

Williams Lake Timber Supply Area – TSA 29

Vegetation Resources Inventory Strategic Inventory Plan

Nona Phillips Forestry Consulting
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Acknowledgements

This planning process for the Williams Lake Timber Supply Area was initiated by the Vegetation Resources Inventory staff in the Ministry of Forests, Southern Interior Forest Region, Kamloops. This idea was positively responded to by the local licensees, with John Stace-Smith of Tolko Industries Ltd. as the lead. It has been supported by both industry and government Stakeholders including the following:

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Executive Summary

The Ministry of Forests & Range (MFR) has recently completed Timber Supply Review 3 (TSR3) in the Williams Lake Timber Supply Area (WLTSA). The current 'Rationale for Allowable Annual Cut (AAC) Determination' was a process initiated to respond to the beetle epidemic in the pine forests of this TSA. The Chief Forester has recommended a series of tasks to be completed prior to the development of the next data package, primarily based on the beetle harvesting.

The Ministry of Forests & Range staff recognizes that portions of the inventory in the Chilcotin Forest District are among the older inventories in the province. This is one consideration when prioritizing undertaking an inventory project. In the Williams Lake TSA, the Mountain Pine Beetle (MPB) epidemic has devastated the forest. Both the Chilcotin and Central Cariboo Forest Districts do not have a current forest cover (FC) inventory for the live tree component and lack critical information required to proceed into the next Timber Supply Review (TSR).

Through the Vegetation Resources Inventory (VRI) Strategic Inventory Planning (VSIP) process, the Stakeholder group in the Williams Lakes TSA is investigating the type and timing of undertaking inventory options, both for TSR and operational planning purposes. This document provides a record of the decision-making process.

The initial step in the preparation of this Strategic Inventory Plan was to bring together the Stakeholders at a meeting in Williams Lake on January 29, 2008. The meeting's agenda was designed to:

1. provide background on the Vegetation Resources Inventory process
2. discuss client data needs in the TSA
3. investigate support that can be provided through the Vegetation Resources Inventory

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

1. Live volume for all species.
2. Merchantability and 'shelf life', particularly in the 'pure' dead standing timber.
3. Post Harvested Regenerated (PHR) stands – Will these be a source of future long-term timber. Are they achieving expected site productivity? Mortality in the pine types?
4. Biodiversity/habitat management.

The Strategic Inventory Plan for the Williams Lake TSA outlines the following decisions:

1. Undertaking a Vegetation Resources Inventory investment is appropriate for this TSA.
2. A Phase I VRI (photo interpretation) will be the first VRI activity undertaken in this project. The current (2005-2006) air photos do not truly reflect the mortality in the forest. A new flight requirement is recommended that shows the current

- level of MPB incidence and spread and the remaining 'green' component within the forest.
3. The project will be broken into 'Blocks' based on limitations of resources (funds and skilled photo interpreters) and the MPB timing. The Regional Entomologist presentation on the Mountain Pine Beetle at the Stakeholder meeting showed a difference in residual activity east and west of the Fraser River. The 'Eastern' Block ('Horsefly' in this plan) could be flown as soon as the 2008 field season. The photos for the rest of the TSA should not be flown sooner than 2009.
 4. The area of the TSA that will be included in the Phase I activity will be finalized during the writing of the Project Implementation Plan (VIP) for Photo Interpretation.
 5. Phase II ground sampling with Net Volume Adjustment Factor (NVAF) destructive sampling and Analysis and Adjustment of the inventory will complete the project.
 6. An additional Stakeholder Meeting is recommended at the initiation of the Project Implementation Plan for ground sampling.
 7. The ground sampling project discussions started in the VSIP will need to be finalized in the Phase II VIP, including the landbase, sample type, sample size and strata. The utility of the TSA's previous VRI Phase II ground samples and NVAF sample trees will be analysed at that time and a decision made regarding their incorporation.
 8. Details of the NVAF destructive sampling will also be part of the Project Implementation Plan for Ground Sampling and NVAF.
 9. The decision regarding initiating a monitoring program on this TSA has been deferred.

Timelines for the follow up planning requirement in the VRI process, a VRI Project Implementation Plan for Photo Interpretation and a VIP for Ground Sampling and NVAF, will be assessed following this VSIP's approval and sign-off. An outline of the requirements for each VIP is provided in a Ministry of Forests & Range Standard. The VIP provides operational details and final decisions for each activity that is part of the Williams Lake TSA VRI project.

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1. Introduction

1.1 Background

The Vegetation Resources Inventory (VRI) in the province of British Columbia (BC) is a 'broad' inventory designed to support, among other things, the Timber Supply Review (TSR) process. The current Timber Supply Review in the Williams Lake Timber Supply Area (WLTSA) reflects management practices that are evolving in response to the Mountain Pine Beetle (MPB) attack.

Undertaking a Vegetation Resources Inventory project requires starting with a formalized plan. Often supported by a contracted VRI specialist, the VRI Strategic Inventory Planning (VSIP) process requires local Stakeholders' involvement in making decisions on project direction and indirectly leading it. While the process does follow a kind of 'template', it should be unique and relevant to the management unit and its clients.

The Vegetation Resources Inventory Strategic Inventory Plan builds the Business Case for a VRI project. It details the history of the existing inventory and identifies local forest management issues and evaluates the effectiveness of the 'phases' of the VRI to address these issues. During the strategic planning phase, the various components of the inventory are assessed for their appropriateness to collect data related to specific information gaps and management decisions. The VSIP provides direction for the next step in the VRI planning process, the development of the more detailed Project Implementation Plan (VPIP).

Nona Phillips Forestry Consulting has prepared this plan in consultation with the Williams Lake TSA Stakeholders. Included in the Stakeholders' group are the following:

- Tolko Industries Ltd., Williams Lake
- West Fraser Mills Ltd., Williams Lake
- BC Timber Sales, Cariboo Chilcotin Business Area
- West Chilcotin Forest Products Ltd., Anahim Lake
- Ministry of Forests and Range (MFR)
 - – Forest Analysis & Inventory Branch (FAIB)
 - – Southern Interior Forest Region (SIFR)
 - – Central Cariboo Forest District
 - – Chilcotin Forest District
- Ministry of Environment (MoE), Williams Lake

This VSIP is the product of an initial 'issues paper' (provided prior to the Stakeholders' Meeting), input received during the Stakeholders meeting held in Williams Lake on January 29, 2008, comments from the Stakeholders following the meeting and edits to 'draft' editions of this plan.

1.2 Vegetation Resources Inventory Overview

In 1991, the Forest Resources Commission recommended “that the Government of British Columbia undertake a commitment to complete inventories for all renewable forest resource values using standardized compatible systems”.

The Vegetation Resources Inventory is one of a number of inventories that were developed in the 1990's in the province. The VRI has been the ‘standard’ for forest cover (FC) inventory in British Columbia since 1996. The Resources Information Standards Committee (RISC) has evolved as the group who oversees the protocols required to complete an inventory program.

As stated on the Ministry of Forest and Range’s website for the Vegetation Resources Inventory¹, the VRI was designed to answer two questions:

1. Where is the resource located?
2. How much of a given vegetation resource is within a management 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 address inventory related questions in a specific management unit.

Critical to deciding the direction for a VRI project, this planning process recognizes that it is important for Stakeholders to have some understanding of this inventory, through an overview. The Vegetation Resources Inventory has several components that may be undertaken in combination or in some cases individually, including:

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 VRI maps

¹ <http://www.for.gov.bc.ca/hts/vri/index.html>

2. Phase II 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 (NVAF) process is used to correct for errors in the estimation of net tree volume. The NVAF work, a mandatory component of the Phase II program, 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.

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 programs are recognized by the Province to be part of the VRI process and may be funded by the Forest Investment Account (FIA). The following are features of this work:

- RISC Procedures exist that determine the methodology for data collection. Based on the National Forest Inventory (NFI) – British Columbia Standard.
- Creates a permanent, remeasurable design that is a statistically based system of monitoring and reporting.
- Allows for repeated measurement of forest attributes over time, at defined locations.
- Monitors change over a long term at intervals of 5 to 10 years.
- Projects often include collecting full VRI ground sampling data, including timber and ecology.
- Addresses mid to long term issues i.e. projects often target managed stands in younger age classes.

1.3 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 for each management unit.
- The Strategic Inventory Plan provides background on the VRI process, tailoring the inventory to the business needs identified by an interactive process with the Stakeholders.
- Project Implementation plans are working documents that outline the operational activities associated with implementing and documenting the inventory decisions identified in the VSIP. A VPIP includes details on the geographic area, scheduling, roles and responsibilities, costs and deliverables.
- Together the VSIP and VPIP form a critical part of the record for Vegetation Resources Inventory projects and they have high value in both the short and long term. If diligently written, they archive the initiation of the process. The VPIP should provide a guideline to execute the applicable phase of the VRI.
- Implementation will follow the 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>

1.4 Vegetation Resources Inventory Planning

The VRI planning process is a requirement of both the Ministry of Forests & Range and the Forest Investment Account and approval is required by the MFR prior to undertaking a VRI project. This is to ensure that there is a need for an inventory project and that the activities proposed address issues identified in the TSA.

The steps in the planning process are:

- Identify Stakeholders and consult with them throughout the project. Initially, a meeting is held with the Stakeholders to describe the process and their input is obtained to identify issues specific to the management unit. This client group is updated throughout the planning process and provided with opportunities to comment on critical decisions.
- Develop a VRI Strategic Inventory Plan that records the current state of the inventory and investigates additional data requirements. Based on the 'Business need', this plan may include a recommendation to

undertake VRI activities. As required, VRI tools will be identified that support local forest management issues.

- Prepare a VRI Project Implementation Plan for each prescribed activity as directed by the approved VSIP. A separate plan is required for Phase I photo interpretation and Phase II ground sampling. The ground sampling VPIP includes Net Volume Adjustment Factor sampling, analysis and adjustment and monitoring activities as well as details on the ground samples.

Approved VRI Strategic and Project Implementation Plans are time-sensitive documents, with a 'life span' of 5 years prior to their requirement for review before undertaking a project under their direction. They are available to the public and posted on the Vegetation Resources Inventory web-site:

http://www.for.gov.bc.ca/hts/vri/reports&pub/vri_vripub.html#top

1.5 Funding

This project is being funded by the Licensee component of the Stakeholder group, utilizing money from their Forest Investment Account allocation, administered by PriceWaterhouseCoopers (PWC). Any inventory projects that develop as a result of this planning may be eligible for funding through the FIA process, subject to approval from the Ministry of Forests & Range.

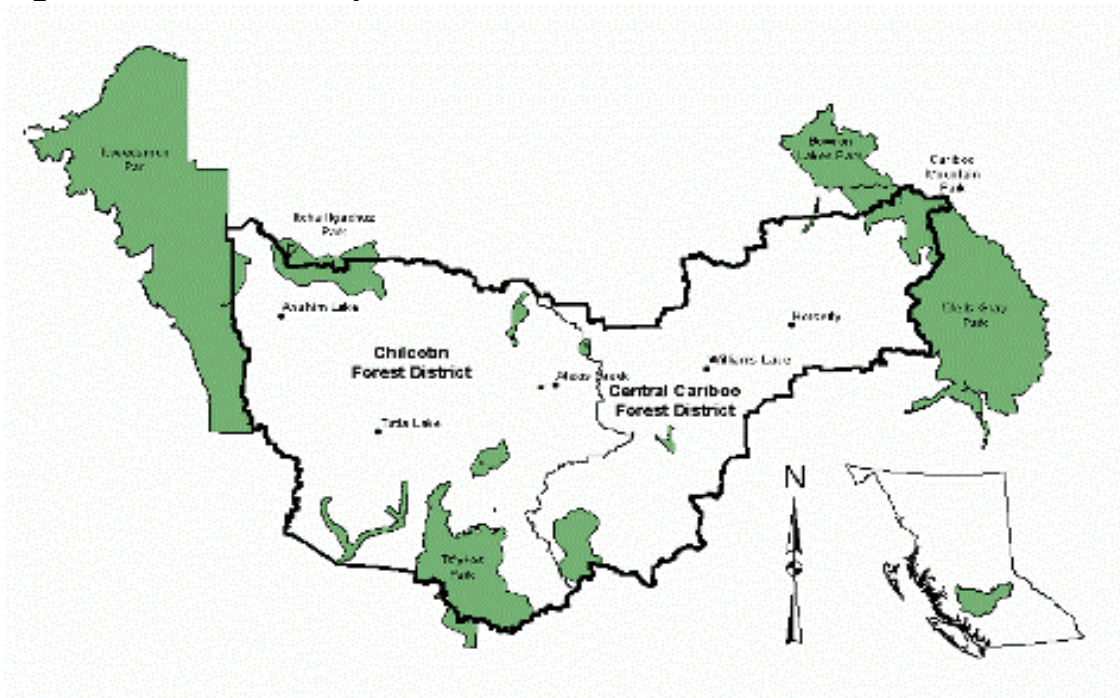
An approximate cost of the type of projects under consideration has been developed as part of this planning process, utilizing historic costs from similar projects on similar landscapes.

2. Business Considerations

2.1 Current Landbase (adapted from the Williams Lake TSA Rationale for Allowable Annual Cut (AAC) Determination – April 18, 2007)

The Williams Lake TSA is one of fifteen TSAs in the Southern Interior Forest Region of the Ministry of Forests and Range. It is bounded by the Quesnel TSA to the north, Wells Gray and Mitchell-Niagara Parks to the east, the 100 Mile House and Lillooet TSAs to the south, and Tweedsmuir Provincial Park, Kingcome and Sunshine Coast TSAs to the west. It comprises approximately 4.9 million hectares. It is administered from two MFR offices; Central Cariboo Forest District in Williams Lake in the east and Chilcotin Forest District in Alexis Creek in the west. Figure 1 is an overview map of the TSA.

Figure 1 - Overview map of the Williams Lake TSA



Williams Lake is the largest community in the TSA (11,153 residents²). The population for the neighbouring area is approximately 19,720, bringing the number for the immediate service area to be estimated at 30,873. Smaller communities within the TSA include Alexis Creek, Horsefly, Likely, Anahim Lake, Tatla Lake, Riske Creek, Big Creek, Nimpo Lake 150 Mile House, Big Lake and McLeese Lake.

Table 1 summarizes the area managed by the BC Ministry of Forests and Range and reductions made to derive the timber harvesting land base (THLB). The portion of the total TSA area that will be included in VRI Phase I and Phase II activities will be determined during Project Implementation planning.

Table 1: Area Summary for the Williams Lake Timber Supply Area³

Land Classification	Productive forest area by classification (ha)	Area (ha)	Percent of total TSA Area	Percent of productive crown forest land
Total TSA Area		4,904,558		
Land not managed by BC Ministry of Forest and Range		731,929		

²2001 census on City of Williams Lake, Chamber of Commerce Community profile, <http://www.williamslakechamber.com/index.asp?p=182>

³ From Williams Lake Timber Supply Area Analysis Report –September, 2001

Non-productive forest		1,026,803		
Productive forest managed by BC Ministry of Forest and Range		3,145,826	64.1	100.0
Reductions to the Crown forest available for timber supply				
Non-commercial brush		1,587	0.0	0.1
Existing unclassified roads and trails in stands under 60 years old	14,801	14,801	.3	0.5
Environmentally sensitive areas	117,269	115,742	2.4	3.7
Steep slopes	111,363	71,436	1.5	2.3
Currently unharvested stand types	122,977	97,877	2.0	3.1
Sites with low productivity	248,135	207,689	4.2	6.6
Caribou no-harvest areas	104,052	75,218	1.5	2.4
Parks	109,023	74,149	1.5	2.4
Lake buffers for Class A lakes	2,150	1,726	0.0	0.1
Riparian reserves		50,054	1.0	1.6
Not satisfactorily stocked areas (except those created by logging)	15,451	10,314	0.2	0.3
Stands not expected to reach the minimum merchantable height 160 years of age	160,952	9,996	0.2	0.3
Stands not expected to reach the minimum merchantable volume 160 years of age	399,990	225,323	4.6	7.2
Wildlife tree patches		93,663	1.9	3.0
Total Reductions		1,049,575	21.4	33.4
Current Timber Harvesting Land base		2,096,251	42.7	66.6
Future Additions				
Beetle attacked stands expected to regenerate naturally and contribute to the timber harvesting land base		85,039	1.7	2.7

Future Reductions				
Future road trails and landings		59,289	1.2	1.9
Future Timber Harvesting Land Base		2,122,001	43.3	67.5

The Williams Lake TSA includes three general landscape types. The Chilcotin Plateau, west of the Fraser River, is characterized by a drier climate with extensive lodgepole pine forests and some Douglas-fir, and is bounded on the west by the Coast Mountains. The central portion of the TSA, both east and west of the Fraser River, has mixed species forests, primarily leading in Douglas fir and lodgepole pine, interspersed with open range. To the east of the Fraser River, the rolling plateau gently increases in elevation to meet the Cariboo Mountains and Quesnel Highlands where forests of spruce, pine, western red cedar, western hemlock and sub-alpine fir predominate.

There are forty-three biogeoclimatic subzones/variants in the TSA. The dominant tree species in the TSA are lodgepole pine (about 63% of the volume in the THLB) and Douglas fir (15%). Other tree species present include spruce, subalpine fir (balsam), western red cedar and western hemlock. The Age-class distribution shows about 78% of the volume on the THLB in stands older than minimum harvestable age.⁴

There are ten First Nation communities in the TSA:

Scewepemc (Shuswap)

- Xats'ull (Soda Creek)
- Satl'tem/Stwecem'c (Dog Creek/Canoe Creek)
- Esketmc First Nation (Alkali Lake)
- T'exelc (Williams Lake)

Tsilhqot'in (Chilcotin)

- Tl'esqox (Toosey)
- T'letinqox (Anahim)
- Yunesit'in (Stone)
- Xenigwet'in (Nemiah Valley)
- Tsi Del Del (Alexis Creek)

Southern Carrier Community

- Ulkatcho

⁴ From Tanz, Jordan. Growth and Yield Issues Related to TSR (Cariboo Forest Region). February, 2002. Page 15. From the same report, 13% of the THLB is considered to be existing managed forest (younger than 34 yr. in the main TSA, younger than 20 in the western supply blocks).

Additionally, twelve First Nations assert traditional territorial interests in the area but do not reside in the TSA:

- Scewepemc (Shuswap)
 - Tsq’escen (Canim Lake)
 - High Bar
 - Whispering Pines/Clinton
- Tsilhqot’in (Chilcotin)
- ’Esdilagh (Alexandria)
- Southern Carrier Community
 - Lheidli T’enneh
 - Lhtako (Red Bluff)
 - Nazko
 - Lhoosk’ux Dene (Kluskus Band)
- Stl’atl’imx (Lillooet)
 - Ts’kw’aylaxw (Pavilion)
- Coast Salish
 - Homalco
 - Nuxalk
- Kwakiutl
 - Da’naxda’xw/Awaetlala

2.2 Forest Cover Inventory History

Projects that resulted in the current Forest Cover Inventory in the Williams Lake TSA were undertaken in four Public Sustained Yield Units (PSYUs) that comprised the TSA. Table 2 provides a record of this history.

Table 2: Inventories completed in the Williams Lake TSA⁵

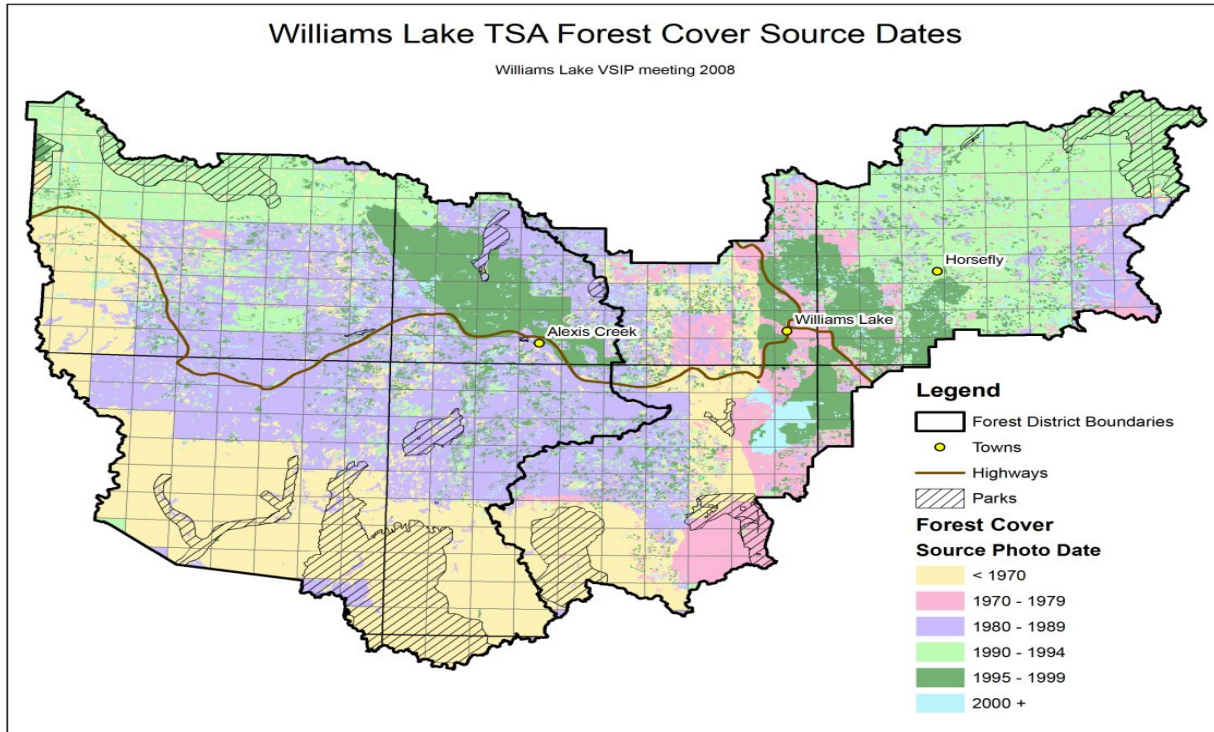
Unit Name	Type of Inventory ⁶	Inventory Date
Chilko PSYU	Reinventory	1966
Chilko PSYU	Reinventory (4 projects)	1988/89 and 1990/92
Stum PSYU	Reinventory	1963, 1966
Stum PSYU	Reinventory	1979
Stum PSYU	Reinventory	1980
Stum PSYU	Reinventory (5 projects)	1988/89 and 1994/95
Quesnel Lake PSYU	Reinventory	1971
Quesnel Lake PSYU	Reinventory	1989/90 and 1991
Williams Lake PSYU	Reinventory	1973

⁵ Most details for this table come from a similar table in: J.S. Thrower & Associates. Williams Lake TSA Vegetation Resource Inventory Ground Sampling Plan Final Report Addendum. Page 4.

⁶ The old PSYU Inventory was called a Unit Survey, not a Reinventory. All of the attributes collected were mid-pointed range values i.e. age class, height class. Anything from approximately 1987 to 1996 was a Reinventory with more refined attributes. Personal Communication, Jim Grace, February 20, 2008.

Williams Lake TSA (less Lignum IFPA)	VRI Phase 11 and NVAF	1998-2002
Lignum IFPA	VRI Phase I, II and NVAF	1997-2002

Figure 2



The FIP inventory was rolled over to the VRI format. It is important to understand that in this rollover process, the inventory does not contain VRI attributes that were not part of the FIP files i.e. ecological attributes and additional timber and wildlife attributes.

The most current disturbance update of the VRI files for the Williams Lake TSA is August 2004.

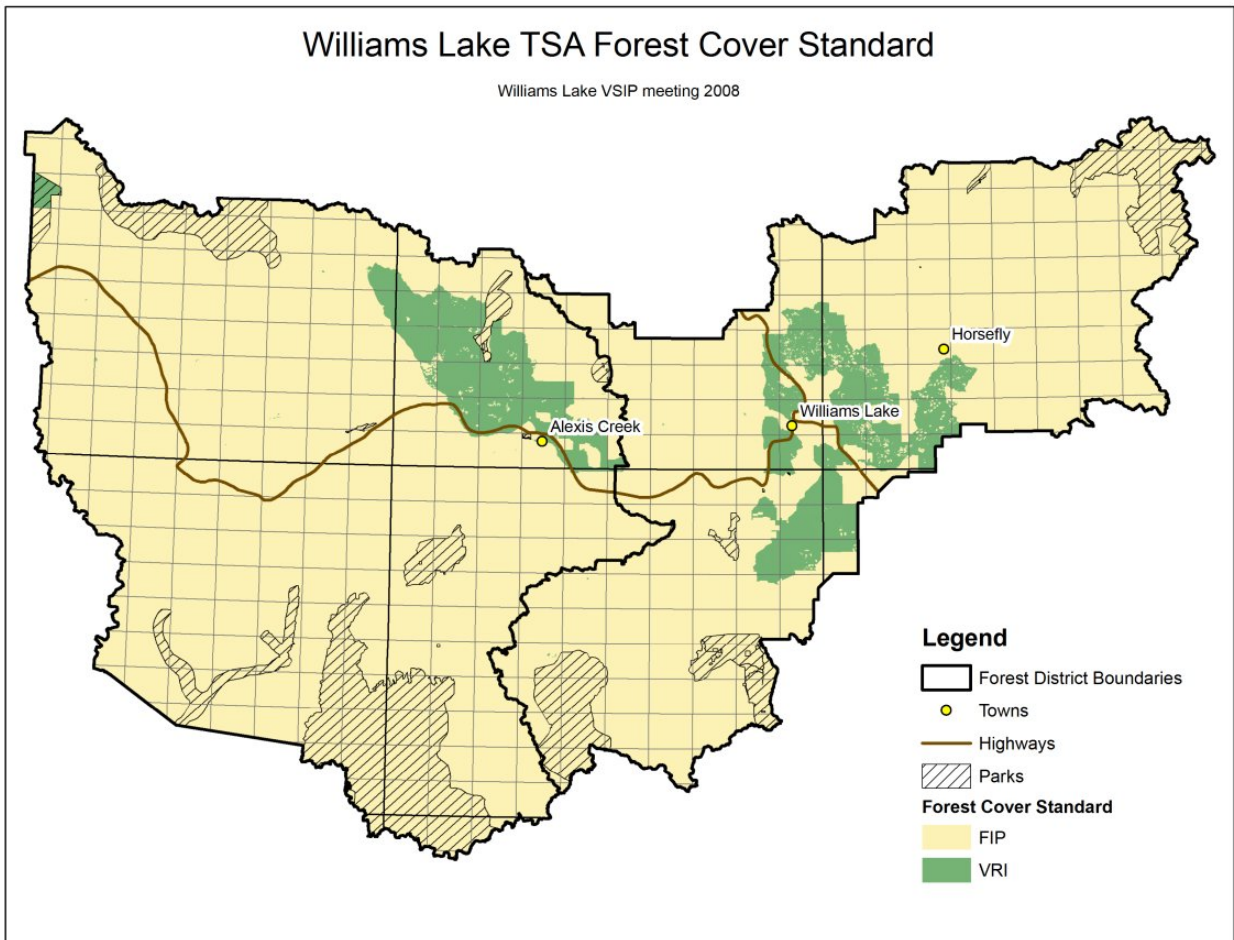
In the late 1990s, Lignum managed an Innovative Forest Practices Agreement (IFPA) that was part of both Williams Lake and 100 Mile House TSAs. (This IFPA has since been assumed by Tolko Industries Ltd.) A large amount of inventory work was funded in the IFPA using Forest Renewal BC (FRBC) dollars. This included VRI Phase II ground sampling followed by a Phase I photo interpretation inventory all completed following the RISC Procedures and Standards. The IFPA in Williams Lake TSA was comprised of two blocks, one in the central area and another in the west⁷. According to the MFR requirements, the work was completed to the IFPA boundary and not by full mapsheets. The

⁷ In the April 18, 2007 Rationale for AAC determination, the IFPA in this TSA was estimated to be approximately 10% of the inventory. p.13

Phase I work as submitted to the MFR is part of the currently available forest cover maps for the TSA.

On page 13 of the 2007 Timber Supply Review Rationale it is noted that volume adjustments were determined separately for the IFPA area and for the remaining 90% of the inventory. For the 'FC1' area, new volume adjustment methods were used whereas because the IFPA area was compiled when the VRI Phase I and II standards were applied, the new compilation methods were not used in the analysis.⁸

Figure 3 – Williams Lake TSA including IFPA area



2.3 Inventory Audit

A significant inventory initiative that occurred in most managed tenures in British Columbia between 1992 and 1999 was the Inventory Audit program. The inventory audit methodology was developed to provide a statistical description of

⁸ These facts were added as part of the consideration of the challenges of having an inconsistent inventory in a management unit for TSR.

the forest inventory's volume. To achieve this goal, statistical analysis techniques examined the accuracy of forest polygon attributes and the total standing volume in a timber supply area.⁹

An inventory audit was undertaken in the Williams Lake TSA in 1995. In the audit process, a random sample of 50 forested polygons from the total forested area in the management unit was selected for sampling. In the Williams Lake TSA, the analysis of the initial effort showed a large sampling error associated with the mature component of the sample (stands over 60 years). As a result, an additional 74 mature polygons were sampled in 1997 to ensure that the variability of the volumes estimates was within an acceptable level.

Based on the analysis of the data for the 124 samples, in stands greater than 60 years of age on the operable land base, the inventory volume appeared to be overestimated. The mean audit volume was 145 cubic metres per hectare while the mean inventory volume was 167 cubic metres per hectare. The difference of 22 cubic metres per hectare between the two estimates was statistically significant 19 times out of 20. Further study concluded that the bias in the inventory volume was almost equally associated with the VDYP model and the inventory classification attributes.

In the immature component of the inventory, the audit results suggested that the site index may be underestimated in young stands.

The Inventory Audit Report referenced some of the following Provincial inventory initiatives that followed in the late 1990s and into the next decade in this TSA:

1. A VRI Phase II ground sampling and NVAF program in the Williams Lake TSA over the period 1998 to 2002.
2. Provincial site productivity work – the Old Growth Site Index (OGSI) project.
3. The Cariboo-wide Predictive Ecosystem Mapping (PEM) project which has included Williams Lake TSA (2004-2008) with follow up SIBEC sampling initiated in the TSA in the 2006 field season.

2.4 WL TSA VRI and Analysis of the VRI ground sampling data, 2003

A summary of the VRI work undertaken in the Williams Lake TSA (excluding the Lignum IFPA) including the landbase sampled and a complete analysis are provided in the statistical adjustment report completed by Jahraus & Associates Consulting Inc.¹⁰ Over 3 field seasons, 1998 to 2001, 333 ground samples were

⁹ Resource Inventory Branch, Inventory Audit Sampling Standards & Procedures 1998.

http://www.for.gov.bc.ca/hts/vri/audits/audit_manuals/auditsp.pdf

¹⁰ Available on the Ministry of Forests & Range, Forest Analysis & Inventory Branch website, VRI reports & publications:

http://www.for.gov.bc.ca/hts/vri/reports&pub/tsa_analysis/williamslaketsa_vri_adjustment.pdf

established in the TSA. In 2001 and 2002, 136 trees were destructively sampled following the NVAF procedures. While this report was not followed up with an adjustment of the inventory files for the Williams Lake TSA, it is important for its analysis of the trends in the inventory based on the VRI ground sampling. It is outside the scope of this plan to outline all of the conclusions. Overall, the study suggests volumes are underestimated by about 14% in the Vegetated Treed population greater than 30 years of age. The volume underestimation was consistent across all strata with the exception of insect-attacked lodgepole pine in the IDF and SBPS Biogeoclimatic zones (BGC) and deciduous (Cottonwood(Act)/Trembling Aspen (At)) samples where volume is overestimated.

In the past, a pre-inventory assessment (PIA) was often conducted by Forest Inventory staff, analyzing relevant data to determine the requirement of a new forest cover inventory. In this era, the conflicting results from the audit analysis and from the VRI ground sampling would have been a significant discrepancy worthy of investigation. However at this point in time, while it is interesting to ponder this difference, the mountain pine beetle has changed the forest cover and removed any uncertainty of the requirement for a new inventory in this TSA.

A large amount of ground sampling and NVAF destructive sampling occurred during the initial Williams Lake VRI project. During the preparation of the Phase II VPIP, an analysis of the utility of any of the previous sampling should occur. The ground sampling was polygon-based on the current inventory delineation, and was post stratified, so its incorporation may be complicated. But the NVAF samples, stratified by species, may have potential.

2.5 Site productivity

Another significant inventory initiative referenced in the 2003 Timber Supply Review¹¹ was the MFR-lead Old Growth Site Index project that occurred across the province including in this TSA. This work verified the growing belief that actual site indices (SI) may be higher than those indicated using existing data based on mature stands.

In 2000, a committee self-named as the Cariboo Site Productivity Working Group (CSPA WG) investigated undertaking a site index project in the former Cariboo Forest Region. The project that developed was designed to create an ecosystem map that would create a spatial link to site productivity. Potentially, this would allow the Chief Forester to consider site index estimates other than those existing in the forest cover inventory. Under this FRBC and Forest Investment Account funded project a methodology evolved through a true 'pilot' project that has proved to be both accurate (by operational inventory standards) and cost effective. The Predictive Ecosystem Mapping project in the Cariboos will deliver

¹¹ From Pedersen, Larry. WL TSA Rationale for AAA Determination. January 1, 2003. p19&20.

a data base for 8.2 million hectares including the Williams Lake TSA to the clients in the spring of 2008. This project has achieved an overall accuracy of 65% which is the standard required for its use in the base case for timber supply analysis.¹² The link to site index in WL TSA will be SIBEC, the MFR Research Branch's correlation of BEC site factor information with site index.

These studies were based on the premise that Province-wide, productivity has a trend to be under-estimated for the majority of sites occupied by old growth stands. With the transition occurring in the forest of the Cariboos, this ability to assess the potential of forest sites for future growth will be important in setting priorities for forest management activities.

2.6 Forest Management and Inventory Issues

At the Stakeholders' meeting there was a discussion about the TSA's issues and how the VRI might help to address them. A set of issues identified in provincial VRI planning processes and local timber supply reviews and inventory planning exercises was provided for review. Table 3 records the ones identified as relevant to this TSA. It also provides an assessment of the effectiveness of the VRI activities.

Table 3: Forest Management and Inventory Issues

	Issue	VRI Effectiveness		Remarks
		Photo-Interpreted Estimates	Ground Sampling	
1.	Mountain Pine Beetle Currently lodgepole pine leading stands, both pure and mixed with other species, represent approximately 63 percent of the TSA's timber harvesting land base. There needs to be more information about existing structure.	Low	Moderate - High	New photo interpreted Estimates (Phase I) are not useful in management of MPB issues. New Phase I will be useful using photos flown after the infestation is finished. Ground Sampling (Phase 2) can give good information about current attributes and volumes of MPB stands across the TSA.
2.	'Snapshot' estimate of current volumes for managed stands. <ul style="list-style-type: none"> Concern that the current inventory does not present the existing volume accurately. Concern that stand degradation in PI and possibly other insect-infested stands is continuing. 	Moderate	High	Important to use photos that show post-beetle forest. New Phase I can provide more accurate attributes for VDYP to use in deriving volumes. Ground Sampling will provide good data on actual volumes at the strata level but possibly not at the polygon level. The data can be used to adjust the database.
3.	Mid-term wood supply -key issue to get information on this part of the forest in this TSA	Low to Moderate	High	Identify strata that define this part of the population. Make this a priority in the ground sampling.
4.	Volume of dead wood. -Changes in Interior log grades require that the Chief Forester consider dead wood volumes in	Low	High	To date the Chief Forester has used the inventory audit on other TSAs. Currently Phase I does not capture dead tree

¹² Meidinger, D.V. Protocol for accuracy assessment of ecosystem maps. 2003. BC Min of Forests Research Branch publication. Tech. Rep. 011. page 19

	Issue	VRI Effectiveness		Remarks
		Photo-Interpreted Estimates	Ground Sampling	
	TSR determinations. -Licensees may want to capture dead wood attributes in the inventory.			attributes in the inventory. This may have to be considered in MPB TSAs. Ground Sampling & NVAF would be effective to provide good information on dead potential volumes.
5.	Uneven-aged management (Douglas Fir) <ul style="list-style-type: none"> - Importance of this portion of the forest has escalated as it is seen to be a primary source of Mid-term timber supply. - Variable nature of IDF polygons is an issue. 	Moderate	Moderate	Phase I – New VRI procedures have potential to provide data on multi-layered stands. Phase II data can be used to help check the volumes assigned i.e. in the IDF. If MFR develops new protocol for additional auxiliary plots in the IDF samples, this TSA would incorporate this into the Phase II project.
6.	Mortality in immature stands. Timber Supply group is interested in the amount of MPB activity in stands less than 60 years old.	Low	Moderate	Ground Sampling can target a strata with age classes 31 to 60 years to collect data. A Monitoring project could also target this population to provide data at establishment and at intervals. To date, FFT has targeted stands up to 30 years of age.
7.	Additional data on understory is desirable (i.e. poles, saplings) to identify potential for mid term wood supply.	Low	High	Ground sampling can provide data on the understory. An investigation of Dave Coates' paper (Research Branch) may result in changes including adding several additional classes in the 'small tree plot' and size of plot (see Lakes TSA VRI plans). Phase I options – Important to have photos flown when forest is 'grey' to show some of understory. Also may be able to use digital large scale photography to help capture understory data.
8.	Stakeholders have identified issues with the following inventory attributes: <ul style="list-style-type: none"> • Species composition in mixed stands • In SBS – Fd-PI composition 	Moderate	NA	Phase 1 may improve individual polygon values and reduce errors in attributes.
9.	'Growth rates' Site index in both managed and unmanaged stands:: <ul style="list-style-type: none"> - Better estimates in immature stands. - Concern that current site index may underestimate growth rates - Site Index adjustments for species other than PI 	Moderate	High	VRI does provided data on attributes that affect site index i.e. age & height. Phase I can provide better estimates of height for use in determining Site index. Ground Sampling can provide good data for Site Index based on current stands. Monitoring can provide data, over time. Target populations i.e. managed stands can become stratum in either a Phase II or Monitoring project.
10.	Decay, waste, and breakage	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. Chief Forester mentioned in past TSR Rationale the need to improve net volume data in cedar and hemlock. Breakage is not part of the VRI system.
11.	Landscape-level biodiversity - Concern in retention of structure in stands	Moderate	Moderate	Photo interpretation can provide more detailed information on non-forest attributes.

	Issue	VRI Effectiveness		Remarks
		Photo-Interpreted Estimates	Ground Sampling	
				Ground Sampling can provide data on Coarse Woody Debris, Forest Succession and ecology.
12.	Ungulate Winter Range, Wildlife management areas	Moderate	Low	Phase I can provide more detailed information on non-forest attributes.
13.	Implications of managing for species at risk i.e. caribou -VRI attributes are important here	Moderate	Low to Moderate	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. Both Phase I and Phase II may improve forest cover attributes to provide support for this issue.

In summary, the Stakeholder group determined that the following issues were of concern:

- Uncertainty regarding the potential mid-term timber supply
- Insufficient information about current attributes and volumes of non-pine mature and immature stands in the TSA.
- Insufficient data on understory of Mountain Pine Beetle affected stands.
- Better estimates of species composition in mixed coniferous stands
- Uneven-aged (dry belt Douglas fir) management issues: top height and age measurements (which are almost meaningless attributes in these complex stands); potential incorrect volumes; inaccurate estimates of wildlife-related attributes i.e. crown closure
- Decay, waste and breakage factors for spruce-balsam stands, cedar-hemlock stands and sub alpine fir stands
- Green-up age estimation
- Uncertainty in regenerated stand volumes
- Riparian habitat areas
- Wildlife habitat area delineation
- Provincial and TSA monitoring of the indicators of sustainable forest management. This involves measuring changes and trends in some of these indicators which included percent and extent of area by forest type and age class, mean annual increment by forest type and age class.
- Lack of data in immature coniferous polygons, (stands 31 to 60 years of age. Either VRI ground sampling or Monitoring could target this stratum to collect data to provide Timber Supply with information on wood available in the mid to long term.
- Information on dead wood volume. Shelf life data that has been collected through other projects should be analysed and a model developed to apply locally.

2.7 VRI Activities and Products

2.7.1 VRI Photo Interpretation (Phase 1)

Current 2005/06 1:20K photos that cover the William Lake TSA are not adequate for VRI purposes. The preset model data (photography) is of poor quality and the MPB was not finished when it was acquired. Once new photos are acquired in the required format, Phase I including the delineation of new polygons and the estimation of new attributes would take 2 to 3 years to complete.

There are several major differences between the standards of some of the previous inventories in this TSA and the VRI standards that are now in place.

A discrete value for height and age is required rather than a class that was used in inventory data collection prior to 1988 (e.g. Height Class 2 = 10.5m - 19.4m). Differences in height of 2-3 metres now require a new polygon.

Equal emphasis is placed on stands of all ages and species. The older inventories tended to be biased toward mature timber and the commercial species of the time.

In the areas with Unit Surveys, delineation should improve with a new inventory. The old inventory's linework is based on the Kail plotting to NTS map bases. The linework has since been spliced into the BCGS sheets, hand digitized and then rubber sheeted onto the TRIM base.

The delineation and attribute collection on non-treed types is part of the VRI photo interpretation. There is greater attention paid to these types and the delineation is much finer. There are no more large polygons with an Alpine label. A polygon like this could be broken up into: bedrock, snow cover, shrub tall, shrub low, herbs, avalanche chutes, talus, etc.

The VRI collects attributes that were not collected in the previous inventory, including:

- Timber: 2nd species, age and height, density, basal area, vertical complexity, tree cover pattern.
- Ecology: site position meso, modifying process, surface expression, SMR, SNR.
- Non treed types: Percentage cover for herbs, shrubs and non-vegetated types.

VRI does not collect 'cultural' attributes – NPBR, NCBR, Alpine Forest, NP, Rock, Open Range, Swamp, NSR, etc. The photo interpreters now estimate what they see rather than making a 'cultural judgement' about the value. For

example, Open Range might have a graminoid label with low tree Crown Closure (cc).

2.7.2 VRI Ground Sampling (Phase II)

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

Prior to undertaking a Phase II Ground Sampling program, there are three areas where initial decisions that must be made by the Stakeholders.

1. 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”:¹³ Optional plot types in Phase 2 VRI sampling include:
 - O - Full VRI – includes timber and ecology data¹⁴ collection. Coarse Woody Debris (CWD) and Succession are included as part of the ecological data.
 - Q - Timber Emphasis – tree information only is collected.
 - D - Timber Emphasis plus Coarse woody debris data.
 - T – Timber Emphasis plus Succession information.
 - Z – Timber Emphasis with Site Series
3. Net Volume Adjustment Factor 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.

Net Volume Adjustment Factor sampling requires these actions:

- Step 1 – Based on the sample list developed for ground sampling, prior to fieldwork, a sub-set of the ground samples is selected to ‘enhance’

¹³ A complete listing can be found on page 30 of the VRI Ground Sampling Procedures.

¹⁴ At this time, with the investment by the WLTA licensees in the ecologically-based PEM inventory recently completed, the local Stakeholders are of the opinion that it is unlikely that any ecology data collection will be part of the WLTA Phase II ground sampling program.

to provide the population from which a tree list is developed for the NVAF destructive sampling.¹⁵

- Step 2 - Sample trees are selected from this sub-set of the ground samples using the following considerations: age-class, strata, diameter and geographic distribution.
- Step 3 – The sample trees selected in Step 2 are felled and sectioned to measure actual net volume according to the NVAF protocol.

When the Project Implementation Plan for the Phase II Ground Sampling and NVAF is being written, the following additional work should be investigated with the Stakeholders based on their requirement to obtain data regarding merchantability:

1. Shelf life attributes data collection.
2. Estimation of the VRI and/or Interior log grades by the NVAF sampler for the felled tree.
3. Measurement of unmerchantable sound wood by the NVAF sampler using scaling conventions to determine the volume of sawable wood for each sample tree.
4. A scale of each sample tree by a licensed scaler.

On this TSA, with the likelihood that Phase I will be the first step in a new VRI, it is recommended that the preparation of the VPIP for Ground Sampling and NVAF be delayed until the photo interpretation activity is nearly complete. At that time, an additional Stakeholders' meeting would be advisable to review the Phase II activities and to provide focus to the operational plan for ground sampling.

2.8 Follow up Activities

2.8.1 Ground Sampling Analysis and Inventory Attribute Adjustment

The inventory will be adjusted to the current MFR standards for the following attributes:

- Height
- Age
- Stems/hectare
- Basal Area (BA)
- Volume at 5 different utilization levels

The findings of the NVAF work will be incorporated into this adjustment. Ideally the data collected will be of a large enough sampling size to reach decisions by species or species group. As suggested in Section 2.4, the

¹⁵ The selection of the NVAF samples and the trees to be destructively sampled is made in an unbiased manner according to the NVAF Standards.

Provincial Volume and Decay officer may want to examine the NVAF data collected during the original VRI project in the TSA for its value in adding it to the database.

In addition to the standard procedures' analysis, analysis should be completed related to any additional data collected. For 'tree data' this could include dead tree volume, interior log grading and the scaling procedure on the NVAF. It should be noted that cost recovery would be at the licensee's expense for both the data collection and compilation for any supplementary data collected beyond the VRI 'standard' procedures,

2.8.2 Monitoring

Many TFLs and some TSAs have undertaken long term monitoring projects based on various identified business needs. The focus of monitoring projects is to answer questions about uncertainty in forest management issues. These projects create the opportunity to monitor changes and trends of the timber and non-timber resources over time.

Many ongoing projects have established plots in Post-Harvest Regenerated (PHR) stands. Their primary objective is to assess whether these stands are growing as predicted, and whether they will produce volumes according to existing models. A secondary objective is to monitor the site index of these stands.

To conduct an effective monitoring program for a management unit, decisions for the project must be clearly defined including:

- What is to be monitored?
- Why is it being monitored?
- What is going to be done with the data?

During the VRI planning process, the Stakeholders may choose to delay a decision on developing a monitoring program. A plan can be incorporated at the Project Implementation stage or later through an amendment to the VPIP.

3 Inventory Plan

3.1 Overview

Over the last 3 decades in the Williams Lake TSA, the approach to the inventory has resulted in a meshing of numerous initiatives on this large land base. The MPB epidemic has created an opportunity to develop a consistent standardized inventory across the TSA.

This section takes the theoretical discussions on the Vegetation Resources Inventory outlined in Sections 1.2, 2.6 and 2.7 and provides direction to a VRI project.

3.2 Phase I - Photo Interpretation

At the Stakeholders' meeting the consensus was that the changed forest cover in the Williams Lake TSA due to insect attack has created a need for a new forest cover inventory, starting with Phase I photo interpretation.

The most current photos for most of this TSA are from 2005-2006. Using this photography in its softcopy (digital) format would affect the quality of a Vegetation Resources Inventory. Among the issues of concern are:

- 1) The 2005 preset data coverage is felt to be of very poor quality.¹⁶
- 2) There are gaps in the most recent photo coverage.
- 3) Normally, MFR Inventory Branch considers a 5 year life span an appropriate time frame for photography to be used for VRI. If the project is not started very soon, the project will be beyond this timeframe.
- 4) The Inventory Branch maintains that new VRI initiatives must be delayed until the beetle has fully run its course. The Regional Entomologist, Leo Rankin has indicated that the MPB was still active in 2007¹⁷. It is questionable whether these photos capture the post-beetle forest cover.

The resource requirements in undertaking a Phase I project are sizeable. Both funds (through a portion of the provincial allocation from the Forest Investment Account inventory fund) and qualified interpreters are limited. Due to these resource limitations, the Stakeholders have proposed a 'phased approach' to undertake the Williams Lake VRI. Based on the MPB activity pattern, the project area has been divided into the three blocks illustrated in Figure 4. The Mountain Pine Beetle infestation on the east side of the Fraser River has collapsed and photos could be flown as soon as the 2008 field season. West of the Fraser River, the beetle's activity is diminishing, progressing from north to south. Starting photo acquisition activity here in 2009 would be more appropriate.

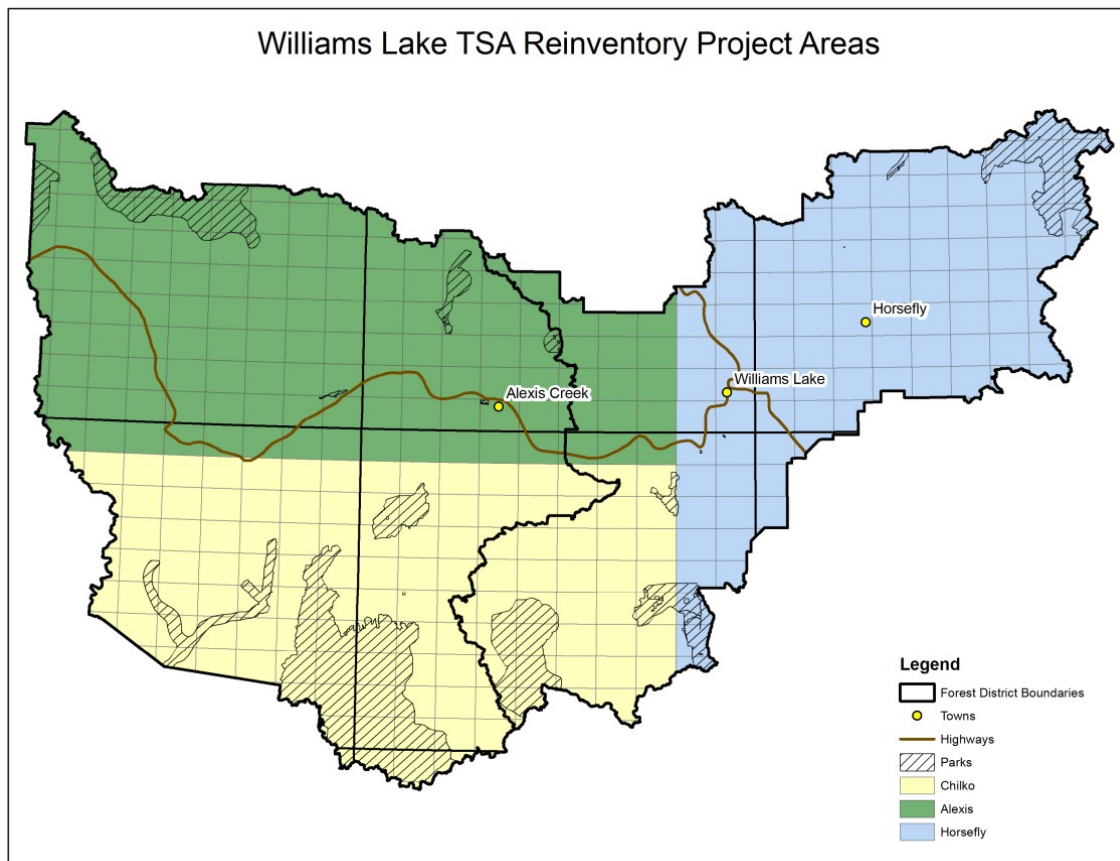
Table 4: Approximate VRI Project Block breakdown

Project	Chilko	Horsefly	Alexis
Total Area	1,754,028	1,338,085	1,841,550
Maps	130	114	141
Full map equivalents	114.6	87.5	120.4

¹⁶ Jim Grace, Personal communication, Stakeholders' Meeting. January 29, 2008

¹⁷ Leo Rankin, Personal communication, Stakeholders' Meeting presentation. January 29, 2008

Figure 4 – Williams Lake TSA – Proposed VRI project blocks



The flying will cover the entire TSA. The area of the photo interpreted inventory will be finalized in the VPIP for Phase I¹⁸. Discussion has focused on delineating much of the TSA, including the Lignum IFPA¹⁹. Due to their contribution to non-timber values, Parks will be assessed on an individual basis for Phase I. The following areas will definitely be excluded:

- Large tracts of Private Land
- The Esketemic Community Forest (new Phase I VRI completed 2007)
- Woodlots with recent VRI
- Community Forests (Tatla, Likely and Williams Lake) if they are pursuing their own inventory projects under a separate FIA-funded allocation

Field work including Phase I ground calls and Phase II Ground sampling will be confined to the Vegetated Treed polygons outside of private land or Parks.

¹⁸ The exclusions are based on preliminary input from the Stakeholders. The landbase for the Phase I work (including Federal land) will be reassessed and finalized in the VPIP.

¹⁹ Although the IFPA has a more recent VRI (see Section 2.2), the forest cover has also been changed by the MPB epidemic.

The trend in photo interpretation is softcopy technology. Softcopy refers to the project being done using digital air photos, on a computer screen. After the TSA is flown, the scanning of the photos, aerial triangulation and digital model building will occur before the project begins.

Subject to continuous funding, once the photos are available, two to three years are required to complete a new Phase I.

Based on expected timelines, the delineation could be bid out and started in the same fiscal year in which the new photos are flown and produced. A decision on average polygon size or the desired number of polygons per mapsheet would be part of the Request for Proposal (RFP) to qualified contractors.

Fieldwork would follow in the next field season. The fieldwork is a mixture of ground and air calibration points completed throughout the project area. The goal is to improve the ability of the contractor to interpret the photos in the office by providing reference points with field measurements. The amount of fieldwork completed would be specified in the RFP and is determined by the forest management and inventory issues identified and approved funding levels.

Attribute estimation follows the fieldwork.

At the Stakeholders' meeting, the addition of large format digital or conventional (LSP) photography to the project was discussed with regard to its ability to assist with field data collection. Large format photography has a variety of uses, from accessing remote or inaccessible areas to providing measurements or details of understory or brush conditions, heights, density, number of snags, etc. It creates the opportunity to collect a large amount of data in a short time frame and have it available to revisit at any time without having to go back to the field. Its overall costs may be cheaper than any similar ground field visitation program. The VPIP will include an assessment and decision regarding adding this tool to the Williams Lake Phase I project.

3.3 Phase II Ground Sampling

In the Vegetation Resources Inventory for Williams Lake TSA, a Phase II ground sampling program, including NVAF will occur when the photo interpretation is completed. The Phase I polygons are required to prepare the Phase II sample lists. The ground sampling will provide information on the quality of the photo interpreted inventory and ratios to be used to adjust the inventory.

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 in a project.

3.3.2 Target Population

The target population selected for sampling in other TSA's is often the Vegetated Treed²⁰ landbase greater than 30 years of age.

3.3.3 Sample Size

The number of samples required to achieve the sampling error standard is a function of the variation of net volume with the inventory unit, estimated by the coefficient of variation (CV). Typically, 100 samples are required for a management unit.

Following the current RISC standard 'Guidelines for the Preparation of a Project Implementation Plan for Ground Sampling and NVAF Sampling' to derive an estimate of the coefficient of variation, the standard recommends using the CV from the Inventory Audit, increased by an additional 10% to account for differences in the sampling methodology. For Williams Lake TSA, 65%²¹ was the CV estimated from the Inventory Audit data used to achieve a sampling error of $\pm 10\%$ for net volume. According to the VRI Standard, between 145 and 170 samples would be required to achieve this target.

This sample size will need to be reviewed at the time of preparing the VPIP for the Phase II work. The forest that the Audit program assessed has changed due to the Mountain Pine Beetle and the CV could be different for the new inventory. During this review, the Stakeholders may also want to consider the experience of other post-MPB management units or choose to complete a preliminary study to determine the sample size.

3.3.4 Sample Selection

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

Unlike the practice in the previous VRI project in the Williams Lake TSA where the samples were post-stratified, the population will be pre-stratified. Identification of the strata will be discussed and confirmed during the writing

²⁰ B.C. Land Cover Classification Scheme

²¹ Ministry of Forests Resources Inventory Branch. Williams Lake TSA VRI Strategic Inventory Plan. Updated to February 1, 1999. p.13

of the ground sampling VPIP. It is recommended that this decision-making considers following the lead of other VRI planning tables. Commonly, the strata are based on species or species groupings that are significant in terms of the population and the Stakeholder's identified interests.

In an effort to simplify the analysis process, consideration should be given to weighting the strata based on their occurrence in the landbase.

An additional issue to consider is that from a statistical viewpoint, a stratum must be of sufficient size to derive adequate sample numbers to allow discussion and conclusions by individual stratum, in the analysis. This is generally understood to be a minimum of 15 samples in a stratum.²² Otherwise, the analysis conclusions will be more general and therefore may not provide species-specific answers that may have been amongst the project's objectives.

3.3.5 Net Volume Adjustment Factor Sampling

The current NVAF sampling standard is the destructive sampling of 100 trees, 90 live and 10 dead.

NVAF sample trees can be used to create statistical adjustments of loss factors and taper equations. The Southern Interior Forest Region and Forest Analysis & Inventory Branch Volume & Decay staff will provide guidance during the VRI planning process to ensure appropriate decisions are made regarding sampling strata, sample size and the live/dead ratio in this TSA. Analysis of the utility of the previous NVAF sampling in the TSA (as referenced in Section 2.4) would be finalized at this stage. The Planning and Sampling Contractors representing the Licensees will work with the MFR to develop the NVAF ground sampling plan for the TSA.

It is premature to consider the additions to the NVAF destructive sampling work referenced in Section 2.7.2 that might provide localized shelf life and merchantability data. Discussion of these activities will occur at the Project Implementation Planning stage and if required, the Stakeholders will seek a variance to the Standard.

Finally, in regard to the NVAF data collection, on page 13 of the 2007 AAC Rationale, the Chief Forester noted that Cedar and Hemlock are 'currently being examined and improvements in net volume will be available for future determinations'. While he does not state what studies he is referring to, certainly the VRI NVAF with Cedar and Hemlock species stratum could provide this data if the stratum are of sufficient size²³.

²² Personal communication, MFR statistician, Sam Otukol.

²³ This number will need to be confirmed with the Provincial Volume & Decay Officer when the VPIP is being written.

3.3.6 Monitoring Plots

Monitoring can provide data to fill information gaps over the long term. In developing a monitoring program, it is important to have identified long-term objectives. If there is a desire to establish a monitoring program in the short-term, the plots can be gridded across the landbase using the VRI 100 m. grids, independent of the delineation of the landbase.

At the Stakeholders meeting, the discussion did not resolve whether there is an interest in undertaking a monitoring project in the initial planning cycle and no objectives were identified. The usual concerns were expressed: no guarantee of available funding at the time of remeasurement; and the desire of participants to utilize existing plots from other projects as monitoring plots. Regarding current plots that exist, they could be investigated before abandoning their potential for utility, although it is unlikely that these projects followed the VRI monitoring requirement of a random sampling location.

Monitoring can be further discussed at the Project Implementation Planning stage.

3.3.7 Implementation

During the Stakeholders' meeting the following were recognized as factors affecting implementation:

1. Acquisition of new photography
2. Timing to start a new VRI based on the MPB and other insect infestations, to capture the best foundation for a Phase I project.
3. Requirement to complete the project in blocks based on the beetle, available funding and certified VRI contracting staff constraints.
(See Section 3.2)

In regard to implementation, the local Stakeholders are concerned about obtaining better information regarding the existing forest inventory prior to the next TSR (scheduled for 2011). Realistically, only the eastern side of the TSA (the 'Horsefly' block) could meet this timeline provided the project has available funding, good planning and project management to ensure this delivery.

A ground sampling program could be completed in a 2 year time frame, dependent on availability of funding and certified crews. One option that was suggested at the Stakeholders' meeting was that the Phase II sampling could be undertaken in the East when the Phase I is completed i.e. 70 samples in east. The Phase I could continue in the western blocks while sampling occurs in the east. A separate Phase II VPIP for the east and west might be considered, following the completion of the respective Phase I.

The alternative would be to conduct all of the ground sampling following the entire Phase I project for the TSA.

This initial discussion will need to be developed in the TSA's Project Implementation Plans.

3.4 VPIP Project Implementation Plans

The next step in the planning process for the Williams Lake TSA is to develop the Project Implementation Plans for Phase I and/or Phase II, based on the VRI work decided in this VSIP. As stated in Section 1.4, a unique Project Implementation Plan is required for each Phase of the VRI project prescribed. The VPIP will finalize and document details, following further recommendations and direction provided by the Stakeholders. Section 2.7.2 recommends that the VPIP for Phase II be written once the Phase I is near completion, so that it is relevant for an operational ground sampling project. Section 3.3.2 suggests considering a separate Phase II VPIP for the TSA east and west of the Fraser River.

3.5 Roles and Responsibilities

The following is an outline of organizational roles and responsibilities in the development of a VRI project.

Licensees (including 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 specified VRI activity/project.
- Inform other Stakeholders of the planning process and involve them in the project i.e. MFR and other key government agencies.
- Submit Strategic and Project Implementation plans to the appropriate MFR Regional office staff for their support, review and sign off.
- Sign off final approved edition of project plan(s).
- 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 MFR/Provincial Data Warehouse (as appropriate).

MFR – Regional Office, Vegetation Resources Inventory Section

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

- Provide expertise to projects as they are ongoing.
- Facilitate the acceptance of the data as is appropriate.

MFR – Forest Analysis & Inventory Branch, Inventory Section

- Sign off final approved edition of project plan(s).

Stakeholder involvement is important to ensure that the plan is based on local knowledge and the project reflects local objectives and requirements. Documentation of opportunities for all Stakeholders to be involved in the planning process will be maintained on the project files that will be retained by the Lead Licensee and VRI Inventory staff in the Regional office. This includes the Stakeholder meeting agenda, record and presentations. All Stakeholders have also been provided with the opportunity to review editions of the draft Strategic Implementation Plan prior to sign off.

3.6 Costs

Table 5: Estimated sample sizes and costs for VRI Phase I and II activities

VRI Activity	Sample Size	Unit Cost	Total Cost
Photo Interpretation			
VPIP preparation			\$20,000
Contract Administration	4 years	\$10,000	\$40,000
Photo Acquisition Block 1 – Horsefly	87.5 mapsheet equivalents	\$4500	\$393,750
Block2-Alexis	120.4 mapsheet equivalents	\$4500	\$541,800
Block 3-Chilcotin	114.6 mapsheet equivalents	\$4500	\$515,700
VRI Interpretation	3,145,826 ²⁴	\$1.25	\$3,932,283
Quality Assurance	3,145,826	\$0.05	\$157,291.30
TOTAL PHASE I			\$5,600,824.30
Ground Sampling			
VPIP preparation			\$30,000
Contract admin.	2 years	\$10,000	\$20,000
Timber Emphasis plots - timber data collection	170	\$1500	\$255,000
Heli access-estimate			\$35,000
Mentoring & QA – TEP	20	\$1000	\$20,000
NVAF destructive sampling	100	\$700	\$70,000
Heli access-estimate			\$6,000
Mentoring & QA-NVAF			\$10,000
'interim analysis' - east			\$15,000
Final Compilation/analysis & inventory file adjustment			\$20,000
TOTAL PHASE II			\$481,000

²⁴ Based on the TSA area with deductions for areas not managed by the MFR i.e. Parks, woodlots, private

Table 6: Sample size & estimated funding breakdown for VRI Monitoring project

VRI Activity	Sample Size	Unit Cost	Total Cost
MONITORING			
Contract Admin – includes GIS work			\$8,000
Sample Establishment	25	\$2,500	\$62,500
Helicopter Access			\$5,000
Mentoring & QA – includes some heli			\$5,000
TOTAL MONITORING			\$80,500

Bibliography

1. British Columbia Ministry of Forests & Range, Timber Supply Branch. Williams Lake TSA - Rationale for Allowable Annual Cut (AAC) Determination – Jim Snetsinger, Chief Forester. April 18, 2007. Victoria, B.C.
2. British Columbia Ministry of Forests Timber Supply Branch. Williams Lake Timber Supply Area Analysis Report. September, 2004. Victoria, B.C.
3. British Columbia Ministry of Forests & Range, Timber Supply Branch. Williams Lake TSA - Rationale for Allowable Annual Cut (AAC) Determination – Larry Pedersen, Chief Forester. January 1, 2003. Victoria, B.C.
4. British Columbia Ministry of Forests and Range Forest Analysis & Inventory Branch, VRI Section. VRI VSIP Williams Lake TSA Stakeholder Meeting – PowerPoint slides. January 29, 2008. Victoria, B.C.
5. J.S. Thrower & Associates Ltd. Williams Lake TSA Vegetation Resources Inventory Ground Sampling Plan - Executive Summary, June 9, 1997 and Final Report Addendum, October 20, 1997. Ministry of Forests Project MFI-401-033.
6. Jahraus & Associates Consulting Inc. Williams Lake TSA – Documentation of Analysis for Vegetation Resources Inventory Statistical Adjustment. March, 2003. Prepared for Riverside Forest Products Ltd.
7. K. David Coates, et al. May 26, 2006. Abundance of Secondary Structure in Lodgepole Pine Stands Affected by the Mountain Pine Beetle. Bulkley Valley Centre for Natural Resource Research and Management.
8. Meidinger, D.V. Protocol for accuracy assessment of ecosystem maps. 2003. Res. Br., B.C. Min. For., Victoria, B.C. Tech. Rep. 011.
9. Ministry of Forests. Williams Lake TSA Vegetation Resources Strategic Inventory Plan. Updated to February 1, 1999.
10. Ministry of Forests, Resources Inventory Branch. Williams Lake TSA Inventory Audit. June 29, 1998.
11. Ministry of Forests & Range website for VRI - http://www.for.gov.bc.ca/hts/vri/reports&pub/vri_vripub.html#top

12. Mulvihill, Chris. Draft VSIP Documents For Kootenay Lake and Invermere TSAs. June, 2006. British Columbia Ministry of Forests and Range Forest Analysis & Inventory Branch, Southern Interior Region.
13. Phillips, Nona. Vegetation Resources Inventory Strategic Inventory Plans for Lakes TSA, Robson Valley TSA and Revelstoke TSA. September 2006 to November, 2007.
14. Tanz, J.S. Growth & Yield issues related to TSR (Cariboo Forest Region). February, 2002. Cortex Consultants for the SIGY Co-op.
15. Timberline Forest Inventory Consultants. A User's Guide to the Vegetation Resources Inventory. March 31, 2005. FIA/ Tolko Industries Limited.
16. Various. Personal Communication with Stakeholders and MFR staff including John Stace-Smith, Shawn Meisner, Guy Burdikin, Chris Mulvihill, Matt Makar, Jim Grace, Will Smith, Gary Johansen and Laurence Bowdige regarding issues related to the preparing of this VSIP. Phase I cost details provided by Ken Blagborne, FDI Forest Dimensions Inc.

VRI Standards & Procedures

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

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

The following is a list of the critical Standards and Procedures for a VRI project:

Photo Interpretation

Vegetation Resources Inventory Guidelines for Preparing a Project Implementation Plan for Photo Interpretation, Version 2.1, June 2007

Vegetation Resources Inventory Photo Interpretation Procedures Version 2.4, March 2002

Vegetation Resources Inventory Photo Interpretation Standards and Quality Assurance Procedures, Version 3.0, April 2006

Vegetation Resources Inventory Air Call Data Collection Procedures and Standards, Version 2.1, June 2007

Vegetation Resources Inventory Ground Call Data Collection Procedures and Standards Version 3.1, June 2007

Ground Sampling:

Strategic Inventory Planning (VSIP), January 2005

Vegetation Resources Inventory Guidelines for Preparing a Project Implementation Plan for Ground Sampling and Net Volume Adjustment Factor Sampling Version 3.0, May 2007

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 4.7, July 2007

Vegetation Resources Inventory Ground Sampling Procedures Version 4.7
Addendum, July 2007

Ground Sampling Procedure Appendices Version 4.5, March 2004

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 4.2,
June 2007

Net Volume Adjustment Factor Sampling Standards and Procedures Version 4.2,
Addendum, April 2007

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 2.1, May 2007

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Appendix A

Attendance at Stakeholders' Meeting

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Stakeholders' Meeting
January 29, 2008, Tolko Industries Ltd. Boardroom, Williams Lake, B.C.

Meeting initiated and lead by Nona Phillips, Inventory Contractor

Participant	Affiliation
John Stace-Smith Shawn Meisner	Projects Forester, Tolko Industries Ltd. Planning Forester, Tolko Industries Ltd.
Guy Burdikin Mauro Calabrese	Silviculture Forester, West Fraser Mills Ltd., Williams Lake Division Planning Forester, West Fraser Mills Ltd., Williams Lake Division
Brenda Mann	Planning Forester, BC Timber Sales, Cariboo- Chilcotin Business Area
Gary Johansen	MFR, Planning, Forest Analysis & Inventory Branch, Victoria
Jim Grace Matt Makar	MFR, VRI Inventory-Phase I, Southern Interior Forest Region, Kamloops MFR, VRI Inventory-Phase II, Southern Interior Forest Region, Kamloops
Kevin Johnston	MFR, Stewardship, Southern Interior Forest Region, Kamloops
Ray Leduc & Kerri Howse	MFR, Stewardship Officers, Central Cariboo Forest District, Williams Lake
Doug Porter	MFR, Stewardship Auxiliary, Chilcotin Forest District, Alexis Creek
Guy Newsome Leo Rankin	MFR, Silviculture Practices Forester, Southern Interior Forest Region, Williams Lake MFR, Regional Entomologist, Southern Interior Interior Forest Region, Williams Lake
Mark McGirr	ILMB, GIS, Williams Lake
Joanne McLeod	MoE, A/Ecosystem Officer, Williams Lake
Mircea Rau	Planner, UBC Research Forest & Williams Lake Community Forest

Other Stakeholders invited but who could not attend:

John McCarvil – Business Manager, YKW

Wayne Murray – West Chilcotin Forest Products, Anahim Lake

Bob Osmachenko – Stewardship Office, MFR – Chilcotin District

Brian Lapointe – Esketmc Community Forest

MoE – John Youds was contacted. Becky Bings was named to be the MoE representative, but could not attend

Jeff Stone, Albert Nussbaum, Tim Bogle – MFR – Timber Supply Analysis group

Jeff is the local contact but could not attend. Albert Nussbaum was contacted for an alternate and Tim Bogle who has done the WL TSA TSR in the past was also contacted. None of these people could attend.

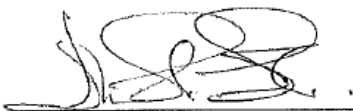
Appendix B

VSIP Approval Signature Page

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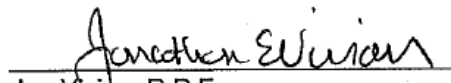
**Williams Lake Timber Supply Area Vegetation Resources
Inventory Strategic Inventory Plan Approval**

The Williams Lake TSA Vegetation Resources Inventory Strategic Inventory Plan was prepared in consultation with Ministry of Forests & Range staff. I have read and concur that this plan, dated March 5, 2008, 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. .



John Stace-Smith, Tolko Industries Ltd., Williams Lake, B.C. Date
Lead Proponent

March 17, 2008



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

08.03.19
Date