Tree Farm License 47, Bonanza Lake & Johnstone Straits Management Units

Vegetation Resources Inventory

Strategic Inventory Plan

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ON BEHALF OF:
TFL FOREST LTD

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EXECUTIVE SUMMARY

This Vegetation Resources Inventory (VRI) Preliminary Strategic Inventory Plan (VSIP) outlines the VRI activities and products that address forest management and inventory issues in Tree Farm License (TFL) 47 held by TFL Forest Ltd. (TimberWest).

The following VRI activities and products are planned:

TimberWest is planning to undertake a Vegetation Resources Inventory (VRI) for the Bonanza Lake and Johnstone Strait MU's of TFL 47.

The Phase I database will support timber-emphasis inventories, habitat mapping, ecosystem mapping, riparian mapping, and other applications.

Conduct Phase II timber emphasis ground sampling in the Vegetated Treed area of the TFL to provide statistically valid timber volumes and polygon-specific tree attributes for the subsequent timber supply reviews. The ground sampling will include Net Volume Adjustment Factor (NVAF) sampling to create a statistically based net volume adjustment of ground samples and also provide sensitivities around the accuracy of taper equations and the decay estimates from net factoring or loss factors.

Conduct finer polygon delineation and timber emphasis ground sampling in the second growth stands in the TFL 47 to improve species composition descriptions and spatial data for these stands.

These VRI activities and products will support timber supply objectives and other resource specific interpretations. They may be implemented in smaller units (e.g., Management Zones) across the TFL. They may also be jointly implemented to address common management issues within the Coast Region.

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1. INTRODUCTION

1.1 Background

This Vegetation Resources Inventory (VRI) Preliminary Strategic Inventory Plan (VSIP) outlines the VRI activities and products that address forest management and inventory issues in Tree Farm License (TFL) 47 held by TFL Forest Ltd. (TimberWest).

The TFL consists of three separate management units; Moresby, Bonanza Lake and Johnstone Straits. The Moresby unit is on the Queen Charlotte Islands (Haida Gwaii), and is managed by Teal Cedar Products Ltd. under agreement with TimberWest. The Bonanza Lake and Johnstone Strait units are on Vancouver Island and the adjacent mainland and islands. Due to geographic separation and to differing timber supply dynamics and management arrangements, only the Bonanza Lake and Johnstone Straits units are addressed in this VSIP. Although harvest on Bonanza remains largely old growth, harvest on the Johnstone Strait unit has been largely second growth for over a decade. TimberWest is planning to undertake a Vegetation Resources Inventory (VRI) for the Bonanza Lake and Johnstone Straits MU's of TFL 47.

The TFL has a high proportion of operable and productive land. It is primarily a hemlock, cedar, and Douglas fir forest. In comparison to the coastal region in general, it is a relatively young forest. Table 1.1 provides a land base summary of the Bonanza Lake and Johnstone Strait Management Units as determined in 2003.

Table 1.1 TFL 47 Area Summary

Management Unit	Total Land Base (ha)	Timber Harvesting Land Base (ha)
Johnstone Strait	101,847	71,260
Bonanza Lake	38,020	21,676
Total Area	**139,867**	**92,936**

Table 1.2 provides a summary of the allowable annual cut (AAC) for TFL 47 by management unit as determined in 2003.

Table 1.2 TFL 47 Allowable Annual Cut

Management Unit	LRSY* (m^3/yr net of NRLs)	AAC Determination (m^3/year)	Effective AAC** (m^3/year)
Johnstone Strait	634,680	500,000	492,000
Bonanza Lake	169,400	180,000	180,000
Total	**804,080**	**680,000*** **	**672,000**

* LRSY is based on managed stand yields and culmination of mean annual increment.

** Hanson Island within the Johnstone Strait MU was included in the areas designated under the *Central Coast Designated Area Regulation.* Therefore, on July 3, 2002 the Chief Forester of B.C. signed an order reducing the AAC for TFL 47 by 8,000 cubic metres. He attributed this reduction to the Johnstone Strait unit.

*** The TFL AAC is another 100,000 m^3 higher at 780,000 m^3/year when the Moresby Management Unit is included.

1.2 VRI Overview

The VRI is a vegetation (forest) inventory process that has been approved by the Resources Inventory Committee (RIC) to assess the quantity and quality of BC's timber and vegetation resources. The VRI estimates overall population totals and averages, as well as individual polygon attributes, for timber and non-timber resources. Its design is simple, reasonably efficient, statistically defensible, and addresses issues raised by the Forest Resources Commission in its 1991 report, *The Future of Our Forests*.

The VRI consists of several components:

1. BC Land Cover Classification Scheme (BCLCS)
2. Photo Interpreted Estimates (Phase I)
3. Ground Sampling (Phase II) – timber emphasis, ecology, coarse woody debris
4. Net Volume Adjustment Factor (NVAF) sampling
5. Within Polygon Variation (WPV) sampling
6. Statistical Adjustment.

One or more of these components can address specific forest management or inventory issues. For more information, VRI manuals are available through the internet at http://srmwww.gov.bc.ca/risc/pubs/teveg/index.htm.

1.3 VRI Planning

The VRI planning process requires that a Strategic Inventory Plan (VSIP) and Project Implementation Plan (VPIP) are developed for defined units (e.g. TFL or TSA). A VSIP outlines VRI products to address forest management issues and provides strategic direction for implementing the inventory activities. A VPIP details the operational activities identified in the VSIP (e.g., ground sampling or photo interpretation projects) and identifies project areas, priorities, plot location, yearly inventory costs, and roles and responsibilities. Guidelines for preparing VPIPs are available on the Internet at http://srmwww.gov.bc.ca/tib/fia/vri.htm. No guidelines exist for the preparation of a VSIP.

The VRI planning process is an important component of the overall VRI process and related activities (Figure 1). The intent of the VRI planning process is to ensure that baseline products meet a range of applications and they are efficiently implemented. These processes and activities include:

1. Forest management decision processes (land integration planning)
2. Identifying forest management issues
3. VRI Strategic planning (prepare a VSIP)
4. VRI operational planning (prepare VPIPs)
5. Implementation, including development and maintenance of procedures and standards;
   a). Management inventories
   b). Database management
   c). Data interpretation
6. TimberWest prepares a final VSIP, which is signed off by indicated individuals.
7. VPIP process begins

The steps for preparing a VPIP include:

1. Review and update VSIP recommendations
2. Secure funding
3. Identify project activities and geographic areas
4. Specify roles and responsibilities for project implementation
5. Prepare VPIP

1.4 VRI Components

VRI is a Ministry of Forests and Range approved process consisting of four components as described in 1.4.1 through 1.4.4.

1.4.1 Phase I - Photo Interpretation:

Prior to commencing the Phase I of a VRI project, a *Vegetation Resource Inventory Project Implementation Plan (VPIP) for Photo Interpretation* must be completed and subsequently approved by the Ministry of Forests and Range. This plan will detail photo acquisition requirements, the VRI Phase 1 process, standards for adherence, and a photo interpretation plan to carry out the Phase 1 of the VRI.

Phase I is the photo interpretation phase of a VRI and entails polygon delineation and attribute estimation by certified photo interpreters through the use of aerial photographs or softcopy images. The delineation identifies the location of the forest resources and the attribute estimation component provides estimates of numerous attributes including land cover type, crown closure, tree species, height, age, stand structure, volume, basal area, density, slope position, moisture and nutrient regime, snags, shrubs, herbs, and bryoids.

Estimation of attributes from field reference points is based upon field procedures using a combination of air and ground calibration points.

1.4.2 Phase II - Ground Sampling

Prior to commencing Phase II, a *Vegetation Resource Inventory Project Implementation Plan (VPIP) for Ground Sampling* must be completed and subsequently approved by the Ministry of Forests and Range. This plan details the Phase II sample selection process and standards for adherence.

The VPIP will detail the Phase II project and sampling objectives, target and sample populations, and sample selection and sample size details. The VPIP will include discussion of the field program and will include the proposed implementation schedule. The VPIP will include details on a proposed NVAF program including sample size and sample selection. Finally, the VPIP will discuss the proposed data compilation, analysis, and statistical adjustment.

1.4.3 Net Volume Adjustment Factor (NVAF) Sampling

As per the Ministry of Forests and Range Vegetation Resource Inventory standards, all new Ground Sampling Vegetation Resource Inventories must complete Net Volume Adjustment Factor Sampling.

This sampling involves detailed stem analysis of sample trees that have been randomly selected from the Phase II plots. The NVAF is used to correct the VRI estimates of net close tree utilization for all species and the NVAF adjusted VRI ground sample volumes are used to correct the VDYP yield table model.

1.4.4 Final Compilation, Analysis and Statistical Adjustment

Adjustment to the Phase I using the results of Phase II sampling data for the entire VRI project area is the final VRI phase. The NVAF information is utilized to adjust the Phase II sample estimates for hidden decay and taper equation bias and the Phase II plot estimates are used to adjust the Phase I photo interpretation attribute estimates. The final product is a statistically valid new inventory supported by re-adjustment of photo-estimated attributes based on ground samples.

1.5 Funding

Currently, funding for VRI activities are FIA eligible. TimberWest develops criteria for setting VRI activity priorities and products during the FIA planning process. Estimated costs for Phase I and Phase II VRI work are as follows:

Phase I	Air Photo Acquisition	$75,000
	Air Photo Interpretation	$110,000
Phase II	Sampling	$150,000
	NVAF	$50,000
Total		$385,000

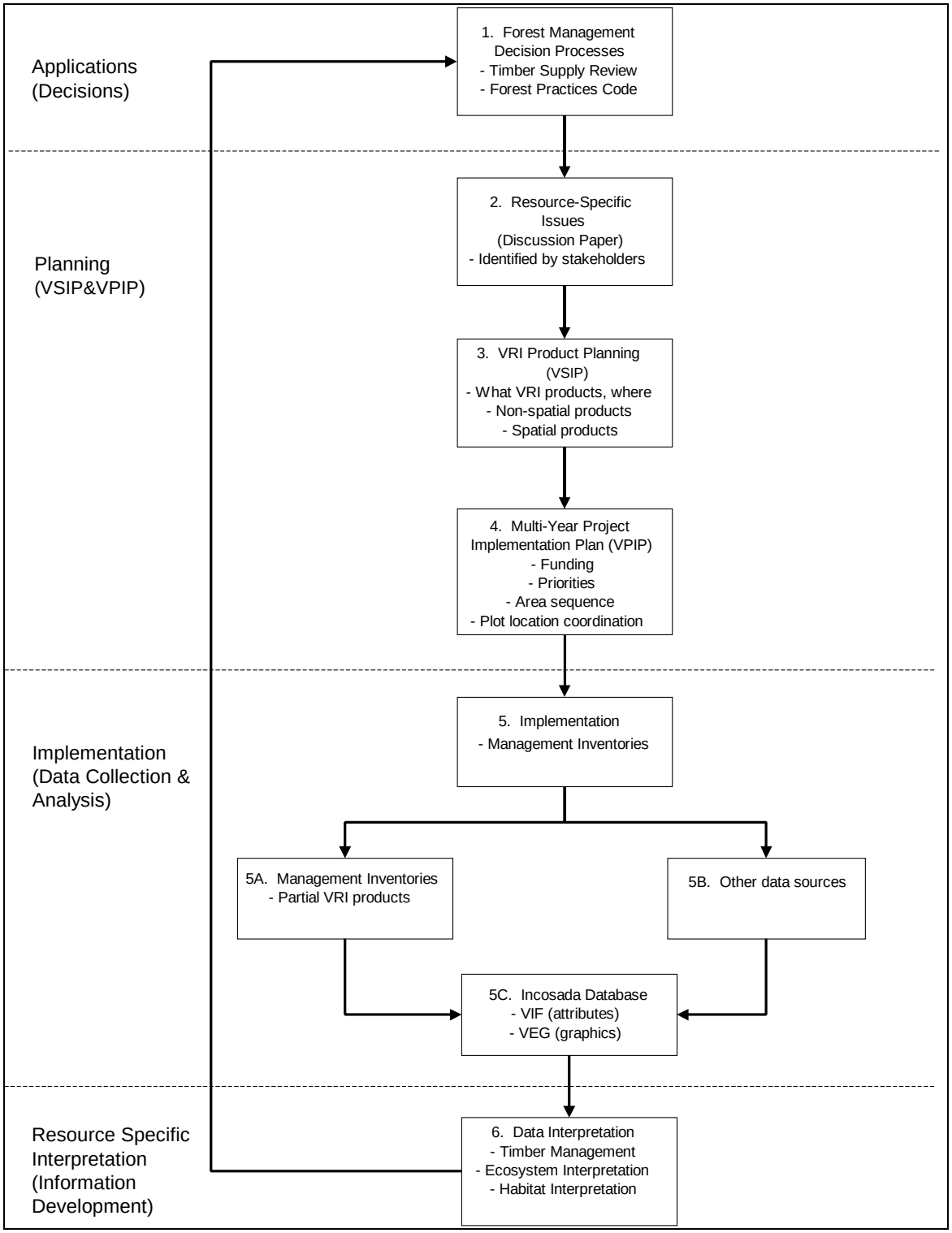


Figure 1.1 The VRI Management Inventory Process

2. BUSINESS CONSIDERATIONS

2.1 Current Forest Cover Inventory and Forest Management Considerations

The status of forest cover inventory on the TFL, the most basic and important input to timber supply analysis is summarized in Table 2 below.

Table 2.1 Inventory Status

Unit and Grouping	Approximate Area (ha)	Vintage	Notes
Johnstone Strait			
Immature and younger mature	85,000 ha	1970 inventory of entire unit, approx. 102,000 ha	Stands below 250 years of age were classified, and older stands were classified and sampled for volume. Sampling was random. Site index was based on the age/height relationship of dominants and co-dominants. Data was stored in ten-year age classes and six site classes.
Old growth	10,000 ha	1983 re-inventory	The 1983 re-inventory was targeted at old growth. In 1996 a forest inventory audit found no statistical difference in overall volume estimates.
Deciduous	7,000 ha	1994 re-inventory	Deciduous stands targeted.
Bonanza Lake			
Immature	24,000 ha	1970 inventory of entire unit, approx. 38,000 ha	The 1970 inventory was of the full area but a 1980 inventory audit raised questions with respect to the mature portion.
Mature	14,000 ha	1989 re-inventory	The 1989 re-inventory was targeted at old growth. Air photos from 1988 were stratified and classified using extensive volume sampling. 1999 forest inventory audit found no statistical difference in overall volume estimates.

2.1.1 Johnstone Strait Management Unit

Based on discussions with TimberWest staff, the following can be said of the forest inventory of the Johnstone Strait Management Unit. It is out-dated and unreliable for certain attributes. The second growth inventory is the oldest, and this is the major

portion of the unit. It has been handed down from company owner to company owner four times and endured conversions and transformations. Age in the old growth is unreliable and the source of age in the second growth is unknown. Old growth heights are stratum averages. Second growth heights are model predictions based on average site index of the site class.

In the 2003 AAC rationale document, the B.C. Chief Forester strongly suggested and requested that TimberWest consider carrying out a re-inventory for the Johnstone Strait Management Unit prior to the next timber supply analysis.

2.1.2 Bonanza Lake Management Unit Inventory

This section provides a chronology of activity on the Bonanza management unit, associated with the 1989 re-inventory.

- Inventory to address old growth.
- New 1988 1:15,000 scale colour photos for the entire area were pre-stratified.
- In 1989 the entire area was retyped on mylars from 1:70,000 black and white TRIM photographs (date of photos unknown), including classification by species and net volume codes (four classes). Transfer to the 1:10,000 scale mylars was accomplished using a Stereo-Metrograph and a random map sheet grid. The result was a three to five fold increase in number of polygons over the 1988 photos.
- 1989 field work (cruise plots established on strips) was internally check cruised but no MoF checking was done.
- Cruise strips and plots were plotted on the mylars and cruised stands classified by species and net volume code. With no stereo photos, or photos with typing matching the mylar, the cruisers "guessed" at typing and classification changes. These edits represented 40% of the inventory.
- In 1990 the type lines were digitized by matching planimetric detail on the mylars to TREE[1] base maps.
- In 1990 the 1989 cruise plots in mature stands were assigned to one of 45 strata by species and net volume code, and a total net volume compiled. The site index for each stratum was calculated using a weighted average of sample trees.

In 1994 it was decided to migrate the inventory to B.C. Ministry of Forests standards.

- In 1995 the process began again with the 1988 photos.
- All available cruise plots were plotted onto the 1988 photos (1970 inventory plots, 1977 growth and yield plots, 1978-1983 Crown Forest plots, 1989 mature and immature plots).

[1] Basemaps created using preliminary TRIM triangulation in NAD'83.

- All stands were classified by species in percent, gross volume, age as date of establishment (stands over 250 years = 1690, immature based on measurement), height in metres, site index (mature based on age = 250, immature conversion to base metric base 50 from imperial base 100 classes I to V), crown closure by percent, and basal area. Cruise plot data was used, stands not cruised were interpreted.
- In 1996 a pseudo-transfer technique used to transfer the lines from the 1:15,000 photos to 1:10,000 1987 orthophotos (NAD 83 but not TRIM based). UTM coordinates of the TREE base maps were identified on the orthophotos using planimetric detail.
- Polygon linework on the typed orthophotos was digitized using the TREE UTM coordinates as control. Linework, sample plots, and strip numbers were captured into TREE base maps. Polygons were matched to cruise plots.
- In 1996 the TREE base maps were shifted to TRIM.
- Although the full unit had been typed on the 1988 photos, it was decided in 1996 that the 1970 inventory of immature stands was at a resolution more appropriate to timber supply and 24,000 ha of this inventory was merged with the 14,000 ha of mature stands inventoried on the 1988 photos. This was what was placed on the TRIM base.
- Updates for 1988 to 1996 were undertaken based on division operational maps. These could be checked with new orthophotos based on 1:50,000 1995 photography.

The methodologies outlined above raise the following concerns with the inventory data:

- Lack of confidence in positional accuracy due to multiple data sources and conversion processes and unknown methodology for inventory update;
- Inventory update from 1996 to 2005 must be incorporated into analysis; and
- The inventory of young immature is 34 years old, projection over that time does not reflect stand dynamics such as species composition changes, and it lacks precision due to class-based attribution.

2.1.3 Inventory Audit

The Ministry of Forests undertook an inventory audit of each management unit (Johnstone Strait in 1995 and Bonanza Lake in 1999). The results suggested that volume prediction is acceptable, but that assessment was of overall volume prediction and may disguise volume prediction at any sub-strata (such as by species or site grouping) level. Indeed, on the Johnstone Strait unit the inventory appeared to underestimate volume, and on the Bonanza Lake unit it was the opposite situation. In neither case however was the difference found to be statistically significant. Further analysis of this would involve investigation using the inventory audit data. Also adding uncertainty to this study is the methodology used to compile the inventory volumes used in the comparison of inventory values to ground based estimates. Inventory

estimates were based on analysis unit volumes prepared for timber supply from strata based volume over age curves.

In preparation for the new inventory on the Johnstone Straits and Bonanza Lake MU's, 1:15,000 color photos are scheduled to be flown (weather pending) in 2006 . The inventory will be completed using either traditional hardcopy photos or digital softcopy photogrammetric technology.

2.1.4 Inventory Discussion

The state of the forest cover inventory for both management units introduces considerable uncertainty to timber supply analysis; especially spatial analysis that would otherwise have added capability for modeling complicated integrated resource management.

Figure 2.1 provides the timber harvest flows predicted by the MP No 3. in testing the sensitivity of the analysis to risk associated with incorrect natural stand yields. The sensitivity runs used volume plus or minus 10%. The results of the inventory audits indicate that this was an appropriate level for testing. The analyses for both Bonanza and Johnstone are very sensitive to changes in natural stand yields. In the case of the Johnstone Strait unit, there is no short-term risk associated with overestimation and some opportunity associated with underestimation. With a heavier dependence on old growth, short-term harvest on the Bonanza unit is at risk with overestimation and presents no opportunities with underestimation.

Figure 2.2 presents a summation of the harvest flows for the two units, and a "most likely outcome" graph.

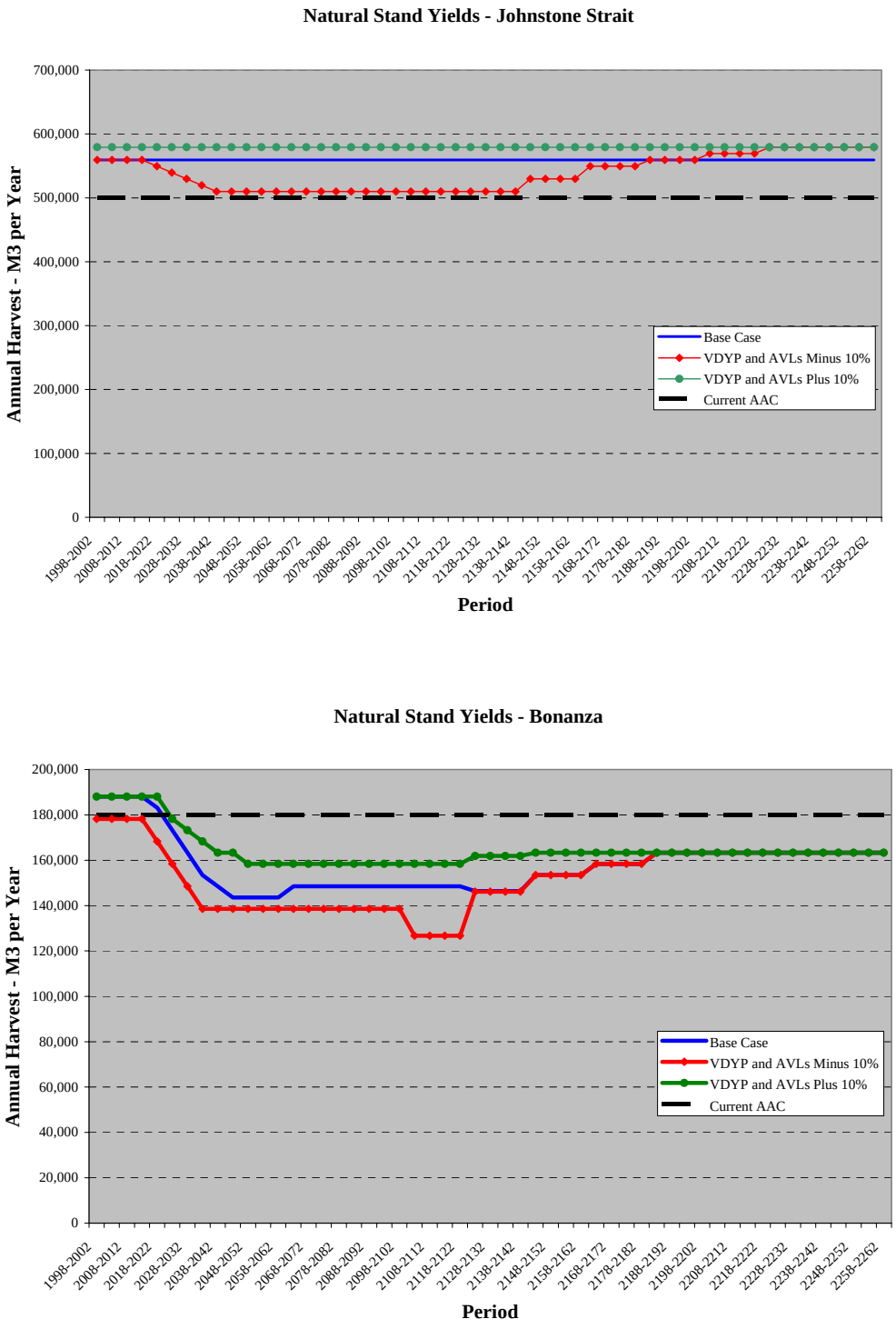
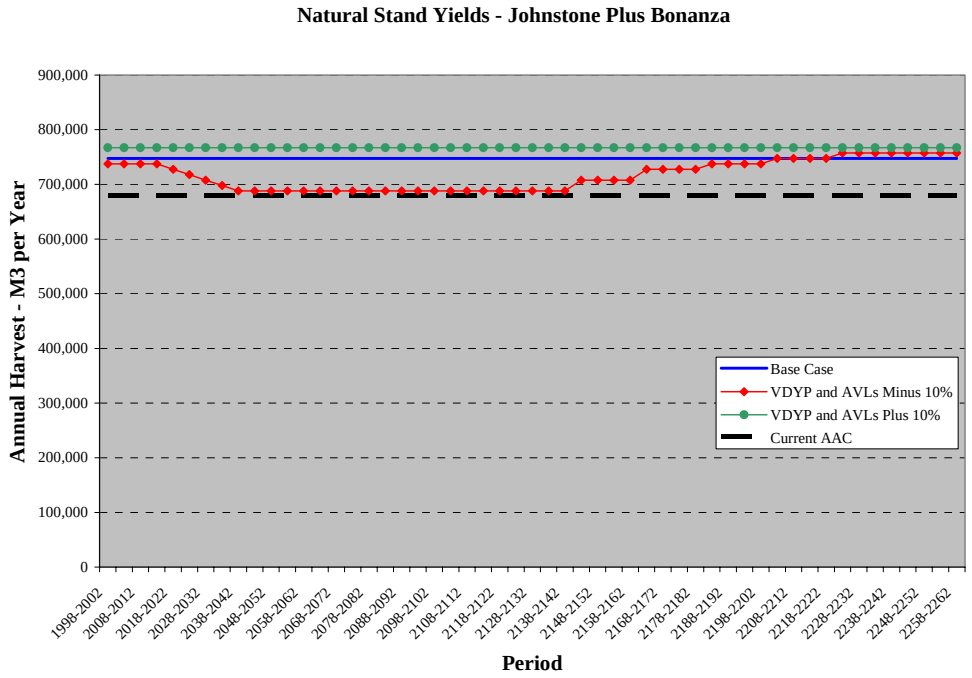


Figure 2.1 Harvest Projections – Natural Stand Yields Sensitivities



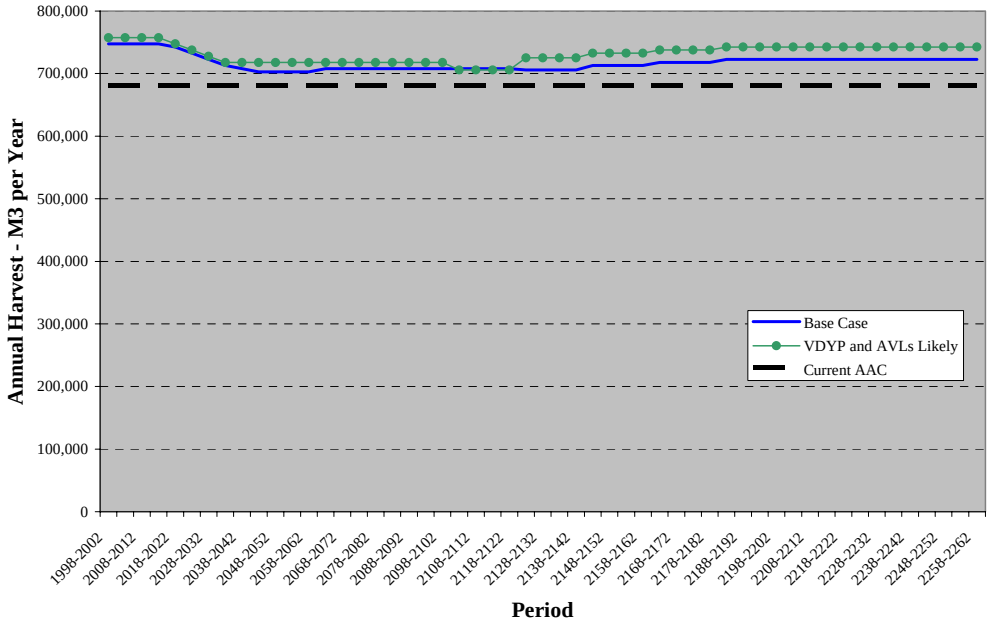


Figure 2.2 Harvest Projections – Natural Stand Yields Johnstone plus Bonanza

2.2 Forest Management Considerations

Forest management issues in TFL 47 are summarized below in Table .

Table 3.1 Forest Management Issues

	Issue[2]	VRI Implication		Remarks
		Photo-Interpretation (Phase 1)	Ground Sampling (Phase II)	
1	Inventory audit	Required	Required	Volume estimates from VRI ground sampling will provide additional data to adjust inventory estimates. The Ministry of Forests undertook an inventory audit of each management unit (Johnstone Strait in 1995 and Bonanza in 1999). The results suggested that volume prediction is acceptable, but that assessment was of overall volume prediction and may disguise volume prediction at any sub-strata (such as by species or site grouping) level
2	Uncertainty to timber Supply analysis	Required	Required	The state of the forest cover inventory for both management units introduces considerable uncertainty to timber supply analysis; especially spatial analysis that would otherwise have added capability for modeling complicated integrated resource management.
3	Productivity	Required	Required	Old growth site index bias is an acknowledged problem in the forest inventories of British Columbia. As no studies had yet been conducted to provide local site index estimates for TFL 47, site indices from the forest inventory were used in the base case forecasts. This represented considerable uncertainty, and underestimation, in timber supply analysis for the TFL due to the wide ranging impact of forest productivity.
4	Operability criteria: re examine the distribution	Required	Required	VRI may provide additional information to use in confirming the distribution of merchantable timber in the TFL.
5	Management for Wildlife and Biodiversity:	Required	Required	Spatial data derived from the photo interpretation and ground sampling may provide additional information useful in delineating wildlife tree patches, ungulate winter ranges, seral stage and stand attributes.
6	Low Sites:	Required	Required	The operability mapping used for MP No. 3 removed many low productivity stands. Better age and height information will result in low sites being more accurately identified.

[2] Issues compiled from 'TFL 47 Review of Inventory and Timber Supply Issues', March 2005

	Issue[2]	VRI Implication		Remarks
		Photo-Interpretation (Phase 1)	Ground Sampling (Phase II)	
7	Riparian management:	Required	Required	Spatial data from photo interpretation may provide additional information for riparian area designation.
8	Land use planning:	Required	Required	Updated forest cover data provided by the VRI could be used to in the process of identifying areas of interest specific to the land use objective at hand (i.e. The *Central Coast Land Resource Management Plan* (CCLRMP) and the *Vancouver Island Land Use Plan Higher Level Plan* (VILUP)
9	Visual Quality Objectives:	Required	Optional	VRI will provide updated spatial information useful in effectively assessing visual impact of timber harvesting activities.
10	Deciduous Stands	Required	Optional	MoF staff contends that in the base case for the Johnstone Strait unit the inclusion in the timber harvesting land base of stands that include a component of alder may have caused an overestimate in the base case forecast. TimberWest considered some of these to be of doubtful merchantability (older stands and low quality stands). VRI will provide updated deciduous spatial information.

2.3 VRI Activities and Products

The following VRI activities and products are recommended to address the forest management issues identified for TFL 47. These recommendations are based on the issues identified in Table 3 and Section 2.1.

1. Acquire new 1:15,000 scale color photography (scheduled for 2006)
2. Conduct a Phase I photo-interpretation for the entire TFL 47. The Phase I database will support timber-emphasis inventories, habitat mapping, ecosystem mapping, riparian mapping, and other applications over the TFL.
3. Conduct Phase II timber emphasis ground sampling in the vegetated-treed areas of the TFL, to provide statistically valid timber volumes and polygon-specific tree attributes. These data will support the next timber supply review (TSR) in TFL 47.
4. In concert with the ground sampling, conduct Net Volume Adjustment Factor (NVAF) sampling to create a statistically based net volume adjustment of ground samples

and also provide sensitivities around the accuracy of taper equations and the decay estimates from net factoring or loss factors.

5. Adjust the Phase I photo-interpreted attribute data.

A preliminary strategic inventory plan to address the identified products so far is outlined in section 3.

3. STRATEGIC INVENTORY PLAN

3.1 Overview

This section outlines a preliminary strategic inventory plan to develop specific VRI products discussed in Section 2.3. The VRI products include a new spatial vegetation inventory (Phase I) over TFL 47 and a timber emphasis inventory in the vegetated treed landbase. These products can be obtained through completion of VRI photo interpretation, ground sampling and statistical adjustment.

3.2 Photo-Interpretation (Phase 1)

3.2.1 Objective

The objective is to improve TFL polygon information – especially in areas where specific management issues occur – using photo interpretation. The VRI product is a spatial database consisting of unadjusted photo-interpreted estimates. Ground sampling, used to check and adjust the photo-interpreted estimates, is discussed as a separate process (Section 3.3).

3.2.2 Target Area

All TFL lands outside of the Class 'A' parks identified in the Johnstone Strait MU will be updated to VRI standards through new photo interpretation. Some small non-TFL areas found within larger TFL parcels will be mapped for completeness. The target area is shown below in Figure 3.1.

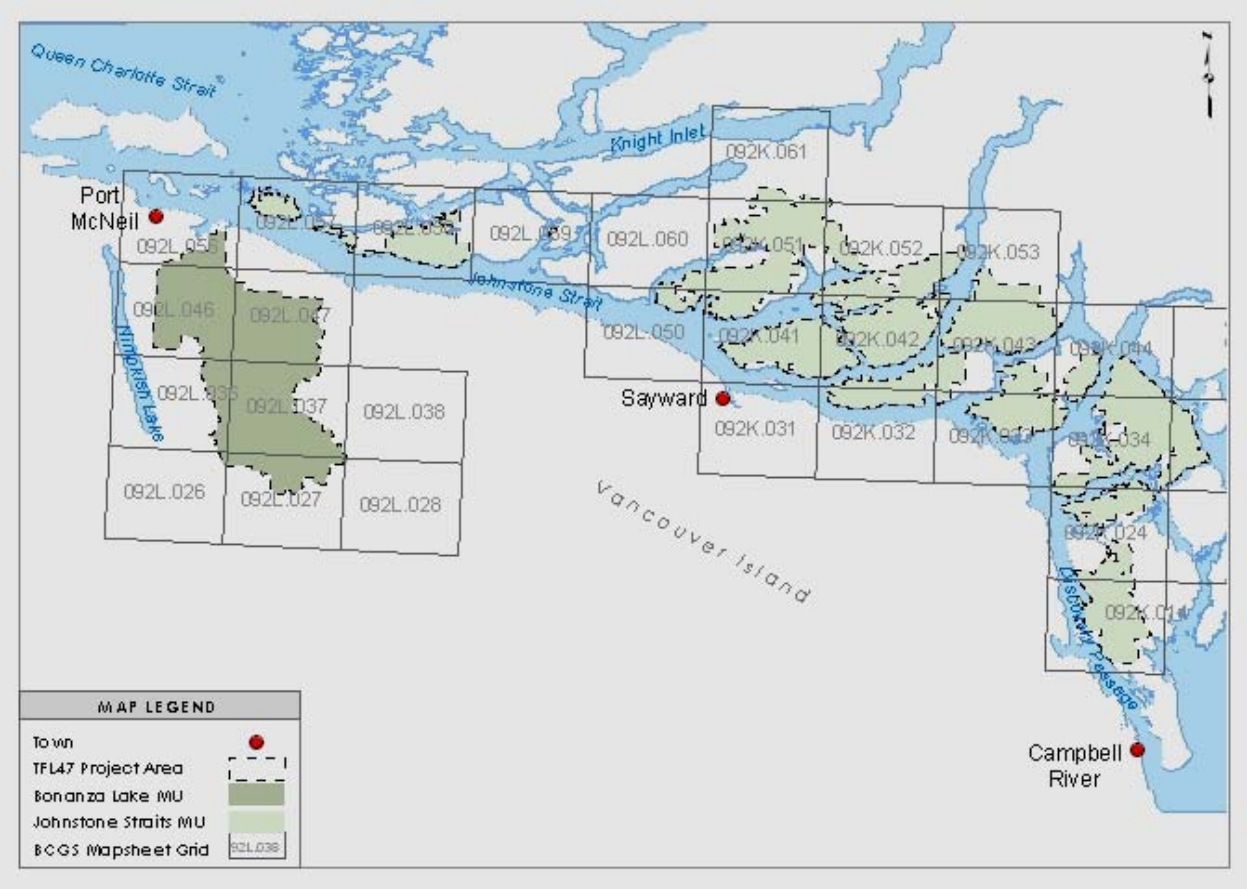


Figure 3.1 Target Area

3.2.3 Target Attributes

All attributes listed on the VRI photo interpretation attribute form will be targeted. These attributes will be interpreted to current VRI photo interpretation standards.

3.2.4 Methods

The VRI Phase I inventory will be completed either using traditional methods or utilizing softcopy technology.

Provincially Certified Photo Interpreters will complete the Phase I polygon delineation and attribute estimation according to the most current MoFR VRI standards. It is anticipated that the 1:15, 000 color photos will assist in the identification of species composition, and will further assist in the identification of deciduous stands, and improve classification of Non Forested Polygons.

There are five general categories of data that are estimated during the attribute estimation of polygons:

1. Ecology: Data to be collected is to include surface expression, modifying process, site situation and slope position, alpine designations, and soil nutrient regime.

2. Land Classification – Land cover component: Data to be collected is to include treed (broadleaf, coniferous, mixed) terrain identification if trees are absent including snow, water, rock, and soil moisture regime.

3. Site Index – Data to be collected is to include species, source, and site index.

4. Tree Attributes – Data to be collected is to include crown closure, tree layer, vertical complexity, species and age of leading and second species, basal area, density, and snag frequency.

5. Non-treed attributes- Data to be collected is to include: Shrub height and crown closure, herb type and percent cover, and bryoid percent cover.[3]

Air and ground field calibration will be established by the photo interpreters to gain local knowledge and improve VRI attribute estimation. Prior to any field sampling plan, a comprehensive analysis of existing inventory data sources and cruise plot information will be completed. This analysis will identify where knowledge gaps currently exist and will ensure that future Phase I VRI data collection will occur only in the most important priority types. This approach will ensure that the limited resources allocated to the field data collection program will be effectively spent.

3.3 Timber Emphasis Inventory – Vegetated Treed Areas

3.3.1 Ground Sampling (Phase II) Objectives

The main objective of the ground sampling timber emphasis inventory is to:

> *Install an adequate number of Phase II VRI sample clusters to statistically adjust the photo interpreted timber inventory attributes in the Vegetated Treed (VT) areas of the TFL, to achieve a sampling error between 10 and 15% (95% probability) for overall net timber volume in the VT area, and reasonably accurate individual polygon adjusted estimates.*

[3] TFL 18 VSIP, Canfor (March 2005)

Net timber volume is gross volume less stumps, tops, decay, waste, and breakage. Decay and waste will be estimated using VRI call grading/net factoring and NVAF sampling. Breakage will be estimated using existing loss factors.

3.3.2 Target Population

The target population will be the vegetated treed (VT) portion of the Bonanza Lake and Johnstone Straits Management Units that are also considered operable by the operability linework. The operable area within these MUs will be priorized for ground sampling as it provides cost effective VRI ground sampling and focuses sampling activities in the portion of the landbase that is particularly important to the stakeholders.[4]

3.3.3 Sample Size

The estimated number of sample clusters that will be installed in the VT area is yet to be determined because the decision to implement a new Phase II program will need to be discussed between the licensees and MFR Forest Analysis and Inventory Branch and documented in the Phase II VPIP.[5] It will be determined during the development of the Phase II Ground Sampling VPIP whether the Bonanza Lake and Johnstone Strait Management Units will be combined into one sample list or treated separately.

3.3.4 Sampling Approach

VRI Timber Emphasis Plots (TEP) should be used to gather data following the current VRI Ground Sampling Manual. These TEPs could provide a sampling framework for additional sampling, such as monitoring (where a subset of the TEPs would be re-measured over time).

3.3.5 Sample Selection

Sample polygons would be selected using the MOF probability of selection proportional to size with replacement (PPSWR). The selection process would follow the procedures outlined in the document, “Sample Selection Procedures for Ground Sampling v3.3”, which was produced by the Ministry of Sustainable Resource Management, Terrestrial Information Branch, in December 2002.[6]. It will be determined during the development

[4] Approved Soo TSA VSIP, March 2006

[5] Approved Soo TSA VSIP, March 2006

[6] Approved Sunshine Coast TSA VSIP, March 2006

of the Phase II Ground Sampling VPIP whether the Bonanza Lake and Johnstone Strait Management Units will be combined into one sample list or treated separately.

3.3.6 Net Volume Adjustment Factor Sampling

As per the Ministry of Forests and Range standards, the net volume adjustment factor (NVAF) sampling is mandatory for the inventory. 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; it will be used to statistically adjust the estimate of net merchantable volume of VRI ground samples.

The objective of the NVAF portion of the inventory is to complete destructive tree sampling and obtain local information for hidden decay, waste, and stem taper in order to statistically adjust the cruiser calls for net volume.

In the ground sampling phase of the NVAF process, ground sampling crews will provide detailed enhanced cruising (net factoring and call grading) of all the trees (live, dead, standing or fallen) within the selected auxiliaries at the same time as they are conducting regular timber emphasis sampling within the TFL. Once the enhanced data is collected then the NVAF enhanced tree data will be compiled in a tree matrix and a sample design for selected trees will be developed.

A minimum of 60 trees (50 live, 10 dead) will be selected from at least 17 VT polygons. The finalized ground-sampling plan will provide additional details on stratification of destructive sampling plots.

All NVAF planning and implementation will follow the Net Volume Adjustment Factor Sampling Standards and Procedures, MOF, Version v4.0, March 2004. It will be determined during the development of the Phase II Ground Sampling VPIP whether the Bonanza Lake and Johnstone Strait Management Units will be combined into one sample list or treated separately.

3.3.7 Implementation

A VPIP for ground sampling should be developed following the Ministry of Forests and Range guidelines in *Vegetation Resources Inventory Guidelines for Preparing a Project Implementation Plan for Ground Sampling*.

3.4 Monitoring

The Ministry of Forests and Range is responsible for monitoring this VRI planning process and ensuring that the MOFR business needs are met.

3.5 Approval/Sign-off of VSIP

Suggested sign-off contacts are:

Agencies	Contact
Ministry of Forests and Range	Jon Vivian
MOF Campbell River Forest District	Rory Annett

Licensee Contacts:

Licensees	Contact
TFL Forest Ltd. (TimberWest)	Bruce Storry

I have read and agree that the activities and products outlined in this proposal will meet the Ministry of Forests and Range business needs.

_____

Manager

Development and Policy Forest Analysis Branch, Ministry of Forests
or other suitable MOF representative

APPENDIX I – GLOSSARY OF TERMS

Ground Sampling

Ground sampling is the field measurement of timber, ecology, range, and/or coarse woody debris values at one or more locations within each sample polygon. Sample polygons are selected using the probability proportional to size with replacement (PPSWR) method. To accommodate a 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. The inventory unit could be a specific a geographic area (e.g. TFL or TFL) where a specific set of attributes is needed. The size of the inventory unit depends upon the sampling objectives.

Landcover Classification

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

Management VRI

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

National Forest Inventory (NFI)

The NFI provides information on Canada's resources across all provinces and allows the Federal Government a consistent framework for reporting on Canada's inventory,

including reporting on the Criteria and Indicators and the Kyoto protocols. The inventory unit for the NFI is the entire country, although it is implemented province-by-province. BC's provincial CMI system will provide the data needed for the NFI as well as provincial reporting.

Net Volume Adjustment Factor (NVAF) Sampling

NVAF sampling provides factors to adjust net tree volume estimated from net factoring and taper equations. The adjustment accounts for hidden decay and possible taper equation bias. NVAF sampling involves detailed stem analysis of sample trees, calculation of actual net volume, and calculation of the ratio between actual net volume and estimated net volume (where estimated net volume is obtained from net factoring and taper equations). The NVAF (and VRI net factoring) replaces the existing loss factors for inventory applications. It does not, however, replace the loss factors for revenue applications.

Photo-Interpretation

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

Post-Stratification

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

Pre-Stratification

Pre-stratification divides 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 special characteristics of each stratum.

Resource-Specific Interpretations

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

Sample Size

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

Statistical Analysis

Statistical analysis or adjustment is the process of adjusting the values of the photo-interpretation variables using ground sampling observations. Ground observations are compared to photo-estimated values to develop adjustment factors by species groups. These factors are then applied to the polygons in the photo interpretation database to produce the final adjusted database.

Sub-unit

Sub-unit describes the inventory unit within an Inventory Unit. For example, if the inventory unit is defined as the Vegetated Treed area in a TFL, then a sub-unit may be defined by a specific geographic area (e.g., operable landbase) or stand type (e.g., problem forest types) within the Vegetated Treed area in the TFL.

Target Precision

Target precision expresses the amount of variation in key attributes (e.g., timber volume) desired in the final results. Target precision, usually expressed as the coefficient of variation (CV), is used to calculate the minimum sample size for subsequent ground sampling. The current target precision for timber volume is $\pm$10% (90% or 95% probability); stakeholders define the probability (uncertainty) level.

Vegetation Resources Inventory (VRI)

VRI is an improved vegetation inventory process for assessing 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.
- *WPV Sampling*: intensive sampling of selected polygons to determine the error between the estimated attribute values and the "true" attribute values.
- *Statistical Adjustment*: the adjustment of the photo-interpreted estimates for all polygons in an inventory unit or management unit using the values measured during ground sampling.

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

Within Polygon Variation Sampling

WPV sampling provides information for expressing the true individual polygon error, assessed as the difference between the adjusted polygon value and the "true" value for that polygon. The "true" value for the polygon is an estimate derived from a small sample of polygons that are intensively sampled on the ground.