KALUM TIMBER SUPPLY AREA

Vegetation Resources Inventory
Project Implementation Plan

PREPARED BY:
LM FOREST RESOURCE SOLUTIONS LTD.

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EXECUTIVE SUMMARY

This VRI Ground Sampling Project Implementation Plan (VPIP) has been developed for VRI timber emphasis ground sampling in the Kalum TSA during the 2004 fiscal year. This preliminary plan was prepared by LM Forest Resource Solutions Ltd.. The purpose of this VPIP is to summarize identified VRI needs and provide details for implementation of timber emphasis ground sampling and net volume adjustment factoring (NVAF) in terms of geographic area, scheduling, priorities, plot location, estimated costs by year, and roles and responsibilities. This information may be used by the DFAM group to assist in long term planning.

The recommended minimum target population is Vegetated Treed (VT) stands over 120 years of age within the operable landbase within the Kalum TSA. Sample polygons should be selected over the entire target population using probability proportional to size with replacement (PPSWR) sampling. Sample polygons will be stratified into 2 strata based on forest type (leading-species groups), specifically, hemlock leading and other leading. Each of these strata will be further sub-stratified into high, medium and low volume classifications, for a total of 6 strata for sample polygons. NVAF sampling should be also be completed. The estimated total cost of the ground sampling VRI inventory is approximately $220,500 for 50 ground sample clusters and 85 NVAF trees. This cost includes administration, installation of the VRI sample clusters, NVAF, helicopter access, mentoring, quality assurance, statistical analysis, and inventory file adjustment.

This plan must be approved by MSRM and MoF prior to implementation. As well, it is recommended that this plan be reviewed by the stakeholders to ensure it meets their business needs.

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1. INTRODUCTION

1.1 Vegetation Resources Inventory Overview

The Vegetation Resources Inventory is designed to answer two questions:

1. Where is the resource located?
2. How much of a given vegetation resource (for example, timber or coarse woody debris) is within an inventory unit?

The Vegetation Resources Inventory is carried out in two phases. Phase I (Photo Interpretation) involves estimating vegetation polygon characteristics from existing information, aerial photography, and other sources. No statistical based ground sampling is done in Phase I. Phase II (Ground Sampling) provides the information necessary to determine how much of a given characteristic is within the inventory area.

Ground samples alone cannot be collected in sufficient numbers to provide the specific locations of the vegetation characteristics being inventoried. Ground measurements are used to estimate population attributes. The relationship between the attributes from the photo estimates and ground samples is used to adjust the Phase I, photo-interpreted polygon estimate. Population attributes are used to adjust the description for each polygon.

1.2 Background

This Vegetation Resources Inventory (VRI) Project Implementation Plan (VPIP) was prepared by LM Forest Resource Solutions and is based on the Kalum TSA VRI Strategic Inventory Plan (VSIP) finalized in April 2004. The VSIP outlined VRI activities and products needed to address forest management and inventory issues in the Kalum Timber Supply Area (TSA), as identified by stakeholders. The VSIP provided strategies for photo interpretation, timber emphasis ground sampling, monitoring, and associated research projects in the TSA.

The VPIP identifies the needs for VRI management inventories, and provides the details for implementation of timber emphasis VRI ground sampling and NVAF in terms of geographic areas, scheduling, priorities, plot location coordination, estimated inventory costs by year, and roles and responsibilities.

1.3 Rationale

Stakeholders identified the need to obtain more information on standing volume, particularly decay, in the Kalum Timber Supply Area. The issue of decay was also identified by the chief forester in the 1999 Kalum Timber Supply Review. It was noted in this document that the short and mid term timber supply in the Kalum TSA is very sensitive to uncertainty in existing stand volume estimates. The chief forester recommended that information be gathered that could be used to reflect appropriate timber supply assumptions in the next analysis for existing stand volumes, in particular the amount of decay.

An inventory audit, performed in the Kalum TSA in 1997, showed no significant difference between audit and inventory standing volumes (509m^3/ha in the audit vs. 496m^3/ha in the inventory data base (a 3% gain)) for the mature forested land base (60 yrs+). Only 31 of the 50 audit samples, however, were in the operable landbase, and audit volumes for the operable area were predicted to be 2% less than inventory values. The difference between these two estimates (9m^3/ha) was also not statistically significant. No meaningful comparisons could be made of the nineteen samples located in **in**operable forested areas due to the small sample size.

The audit did, however, reveal that for the entire forested land base, the yield model (VDYP) is underestimating volume by 9% on average. Loss factors are a significant consideration in this assertion. If, for example, incorrect loss factors result in an overestimate of volumes, audit results could be significantly different. Height, another driver of yield, was indicated to be overestimated by 7% in the inventory database.

The audit also showed that 60% of the growth type groups were accurately predicted in the inventory database. At the stand level, the correlation between the inventory and audit was weak, which may be attributed to the heterogeneity in stands in the Kalum TSA.

Timber emphasis Phase II ground sampling in VT stands over 120 years old in the operable landbase within the Kalum TSA will provide statistically valid timber volumes and polygon-specific tree attributes. It is expected that ground sampling and NVAF will result in the following outcomes:

- Fewer errors in the database quantified in the inventory audit because there will be a means to adjust the photo-interpreted attribute values.
- Acquisition of more accurate information on actual decay and waste.
- A basis for developing more accurate taper equations or adjustments to taper (More accurate taper equations or adjustments to taper will not be a direct product of this plan,

but the information gained in this project will allow for the development of such products).

These outcomes will contribute to the next timber supply review (TSR) in the Kalum TSA, expected prior to November 2007.

1.4 Landbase

The Kalum TSA lies within the Northern Interior Forest Region and is administered from the Kalum Forest District office in Terrace. The Kalum TSA comprises a total of 539,319 hectares centred on the community of Terrace. The TSA is bordered by the Nass, Kispiox, North Coast and Bulkley TSAs, as well as two Tree Farm Licenses (TFL 1 and TFL 41). Adjacent to the TSA are several parks, including the Nisga'a Memorial Lava Bed Provincial Park, the Lakelse Lake Provincial Park, the Exchamsiks River Provincial Park and the Gitnadoix River Recreation Area.

Of the 539,319 hectares in the TSA, 36,213 hectares or approximately 6.7 percent are not managed directly by the British Columbia Forest Service (BCFS), including parks, ecological reserves, private land and various special use permit areas. An additional 305,698 hectares, or approximately 57 percent, are non-productive areas which include rock, swamp, alpine areas and water bodies. Productive forest land managed by the BCFS totals 197,408 hectares or roughly 37 percent of the total area. Further reductions applied to the productive forest land base result in 98,256 hectares or approximately 50 percent of the productive forest land considered to be available for timber harvesting. Hemlock species dominate in stands on about 76 percent of the area, balsam dominates on 8 percent, spruce on 6 percent, and lodgepole pine on 5 percent.

The May 2000 Nisga'a final agreement identifies a total of 32,286 ha in the Kalum Forest District. Approximately 4,700 ha are in the timber harvesting landbase. The largest reduction in area was to TFL 1 and the reduction to the Kalum TSA was minimal.

The landbase selected for the target population is Vegetated Treed (VT) stands over 120 years of age within the operable landbase of the Kalum TSA. FIP files projected to 2002 were utilized to assemble the target population. The BC Land Cover Classification Scheme (BCLCS) was not an attribute of these files. In absence of the BCLCS, a surrogate measure for VT was utilized. A measure of greater than or equal to 10% crown closure was used in lieu of the VT classification (greater than or equal to 10% tree cover). Only 4 stands, totaling less than 100 ha, were equal to

10% crown closure in our target population. Every other stand included in the target population measured 20% crown closure or greater.

The utilization of the FIP files as opposed to the vegetation files (which include VRI attributes) was necessary for this project as there was some urgency in developing the plan for implementation in the current fiscal year. The utilization of these files will likely increase the time spent on the analysis and adjustment.

The operable landbase in the Kalum Forest District was being updated concurrent to the preparation of this plan. The operability criteria used to determine operable stands for the purposes of this project have been included in Appendix D, although the slope parameters had not been applied at the time this document was prepared. To address the slope parameters, each sample polygon was individually reviewed for slope. The operable slope limit used was 90%, consistent with the operability review in the Kalum Forest District. Polygons with any portion of operable terrain were considered operable for this exercise. No polygons were split in this operability definition.
Slope data from MSRM was used to determine slopes.

Table 1 reflects the target population by leading species. This information was used in the development of the sampling list.

Leading Species	Area (ha)	Percent (%)
H	10,155.8	
Hm	8,744.7	
Hw	44,178.8	
Sub-total	**63,079.3**	**85.1**
Ac	1,125.0	
At	126.3	
B	403.0	
Ba	5,208.7	
Bl	3.4	
Cw	1,103.3	
Dr	<0.1	
E	<0.1	
Ep	8.7	
Pl	638.0	
S	1,588.1	
SS	711.1	
Sw	28.8	
Yc	72.4	
Sub-total	**11,016.8**	**14.9**
TOTAL	***74,096.1***	***100***

2. SAMPLING PLAN

2.1 Overview

The information presented here includes: inventory objectives, target population, sample size and selection, and the VRI tools to be used.

2.2 Inventory Objectives

The primary objective of this initiative is to provide a statistically valid estimate for volume loss due to decay on all old growth species for the Kalum TSA.

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

> *Install an adequate number of Phase II VRI sample clusters to adjust the timber inventory in VT stands over 120 years old in the operable landbase within the Kalum TSA, to achieve a sampling error of ± 15% (95% probability) for overall net timber volumes in these areas.*

It is expected that the sampling error of ± 15% will be achieved with the estimated sample size. This expectation will be realized after ground sampling is complete. If the sampling error is not achieved, there are two available options. The first option would be to secure funding for a second year of sampling to make up the number of samples required to achieve the target sampling error. The second option would be to present the information in TSR regardless and advocate for its consideration.

The objective of NVAF sampling is to:

> *Complete an adequate number of NVAF samples to achieve the following sample errors at the 95% level of probability.*

Hemlock 8 to 12%
Other Species 12 to 15%
Dead Potential 20 to 30%

All Live Trees 6 to 10%

The above sample errors were derived by Will Smith (2004).

Net timber volume is gross volume minus 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, which were produced in 1976 using the best science of the day.

2.3 Target Population

The recommended minimum target population is Vegetated Treed (VT) stands over 120 years of age within the operable landbase within the Kalum TSA. Parks, park reserves or equivalents, and provincial ecological reserves have not been included in the sample population, as well as private lands and federal and Indian reserves.

2.4 Sample Size

To meet the inventory objectives (section 2.2), a minimum sample size of 50 VRI sample clusters was recommended (Table 2). Based on a coefficient of variation of 48%, it is expected that this sample size will provide a sampling error slightly less than 15% at the 95% level of probability for the entire population. The (CV) of 48% was inflated from an inventory audit CV of 36%.

Table 2. Sample cluster distribution in the target population.

Landbase	Area (%)	Number of clusters
Hemlock	85	43
Other	15	7
Total	*100*	*50*

Figure 1 is included to demonstrate the impact of reducing overall target sampling error and the impact of sample size, assuming a CV of 50%. The CV for the Kalum TSA was assumed to be 48% based on the inventory audit analysis.

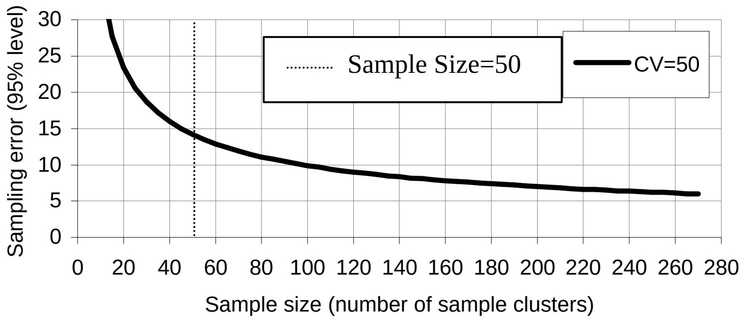

Figure 1. Decreasing sampling error with increasing sample size.[1]

2.5 Sample Selection

Samples will be selected using the most current FIP files. Sample polygons will be selected using the stratified probability proportional to size with replacement (PPSWR) sample selection method. Sample polygons will be initially stratified into 2 strata based on forest type (leading-species groups), specifically, hemlock leading and other leading. Each of these strata will then be further sub-stratified into high, medium and low volume classifications (volume per hectare), for a total of 6 strata for sample polygons. Sample allocation to individual leading-species strata and substrata should be proportional to strata or sub-strata areas. The final sample population should be compared to the target population to ensure a correct representative sample has been selected. Further detail on sample selection can be found in Appendix C. A list of sample polygons is provided in Appendix B. A comparison of age and volume distribution between the sample population and the target population is available in Appendix E.

Prior to the start of ground sampling, the VPIP must be approved by MSRM and the Kalum Forest District. As administrator for the Land Based investment Program (which is the funding mechanism for this project), PricewaterhouseCoopers (PwC) will also need to approve the plan for funding.

2.6 Measurements

The ground sampling involves collecting tree attribute data on a representative sample of stands using the Vegetation Resource Inventory (VRI) procedures. VRI certified crews will gather data following the current VRI Ground Sampling Manual. Measurements will be recorded using VRI Card Types 1-3 (CH Header, CP Compass, CL Cluster Layout), and 8-11 (TD Tree Details, TL Tree Loss Indicators, TS Small Tree, Stump and Site Tree Data, TA Auxiliary Tree Card). In accordance

[1]The CV, or coefficient of variation, is estimated from the inventory audit data.

with the procedures for VRI, GPS co-ordinates will be collected at the tiepoint, as well as for each integrated plot center.

2.7 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). NVAF data is used to adjust the estimated net tree volume to account for hidden decay and possible taper equation bias (e.g. in hemlock stands). The recommended minimum sample size is eighty-five trees (45 hemlock / 30 other / 10 dead potential) selected at random from ground sample polygons. A total list of dead potential trees should be constructed during enhancement of sample clusters, and 10 trees should be randomly selected from this list. The trees are destructively sampled for NVAF. For more information on the selection of trees to be felled, please see the NVAF sampling manual at: srmwww.gov.bc.ca/tib/vri/vri/standards/nvaf/nvaf_2k4.pdf

It is recommended that sample clusters be enhanced for NVAF at the time of ground sample establishment. It is believed that the coastal old growth characteristics of the target population would make enhancement at the time of NVAF sampling a difficult task. Crews should have adequate time to complete ground sampling and enhancements in one field day. 25 sample polygons are recommended for NVAF sampling, and two randomly selected auxiliary plots are recommended for enhancement at each cluster. A randomly selected sample list of the planned 25 polygons has been created based on the area weighted stratification and is included in Appendix F.

The recommended hemlock NVAF sample size should capture a wide range of diameters, as well as risk groups and heights to facilitate trends analysis within the species for taper and loss error (Will Smith 2004). The total sample size of 85 will likely allow for post stratification to improve the precision of the inventory’s overall averages and totals. As well, the sample should provide an excellent basis for further sampling if required.

2.8 Within Polygon Variation Sampling

No WPV sampling is planned at this time. WPV sampling provides information to estimate individual polygon error, assessed as the difference between adjusted polygon value and “true” value for that polygon based on intensive sampling of sample polygons.

3. IMPLEMENTATION PLAN

3.1 Overview

One year of ground sampling and NVAF has been recommended for the Kalum TSA. The project is anticipated to receive funding under the Land Based Investment Program of FIA in 2004. Given the finite funding and timeframe, stakeholders must make every effort to ensure that the project is completed on schedule to ensure that the data will provide an overall unbiased estimate.

Implementation of VRI ground sampling and NVAF could begin immediately following approval of this plan.

Schedule

The VRI will be implemented as follows (approximate schedule):

Stage 1

1. Finalize draft plan objectives based on VSIP approval by stakeholders (May 2004) (LM)
2. Finalize VPIP. (Jun 2004) (LM)
3. Obtain Stakeholder approval on VPIP. (Jun 2004) (LM, Kalum Forest District)
4. Select sample locations in polygons using GIS (Jun 2004) (LM)
5. Prepare access plan (Jun 2004) (LM)
6. Prepare sample packages; each to include photo stereo-pair for access, document photo photocopies, sample cluster location maps, and access maps. (Jun 2004) (LM)
7. Obtain approval and funding confirmation from PwC (Jun 2004) (KFD)

Stage 2

8. Tender and select contract crews, and award contracts (Jun 2004) (Stakeholder representative)
9. Conduct quality assurance (10% check) (Jul-Sep 2004) (MSRM Northern Interior Forest Region).
10. Complete VRI and NVAF sampling. (Jul-Sep 2004) (Contractor)
11. Validate and compile data from completed sample clusters and perform final analysis / adjust inventory files / prepare final report (Nov 2004) (Stakeholder representative)

3.2 Sample Packages

Field sample packages should include most current photo stereo-pairs (or photocopies) for access, copy of document photo (where possible), sample cluster location and access maps clearly indicating sample cluster location and polygon boundaries; and overview maps for general polygon location. Maps will be plotted showing the VRI grid overlays and selected sample locations. Sample locations within a polygon will be selected using GIS.

3.3 Project Support

The MOF will provide aluminum stakes, field maps, photos, and field cards to the contract crews. Provision of other equipment such as GPS will be the responsibility of the contract crews.

MRSM will provide mentoring to the contractor. A regional MSRM official will be present at the onset of the fieldwork to provide training and support for the first 1 to 3 days of ground sampling. Mentoring for the NVAF portion of the contract should be provided by an expert cruiser and certified faller.

3.4 Fieldwork

Fieldwork will be completed using VRI measurement protocols and VRI certified crews (timber emphasis). The VRI Card Types 1-3 and 8-11 should be completed to address timber emphasis issues using the most up to data VRI Ground Sampling manual.

3.5 Quality Assurance

Ground sampling quality assurance is the responsibility of stakeholders. MSRM may provide guidance in the performance of quality assurance activities. The VRI quality assurance standards typically require inspection of at least 10% of the samples. The field crews are responsible for the quality control of their own work.

NVAF quality assurance will likely be conducted by an independent contractor.

3.6 Data Compilation, Analysis, and Adjustment

Data will be compiled by the contractor and entered into TIMVEG. Error-free data will then be stored by MSRM in their system. Incomplete or incorrect data submissions will be delivered back to the contractor for correction. The stakeholders are responsible for the statistical analysis and database adjustment as well, and a competent contractor should be chosen for these tasks.

3.7 Roles and Responsibilities

General:

- Select and review the sample polygons (LM).
- Select sample locations within polygons (LM).
- Prepare all sample packages (LM).

- Prepare Access Plan (LM).
- Ensure sample packages are assembled and complete (LM).
- Approve implementation plan (Stakeholders, MSRM, MoF).
- Submit plan to PwC for funding (Kalum Forest District).
- Coordinate project activities, and ensure all contractors are qualified and certified; and tender and manage fieldwork contracts (Kalum Forest District/stakeholders).
- Award VRI contracts (Stakeholders).
- Assess access and coordinate the use of helicopters (contractor).
- Mentor ground sampling crews (MSRM).
- Mentor NVAF crews (MSRM or contractor).
- Conduct ground sample quality assurance (MSRM)
- Conduct NVAF quality assurance (MSRM or contractor).
- Validate and compile data (contractor-quality assurance by MSRM).
- Statistical analysis and adjustment (contractor)
- Audit of statistical analysis and adjustment (MSRM)

3.8 Approximate Costs

Estimated sample sizes and costs for completion of ground sampling and NVAF are listed in Table 3. The estimated total cost is $220,500. Efforts will be made early on in the project to determine the appropriateness of the estimated budget. The most variable factors are the bid price per sample and the number of samples that require helicopter access.

Table 3. Estimated costs for the timber emphasis VRI and NVAF in the Kalum TSA.

VRI Activity	Units	Unit Cost($)	Total Cost ($)
Contract Administration	1	10,000	10,000
Timber Emphasis Plots	50 clusters	1,500/cluster	75,000
NVAF	85 trees	600/tree	51,000
Helicopter Access	37 drops	1,500	55,500
Mentoring (crew training)	1	4,000	4,000
Quality Assurance	1	10,000	10,000
Compilation, Analysis, Adjustment	1	15,000	15,000
Total			*220,500*

APPENDIX A – GLOSSARY OF TERMS[2]

District-wide VRI

This is synonymous with provincial VRI; see Provincial VRI.

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 proportional to their area from a sorted list. 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. For the provincial VRI, the inventory unit is the Forest District, which includes the timber harvesting landbase, parks, recreational areas, private, and federal lands. For management inventories, the inventory unit is a subset of the provincial VRI inventory unit that focuses on a geographic area or specific attribute set, depending upon 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.,

[2] Source: Ft Nelson TSA VRI Ground Sample and Monitoring Project Implementation Plan

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. The inventory unit for the NFI is the entire country, although it is implemented province-by-province.

Net Volume Adjustment Factor (NVAF) Sampling

NVAF sampling provides factors to adjust net tree volume 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).

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.

PPSWR (Probability Proportional to Size With Replacement)

This is a sample selection method in which samples (polygons) are selected with probability proportional to their size. That is, the larger polygons have a higher chance of being included in the sample.

Provincial VRI

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

Resource-Specific Interpretations

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

Retrofit

Retrofitting is the process of translating and upgrading an existing photo-based inventory to VRI standards. If the polygon linework and attributes are of acceptable quality, the existing FIP (Forest Inventory Planning) databases are translated to VIF (Vegetation Inventory Files) databases and the additional attributes required by the VRI are re-estimated from aerial photographs.

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

Sub-unit

Sub-unit describes the inventory unit of a management inventory (i.e., the management inventory target population is a subset of the provincial VRI inventory unit). A sub-unit may be defined by a specific geographic area (e.g., operable landbase) or stand type (e.g., problem forest types) within the Forest District.

Target Precision

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

Vegetation Resources Inventory (VRI)

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

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.

APPENDIX B - LIST OF SAMPLE POLYGONS

The following sample polygon list contains 150 polygons divided into six sub-strata, defined as:

- Hemlock leading, high volume classification
- Hemlock leading, low volume classification
- Hemlock leading, medium volume classification
- Other (than hemlock) leading, high volume classification
- Other (than hemlock) low volume classification
- Other (than hemlock) medium volume classification

Each sub-stratum contains **3 times** the planned number of sample polygons, bringing the total list to 150, although only 50 samples are planned for ground sampling. The extra sample polygons have been included for the following reasons:

- A polygon may be need to be dropped if unsafe conditions or extremely poor access exists. If either of these conditions exist, you must follow these standards: http://srmwww.gov.bc.ca/tib/vri/vri/standards/index.html
  If a plot is dropped in accordance with these standards, the project administrator should be notified immediately.
- Samples falling in completely inoperable polygons (as defined in section 1.4) will be removed from the population. The assessment of an inoperable polygon will not be made by the field crews while in the field. All samples will be assessed in the office for operability using the stated slope standards. Once a sample has been deemed operable in the office… every reasonable effort will be made to sample it in the field.
- A polygon may have been disturbed since the last projection and not have the intended attributes (e.g. the stand has been logged and is therefore, by definition not VT and outside the population of interest).
- The stakeholders may wish to expand on this research at a future date.

= Planned sample polygon list (n=50) for VRI ground sampling (selected using probability proportional to size with replacement). The total list included in this appendix contains 150 polygons.

Other Leading, High Volume Sub-Strata

OBJECTID	MAPSTAND	SPC1	PCT1	SPC2	PCT2	SPC3	PCT3	SPC4	PCT4	Shape_Area	priority

853	103P017	119	BA	80 S	20	0	0	382786.70146800000	1
229	103I034	230	CW	50 H	30 S	20	0	206467.24476500000	2
700	103I078	134	BA	60 HM	40	0	0	442221.18721900000	3
166	103I028	2274	S	50 HW	30 BA	20	0	34831.52493950000	4
708	103I078	80	BA	60 HW	40	0	0	1137055.07956000000	5
896	103P013	184	BA	40 HW	40 S	20	0	172529.62468700000	6
860	103P013	297	BA	40 S	40 HW	20	0	50266.20781300000	7
700	103I078	134	BA	60 HM	40	0	0	442221.18721900000	8
721	103P013	178	S	50 HW	30 BA	20	0	125032.24500100000	9

Other Leading, Low Volume Sub-Strata

939	103P014	45	AC	100	0	0	0	94216.27800150000	1
602	103I067	273	AC	40 DR	30 HW	20 PL	10	57791.80989100000	2
698	103I077	183	BA	60 S	20 HW	20	0	98018.35025050000	3

Other Leading, Medium Volume Sub-Strata

288	103I038	156	PL	80 HW	20	0	0	157699.24563500000	1
377	103I046	459	SS	40 AC	40 CW	10 HW	10	221675.45521800000	2
753	103I087	83	BA	50 HW	40 HM	10	0	1326708.76184000000	3
410	103I046	343	BA	70 HW	30	0	0	586848.30481200000	4
828	103P017	170	BA	70 HM	20 S	10	0	1238641.92547000000	5
752	103I086	13	S	60 AC	20 CW	10 HW	10	52970.80987450000	6
258	103I039	190	BA	50 HM	30 HW	20	0	102164.95328200000	7
818	103P017	166	BA	70 S	20 HW	10	0	1112077.62594000000	8
744	103I088	154	B	60 H	30 S	10	0	432719.08400000000	9

Hemlock Leading, High Volume Sub-Strata

2432	103I060	135	HW	80 BA	20	0	0	922841.79956400000	1
2243	103I060	46	HW	60 BA	40	0	0	1278145.31206000000	2
2102	103I059	235	HW	60 BA	40	0	0	444639.53000000000	3
3049	103I079	437	HW	70 BA	30	0	0	1017494.68846000000	4
2225	103I059	226	HW	60 BA	40	0	0	1043244.80328000000	5
3462	103P007	90	HW	50 S	30 BA	20	0	442384.00850000000	6
2340	103I055	141	HW	70 BA	20 AC	10	0	324220.49431300000	7
2382	103I067	353	HW	80 SS	20	0	0	25663.25281400000	8
2524	103I058	44	HM	50 HW	30 BA	10 SS	10	370090.40243700000	9
3289	103I089	25	H	70 B	20 CW	10	0	926878.33918700000	10
2076	103I056	289	HW	60 BA	40	0	0	250427.32062500000	11
2129	103I057	39	HW	50 BA	50	0	0	125774.28293800000	12
3625	103P013	244	HW	60 BA	30 S	10	0	199255.70643700000	13
3183	103I078	64	HW	60 BA	40	0	0	429667.34865700000	14
3085	103I079	341	HW	100	0	0	0	148069.65132600000	15
167	103H097	161	HW	50 BA	50	0	0	173490.91902600000	16
946	103I034	189	H	60 B	40	0	0	134534.03907900000	17
2518	103I058	40	HW	40 BA	40 SS	20	0	285696.66318800000	18
3265	103I089	29	HW	65 B	25 CW	10	0	1976958.93456000000	19
2897	103I069	146	HW	70 BA	20 CW	10	0	633000.19062400000	20
3498	103P007	121	HW	60 S	20 BA	20	0	266785.15715700000	21
3502	103P007	45	HW	50 BA	30 S	20	0	471539.69581200000	22
2440	103I059	38	HW	60 BA	40	0	0	69560.57103200000	23
908	103I039	151	HW	50 BA	30 HM	20	0	416972.22294300000	24
1428	103I048	358	HW	60 SS	30 CW	10	0	321704.32118900000	25
3173	103I079	69	HW	80 BA	20	0	0	685042.64144000000	26
1069	103I034	130	H	60 S	40	0	0	26262.18212550000	27
157	103I008	213	HW	60 BA	40	0	0	637627.17360800000	28

3473	103P007	197	HW	60 BA	40		0		0	325653.93634600000	29
2518	103I058	40	HW	40 BA	40 SS		20		0	285696.66318800000	30
697	103I034	366	H	50 S	30 B		10 CW		10	560753.86528300000	31
2579	103I068	254	HM	50 BA	40 HW		10		0	609622.55040500000	32
2243	103I060	46	HW	60 BA	40		0		0	1278145.31206000000	33
2188	103I069	493	HW	40 BA	40 HM		20		0	220537.61584500000	34
974	103I037	197	HW	70 BA	20 CW		10		0	112010.64310000000	35
1558	103I047	186	HW	70 CW	30		0		0	25036.82465650000	36
2244	103I059	159	HW	70 BA	30		0		0	495417.53750000000	37
3165	103I079	67	HW	60 BA	40		0		0	1174980.96894000000	38
3165	103I079	67	HW	60 BA	40		0		0	1174980.96894000000	39
1781	103I046	77	HM	50 BA	30 HW		20		0	408332.69418600000	40
1920	103I008	109	HW	70 BA	30		0		0	308795.94269800000	41
2661	103I069	374	HW	70 BA	30		0		0	187478.90443700000	42
3083	103I079	90	HW	50 BA	50		0		0	139453.87015600000	43
2507	103I059	45	HW	60 BA	30 CW		10		0	276770.55693700000	44
3435	103P007	76	HW	70 BA	30		0		0	899621.43340600000	45
2521	103I058	16	HW	40 SS	30 BA		30		0	278188.80456100000	46
2257	103I058	140	HW	50 BA	50		0		0	104349.19990500000	47
2107	103I056	216	HW	70 BA	10 CW		10 SS		10	137898.80693700000	48

Hemlock Leading, Low Volume Sub-Strata

1549	103I045	148	HM	35 HW	35 BA	30	0	632061.02562500000	1
238	103H096	65	HW	90 CW	10	0	0	44976.24208750000	2
109	103H086	54	HW	50 YC	30 BA	20	0	243713.70278100000	3
1027	103I038	239	HW	90 BA	10	0	0	1750747.05500000000	4
1399	103I044	126	H	60 B	40	0	0	425914.52306500000	5
2913	103I069	38	HW	80 BA	10 S	10	0	261066.63740500000	6
1500	103I046	204	HW	50 BA	20 CW	20 SS	10	287996.40664300000	7
3751	103P036	7	HW	60 PL	30 AT	10	0	201844.98484400000	8
1528	103I047	422	HW	68 CW	20 BA	10 SS	2	821113.99657500000	9
3443	103P014	5	H	60 B	30 S	10	0	117162.74551400000	10
1933	103I037	766	HW	70 S	15 BA	15	0	48454.10967800000	11
725	103I038	93	HW	60 CW	40	0	0	175692.87456100000	12
3221	103I077	24	HW	90 PL	10	0	0	91578.48918750000	13
1414	103I045	337	HW	40 EP	30 SS	10 CW	10	328826.05634500000	14
64	103H086	68	HW	70 CW	20 BA	10	0	47009.56418750000	15
872	103I038	278	HW	90 BA	10	0	0	309015.11089200000	16
2395	103I056	16	HW	60 BA	40	0	0	101701.34228100000	17
3476	103P003	128	HW	90 S	10	0	0	352349.21550000000	18
1813	103I007	19	HW	100	0	0	0	255742.88461100000	19
1009	103I038	210	HW	70 BA	20 CW	10	0	365687.35292100000	20
1937	103I033	138	H	60 B	30 S	10	0	81378.87423550000	21
132	103H086	58	HW	60 YC	30 BA	10	0	290768.62839200000	22
950	103I035	40	HM	50 BA	50	0	0	141511.15098500000	23
1577	103I048	473	HM	80 BA	20	0	0	1155888.56644000000	24
67	103I018	2020	HW	50 BA	20 CW	20 SS	10	83290.76090650000	25
1317	103I046	145	HW	40 EP	30 SS	10 CW	10	86657.60784250000	26
1528	103I047	422	HW	68 CW	20 BA	10 SS	2	821113.99657500000	27
3101	103I079	266	HW	80 BA	20	0	0	512639.98737400000	28
3141	103I077	218	HW	100	0	0	0	99906.92596850000	29
1616	103I043	103	H	60 CW	40	0	0	172312.35775200000	30
920	103I037	31	HW	40 HM	40 BA	20	0	100878.85162600000	31

3402	103I092	387	H	60 CW		30 S		10		0	581656.58053300000	32
1431	103I048	484	HW	70 CW		23 SS		7		0	127500.59671800000	33
1579	103I047	404	HW	85 CW		10 BA		5		0	1177257.35728000000	34
1993	103I045	264	HM	75 HW		17 BA		8		0	272850.93703100000	35
1641	103I045	169	HW	50 HM		30 BA		20		0	514051.47290800000	36

Hemlock Leading, Medium Volume Sub-Strata

2731	103I070	48	HW	100		0		0		0	268105.98518700000	1
1662	103I044	28	H	60 B		40		0		0	111207.10228300000	2
210	103H097	162	HW	60 BA		20 CW		20		0	793661.28999800000	3
2609	103I068	385	HW	40 S		30 PL		20 CW		10	59471.83713150000	4
3010	103I080	160	HW	100		0		0		0	542576.83775000000	5
880	103I038	205	HW	60 BA		30 CW		10		0	260687.56964500000	6
925	103I040	36	HM	60 BA		40		0		0	771156.84950100000	7
765	103I037	130	HW	80 BA		20		0		0	27406.59323450000	8
3375	103I087	1	HW	80 BA		20		0		0	94792.68659350000	9
318	103H097	239	HW	60 YC		20 BA		20		0	244830.99348600000	10
1891	103I018	1788	HW	60 BA		40		0		0	153266.83285900000	11
1666	103I045	101	HW	50 BA		30 SS		20		0	129437.93662600000	12
973	103I039	130	HW	90 BA		10		0		0	238707.80946300000	13
6	103H086	191	HW	50 CW		40 SS		10		0	170429.10173500000	14
1617	103I046	335	HM	70 HW		20 BA		10		0	380982.27346900000	15
235	103H096	94	HW	60 CW		40		0		0	257465.68966400000	16
1614	103I045	321	HW	80 BA		20		0		0	530956.96021900000	17
3301	103I089	8	H	60 B		40		0		0	623330.44143700000	18
2744	103I080	11	H	60 B		40		0		0	240221.01487300000	19
799	103I038	80	HW	70 SS		30		0		0	111268.12726700000	20
2317	103I060	172	HW	80 BA		20		0		0	1532696.32588000000	21
3362	103I086	52	HW	40 PL		30 S		10 BA		10	909700.59926600000	22
3142	103I077	70	HW	40 BA		20 CW		20 S		20	143073.78175000000	23
2042	103I058	468	HW	90 BA		10		0		0	721964.40372000000	24
1636	103I046	435	HW	90 BA		10		0		0	248268.41543800000	25
3047	103I080	99	H	90 B		10		0		0	1522077.18278000000	26
2585	103I055	47	HW	60 BA		40		0		0	547671.89743800000	27
3386	103I097	111	HM	70 BA		30		0		0	293467.41168800000	28
3484	103P007	21	HW	60 BA		20 S		20		0	1023066.95444000000	29
2001	103I044	82	H	60 B		40		0		0	262059.36628200000	30
3482	103P007	202	HM	50 BA		50		0		0	694313.99387400000	31
3300	103I088	40	H	70 B		30		0		0	751783.53903100000	32
2742	103I078	127	HW	80 BA		20		0		0	225167.96171700000	33
1911	103H097	216	HW	60 CW		20 BA		20		0	148783.85325000000	34
2480	103I059	80	HW	50 BA		30 HM		20		0	352045.29265500000	35
1361	103I045	121	HW	70 BA		20 CW		10		0	549958.02053100000	36
2583	103I054	19	H	60 B		30 S		10		0	132642.27234400000	37
273	103I037	198	HW	80 BA		20		0		0	95159.82595450000	38
2042	103I058	468	HW	90 BA		10		0		0	721964.40372000000	39
2239	103I054	103	H	60 B		30 CW		10		0	105227.32734300000	40
1416	103I045	247	HW	50 CW		30 SS		20		0	85273.59553100000	41
262	103I008	158	HW	70 BA		20 CW		10		0	516550.36582400000	42
1734	103I047	11	HM	60 BA		40		0		0	555891.33390400000	43
2217	103I056	96	HW	70 BA		30		0		0	469908.60090900000	44
1588	103I044	60	H	60 B		40		0		0	367995.50190500000	45

APPENDIX C – SAMPLE SELECTION DOCUMENTATION

(Vegetation Resources Inventory, Sampling Selection Procedures, GIS)

The following are the GIS steps and procedures followed to select sampling polygons for vegetation resources inventory. The steps were initially performed by Andy Muma (GIS Technician, MapWood GIS & Forest Consultants). Further analysis was performed by Dennis Rasmussen, (GIS Coordinator, Tyhee Forestry Consultants Ltd.)

The software used for the analysis was ArcGIS Desktop version 8.3. All analysis and resultant data was performed and managed using ESRI's Personal Geodatabase format.

The database used for the sample selection was received from Jim Knox of Magellan Digital Mapping, who was preparing an operability assessment of the Kalum Forest District concurrent to this plan. The database was received from the Regional District in November 2003. The graphic files are shapefiles, and the attribute files are FIP files were projected to 2002 (polygons that would reach age 120 from 2002 to 2004 counted for less than 1% of the total target population). These 2002 projections were used for this sample selection.

Step 1 **ASSEMBLING POPULATION DATA**

Received files from MapWood (files were adjusted following steps 1a through 1f).

Step 1a

Received two shape files from Kevin Kilpatrick. The files were a clip of the forest inventory polygons separated by FIZ A and J and appropriately named fiza_op.shp and fizj_op.shp. The data was geo-referenced to NAD 1983 and project to BC Environment Albers. No corresponding metadata was submitted. This clip was based on areas classified as cable, ground and aerial having marginal sawlog, pulp, and sawlog. This information was stated in e-mail and was received April 23 / 2004

Step 1b

Imported shape files into ESRI's Personal Geodatabase format (spatial Access.mdb file) for GIS analysis. The data was cleaned and validated at 0.5m-cluster tolerance and checked for sliver gaps and overlaps. The two feature classes created were named fizA_op and fizJ_op

Step 1c

Merged fizA_op and fizJ_op to one combined feature class called fizJ_A

Step 1d

Selected from feature classes fizJ_A all polygons 120 years and older. This selection was based on the attribute field [AGE_PRJ] meeting criteria for [AGE_PRJ] greater than or equal to 120. The resultant feature classes were named fizJ_A_120. *Note:

Step 1e **SEPARATE POLYGONS BY STRATA**

Selected hemlock-leading polygons from the feature fizJ_A_120. (Step 4) The selection was based on the attribute field [SPC1] meeting criteria for
[SPC1] = “HW” or “HM” or “H”. The resultant feature class was named fizJ_A_120_H.

Step 1f

Selected all other non hemlock-leading polygons from the feature class fizJ_A_120_O. This selection was based on the attribute field [SPC1] meeting criteria for [SPC1] not equal to “HW” or “HM”or “H”. The resultant feature classes were named fizJ_A_120_O.

Step 2

Imported and overlaid Ministry ownership file and created a file FizJ_A_O_120 which included all stands >120 years for ownership codes 61C, 61N, 62C, 69C, 69N, and 70N. Ownership that was excluded was codes 40N, 50N, 52N, 60N, 63N and 67N.

Step 3

Added field Totvol1 and added all volumes for utilization level 1 for species 1 to species 6.

Step 4

Selected from FizJ_A_O_120 all Hemlock leading and created a file called FizJ_A_O_120_H, and all other leading species to create a file called FizJ_A_O_120_O.

Step 5 **SEPARATE STRATA INTO SUB-STRATA**

Sorted resultant feature classes fizJ_A_O_120_H, and fizJ_A_O_120_O, fizA_120_O by volume. This sort was based on the attribute field [Totvol1]. The sort resulted in a count of 3,758 polygons in the hemlock leading stratum, and 1,052 polygons in the other leading stratum.

Step 6

Divide fizJ_A_O_120_H, and fizJ_A_O_120_O, total number of polygons by **3** to create three sub-strata feature classes and classify in a new field called “Totvol1_code” and classify with “H”, “M” and “L” for High, medium and low volume classifications (sub-strata) for both hemlock and other leading polygons (strata).

Calculations completed as follows:

fizJ_A_120_H

3758 / 3

=1252.66

Note: Hemlock High and Medium sub-strata were allocated 1253 polygons each and the Hemlock Low sub-stratum was allocated 1252 polygons.

fizJ_A_O_120_O

1051* / 3

=350.33

Note: 1,051 polygons were used in the Other leading stratum, not 1,052. One 0.4 ha Aspen leading polygon NSR polygon was removed from the population.

Note: Other High sub-stratum was allocated 351 polygons and Other Medium and Low sub-strata were allocated 350 polygons each.

Step 7 **DETERMINE SAMPLE ALLOCATION PER SUB-STRATUM**

50 is the recommended sample size for this population. 100 extra samples were included in the sample list for a total of 150 samples allocated per sub-stratum by area weight. The results of this allocation are in Table 1 below.

Step 8 **DETERMINE AREA SIZE BY SUB-STRATUM AND ACCUMULATE POLYGON AREAS IN EACH SUB-STRATUM**

Area fields for each sub-stratum were accumulated and calculated based on weighted sample polygons. The results of this determination are in Table 1 below.

Step 9 **GENERATE AS MANY RANDOM NUMBERS AS THERE ARE ALLOCATED SAMPLES FOR EACH SUB-STRATUM AND USE THESE NUMBERS TO IDENTIFY SAMPLE POLYGONS**

A random number generator was used to determine the sample polygons using the PPSWR method. The polygons were sorted based on the FC_TAG field for this exercise. Selected sample polygons were therefore put back into the population after selection. The complete sample list is available in Appendix B.

Table 1: Sample Selection Results

Strata	Sub-strata	Total Polygon Area (ha)	Area (%)	# of samples (/150)	# of samples (/50)
Hemlock Leading	High	23,799.5	37.7	48	16
	Medium	22,381.4	35.5	45	15
	Low	16,898.4	26.8	36	12
	Sub Total	*63,079.3*	*85.1*	*129*	*43*
Other Leading	High	4,231.2	38.4	9	3
	Medium	4,550.9	41.3	9	3
	Low	2,234.6	20.3	3	1
	Sub Total	*11,017.2*	*14.9*	*21*	*7*
TOTAL		**74,096.5**		**150**	**50**

APPENDIX D – OPERABLE LANDBASE CRITERIA

November 20, 2003

Kalum TSA, TFL 1 & 41 Operability - Slope Parameters for Primary Harvest Code

Primary Codes	FIZ A	FIZ J
G (Ground-based)	≤ 30% slope	≤ 40% slope
C (Cable)	> 30 ≤ 80% slope	> 40 ≤ 80% slope
A (Aerial)	> 80 ≤ 90% slope	> 80 ≤ 90% slope
I (Inoperable)	> 90% slope	> 90% slope

Kalum TSA, TFL 1, TFL 41 - Stand Quality Code Parameters and description

Mature = Age Class 5 – 9
Immature = Age class ≤ 4 (≤ 80 years)
Minimum Harvest Age = Age at which 250m3/ha is achieved as per G&Y table having a height of 22m and dbh of 25 cm

G, M, P, L sites are as per the Kalum TSR: Good sites: SI ≥ 26 Medium sites: SI ≥ 15, <26
Poor sites: SI ≥ 10, < 15 Low sites: SI < 10. SI will be applied (also allow for the opportunity to run the model using the GMPL site class values as well)

<table>
<tr><th>FIZ A</th><th>FIZ J</th></tr>
<tr><td colspan="2">S – Coniferous Sawlog stands i.e. primarily of sawlog grade (licencee best estimate)</td></tr>
<tr><td>
• Coniferous leading stands, all species, age class ≤ 5 to 7, height class ≥ 3; site class G or M; Net merchantable volume at minimum harvest age ≥ 300 m3/ha
• Spruce, Pine, Balsam, or Cedar leading stands; age class 8 or 9, height class ≥ 4; Site class G or M; Net merchantable volume ≥ 300 m3/ha
• Hemlock leading stands; age class 9, height class ≥ 4; Site class G and M; Net merchantable volume ≥ 300 m3/ha; ≥20% Spruce, Pine, Balsam, or Cedar
• Hemlock leading stands; age class 8, height class ≥ 4; Site class G and M; Net merchantable volume ≥ 300 m3/ha
• All immature coniferous leading stands; Net merchantable volume at minimum harvest age ≥ 300 m3/ha
</td><td>
• Coniferous leading stands, all species, age class 5 to 7, height class ≥ 3; site class G, M or P; Net merchantable volume at minimum harvest age ≥ 250 m3/ha
• Spruce, Pine, Balsam, and Cedar leading stands; age class 8 or 9, height class ≥ 3; Site class G or M; Net merchantable volume ≥ 250 m3/ha
• Hemlock leading stands; age class 9, height class ≥ 3; Site class G or M; Net merchantable volume ≥ 250 m3/ha; ≥20% Spruce, Pine, Balsam, and Cedar
• Hemlock leading stands; age class 8, height class ≥ 3; Site class G; Net merchantable volume ≥ 250 m3/ha
• All immature coniferous leading stands with height class ≥ 3; Net merchantable volume at minimum harvest age ≥ 250 m3/ha
• All immature coniferous leading stands with height class < 3 that have resulted from previous logging/catastrophic events where silviculture activities have taken place; Net merchantable volume at minimum harvest age ≥ 250 m3/ha
•
</td></tr>
<tr><td colspan="2">M – Marginal Coniferous Sawlog stands i.e. stands that are not “sawlog”, but not poor enough to be designated as “pulplog”</td></tr>
</table>

• Hemlock leading stands; age class 9, height class ≥ 4; Site class G and M; Net merchantable volume ≥ 300m3/ha; <20% Spruce, Pine, Balsam, or Cedar • Hemlock leading stands; age class 8 or 9, height class = 3; Site class G and M; Net merchantable volume ≥ 300 m3/ha • Spruce, Pine, Balsam, and Cedar leading stands, age class 8 or 9; height class = 3; site class G and M; Net merchantable volume ≥ 300 m3/ha. • **ADDED:** Deciduous leading stands with greater that 50% of the stand volume comprised of deciduous species, and with ≥ 30 % Spruce and/or Cedar content. •	• Hemlock leading stands; age class 9, height class ≥ 3; Site class G or M; Net merchantable volume ≥ 250 m3/ha; <20% Spruce, Pine, Balsam, and Cedar • Hemlock leading stands; age class 8, height class ≥ 3; Site class M; Net merchantable volume ≥ 250 m3/ha • Spruce, Pine, Balsam, and Cedar leading stands, age class 8 or 9; height class ≥ 3; site class P; Net merchantable volume ≥ 250 m3/ha. • Deciduous leading stands with greater that 50% of the stand volume comprised of deciduous species, and with ≥ 30 % Spruce and/or Cedar content.
P – Coniferous Pulplog stands i.e. primarily of Pulplog grade (licencee best estimate)	
• Coniferous leading stands; age class 8 or 9, height class ≥ 3; Site class P; Net merchantable volume ≥ 300 m3/ha	• Hemlock leading stands; age class 8 or 9, height class ≥ 3; Site class P; Net merchantable volume ≥ 250 m3/ha
D- Deciduous leading stands	
• All stands having greater than 50% of the stand volume comprised of deciduous species and < 30 % Spruce and/or Cedar content.	• All stands having greater than 50% of the stand volume comprised of deciduous species and < 30 % Spruce and/or Cedar content.
L – Low sites	
• Conifer leading stands, age class 4 and greater, stocking classes 2,3, and 4 • Mature coniferous stands with a height class of 2 or less; • Stands with volumes of ≤ 300 m3 at minimum harvest age age > 140 years; • Site productivity "L" or site indices of less than 10 at 50 years.	• Conifer leading stands, age class 4 and greater, stocking classes 2,3, and 4 • Mature coniferous stands with a height class of 2 or less; • Stands with volumes of ≤ 250 m3 at minimum harvest age age > 140 years; • Site productivity "L" or site indices of less than 10 at 50 years.
T- Density problems	
• Coniferous leading stands, **age class 5 and greater**, stocking classes 2, 3,and 4; • Immature stands resulting from catastrophic events that have had no silviculture treatments.	• Coniferous leading stands, **age class 5 and greater**, stocking classes 2, 3,and 4; • Immature stands resulting from catastrophic events that have had no silviculture treatments.

APPENDIX E – COMPARISON BETWEEN THE POPULATION AND THE SAMPLE POLYGONS

The following tables compare the percent distribution of samples to the distribution (by area) of the total population. Relationships are depicted for the distribution of sample by mapsheet, age class, height class, and leading species. They reveal a strong co-relation between the two populations and prove that the sample selection was effective.

Sample - Population Comparison Mapsheet Distribution

Mapsheet	Mapsheet Area (ha)	% Total Population Area	Sample Distribution %	# Samples
093L001	78.98064924	0.11%	0.00%	0
103H086	2221.019487	3.00%	2.67%	4
103H087	206.0041674	0.28%	0.00%	0
103H096	1446.476562	1.95%	1.33%	2
103H097	2299.916958	3.10%	2.67%	4
103I007	697.3442647	0.94%	0.67%	1
103I008	1681.635593	2.27%	2.00%	3
103I017	147.2431094	0.20%	0.00%	0
103I018	943.5286326	1.27%	1.33%	2
103I023	235.4278404	0.32%	0.00%	0
103I024	10.68798879	0.01%	0.00%	0
103I027	90.84010325	0.12%	0.00%	0
103I028	263.1140957	0.36%	0.67%	1
103I032	9.072541856	0.01%	0.00%	0
103I033	1325.602571	1.79%	0.67%	1
103I034	2455.97731	3.31%	2.67%	4
103I035	516.5431449	0.70%	0.67%	1
103I037	1263.281676	1.70%	3.33%	5
103I038	2595.039064	3.50%	4.67%	7
103I039	2025.360186	2.73%	2.00%	3
103I040	771.6692756	1.04%	0.67%	1
103I043	1087.047832	1.47%	0.67%	1
103I044	615.7386712	0.83%	2.67%	4
103I045	2660.172624	3.59%	5.33%	8
103I046	2454.199999	3.31%	4.67%	7
103I047	2482.323721	3.35%	3.33%	5
103I048	2856.555274	3.86%	2.00%	3
103I049	693.1616516	0.94%	0.00%	0
103I052	63.73578564	0.09%	0.00%	0
103I053	54.20204936	0.07%	0.00%	0
103I054	329.5013272	0.44%	1.33%	2
103I055	1029.788491	1.39%	1.33%	2
103I056	1708.504871	2.31%	2.67%	4
103I057	1934.364143	2.61%	0.67%	1
103I058	2964.746557	4.00%	4.67%	7
103I059	2362.846346	3.19%	4.00%	6

103I060	1515.990867	2.05%	2.67%	4
103I062	2.069766219	0.00%	0.00%	0
103I064	17.85781552	0.02%	0.00%	0
103I065	4.496525378	0.01%	0.00%	0
103I067	1238.033973	1.67%	1.33%	2
103I068	1919.563193	2.59%	1.33%	2
103I069	2233.909462	3.01%	2.67%	4
103I070	416.8607256	0.56%	0.67%	1
103I077	1066.111469	1.44%	2.67%	4
103I078	1223.877306	1.65%	3.33%	5
103I079	3594.788671	4.85%	4.67%	7
103I080	1013.331421	1.37%	2.00%	3
103I086	267.5645034	0.36%	1.33%	2
103I087	1318.198649	1.78%	1.33%	2
103I088	1649.775688	2.23%	1.33%	2
103I089	1565.02504	2.11%	2.00%	3
103I090	115.3649952	0.16%	0.00%	0
103I091	15.89774017	0.02%	0.00%	0
103I092	497.9478316	0.67%	0.67%	1
103I097	252.6919932	0.34%	0.67%	1
103P002	0.027404228	0.00%	0.00%	0
103P003	675.1870001	0.91%	0.67%	1
103P006	311.2874072	0.42%	0.00%	0
103P007	2421.787246	3.27%	4.67%	7
103P013	3013.019573	4.07%	2.67%	4
103P014	952.3346136	1.29%	1.33%	2
103P015	15.526599	0.02%	0.00%	0
103P017	968.3896604	1.31%	2.00%	3
103P023	19.5634267	0.03%	0.00%	0
103P024	10.09255659	0.01%	0.00%	0
103P025	637.8521774	0.86%	0.00%	0
103P035	438.2945032	0.59%	0.00%	0
103P036	121.7208201	0.16%	0.67%	1
TOTAL	**74096.09519**	**100.00%**	**100.00%**	**150**

Sample - Population Comparison Age Class

Age Class	Area (ha)	% Total Population Area	Sample Distribution %	# Samples
6	6.61	0.01%	0.00%	0
7	2052.99	2.77%	2.00%	3
8	16024.57	21.63%	19.33%	29
9	56011.91	75.59%	78.67%	118
TOTAL	**74096.1**	**100.00%**	**100.00%**	**150**

Sample - Population Comparison Height Class

Height Class	Area (ha)	% Total Population Area	Sample Distribution %	# Samples
3	14950.65	20.18%	21.33%	32
4	41380.79	55.85%	56.00%	84
5	15535.72	20.97%	21.33%	32
6	1879.22	2.54%	1.33%	2
7	288	0.39%	0.00%	0
8	61.72	0.08%	0.00%	0
TOTAL	**74096.1**	**100.00%**	**100.00%**	**150**

Sample - Population Comparison Leading Species

Leading Species	Area (ha)	% Total Population Area	Sample Distribution %	# Samples
H	10,155.80	13.71%	12.00%	18
Hm	8,744.70	11.80%	8.00%	12
Hw	44,178.80	59.62%	66.00%	99
Ac	1,125.00	1.52%	1.33%	2
At	126.3	0.17%	0.00%	0
B	403	0.54%	0.67%	1
Ba	5,208.70	7.03%	8.00%	12.00
Bl	3.4	0.00%	0.00%	0
Cw	1,103.30	1.49%	0.67%	1
Dr	0	0.00%	0.00%	0
E	0	0.00%	0.00%	0
Ep	8.7	0.01%	0.00%	0
Pl	638	0.86%	0.67%	1
S	1,588.10	2.14%	2.00%	3
SS	711.1	0.96%	0.67%	1
Sw	28.8	0.04%	0.00%	0
Yc	72.4	0.10%	0.00%	0
TOTAL	**74,096.10**	**100.00%**	**100.00%**	**150**

APPENDIX F – NVAF SAMPLING POLYGON SELECTION

= Planned sample list for NVAF sampling (n=25). The total sample list contains 50 polygons and represents the planned sample list for ground sampling. The 25 NVAF polygons were randomly selected from each sub-stratum of ground sample polygons.

OBJECTID	MAPSTAND	SPC1	PCT1	SPC2	PCT2	SPC3	PCT3	SPC4	PCT4	Shape_Area	priority
Other Leading, High Volume Sub-Strata											
853	103P017 119	BA	80	S	20		0		0	382786.70146800000	1
229	103I034 230	CW	50	H	30	S	20		0	206467.24476500000	2
700	103I078 134	BA	60	HM	40		0		0	442221.18721900000	3
Other Leading, Low Volume Sub-Strata											
939	103P014 45	AC	100		0		0		0	94216.27800150000	1
Other Leading, Medium Volume Sub-Strata											
288	103I038 156	PL	80	HW	20		0		0	157699.24563500000	1
377	103I046 459	SS	40	AC	40	CW	10	HW	10	221675.45521800000	2
753	103I087 83	BA	50	HW	40	HM	10		0	1326708.76184000000	3
Hemlock Leading, High Volume Sub-Strata											
2432	103I060 135	HW	80	BA	20		0		0	922841.79956400000	1
2243	103I060 46	HW	60	BA	40		0		0	1278145.31206000000	2
2102	103I059 235	HW	60	BA	40		0		0	444639.53000000000	3
3049	103I079 437	HW	70	BA	30		0		0	1017494.68846000000	4
2225	103I059 226	HW	60	BA	40		0		0	1043244.80328000000	5
3462	103P007 90	HW	50	S	30	BA	20		0	442384.00850000000	6
2340	103I055 141	HW	70	BA	20	AC	10		0	324220.49431300000	7
2382	103I067 353	HW	80	SS	20		0		0	25663.25281400000	8
2524	103I058 44	HM	50	HW	30	BA	10	SS	10	370090.40243700000	9
3289	103I089 25	H	70	B	20	CW	10		0	926878.33918700000	10
2076	103I056 289	HW	60	BA	40		0		0	250427.32062500000	11
2129	103I057 39	HW	50	BA	50		0		0	125774.28293800000	12
3625	103P013 244	HW	60	BA	30	S	10		0	199255.70643700000	13
3183	103I078 64	HW	60	BA	40		0		0	429667.34865700000	14
3085	103I079 341	HW	100		0		0		0	148069.65132600000	15
167	103H097 161	HW	50	BA	50		0		0	173490.91902600000	16
Hemlock Leading, Low Volume Sub-Strata											
1549	103I045 148	HM	35	HW	35	BA	30		0	632061.02562500000	1
238	103H096 65	HW	90	CW	10		0		0	44976.24208750000	2
109	103H086 54	HW	50	YC	30	BA	20		0	243713.70278100000	3
1027	103I038 239	HW	90	BA	10		0		0	1750747.05500000000	4
1399	103I044 126	H	60	B	40		0		0	425914.52306500000	5
2913	103I069 38	HW	80	BA	10	S	10		0	261066.63740500000	6
1500	103I046 204	HW	50	BA	20	CW	20	SS	10	287996.40664300000	7
3751	103P036 7	HW	60	PL	30	AT	10		0	201844.98484400000	8
1528	103I047 422	HW	68	CW	20	BA	10	SS	2	821113.99657500000	9
3443	103P014 5	H	60	B	30	S	10		0	117162.74551400000	10
1933	103I037 766	HW	70	S	15	BA	15		0	48454.10967800000	11
725	103I038 93	HW	60	CW	40		0		0	175692.87456100000	12

Hemlock Leading, Medium Volume Sub-Strata

2731	103I070	48	HW	100	0	0	0	268105.98518700000	1
1662	103I044	28	H	60 B	40	0	0	111207.10228300000	2
210	103H097	162	HW	60 BA	20 CW	20	0	793661.28999800000	3
2609	103I068	385	HW	40 S	30 PL	20 CW	10	59471.83713150000	4
3010	103I080	160	HW	100	0	0	0	542576.83775000000	5
880	103I038	205	HW	60 BA	30 CW	10	0	260687.56964500000	6
925	103I040	36	HM	60 BA	40	0	0	771156.84950100000	7
765	103I037	130	HW	80 BA	20	0	0	27406.59323450000	8
3375	103I087	1	HW	80 BA	20	0	0	94792.68659350000	9
318	103H097	239	HW	60 YC	20 BA	20	0	244830.99348600000	10
1891	103I018	1788	HW	60 BA	40	0	0	153266.83285900000	11
1666	103I045	101	HW	50 BA	30 SS	20	0	129437.93662600000	12
973	103I039	130	HW	90 BA	10	0	0	238707.80946300000	13
6	103H086	191	HW	50 CW	40 SS	10	0	170429.10173500000	14
1617	103I046	335	HM	70 HW	20 BA	10	0	380982.27346900000	15

APPENDIX G – APPROVAL/SIGNING

I have read and concur with the Kalum Timber Supply Area Strategic Inventory Plan, dated April 20, 2004. It is understood that this is an agreement-in-principle and does not commit the signatories to completing the inventory activities outlined within the plan. Modifications to this plan or more detailed plans need to be reviewed and approved by the signatories.

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Ministry of Forests Forest Analysis Branch

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Director
Ministry of Sustainable Resource Management, Resource Information Branch

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West Fraser Mills Ltd.

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New Skeena Forest Products Inc.

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Bell Pole Co.