parks in any new photo interpretation will be assessed based on the costs, merits and business needs of collecting this information at that time. The McBride and Valemount Community Forests could also be included with the TSA.

The trend in photo interpretation is softcopy technology. Softcopy refers to the project being done using digital air photos, on a computer screen. The scanning of the photos, aerial triangulation and digital model building would have to occur before the project can begin.

Delineation could occur once the photo preparation is complete, and based on expectations for this, could be bid out before the end of this fiscal year. Delineation is the process of dividing up the area into homogeneous polygons. A decision on average polygon size or the desired number of polygons per mapsheet would be part of the Request for Proposal to qualified contractors.

Field work could occur in the same year as delineation is undertaken. The field work is a combination of ground and air calibration points completed throughout the project area. The objective is to improve the ability of the contractor to interpret the photos in the office. The amount of fieldwork completed is specified in the RFP, and is determined by the budget. It is at the time of the development of the plan for field work that specific issues of the inventory i.e. miscalled species should be addressed. Attribute estimation follows the fieldwork.

The timeframe for a new Phase I in the Robson Valley would be dependent on the availability of digital photos, adequate funds and qualified contractors to work within the schedule developed by the Licensees. The TSA was flown at a 1:20,000 scale (colour) in 2005 and 2006, as shown in the map below<sup>5</sup>. They should be available through a government contract completed by March 31, 2007.<sup>6</sup> Any areas without new coverage, as shown in Figure 3, would have to be addressed if a new Phase I project is proposed in the VPIP for Photo Interpretation.

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<sup>5</sup> Figure 3 Map prepared by Jim Grace, VRI Forester, Southern Interior Forest Region, for presentation at the Stakeholders' Meeting in Dunster, November 21, 2006.

<sup>6</sup> November 2006. Personal communication, Jim Grace.

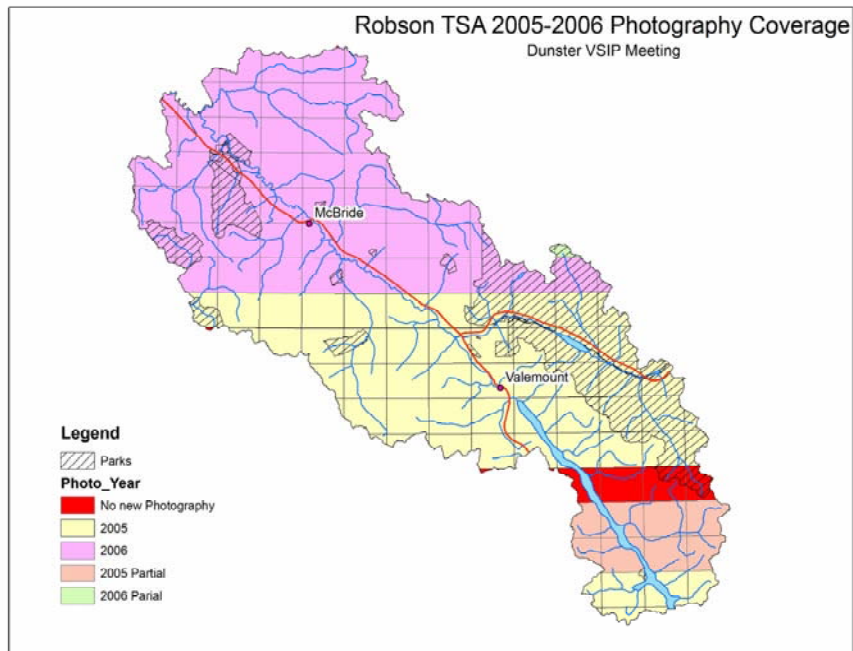


Fig. 3

Generally, the process to complete a new Phase I takes 2 to 3 years.

Since photo availability is a relatively minor issue for this TSA, the most important consideration becomes whether there is a business need for a new Phase I inventory. In the August, 2006 Timber Supply Review rationale, the Chief Forester did not identify any issues with the Robson Valley TSA inventory that would suggest undergoing the expense of a new photo interpretation of the land base.

A new Phase I inventory will give an up-to-date snapshot of the forest to the time of the photo flights. There is an assumption that “new is better” and “better means more accurate”. One of the major objectives for doing a Phase I inventory is to get better volumes of timber in the study area. For this TSA, the audit revealed no issues with the overall inventory volume in the Robson Valley. The question asked to the local licensees at the Stakeholders’ meeting was whether the actual volumes harvested are comparable to expectations from the inventory.

The next question is whether the clients are looking for greater accuracy of the other attributes in the polygon descriptions, and whether this can be achieved? The audit suggested a 57% match of the Growth type groups from the inventory (i.e. map labels) and the audit growth type groups: 59% of the samples matched by leading species. The weakest correlation where a significant difference was noted was with the ages. (Average Audit or ground age was approximately 28 years younger than the inventory age average.) The discrepancy in this attribute may be less significant for an inventory where a large proportion of the landbase is in the older age classes.

## 2.5.2 VRI Ground Sampling

The VRI Ground Sampling phase requires a completed photo interpreted inventory – either new or existing. It involves establishment of ‘cluster’ ground samples and the completion of Net Volume Adjustment Factoring destructive sampling. It should be followed up by the statistical analysis and adjustment of the photo interpreted database.

A Phase 2 ground sampling program requires three essential steps to be completed with Stakeholder input:

1. Decisions on the overall project design. This includes deciding the sampling population, the sample strata and working out the number of samples that will be completed in the project.
2. Selecting activities to be completed in the project from the “ground sampling toolkit”: The options in Phase 2 VRI include:
  - Full VRI – includes ecological, timber and Coarse Woody Debris (CWD) information to VRI certification standards
  - Timber Emphasis – tree information only is collected
  - CWD – Coarse Woody debris data is collected as an additional option on Timber Emphasis plots
  - Succession information – The Succession card’s completion is an option on Timber Emphasis plots

Each of the Phase 2 activities was presented at the Stakeholders’ meeting. Section 3.3 of this document “Phase II Ground Sampling” will reference the decision on the option selected for the Robson Valley VRI project.

3. Resolving the Sampling Plan for the Net Volume Adjustment Factor destructive sampling.

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 estimated net volume is obtained from net factoring and taper equations). The NVAF data provides an adjustment factor that is used during sample compilation to produce unbiased estimates of net merchantable tree volume. Its completion involves the following:

- Step 1 - Random selection of sample trees from a sub-set of the ground samples, following the initial data collection.
- Step 2 – The sample trees selected in Step 1 are felled and sectioned according to the NVAF protocol to measure the actual net volume.

Options added to the NVAF sampling in projects undertaken in other TSAs in 2006/07 included data collection for ‘shelf life’, related to the Mountain Pine Beetle

(MPB) epidemic in the province, and the collection of Interior Log Grades when Net factoring. Data collected and analysed from these projects may feed into this TSA at a later date. At this time, there is no plan to collect this data in the Robson Valley TSA VRI project.

## **2.6 Follow up Activities**

### **2.6.1 Ground Sampling Analysis and Inventory Attribute Adjustment**

The Vegetation Resources Inventory was designed to have Ground Sampling followed by a standard analysis for the regular suite of VRI data collected. The inventory may be adjusted for the following attributes:

- Height
- Age
- Volume

The findings of the NVAF work are incorporated into this adjustment. If the sample size is of significant size to stratify the population i.e. by species, then conclusions can be made by species or species group.

### **2.6.2 'Other' Attributes – Analysis**

The following additional work has been considered to add to the data collection for this project:

1. Data for mid-term timber assessment - Increased diameter classes in the 'Small tree' plot. Increasing the 'Small tree plot' size from 1/500 ha. to 1/200 ha.
2. Dead wood volume – Tally dead trees in the auxiliary plots.

Since this data is outside of the current protocol for VRI, it may need to be collected on supplementary data sheets. Branch staff is currently assessing this requirement and will provide a recommended method for data collection and compilation. Analysis related to the collection of this data will have to be conducted in addition to the 'standard' analysis.

### **2.6.3 Monitoring**

Many Tree Farm Licenses (TFLs) and some TSAs have undertaken long term monitoring projects based on business needs. Some of this recent work has been related to the Mountain Pine Beetle infestation, with the goal being to monitor the changes and trends of the timber and non-timber resources of MPB affected stands over time. Other non-beetle focused studies are in Post-Harvest Regenerated stands, with the primary objective to monitor change in net merchantable volume

and mean annual increment. The secondary objective is to monitor the site index of these stands. Since these stands will support upward pressure on the timber supply in the mid to long term, clients for these projects see it as important to monitor increased growth on the landbase.

The monitoring protocols currently in use for management unit monitoring were developed for the National Forest Inventory (NFI). There are RISC Standards and Procedures for completing these plots.

To conduct an effective monitoring program for a TSA, there must be clearly defined objectives. Details must be determined including:

- What is to be monitored?
- Why is it being monitored?
- What is going to be done with the data in terms of both analysis and Ministry acceptance of the analysed data?

There must also be an assurance of a funding mechanism to remeasure monitoring plots at a prescribed interval, to ensure that this is a worthwhile investment at the establishment phase.

## **3 Inventory Plan**

### **3.1 Overview**

This section takes the theoretical discussions on the Vegetation Resources Inventory in Sections 1.3, 2.5 and 2.6 and describes how it will be applied in the Robson Valley TSA project.

### **3.2 Phase I – Photo Interpretation**

Although a new Phase 1 may be able to improve delineation in some cases i.e. update polygons, due to the stage of the Mountain Pine Beetle attack (still early in this TSA), the confirmation of reasonable volumes identified by the Inventory Audit and the relatively young age of the current forest cover inventory (approximately 12 years), the Stakeholders do not see a new Phase I as a high value or priority for this unit at this time. The need for new photo interpretation in this unit will need to be re-evaluated in the future.



### 3.3 Phase II Ground Sampling

A review of the issues outlined in the Table in Section 2.4 that are pertinent in this TSA has resulted in the decision that Phase 2 and NVAF sampling would be the most effective option to supply data for the Licensee's information needs. The type of Phase 2 ground sampling will be Timber Emphasis. A discussion regarding other TSA issues such as biodiversity revealed that there are alternate studies ongoing to satisfy other information needs. The additional data referenced in Section 2.6.2 of this plan will be collected.

Prior to the finalization of this VSIP preparation, Sections 3.3.1 to 3.5 of this plan were circulated to the Stakeholders to confirm that the project direction stated in this plan is being guided by them.

#### 3.3.1 Inventory Objectives

The objective of VRI ground sampling is to attain statistically valid timber volumes in the live and dead timber. A sample error objective of +/- 10% for overall inventory volumes, 95% probability will be targeted.

#### 3.3.2 Target Population

To determine the target population for sampling, the land base often used in other provincial VRI projects will be adopted. That is the Vegetated Treed<sup>7</sup> (VT) land base. The age class for sampling will be greater than 60 years. Exclusions will include private land, Indian reserve, parks, and protected areas. The Community Forests for Valemount and McBride will be included with the rest of the TSA. An 'operability limit' to the Vegetated Treed land base will be developed and applied in the Project Implementation Planning process and will become the basis for the development of the sampling list population. The intention would be to provide a simple guideline i.e. Biogeoclimatic Zone exclusions or an elevation line to differentiate the inoperable from the operable vegetated treed land base. The interest for VRI sampling is in biological similarity, as opposed to economic operability which has been used to determine the operable land base for TSR (Timber Harvesting Land Base). It was decided not to use the BC Timber Sales, Prince George Business Area total chance planning<sup>8</sup> for the Hugh Allen chart area to identify potential sample locations because of the different project objective.

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<sup>7</sup> B.C. Land Cover Classification Scheme

<sup>8</sup> Denise Hogue, pers. communication. - The BC Timber Sales work is total chance planning in some of their chart areas whereby one phase of the project involves analyzing the TSR THLB through photo interpretation for economic operability.

### 3.3.3 Sample Size

At the time of preparing the Project Implementation Plan for the Ground Sampling project, estimates of the variability for volumes will be determined, and based on a sampling objective of +/- 10% for overall inventory volumes, 95% probability, a sample size will be calculated. The Robson Valley TSA Inventory Audit report - <http://www.for.gov.bc.ca/hts/vri/audits/reports&pub/reports/robsonvalley-auditreport.pdf> – will be used as a reference to develop this work.

### 3.3.4 Sample Selection

The sample selection will follow the Provincial Standard. The selection of sample polygons is based on stratified sampling using the Probability Proportional to Size with Replacement (PPSWR) sampling method.

The population will be pre-stratified. At previous planning tables across the province, these strata were based on species or species groupings that would be significant for the clients. Overall, a stratum must be of sufficient size in the population to derive adequate sampling to reach a conclusion that will be statistically significant to be discussed in the analysis. This is generally understood to be 15 samples in a stratum.

Table 2<sup>9</sup>: Example Distribution of Samples – Based on Approximate Population Areas from TSR3 in Section 2.1 of this plan and Stakeholder interest.

Stratum	Planned number of samples
Spruce	50
Balsam	17
Pine, Douglas Fir & minor species	18
Cedar-Hemlock	15
Total	100

The Stakeholders are interested in increasing their knowledge through ground sampling and analysis in the following species: balsam, cedar and hemlock. Cedar and hemlock are not proportionately represented in the population to provide 15 samples if they are in a separate stratum. The interest in this stratum suggests a requirement to increase sampling in a Cedar-hemlock stratum through weighting. Specifics on the development of the strata will be included in the Project Implementation Plan.

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<sup>9</sup> The number of samples and the number of hectares represented by each sample will not be known until after the ground sampling plan has been completed.

### 3.3.5 Net Volume Adjustment Factor Sampling

The NVAF destructive sampling provides data on decay and taper.

The Planning and Sampling Contractors will work with Forest Analysis & Inventory Branch to develop a sampling plan that identifies the number of ground samples that may potentially contain trees to be destructively sampled. The sample list where the NVAF data is to be collected will also be identified during the overall sample selection process.

A minimum 100 tree sample is required to meet the NVAF Standard<sup>10</sup>. The MoFR Forest Analysis & Inventory Branch staff will provide guidance to the project to ensure appropriate decisions are made regarding sampling strata, sample size and the live/dead ratio in this TSA.

At the time of the writing of the VSIP, there appears to be an interest in obtaining information on minor species represented in the population from the NVAF work. This would require increasing the sampling in certain species or species groups to achieve the minimum sampling error so that some conclusions can be reached by strata. An example of this breakdown for NVAF might be:

Table 3

Species group	Number of trees
Dead – All species	10
Live – Cedar	20
Live – Hemlock	20
Live - Spruce-Douglas Fir	20
Live - PI-other minor species	20
Live – Balsam	20
Total	110

### 3.3.6 Monitoring Plots

While there is interest to develop a plan to integrate a Monitoring protocol in the Robson TSA, the group feels that it is too early in the process to commit to a definite plan. Consideration will be made in regard to monitoring objectives suggested including monitoring young stands, mountain pine beetle issues including mortality rates and regeneration in affected stands, and certification. During the course of the VRI Phase 2 Ground Sampling and NVAF project a monitoring focus for the TSA may evolve. This would be addressed as an amendment to the planning documents at a later date.

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<sup>10</sup> Will Smith, personal Communication. At the time of the writing of this VSIP, the Standard states that the minimum will be 100 trees, 75 live and 25 dead. The number of dead trees may be reduced in future sampling projects although the overall minimum sample size will remain at 100.

### **3.3.7 Implementation**

All phases of a ground sampling program could be completed in a 2 year time frame, dependent on availability of funding and certified crews. Commencement of ground sampling could start in the 2007/08 fiscal year. The initial emphasis might be on completing the samples for NVAF so that this data could be compiled and the NVAF tree list developed at the end of the first field season.

Availability of funding and of certified contractors will be key factors in maintaining a 2 year timeframe. The VPIP will provide an option to conduct the projects over 3 years.

### **3.4 Vegetation Resources Inventory Project Implementation Plan**

If VRI work is to be started within the next fiscal year, following the completion of the VSIP, the next step in the planning process is to develop the VPIP. Using the direction of the VSIP, with input from the Stakeholders, the VPIP will specify the operational details for the inventory.

### **3.5 Roles and Responsibilities**

A VSIP usually outlines organizational roles and responsibilities in the development of a VRI project. The Stakeholders have reviewed and accepted the following:

Licensees (including Community Forests and BC Timber Sales):

- Initiate inventory projects through FIA funding process to support planning of VRI inventories.
- Prepare requisite plans for inventory work. VSIP to establish the overall VRI strategy. VPIP prior to undertaking a VRI project.
- Inform other Stakeholders of the planning process and involve them in the project i.e. MoFR and other key government agencies.
- Submit Strategic and Project Implementation plans to the appropriate MoFR Forest Analysis & Inventory Branch staff for their support, review and sign off.
- Apply to Price-Waterhouse Coopers for approval of project funding based on approved Plans.
- Complete the RISC inventory activities following the appropriate Standards and Procedures outlined in the Implementation Plan.
- Submit data from completed projects to the MoFR/Provincial Data Warehouse (as appropriate).

MoFR – Forest Analysis & Inventory Branch, Inventory Section

- Provide mentoring and advice regarding the Vegetation Resources Inventory methodology.
- Coordinate plan review within the MoFR.

- Sign off final approved edition of project plan(s).
- Provide expertise to projects as they are ongoing.
- Facilitate the acceptance of the data as is appropriate.

### 3.6 Costs

The following Tables outline estimated costs for the project, based on recent costs for other projects applied to the Robson Valley TSA.

Table 4. Estimated sample sizes and costs for VRI Phase II activities in the Robson Valley TSA

VRI Activity	Sample Size	Unit Cost	Total Cost
<u>GROUND SAMPLING</u>			
Contract administration & materials-3 years			\$15,000
VSIP and VIP preparation -includes Sampling plans development and package preparation			\$30,000
Timber Emphasis Plots – timber data collection	100	\$1,800/sample	\$180,000
NVAF destructive sampling	110	\$800/tree	\$88,000
Helicopter access-estimate			\$95,000
Mentoring & Quality Assurance-Timber emphasis plots			\$16,000
Quality Assurance-NVAF			\$7,000
Final Compilation/analysis and inventory file adjustment			\$15,000
<b>Total Phase II</b>			<b>\$446,000</b>

Table 5. Sample size and estimated funding breakdown for VRI Monitoring project

<u>MONITORING</u>			
Contract Administration – includes GIS work			\$9,000
Sample Establishment	25	\$2,500/sample	\$62,500
Helicopter Access			\$5,000
Mentoring	1 crew	\$1,000	\$1,000
Quality Assurance		\$3000	\$3,000
<b>Total Monitoring</b>			<b>\$80,500</b>

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[http://www.for.gov.bc.ca/hts/vri/reports&pub/vri\\_vripub.html#top](http://www.for.gov.bc.ca/hts/vri/reports&pub/vri_vripub.html#top)
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12. Timberline Forest Inventory Consultants. March 31, 2005. A User's Guide to the Vegetation Resources Inventory. FIA/ Tolko Industries Limited.

The most recent edition of the **Vegetation Resources Inventory Standards and Procedures** will be followed for the completing this project. These are located at the website:

<http://ilmbwww.gov.bc.ca/risc/pubs/teveg/index.htm>

## **Ground Sampling**

Vegetation Resources Inventory Guidelines for Preparing a Project Implementation Plan for Ground Sampling and Net Volume Adjustment Factor Sampling Version 2.0, March 2006

Vegetation Resources Inventory Sample Selection Procedures for Ground Sampling Version 3.3, December 2002

Vegetation Resources Inventory Sample Selection Procedures for Ground Sampling Version 3.3 Errata No. 1, April 2005

Vegetation Resources Inventory Ground Sampling Procedures Version 4.5, March 2004

Vegetation Resources Inventory Ground Sampling Procedures Version 4.5 Errata No. 1, February 2005

Vegetation Resources Inventory Quality Assurance Procedures for VRI Ground Sampling Version 3.0, March 2004

Vegetation Resources Inventory Data Collection Standards for VRI Ground Sampling Version 2.1, March 2006

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

Net Volume Adjustment Factor Sampling Standards and Procedures Version 4.1, March 2006

## **VRI – Analysis and Adjustment**

Vegetation Resources Inventory Procedures and Standards for Data Analysis Attribute Adjustment and Implementation of Adjustment in a Corporate Database Version 2.0, March 2004

## **Monitoring**

National Forest Inventory BC Change Monitoring Procedures for Provincial and National Reporting Version 1.4, March 2005

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

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



# Appendix A

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## Attendance at Stakeholders' Meeting



**Attendance at Stakeholders' Meeting  
November 21, 2006  
Dunster Community Hall**

Meeting initiated and lead by Nona Phillips, Inventory Contractor

<b>Participant</b>	<b>Affiliation</b>
Tony Bild	Valemount Forest Products Ltd
Ainslie Jackman	Hauer Bros. Lumber Ltd.
Marc von der Gonna	McBride Lake Community Forest Corporation
Denise Hogue	BC Timber Sales, Prince George Business Area
Gary Johansen	MOFR, Planning, Forest Analysis & Inventory Branch, Victoria
Will Smith Victoria	MOFR, NVAF - Forest Analysis & Inventory Branch,
Jim Grace	MoFR, VRI Inventory-Phase I, Southern Interior Forest Region, Kamloops
Matt Makar	MoFR, VRI Inventory-Phase II, Southern Interior Forest Region, Kamloops
Cheryl Delwisch	MOFR, Timber Supply Planner, Southern Interior Forest Region, Kamloops
Norma Stromberg-Jones	MOFR, Headwaters Forest District, McBride Satellite Office
Elia Ganderski	MOFR, Headwaters Forest District, Clearwater
Wayne Van Velzen	MoE, BC Parks-Robson, Valemount base



# Appendix B

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## Glossary of Terms



# **Glossary of Terms** (From 14 March 2006 RISC Standard, VRI Guidelines for Preparing a Project Implementation Plan for Ground Sampling and Net Volume Adjustment Factor Sampling)

## **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 management unit inventories, the unit is usually a TSA or TFL.

## **Land Cover Classification**

The BC Land Cover Classification Scheme (BCLCCS) 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 BCLCCS is hierarchical and reflects the current state of the land cover (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 Unit.**

A management unit is an administrative area used for inventory reporting purposes. The most common inventory units are TFLs and TSAs. However, forest districts or provincial parks could also be considered as inventory units if they were identified as areas of interest for reporting purposes.

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

NVAF sampling provides factors to adjust net tree volume from the ground sampling, where net tree volume is estimated from the VRI net factoring process and taper equations. The factors account for hidden decay and possible taper equation bias. Sampling involves detailed stem analysis of sample trees to calculate actual net volume. The actual net volume is compared to the estimated net volume.

## **Photo Interpretation**

Photo-interpretation involves the subjective delineation of polygons and the photo estimation of attributes for all polygons in an inventory unit. Medium scale aerial photographs are most often used in the photo-interpretation process.

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## **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 may be applied to the corresponding population post-strata to improve the precision of the inventory's overall averages and totals. In the VRI, these strata (leading species) are usually pre-defined in the sample selection phase.

### **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**

A set of sampling units selected randomly to represent a population.

### **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. The current sampling error requirement for a management unit is +/- 10% at the 95% level of probability.

### **Sampling Unit**

The smallest indivisible unit in the population that is eligible for sample selection.

### **Statistical Adjustment**

Statistical adjustment is the application of adjustment factors, computed from a random sample, to adjust timber attributes.

### **Sub-unit**

A sub-unit is a small area or stratum of interest within an inventory unit such as a TSA or a TFL

### **Target Population**

The population is the portion of a forest district, TFL, or TSA, for which statistical estimates are required. For instance, in a TSA where vegetated treed, vegetated non-treed and non vegetated polygons are delineated, the target population may be only the vegetated treed (VT) polygons.

### **Target Sampling Error**

Is the precision we expect a sample of a given sample size to produce. This precision depends on confidence we wish to place on a sample and the variability (CV) within the population.



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

The VRI is the MOFR standard 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 Interpretation*: 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 a management unit 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 C

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**VSIP Approval Signature Page**

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## Robson Valley Timber Supply Area Vegetation Resources Inventory Strategic Inventory Plan Approval

The Robson Valley TSA Vegetation Resources Inventory Strategic Inventory Plan was prepared in consultation with MOFR staff. I have read and concur that this plan, dated March 19, 2007, meets current VRI standards, business needs and considerations. 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. .

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Valemount Forest Products Ltd. (*Lead proponent*)

Date

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Ian Hamann, P.Eng., R.P.F.  
Timber Sales Manager  
BC Timber Sales, Prince George Business Area

Date

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Jon Vivian, R.P.F.  
Manager  
Vegetation Resource Inventory  
Forest Analysis and Inventory Branch  
Ministry of Forests and Range

Date