Babine Forest Products Co.
Enhanced Forest Management Pilot Project
Vegetation Resources Inventory Sampling Plan

Submitted to:

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1   INTRODUCTION

1.1   Background

In the spring of 1997, Babine Forest Products Ltd. initiated a project to conduct a Pre-Inventory Analysis (PIA) on their EFMPP (Enhanced Forest Management Pilot Project) Area. Fieldwork was completed during the fall of 1997 with a final PIA report delivered in February 1998. The PIA document provided recommendations and stated objectives regarding a vegetation inventory that Babine Forest Products proposed to complete.

To enhance the proposed re-inventory of the EFMPP area, Babine Forest Products Co. decided to incorporate the Ministry of Forests' BC Vegetation Resources Inventory protocol. This sampling plan discusses the procedures and standards that will be followed to complete the VRI sampling of the EFMPP area sub-unit inventory. Vegetation Inventory standards follow the MoF Vegetation Resources Inventory Sampling Standards and Procedures. These standards will be used to ensure continuity of procedures throughout the period of inventory sampling. This plan will include completion of Phase II ground sampling to check the accuracy of the new VRI Phase I in 2000, and to adjust the inventory in 2001.

The ground sampling in the TSA will involve installing full VRI samples (Timber/Ecology), timber emphasis sample clusters (TEP), and net volume adjustment factor (NVAF) sampling. This ground sampling, followed by statistical adjustment of the new Phase I estimates, will provide a higher statistical confidence in the timber volume estimates across the EFMPP landbase. Specifically, the adjusted VRI will:

- Address the timber inventory accuracy concerns in the EFMPP portion of the TSA; and
- Meet the timber inventory needs of Babine's EFMPP. Babine requires accurate estimates of the standing crop inventory and annual growth, to model the effects of forest management at the stand and forest levels in the spatial timber supply analysis process.

1.2   Document Objectives

This sampling plan outlines the objectives, standards and procedures to be followed for collecting inventory data to adjust the VRI in Babine's EFMPP area. This plan is submitted for approval by Babine and the MoF.

1.3   EFMPP Area Statistics

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Babine Forest Products Co. EFMPP area is located within the Lakes Forest District of the Prince Rupert Forest Region and covers a total area of approximately 354,764 ha. Of this total and according to the current forest cover inventory, approximately 211,477 ha. (60%) is occupied by productive mature forests, 94,640 ha. (27%) is occupied by productive immature forests. Of the remaining 48,647 ha. (13%), 4400 ha. (1.21%) is occupied by productive immature NSR types, 5,775 ha. (1.7%) by non-productive forested types, and 35,873 ha. (10.2%) by non-productive types. See Table 1 for a complete breakdown of the area based on the current forest cover inventory.

The EFMPP area is located to the north and south of the town of Burns Lake as three non-contiguous compartments: around Babine Lake (North Babine, South Babine and North Decker compartments), around Maxan Creek (South Decker compartment) and, northwest of Cheslatta Lake (Ootsa compartment) (refer to the Key Map).

The dominant topographic feature of the EFMPP area is Babine Lake, found centrally in the northern compartments, while the remaining areas of the EFMPP feature more gently rolling terrain. The major drainage's of the EFMPP area include:

- The Babine River drainage with Babine Lake acting as the drainage systems reservoir;
- The Sutherland River draining a significant portion of the eastern side of the northern compartment;
- Butterfield, Fleming and Tildesley Creeks which drain a significant portion of the northern compartment north of Babine Lake;
- Pinkut Creek, the only drainage of significance draining the northern compartment south of Babine Lake;
- Maxan Creek, which drains the majority of the southwest compartment;
- Ootsanee Lake drainage in the southern compartment.

Figure 1   Key Map of Project Area

Table 1   Gross Area Summary for the EFMPP Area; Productive Forest/Non-Productive Forest/ Non-Productive Categories (statistics from EFMPP Forest Cover Inventory)

Descriptor	Area (ha)	Area % of EFMPP Area
Productive Mature (all type groups)	211,477.47	59.60
Productive Immature (all type groups)	94,640.90	26.70
Productive Immature: NSR	4,410.93	0.13
NP Forest	4,639.44	1.31
Alpine Forest	1,135.13	0.32
Alpine	1,586.91	0.45
Rock	653.72	0.18
Sand	4.06	0.00
Claybank	4.86	0.00
NP (Misc.)	2,855.14	0.81
Lake	23,972.73	6.76
River	190.17	0.05
Swamp	5,971.02	1.68
Cultivated	5.28	0.00
Urban	240.59	0.07
Meadow	253.74	0.07
Open Range	133.24	0.04
NTA	2.38	0.00
Total Productive Forest	310,529.30	87.60
Total Non-Productive Forest	5,774.57	1.70
Total Non-Productive & NTA	35,873.78	10.20

1.4   Biogeoclimatic

Five Biogeoclimatic sub-zone/variants are found within the boundaries of the EFMPP area. The Moist Cold Sub-Zone Babine Variant of the Sub-Boreal Spruce Zone (SBS mc2) covers the majority of the northern compartment and isolated pockets within the other two compartments. The Dry Cool Sub-Zone of the Sub-Boreal Spruce Zone (SBS dk) along the majority of the north and south shorelines of Babine Lake and up the Sutherland River (northern compartment) and covering the majority of the west central and southern compartments. The Wet Cool Takla variant of the Sub-Boreal Spruce Zone (SBS wks) is located in the northeast corner of the northern compartment of the chart area. The Moist Cold Sub-Zone of the Engelmann Spruce Sub-Alpine Fir Zone (ESSF mc) occupies the mid to higher elevation areas

occurring in the northern compartment of the chart area. The Alpine Tundra Zone (AT) can be found in the western, northern and eastern corners of the northern compartment of the EFMPP area, but is relatively insignificant in size and percent cover.

Table 2 Summary of Climatic Data by Biogeoclimatic Sub-Zone for the EFMPP Area

Zone	Sub-Zone Variant	Mean Annual Precip. (mm)	Mean May-Sept. Precip. (mm)	Mean Annual Temp (c)	Mean May-Sept. Temp (c)
SBS	SBSmc2	650	300	1.9	10.5
	SBSdk	440	210	3.2	11.6
	SBSwk3	1000	450	3.0	11.3
ESSF	ESSFmc	1100	410	1.4	10.0
AT	AT	> 1400	> 400	< 1.0	< 9.0

Table 3 Summary of Biophysical Attributes by Biogeoclimatic Sub-Zone in EFMPP Area

Unit	Elevation	Major Tree Species	Minor Tree Species	Area (ha)	% of Total
SBS mc2	700-1000	Sx. Bl. Pl	At. Fd. Sb. Ac	198.713	57
SBS dk	600-900	Sx. Pl	Bl. At. Ep. Fd. Sb	100.348	28
SBS wk3	900-1300	Sx. Bl	Pl. At. Ep. Fd. Sb. Ac	4.687	1
ESSF mc	1000-1800	Bl. Se	Pl. At. Ac	47.843	13
AT	>1800	Bl. Se as Krummholz	Hm. Pa	3.172	1

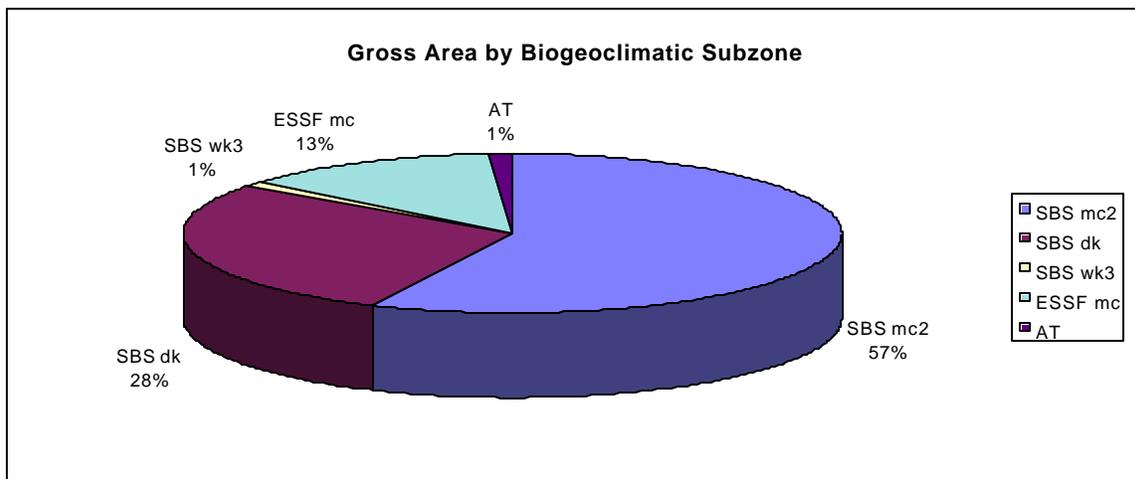Timberline
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Figure 2   Gross Area by Biogeoclimatic Sub-Zone on the EFMPP Area

2   GROUND SAMPLING PLAN

2.1   Objectives

Phase II samples provide the means for unbiased estimation of the population totals or coverage's, and they will be used to adjust individual polygon photos estimates. The adjustments are based on the relationships, ratio or regression, between the photo attribute estimates and the Phase II samples. Ground sampling also provides the means to make assessments of precision.

The Phase II adjustment procedures have not been finalized, but it is anticipated that only a subset of the classification estimates will undergo statistical adjustments. The selected attributes for adjustment will undoubtedly be related to tree cover information such as species composition (only if sufficient samples are collected within a fairly narrow species grouping), age, height, basal area, and gross volume.

The objectives of the ground sampling are to:

- Adequately sample in the Babine EFMPP area to verify the overall veracity of the new VRI in the Vegetated Treed landbase.

- Adequately sample in the Babine EFMPP area to adjust the inventory in the Vegetated Treed landbase. The sampling will aim is to achieve a sampling error of ±10% (90% probability) for net timber volume (gross volume less stumps, tops, decay, waste and breakage). The 90% probability, which is lower than the MoF standard of 95% probability, was chosen as a balance between cost and desired precision.

2.2   Sampling Approach

The overall approach is to select an adequate number of samples over the EFMPP area to achieve Objectives 1and 2. The EFMPP area and the remaining area of the Lakes TSA are being treated as two separate inventory units for sampling and analysis purposes. The EFMPP area is being treated as a sub-unit inventory of the overall Lakes TSA as per the *Lakes TSA Sampling Plan*. The inventory results from the two sub-populations will at some point in time be combined to provide overall TSA totals.

2.3   Target Population

The target population is the entire vegetated landbase (less lakes, rivers, alpine, rock, and anthropogenic cover) of the EFMPP area, totaling approximately 331,294 ha. (derived from current forest cover data presented in Table 1). As the majority of the EFMPP area is operable, no specific percentage of samples will be allocated to either the operable or inoperable landbase.

2.4   Sample Size

The number of Phase II samples required for the Lakes District *Provincial VRI* has been estimated to be approximately 95. For the BFP EFMPP sub-unit inventory, it is suggested that 81 VRI Phase II Samples be installed using a CV of 45 and a SE of 10% [MoF requirement].

Initially, as reported in the EFMPP VRI Technical Plan, the ratio of Full VRI and Timber Emphasis Plots (TEP) was to be the same as for the Provincial VRI plots planned for the Lakes District as reported in the Lakes District VRI Sampling Plan. This worked out to 46 Full VRI measurement plots and 35 TEP, with forty of the Full VRI Phase II plots (or 87 %) being installed in the vegetated treed portion of the EFMPP area (approximately 87% of the EFMPP landbase is Vegetated Treed). The remaining 6 Full VRI plots were to be installed in the vegetated non-treed areas of the landbase.

On re-assessing the objectives of the Phase II Sampling, specific to the EFMPP, and in light of recent trends in sampling where greater emphasis has been placed on completion of Timber Emphasis Plots and NVAF Sampling. With this in mind, sampling has focused on the Timber Emphasis Plots (TEP) and NVAF sampling, but not to the exclusion of full VRI plots, as summarized in Table 4 below.

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Sample Type	Full VRI	TEP	Total Sample
Vegetated Treed	5	70	75
Remainder of EFMPP area	6	0	6
Total	*11*	*70*	*81*

Table 4   Sample Sizes (number of samples) for Ground Sampling in the EFMPP Area.

These samples will be established according to methodology developed by the MoF Resource Inventory Branch and will involve:

- Selection of candidate polygons from a sorted list of Phase I polygons (MoF);
- Random selection of plot locations from the UTM grid (MoF);
- Establishment of a main full measure variable plot and satellite count plots to collect volumetric data;
- Selection to top height trees for site index determination;
- Collection of ecosystem and range data through ALL VRI measurement plots only.

This target sampling error is associated with a 90% probability; meaning that there is a 10% chance the true overall net volume in the EFMPP area may be outside the confidence limits estimated with the target sampling error.

2.5   Measurements

The ground samples will be a combination of Full VRI plots and TEP (Timber Emphasis plots). Measurements will be based on the *Vegetation Resources Inventory Ground Sampling Manual - Version 4*.

2.6   Sample Selection

Due to the scheduling delays in the completion of the VRI Phase I and MoF Branch staff unavailability J.S. Thrower and Associates will select the sample polygons for the EFMPP area using the stratified PPSWR (probability proportional to size with replacement) method developed by the MOF (This is the most recent standard), from a list compiled from the new VRI Phase I file. The list will include all

vegetated and vegetated treed areas and will be sorted by land cover classification type, leading tree species, age, and site index (Appendices A, B, C, and D).

2.7   Net Volume Adjustment Factor Sampling

Net Volume Adjustment Factor (NVAF) sampling is one of the VRI sampling support activities that have come into increased prominence recently. It involves destructive sampling of sample trees to determine actual net volume, which is compared to the estimated net volume from the VRI Phase II sample call grading and net factoring process. The NVAF sampling, used to account for hidden decay and possible taper equation bias, will be conducted to check and adjust the net volume in the EFMPP area. It is proposed that approximately 21 trees be selected from approximately 7 locations for destructive sampling as part of the NVAF in the EFMPP area in 2000.

2.8   Within Polygon Variation (WPV) Sampling

Another supporting activity of the VRI is Within Polygon Variation sampling. It provides information for expressing the total inventory error and the accuracy of individual polygon estimates. At this juncture, WPV sampling is not scheduled for the EFMPP area. WPV sampling may be completed at a later date.

Sampling for WPV involves detailed sampling of individual sample polygons. The sample polygons are either selected at random if the selection is made from the polygons picked for the VRI ground sampling, or alternatively, the sample polygons are selected independent of the VRI ground sampling, in which case they should be selected with probability proportional to area. Well-distributed plots are established within each selected polygon to be sampled to collect measured data on numerous tree attributes.

Results from intensive sampling are assumed as the **true** values for the sampled polygons, and are compared to the adjusted polygon values.

2.9   Compilation

The inventory in the EFMPP will be compiled separately and independently from the remainder of the Lakes TSA at this point so the compilation does not affect the estimates of volume in the area of the TSA outside of the EFMPP area.

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3   3.0   PROJECT IMPLEMENTATION PLAN

3.1   Overview

Completion of VRI Phase II ground sampling in the EFMPP area is planned for the 2000 field season. The funding source for the ground sampling is from the EFMPP through Forest Renewal BC. In 2000, the 81 projected VRI samples will be installed across the EFMPP area to complete the field -sampling phase of the VRI. Timberline will manage this project on behalf of Babine Forest Products.

3.2   Schedule

The VRI Phase II in the EFMPP area will be implemented in 2000 as follows:

- Prepare and submit a D*raft* Sampling Plan for initial approval by the MoF (May 20 to June 4) (Timberline for Babine Forest Products Co.).

- Select the sample polygons (September 7 to 8) (J.S. Thrower and Associates Ltd.?).

- Prepare and submit a Final Sampling Plan (inclusive of sample polygons) for approval by the MoF (September 8 to 11) (Timberline for Babine Forest Products Co.).

- Select sample locations in polygons using GIS (September 11 to 13) (Resources Inventory Branch / J.S. Thrower and Associates Ltd.).

- Prepare sample packages; each to include photo stereo-pair for access, document photo photocopies, sample cluster location map (1:10,000), and access maps (1:20,000) (July 20-28) (Timberline for Babine Forest Products Co.).

- Select an independent quality control sampler (July 10 to 15) (Timberline with Babine Forest Products Co.)

- Prepare a fieldwork plan to ensure the completion of all full VRI plots (with ecology) before September 31st. Select at random a sub-sample of 7 sample polygons for NVAF sampling from the vegetated treed samples; identify these NVAF sample polygons and ensure they are sampled early in the field season, to enable sample tree selection (September 18-22) (Timberline).

- Locate and measure VRI sample clusters; enter and edit the data (September 25 to October 31) (Field crews). The quality assurance contractor will spot-check the data to compare field card data to the entered data.

- Conduct quality assurance (10% check) (September 25 to 30 and October 17-20) (Independent quality assurance contractor).

- Sample NVAF samples (September 25-30)
- Complete stem analysis (October 5 to 15) (Contract crew). Timberline will prepare the tree-sampling matrix, and select the sample trees.

- Validate and compile data from completed samples and prepare inventory summary reports (October 31- December 15)(MoF). Timberline will ensure data submitted to MoF is clean.

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- Conduct statistical analysis and adjust inventory files (if necessary) prior to timber supply analysis (December 15- to January 15) (MoF / J.S. Thrower and Assoc.?).

3.3   Sample Packages

Field sample packages will be prepared by Timberline and approved by the quality assurance contractor who will inform the MoF of the approval prior to beginning fieldwork. They will include the following:

- The most current photo stereo-pairs for access;
- A copy of the relevant document photo;
- A sample location map (1:10,000);
- An access map (1:20,000) indicating sample location and polygon boundaries; and
- An overview map (1:250,000) 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.

3.4   Project Support

Provision of field supplies such as aluminum stakes, field cards, and equipment (including GPS) will be the responsibility of the field crews. Helicopter use will be provided and arranged by Timberline and Babine Forest Products.

3.5   Fieldwork

Fieldwork will be completed using VRI measurement protocols and certified crews. The VRI Card Types 1-3 and 8-11 will be completed according the VRI Ground Sampling version 4. Timberline will manage the fieldwork and ensure data quality.

3.6   Quality Assurance

Quality assurance must be conducted. The VRI quality assurance standards require inspection of at least 10% of the samples. An independent and mutually agreed to certified quality assurance field checker (R. Martens) will conduct a minimum of 10% checking of samples. The field crews will be responsible for the quality control of their own work through a plot and field card exchange and evaluation process between the project samplers.

3.7   Data Compilation, Analysis, and Adjustment

The MoF Resources Inventory Branch will complete the data compilation. The sampler who completed the plot will complete all data entry.   The MoF Resources Inventory Branch will complete the statistical analysis and database adjustment of the EFMPP area.

3.8   Roles and Responsibilities

3.8.1   Ministry of Forests

The MoF will:

- Select the sample polygons (contract to J.S. Thrower and Associates)
- Select sample locations within polygons (Contract to J.S. Thrower and Associates)
- Mentor NVAF crews (Resources Inventory Branch)
- Conduct NVAF quality assurance (Resources Inventory Branch)
- Check data after initial compilation (Prince Rupert Forest Region)
- Validate and compile data (Resources Inventory Branch)
- Provide attribute files and minimum standards for statistical analysis (Resources Inventory Branch)
- Prepare and sign-off Standards Agreement and Schedule A (Agreement between BFP and the MoF Prince Rupert Forest Region) (Prince Rupert Forest Region)

3.8.2   Babine Forest Products Co.

Babine will:

- Liaise with the MoF to ensure EFMPP and TSA/District goals are met
- Conduct sample cluster quality assurance (R. Martens, independent QA contractor through BFP)

3.8.3   Timberline

Timberline, on behalf of Babine, will:
- Prepare Sampling Plan for EFMPP area
- Prepare all sample packages
- Coordinate mentor for field crews at the start of fieldwork
- Coordinate project activities
- Liaise, in conjunction with BFP, with the MoF
- Monitor and communicate project progress to MoF and BFP
- Assess access and coordinate the use of helicopters
- Monitor the budget

- Identify access routes and potential tie points
- Ensure sample packages are assembled and complete
- Over see ground sampling activities
- Ensure quality assurance (QA) is complete
- Assist in coordinating technical expertise where required
- Ensure the data submitted to the MoF is clean

3.8.4   Sampling Crews

Sampling crews will:

- Complete field sampling
- Conduct internal quality control
- Enter the sample data

3.8.5   Quality Assurance Sampler

- Complete QA work for 10% of the VRI samples, and issue quality certificates
- Complete call grading/net factoring of the NVAF samples (may require a second QA contractor)
- Enter the sample data
- Prepare the QA report

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APPENDICES

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APPENDIX 1

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Map Sheet Numbers for the BFP EFMPP
Area Database Sampled

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093F072	093K036
093F073	093K041
093F082	093K042
093F083	093K043
093F092	093K044
093F093	093K045
	093K046
093L010	093K051
093L020	093K052
093L030	093K053
093L040	093K054
093K001	093K055
093K002	093K061
093K011	093K062
093K012	093K063
093K021	093K071
093K031	093K072
093L050	093K073
093L060	093K081
093L070	093K082
093K023	093K083
093K024	093K092
093K025	093K093
093K026	
093K032	
093K033	
093K034	
093K035	

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APPENDIX 2

List of Sample Polygons in the EFMPP Area

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APPENDIX 3

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Comparison Between Population and
The Sample Polygons in the EFMPP Area

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