

Silviculture Surveys Procedures Manual

Regen Delay, Stocking and Free Growing Surveys
plus Alternative Survey Methodologies



Ministry of
Forests, Lands, Natural
Resource Operations
and Rural Development

RESOURCE PRACTICES BRANCH

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Table of Contents

1	Introduction.....	7
1.1	Manual Organization	7
1.2	Background	8
1.3	Legislation.....	10
1.3.1	FPC versus FRPA to a surveyor	10
1.3.2	FPC or FRPA Survey Data Submission Requirements - RESULTS - Information Submission Specifications (RISS)	11
2	Survey Principles	11
2.1	Survey Timing	12
2.1.1	Regeneration Delay Survey Timing.....	13
2.1.2	Stocking Survey Timing	14
2.1.3	Free Growing Survey Timing	14
3	Preparing for a Survey	16
3.1	File Review	16
3.1.1	Silviculture Plans and Prescriptions.....	16
3.1.2	Backlog Standards - Pre-1987 Stands with No Silviculture Plan or Prescription	20
3.2	Preliminary Stratification.....	21
3.3	Regeneration Delay Surveys.....	23
3.3.1	Well-spaced Trees Definition	23
3.3.2	Advance Regeneration Definition.....	24
3.4	Free Growing Surveys	24
3.4.1	Combined Stocking and Free Growing Surveys.....	25
3.4.2	Free Growing Definition.....	25
3.4.3	Guidance Procedures for the Assessment of Vegetation Competition in Conifer Managed Stands – 2015.....	29
3.4.4	Maximum Density	33
3.5	Site Index	39
3.5.1	Methods to Determine Site Index	39
3.6	Basal Area Forest Cover Requirements – for all Milestones.....	41
3.7	Dispersed Types.....	41
3.8	Walk-through	43
3.8.1	Field Stratification	45
3.8.2	Ecological Classification	47

3.8.3	SU Mapping Variation.....	47
3.8.4	Preliminary Assessment of Forest Health Factors	48
3.8.5	Site Index Determination Method.....	48
3.8.6	Potential Treatments	48
3.8.7	Minimum Stratum Size	48
4	Sampling Principles	49
4.1.1	Survey Objective.....	50
4.1.2	Sampling Intensity	50
4.1.3	Plot Radius and Plot Multiplier.....	50
4.1.4	M-value	51
4.1.5	Tallying in Excess of the M-value	52
4.1.6	Sampling Methods	53
5	Field Marking Procedures.....	59
5.1	Point of Commencements	59
5.2	Marking Plots.....	59
5.3	Strip Lines	60
6	Amendments	61
7	Field Data Collection	62
7.1	Data Field Descriptions for the Front of the Ministry of Forests FS 657 Card	63
7.2	Data Field Descriptions for the Back of FS 657 card	74
7.3	Silviculture Survey Plot Card of the Ministry of Forests - FS 658.....	79
7.4	Allowable Errors in Measurement	88
7.5	Forest Health	89
8	Data Compilation	90
8.1	Data Field Descriptions for the Ministry of Forests	FS 659.... 90
8.1.1	Statistics	102
8.1.2	Treatment Recommendations	108
	Follow-up surveys should also be scheduled as part of the recommendations.....	111
8.1.3	Reports	111
8.1.4	Inventory Label - Polygon	116
8.1.5	Silviculture Label - SU	117
9	Alternative Survey Methodologies	118
9.1	Survey Methodology Selection Matrix	119
9.2	Complex Vertical Structure Survey Methodologies	120
9.2.1	Multi storey Survey.....	120
9.2.2	Layered Survey	131

9.2.3	Deviation from Potential Survey-Interior DFP Method	134
9.2.4	Single Entry Dispersed Retention (SEDRSS) Survey 2014	142
9.2.5	Boreal Mixedwood Stand Structures Survey– NI Forest Region	171
9.3	Complex Horizontal Structure Survey Methodologies	182
9.3.1	Even-aged Clustered Stand Structures Survey	182
9.3.2	Intermediate Cuts – Commercial Thinning Survey (Openings without regeneration objectives)	183
9.3.3	Coastal Mixedwood Stand Structure Survey – Coastal Forest Region.....	185
9.3.4	Clearcut with Reserves Survey Data.....	191
9.3.5	Small Scale Harvested Openings Survey– Small Scale Salvage (SSS) or Helicopter Harvested Units	194
9.4	Other Alternative Survey Methodologies	196
9.4.1	Green-up (Adjacency) Survey	196
9.4.2	Use of Planting Quality Inspection plots (FS 704) to meet Regen Delay Declaration Survey.....	199
9.4.3	Use of Juvenile Spacing Quality Inspection plots (FS 749) to meet Free Growing Declaration Survey	200
10	Provincial Surveys Accreditation and Training	201
11	Appendices.....	203
	Appendix 1: Glossary	203
	Appendix 2: Determining area of dispersed strata.....	221
	Appendix 3: List of References and Hyperlinks	223
	Acts	223
	Regulations	223
	Guidebooks	224
	Field Cards	225
	FORREX - Stand Establishment Decision Aids (SEDA).....	225
	Training Materials.....	226
	Policies and Other Documents.....	226
	Land Management Handbooks	226
	FRDA Handbooks.....	229
	Miscellaneous Publications.....	230
	Appendix 4: Best Practices in Estimating Basal Area – including the Use of a Prism	232
	Appendix 5: Magnetic Declination and Annual Change	235
	Appendix 6 Forest Cover Map Legend.....	236
A 6.1	New Forest Cover Label	236

A 6.2 Old Forest Cover Legend.....	238
Appendix 7: Table of Age Corrections for Boring Height	241
Appendix 8: Ministry of Forests Field Cards and Forms	242
Appendix 9: Crown Closure Comparative Diagrams	244
Appendix 10: FS660 Silviculture Reference Card (Oct. 2017)	245
Appendix 10: Free-Growing Damage Criteria for Even-Aged (Age Class 1) Coniferous Trees (rev. 6, July 2014)	283
Appendix 11: Broadleaf Forest Health Free-Growing Damage Criteria as a supplement to the FS 660 (Oct 2011).....	290
Appendix 12: Technology in Silviculture Surveys.....	294
Global Positioning System Use and Mapping Software for Tablets	295
Appendix 13: Local Geographic Free Growing Competition Assessment Criteria ...	303
A 13.1 – Coast Area FG Guidance	304
A 13.2 – North (Northern Interior) Area FG Guidance	306
A 13.3 – South (Southern Interior) Area FG Guidance	308
A 13.3.1 – South Area – Williams Lake, Quesnel and 100 Mile TSA's (SBPSmk, SBPSdc, SBSdw1, SBSdw2, IDFdk3, and IDFdk1 only) Alternative FG Guidance	309
Appendix 14a: Stand Structures.....	314
Appendix 14b: Guidance Matrix for Reporting Retention Openings into RESULTS	316
Appendix 15: The Forest and Range Practices Act and the Regulatory Framework (additional details)	328
15.1 Forest and Range Practices Act	328
15.2 Forest Planning and Practices Regulation.....	329
15.3 Woodlot Licence Planning and Practices Regulation.....	329
15.4 Forest Practices Code Guidebooks	330

1 Introduction

This manual has been prepared by the Resource Practices Branch as a reference for data collection and compilation of silviculture surveys, including stocking and free growing surveys as well as the associated sub-surveys such as plantability, brushing and forest health surveys. There are no explicit legislated survey requirements to use the procedures outlined in this manual, but there are reporting requirements for licensee obligations. These survey procedures will provide the necessary guidance to meet the legislated reporting requirements.

Concepts believed to be “best practices” but not necessarily required by legislation have been highlighted using purple text in a box like this.

Recently revised subjects and commonly misunderstood issues have been highlighted using blue text in a box like this.

While there is no requirement to follow the procedures described in this manual, the results reported by a licensee must be consistent with the results that would be reached by the procedures described in this manual. This concept also applies to the use of electronic data collectors. The method of capturing survey data may vary but the calculated and reported results must be consistent with the results of having used the methods in this manual.

Survey methods and stocking standards contained within an approved Forest Stewardship Plan (FSP) take precedence over the guidance methodologies provided herein.

Variations from this procedures manual are acceptable if the outcomes resulting from the alternative methods are the same as those that would be found using the guidance in this document.

1.1 Manual Organization

This document has been grouped into sections that reflect the different stand structures that a surveyor may encounter (See Appendix 14 for illustrations of recognized stand structures used in British Columbia):

<u>Sections 1 to 6</u>	Fundamentals of Silviculture Surveying - Common to all survey designs and methodologies.
<u>Sections 7 to 8</u>	Standard Clearcut Even-aged Stand Structure - Data collection and data compilation using standard MoFLNRORD field cards.
<u>Section 9.0</u>	Alternative Survey Methodologies
<u>Section 9.2</u>	Complex Vertical Stand Structure – Multi-Storey (uneven-aged) Survey; Layered (even-aged); Deviation from Potential (DFP – even-aged) and Single Entry Dispersed Retention Stocking Standard (SEDRSS - even-aged); Boreal Mixedwood Survey (even-aged).

Section 9.3

Complex Horizontal Stand Structure – Even-aged Clustered Stands; Intermediate Cut – Commercial Thinning; Clearcut with Reserves; Small Scale Harvested Openings; Coastal & Interior Mixedwood – Patch Mixtures.

Efforts have been made to write the first 8 Sections of the manual to correspond with the chronological sequence in which surveys are conducted, from the office preparation to the final survey summary report that is submitted to the Ministry of Forests, Lands, Natural Resource Operations and Rural Development.

This document contains numerous links to additional references found online or within this document. For additional information and general survey reference materials, please visit the [silviculture surveys website](#).

The *Silviculture Survey Procedures Manual* will be subject to on-going review by ministry and non-ministry survey experts, and will continue to be updated as survey methods improve. Your suggestions for improvements to this manual can be sent to the Resource Practices Branch Provincial [Silviculture Performance Assessment Specialist](#).

1.2 Background

Each year, silviculture surveys are conducted on approximately one million hectares of crown land. In terms of hectares treated, silviculture surveys exceed the hectares of all other silviculture activities combined.

On a per hectare basis, silviculture surveys are one of the lowest cost silviculture activities. This, however, does not mean that they are of little value or that surveyors require minimal experience and training. Surveys costing relatively few dollars per hectare provide the information necessary to accurately prescribe silviculture investments costing hundreds of dollars per hectare, or even thousands of dollars per hectare.

Silviculture surveys assemble the baseline information required to develop and implement effective silviculture programs. They are an essential element in the confirmation of completed silviculture obligations and may also be used in assessment of due diligence with respect to achievement of free growing obligations. The silviculture survey is the tool used to measure the achievement of stated objectives.

Survey information may be used for planning treatments, conducting resource analyses, preparing annual reports, conducting audits, or monitoring compliance with [silviculture plans or prescriptions](#). Forest managers are using this information increasingly, as the input data for growth projection models. Survey data can also be used to update long-term history files for openings and forest cover maps.

Accuracy and consistency in conducting surveys is vitally important. Poor or incorrect data collection can result in improper treatments being recommended and completed, or lead to incorrect land status classification. Consistency is required to allow comparisons to be made between blocks, licensees and districts.

Standardized concepts ensure the survey system remains consistent and predictable. They also allow comparison between agreed standards and current conditions. Deviation from standardized concepts may be discussed in individual plans or contracts. Where no specifics are discussed, standardized concepts should be used.

Silviculture surveys are based on standards that may have been created many years in the past. The [silviculture plan or prescription](#) covering an opening is legally binding until the requirements contained within it are met or amended by mutual agreement. This means that even a Pre-Harvest Silviculture Prescription created in 1987 is still in effect until its standards are met, amended or replaced with approved FSP or Woodlot Licence Plan (WLP) standards. Surveyors must understand the terms and implications of the older documents even though current standards may be quite different.

Stocking standards, regardless of the document they are contained within, state the reforestation requirements.

For the purpose of simplicity in this manual reference is made to the collective set of documents that provide stocking standards and reforestation objectives as the **silviculture plans and prescriptions**.

Within the last three decades forest legislation in British Columbia has evolved. Surveyors have operated within seven broad eras and are currently in a transition into the seventh. With the addition of each era the role of a silviculture surveyor becomes more complex.

The various eras are:

Pre January 1, 1982

With a few exceptions, before 1982, persons who harvested on provincial forest land had no obligation to reforest. The Ministry of Forests managed the reforestation activities.

January 1, 1982 to October 1, 1987

With a few exceptions, before October 1, 1987, persons who harvested on provincial forest land had no obligation to reforest. This era is complicated in that there was an expectation for the licensees to manage the reforestation activities, but for the Ministry of Forests to fund the activities.

October 1, 1987 to April 1, 1994

Licence holders were obligated to create a [Pre Harvest Silviculture Prescription](#) (PHSP) stating the harvesting and reforestation objectives. All reforestation activities were managed and funded by the licensee.

April 1, 1994 to June 15, 1995

The Silviculture Regulations were reformulated and renamed the Silviculture Practices Regulation. The PHSP became the [Silviculture Prescription](#) (SP).

June 15, 1995 to December 17, 2002

Forest management activities were directed by The Forest Practices Code (FPC), and its more than a dozen regulations and many guidebooks.

November 30, 1998 to present

For woodlot licensees only, silviculture prescriptions were replaced by woodlot site plans and default standards in accordance with the new Woodlot Licence Forest Management Regulation. Transition period from the Forest Practices Code to the Forest and Range Practices Act depended on the expiration date of an individual woodlot license's Forest Development Plan.

December 17, 2002 to January 31, 2004

The Silviculture Prescription changed to the [Site Plan](#) within this period but operations continued under the Forest Practices Code. In this era stocking standards may have migrated into the Forest Development Plan in the form of Silviculture Regimes.

January 31, 2004 to present

The current era is under the [Forest and Range Practices Act](#) (FRPA) and its regulations. There were transitional periods that lead to full implementation as of effect January 1, 2006. Stocking standards for this era on non-woodlot areas are found in the Site Plan (SP) and associated Forest Stewardship Plan (FSP). For woodlot licenses only, site plans are not a legal requirement as stocking standards are described in the Woodlot Licence Plan. Full implementation to the Forest and Range Practices Act depends on the expiration date of an individual woodlot license's Forest Development Plan.

1.3 Legislation

The discussion that follows should be considered as general guidance and discussion. This should not be construed to be legal interpretation. The linkages between silviculture surveys and the Forest and Range Practices Act, and its associated regulations, are discussed in more detail in Appendix 15.

1.3.1 FPC versus FRPA to a surveyor

Openings being held by a licensee can still be under two types of legislative umbrella: either still under the Forest Practices Code (FPC) or they can be under Forest and Range Practices Act (FRPA) and the corresponding regulations - Forest Planning and Practices Legislation (FPPR) or Woodlot Licence Planning and Practices Regulation (WLPPR).

1.3.1.1 Openings under FPC:

These would be openings that are still linked with a Forest Development Plan (FDP) and Silviculture Prescription (SP) or woodlot site plan under the FPC. A licensee can still opt to retain their obligations under these approved plans, up to relief of their obligations. These openings must be surveyed to the stocking standards as outlined in these documents. However, the methodology does not need conform to procedures outlined in this manual. That aspect of the FPC was removed when FRPA was passed. As well the

content required to be submitted with a declaration of a FPC opening now must correspond with the data requirements as expected from FRPA openings.

1.3.1.2 Openings under FRPA:

These would be openings established under the umbrella of an approved Forest Stewardship Plan (FSP) or Woodlot Licence Plan (WLP), **and/or** old FPC openings where the FSP specified, either the specific blocks FRPA standards would be applied to, or a process for FRPA standards to be applied to blocks with an FPC obligation. . Therefore these openings will be surveyed to the stocking standards outlined in the FSP or WLP. As well, there is no requirement that the field procedures and methodologies in this manual be adhered to by the surveyor. The only requirement is as above, that the data submitted by the licensee conforms to the content required.

1.3.2 FPC or FRPA Survey Data Submission Requirements - [RESULTS - Information Submission Specifications](#) (RISS)

The survey data submission requirements outlined in this manual are consistent with the requirements for RESULTS submissions. Refer to the [RESULTS website](#) for a detailed discussion on the requirements of these submissions.

This direction is empowered in FPPR by section 97 (7) - *"a written declaration ...for the regeneration date or free growing date include a forest cover inventory"* and in WLPPR by section 75 (3) – *"... must carry out a survey ... on or before free growing date, identifying ... the forest cover inventory"*. The precision standards for reported forest cover attributes are empowered by FPPR section 86(6) - *"must be reported in a form and manner that is satisfactory to the minister"* and refers to Table 16: Minimum precision standards for data submissions in the RISS documentation. The definition of forest cover and authority to define the content of these labels is in FPPR section 1- *"includes information required by the minister"*. This definition also applies to the WLPPR in accordance with WLPPR section 1 (1). This authority has been delegated to the Chief Forester's signature.

2 Survey Principles

The survey methods in this manual have been carefully developed to promote a balance between the costs of performing surveys and the level of risk of making a wrong decision as a result of inconclusive data collected. In Section 7, the [relative importance of each data item](#) found on the survey plot cards is discussed.

The basic survey principles are based on an understanding of:

- a licensee's freedom to manage the forest resource (within the context of their licence agreement and the legal framework);
- a licensee's responsibility to meet stated reforestation objectives;
- reporting requirements (RESULTS);
- the role of the Professional Forester and Registered Forest Technologist; and
- the role of compliance and enforcement activities regarding milestone obligations of licensees.

The process of conducting most silviculture surveys has five steps:

1. **Office review:** Preparing for the survey; reviewing currently available information, especially the silviculture plan or prescriptions and its associated approved amendments; completing [preliminary stratification](#); analyzing imagery, and reviewing block history.
2. **Walk-through of each stratum:** Identifying the location of standards units (SUs) from the [silviculture plans and prescriptions](#); [stratifying](#) these SUs according to silviculture survey stratification requirements; determining the [survey objectives](#), [methods](#) and sampling [intensity](#); determining the site index method; identifying the leading and second species in the [inventory label](#); and listing preliminary treatment recommendations.
3. **Data gathering for each stratum:** Finalizing the survey design, [sampling methodology](#) and [intensity](#); collecting the data within each standards unit and stratum.
4. **Summary of each stratum:** Summarizing the data, by calculating [statistics](#) where applicable; preparing [inventory label](#) and [silviculture labels](#); and preparing treatment recommendations.
5. **Reporting of each stratum:** Submitting forest cover, label and map data into [RESULTS](#).

This manual allows flexibility within the bounds of standard principles that make up the silviculture survey procedures. Alternate survey methods that can produce significantly similar results are acceptable.

Consistent and accurate data collection, summarization, data analysis and treatment recommendations are essential. The forest professional who submits reports based on poor survey data is held professionally accountable for their actions.

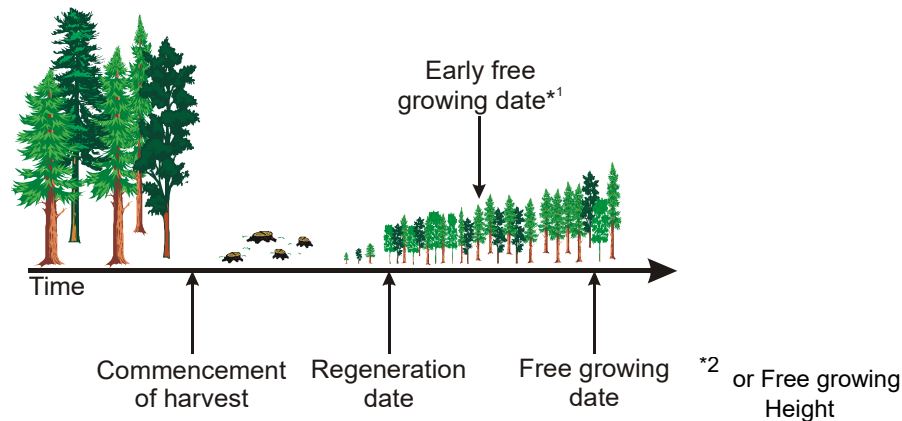
2.1 Survey Timing

Survey timing is an issue usually left to the licensee's silviculture manager. It is also important for surveyors to have an understanding of the issue as they will be asked to provide recommendations that include survey timing. Silviculture plans or prescriptions usually specify the regeneration date, may have an early free growing date and will always have a late free growing date. Usually these are expressed in terms of the number of years following the [commencement of harvest](#) to attain a stocked or free growing stand.

The accuracy of the regeneration date and free growing date requirements is assumed to be to the month where a specific date is not available or accurate. This is relevant since there are known errors within the various corporate databases. Often the 1st or 15th or 30th day has been entered as a default value.

It is also necessary to redefine the terms used to describe the various survey types or names to ensure consistency.

- The survey used to prove that the regeneration requirements have been met will be referred to as the **Regeneration Delay Survey**. This distinction is important since the definition of a well-spaced tree is strictly applied. This definition is dramatically different than has been used in previous years.
- Intermediate surveys, conducted after the regeneration obligation has been met and before the free growing survey proves the stratum to be free growing will be called the **Stocking Survey**. Its objective is to reassess the stocking status, need for treatments (fill plant, brushing, spacing), and monitor the progress of the young stand toward meeting the free growing requirements.
- The **Free Growing survey** is undertaken when it is likely that the survey will find that the stand meets the free growing requirements.



*1 Not all silviculture plans and prescriptions have an early free growing date.

*2 For openings managed under FRPA free growing heights are used to replace the need for the Early Free Growing Date.

Figure1: Reforestation timeline.

2.1.1 Regeneration Delay Survey Timing

The Regeneration Delay survey is used to prove that the regeneration requirements have been met. Previous terms used included stocking surveys and regen surveys. This clarification is necessary as a result of the redefinition of a well-spaced tree.

Regeneration delay surveys must be completed on or before the regeneration date. Woodlot licensees are the exception – they must establish a stand that conforms to the

applicable stocking standards by the regeneration date but are not required to complete a survey. The regeneration delay survey can be effectively completed at any snow free time of year. Where the presence of vegetation makes small trees difficult to locate, it will be advantageous to schedule regeneration delay surveys for early spring, or late fall, after leaf fall but before snowfall. This will reduce the likelihood of missing trees during data collection. However, on some sites it may be desirable to do the survey during leaf out to prove regeneration requirements have been met and properly evaluate vegetation competition.

It is generally advantageous for a licensee to complete a regeneration delay survey as soon as possible. It may be done in conjunction with planting quality checks. (see Using the Planting Quality Inspection [FS 704](#) to report regeneration obligation met). This allows economic efficiencies while ensuring the legal responsibility is completed well within the legal timeframe. It also provides the licensee with more flexibility to deal with potential unsuitable weather or unsatisfactory stocking.

Example: An opening, in which the harvesting began on February 15th 2004, has a four year regeneration delay. The District Manager is expecting the licensee to prove that the opening is satisfactorily restocked before the end of February 2008.

Given the typical winter snow conditions over most of the province, the last reasonable time to complete the regeneration delay survey will be fall of 2007. Leaving the survey to this late date leaves the licensee at some risk. What if the area is not sufficiently restocked? There is no practical way to remedy the problem in time to meet the deadline.

2.1.2 Stocking Survey Timing

The stocking survey is any non-reportable intermediate survey that is intended to assess the progress of an opening toward meeting the free growing requirements. Historically there have been a few terms to describe these surveys: regen survey, stocking/free growing surveys, regen performance surveys etc. Although these are not mandatory surveys, they represent the greatest number of surveys conducted. As a result it is prudent that we provide guidance. They are necessary for forest managers to confirm continued sufficient stocking, and to project treatment needs necessary to achieve free growing status before the late free growing date.

2.1.3 Free Growing Survey Timing

Licensees who are required to establish a free growing stand must report an inventory on the harvested area before the late free growing date. Many older silviculture plans or prescriptions have both early and late free growing assessment dates. More current openings managed under the Forest and Range Practices Act will have free growing heights but no early free growing date. As with regeneration delay surveys, pre-planning of the free growing survey is beneficial.

In areas where herbaceous vegetation competition may be a factor in the free growing determination, free growing surveys should be done between the time of maximum leaf out and before leaf fall.

On sites where vegetation competition is a smaller factor in determining free growing status, or the competing vegetation is nearly exclusively broadleaf competition, the survey can be done any time of the year, subject to the limitations of snow depth.

Section 107 (4) and (5) of the Forest Range and Practices Act (FRPA) indicates the District Manager has the option to reject a free growing declaration, if the stand is under threat from [competing vegetation](#) or [forest health](#), or is unlikely to remain free growing without a further treatment.

Utilizing existing guidance such as the following, are considered best management practices to potentially limit the risk of rejection:

1. **Table 1** - Number of years growth, recommended following a brushing treatment prior to a free growing survey;

Biogeoclimatic zone	Number of years ¹
ICH, IDF, MS, PP, BG, SBPS, CWH, CDF, MH, and ESSF	2
SBS and BWBS	
• following herbicide treatment	2
• manually or otherwise treated	3

1) Number of years is defined as “the number of complete (full summer months) growing seasons, post treatment”.

2. Free Growing Damage Criteria (Appendix 5 of the Establishment to Free Growing Guidebook) and;
3. *Free Growing Guidelines* (Appendix 13 of this manual).
4. Where a juvenile spacing treatment has been completed, a waiting period following the treatment is not required before conducting a free growing survey.
5. A free growing declaration under FRPA section 107 should only be made when the stand is currently free growing and likely to remain so in the future.

In general it is advisable to schedule free growing surveys as early as possible in the development of the stand. This will allow for the identification of issues early and the opportunity to manage the issues prior to the late free growing assessment date.

3 Preparing for a Survey

3.1 File Review

The objective of a file review is to prepare the surveyor for undertaking a survey, make a preliminary assessment of the site and stand conditions, identify the survey standards from the silviculture plans and prescriptions and determine the history of previous activities. In general, gain as much knowledge of an area from the existing information as possible and be prepared to gather the correct data during the upcoming survey.

The following is a list of information that a surveyor should consider before conducting any silviculture survey:

- silviculture plan or prescription and any amendments, - Note: woodlot licensees have different requirements and standards in their WLP or defaulted in the WLPPR;
- silviculture treatment regime;
- forest cover map;
- Biogeoclimatic map;
- imagery of opening, including orthomosaics, captured digitally by UAV, Lidar or remote sensing techniques;
- corporate database describing history, (including RESULTS database);
- previously prepared silviculture treatment prescriptions and post treatment reports;
- previous surveys; and
- previous methods of [site index](#) determination.

Once the reference materials and information have been gathered and reviewed for each opening, some of the fields on the Silviculture Survey [FS 657](#) card can be completed. A few examples of these include the opening number, licence number, licensee, stocking standards, forest region and district.

Even though many of the data fields of the site description portion of the [FS 657](#) field card can be found within the opening file, these items should be left blank until the walk-through is completed. A few of these include the soil texture, elevation, [aspect](#), slope percent, survey date and ecological classification.

3.1.1 Silviculture Plans and Prescriptions

Before a survey is carried out on an opening, surveyors must familiarize themselves with the opening and, in particular, the associated silviculture plans and prescriptions. The silviculture plans and prescriptions is the collective term for pre-harvest silviculture prescriptions, silviculture prescriptions, site plans, woodlot pre-harvest map or other site

specific documents that contain management objectives and [stocking standards](#) that will be used during surveys to measure the success of re-establishing a free growing stand. These site specific plans describe the nature and extent of timber harvesting and silviculture activities proposed for an opening.

The silviculture plan and prescription is the source of the stocking standards and parameters used to conduct the survey. **Surveyors do not usually create any other standards, when ones already exist, but may make recommendations for different standards where ecologically suitable and defensible.**

On October 31, 1987 the requirement to create a site specific harvesting and reforestation plan became required. The document was called a pre-harvest silviculture prescription (PHSP). Generally, areas harvested before this point will not have a standards document. See also [Pre-1987 Stands with No Silviculture Prescription](#). On April 1, 1994, the pre-harvest silviculture prescription form evolved to become silviculture prescription (SP). June 15, 1995 the Forest Practices Code came into force and provided for the creation of silviculture prescriptions on [backlog](#) areas, (those areas disturbed before October 31, 1987) where treatments were proposed. On November 30, 1998, for woodlot licenses only, the silviculture prescription was replaced by the woodlot site plan. On December 17, 2002 the silviculture prescription evolved to the Site Plan, in association with the Forest Development Plan. The latest evolution occurred with The Forest and Range Practices Act (FRPA). For woodlot licenses under FRPA, site plans were replaced by a pre-harvest map showing stocking standards for a specified area.

3.1.1.1 Standards Unit versus Treatment Unit

Throughout the years of silviculture plan and prescription development, there has been an evolution of many of their components. One of the changes has been the use of the terms ‘treatment unit’ and ‘standards unit’. The current definitions are as follows:

Standards Unit (SU): An area within a cutblock that is subject to uniform soil disturbance limits and stocking standards.

Treatment Unit (TU): An area of land upon which a silviculture activity is planned and carried out.

There may be more than one Treatment Unit (TU) within a Standards Unit (SU). If more than one treatment unit has identical stocking standards, these treatment units can be surveyed as a single stratum, all other parameters being similar. Since the requirement for silviculture plans or prescriptions was first established, there has been periodic evolution of the document. Content requirements have changed. The size of these documents range from one page to dozens of pages. One constant is their inclusion of [stocking standards](#). These are the various specifications for the regenerating crop trees. Surveyors must know where stocking standards are found and how to use them. If they can be provided electronically by the licensee, the surveyor should confirm that the licensee is taking responsibility for their accuracy.

3.1.1.1.1 MSS versus MSSp versus MSSpa

With the creation of the *Silviculture Practices Regulation*, in April of 1994, one of the requirements for silviculture prescriptions was the addition of the minimum number of preferred species. The goal of this requirement was to ensure that reforestation activities be targeted to produce not just species that are ecologically suited to the site **but also** to produce those species that have the greatest commercial viability.

For example, a silviculture plan or prescription indicates:

- Douglas-fir and spruce are preferred and western hemlock is acceptable
- the [minimum stocking](#) is 700 trees per hectare
- the [minimum preferred stocking](#) is 600 trees per hectare

This sample opening must have at least 700 free growing trees per hectare in any proportion of Douglas-fir, spruce and western hemlock. However, there must be at least 600 free growing trees per hectare in any combination of Douglas-fir and/or spruce for the area to be considered free growing.

The minimum stocking standard is often abbreviated as MSS or MSSpa, while the minimum preferred stocking standard is abbreviated as MSSp.

Most silviculture prescriptions or site plans make reference to both [preferred](#) and [acceptable species](#) in their stocking standards or stocking requirements section. Generally, silviculture prescriptions approved prior to April 1, 1994 will not have minimum preferred stocking standards unless it was amended for some other reason since it was originally created. The minimum preferred stocking standard concept is only a requirement if it is explicitly stated in the silviculture plan or prescription.

3.1.1.1.2 Order of Species

While there is great significance in the designation of [preferred](#) and [acceptable species](#), there is no significance in the order (or relative position), in which they are recorded in the stocking standards section of the silviculture plan or prescription.

3.1.1.1.3 Species in Parentheses

Some older pre harvest silviculture prescriptions, or silviculture prescriptions, used a method of placing parentheses around those species that would be restricted to a certain percentage of the minimum-stocking standard.

For example, upon review of an older silviculture prescription, Douglas-fir, spruce, and (western hemlock) are listed as the [acceptable species](#) in the stocking standards section. This would suggest that, when determining [stocking status](#), only a small percentage of the minimum stocking standard could be comprised of western hemlock. The actual percentage must be specified in the silviculture prescription. It is recommended to contact the local Natural Resource District office to identify the correct percentage for the era of the silviculture prescription. The maximum percentage of ‘bracketed species’ ranged from 10 to a maximum of 30%.

3.1.1.1.4 “Double Standards”

Some older pre harvest silviculture prescriptions or silviculture prescriptions (found in the former Kamloops Forest Region in particular), contain two sets of stocking standard values. The most common format indicates one set of stocking standards for pure lodgepole pine stands and a second set for “other” species. The “Pli” standards are used where the silviculture label has 80% or more lodgepole pine; otherwise, the “other” standards are used.

3.1.1.1.5 Minimum Inter-Tree Distance (MITD)

The silviculture plan or prescription specifies a minimum horizontal [inter-tree distance](#). All trees considered well-spaced and free growing must be at least this specified distance from other well-spaced or free growing trees. MITD is always measured horizontally between well-spaced stems. On steep slopes, attention to maintain a horizontal measuring distance is required.

If a minimum horizontal inter-tree distance is not specified, discussions may be required between the licensee and the Ministry of Natural Resource Operations. From 1994 to 1998 the default inter-tree distance was assumed to be 2.0m if it was not specified in the pre harvest silviculture prescription or silviculture prescription.

Some silviculture plans and prescriptions and Forest Stewardship Plans provide for the [minimum inter-tree distance](#) to be changed when certain conditions exist, (e.g. colluvial slopes, site preparation, planting).

3.1.1.1.6 Target Leader Growth

Through the late 1980’s and early 1990’s, silviculture prescriptions and pre-harvest silviculture prescriptions included a target leader growth or target leader length in the stocking standards. The intent was to ensure that not only sufficient quantities of trees were present on the site but that they were also growing at a minimum rate. A species-specific growth rate per year or per three year period was common. The concept of minimum growth rates was replaced by the minimum free growing height in later silviculture plan or prescriptions.

Target leader growth is not a legally binding component of the stocking standards and compliance is not required.

3.1.1.1.7 Minimum Free Growing Height

Another change in the post 1994 era was the requirement for trees to be at least a minimum height before they could be considered free growing. If these values are not found or defaults referenced in the silviculture plan or prescription, then there are no legal requirements for a tree to meet this height specification. The only exception to this is if the surveyor is using the revised free growing guidelines found in Appendix 13 of this manual or Appendix 9 of the [Establishment to Free Growing Guidebook](#), in which case, a minimum height is required.

The addition of minimum free growing heights and the application of relaxed definitions of “competing vegetation” are the only adjustments to be made to the standards if the Free Growing Guidelines are applied.

3.1.1.1.8 Adjustment of the Early Free Growing Dates

The subject of changing the early free growing date, also known as the “sliding rule” is discussed in the [Establishment to Free Growing Guidebook](#) page 35. This concept is applicable where an early free growing date is specified in the silviculture plan or prescription. It encourages licensees to conduct prompt reforestation activities by allowing the early free growing date be moved earlier. It may be moved back an amount equal to the amount of time the regeneration requirements were met before regeneration date. For example if the regeneration plan provides a 4 year regeneration date and the licensee shows the standards unit is SR in year 3, the early free growing date can be moved one year earlier. This has no effect on the late free growing date. Woodlot site plans were not required to include an early free growing date but some did. For blocks under Silviculture prescriptions or woodlot site plans, an amendment requiring approval is necessary to adjust the early free growing date. For blocks under a Forest Development Plan (FDP) site plan, an amendment requiring approval to an FDP stocking standard may also be required to adjust the early free growing date.

The District Manager has the option to decline the application of this concept such as, where forest health issues risk the continued free growing status.

3.1.1.1.9 Minimum Age of a Free Growing Tree

There is no legally required minimum age of a free growing tree, unless it is specifically stated in the silviculture plans and prescriptions.

One guidance exception is for surveys on singletree selection systems, generally drybelt Douglas fir management, the [Establishment to Free Growing Guidebook](#), page 38 indicates free growing trees must be on site for 5 years and be 40 cm tall.

3.1.2 Backlog Standards - Pre-1987 Stands with No Silviculture Plan or Prescription

Most areas harvested prior to October 31, 1987 do not have a silviculture plan or prescription.

It is recommended to refer to the following Backlog policy and procedures for guidance and they are located on the following link: [Backlog Management Policy](#).

Some regions and districts have prepared procedures for conducting surveys on these areas. The most common version includes direction for surveyors to create stocking standards using the [Establishment to Free Growing Guidebook](#). This is not the intended use for this guidebook, but is often a reasonable solution.

3.2 Preliminary Stratification

The office review uses the information found in the opening file, in the silviculture plan or prescription and in the corporate database or RESULTS as the basis for the preliminary stratification. The data found on file, including imagery, previous surveys, previous treatments and other maps provides the background for an opening and can help give an initial impression of what can be expected. This is a critical first step in the survey process.

The first step in preliminary stratification for any regeneration delay, stocking or free growing survey is to identify the standards unit(s) (SU) described in the silviculture plan or prescription. Each SU has distinct survey parameters and must be surveyed independently of the others to ensure legal stocking and free growing requirements have been achieved. SUs are then subdivided, or stratified based on silviculture survey stratification criteria such as forest cover, [stocking status](#), forest health factors, treatment reasons, etc. Additional stratification may be required based on a re-evaluation of the biogeoclimatic ecosystem classification where the classification impacts stocking standards or site index determination. This must be done with special care since it may result in the need for an amendment to the silviculture plan or prescription.

In a few very rare cases it is possible to survey two standards units as one stratum. This is only possible if all the factors of the stocking standards in the silviculture plan or prescription are identical and the two areas are significantly similar (not different enough to be stratified).

Scenario Example: An example map has been provided in Figure 2 to assist with the description of preliminary stratification.

The crosshatched area is Standards Unit 1; the dotted area is Standards Unit 2. These two halves of the opening have different stocking standards.

Regardless of any other subsequent stratification, the boundary between stratum A and stratum B must be maintained.

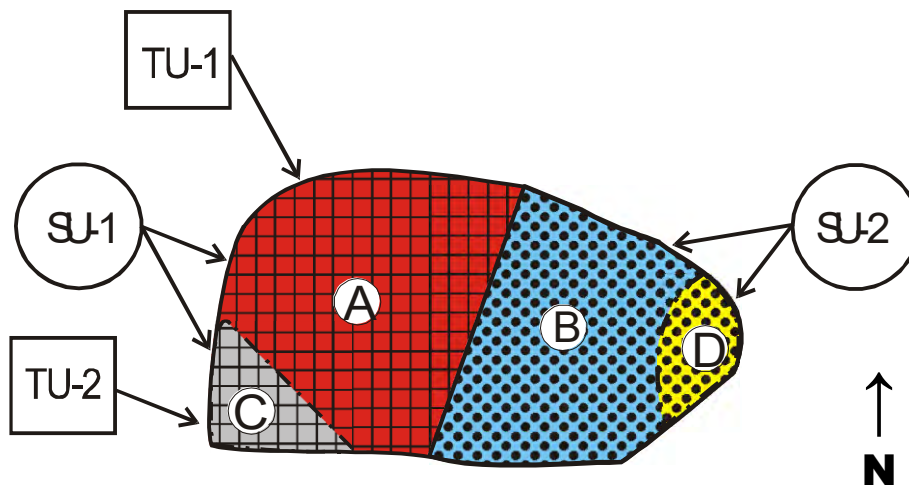


Figure 2: Preliminary Stratification

In this particular silviculture prescription SU 1 has two Treatment Units (TUs). The stocking standards for TU 2 are the same as TU1, but TU2 has a restriction for no ground-based machinery to be used. We can suspect there may be something different about this area. Therefore standards unit 1 is tentatively split into 2 strata, A and C. Once the walk-through has been completed, this stratification will be either confirmed or eliminated.

Upon further review of the information on file, the satellite imagery indicates a lighter color in the eastern edge of SU 2. The cause is currently unknown. This portion of stratum B appears to be different than the remainder of the stratum. Stratum D is therefore noted and will be investigated during the walk-through.

This and other preliminary stratification will be reconsidered during the walk-through. The standards unit boundary is not reconsidered; it remains fixed unless an amendment to the silviculture plan or prescription is prepared.

Figure 3 provides the final stratification for our fictional opening. During the walk-through it was confirmed that stratum A and C are significantly different. As a result of the machine free restriction, the understorey of previously suppressed balsam was not damaged during harvesting or mechanical [site preparation](#). There is a higher component of balsam, in the south west corner and as a result the inventory label will be different. Stratum C is retained and surveyed separately from stratum A.

Stratum D turned out to have a higher percentage cover of grass than the remainder of the east half of the opening. While it appeared as a different color, the satellite imagery used was not recent. The free growing trees have grown since the imagery and are now unaffected by the difference in herb species or grass species on this stratum. The stratification, prior to establishing plots has been finalized as seen in the figure below.

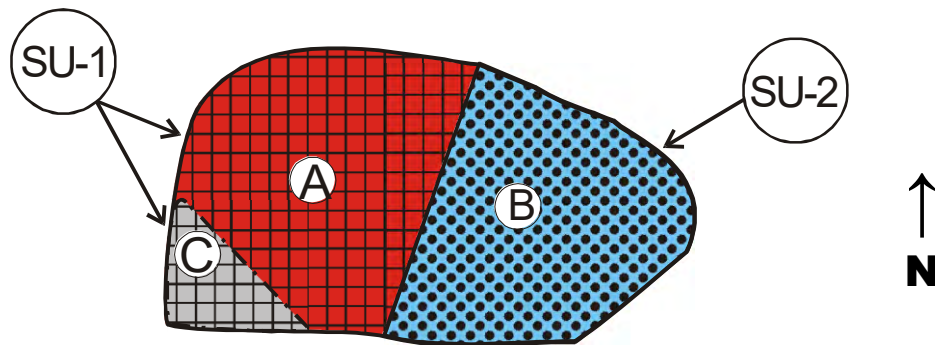


Figure 3: Stratification Following the Walk-through

Take note that even if the current characteristics of stratum A and B are identical, these are two separate standards units and therefore must be surveyed as separate strata.

Stratification based on an assessment completed while walking the block to establish plots is not the most recommended practice, but is the usual practice if a walk-through is not completed prior to plot establishment.

3.3 Regeneration Delay Surveys

Tally Method: Tally the number of trees within the plot by species that meet all of the acceptability criteria and the minimum [inter-tree distance](#) requirements, **including those that exceed the M-value** and record these in the appropriate species columns of the [FS 658](#) (field number 98).

In the TOTAL W column, record the sum of preferred and acceptable well-spaced trees in the plot, up to the maximum per plot indicated on the [FS 657](#) (M-value). If the maximum is reached, or exceeded, record the letter “M” rather than the numeric value (field number 99).

Follow the arithmetic procedure on the [FS 659](#).

Surveyors are expected to produce silviculture labels as part of the survey report. The details of [silviculture labels](#) are described later in this document.

This method is also recommended for use in stocking surveys.

3.3.1 Well-spaced Trees Definition

Trees that contribute to stocking are defined as well-spaced, and represent the crop tree subset of all the trees in a plot. These are the trees most likely to form the managed portion of the new crop and will likely need additional time to meet the requirements of a free growing tree. Over the years, as legislation has evolved, so has the definition of the well-spaced tree. The current legislation has no definition of a well-spaced tree. It is clear that there are two well-spaced tree characteristics to consider that will be mandatory once this well-spaced tree grows to free growing status. These mandatory factors are:

- the [preferred](#) or [acceptable species](#) listed in the silviculture plan or prescription
- at least the minimum [inter-tree distance](#) as specified in the silviculture plan or prescription from any other tree that is recorded as a well-spaced tree

Local Natural Resource District specific criteria may be applicable to well-spaced tree criteria and if authorized by the District Manager, the surveyor must consider them. The intent is to apply criteria that increase the likelihood for the trees selected as well-spaced to survive and thrive to a free growing status. These may be developed cooperatively by local silviculture practitioner steering committees, including joint stocking standards working groups. Guidance provided may specifically include:

- minimum age and/or heights;
- suitable growing microsites;
- forest health criteria.

Note: The [Free Growing Damage Criteria](#) does not apply to the regeneration delay survey, however it is highly recommended that it be used during the regen delay surveys and stocking surveys. This makes sense as damage agents that affect well-spaced trees at the regeneration stage will likely affect the same trees at the free growing stage. For example, if mistletoe is found on a young tree, it will persist through to the free growing

stage and beyond. This tree should not be accepted as well-spaced during the stocking survey. This same tree must not be accepted in the free growing survey.

Note: As the damage criteria were developed for free growing trees, they may not all apply perfectly to younger stems being assessed at the time of a stocking survey.

Therefore, in the interest of achieving a free growing stand, it is highly recommended that the surveyor consider with caution, damage agents affecting well-spaced trees, to avoid misleading the licensee regarding the health of the stand at the time of a stocking survey.

3.3.2 Advance Regeneration Definition

Advance regeneration is defined as trees that are present on an opening that were established prior to the disturbance that created the opening. They may make up all, part, or none of the reforestation obligation. They may also be present on the opening as part of a strategy to increase biodiversity or to maintain visual quality objectives.

These trees may only be tallied as well-spaced and/or free growing trees if they meet the criteria specified in the silviculture plan or prescription.

Where acceptability criteria have not been included in the silviculture plan or prescription or where there are no regional guidelines, the best management practice is to consult Appendix 10 of the *Establishment to Free Growing Guidebook* or the acceptability criteria found in the current FS 660.

3.4 Free Growing Surveys

Tally Method: Tally the number of free growing trees within the plot by species that meet the free growing height, quality, health, minimum [inter-tree distance](#) and vegetation free requirements, **including those that exceed the M-value** and record in the appropriate species columns of the [FS 658](#) (field number 98).

In the TOTAL FG column, record the sum of preferred and acceptable free growing trees in the plot, up to the maximum per plot indicated on the [FS 657](#) (M-value). If the maximum is reached, or exceeded, record the letter “M” rather than the numeric value (field number 99).

Surveyors are expected to produce silviculture labels as part of the survey report. The details of [silviculture labels](#) are described later in this document.

Free growing trees are described when the stratum is found to be free growing. If it is not free growing, then the well-spaced trees are described.

Even with a thorough walk-through, the stocking status of many strata will remain undetermined thus it is generally preferable to record two completely separate rows of data on plot cards: one row to describe well-spaced trees and a second row for free growing tree data. Once the data collection has been completed and [statistics calculations](#) completed, the most appropriate data can be summarized.

Follow the arithmetic procedure on the [FS 659](#) .

3.4.1 Combined Stocking and Free Growing Surveys

A stocking survey often collects free growing data as well. This is done to provide useful information to the silviculture manager regarding the progress of the opening. In some cases, the block may actually turn out to be free growing. When this occurs, the free growing data is used in the silviculture label and a free growing declaration may be made.

The reciprocal is also the case when stocking information is also collected during a free growing survey. If the survey finds that the opening is not free growing, the stocking data is used in the silviculture label.

As the objective of the stocking survey is to maximize the number of preferred and acceptable stems, while the objective of the free growing survey is to maximize the number of free growing stems, the free growing trees selected in a plot will not always be a subset of the well-spaced trees selected during a stocking survey.

3.4.2 Free Growing Definition

Free growing trees are the subset of well-spaced trees that not only meet the minimum free growing height criteria, but are healthy, with growth not impeded by competition from plants, shrubs and other trees. It is the stand of trees that we can expect to produce a commercially valuable crop tree. The assessment process is conducted at two levels: at the tree level and at the stratum level.

3.4.2.1 Tree Level

A free growing tree meets the criteria of a well-spaced tree and the following additional criteria:

- Is it free of unacceptable levels of forest health damage? Refer to the [FS 660](#) or Appendix 5 the Establishment to [Free Growing Guidebook](#), [Free Growing Damage Criteria](#) Appendix 5;
- Is it free of unacceptable levels of vegetative competition (herb, shrub or broadleaf tree)?
- Has it achieved the minimum Free Growing Height? and
- Does it meet any additional criteria explicitly stated in the silviculture plan or prescription for the area?

3.4.2.2 Stratum Level

At the stratum level surveyors consider the following questions:

- Are there sufficient free growing preferred plus acceptable tree species per hectare?
- If specified in the silviculture plan or prescription, are there sufficient free growing preferred tree species per hectare?
- If specified in the silviculture plan or prescription, are there less than the maximum density value of countable conifers present?
- Has a brushing treatment recently been completed? (This is not a mandatory requirement under FRPA). However, it is a recommended “best practice” that there is significant risk of vegetation re-sprouting following a brushing treatment by certain species in certain ecosystems. It may be unlikely that the stratum will remain free growing into the near future, therefore a post brushing treatment waiting period may be necessary (refer to Table 1, located in section 2.1.3).

3.4.2.3 Recording Unacceptable Species as Well-spaced or Free Growing

It is suggested, but not required, to record well-spaced or free growing species that are performing well on the opening, but are considered unacceptable according to the silviculture prescription or site.

The surveyor must always maximize the plot with the preferred and acceptable species before tallying any unacceptable species. Unacceptable species must be recorded and compiled separately to avoid any potential confusion with the preferred and acceptable species.

The intent of tallying unacceptable species is primarily for treatment recommendations. Tallying unacceptable species will also provide justification when recommending an amendment to allow the unacceptable species to be considered as an acceptable species on the opening.

3.4.2.4 General Eras of Free Growing Standards

There are three general eras of definitions and specifications of the assessment of competing vegetation:

- Pre 1994 Silviculture Practices Regulation Period;
- Post 1994 Silviculture Practices Regulation Period;
- Two Options Time Period.

3.4.2.4.1 Pre 1994 Silviculture Practices Regulation Era

The pre 1994 Silviculture Practices Regulation Era covers a time frame of December 17, 1987 through to February 7, 1994. These older silviculture prescriptions or site plans have a wide range of specifications with regards to free growing definitions. Some have no specifications for the determination of free growing status. In this era, there were regional and district specific methods of defining “free from unacceptable levels of vegetative competition”.

3.4.2.4.2 Conifer Brush Ratio - Post 1994 Silviculture Practices Regulation Era

The Post 1994 Silviculture Practices Regulation Period era is characterized by a consistent approach to free growing determination. It covers the period of time from February 7, 1994 through to spring 2000.

The effective growing space of a tree is defined as a one-meter radius cylinder around the tree. For a tree to be considered free growing, the tree must be at least the required height above the competing brush. The required height is expressed in the form of percent conifer to brush ratio. The two most common conifer-to-brush ratios used in the province are 125 percent and 150 percent. Others may be present in specific silviculture plans and prescriptions.

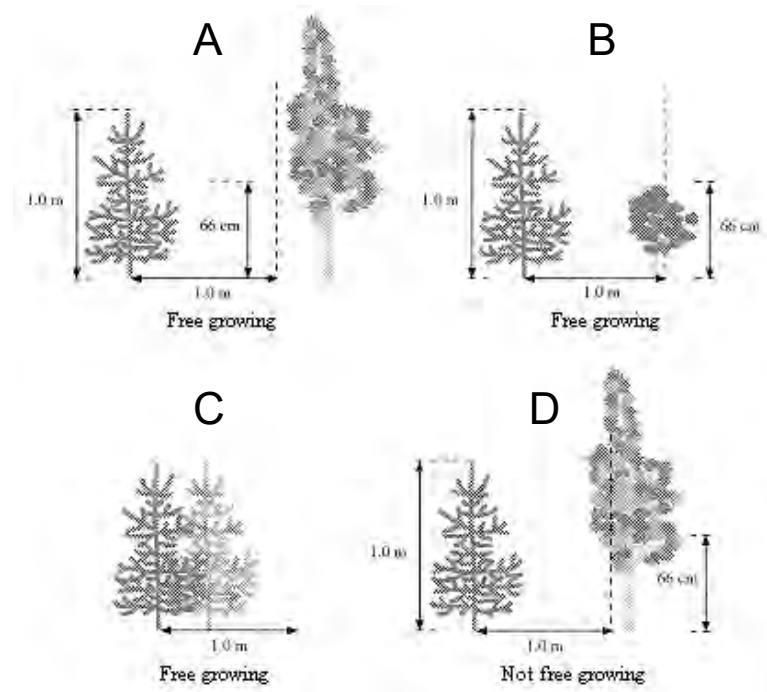


Figure 4: Examples of free growing determination.

Example A: The crop tree is free growing because there is no vegetation within a 1m radius.

Example B: The crop tree is free growing because the crop tree is 150% or more the height of the tallest [competing vegetation](#) within a 1m radius of the crop tree.

Example C: The crop tree is free growing because there is no competing vegetation taller than 66cm (150% the height of the conifer) within a 1m radius. Other conifers are not considered as competition at this stage. They are considered at the stratum level with [maximum density](#).

Example D: The crop tree is not free growing because the crop tree is not 150% or more the height of the tallest competing vegetation within a 1m radius of the crop tree. Any encroachment of vegetation within the 1m radius cylinder makes the crop tree not free growing. This may be as little as a single leaf or other relatively minimal vegetation.

3.4.2.4.3 Two Options Time Period

In the spring of 1999, a document entitled, Interim Free Growing Guidelines was introduced. This was formalized in 2000 and incorporated into the Establishment to Free Growing Guidelines Appendix 9 and remains recommended practice. The licensee responsible for producing a free growing opening has the choice to select one of two methods of assessing the level of [competing vegetation](#) to determine the free growing status of the area being surveyed. The method used is recorded by checking the appropriate box on the FS 657.

It may be acceptable to specific District Managers to select separate methods for each standards unit within an opening and pre-approved is recommended.

Method 1:

- Survey the opening based on the parameters specified in the silviculture plan or prescription.

Method 2:

- Survey the opening based on the procedures for assessing [competing vegetation](#) described in Appendix 13 of this manual or Appendix 9 of each regional [Establishment to Free Growing Guidebook](#), (Cariboo Region link provided).
- This procedure requires that licensees accept the added minimum free growing height standards, as found in the Establishment to Free Growing Guidebook or Forest Stewardship Plan, if they are not already described in their current silviculture plan or prescription when using the new “free from brush” guidelines. None of the other stocking standards change; the minimum inter-tree distance, species acceptability, conifer to brush ratio, the minimum free growing heights (if specified), and the minimum and target stocking standards are still used as prescribed in the silviculture plan or prescription. Only minimum free growing heights are added in “compensation” for reduced vegetation competition specifications.

3.4.3 Guidance Procedures for the Assessment of Vegetation Competition in Conifer Managed Stands – 2015

3.4.3.1 Introduction to Assessing Vegetation Competition

A free growing stand as defined in the *Forest and Range Practices Act* (FRPA) is: “a stand of healthy trees of a commercially valuable species, the growth of which is **not impeded by competition from plants, shrubs, or other trees**”.

The intent of the free growing concept is to identify the point where a managed stand is not being impeded by brush and can reasonably be expected to continue development to maturity without significant additional intervention. At this stage, liability and responsibility for free growing stands reverts from the obligation holder to the Crown.

In this section and the subsequent Appendix 13, guidance has been provided for regionally specific competition threshold criteria of acceptable vegetation competition in conifer stands.

These free growing criteria are **not a competition index** or a decision tool for treating stands. Rather, they identify a desired state of the free growing crop within the free growing assessment period, which represents an “acceptable” level of risk to the Crown.

3.4.3.2 Methods for evaluating acceptable levels of brush and broadleaf tree competition at free growing

Licensees with free growing obligations have three options available for competition evaluation:

- 1) Use the defined unique **Acceptable Competition criteria and procedures in an approved FSP or SP**;
- 2) Use the **default Crop/Brush Ratios in the FDP Stocking Standards** ([Reference Guide for FDP Stocking Standards](#)); or
- 3) Use **the Local Geographic Competition Assessment Criteria** listed below and linked to sections of **Appendix 13**, for the licensees operating region.

3.4.3.3 Vegetation Categories

Regardless of the assessment methodology, the risk that future treatments will be required, will vary with the type of vegetation and the maturity of the crop tree. The following illustration shows the relative risk as a function of potential height growth over time per vegetation type.

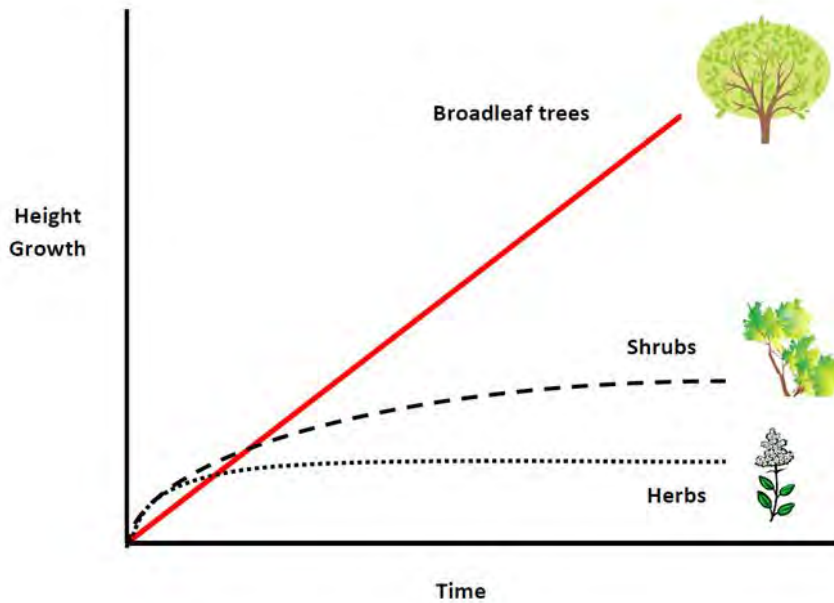


Figure 4a: relative Height growth over time per Vegetation Category

For this reason, acceptable levels of vegetation within the effective growing space of a crop tree will usually be evaluated separately, following three broad vegetation categories and hierarchy:

<p style="text-align: center;">1st</p> <p style="text-align: center;">Shrubs and Herbs</p> <ul style="list-style-type: none"> vegetation communities <i>without broadleaf</i> tree competition 	
2nd	2nd
<p style="text-align: center;">Interior Broadleaf</p> <ul style="list-style-type: none"> vegetation communities that include <i>aspen, birch, and upland cottonwood</i> 	<p style="text-align: center;">Coast Broadleaf</p> <ul style="list-style-type: none"> vegetation communities with <i>red alder, big leaf maple, and cottonwood</i> (coastal form)

This conceptual approach to evaluating vegetation types separately is incorporated into the competition guidance contained in the Appendix 13 section of this manual.

3.4.3.4 Shrub and Herb Competition Details for all criteria in Appendix 13

Shrub and herb (or non-broadleaf tree vegetation) includes all other types of vegetation including herbaceous/low shrub and tall woody shrub species (e.g., fireweed and willow). To be Free Growing, the crop tree must be taller than the shrub and herb vegetation in at least three quadrants of its effective growing space.

Note: Quadrant - Is represented by a 1 meter radius cylinder around the crop tree (as shown in Figure 4b below). This cylinder extends upwards, beyond the height of the crop tree being assessed. The cylinder can be rotated to minimize the number of quadrants occupied by competing vegetation.

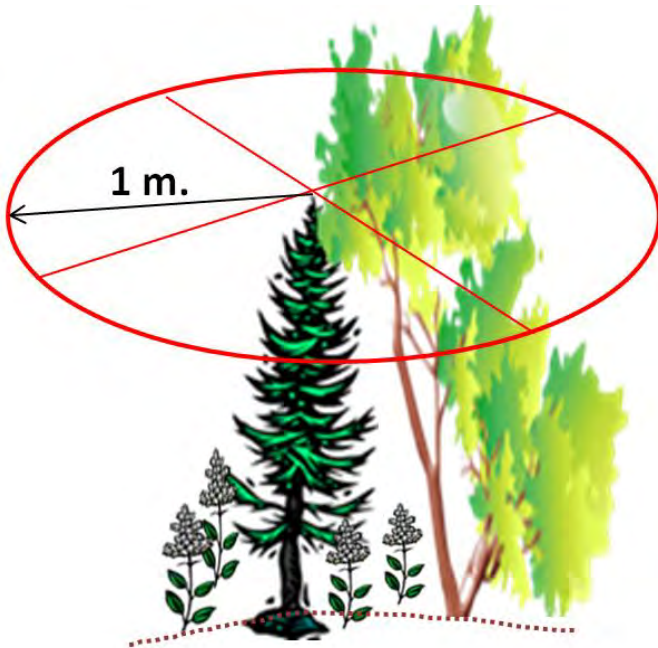


Figure 4b: FG Crop tree that is taller than shrub in at least 3 of 4 quadrants

3.4.3.5 Broadleaf Competition Details

Preferred or Acceptable Conifer overtopped by an Acceptable Deciduous (also identified as a Countable Broadleaf)

Appendix 13 allowance for a capped specific number of broadleaf per plot would not apply to SU's with acceptable broadleaf species in their stocking standards. The concept of "potentially free growing tree" with one broadleaf in a quadrant and allowable

broadleaf in the plot of between 2 to 5, would not apply. Therefore the “crop tree to brush ratio” would apply to conifers in these types of SUs. Acceptable broadleaf would be considered free growing if they are well-spaced and meet the broadleaf damage criteria (free from brush does not apply to broadleaf in this case).

The Potentially FG concept doesn’t apply when broadleaf Ep, At or Act are either preferred or acceptable species in the SU’s Stocking Standards.

Layer 1 (≥ 12.5 dbh) Broadleaf Species will be considered **non-competitive** when using the quadrant method for assessing Free Growing Conifers, if the collective layer one, total broadleaf species in the plot must be $< 8 \text{ m}^2$ Basal Area (Rationale: 8 m^2 is the threshold BA used by Comeau and Cortini in the *Mixedwood Well Growing* standards developed for the Aspen and Sw mixtures).

Broadleaf tree clumps

The crown area of multiple stemmed broadleaf trees is larger than that of single-stemmed individuals. However, the total crown area and competitive effects of a multiple stemmed tree are often not as large as would be encountered with the same number of single-stemmed trees.

While numerous birch stems will often originate from one stump, aspen is more likely to sucker from below the ground or at the root collar (see Figure 4c). Table 1a shows the relationship between the actual number of birch, aspen, cottonwood or red alder stems originating from a cut stump and the related number of countable broadleaf trees used during a free growing assessment. For birch, aspen, cottonwood and red alder that originate from below the ground level, all stems greater than the median height of the potentially free growing trees will be tallied as countable stems.

Note: This principle applies only to the determination of a free growing tree. It is not used in the assessment of total trees.



Figure 4c. Numerous broadleaf stems originating from a stump and from below ground root suckers. Left: Three stems originating from a birch stump would be tallied as two countable trees. Right: Three aspen stems originating from below ground aspen root suckers are tallied as three countable trees.

Number of stems	Number to count
1	1
2–5	2
6 +	3

Table 1a. A comparison of multi-stemmed birch, aspen, cottonwood or red alder with numbers of countable broadleaf stems.

Note: to use this table, the multi-stemmed deciduous must originate from one above-ground stem or stump.

3.4.3.6 Local Geographic Free Growing Competition Assessment Criteria – Appendix 13

The province has been separated in to 3 broad geographic regions for these Competition Criteria. These rough separations are based on:

- 1) Different Broadleaf species (i.e. red alder on the Coast and aspen in the Interior); and
- 2) Different Broadleaf species competitiveness relative to the local ecologies (i.e. aspen is more competitive in the North Area than in the South Area)

Within these broad regionally mapped separations there may be more detailed criteria potentially per local BEC variants.

Refer to **Appendix 13** on page for the specific Local Geographic Competition Assessment Criteria Broadleaf Criteria for local BEC variants of interest.

3.4.4 Maximum Density

The term maximum density is used to describe a tree density threshold, above which the licensee responsible for an opening is obligated to conduct a juvenile spacing treatment prior to declaring a stand free growing.

The term repression level, as used in early silviculture prescriptions, has the same meaning as our current definition of maximum density.

3.4.4.1.1 Forest Practices Code (FPC) era Opening:

Density levels must be controlled as per the densities prescribed in the approved SP or PHSP. If the SP or PHSP does not state a maximum density or repression level, default densities would apply, as described below. For Woodlot Licensees, the maximum density thresholds are outlined in WLFMR sec 78(7) – which parallel the approach listed below.

If the silviculture prescription was approved on or after April 1, 1994, and the number of countable conifers per hectare exceeds 10 000 or a number specified by the regional

manager, prior to the free growing date, the number of conifers must be reduced to within the range specified in the silviculture plan or prescription.

For silviculture prescriptions or site plans approved before April 1, 1994, that state a maximum density or repression level, spacing is required if the density of lodgepole pine or drybelt Douglas-fir exceeds 10 000 per hectare or a number specified by the District Manager.

Maximum density thresholds have been changed by the Regional Executive Directors of the northern and southern interior:

- The [Northern](#) Interior Forest Region, in August of 2007, redefined the thresholds for the maximum density juvenile spacing obligation by a licence to:
 - 20,000 countable conifers per hectare where lodgepole pine is >80 in the inventory label,
 - 10,000 countable conifers per hectare all others
- The [Southern](#) Interior Forest Region, in February 2006, redefined the thresholds for the maximum density juvenile spacing obligation by a licence to:
 - 25,000 countable conifers per hectare where lodgepole pine is >80 in the inventory label,
 - 10,000 countable conifers per hectare all others.

3.4.4.1.2 Forest and Range Practices Act (FRPA) era Opening

For those areas managed under a FSP or WLP, maximum density levels approved within the plan will apply. If a FSP or WLP does not have a stated maximum density, then there is no default maximum density that applies.

For areas harvested after January 31, 2004, under a FSP and areas where the FSP has specified that FRPA FSP stocking standards apply, the responsibility to conduct juvenile spacing treatments will depend on the contents of the plan itself.

3.4.4.1.3 Forests for Tomorrow (FFT) and the use of the Repression Density Decision Key (RDDK)

Considerable effort has been invested by Forests for Tomorrow (FFT) and industry stakeholders to review the funding criteria for juvenile spacing activities proposed on areas under the responsibility of the FFT program. Decision making tools have since been developed by experts and specialists, in collaboration with government and industry to help guide economically sound decisions as to when and where to conduct juvenile spacing treatments. Stand level repression is influenced by high initial densities and low site quality, as well as initial disturbance type. There is a higher likelihood that post-wildfire regenerated stands will experience repression at lower densities than post-harvest regenerated stands, due to the swift and abundant germination occurring after a wildfire event. Trees continue to grow, but they do so at a slower rate, as though the site quality or site productivity has been reduced. The [Repression Density Decision Key](#) was developed to identify the most suitable stands for spacing, by interpreting this loss of site index and

considering costs of treatments and the probability of those stands recovering from growth losses if juvenile spacing treatments were conducted.

The [Pre-stand Tending Survey and Prescription Development Standard for Repressed Stands Eligible for FFT Funding](#) document guides the survey procedures and prescription development expectations for **repressed stands eligible for FFT funding**. This survey standard highlights specific changes to survey plot sizes, estimates of site index, and definitions of ‘countable conifers’ to include dominant and co-dominant tree counts. This survey standard specifically links to the [Repression Density Decision Key](#) to develop treatment recommendations.

Additional silviculture survey activity standards, specific to the Forests for Tomorrow program, including post wildfire assessments, can be found on the [FFT website](#) under the Current Reforestation and Timber Supply Mitigation sections.

3.4.4.2 Countable conifers

When determining if the total number of conifer trees (TC) exceeds [maximum density](#), an understanding of countable conifers is required.

On areas where the number of countable conifers are well below the maximum density, it would be irrelevant to collect countable conifer data.

The following methodology steps are used for determining the number of countable conifers:

For even aged silviculture systems:

1. Determine the median height (explained in section 3.4.2.2.1) of the **well-spaced** trees in the plot. The surveyor should tally the tallest well-spaced trees. It is not required and can be detrimental to tally more well-spaced trees than the M value .
2. Where the median height is:
 - ≤ 2 m.,
 - the countable height is 30% times the median height as determined in step 1.
 - > 2 m.,
 - the countable height is 50% times the median height as determined in step 1.
3. Countable conifers are either:
 - I. All the lodgepole pine or drybelt Douglas-fir above the countable size calculated in step 2 for all those silviculture prescriptions or site plans approved before April 1, 1994, or
 - II. All conifers taller than the countable size calculated in step 2, for all those silviculture prescriptions or site plans approved after April 1, 1994, but not under a Forest Stewardship Plan, or

- III. Other maximum density and or countable conifer definitions that may be specified in Forest Development Plans or Forest Stewardship Plans.

For stands managed on a single tree selection basis:

1. All conifers in layer three (>1.3m tall but <7.49 cm [dbh](#)) contribute toward the maximum density determination and are considered countable conifers.

On areas where the number of countable conifers are well below the maximum density, it would be irrelevant to collect countable conifer data.

3.4.4.2.1 Median Height Determination Procedure

Median height, as it is used for countable height is defined as the “middle” height.

Procedural Steps:

1. Identify up to the M-value number of **well-spaced** trees in the plot (best to select the tallest well-spaced trees).
2. Determine the median height of the well-spaced tree. This involves measuring all of the well-spaced trees; arrange their values in order from smallest to tallest. Select the height of the middle tree, or the average height of the two middle trees.

Example: In the example below, figure 5, the countable height is equal to the measured height of tree number four, times 50%. $2.1 \times 50\% = 1.05\text{m}$, or 105 cm. The trees taller than 105 cm are countable. Tree number 4 may or may not be a free growing tree, but it is one of the five well-spaced trees.

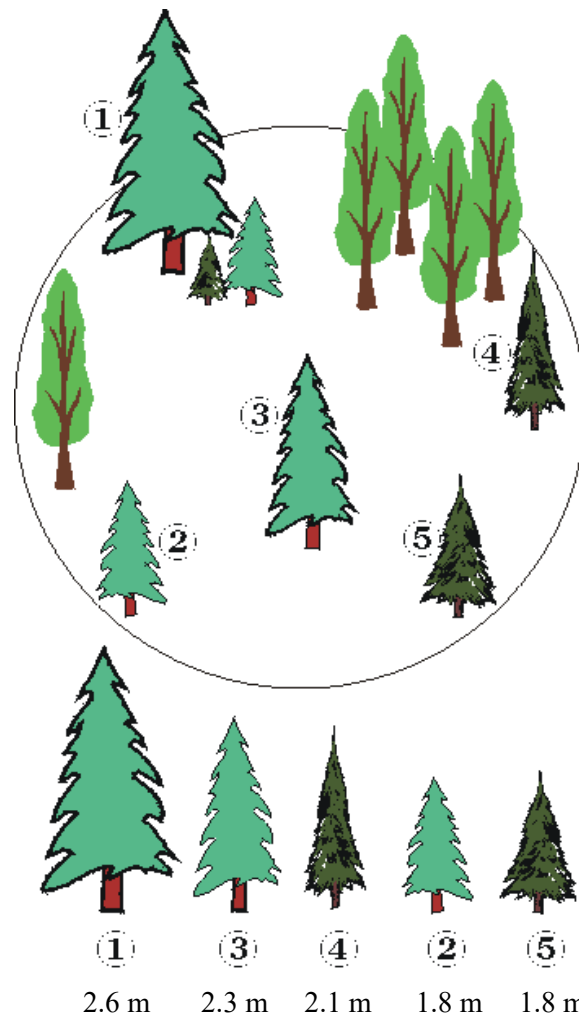


Figure 5: An example of median height determination with an odd number of free growing trees on an even-aged stand.

In the example below, figure 6, the countable height is determined by the average of the measured heights of trees two and four, times 30 %. $(2.1 + 1.8)/2 \times 30\% = 0.58 \text{ m}$ or 58 cm.

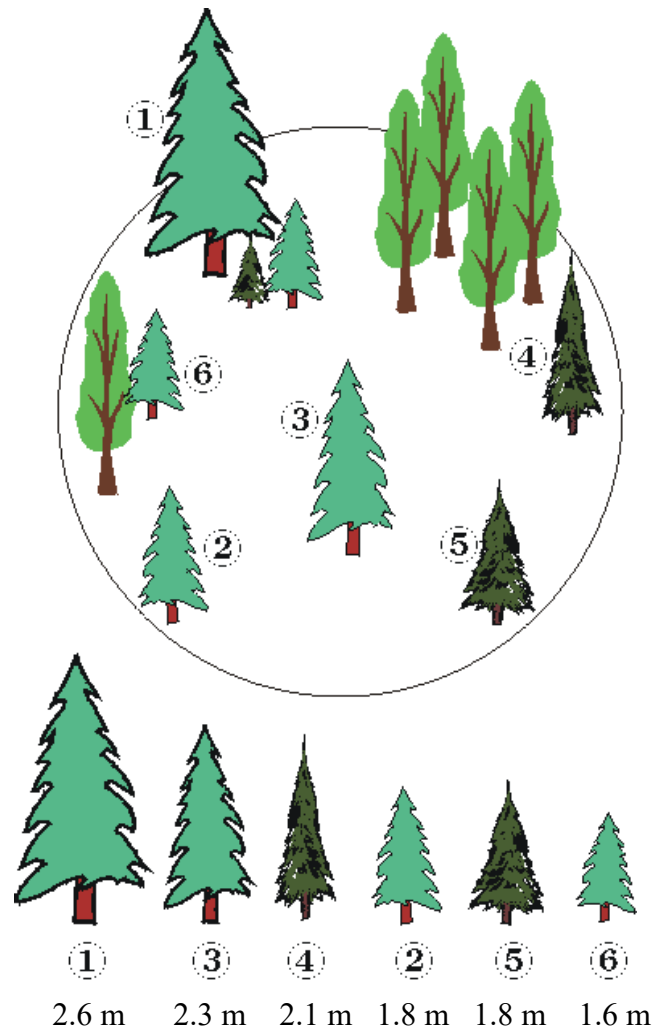


Figure6: An example of median height determination with an even number of free growing trees on an even-aged stand.

3.5 Site Index

[Site index](#) is a measure of the growing potential of a site. Site index is defined as the average top height of trees, of a certain species, at fifty years breast height age.

Accurate site index values are required for inventory, timber supply analysis and silviculture decision making. In silviculture, site index is often used to select or rank sites for treatment, to prescribe appropriate treatments and to schedule these treatments. The reporting of site index is an integral part of an inventory label.

A complete discussion on site index determination can be found at:

<http://www.for.gov.bc.ca/hre/sibec/> publication [Site Index Estimate by Site Series](#).

3.5.1 Methods to Determine Site Index

During the walk-through, a surveyor must decide which method will be used to determine the [site index](#) for each stratum. Guidance on site index method selection is provided on the [FS 660](#).

There are five methods used to determine site index: growth intercept, [SIBEC](#) (site index by biogeoclimatic classification), site index curves, site class conversion and professional interpretation. These methods differ in their accuracy, availability and in the input data required. A key to assist surveyors in selecting the method to use for estimating site index is provided on the [FS 660](#). Each of the [site index determination methods](#) has an approved abbreviation (these are listed in Section 8.1, data point #172). The two approaches commonly used by surveyors are the SIBEC and Growth Intercept (GI) methods.

It is strongly encouraged to select the most reliable method for estimating site index as outlined in the decision key – in particular, to use the Growth Intercept method wherever it is suitable and feasible.

The SIBEC method requires the surveyor to use the site index value by species based on the biogeoclimatic classification of the stratum or polygon. There are tables to be used if done manually. Silviculture survey data collection and summary programs generally have these tables built into them. Surveyors should be mindful that this method is reliant on the correct biogeoclimatic classification being used.

To use the Growth Intercept method, you must have: approximately 500 stems per hectare of a silviculturally suitable species, that have at least three years growth above breast height (1.3m), are not scheduled to be eliminated through treatment, are growing at potential, and have available Growth Intercept tables. For example, stands with significant competing vegetation or forest health factors that are impacting height growth are not suitable for the use of the GI method.

If the stand is deemed suitable for the GI method, samples are collected using the same plot centre as your stocking or free growing survey. A 5.64m plot is used to select the top 100 stems per hectare. The tallest stem of the correct species is selected from the plot, and the species, total height and breast-height age is recorded. If there are no trees growing at potential at a plot, then the plot is skipped or completed in an unbiased

fashion before the next plot. Plot intensity is contract specific, but normally no more than ten samples per stratum are required.

[Site Tools 4.0](#) provides convenient access to determining site index for a stand using the GI and Site Index Curve methods. Site index is calculated from the height and age of sample trees measured on the site.

Specifically for GI, once the latest version of Site Tools is loaded on your computer, follow these steps:

- 1) Click on Tools in the top menu bar and select “Calculate Value”;
- 2) Select your SI species from the drop down menu (note the recommended equation to be used will appear below species);
- 3) Select “Calculate SI” from the next drop down menu;
- 4) Enter your sample tree total height and breast height age and then click “Calculate”;
- 5) The GI Site Index will be displayed to the right of the screen.

3.5.1.1 Leading Species Issues when determining Site Index

SIBEC

When the leading species of the inventory label is not the appropriate choice for determining site index using the SIBEC method, (i.e. a deciduous species not identified on the SIBEC tables) it is recommended as a best practice that the next leading species of the inventory label should be chosen for the site index species. This may commonly be the leading species in the silviculture label. If this is done, a comment should be submitted along with the RESULTS entry to identify this difference.

Growth Intercept

When using the Growth Intercept method, normally the leading species on the inventory label is chosen as the site index species. When the leading species of the inventory label is not the appropriate choice for determining site index using the Growth Intercept method, (when it is silviculturally unsuitable - not a preferred or acceptable species, suppressed or its height is affected by forest health factors), it is recommended as a best practice that the leading species of the silviculture label should be chosen for the site index species. If this is done, a comment should be submitted along with the RESULTS entry to identify this difference. An acceptable alternative practice, if the leading species in the inventory is not a species available for Growth Intercept methodology, a conversion between species is available for some species in the Site Tools program.

3.6 Basal Area Forest Cover Requirements – for all Milestones

[Basal area](#) (BA) is the cumulative cross sectional area, represented in m^2 , of the live trees, that are greater than or equal to 12.5 centimeters in diameter (Layer 1 trees), measured at breast height.

Basal area must be collected and reported (as a legal requirement) into RESULTS for Layer 1 stems, where the following situations and circumstances are present in a surveyed SU:

1. If the stocking standards in the silviculture plan or prescription require that a specific basal area per hectare be retained after harvest;
2. For all SUs regardless of the stocking standards, if there is a retained overstorey of Layer 1 stems that are $> 5 \text{ m}^2/\text{ha}$. In this situation for all legal reporting milestones (regen and free growing) **a complete inventory** must be reported into RESULTS, **including the ave. BA in m^2/ha** for the Layer 1 overstorey layer (*As per the Chief Forester directive effective July 8, 2015, but allowing for a transition compliance period starting for all 2016 surveys to be reported*).

Best practice procedures for measuring basal area are contained in [Appendix 4](#).

3.7 Dispersed Types

In some cases, strata in an opening may be better described by their characteristics rather than by their geographic location. When the walk-through identifies strata that are so distinctly different, but so intimately mixed that it is impractical to map the location of each portion of the strata, these can be surveyed as dispersed types. During the walk-through the characteristics of each of the strata must be clearly and distinctively defined for application during the field data collection.

Dispersed types are considered at the time of a stocking survey when dispersed areas < 1.0 hectare in size add up to a significant total area (approximately 2 or more hectares) and the survey demonstrates that the free growing status may be compromised. Examples would include numerous NSR holes or brush accumulations that are individually < 1.0 hectare in size each, but all together add up to a significant area over the entire SU.

Dispersed types are generally not recognized at the time of free growing. To do so would require accurate spatial data. The variability that may be present at the time of free growing due to dispersed types is addressed by increased plot intensity if required.

It is preferable that these dispersed strata are identified in the silviculture plan or prescription; if not an [amendment](#) to the silviculture plan or prescription may be required, if a change of the stocking standards for one or more of the strata is required.

Identifying an area as a dispersed type is not a replacement for proper stratification.

Dispersed strata must:

- have distinctively different characteristics that can be clearly described, **and**
- have occurrences of each stratum that are impractical to map (too small and numerous and/or too inter-mixed)

The following methodology is used to sample dispersed strata:

- clearly define the characteristics of each stratum
- establish the number of plots in each stratum that are required to meet the desired statistical precision. Plots may have to be moved to ensure that they are fully located within a stratum. If a grid pattern sampling design is used, plots should be moved along the strip line in increments of 10m until the plot falls fully within one of the strata.
- estimate the proportion of the opening that is representative of each stratum
- summarize the data for each stratum separately
- record stratum labels on the map.

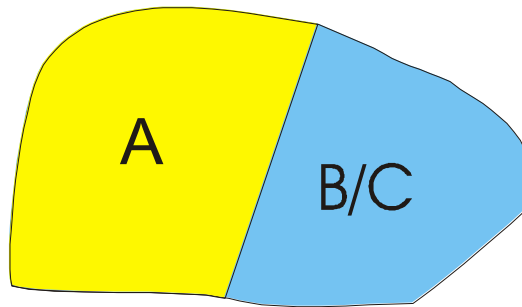


Figure 7: An example of dispersed strata map label

The determination of the area represented by each stratum is relatively complex. (Further detail on how to determine the area of a Dispersed Strata is contained in **Appendix 2**). Area is expressed as a percentage of the combined total area of the dispersed strata. Area can be determined by either:

- visual estimate;
- photo interpretation;
- [line intersect](#) ; or
- [high intensity point sampling](#) .

(Visual estimates or photo interpretation are the most simple, but are typically the least accurate)

Stratum		Proportion of Area Represented by Each Stratum	Area (ha)
A		n/a	8
B	} Combined Area 10ha	60%	6
C		40%	4
		Net Area to be Reforested	18

Table 2: An example of a dispersed strata area calculation

3.8 Walk-through

A walk-through is an initial reconnaissance of the opening. As the name walk-through implies, one of the most effective ways of conducting the walk-through is to physically walk-through the opening, visually noting the characteristics found on the opening. The procedure can often be completed by other methods such as all-terrain vehicles, UAVs, and aircraft.

This step in the survey process is often not performed to the formal level as outlined in this manual. This step is at the discretion of the surveyor and can often depend on the strength of the initial stratification, the surveyor's local knowledge of the opening being surveyed and the time allotted to this step in the survey contract. It is recommended that all surveyors perform a walk-through or initial reconnaissance of each opening, but this is not a required step.

The walk-through is used to confirm a variety of site and survey decision information, including but not limited to the following:

- ecological classification
- stratification
- definition of dispersed strata
- survey objectives
- sampling method
- sampling intensity
- identification of the leading and second inventory species
- method of determining [site index](#)
- [forest health](#) factors present
- limiting factors
- potential treatments

- stand structure (even-aged, even-aged layered, DFP, SEDRSS, or multi-storey uneven-aged - as related to the stocking standards for the opening)
- dispersed retention with basal area exceeding 5 m²/ ha
- prism size to use to capture basal area

3.8.1 Field Stratification

Stratification is the **most critical** step in the survey process. Stratification is the process of defining and identifying populations with similar characteristics within an opening. The objective of stratification is to increase sampling precision by delineating homogenous strata within an opening, so that there is less variation within each stratum than within the entire opening. Stratification is used to increase the efficiency of the survey by reducing the number of plots required per stratum to reach a desired sampling precision. Stratification can also improve the reliability of the treatment recommendations.

Stratification is required to meet the legal requirements specified in the silviculture plan or prescription. Silviculture prescriptions or site plans contain one or more standards units that are developed according to biogeoclimatic classification, site attributes and stand management objectives. If more than one standard unit is defined in the silviculture plan or prescription, these standard units must be stratified and surveyed separately.

These standards units (**SUs are the first initial stratification criteria**) are further subdivided based on the following stratification criteria:

- | | |
|-----------------------------------|--|
| • <u>stocking</u> | NSR, SR, FG |
| • leading inventory label species | Change of leading species,
for example, Fd ₈₀ Ss ₂₀ vs. Ss ₇₀ Cw ₃₀ |
| • inventory species composition | >20% difference,
for example, Fd ₉₀ Ss ₁₀ vs. Fd ₆₀ Ss ₄₀ |
| • <u>age class</u> | >20 years difference between leading species* |
| • <u>height class</u> | >10 m difference between leading species* |
| • <u>crown closure</u> | >20% difference between strata |
| • site index | >3 m difference in SI 50 |
| • treatment recommendations | |
| • stand structure | |
- * **Note:** These are the minimum requirement guidelines set by the Forest Analysis and Inventory Branch.

The following two examples provide a comparison of the significantly different survey findings that correct stratification will result in. Figure 8 depicts the results of an unstratified survey for a fictional opening. Figure 9 demonstrates the results of correct stratification for the same opening.

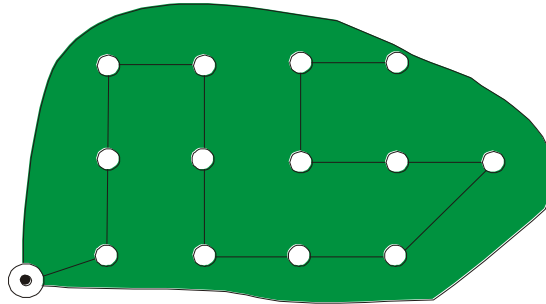


Figure 8: Systematically positioned plots without stratification

Well-spaced	750 ws/ha
Minimum stocking standard	700 ws/ha
Confidence interval	200 ws/ha
Recommendation	establish more plots? or Fill plant

The results of this survey without stratification are inconclusive.

After a thorough file review, preliminary stratification and walk-through, two strata were identified and sampled separately. The data from the thirteen plots indicate the following results:

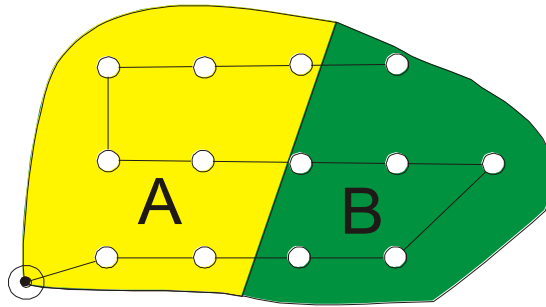


Figure 9: Systematically positioned plots after pre-stratification

Stratum A		Stratum B	
Well-spaced	1000 ws/ha	Well-spaced	500 ws/ha
Minimum stocking standard	700 ws/ha	Minimum stocking standard	700 ws/ha
Confidence interval	75 ws/ha	Confidence interval	70 ws/ha
Recommendation	* Satisfactorily restocked	Recommendation	* fill plant

The results of the **correctly stratified survey** are more likely to provide definitive results, and describe the condition of the current opening.

3.8.2 Ecological Classification

The ecological classification should be confirmed during the walk through. The classification completed during the preparation of the silviculture plan or prescription can be used as a likely reliable starting point for field verification. If there is a variation in the ecological classification from that of the silviculture plan or prescription, that will change the stocking standards, then an amendment should be recommended. Correct classification is also important where SIBEC is being used to assess site index.

3.8.3 SU Mapping Variation

During a walk-through it may become apparent that the standards unit boundaries as mapped in the silviculture plan and prescription do not match the location of the characteristics as they are found on the site.

The ability to see and accurately map terrain features and ecological classification is generally enhanced once the mature forest is removed during harvest operations. As a result it is common to see more accurately the actual location of the intended standards unit boundaries after the opening has been harvested.

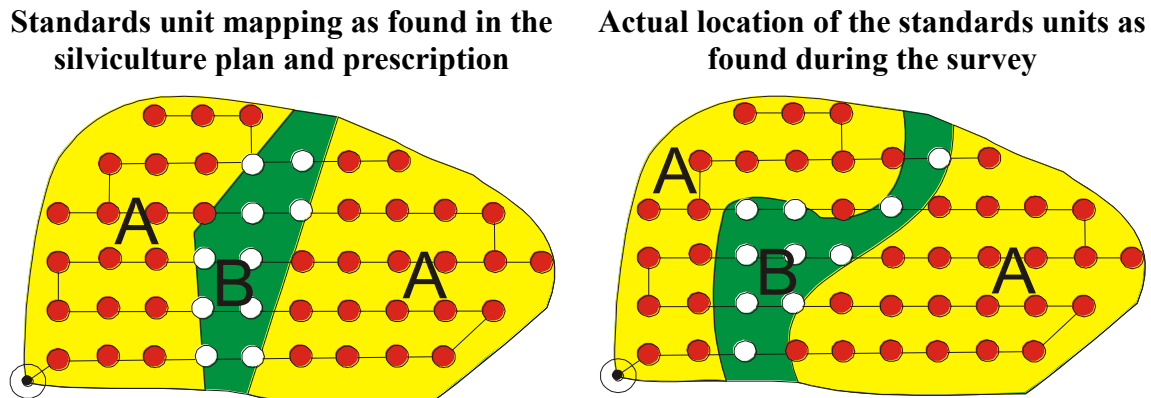


Figure 10: Standards unit mapping variation

The sample diagrams above show that the intent of the prescription was to recognize the presence of, for example, a wetter, low lying standards unit B. A portion of the block that meets the characteristics of standards unit B is identified and mapped during the walk-through. It is approximately the same size and position, yet noticeably different. If one were to follow only the standards unit map, many of the plots and their data would be summarized as representing the wrong stratum.

When the intent of the prescription is clear, surveyors are directed to update the standards unit mapping. The variation must be pointed out and consideration be given to the need for an amendment.

The magnitude of the difference will dictate the relative necessity to recommend an amendment. In the above example, the area represented by B is similar and therefore an amendment may be of little value. In both there are approximately 10 ha of the standards

unit B. Generally when a change in standards unit boundaries occurs, an amendment is required.

3.8.4 Preliminary Assessment of Forest Health Factors

During the walk-through, a preliminary assessment of forest health factors should be noted and recorded. The walk-through is done with less rigidity, than the typical systematic survey grid pattern, therefore allowing the surveyor to assess trees that have unusual color, vigour or form. The forest health factors noted are recorded on the back of the [FS 657](#) field card. A blank field card or tablet may also be used.

3.8.5 Site Index Determination Method

During the walk-through surveyors are expected to ascertain the most appropriate method for the determination of [site index](#). The [site index training materials](#) describe the process in detail. In brief, the characteristics of the survey site are compared to the site index determination methods and the site index method is then selected.

3.8.6 Potential Treatments

While completing the walk-through it often becomes apparent to the experienced silviculture surveyor that a specific treatment, or treatments, will be required. As a result, additional data can be collected during the survey that will provide a more precise prescription for the subsequent treatment. For example, if few trees are identified during the walk-through, a [planting](#) project may be required, therefore the surveyor should take the extra time required to collect the additional data required to complete a planting prescription. The same can be said for anticipated [site preparation](#), brushing and spacing treatments.

3.8.7 Minimum Stratum Size

The minimum stratum size is a complex composite of:

- legislative and contractual obligations
- operational feasibility
- biological practicality
- cost, benefit and risk

In the spring of 2007, strata size and distribution became specified in regulation:

- Reserves and NP areas – 0.25 ha mappable*

* Mappable is suggested as being defined as a polygon greater than 20m throughout its length. Areas that do not meet the stocking obligations less than 20m from the nearest NSR or Not FG area are considered contiguous units.(Note: “Mappable” may be defined within an approved FSP).

- SUs less than 1 ha – the entire SU

Milestone Surveys:

- Regeneration delay and free growing – 1 ha
- Mappable not free growing portion of a SU – 1 to 2 ha, maximum of 5% of the SU NAR. For example, an SU with an NAR of 30 ha may have a *non* free growing portion up to 1.5 ha in size (5% of 30 hectares). The *non* free growing area will need to be assessed to develop a silviculture and inventory label and spatial data, as per the free growing portion, prior to the SU being submitted for declaration.

Note: Refer the following document [Forest Cover Stratification and Milestone Declaration v1.4](#) for examples and illustrations of conditions referenced above.

The reforestation obligation is for the net area defined in the silviculture plan or prescription.

4 Sampling Principles

The current silviculture survey procedures have two survey principles at its foundation:

- 1. Identify strata**
- 2. Gather data within each stratum**

The data gathering principle has three sub-components

- a. Survey Objective
- b. Survey Method
- c. Survey Intensity

There are many sampling objectives, methods and intensities that can produce valid results, but they will only withstand an intensive review if stratification has been done correctly.

Forest management legislation requires a “forest cover inventory” to be produced through a survey but the particular survey methodology or intensity is not defined. The emphasis is put on the expectation for the survey to accurately represent the stand as opposed to the methods and intensity of the survey conducted. The results reported are expected to be significantly similar to those resulting from using the methods described in this manual.

4.1.1 Survey Objective

It is recommended that the survey objective be determined by the surveyor during the walk-through. The selection of the survey objective or objectives is based on a combination of the office and field observations.

Example: A licensee survey contract may indicate you are to conduct a free growing survey. During your walk-through you find significant mortality from some forest health factor. Not only is the stand not free growing, but in fact it is NSR. The licensee would likely not want a free growing survey completed, instead they would prefer stocking and plantability data collected.

4.1.2 Sampling Intensity

Generally, sampling is performed where it is too time consuming to complete a full inventory. In the case of silviculture surveys the time required to count every tree in a stratum is excessively costly compared to the relative accuracy required. As a result, we collect data from a relatively small number of small sample plots, and then average the data and project the information over the entire stratum.

The intensity of the survey should be varied to match the variability of the population. That is, the more obvious the answer is to the questions posed in the survey objective, the less intensive the level of sampling is required. Conversely, the closer the characteristics of a survey stratum are to an important threshold, such as minimum stocking standard or maximum density, the more intensively the stratum should be sampled.

Example A: During your walk-through you can visually see the rows of planted trees that were planted 13 years ago are now over 3 meters tall. Survival was nearly 100% and forest health factors are very few. Natural regeneration and the competing vegetation are minimal. This stratum is very clearly free growing. A light intensity survey with few, if any, plots would be acceptable.

Example B: Another stratum on the same opening has had poor survival. Stocking is patchy resulting from years of frost damage. Survival is better on the ridges, but poor in the depressions. Heights of the well-spaced trees range from 30 to 200cm. A more intensive and more structured survey methodology will be required to adequately sample this diverse stratum.

The better the stratification, the less plots will be required to achieve acceptable survey results. Generally more plots will result in a tighter survey confidence interval; however establishing large volumes of plots is not a substitute for inadequate stratification.

4.1.3 Plot Radius and Plot Multiplier

Circular plots with a known radius are integral to the sampling procedure. The most common plot radius for the collection of silviculture data is 3.99 meters. There is no mandatory requirement to use any specific plot size, but the 3.99m plot radius has

become a commonly used sample size. A “rule of thumb” is to select a plot radius that will ensure four or more well-spaced crop trees will be found in the plot at target stocking.

A plot with a 3.99 meter radius has an area of 50 m². This is determined using the formula for calculating the area of a circle. A hectare is 10 000 m². This means that a 3.99 meter plot represents 1/200 of a hectare. The plot multiplier is determined by dividing 10 000 m² by 50 m². Therefore, the plot multiplier is 200. The same mathematical principles can be applied to a plot radius of 5.64 meters. The plot multiplier is 100. For a 1.26 m plot radius, the multiplier is 2000.

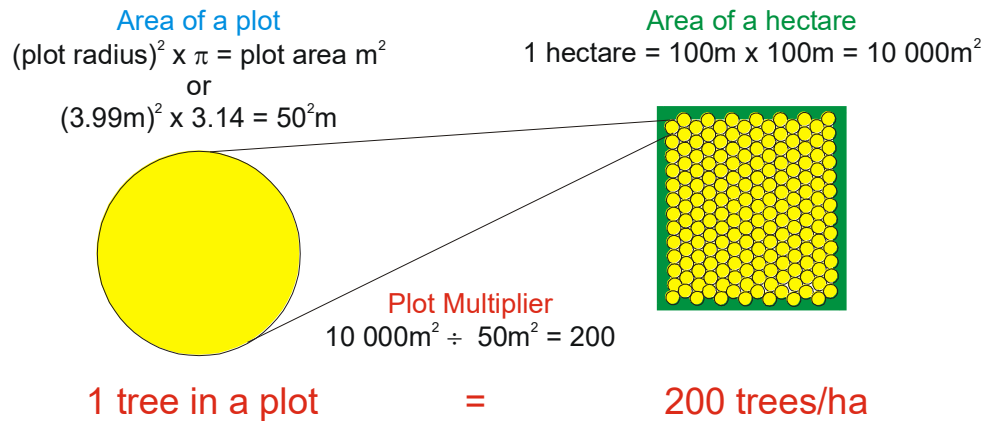


Figure 11: Plot multiplier concept

For a complete range of possible plot radii and their associated areas and plot multipliers, refer to item number 5 on the [FS 660](#) card.

4.1.4 M-value

The ‘M’ in [M-value](#) represents maximum. That is, the maximum allowable number of well-spaced or free growing trees that may be recorded in a single plot.

- The M value is derived from the Target Stocking Standard (TSS) divided by the plot multiplier – it is not a value set or predetermined – and is solely a function of this equation.
- **Example:** If the TSS is 1200 and the plot multiplier is 200, the **M value is 6**.

The M-value is one of the principle factors considered within the formulation of stocking standards. The M-value acts as a cap on the number of trees in a single plot that can compensate for low stocking in other plots. Without the M-value, over stocked plots would over compensate for under stocked plots. The result would be an unacceptable level of variation in stocking, or a ‘patchy’ stand. When stands of equal densities are compared, we find that the stand with an even distribution produces more volume over a rotation than the stand with a patchy distribution.

The subject of “M” value, its necessity in our survey system and the effects changing it has on the resulting stands is discussed in [Land Management Handbook number 50](#).

The M-value is an integral part of the silviculture survey process and is essential to the determination of [stocking](#), (NSR, SR or FG). The M-value, along with the minimum [inter-tree distance](#) and stratification criteria provides the District Manager with some measure of assurance that the regenerated stand is sufficiently consistent in its stocking distribution.

Example: Consider the following extreme data set:

Plot Number	Number of Well-spaced Trees in Each Plot	
	Without M	With M
1	11	6
2	11	6
3	11	6
4	1	1
5	0	0
6	1	1
Total	35	20
Average	5.8	3.3
Trees per hectare assuming 3.99m plots	1167 tr/ha	667 tr/ha
	Target Stocking Standard	Minimum stocking Standard
	1200	700

The example above depicts a situation where ignoring the M-value would produce a result of 1167 well-spaced trees per hectare. This would suggest a near fully stocked stratum. Utilizing the M-value suggests a stocked stratum is below minimum. In reality this describes a stratum with patchy stocking levels and a great deal of variability in the stratum that may not have been stratified correctly.

4.1.5 Tallying in Excess of the M-value

Tallying trees in excess of the M-value was optional for many years. Some forest managers have expressed an interest in knowing the number of well-spaced and/or free growing trees without the limitations of the M-value. At the request of many licensee representatives this additional data was added to the mandatory reporting requirements for surveys submitted after December 31, 2004.

The [stocking](#) of a stratum is still determined based on the survey results which apply the M-value. The reporting of well-spaced or free growing **trees per hectare** in silviculture labels is also still based on survey results which apply the M-value. The process for calculating the **species composition** in the silviculture label includes all those trees in excess of the M-value.

4.1.6 Sampling Methods

The establishment of plots is the basis for the statistical methods used in the survey. The requirement for a systematic pattern has often been stressed as important to the integrity of the sampling method. Regardless of the sampling method used, stratification must be correctly completed.

The basis for statistics requires that all potential plots in the survey area have an equal chance of being selected. **The purpose of systematic locations for the plots is to ensure that there is no ‘bias’ in the collected data.** For instance, plots on rocky outcrops or in thick brush will be as likely to be chosen as plots in ‘farm-field’ spots. It has the added benefit of ensuring appropriate coverage and simplifying the mapping of the stratum.

The provincial survey system provides a great deal of flexibility in selection of intensity and survey design. A survey is reliant on the completion of stratification first, followed by the sampling of the resulting strata and lastly an analysis of the statistical reliability of the data collected. The method of sampling and the number of samples collected is determined by the surveyor beforehand based on the homogeneity of the stratum.

Surveyors are expected to select the most appropriate survey method and intensity to adequately sample the characteristics of individual strata. Regardless of the sampling pattern used, the results should be significantly similar. If they are not, then the selected method may not have been appropriate.

The minimum number of plots per stratum or polygon is 5. With a stratum ≥ 5 ha, initial layout does not exceed 1 plot/ha. The maximum number of plots established is 1.5 plots/ha, unless of course the stratum size is < 3.0 ha where 5 plots become a minimum requirement as well as a maximum number required.

The credibility of the survey results is only as good as the appropriateness of the sampling method and sampling intensity chosen by the surveyor. All of the methods discussed below are equally valid survey methods. The key is selecting a sampling method and sampling intensity suitable for the complexity of the stratum being surveyed.

Considerations:

- Homogeneous populations can be adequately sampled with few plots and with less structured sampling design.
- The less structured survey methods are more likely to have satisfactory results when completed by more experienced surveyors.

The sampling method used is recorded on the bottom right corner of the FS 657 card, field 56.

It is important to make a distinction between the sampling method and the sampling intensity. The four methods used, in order of decreasing structure are: Grid Sampling, Vector Sampling, Representative Sampling and Visual Assessments. All can be equally valid survey methods when applied under the correct conditions.

4.1.6.1 Grid Sampling

The grid pattern method of plot positioning has historically been the most commonly used method. It is the most structured of the methods and as such is often the most expensive. It has the advantage of being a systematic method which will provide accurate, reproducible results. It also provides proof that surveyor has walked over the strata being reported on. The grid system may be used with a low or high plot intensity, which should depend on the variability within the stratum.

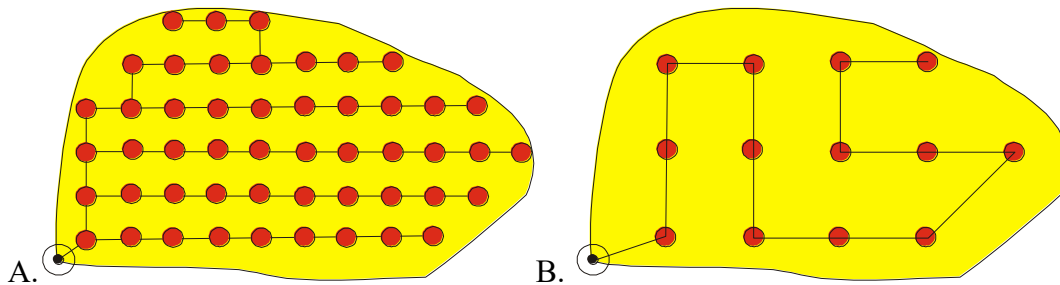
The grid pattern method is effective where a larger number of plots are required in a stratum. The grid pattern results in a more predictable plot location.

Although one plot per hectare on a grid pattern was the most commonly used in past years, it is not a provincial standard.

The grid pattern can also be very effectively applied when few plots are required, by simply widening the distance between plots and or strip lines, in examples A and B below. Plots are positioned at equal intervals along pre-determined strip lines. The example D shows an offset grid pattern that is also acceptable. The key to maintaining the randomness of this sampling method is the arbitrary selection of the starting point and maintaining the systematic positioning of the plots. Bearings and distances are predefined at the beginning of the survey.

Inherent to the grid sampling method, some pre-determined plot locations can end up in the field as being too close to timber edges (under drip lines) or in unmappable non-productive (NP) areas. It is recommended as a best management practice to include a version of the following clauses in survey contracts, to give guidance to surveyors to adjust survey grid designs and to standardize field offset standards for plot locations:

- If established plots in the field are located in un-mappable NP, then the plot should be offset a predetermined distance and bearing only ONCE (after this initial offset, if an issue of placement is still occurring, the plot will be dropped);
- The survey should continue on the original grid design and NOT from the offset plot (in order to remain on the original survey design pattern).



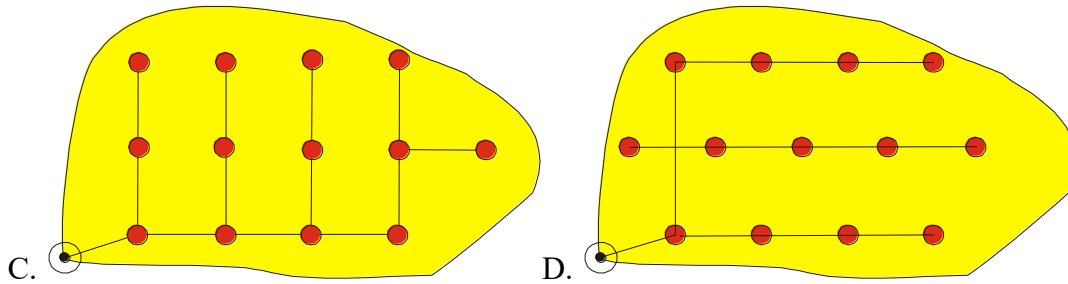


Figure 12: Examples of locating plots on a grid pattern

4.1.6.2 Vector Sampling

Vector sampling is less structured than the grid system and can be used when few plots are required. It is also useful for small, narrow and irregularly shaped strata.

Procedural Steps:

1. The walk-through and stratification is completed as normal.
2. Based on the variability of the strata, as found during the walk-through, estimate the number of plots to adequately sample the stratum. This is often difficult for new surveyors.
3. Draw a desired sample strip line pattern on the stratum map. Measure the total length and bearing for each line segment. (Single line should be limited to very small strata.)
If more than two bearing changes are required, vector sampling should be reconsidered in favor of grid sampling - unless mitigating factors preclude the use of grid sampling and a vector line with more than two compass bearings changes are required.

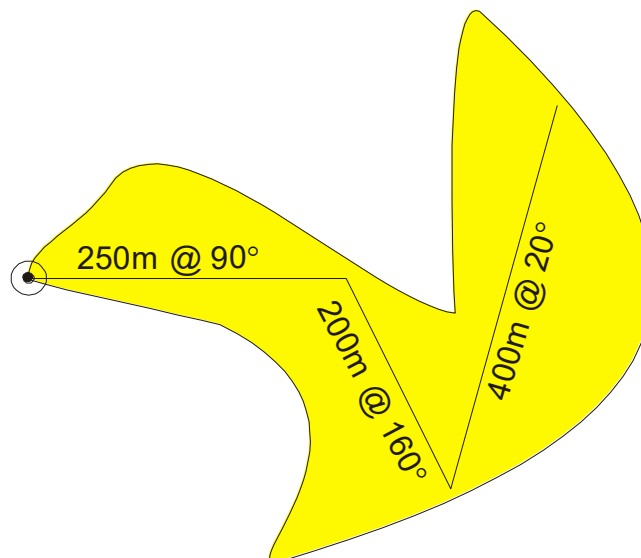


Figure 13: Example of bearing and distance for plots along vectors

4. To calculate the distance between plots along the line, divide the total length of the lines by the number of plots. Rounding this value will make the field application of

the method easier without affecting the results. In this example $850\text{m} \div 6 \text{ plots} = 141.6\text{m}$, or 142m.

5. In openings that are < 10 ha in size and of irregular shapes, it is suggested as a best management practice for surveyors to switch to non-cardinal bearings and the vector sampling design.

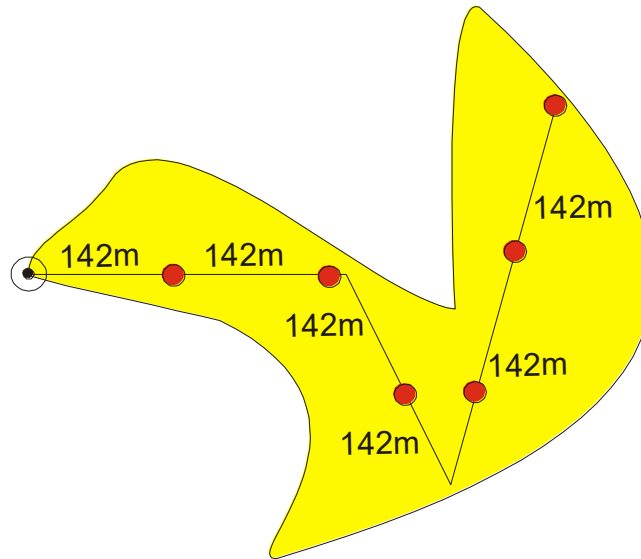


Figure 14: Example of locating plots along vectors

4.1.6.3 Representative Sampling

Representative sampling is a subjective assessment of an opening when compared with the more formal methods of silviculture surveys described in this manual. It should not be confused with the walk-through done before silviculture surveys.

Representative sampling is a valid survey method where the conditions are clearly visually evident. Where it is appropriately applied, it can be an efficient and effective sampling method. **If there is any chance that a knowledgeable forest practitioner would find a differing result, or that the expected precision standards would not be met, then this method is not appropriate and grid or vector sampling should be conducted.**

This survey is best applied when:

- the outcome of the survey is **obvious** and only a small quantity of data is required to substantiate a recommendation. i.e. Where the outcome is intuitively known. (i.e. obviously free growing, or grossly over maximum density, or in serious need of a brushing treatment). In other words, the decisions are apparent without the likelihood of controversy. It is not suitable where population variability is high or tree densities are near the important thresholds of maximum density, SR and FG status;

- used by skilled and knowledgeable surveyors with **many years** of directly related experience.
- an update is required to confirm conditions or characteristics following a treatment such as juvenile spacing or brushing treatments proving the treatments have been effective; or
- an opening is nearing free growing and the manager wishes to confirm that it is on track and to schedule a final free growing survey.

Procedural Steps:

1. The walk-through and stratification is completed as normal.
2. The surveyor walks the stratum stopping periodically to assess whether if a plot were established at that point, the data collected would represent the stratum. If the answer is yes, a plot is established at this point. If the answer is no, the surveyor continues and repeats the process. If the answer is repeatedly no, or inconclusive, then this stand is not suitable for the representative sampling method. Grid or vector sampling would be more appropriate.
3. Upon collecting 5 or more plots, the survey summary compilation is completed as normal.

The surveyor still provides all the expected survey results. Inventory and silviculture labels are generated based on the visual observations. **Warning: these results are expected to meet the same levels of precision standards specified in Section 7 (page 48) of the RESULTS Information Submission Specifications – Licensee Submissions (edition 4) document, as for formal surveys. Since formal plots are not established, statistical analysis is not required.**

4.1.6.4 Visual Assessments

A visual assessment is a subjective assessment of an opening when compared with the more formal methods of silviculture surveys described in this manual. This survey method may also be referred to as a ‘reconnaissance survey’. It should not be confused with the walk-through done before silviculture surveys.

A visual assessment should be conducted adhering to conventional survey objectives and guiding principles. However, the data gathering procedure becomes less formal. The visual assessment may be a general reconnaissance of the stratum, done by walking through, riding through, using a UAV, or flying over the opening. The information collected will generally involve ocular estimates with few, if any, plots established and a limited amount of quantitative data. Statistical validation is not applicable.

When conducted by a skilled surveyor, the survey results can be sufficiently reliable to meet the required objectives and precision level of the survey.

Visual assessment is a valid survey method where the conditions are clearly visually evident without reasonable justification for debate by experienced forest managers. If there is any chance a knowledgeable forest practitioner would find a differing result, then this method is not appropriate. Grid or vector sampling should be conducted.

Visual assessments can be efficient and effective. The results of the visual assessment are expected to be significantly similar to those that would result from a formal survey.

This survey is best applied when:

- the outcome of the survey is **obvious** and only a small quantity of data is required to substantiate a recommendation. i.e. Where the outcome is intuitively known. (i.e. obviously free growing, or grossly over maximum density, or in serious need of a brushing treatment)
- used by skilled and knowledgeable surveyors with **many years** of directly related experience.
- an update is required to confirm conditions or characteristics following a treatment such as juvenile spacing or brushing treatments proving the treatments have been effective; or
- an opening is nearing free growing and the manager wishes to confirm that it is on track and to schedule a final free growing survey.

Example: An experienced surveyor flies via helicopter over a 13 year old cutblock at low altitude. There are no signs of dead or dying trees, the species composition is clearly a single species. The trees planted ten years ago are now 3m tall. Competing vegetation is limited to herbs and low shrubs. In this case, a combination of file data, visual observations, supporting photographs and brief ground based observations can meet the survey need. Very little if any quantitative data is required to confirm the obvious free growing nature of this block. This example is **obviously** free growing.

The surveyor is still expected to provide all the expected survey results. Inventory and silviculture labels are generated based on the visual observations. **Warning: these results are expected to meet the same levels of precision standards specified in Section 7 (page 48) of the RESULTS Information Submission Specifications – Licensee Submissions (edition 4) document, as the formal surveys. Since formal plots are not established, statistical analysis is not required.**

4.1.6.5 Multiple Sample Designs in an Opening

The methods for plot positioning and or sampling intensity are often different in each of the strata within a single opening. The example below depicts stratum A using a grid plot location method starting from a selected starting tie point. The high level of sampling intensity may have been selected because of the patchy nature of the stocking identified during the walk-through. Stratum B uses a random method of plot location as well as a low level of sampling intensity. This method and intensity may have been selected to reflect the very consistent level of stocking on stratum B. The statistical analysis would subsequently have a small confidence interval.

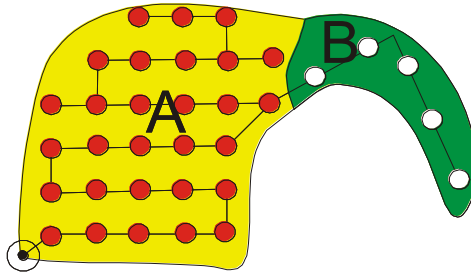


Figure 15: An example of sampling methods that vary by stratum

Guidance for minimum stratum size is also provided in the [Forest Cover Stratification](#).

Confirm the minimum stratum size expectations prior to completing any survey. The District Manager or Forest Stewardship Plan may establish specific minimum stratum sizes for particular types of surveys, e.g., stocking versus free growing.

5 Field Marking Procedures

For all silviculture surveys, the following basic field procedures are recommended.

5.1 Point of Commencements

The point of commencement (P.O.C.) is the beginning or starting point of the survey. A point of commencement may be required for the random sampling method.

All tie points and points of commencement should be tied into easily identifiable features indicated on a map or image (i.e. road junctions, creek crossings, creek junctions or block boundaries).

5.2 Marking Plots

Plot centers must be marked on the ground in such a way that they may be re-located for monitoring or auditing purposes. If the ground is frozen or very rocky ground and a shovel or stick cannot be used for a plot center, a comment should be made on the back of the [FS 657](#) card indicating what was used for the plot center. This topic is also discussed in Appendix 12 GPS Application in Silviculture Surveys.

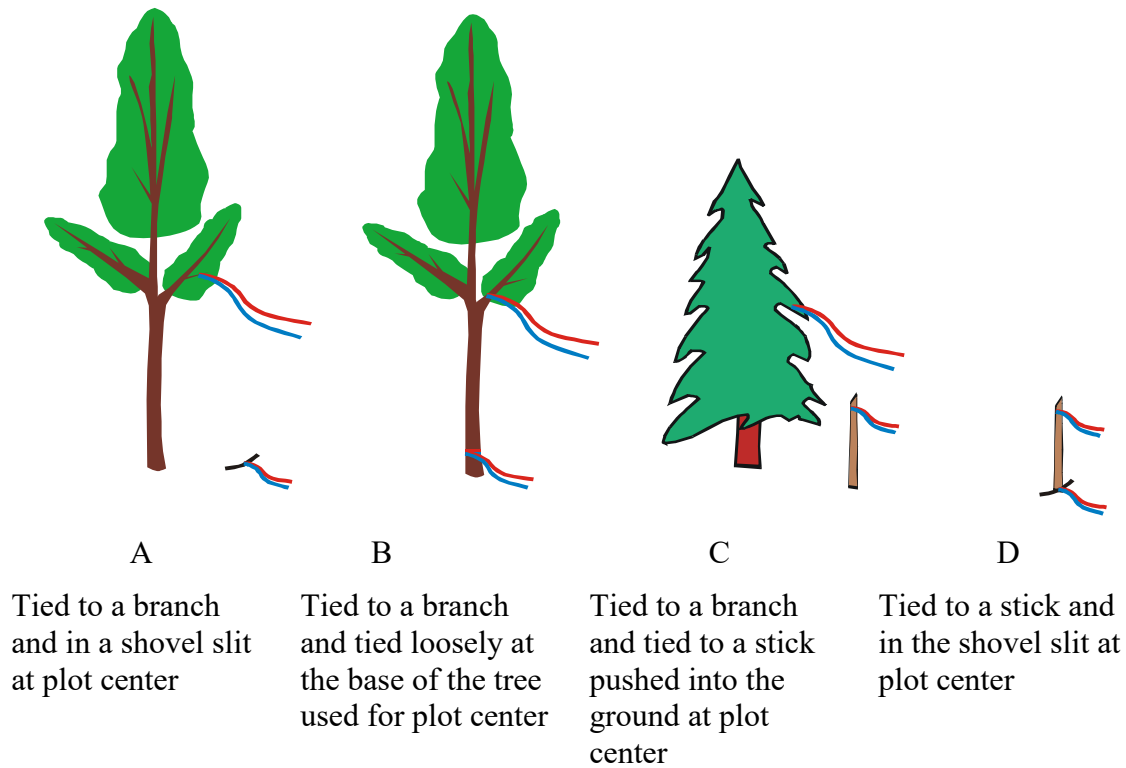


Figure 16: Examples of plot marking methods

Method B should only be used if it will not bias the results of the survey plot. Method D should be limited to areas with low slash and vegetation.

In all cases, the plot is marked in two places with flagging tape/ribbon:

1. as high as possible, to allow for easy identification of the location of the plot; and
2. at the exact location of the center used to measure the plot radius.

5.3 Strip Lines

Strip lines are often used in association with the grid pattern method. They are typically oriented to run up and down hills, thus crossing contour lines and the ecological strata that are often associated with changes in elevation and often strata boundaries. This allows the surveyor to verify eco-stratification boundaries and identify strata boundaries. Strip lines should ensure that each stratum is evenly sampled and that the plots are well distributed. Strip lines should be marked in the field (refer to **Appendix 5** – Magnetic Declination and annual change links).

Where the sampling intensity varies across strata, strip lines and or inter-plot distances may also have to be varied.

6 Amendments

Periodically, the content of a silviculture plan or prescription requires changes. This may be a result of the re-consideration of the biological characteristics of the site, or to remedy a previously unrecognized data entry error, or for many other reasons. Since the silviculture plan or prescription is essentially a contract between a licensee and the government, both parties must agree to any changes.

If an amendment has been approved, it replaces specific components of the silviculture plan or prescription. This must be reflected in the survey that is about to be conducted.

A more complex issue is if an amendment has been applied for but not yet approved, there may be a cover letter, or copy of an un-approved amendment found on the opening file. A licensee may propose an amendment, but it only becomes a legal amendment to the silviculture plan or prescription once the District Manager has approved it. This should trigger further investigation by the surveyor with the project administrator or supervisor.

Unless a prior understanding has been reached between the surveyor(s), the District Manager, and the licensee, the proposed amendments should not be incorporated into the survey methodology until the District Manager has approved the silviculture plan or prescription amendment.

A licensee must prepare an amendment to the silviculture plan or prescription if it becomes evident that the desired results of the silviculture plan or prescription are not achievable. Surveyors should be aware of this scenario when conducting a walk-through and when preparing treatment recommendations. A recommendation to prepare an amendment for a biologically necessary reason is expected of a silviculture surveyor.

In addition, there are other reasons that may also require amendments. While these can be district specific, surveyors should also consider recommending an amendment when:

- **the area** has changed by more than an amount set by the policy of Ministry of Forests, Lands, Natural Resource Operations and Rural Development, or local MNRO Regional or District policy;
- the biogeoclimatic description and subsequent stocking standards are not representative of the current site conditions found on the opening.

In selected situations where licensees employ surveyors skilled in the process of developing stocking standards for silviculture prescriptions or site plans, it may be suitable to collect data using both the specifications in the approved silviculture plans and prescriptions as well as the proposed amendment specifications. This additional information can be used to justify an amendment and will eliminate an additional survey from having to be performed.

7 Field Data Collection

The following Sections 7 and 8 describe the standard methodology for survey data collection for Clearcut even-aged stand structure openings (as depicted by the following illustration).

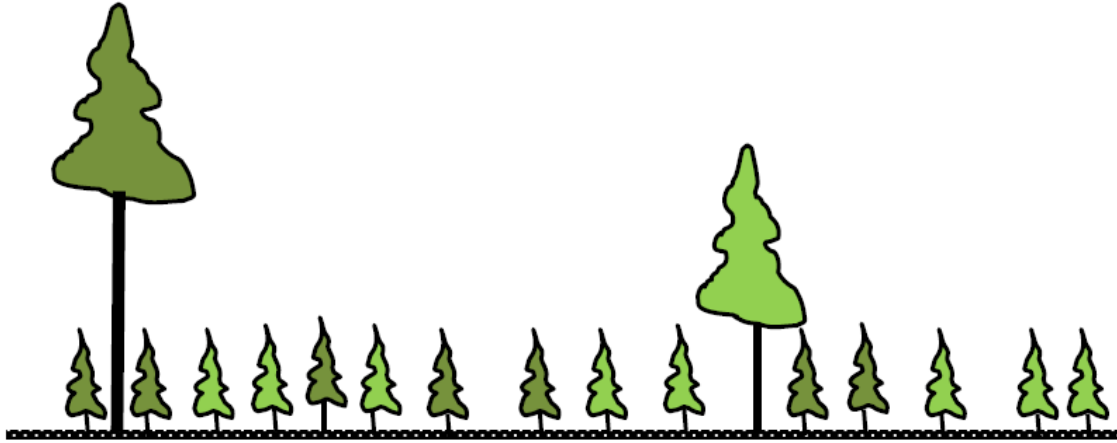


Figure 17: Standard Clearcut Even-aged Stand Structure

While the use of the standard Ministry of Forest’s survey field cards and forms is not mandatory, they do allow for the following:

- organized collection of data required to meet the reforestation obligations of the silviculture plan or prescription
- data recording
- standard data compilation
- standard data summaries
- easy comparison of results

If forms and electronic data software other than those provided by the Ministry of Forests, Lands, Natural Resource Operations and Rural Development are used, it is prudent to consider the data needs for reporting declarations into RESULTS.

The most commonly used forms are highlighted in Appendix 3.

Standard Ministry of Forests, Lands, Natural Resource Operations and Rural Development field cards and forms are available from

<http://www.for.gov.bc.ca/pscripts/ISB/FORMS/forms.asp>.

Where a field is not applicable to a particular stratum, it is a common convention to mark the field with a “–” dash, to signify the field was considered and not forgotten.

7.1 Data Field Descriptions for the Front of the Ministry of Forests FS 657 Card

Stocking standards and administrative information to complete the front of the *Silviculture Survey FS 657* card is obtained by reviewing the silviculture plan or prescription, corporate database, opening files and RESULTS data summary for the opening.

Survey objectives and all site information, including soils and biogeoclimatic classification, should be confirmed in the field. The surveyor is responsible to ensure that all input information is correct. Where corporate data base uploads are used, responsibility for the accuracy of data uploaded should be clarified between the licensee and the surveyor.

Described on the following pages is a comprehensive and detailed description of the information to be recorded on the Silviculture Survey [FS 657](#) card. The Silviculture Survey [FS 657](#) card has a number in each one of the fields that corresponds with the following headings.

Next to the field name you will find two letters separated by “/”. This is provided as an indication of the relative importance of the particular field. Separate ratings are provided for stocking and free growing surveys. The letter to the left of the “/” represents the data importance for regeneration delay surveys and the letter to the right of the “/” represents the data importance for free growing surveys. In a few instances additional clarification is provided where a number is found in superscript. **Example:** H/L - means the data item is required or very important to collect, and do so accurately, during regeneration delay surveys, but is not important and may be omitted during a free growing survey.

The letters are abbreviations for the descriptions listed below.

Abbreviation	Description of Importance	Examples
H	required to meet legislated requirements, essential component, accuracy is critical	survey date, stocking standards, licence, cutting permit, block, licensee
T	desired where it has an effect on treatments being prescribed	% coarse fragments where site preparation is being recommended
L	useful for a complete description of a stratum	project identification, access km
O	optional data, field provided for your convenience	growth intercept sample data
N	not required	BAF for single layered survey, soil depth during a free growing survey

Ministry of Forests, Lands, Natural Resource Operations & Rural Development
BRITISH COLUMBIA

SILVICULTURE SURVEY

USE THIS FORM TO STATE THE STANDARDS USED FOR THE SURVEY AND GATHER DESCRIPTIVE DATA FOR EACH STRATUM. SEE ALSO FS 658, FS 659 AND FS 660 SILVICULTURE REFERENCE CARD.

PAGE 1 OF 5

REGION: NIFR DISTRICT: ABC LOCATION: 5 km on the 8900 Rd PROJECT IDENTIFICATION: SU20ABC-FG099 SURVEY DATE: 20 05 14
MAPSHEET - OPENING NO: 93B023-123 LICENCE NO: FLA12345 CUTTING PERMIT: 678 BLOCK: 9a STANDARDS UNIT: 1 STRATUM: A HISTORY SYMBOL: L06
LICENSEE: Some Company BCC09234-12 SURVEYOR NAME(S) & REGISTRATION NO(S): Anne Simpson, A201500999 STRATUM AREA: 16 (ha) P08

SURVEY OBJECTIVES: ☒ REGEN DELAY ☒ STOCKING ☒ PLANTABILITY ☒ FREE GROWING ☒ BRUSHING ☒ MAXIMUM DENSITY ☐ OTHER

SITE: ELEVATION: MINIMUM 875 MAXIMUM 900 AVERAGE 890 ASPECT SW SLOPE POSITION: M SURFACE EXPRESSION: U SLOPE %: MIN 3 MAX 17 AVG 9

SOIL: LFH (cm): 4 HUMUS FORM: mor SOIL TEXTURE: Sil EFFECTIVE ROOTING DEPTH (cm): >30 SOIL DEPTH (cm): >30 DRAINAGE: ☒ GOOD ☐ FAIR ☐ POOR
COARSE FRAGMENTS: ☐ LOW (< 35%) ☒ MODERATE (35-70%) ☐ HIGH (> 70%)

ECOLOGICAL CLASSIFICATION FOR MOST PREDOMINANT AREA OF STRATUM: BGC ZONE: SBPS SUBZONE: xc VARIANT: 2 SITE SERIES: 01 03 90 % 10 % % EDATOPIC GRID: Moisture: 4 Nutrients: C

ACCEPTABLE TREE CHARACTERISTICS AND SURVEY PARAMETERS (STOCKING STANDARDS)

ACCEPTABILITY	SPECIES	WS HT. / AGE	MIN. FG HT.	LAYER	TARGET STOCKING STANDARD	MAXIMUM PER PLOT or 1/4 VALUE	INTER-TREE SPACING IDEAL	MINIMUM	MINIMUM STOCKING STANDARD (D)	PREF. + ACC. (D)	PREFERRED (D)	CONIFER TO BRUSH RATIO (%)
p	Fdi	-	1.5	1	1200	6	2.0	700	600			125
p	Sx	-	1.5	2			No Longer Used					
p	Cw	-	1.0	3								
a	Bl	-	1.0	4								
u	Pa	-	-									10,000

SAMPLING METHOD: ☐ Visual Assessment ☐ Representative Sampling ☐ Vector Sampling ☒ Grid Sampling

DISTANCE BETWEEN PLOTS: 100m LINES 100m RADIUS AREA MULTIPLIER: 3.99m 50 200 5.64m 100 100

PLANTING STOCKING STANDARD = (TARGET STOCKING STANDARD * EXPECTED SURVIVAL RATE 90 %) = NATURAL FILL-IN triha

FILE ORIGINAL WITH THE LICENSEE/AGENCY RESPONSIBLE FOR THIS OPENING

FS 657 2020/3/26

Figure 18: FS 657 Silviculture Survey card, front side, with sample data.

Ministry of Forests, Lands, Natural Resource Operations & Rural Development
BRITISH COLUMBIA

SILVICULTURE SURVEY

USE THIS FORM TO STATE THE STANDARDS USED FOR THE SURVEY AND GATHER DESCRIPTIVE DATA FOR EACH STRATUM. SEE ALSO FS 658, FS 659 AND FS 660 SILVICULTURE REFERENCE CARD.

PAGE 5 OF 6

REGION: 1 DISTRICT: 2 LOCATION: 3 PROJECT IDENTIFICATION: 4 SURVEY DATE: 6
MAPSHEET - OPENING NO: 7 LICENCE NO: 8 CUTTING PERMIT: 9 BLOCK: 10 STANDARDS UNIT: 11 STRATUM: 12 HISTORY SYMBOL: 17
LICENSEE: 13 SURVEYOR NAME(S) & REGISTRATION NO(S): 15 STRATUM AREA: 16 (ha) P08

SURVEY OBJECTIVES: ☒ REGEN DELAY ☐ STOCKING ☐ PLANTABILITY ☐ FREE GROWING ☐ BRUSHING ☐ MAXIMUM DENSITY ☐ OTHER

SITE: ELEVATION: MINIMUM 19 MAXIMUM AVERAGE ASPECT 20 SLOPE POSITION: 21 SURFACE EXPRESSION: 22 SLOPE %: MIN 23 MAX AVG

SOIL: LFH (cm): 24 HUMUS FORM: 25 SOIL TEXTURE: 26 EFFECTIVE ROOTING DEPTH (cm): 27 SOIL DEPTH (cm): 28 DRAINAGE: ☐ GOOD ☐ FAIR ☐ POOR
COARSE FRAGMENTS: 30 LOW (< 35%) ☐ MODERATE (35-70%) ☐ HIGH (> 70%)

ECOLOGICAL CLASSIFICATION FOR MOST PREDOMINANT AREA OF STRATUM: BGC ZONE: 31 SUBZONE: VARIANT: SITE SERIES: 32 EDATOPIC GRID: Moisture: 34 Nutrients: 33 % % %

ACCEPTABLE TREE CHARACTERISTICS AND SURVEY PARAMETERS (STOCKING STANDARDS)

ACCEPTABILITY	SPECIES	WS HT. / AGE	MIN. FG HT.	LAYER	TARGET STOCKING STANDARD	MAXIMUM PER PLOT or 1/4 VALUE	INTER-TREE SPACING IDEAL	MINIMUM	MINIMUM STOCKING STANDARD (D)	PREF. + ACC. (D)	PREFERRED (D)	CONIFER TO BRUSH RATIO (%)
35	36	37	38	41	42	43	44	45	46			52
				2			No Longer Used					
				3								53
				4								54

SAMPLING METHOD: ☐ Visual Assessment ☐ Representative Sampling ☐ Vector Sampling ☐ Grid Sampling

DISTANCE BETWEEN PLOTS: 56m LINES 57m RADIUS AREA MULTIPLIER: 3.99m 50 200 5.64m 100 100

PLANTING STOCKING STANDARD = (TARGET STOCKING STANDARD * EXPECTED SURVIVAL RATE 51 %) = NATURAL FILL-IN triha

FILE ORIGINAL WITH THE LICENSEE/AGENCY RESPONSIBLE FOR THIS OPENING

FS 657 2020/5/1

FS 657 2020/3/26

Figure 19: FS 657 Silviculture Survey card, front side, with field numbers.

- 1. Region: L/L** Record the name or abbreviation for the region. This information may be located in the silviculture plan or prescription, opening file, corporate database, contract or from local knowledge. A map of the [Forest Regions and Natural Resource Districts](#) may be consulted.
- 2. District: L/L** Record the name or abbreviation for the district. This information may be located in the silviculture plan or prescription, opening file, corporate database, contract or from local knowledge. A map of the [Natural Resource Districts and Regions](#) may be consulted.
- 3. Location: L/L** Record the geographic location of the opening. This information may be located in the silviculture plan or prescription, forest cover map, opening file, corporate database or from local knowledge. It should match any existing description or be corrected if the currently recorded location is misleading.
- 4. Project Identification/Contract Number: L/L** If the survey is being completed under a contract, record the specified project identification number or contract number.
- 5. Page: L/L** Record the page number. Include all silviculture survey cards in a logical numbering sequence. The goal is to provide a logically organized package of survey cards to include in the finished report.
- 6. Survey date: H/H** Record the date in which the survey data was collected in the field.
- 7. Mapsheet -Opening No.: H/H** The complete opening number is made up of both the mapsheet number and the opening number. Record the map sheet and opening number of the area being surveyed. This information may be located in the [silviculture plan or prescription](#), opening file, corporate database or on the forest cover map.
- 8. Licence No.: H/H** Record the licence number of the licensee responsible for the reforestation activities on the opening. This information may be located in the silviculture plan or prescription, corporate database or in the opening file.
- 9. Cutting permit: H/H** Record the cutting permit number assigned to the opening. This information may be located in the silviculture plan or prescription, corporate database or in the opening file. Not every area has a cutting permit number.
- 10. Block: H/H** Record the cut block number assigned to the opening. This information may be located in the silviculture plan or prescription or in the opening file.
- 11. Standards Unit: H/H** Each opening has one or more standards units as defined in the silviculture plan or prescription. Enter the same number or letter as found in the silviculture plan or prescription.
- 12. Stratum: H/H** Capital letters, numbers or a combination of both are acceptable. For an opening with strata that correspond to the standards units, the two fields will likely be the same to limit possible confusion.
- 13. Licensee: H/H** Record the name of the major tenure holder responsible for the reforestation activities on the opening. This information may be located in the silviculture plan or prescription, corporate database or in the opening file.
- 14. (REMOVED 2020) Air Photo No Used: L/L** Record the appropriate air photo numbers for the opening. This information may be located on the air photo that provides

coverage of the block or on a flight line key map that covers the survey area. The air photo number found in the silviculture plan or prescription is often of little value since that photo will usually have been taken before the block was harvested.

15. Surveyor Name(s) & Registration No(s): H¹/H¹ Record the name(s) of the person who completed the survey. The Ministry of Forests, Lands, Natural Resource Operations and Rural Development assigns surveyor accreditation numbers to surveyors who have passed the silviculture survey accreditation exam. Record the silviculture surveyor accreditation number of the surveyor(s) who completed the survey.

¹ – If the survey is being completed without the use of an accredited surveyor enter “none”.

16. Stratum Area (ha): H/H Record the net area of the stratum.

17. History symbol: L/L Record the history of the opening by using the symbols described in the following table. The last 2 digits of the year of the treatment are to be recorded beside the code letter. This information may be located on the forest cover map, in corporate database or in the opening file.

CLASS SYMBOL	CODE	HISTORY OR TREATMENT
Disturbance 	B BE BG BR BW D F I K L L% R S W	Wildfire Escaped Burn Ground Burn Range Burn Wildfire Burn Disease Flooding Insect Fume Kill Logging Logged (10% increments) Site Rehabilitation Slide Windthrow
Regeneration 	P N	Planted (>50 Planted) Natural (>50% Natural)
Stand Tending 	F H J M P R S T W	Fertilization Hack and Squirt Juvenile Spacing Mistletoe control Pruning Conifer Release Sanitation Spacing Commercial Thinning Brushing and Weeding
Site Preparation 	B C G H RB S M MS W	Broadcast burn Chemical Grass Seeded Hand Preparation Range Management Burn Spot Burn Mechanical Mechanical and Spot Burn Windrow

Table 4: History symbols

18. Survey Objectives: H/H Check the box next to the applicable survey objective(s) for the survey being completed. Frequently more than one survey objective may be checked as surveyors regularly do a combination of surveys at the same time. Multiple objectives should be selected with care since the survey standards and methods vary as the primary objective of the survey changes.

With a plantability survey being done in conjunction with a stocking survey there is no conflicting objectives. Both objectives may be checked.

One will often choose to record the number of free growing trees during a stocking survey. The primary objective of a regeneration delay survey is the collection of well-spaced tree and silviculture label data. The objective to be checked is the stocking survey.

The collection of well-spaced data is generally an integral component of a free growing survey but the primary objective is the collection of free growing tree and free growing silviculture label data. The objective to be checked is the free growing survey. However, if both stocking and free growing data is collected, it is recommended both survey objectives should be checked off.

19. Elevation: T/L Record the minimum, maximum and average elevation of the stratum in meters above sea level. This information may be located in the silviculture plan or prescription, in corporate database or on topographical maps. Elevation should be confirmed by contour map, recently calibrated altimeter, TRIM digital elevation database or high quality [GPS](#) during the walk-through.

The elevation calculated by the commonly available inexpensive GPS units is not sufficiently accurate to determine elevation used subsequently for Seedlot selection.

20. Aspect: T/L Record the direction toward which a slope faces for the stratum. This information may be located in the silviculture plan or prescription or in a corporate database. [Aspect](#) should be confirmed during the walk-through. This information is recorded as found in the table below

All three of the columns are acceptable methods.

DESCRIPTION	ABBREVIATION	APPROXIMATE RANGE OF BEARINGS
North	N	337.5 to 22.5 degrees
North East	NE	22.5 to 67.5 degrees
East	E	67.5 to 112.5 degrees
South East	SE	112.5 to 157.5 degrees
South	S	157.5 to 202.5 degrees
South West	SW	202.5 to 247.5 degrees
West	W	247.5 to 292.5 degrees
North West	NW	292.5 to 337.5 degrees
Flat	F	No identifiable aspect , associated with 0% slope
Variable	V	No consistent aspect , associated with

		rolling and broken topography
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Table 5: Aspect and associated abbreviations

21. Slope Pos.: T/L Record the position for the slope of the stratum. This information is recorded as crest, upper slope, middle slope, lower slope, toe, depression and level, as described in Figure 1 on the [FS 660](#) card. This information may be located in the silviculture plan or prescription. Slope position should be confirmed during the walk-through.

Either name or abbreviation are acceptable.

C	Crest
U	Upper slope
M	Middle slope
L	Lower slope
T	Toe
D	Depression
F	Flat or Level

Table 6: Slope position abbreviations

22. Surface Expression: T/T Record the surface expression of the stratum. This information may be located in the silviculture plan or prescription. Surface expression should be confirmed during the walk-through. For more information on surface expression, refer to Figure 2. on the [FS 660](#) card.

Either name or abbreviation are acceptable.

P	Plain
U	Undulating
R	Ridges
T	Terraces
C	Cone
D	Depression
F	Fan
H	Hummock
M	Rolling

Table 7: Surface expression abbreviations

23. Slope %: T/T Record the minimum, maximum and average slope percentage of the stratum. This information may be located in the silviculture plan or prescription. Slope percent should be confirmed during the walk-through using a clinometer.

24. LFH (cm): T/L Record the average depth, in centimeters, of the Litter-Fermented-Humus (LFH) layer of the forest floor. Measure from the top of the mineral soil to the top of the litter layer. This information may be located in the silviculture plan or prescription. LFH depth should be confirmed during the walk-through.

25. Humus Form: T/L Record the humus form of the organic layer of the stratum. Three types of humus form are recognized: Mor, Moder and Mull. The humus form classification can be located in the silviculture plan or prescription, but it can change following harvest. Humus form should be confirmed during the walk-through. For more information on humus form, consult the regional ecological classification field guide, (a link to the one for the [Prince Rupert Region](#) is provided since it is the same for all regions) or [Field Manual for Describing Terrestrial Ecosystems](#).

26. Soil Texture: T/L Record the soil texture of the stratum. This is generally inferred to be the upper 10 to 30 cm. This information may be located in the silviculture plan or prescription or corporate database. Regardless, the soil texture should be confirmed during the walk-through. For more information on soils classification consult the regional ecological classification field guide (a link to the one for the [Kamloops Forest Region](#) is provided since it is the same for all regions) or [Field Manual for Describing Terrestrial Ecosystems](#).

27. Effective Rooting Depth (cm): T/L Record the depth in centimeters of the soil that is available for root development. This should involve digging a soil pit, observing root mats of wind thrown trees or looking at road cuts. This information may be located in the silviculture plan or prescription. Effective rooting depth should be confirmed during the walk-through.

28. Soil Depth (cm): T/N Record the depth in centimeters of the soil to bedrock or parent material. This is generally inferred to be the upper 10 to 30 cm. This should involve digging a soil pit, observing root mats of wind thrown trees or looking at road cuts. This information may be located in the silviculture plan or prescription. Soil depth should be confirmed during the walk-through.

29. Drainage: T/L Check the appropriate box to indicate the drainage of water through the soil. Drainage is often related to the soil texture. This information may be located in the silviculture plan or prescription. Drainage should be confirmed during the walk-through. The three selections can be roughly defined by:

Good	<ul style="list-style-type: none"> • water freely drains into the soil profile • generally associated with coarse textured soils
Fair	<ul style="list-style-type: none"> • intermediate
Poor	<ul style="list-style-type: none"> • water is likely to accumulate on the surface and/or result in surface flow • generally associated with fine textured soils, high soil bulk density

Table 8: Drainage definitions

30. Coarse Fragments: T/L Check the appropriate box to indicate the estimated percent of coarse fragment content. Coarse fragments are greater than 2 millimeters in diameter. This information may be located in the silviculture plan or prescription. Coarse fragment percent should be confirmed during the walk-through.

31. BGC Zone, Subzone and Variant: H/H Record the biogeoclimatic zone, subzone and variant of the stratum. This information can be located in the silviculture plan or prescription, in a corporate database and on biogeoclimatic subzone maps and handbooks. However, biogeoclimatic information should be confirmed during the walk-through.

Regional ecological classification zone and subzone maps and field guides should be used to confirm the biogeoclimatic zone, subzone, variant and site series. Current zone/subzone/phase/variant phase code combinations can be found at http://www.for.gov.bc.ca/hre/becweb/Downloads/Downloads_BECdb/BGCunits_Ver6.xls

Biogeoclimatic subzone/variant mapping is provided as a single ESRI® ArcGIS compatible GIS layer, and can be obtained from http://www.for.gov.bc.ca/hre/becweb/resources/maps/gis_products.html

When the ecological classification determined by the surveyor differs from the silviculture plan or prescription an amendment is not necessarily required. The agency responsible for the silviculture plan or prescription may wish to consider an amendment if the re-evaluated and confirmed classification gives rise to a possible change in the stocking standards.

32. Site Series: H/H The regional field guides for identification and interpretation of ecosystems are used to determine the site series of the stratum. Record the 1°(primary) site series that covers the majority of the stratum. Record the 2°(secondary) site series that is the next predominant site series that covers the stratum. Record the 3°(tertiary) site series, or third most predominant site series that covers the stratum.

33. Site Series %: H/H If there is more than one site series present within the stratum, a percentage should be assigned to each of the different site series. The site series should be rounded to the nearest 10 percent and the combined site series percentages should equal 100 percent.

34. Edatopic grid: L/L The moisture and nutrient co-ordinates of the site can be determined by using the edatopic grid of the corresponding biogeoclimatic zone site series. This information may be located in the silviculture plan or prescription, on biogeoclimatic maps and in handbooks. However, the edatopic grid should be confirmed during the walk-through.

35. Acceptability: H/H Enter **P**, **A** or **U** corresponding to the level of acceptability (preferred, acceptable or unacceptable) as is found in the silviculture plan or prescription.

The use of the unacceptable is intended to clearly identify tree species that are present on the stratum, but are neither preferred nor acceptable. This does not mean that all unacceptable tree species must be listed, rather only those which appear to have potential as an [acceptable species](#) but are not currently listed as such in the silviculture plan or prescription.

If there is no silviculture plan or prescription the preferred and acceptable species are defined in the stocking standards provided by the District Manager. This may be in the form of a district species selection guideline or by consultation with a Professional Forester.

36. Species: H/H Record the species that corresponds to the preferred, acceptable, and unacceptable fields of the FS 657 card. This information may be located in the silviculture plan or prescription. If there are no silviculture plans and prescriptions, the preferred and [acceptable species](#) are defined in the stocking standards provided by the District Manager. Unacceptable species need only be included where unacceptable commercial tree species are present.

37. Ws Ht./Age: H²/H² Record the minimum height and/or minimum age of the corresponding well-spaced trees that will contribute to stocking at the regeneration date. This information is not located in the silviculture plan or prescription, but is often established by the District Manager or licensee.

² – These values may not be specified for all Districts.

38. Min. FG Ht: L/H³ Record the minimum height that a healthy, vegetation competition free well-spaced tree must attain in order to be considered free growing. This information will be specified in the silviculture plan or prescription or stocking standards in a forest stewardship plan (FSP) or forest development plan (FDP). If there is no free growing height stipulated on the silviculture plan or prescription, the free growing trees have no minimum free growing height requirement unless the surveyor, in consultation with the licensee, has selected to use the free growing guidelines found in Appendix 9 of the [Establishment to Free Growing Guidebook](#).

³ – Free growing minimum heights are only required if they are specified in the silviculture plan or prescription or as described in Appendix 9 of the [Establishment to Free Growing Guidebook](#).

39. Silviculture Plan or Prescription Used / Free Growing Guidelines Standards

Used: N/H Check the appropriate box as to which standards are being used for the survey. More information on this subject is found in Appendix 9 of the [Establishment to Free Growing Guidebook](#)

40. Free Growing Damage Standards Used: L⁵/H Record the date or version number of the [Provincial Free Growing Damage Criteria](#) or standards used to determine acceptable free growing trees.

⁵ – see [Acceptable Tree Characteristics](#) earlier in this document.

41. Layer: H/H For as single layered stand, enter the stocking standards into the row for layer 4. For layered surveys additional rows would be completed to match the stocking standards as found in the silviculture plan or prescription.

42. Target Stocking Standard/ha: H/H Record the target stocking standard (TSS) for the stratum being surveyed. The target stocking standard is the target number of preferred and acceptable healthy, well-spaced or free growing trees per hectare. This information may be located in the silviculture plan or prescription.

43. Target Maximum/Plot: H/H Record the maximum number of well-spaced or free growing trees to be tallied in a plot for the stratum. Maximum per plot is also called the "M" value. This is calculated by dividing the target stocking standard per hectare by the [plot multiplier](#) (fields 59 or 60).

The "M" value places a ceiling on the number of well-spaced trees and free growing trees in any one plot. This prevents over-stocking in one plot compensating for under-stocking in other plots. This is a key concept in the survey system. Thus, a relatively uniform distribution of stems must be attained before the opening can achieve regeneration delay or free growing status.

44. Minimum Inter-Tree Spacing: H/H Record the minimum [inter-tree distance](#) between well-spaced or free growing trees. Minimum inter-tree distance specifies the minimum allowable horizontal distance between preferred and/or acceptable trees which are well-spaced or free growing. This information may be located in the silviculture prescription, site plan or FSP. For information regarding accepting trees at the distance allowed at the time of [planting](#), refer to the [Minimum inter-tree distance section](#).

45. Minimum Stocking Standard Preferred + Acceptable: H/H Record the minimum number of healthy, preferred and acceptable, well-spaced or free growing trees per hectare (MSSpa). This number of trees must be on an opening in order to consider the area satisfactorily restocked or free growing. This information may be located in the silviculture plan or prescription. In older silviculture plans or prescriptions, prior to the requirement to specify a MSSp (see next field), MSSpa is referred to as MSS.

46. Minimum Stocking Standard Preferred: H⁶/H⁶ Record the minimum number of healthy, preferred well-spaced or free growing trees per hectare (MSSp). This is the minimum number of trees that must be on the opening in order to consider the area satisfactorily restocked or free growing. This information may be located in the silviculture plan or prescription.

⁶ - If the silviculture plan or prescription was approved prior to April 1, 1994, there will be no minimum stocking standard for preferred species. This field will then be recorded as "--" or N/A. ([see section on MSS vs. MSSp vs. MSSpa](#)).

47. Planting Stocking Standard/ha: T/N Record the target number of planted trees per hectare desired in the stratum. This planting stocking standard is calculated using the formula on either side of field 51 of the FS 657 card then rounded up to the next hundred (e.g. 1333 becomes 1400), or set by district or licensee policy.

48. Planting Maximum/Plot: T/N Record the maximum number of plantable spots to be recorded in a plot for the stratum. This is calculated by dividing the planting stocking standard per hectare by the [plot multiplier](#), (field 59).

49. Planting Ideal Inter-Tree Spacing: T/N This field is recorded in plantability surveys. This distance will be specified in the planting contract, Schedule B. It should be set in consideration of the instructions that will be given to the [planting](#) crews.

50. Planting minimum inter-tree spacing: T/N Record the minimum [inter-tree distance](#) between planted and/or well-spaced trees. This distance will be specified in the [planting](#)

contract, Schedule B. It should be set in consideration of the instructions that will be given to the planting crews. Generally for surveyors who are considering fill-plants, the planting MITD will be the same as the MITD used for the stocking or free growing assessment. This should be confirmed by the contract administrator.

51. Expected Survival %: T/N Record the estimated expected survival of the species that will be planted on the site. This information comes from the contract or the District Manager or can be based on local knowledge or on practical experience. If more than one species is recommended to be planted on the site, the expected survival rate is a combined or pro-rated estimate of each species. The contract should provide the number for the expected natural fill-in rate.

The planting stocking standard is always rounded **up** to the nearest 200. For example, if the planting stocking standard calculation resulted in 1233, this number would be rounded to 1400.

The planting stocking standards calculation can be overridden by the [planting](#) contract.

If a fill-plant is being considered, the relative importance of planting standards including spacing, is high – or “T”.

52. Conifer to Brush Ratio (%): N/H¹ Record the height of the crop tree relative to [competing vegetation](#) for free growing trees. This is usually recorded as a percentage. This information may be located in the silviculture plan or prescription.

If there is no conifer/brush ratio stipulated on the silviculture plan or prescription, there is no legal requirement for the free growing trees to meet a conifer/brush ratio. However, the crop trees must still be free growing and the current method may be appropriate. Consult with the holder of the silviculture plan or prescription on how to assess areas with no conifer/brush ratio specified in the silviculture plan or prescription.

¹ *May not be present on stocking standards approved as part of an FSP as it is not a legal content requirement under FRPA.*

53. Maximum Density (countable conifers/ha): T/H Record the maximum allowable density of the total countable conifers. For more information on this subject refer to the [Maximum Density Section](#).

54. Basal Area Factor (BAF): H/H Record the prism size used in completing the prism sweeps. This would be required when completing a multi-storey, layered, DFP, or SEDRSS survey, and on any other occasion where retention of layer 1 is greater than 5m² (see section 3.6 of this manual).

55. Sampling Method: H/H Check the box corresponding to the sampling method being used on this stratum. Descriptions and recommendations for selecting a sampling method are provided in the [Sampling Principles](#) section of this document.

56. Distance between plots (m): H⁷/H⁷ Record the average distance, in meters, between plots that was used during the survey. If a random sampling design was used, note random in this field or leave it blank.

⁷ – Only required for grid sampling and vector sampling

57. Distance between lines (m): H⁸/H⁸ Record the average distance, in meters, between strip lines that was used during the survey. If a random sampling design was used, note random in this field or leave it blank.

⁸ – Only required for Grid Sampling

58. Radius 3.99 or 5.64 m: H/H Check one of these boxes if a plot radius of 3.99m or 5.64 m is being used or enter a different specific plot radius in the blank provided.

59. Plot Radius (m), Area, Multiplier: H/H Record the plot radius, in meters, used for the survey. Record the plot area, in m², associated with the plot radius used for the survey. This number can be found on Table 5 of the [FS 660](#) card. Record the number used to multiply the tree counts in the survey plot to yield equivalent trees per hectare. Refer to the [Plot Radius and Plot Multiplier](#) section for more information.

7.2 Data Field Descriptions for the Back of FS 657 card

Information gathering to complete the back of the FS 657 is initiated during the walk-through of the stratum and should be completed before leaving the opening. It is important that the information collected in this section is accurate so that it can be incorporated into the development of treatment recommendations and contract requirements.

 Ministry of Forests, Lands, Natural Resource Operations & Rural Development		 GENERAL SITE INFORMATION		PAGE 2 OF 5 STRATUM A	
MAPSHEET	OPENING NO. 93B023-123	LICENCE NO. FLA12345	CUTTING PERMIT 678	BLOCK 9a	STANDARDS UNIT 1
DESCRIPTION OF ACCEPTABLE PLANTABLE SPOTS SCREEFING DEPTH 15 (cm) SCALP SIZE 25 x 25 (cm) TREE SPECIES PLANTERS MUST RECOGNIZE (PRESENT BUT UNACCEPTABLE) Pa MINIMUM HEIGHT FOR TREES TO BE VISIBLE 10 (cm)			ACCEPTABLE PLANTING MEDIUM ☒ MINERAL SOIL ☒ WELL DECOMPOSED ORGANIC MATERIAL OTHER ☐ PLANTING DIFFICULTY (from FS 600 and 703) 23 Points EASY ☒ MODERATE ☐ SEVERE ☐		
VISUAL ESTIMATE OF SITE CONDITIONS ESTIMATED SLASH COVER 15 % AVERAGE SLASH HEIGHT 35 (cm) SLASH CLASS: ☐ HIGH ☒ MEDIUM ☐ LOW ☐ NIL SLASH DISTRIBUTION: ☐ CONTINUOUS ☒ PATCHY ☐ SCATTERED ESTIMATED BRUSH COVER: 10 % AVERAGE BRUSH HEIGHT 1.5 (m) BRUSH SEVERITY: ☐ HIGH ☐ MEDIUM ☒ LOW ☐ NIL BRUSH DISTRIBUTION: ☐ CONTINUOUS ☒ PATCHY ☐ SCATTERED INDIVIDUALS POTENTIAL DANGER TREES: ☒ ON THE PERIMETER/OUTSIDE THE STRATUM WORK HAZARD: ☐ HIGH ☐ MEDIUM ☒ LOW ☐ NIL			MACHINE TRAFFICABILITY: ☒ GOOD ☐ MEDIUM ☐ LOW ☐ NIL SOIL COMPACTION HAZARD: ☐ HIGH ☒ MEDIUM ☐ LOW ☐ NIL INDICATE THE PRESENCE OR ABSENCE OF THE FOLLOWING: WATER BODIES: ☐ YES ☒ NO TYPE _____ HIGH WATER TABLE: ☐ YES ☒ NO DEPTH _____ FISHERIES VALUES: ☐ YES ☒ NO TYPE _____ WILDLIFE VALUES: ☒ YES ☐ NO TYPE moose browse on willow RANGE USE: ☐ YES ☒ NO TYPE DSG, DRA, IWS FOREST HEALTH FACTORS: ☒ YES ☐ NO TYPE _____ RECREATION VALUES: ☐ YES ☒ NO TYPE _____ OTHER RESOURCE VALUES: ☐ YES ☒ NO TYPE _____		
ACCESS 2WD 4WD LAND WALK TOTAL FLOAT AIR WHEEL HELI. WATER DISTANCE: 85 + 12 + 3 = 100 (km) (hrs) TOTAL TRAVEL TIME 1.5 HOURS FROM junction of hwy 71 & 28 (LOCATION: City or major local landmark)			POTENTIAL ROAD CONSTRUCTION AND MAINTENANCE PROBLEMS (Show details on map) ROAD DEACTIVATED 3 km before this block CULVERTS: Number _____ Length _____ Diameter _____ SLIDE - Width _____ (m) _____ (m) _____ (m) WASHOUT - Length _____ (m) _____ (m) _____ (m) NEW ROAD - Length _____ (m) _____ (m) _____ (m)		
OTHER (DESCRIPTION OF MAJOR LIMITING SITE FACTORS, TREATMENT OBJECTIVES AND NEARBY PEST OR SITE PROBLEMS) No significant limitations to free growing status.					

Figure 20: FS 657 Silviculture Survey card, back side, with sample data.

 Ministry of Forests, Lands, Natural Resource Operations & Rural Development		 GENERAL SITE INFORMATION		PAGE 5 OF 12	
MAPSHEET	OPENING NO. 7	LICENCE NO. 8	CUTTING PERMIT 9	BLOCK 10	STANDARDS UNIT 11
DESCRIPTION OF ACCEPTABLE PLANTABLE SPOTS SCREEFING DEPTH 60 (cm) SCALP SIZE 61 x 62 (cm) TREE SPECIES PLANTERS MUST RECOGNIZE (PRESENT BUT UNACCEPTABLE) 63 MINIMUM HEIGHT FOR TREES TO BE VISIBLE 64 (cm)			ACCEPTABLE PLANTING MEDIUM ☒ MINERAL SOIL ☐ WELL DECOMPOSED ORGANIC MATERIAL OTHER ☐ PLANTING DIFFICULTY (from FS 600 and 703) 65 Points EASY ☐ MODERATE ☐ SEVERE ☐		
VISUAL ESTIMATE OF SITE CONDITIONS 67 ESTIMATED SLASH COVER: _____ % AVERAGE SLASH HEIGHT 68 (cm) 69 SLASH CLASS: ☐ HIGH ☐ MEDIUM ☐ LOW ☐ NIL 70 SLASH DISTRIBUTION: ☐ CONTINUOUS ☐ PATCHY ☐ SCATTERED 71 ESTIMATED BRUSH COVER: _____ % AVERAGE BRUSH HEIGHT 72 (m) 73 BRUSH SEVERITY: ☐ HIGH ☐ MEDIUM ☐ LOW ☐ NIL 74 BRUSH DISTRIBUTION: ☐ CONTINUOUS ☐ PATCHY ☐ SCATTERED INDIVIDUALS POTENTIAL DANGER TREES: ☒ ON THE PERIMETER/OUTSIDE THE STRATUM 76 ☐ ON THE PERIMETER/OUTSIDE THE STRATUM 77 WORK HAZARD: ☐ HIGH ☐ MEDIUM ☐ LOW ☐ NIL			78 MACHINE TRAFFICABILITY: ☐ GOOD ☐ MEDIUM ☐ LOW ☐ NIL 79 SOIL COMPACTION HAZARD: ☐ HIGH ☐ MEDIUM ☐ LOW ☐ NIL 80 INDICATE THE PRESENCE OR ABSENCE OF THE FOLLOWING: WATER BODIES: ☐ YES ☐ NO TYPE _____ HIGH WATER TABLE: ☐ YES ☐ NO DEPTH _____ FISHERIES VALUES: ☐ YES ☐ NO TYPE _____ WILDLIFE VALUES: ☐ YES ☐ NO TYPE _____ RANGE USE: ☐ YES ☐ NO TYPE _____ FOREST HEALTH FACTORS: ☐ YES ☐ NO TYPE _____ RECREATION VALUES: ☐ YES ☐ NO TYPE _____ OTHER RESOURCE VALUES: ☐ YES ☐ NO TYPE _____		
ACCESS 81 2WD 4WD LAND WALK TOTAL FLOAT AIR WHEEL HELI. WATER DISTANCE: _____ + _____ + _____ = _____ (km) (hrs) TOTAL TRAVEL TIME 82 HOURS FROM _____ (LOCATION: City or major local landmark)			83 POTENTIAL ROAD CONSTRUCTION AND MAINTENANCE PROBLEMS (Show details on map) ROAD DEACTIVATED _____ km before this block CULVERTS: Number _____ Length _____ Diameter _____ SLIDE - Width _____ (m) _____ (m) _____ (m) WASHOUT - Length _____ (m) _____ (m) _____ (m) NEW ROAD - Length _____ (m) _____ (m) _____ (m)		
OTHER (DESCRIPTION OF MAJOR LIMITING SITE FACTORS, TREATMENT OBJECTIVES AND NEARBY PEST OR SITE PROBLEMS) 85					

Figure 21: FS 657 Silviculture Survey card, back side, with field numbers.

Previously described field numbers will not be repeated in the descriptions to follow. Refer to a previous section for their description.

60. Screening Depth: T/N Record the maximum depth, in centimeters, that is required by the planter to remove the organic matter from a spot to prepare it for [planting](#). This information is district specific and more often site specific.

61. Scalp Size: T/N Record the maximum scalp size, in centimeters, that is required by the planter to remove the organic matter from a spot to prepare it for [planting](#). When recommending the maximum scalp size, one must consider vegetative competition and soil nutrient status. This information is district specific and more often site specific.

62. Acceptable Planting Medium: T/N Record the acceptable [planting](#) medium for the site.

63. Tree Species Planters Must Recognize: T/N Record the tree species that a planter must recognize during [planting](#) that are present but currently considered unacceptable according to a site plan or prescription. This is important as it indicates any unacceptable species the surveyor must space off of during the plantability assessment and what a planter is expected to space off of. This information will be site specific depending on the biogeoclimatic zone site series.

If a fill-plant is being considered, the relative importance of planting standards, as per items 60- 63 (above), is high – or “T”.

64. Minimum Height for Trees to be Visible: T/N Record the minimum height of a tree, in centimeters, that a planter is expected to see during [planting](#) and will influence the number of plantable spots. This value may be different than that shown in the acceptable tree characteristics under height/age on the front of the FS 657 card. This information will be site specific. When establishing this value, consider the height of surrounding vegetation. Guidance here should be provided by the contract or contract administrator.

65. Planting Difficulty Points: T/N Record the number of points for the planting difficulty for the stratum. This information is site specific and can be determined by using Table 10 on the [FS 660](#) card.

66. Planting Difficulty: T/N Check the box that represents the average [planting](#) difficulty for the stratum. This information is site specific and can be determined by using Table 10, and particularly the bottom right (Difficulty Class) on the [FS 660](#) card.

67. Estimated Slash Cover %: T/T Record the estimated percent of the ground that is covered by slash and debris. This is a visual observation that should be averaged throughout the entire stratum. Slash cover percent should be estimated during the walk-through.

68. Average Slash Height (cm): T/T Record the estimated height, in centimeters, of the slash and debris on the ground. This is a visual observation that should be averaged throughout the entire stratum. Average slash height should be estimated during the walk-through.

69. Slash Class: T/T Check the box next to the appropriate estimated slash class. This is a visual observation that should be averaged throughout the entire stratum. Slash class should be estimated during the walk-through.

70. Slash Distribution: T/T Record the estimate of slash continuity. This is a visual observation that should be averaged throughout the entire stratum. Slash distribution should be estimated during the walk-through.

Continuous — slash is spread evenly over the stratum.

Patchy — slash-free areas cover approximately the same percentage of ground as slash-covered areas.

Scattered — slash-free areas are larger than slash-covered areas.

71. Estimated Brush Cover %: T/H Record the estimated percent of [competing vegetation](#) within the stratum. This is a visual observation that should be averaged throughout the entire stratum. It is also collected as part of a stocking or free growing survey. Brush cover should be estimated during the walk-through.

72. Average Brush Height (m): T/H Record the estimated height, in meters, of the [competing vegetation](#) within the stratum. This is a visual observation that should be averaged throughout the entire stratum. It is also collected as part of a stocking or free growing survey. Average brush height should be estimated during the walk-through.

73. Brush Severity: T/H Check the box next to the appropriate estimate of brush severity. This is a visual observation that should be averaged throughout the entire stratum. It is also collected as part of a stocking or free growing survey. Brush severity should be estimated during the walk-through.

74. Brush Distribution: T/H Record the spatial arrangement or distribution estimate of brush continuity. This is a visual observation that should be averaged throughout the entire stratum. Brush distribution should be estimated during the walk-through.

Continuous — brush is spread evenly over the stratum.

Patchy — brush-free areas cover approximately the same percentage of ground as brush-covered areas.

Scattered — brush-free areas are larger than brush-covered areas.

75. Potential Danger Trees: T/T Record the estimated number of danger trees per hectare that are greater than 5 meters in height. This is a visual observation that should be averaged throughout the entire stratum. The number of danger trees should be estimated during the walk-through.

76. Danger Trees on Perimeter / Outside of the Stratum: T/T Check this box if there are danger trees on the perimeter or outside of the stratum.

77. Work Hazard: T/T Record the estimated potential work hazard that the danger trees may pose to workers on the site. Check the appropriate box. This is a visual observation that should be averaged throughout the entire stratum. Work hazard should be estimated during the walk-through. It is often valuable to describe the snag distribution. For example, “found in south corner only” or “none in block, or many on perimeter”. Visit

the Ministry of Forests, Lands, Natural Resource Operations and Rural Development website for information about [Wildlife Danger Tree Assessment](#).

78. Machine Trafficability: T/T Record the ability of a machine to travel through the stratum. Check the appropriate box next to machine trafficability. This is a visual observation that should be averaged throughout the entire stratum. Machine trafficability should be estimated during the walk-through and will be impacted by slope, slash, soil moisture, residuals and drainage patterns (i.e. creeks).

79. Soil Compaction Hazard: T/T Record the soil compaction hazard rating of a machine traveling through the stratum. Soil compaction hazard can be estimated during the walk-through as an average throughout the stratum. This information may be determined by using Table 13 on the [FS 660](#) card.

80. Resource Values: T/T Record the presence or absence of the specified resource values in the area by checking the appropriate boxes, using visual observations. Resource values can be estimated during the walk-through. They can also be found in the silviculture plans and prescriptions.

81. Access: T/T Record the distance, in kilometers or hours, to the opening from a known location. The kilometers or hours should be listed by each of the individual modes of transportation.

82. Total Travel Time: T/T Record the estimated time required to travel to the opening from a known location. The time is to be recorded in hours and should be rounded off to the nearest ¼ hour.

Record the nearest readily identifiable geographic location, such as a city, a town, a village, or a camp.

83. Potential Road Construction and Maintenance Problems: T/T Record on the card and note on the survey map any road construction and maintenance problems which could be encountered during any upgrading, construction, or reconstruction of the access to the opening.

Where a road into an opening has been deactivated, add a check to indicate so and estimate the length of road from the start of the deactivation to the opening. It is not necessary to describe the extent of repairs necessary to re-construct a deactivated road.

84. (REMOVED 2020) Accommodation: T/T Record the most convenient accommodation available when surveying the opening. This may be useful for crews returning to conduct a future treatment.

85. Other: L/L This field is left open for general comments about the stratum. The following are examples of what could be recorded:

- success of treatments to date;
- defining characteristics of the stratum;
- the major limiting factors to achieving free growing;
- the average snow depth during the time of survey;
- ribbon color used;

- the preliminary treatment recommendation(s) for the stratum.

7.3 Silviculture Survey Plot Card of the Ministry of Forests - FS 658

The *Silviculture Survey Plot Card FS 658* is commonly used to collect data from individual plots during a silviculture survey. Data from the FS 658 card(s) is then summarized on the *Silviculture Survey FS 659* Summary cards, or entered into a survey summary program. Detailed on the following pages is a comprehensive discussion regarding the information to be recorded on the FS 658. The sample FS 658 below has a number in each of the fields that correspond with the following headings.

 Ministry of Forests, Lands, Natural Resource Operations & Rural Development		 SILVICULTURE SURVEY PLOT CARD		SURVEYOR NAME(S) & REGISTRATION NO(S) Anne Simpson, A201500999		SURVEY Y M D 20 03 14		PAGE OF 3 5															
MAPSHEET - OPENING NO 938023-123		LICENCE NO FLA12345		CUTTING PERMIT 678		BLOCK 9a		STANDARDS UNIT 1															
POINT OF COMMENCEMENT (DESCRIPTION OR COORDINATES) The north west corner of the block, on west side of the road, pink & blue ribbon																							
BEARING & DISTANCE	PLOT NO.	STRATUM	LAYER	TOTAL TREES	TOTAL CON.	COUNT CON.	COUNT HEIGHT (m)	WELL-SPACED X FREE-GROWING					GI SAM-PLING & DATA SPP	X' PREPARABLE	COMPETING VEGETATION		FOREST HEALTH						
								Fdi	Sx	Cw	Bl	Pa			TOTAL (W)	TOTAL (FG)	AGE	TOTAL HEIGHT (m)	SPECIES	% COVER	PEST CODE	TREE SPECIES AFFECTED	
100m, 180°	1	A	W	81	41	36	1.3	3	1	-	1		5	10	1.7	1	-	Ac	23	2.0	DRA	1Fdi	1Fdi
100m, 90°	2	A	W	58	30	29	0.8	1	1	2	-		4	12	2.4	1	1	Ac	50	2.2	IWS	15x	-
100m, 180°	3	A	W	61	45	41	1.1	3	1	2	1		M	10	1.7	1	-	Sali spp.	15	2.0	DRA	1Fdi	1Fdi
100m, 270°	4	A	W	54	38	38	1.5	3	2	1	1		M			1	-	Ac	40	2.1	DRA	2Fdi	1Fdi
100m, 270°	5	A	W	59	34	32	1.3	4	1	1	1		M	10	1.7	1	-	Sali spp.	20	2.4	DRA	1Fdi	1Fdi
Notes:								Plot 1-The well spaced are clustered to one side so there is still one plantable spot. Plot 5-Willow is being browsed. The remaining well spaced Fdi and Sx will outgrow the minor willow competition in 2 or 3 years. A brushing treatment is not required. Moose browse on the willow.															
								FS 658 2020/3/26 Well spaced/free growing age and height sample data is recorded for the representative well spaced/free growing tree within plots. It is not species specific. Collected approx. 1 per 4 plots, min. 3 per stratum, then mathematically averaged. Inventory label data is collected periodically (approx. 1 per 4 plots, min. 3 per stratum), from visual observations throughout the stratum, then 'roughly averaged' to represent the stratum.															

Figure 22: FS 658 Silviculture Survey Plot card, with sample data.

 Ministry of Forests, Lands, Natural Resource Operations & Rural Development		 SILVICULTURE SURVEY PLOT CARD		SURVEYOR NAME(S) & REGISTRATION NO(S) 15		SURVEY Y M D 6		PAGE OF 5											
MAPSHEET - OPENING NO 7		LICENCE NO 8		CUTTING PERMIT 9		BLOCK 10		STANDARDS UNIT 11											
POINT OF COMMENCEMENT (DESCRIPTION OR COORDINATES) 86																			
BEARING & DISTANCE	PLOT NO.	STRATUM	LAYER	TOTAL TREES	TOTAL CON.	COUNT CON.	COUNT HEIGHT (m)	WELL-SPACED 95 FREE-GROWING					GI SAM-PLING & DATA SPP	X' PREPARABLE	COMPETING VEGETATION		FOREST HEALTH		
								96	97	98	99	100			101	102	103	104	105
87	88	89	90	91	92	93	94												
Notes:								114 115 116 117 118 119 ← 121 → ← 123 → 124											
								FS 658 2020/5/1 Well spaced/free growing age and height sample data is recorded for the representative well spaced/free growing tree within plots. It is not species specific. Collected approx. 1 per 4 plots, min. 3 per stratum, then mathematically averaged. Inventory label data is collected periodically (approx. 1 per 4 plots, min. 3 per stratum), from visual observations throughout the stratum, then 'roughly averaged' to represent the stratum.											

Figure 23: FS 658 Silviculture Survey Plot card, with field numbers

Previously described field numbers will not be repeated in the descriptions to follow. Refer to a previous section for their description.

86. Point of Commencement: H/H Record a written description of the location of the point of commencement in the field. This location should be identifiable on an image and a map.

87. Bearing and Distance: H/H Record the bearing and distance from the point of commencement to the first plot. When using GPS units or tablets, this box may be used to record plot coordinates.

88. Plot No.: H/H Record the plot number assigned to the plot.

89. Stratum: H/H Identify the stratum the plot is in.

90. Layer: H/H In multi-storied, layered, DFP or SEDRSS stands, there are four layers (1 - mature, 2 - pole, 3 - sapling, 4 - seedling) that are tallied separately in each plot. This field may also be used to designate well-spaced stocking data vs. free growing data (“w” or “f”)

91. Total Trees: H/H Record the total number of live coniferous and broadleaf trees within the plot. This includes both acceptable and unacceptable quality trees. Non-commercial tree species (as defined by the Resource Inventory Branch) are not tallied under total trees. **All trees, regardless of their height, are to be tallied, including germinants.** [Table 9](#) provides guidance on the level of accuracy required.

92. Total Conifers: H/H Record the total number of live coniferous trees, including both acceptable and unacceptable quality trees in the plot. **All conifers, regardless of their height, are to be tallied, including germinants.** Refer to the [RESULTS](#) for a list of the tree species, the codes and the common names of those species that are found in British Columbia. A list is also present on the [FS 660](#).

93. Count. Conifers: T/H¹¹ The term ‘countable trees’ is used in reference to maximum density determination. Record the total number of live coniferous trees in the plot, regardless of species and quality, which are greater than or equal to the minimum countable height (See field 94).

This data does not legally need to be collected during stocking surveys or for standards units that do not have a maximum density indicated in the silviculture plan or prescription. If it is apparent during a stocking survey that a spacing treatment may be required, surveyors will typically collect this information. It is not required for strata that are obviously less than maximum density.

¹¹ – Only used for strata with a maximum density requirement in the stocking standards.

94. Count. Height: T/H¹¹ Record the countable height. For guidance on determining countable height consult the [maximum density](#) of this document.

For openings managed on an uneven-aged basis, the calculation of countable height is not applicable, since all conifers in layer 3 contribute towards the maximum density calculations.

¹¹ – Only required for strata with a maximum density requirement in the stocking standards.

95. Well-spaced or Free Growing: H/H Check (✓ or ✕) the appropriate box that corresponds to the objective of the survey. Selecting one of these boxes will signify that the data collected in the columns of field 98, 101 and 102 represents either well-spaced trees or free growing trees. When both stocking and free growing information is collected, check and report information on both lines.

The preference in selecting preferred or acceptable tree species is only important if the stratum has a minimum preferred stocking standard found in field 46. If field 46 is blank, there is no requirement to select preferred or acceptable tree species. Preferred or acceptable species may be selected equally.

Figure 24 assumes field 46 has a minimum preferred stocking standard value. All of the conifers in the example provided are preferred or [acceptable species](#) and meet the well-spaced criteria.

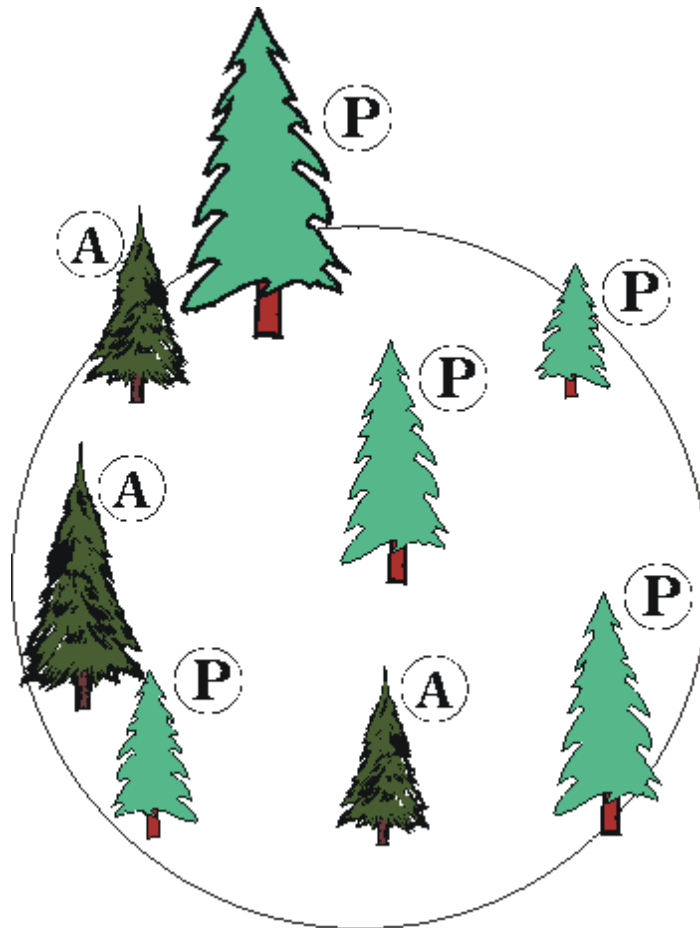


Figure 24. An example of tallying well-spaced trees.

When conducting a regeneration delay or stocking survey, the surveyor is expected to maximize the number of well-spaced trees in each plot, even if this means a reduction in the number that are of the preferred species, within the limits of the M-value.

By selecting only preferred species (marked P in the figure above) only 5 trees would be identified as well-spaced. By selecting a mix of both preferred and acceptable species, more will be identified. If the M-value were 6, it would be simple to select 4 preferred plus 2 acceptable, thereby maximizing well-spaced to the M-value.

96 & 97. Blank (no title): H/H Fields 96 and 97 should be considered together. These two fields are used to provide headings to the columns and subsequent data collection in field 98. The data is found in fields 35 and 36.

Example:

Segment of FS 657

ACCEPTABILITY	SPECIES
P	Pl
P	LW
a	SX
u	BL

Segment of FS 658

PREFERRED AND ACCEPTABLE SPECIES				
P	P	a	u	
Pl	LW	SX	BL	

or

PREFERRED AND ACCEPTABLE SPECIES				
Pl	LW	SX	BL	
P	P	a	u	

All cards used to collect data for a given stratum should be prepared with column labels in the same sequence. Data summary errors are more likely if they are not.

98. Titles Based on Field 96 & 97: H/H The data recorded in the 99 fields depends on the box checked in field 95. Record the number of trees in the appropriate species column as labeled in field 96 & 97.

Record all those present in excess of the [M-value](#) where they exist in the plot.

Unacceptable species can also be recorded here if they are performing well on the opening. Refer to the [recording unacceptable species](#) as well-spaced or free growing section for more information about recording unacceptable species.

Well-spaced and free growing trees may be recorded in field 98, in two separate rows. Ensure if this is done, that the data collected is clearly indicated (this could be a W or WS for well-spaced stocking data and an F or FG for free growing) and recorded in column 90.

99. Total W: H/H Record the sum of the preferred and acceptable well-spaced trees in the plot, up to a maximum of the M-value. If the maximum value is reached, or exceeded, record the letter 'M' rather than the numeric value. The number of Ms will be used in calculations on the [FS 659](#) card.

Do not include unacceptable species in this field.

100. Total FG: N/H Record the sum of the preferred and acceptable free growing trees in the plot up to a maximum of the M-value. If the maximum value is reached, or exceeded, record the letter ‘M’ rather than the numeric value.

When tallying free growing trees, the surveyor must maximize the number of preferred and acceptable trees that meet the criteria for an acceptable free growing tree, using the free growing damage criteria. The ‘M’s will be used in calculations on the FS 659 card.

Do not include unacceptable species in this field.

101. Age: H/H The data recorded in this field depends on the box checked in field 95. Select an average well-spaced or free growing tree (depending on the selection made in field 95) from within the plot. Measure and record the age of the selected average tree.

If collecting stocking and free growing information on two separate lines, ages will be needed for both stocking and free growing status.

In older or multi-storied stands, tree ages are based on ring counts derived from bored core samples. Samples must include the correction factor for the bore height based on the [site index](#). Appendix 7 contains a table to adjust the age at boring height to the actual age.

The age of many young stands can be reliably estimated by counting the number of whorls in species that exhibit determinate growth. Cutting a disc from the base of a sample tree and counting the number of rings will also estimate the age of younger trees, and those species of undetermined leader growth. Destructive sampling for the purpose of accurately determining age is acceptable.

The age of the trees that have been planted can often be determined by adding the age of the planting stock plus the number of completed growing seasons since the planting treatment.

The source of the trees is irrelevant to the determination of age. The point is, “how old is the tree” not “how many years has it been growing on this area”. For example; where 2 year old planting stock has been growing on an opening for 4 years, the age of the tree is recorded as 6, not 4.

Where surveys are being conducted during the growing season, record the number of completed year’s growth. The reported age may be more accurately described as the number of completed growing periods. A survey conducted in June or July will not include the current partial year’s growth.

102. Total Height (m): H/H The data recorded in this field depends on the box checked in field 95. Select an average well-spaced or free growing tree (depending on the selection made in field 95) from within the plot. Measure and record the total height to the last completed year’s growth, from the point of germination to the top of the terminal bud of the dominant leader of the selected average tree. If collecting stocking and free growing information on two separate lines, heights will be needed for both stocking and free growing status.

It is preferred that sample measurements are recorded for approximately 1 out of every 4 plots established. A minimum of three samples collected per stratum is considered a standard practice, although more samples are acceptable if not encouraged.

Where surveys are being conducted during the growing season, record the height to the last completed year's growth. A survey conducted in June or July will not include the current year's leader growth.

103. Plantable: T/N Check (✓ or ✕) in this box if a plantability survey is a survey objective. It is recommended that plantability data be collected on all surveys where significant quantities of plantable spots are present. If a multi-storey survey is being completed, plantability is recorded in the row of data corresponding to layer four, or the lowest layer recorded.

104. Number "In": H¹²/H¹² Check (✓ or ✕) in this box, if a multi-storey survey is being completed or BA is being collected for SUs with > 5 m²/ha. The data entered here corresponds with the data collected for layer 1, and represents the number of layer 1 trees found within the prism sweep. This data is used to calculate the basal area. This data should be collected on all multi-storey surveys, even if BA < 5m², as a best practice.

¹² – Only possibly for multi-storey stands, for SUs with > 5 m²/ha or for any stocking standard that have a minimum basal area specified.

105. GI Sample & Data Spp.: N/H If this stratum is suitable for determining site index by growth intercept method, record the measurements and species here. Refer to site index training materials on the growth intercept method.

106. Plantable/Number "IN": The data recorded in this field is dependant on the box checked in field 103. See field 104 for Importance.

Record the number of plantable spots found in the plot. A plantable spot is defined as suitable microsites on which a seedling could be planted (see field 63). The suitability of the microsites is dependent on site conditions and limiting factors such as soil moisture, soil temperature, soil nutrients, climatic conditions, tree species and the stock type to be planted. The intent of recording the number of plantable spots is to determine if [planting](#) can be completed without [site preparation](#). It will also estimate the number of seedlings that will be required to complete a planting project on the survey area. As a result it is important to record the number of plantable spots based on the same criteria that will be used by the planters. Since the planters will be instructed to plant trees on microsites as directed by the licensee's silviculture staff, it will be important to discuss planting spot selection with them prior to conducting the survey.

During a survey on a multi-storey stand, the plantable data is recorded in the row for layer 4, (or the lowest layer) and the number of layer 1 trees "IN" the prism sweep is recorded in the row for layer 1.

107. Preparable: T/N Record the number of preparable spots found in the plot. A preparable spot is defined as a microsite that is presently unsuitable for [planting](#) but, with [site preparation](#), could become an acceptable planting microsite. Preparable spots are tallied independent from plantable spots.

The preparable data is recorded in the row for layer 4, (or the lowest layer) and the modal diameter of layer 1 trees is recorded in the row for layer 1.

108. Competing Vegetation – Species: T/H Record the first four letters of the genus, followed by the first three letters of the species of the competing herbaceous, shrub or brush species (see table 8 [FS 660](#)). This method is recommended but not essential. Consult with the district for a comprehensive list of [competing vegetation](#).

109. Competing Vegetation - % Cover: T/H Record the average percent of the ground that is covered by the [competing vegetation](#) species. This is an ocular estimate of the competing vegetation percent cover in and around the plot, not just within the plot.

110. Competing Vegetation - Height (m): T/H Record the average height, in meters, of each of the [competing vegetation](#) species. This is an ocular estimate based on the average height of the competing vegetation in and around the plot, not just within the plot.

111. Forest Health – Pest Code: H/H Record the applicable pest code of the [forest health](#) on **each** affected tree within the plot, not just on the well-spaced or free growing trees. Only those trees that are found to be unacceptable based on the [free growing damage criteria](#) are recorded. Forest health data is collected at every plot. If there is more than one forest health factor on the same tree, record only the one with the longer and/or more damaging impact. Multiple rows may be required where multiple forest health factors are present in a single plot.

Refer to the [Damage Agent and Condition Codes FS 747](#) for a comprehensive list of forest health factors and their corresponding pest code.

If a forest health factor is unknown or uncertain, describe and record the type of damage, obtain a sample, and consult either the *Field Guide to Forest Damage in British Columbia*, or the district or regional forest health specialist.

If the licensee requires the surveyor to record all pest incidence, beyond damage criteria for treatment or planning reasons, this can be recorded here but separated from required data. It is suggested to separate this tally in space between plots or in the comments section in order to keep the data separate.

112. Forest Health – Live Trees: H/H Record the number of live trees affected by the [forest health](#) indicated in field 111.

113. Forest Health – Dead Trees: H/H Record the number of dead trees affected by the [forest health](#) indicated in field 111.

114. Notes: L/L Record site specific details that are relevant to the survey and potential treatment recommendations. **If the opening being surveyed is a Retention Silviculture System and has “Dispersed retention”, this would be the appropriate location to record – Tree Cover Pattern observed (refer to section 7.7.2.1.7.1)** Leader height, local anomalies within a stratum, presence of wildlife trees are but a few of the dozens of possible items that might be recorded. The notes can often be as valuable as the numerical values.

Inventory Label Background: Inventory labels are produced to concisely describe important characteristics of the strata surveyed. They provide a general description and constitute a best estimate based on visual observation, versus 100% inventory. Some surveyors may wish to collect data in a manner different than the methods described below. This is acceptable assuming precision standards are met. The inventory label data will be transferred to central Ministry of Forests, Lands, Natural Resource Operations and Rural Development database. It becomes important that the data be recorded in a consistent manner in order to allow subsequent analysis.

Silviculture surveyors receive guidance on the creation of inventory labels from the MoFLNRORD, and Forest Analysis and Inventory Branch. The methods described below are considered their second most representative data source. Permanent sample plots are the only superior data source. The label describes “commercial” tree species. For the purpose of creating inventory labels the list of species considered “commercial” can be found in the reference [RESULTS](#) and the [FS 660](#).

Inventory labels are determined through a combination of visual observations and individual tree measurements from within the stratum. The estimates and measurements are periodically recorded on the FS 658 plot card. Collect at least three sets of observations or approximately one per four plots established to represent each stratum. These will be “roughly” averaged, (mathematically averaged **and** manually adjusted as the surveyor sees fit to best describe the stratum).

Species composition is determined by ocular estimate. This method of visual observations is known to be most directly comparable to the methods by Forest Analysis and Inventory Branch on mature stands. The leading and second species should be determined during the walk-through stage of the survey process for the purposes of stratification.

The determination of species composition is based on tree density for young stands (layers 3 and 4), and volume for layers 1 and 2.

An important expression of the generality of the inventory label can be seen in the requirement for species composition to be rounded to the nearest 10% and expressed as a single digit, e.g. 40% = 4. The combination of all species must sum to 100% or 10.

Inexperienced surveyors often overestimate the minor species present. They also tend to under estimate the proportion represented by small trees that may be visually obscured by larger trees. This is most common where dense layers of shade tolerant species naturally regenerate under the partial shade of larger and older planted trees.

Age and height are recorded to the last completed year’s growth.

115. Str.& Layer: H/H Fields 117 through 124 are provided as a location to record the data used to create inventory labels. Two areas are provided to keep the data for two strata separate. Record the stratum as found in field 12 or the layer (for multistorey surveys) as found in field 90.

116. Leading Spp.: H/H Record the abbreviation for the most abundant species.

117. %: H/H Record a visual estimate of the proportion of total trees present that are Leading Spp. The species composition is rounded to the nearest 10 percent and expressed as 1=10%, 4=40%. When combined, the species composition must equal 100%.

118. Age: H/H Select the average [dominant](#) and [co-dominant](#) tree of the leading species as recorded in field 116 and determine its age.

119. Ht: (m) H/H Select a [dominant](#) or [co-dominant](#) tree of the leading species as recorded in field 116. Height is expressed in m to 1 decimal place.

120. 2nd Spp.: H/H Record the abbreviation for the second most abundant species.

121. % Age Ht. (m): H/H Record the three values as described in field 117, 118 and 119 for the second most abundant species as recorded in field 120.

122. Minor Spp.: H/H For the purpose of data collection, minor species can be considered all those species not already recorded in fields 117 or 121 that represent 10% or more of the total species composition.

123. %: H/H Fields 122 and 123 are treated as a matched pair. The percentage entered in field 123 corresponds to the species entered above it in field 122.

124. Cr Cl: H/H Forest Analysis and Inventory Branch prefers that crown closure be determined from the visual observation from aerial photography. There are a number of “speckle” diagrams available to assist with calibrating the surveyor’s estimate. Since recent aerial photographs are usually not available, we are forced to use ground based visual assessments. Figure 28 a & b in the [FS 660](#), Silviculture Survey Reference may be useful as a benchmark. It should be used with caution, as many junior surveyors tend to overestimate crown closure estimates, particularly on stands with lower site indices.

[Crown closure](#) is estimated to the nearest 1%.

7.4 Allowable Errors in Measurement

The following represents the generally accepted contract tolerances in place in many survey contracts by licensees. These tolerances are secondary to the final data requirements; encrypted in FRPA via the [RESULTS Information Submission Specifications](#), March 2016 – Section 7 Precision Standards. Herein, Table 17 – Minimum Precision Standards – has been established and parallels the suggested allowable errors below:

<u>Attribute</u>	<u>Allowable Error</u>
P.O.C.	± 10 meters
All plot centers and tie points	± 5% of horizontal distance
Total trees, Total conifers and Count conifers per hectare	20%

Well-spaced tr/ha	10%
Free growing tr/ha	10%
Plantable spots/ha	20%
Tree heights	± 20%
Tree diameters	± 20%
Tree ages	± 20%
Site index	± 3 meters
Stratum area in hectares	+ 10%
Forest health factors	≥10% absolute difference (e.g. 2% vs. 13% of incidence of host species)

Table 9: Allowable errors in measurement

7.5 Forest Health

In the context of a survey, any cause of tree damage is called a [forest health](#) factor. A forest health factor is only considered to be a pest on a particular opening when it presents a risk to the successful achievement of management objectives. As a result, only ‘pests’ are recorded in the plot data.

- 1) Tally **only** those occurrences of forest health factors where the extent of damage is **unacceptable** as defined in the [free growing](#) damage criteria for the openings stand structure (even or uneven-aged). If there are two forest health factors on the same tree, only one is recorded. The one to record should be the one with the more detrimental effect. For example, a pest which causes mortality should be recorded over one that causes a growth rate reduction.
- 2) Tally **all** incidences of forest health factors (regardless if acceptable or unacceptable) **if the licensee requires this data**. It is recommended that these values be recorded as notes and included when significant in survey reports and recommendations.

When it appears evident that a particular forest health factor is a serious problem in an opening, the survey should be scheduled for a time when the factor is most apparent and easily seen. **To accurately identify pine rusts in young stands, a recommended best management practice would be to align survey timing with annual sporulation periods: between May and July each year.**

Forest health is a key component of stratification. Areas with treatable incidence levels of forest health factors should be stratified as a separate stratum, as should areas that are NSR or not free growing because of a high incidence of forest health factors.

Useful forest health references include, but are not limited to, the following *Forest Practices Code Guidebooks*:

- [Forest Health Survey](#)
- [Bark Beetle Management](#)
- [Defoliator Management](#)
- [Dwarf Mistletoe Management](#)

- [*Management of Terminal Weevils in BC*](#)
- [*Pine Stem Rust Management*](#)
- [*Root Disease Management*](#)
- [*Tree Wound and Decay*](#)

A valuable companion reference to these guidebooks is the *Field Guide to Forest Damage in British Columbia*.

<https://www.crownpub.bc.ca/Product/Search?term=7610003512#/?statesave=true> .

Additionally, the *Forest Health for Silviculture Surveyors* (2020), as well as the Natural Resources Canada's *Common Tree Diseases of British Columbia* at

<https://cfs.nrcan.gc.ca/publications?id=4633> are useful field guides.

8 Data Compilation

For each stratum identified and confirmed in the field during the walk-through, a separate compilation must be completed. Various field cards (e.g., Silviculture Survey Summary FS 659, Calculation Card for Silviculture Survey Confidence Limits FS 1138A, Steps to Calculate Confidence Limits for Silviculture Surveys FS 1138B, and Silviculture Survey Reference [FS 660](#)) are available to assist in data compilation.

The FS 659 is used to summarize data collected on the [FS 657](#) and [FS 658](#). Before leaving the opening, [statistical calculations](#) must be completed to ensure statistical precision has been met. Additional plots may need to be established in order to meet statistical precision. Comments that will be used to create [treatment recommendations](#) should also be recorded prior to leaving the opening.

The process of completing the FS 659 is described below. Refer to the [FS 657](#) and [FS 658](#) cards to assist in completing this card.

8.1 Data Field Descriptions for the Ministry of Forests FS 659

SILVICULTURE SURVEY PLOT SUMMARY CARD															PAGE 4 OF 5																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																															
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BGC ZONE, SUBZONE, VARIANT, SITE SERIES SBP5xc2-01_03			TARGET STOCKING STANDARD (TSS) 1200			MINIMUM STOCKING STANDARD (MSS or MSS p + a) 700			MINIMUM PREFERRED STOCKING STANDARD (MSS or MSS p) 600			COMPILED BY A. Simpson			DATA ENTRY BY A.S.																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																															
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Figure 25: FS 659 Silviculture Survey Summary card, front side, with sample date.

SILVICULTURE SURVEY PLOT SUMMARY CARD															PAGE 5 OF 5																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																															
MAP SHEET / OPENING NO. 7			LICENCE NO. 8			CUTTING PERMIT 9			BLOCK 10			STANDARDS UNIT 11			STRATUM 12			REPORT DATE 125																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																												
PROJECT IDENTIFICATION 4			LICENSEE 13			PLOT MULTIPLIER 59			TARGET M ² VALUE 43			PLANTING M ² VALUE 48			STRATUM AREA 16			DATA ENTRY DATE 126																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																												
BGC ZONE, SUBZONE, VARIANT, SITE SERIES 31, 32			TARGET STOCKING STANDARD (TSS) 42			MINIMUM STOCKING STANDARD (MSS or MSS p + a) 45			MINIMUM PREFERRED STOCKING STANDARD (MSS or MSS p) 46			COMPILED BY 127			DATA ENTRY BY 128																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																															
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PLOTS (n)</th> <th>LAYER</th> <th>TOTAL TREES (T)</th> <th>TOTAL CONIFERS (TC)</th> <th>COUNT CONIFERS (CC)</th> <th>96</th> <th></th> <th></th> <th></th> <th></th> <th>SUM OF PRE-FERRED (WM's)</th> <th>TOTAL M's (W)</th> <th>AVERAGE WS AGE</th> <th>AVERAGE WS HEIGHT (m)</th> <th>M PLANTABLE (CPM's)</th> <th>TREE #</th> <th>Age at 1.3m</th> <th>Tree Height</th> <th>TREE SI</th> </tr> </thead> <tbody> <tr> <td>129</td> <td>90</td> <td>130</td> <td>131</td> <td>132</td> <td>97</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>149</td> <td>151</td> <td></td> <td></td> <td></td> </tr> <tr> <td colspan="10">SUM OF WS DISREGARDING THE M VALUE (WnoM's)</td> <td>134</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td colspan="10">WELL SPACED SPECIES COMPOSITION</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td colspan="10">SUM OF FG DISREGARDING THE M VALUE (FGnoM's)</td> <td>140</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td colspan="10">FREE GROWING SPECIES COMPOSITION</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td colspan="10">T x pm + n =</td> <td colspan="10">TOTAL TREES per ha 155</td> </tr> <tr> <td colspan="10">TC x pm + n =</td> <td colspan="10">TOTAL CONIFERS per ha</td> </tr> <tr> <td colspan="10">CC x pm + n =</td> <td colspan="10">COUNTABLE CONIFERS per ha</td> </tr> <tr> <td colspan="10">WnoM's x pm + n =</td> <td colspan="10">TOTAL WELL-SPACED per ha (disregarding the M-value)</td> </tr> <tr> <td colspan="10">FGnoM's x pm + n =</td> <td colspan="10">TOTAL FREE GROWING per ha (disregarding the M-value)</td> </tr> <tr> <td colspan="10">[(WM's x MWF) + W] x pm + n =</td> <td colspan="10">WELL SPACED per ha x SPW =</td> </tr> <tr> <td colspan="10">[(FGM's x MWF) + FG] x pm + n =</td> <td colspan="10">FREE 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Figure 26: FS 659 Silviculture Survey Summary card, front side, with field numbers.

Previously described field numbers will not be repeated in the descriptions to follow. Refer to a previous section for their description.

Be sure to summarize only the data for one stratum on each summary card.

125. Report Date: H/H Enter the date that the FS 659 is being filled out.

126. Data Entry Date: H/H Enter the date that the survey information is being entered into RESULTS, GENUS or corporate database.

127. Compiled By: H/H Enter the name or company filling out the FS659 card.

128. Data Entry By: H/H Enter the initials of the person completing the data entry. This is related to field 126.

129. No. plots (n): H/H Record the number of plots established in the stratum.

130. Total trees (T): H/H Record the sum of the total trees from the Total Trees (field 91) of the [FS 658](#) card.

131. Total conifers (TC): H/H Record the sum of the total conifers from the Total Conifers (field 92) of the [FS 658](#) card.

132. Countable conifers (CC): N/H¹¹ Record the sum of the countable conifers from the Countable conifers (field 93) of the [FS 658](#) card.

¹¹ – Only required for strata with a maximum density requirement in the stocking standards.

133. Blank: H/H Record the number of well-spaced trees by species (field 96 or 97) as entered in field 98.

134. Sum of WS disregarding the ‘M’ value (WnoM): H/H Record the sum of all values in field 133.

135. Total M’s (Wm’s): H/H Record the number of ‘M’s in field 99.

136. Total (W): H/H Sum the number of well-spaced trees from field 100 not including the ‘M’s.

137. Well-spaced Species Composition: H/H For each species divide each value from field 133 by the value in field 134.

138. Sum of Preferred (SPW): H⁶/H⁶ Sum the values found in field 137 for each of the columns marked “p” (preferred) as found in fields 97 or 98.

⁶ - If the silviculture plan or prescription was approved prior to April 1, 1994, there will be no minimum stocking standard for preferred species. This field will then be recorded as “-“ or N/A. ([see section on MSS vs. MSSp vs. MSSpa](#)).

139. Blank: H/H Record the number of free growing trees by species (field 96 or 97) as entered in field 98.

140. Sum of FG disregarding the ‘M’ value (FGnoM): H/H This field is the sum of all values found in field 139.

141. Total M’s (FGm’s): L/H Record the number of ‘M’s in field 100.

142. Total (FG): L/H Record the sum of the number of free growing trees from field 100 not including the 'M's.

143. Free Growing Species Composition: H/H For each species divide each value from field 139 by the value in field 140.

144. Sum of Preferred (SPFG): H⁶/H⁶ Sum the values found in field 143 for each of the columns marked "p" (preferred) as found in fields 96 or 97.

⁶ - If the silviculture plan or prescription was approved prior to April 1, 1994, there will be no minimum stocking standard for preferred species. This field will then be recorded as "--" or N/A. ([see section on MSS vs. MSSp vs. MSSpa](#)).

145. WS Sample Tree Age: H/H Record the average age of the sampled well-spaced trees. This is the sum of the Age (field 101) from the [FS 658](#) card divided by the number of sample ages recorded.

146. WS Sample Tree Height (m): H/H Record the average height of the sampled well-spaced trees. This is the sum of the Total Height (m) from field 102 on the [FS 658](#) card divided by the number of sample heights recorded.

147. FG Sample Tree Age: H/H Record the average age of the sampled free growing trees. This is the sum of the Age (field 101) from the [FS 658](#) card divided by the number of sample ages recorded.

148. FG Sample Tree Height (m): H/H Record the average height of the sampled free growing trees. This is the sum of the Total Height (m) from field 102 on the [FS 658](#) card divided by the number of sample heights recorded.

149. Plantable (P): T/N If plantability is selected as an objective on the [FS 657](#) in field 18 record the sum of the plantable spots from field 106 from the [FS 658](#) card, not including M's.

150. 'M' Plantable: T/N If plantability is selected as an objective on the [FS 657](#) field 18 count the number of Ms entered in the plantable spots column, field 106 of the [FS 658](#) card.

151. Preparable (PR): T/N If plantability is selected as an objective on the [FS 657](#) field 18 record the sum of the preparable spots found in field 108 from the [FS 658](#) card.

152. Total Number "IN" (TNI): H¹²/H¹² This field can be required for multi-storey surveys or if required for SUs with > 5 m²/ha in layer 1. Record the sum of the total trees "in" a prism sweep from all plots on the FS 658 card, (field 106). This value can be confused with Plantable data.

¹² – Only mandatory for multi-storey stands that have a minimum basal area, but should be collected as a best practice.

153. (REMOVED 2020) On-Site Cost/ha: L/L When required by the agency responsible for producing the free growing stand, record the survey cost/ha for the stratum.

154. (REMOVED 2020) Funding Source: L/L Record the funding source used to pay for the survey.

155. Calculations: Follow the formulae provided to determine the resulting values.

H/H - Total Trees per ha

H/H - Total Conifers per ha

N/H¹¹ - Countable Conifers per ha

H/H - Total Well-spaced per ha without regard for the M-value

L/H - Free Growing per ha without regard for the M-value

H/H - Total Well-spaced per ha

H²/H² - Preferred Well-spaced per ha

L/H - Free Growing per ha

H²/H² - Preferred Free Growing per ha

T/N¹ - Plantable Spots per ha

T/N¹ - Potentially Preparable per ha

H⁹/H⁹ – Layer 1 Basal Area per ha

¹ - If a fill-plant is being considered, the relative importance of planting standards is high – or “T”.

² - If the silviculture prescription was approved prior to April 1, 1994, there will be no minimum stocking standard for preferred species and there may also be no minimum preferred for some approved FRPA FSP stocking standards. This field will then be recorded as “-“ or N/A. ([see section on MSS vs. MSSp vs. MSSpa](#)). This methodology represents the preferred best management practice approach to calculate the Preferred Well-spaced and Free Growing per ha., for this is the easiest and most efficient approach. Other methodologies are also acceptable as proposed by several practitioners, where the absolute values are used rather than the capped M-value totals.

⁹ – Layers are only required in Multi-storey surveys or as required for a Layered or DFP survey like SEDRSS.

¹¹ – Only required for strata with a maximum density requirement in the stocking standards.

Statistical Calculations: These fields are provided to record the results of the various statistical calculations required following a survey. The methods are fully described in this document under the section entitled [Statistics](#).

The [FS 1138A](#) card may be used to calculate the Silviculture survey confidence limits.

156. Growth Intercept Sample Trees: N/O Data may be collected and directly recorded in this area for the ten growth intercept sample trees. Look up the site index for each sample tree on the FS 415 for the site index species. Average the individual tree site indexes.

157. Site Index Reminders: H/H This text is provided to remind users of the priority when selecting a site index method.

158. Survey Confidence Limits For Well-spaced / Free Growing: H/H Check (✓ or ✕) the box corresponding to the statistics completed.

159. Standard Deviation: H/H While there is a long form manual calculation, instructions are available on the [FS 1138B](#), although most surveyors will choose to use a statistical calculator.

160. Standard Error of the Mean: H/H While there is a long form manual, calculation instructions are available on the [FS 1138B](#), although most surveyors will choose to use a statistical calculator.

161. t.90: H/H Commonly known as the “T value”, it is determine by looking up the value corresponding to field 129 minus 1 on either the [FS 1138B](#) or item 29 on the [FS 660](#).

162. Confidence Interval: H/H The confidence interval is calculated by multiplying field 160 by field 161.

163. Lower Confidence Limit: H/H The lower confidence limit is calculated by subtracting the confidence interval, field 162 from the well-spaced or free growing per ha (field 155), again depending on which box is selected in field 158.

164. Leading Species & %: H/H Average the data found in fields 116. The species composition is roughly averaged and rounded to the nearest 10 percent and expressed as 1=10%, 4=40%. For further details see [inventory label](#). The surveyor may choose to adjust these values up or down as necessary to best reflect the characteristics of the stratum. Fields 164 + 165 + 166 must add up to 100%.

Note: The percent leading species will be based on [Volume](#) for predominantly Layer 1 and 2 SU's and on relative [Density](#) of stems per ha. for younger Layer 3 and 4 dominated SU's.

165. 2nd Species & %: H/H Average the data found in the % column of field 120. The species composition is roughly averaged and rounded to the nearest 10 percent. For further details see [inventory label](#). The surveyor may choose to adjust these values up or down as necessary to best reflect the characteristics of the stratum.

166. Spp & %: H/H Average the data found in fields 122 & 124 for the remainder of the species listed.

167. Ldg. Age (years): H/H Average of the age measurements collected on the FS 658 field 118. This number must be rounded to a whole number. The surveyor may choose to adjust this value up or down as necessary to best reflect the characteristics of the stratum.

168. 2nd Age (years): H/H Average of the age measurements collected on the FS 658 field in the age column of field 121. This number must be rounded to a whole number. The surveyor may choose to adjust this value up or down as necessary to best reflect the characteristics of the stratum.

169. Ldg. Height (m): H/H Record the average of the height measurements collected on the [FS 658](#) field 119. This number is expressed in meters and is rounded to the nearest tenth of a meter. The surveyor may choose to adjust this value up or down as necessary to best reflect the characteristics of the stratum.

170. 2nd Height (m): H/H Record the average of the height measurements collected on the [FS 658](#) under the height column in field 121. This number is expressed in meters and is rounded to the nearest tenth of a meter. The surveyor may choose to adjust this value up or down as necessary to best reflect the characteristics of the stratum.

171. Site Index: H/H Record the site index for the leading species (field 116 and 164) in the inventory label. A complete discussion on [site index](#) determination can be found on the [SIBEC website](#).

172. Source Code: H/H Record the method used to determine the [site index](#) for the stratum. Enter the abbreviation.

Abbreviation	Description	Surveyor Priority
A	Adjacent stand	Very rare
I	Growth intercept, or subsequently converted using the Average site index relationship table found in the FS 660	#1, preferred method for FG Surveys
O	November 1998 provincial SIBEC rollover	Not used by surveyors
C	Site index curve, height age reference curves	May have value in some multi-layered stands or stands > 30 years BHA
H	Stand before harvest, rarely used	Very rare
E	SIBEC or Site index from the biogeoclimatic classification	#1, preferred method for RD survey or #2 common alternative method for FG survey
M	Converted from site class	#3, “last resort”
S	Assigned by District Stewardship Section	local preference

Table 9a: Site Index Method Codes

173. Cr Cl %: H/H Crown Closure is the average of the various crown closure samples collected as recorded in field 124 of the [FS 658](#).

174. Total Trees / ha: H/H Record the number of total trees / ha as calculated in field 155.

175. Survey Year: H/H Enter the last 2 digits of the survey year. For example 2020 = 20.

176. Stocking Status: H/H Check (✓ or ✗) the box corresponding to the correct stocking status as determined by this survey.

177. Silviculture Label Ldg Spp & %: H/H Record the largest value and corresponding species in fields 137 or 143 depending on the value in 184. For well-spaced data, use field 137; free growing 143. Fields 177 + 178 + 179 must equal 100%.

178. Silviculture Label 2nd Spp & %: H/H Record the second largest value in fields 137 or 143 depending on the value in 184. For well-spaced data, use field 137; free growing 143. Fields 177 + 178 + 179 must equal 100%.

179. Silviculture Label Spp & %: H/H Record the remaining values, in decreasing order, in fields 137 or 143 depending on the value in 184. For well-spaced data, use field 137; free growing 143. Fields 177 + 178 + 179 must equal 100%.

180. Silviculture Label Age: H/H The value recorded in this field is dependent on the box checked in field 184. For well-spaced data, record the value in field 145. For free growing data, record the value in field 147.

181. Silviculture Label Height (m): H/H The value recorded in this field is dependent on the box checked in field 184. For well-spaced data, record the value in field 146. For free growing data, record the value in field 148.

182. Site Index: H/H Record the site index of the leading species in the silviculture label. This value may be different than field 171 if the leading species are different.

183. Well-spaced / Free Growing: H/H Check (✓ or ✕) the box corresponding to the data in the silviculture label.

184. Trees / ha: H/H Record the value from the statistics in field 155 for either well-spaced or free growing trees depending on field 184. For well-spaced use the well-spaced per ha value. For free growing use the free growing per ha value (using the calculation employing the M value for each entry).



SILVICULTURE SURVEY PLOT SUMMARY CARD

PAGE 5 OF 5

[illegible]

FS 659 2020/3/26

Figure 31: FS 659 Silviculture Survey Summary card, back side, with sample data.

Ministry of Forests, Lands,
Natural Resource Operations &
Rural Development

SILVICULTURE SURVEY PLOT SUMMARY CARD

PAGE 5 OF

MAP/SHEET - OPENING NO.		7		LICENCE NO.		8		CUTTING PERMIT		9		BLOCK		10		STANDARDS UNIT		11		STRATUM		12		REPORT DATE		Y		M		D		125							
SUMMARY OF COMPETING VEGETATION										CHECK (/) APPROPRIATE BOXES										PEST INFORMATION SUMMARY										REPORT RESULTS IN COLUMN 9									
SPECIES (INCLUDE THE MAIN COMPETING SPECIES)		ESTIMATED % COVER		CURRENT HEIGHT (m)		ANNUAL HT. INCREASE (cm)		DISTRIBUTION		CURRENT COMPETITION					POTENTIAL COMPETITION					1		2		4		5		6		9									
										CONTINUOUS	SCATTERED	HIGH	MEDIUM	LOW	NIL	HIGH	MEDIUM	LOW	NIL																				
185	186	187	188	189						190	191	192	193	194	$\left\{ \frac{(4 + 5)}{((2 \times 6) + 5)} \right\} \times 100$		197																						
PRIMARY TREATMENT RECOMMENDATIONS AND CONSIDERATIONS										RECOMMENDED TREATMENTS										ALTERNATE TREATMENT RECOMMENDATIONS AND CONSIDERATIONS																			
198										199																													
INCLUDE OBJECTIVES, METHODS, YEAR, SEASON, SPECIES, PRIORITY ETC.																																							

FS 659 2020/3/26

Figure 32: FS 659 Silviculture Survey Summary card, back side, with field numbers.

Previously described field numbers will not be repeated in the descriptions to follow. Refer to a previous section for their description.

185. Summary of Competing Vegetation: T/T Record the species abbreviations from the Competing Vegetation-Species (field 108) on the [FS 658](#) card. The seven most significant [competing vegetation](#) are to be recorded in this field.

186. Estimated % Cover: T/T Record the average percent ground cover of each of the species listed in the Summary of Competing Vegetation (field 185). The percent ground cover of each of the [competing vegetation](#) species can be averaged from the Competing Vegetation - % Cover (field 109) of the [FS 658](#) card.

187. Current Height (m) – Minimum, Maximum, and Average: T/T Record the average height of each of the [competing vegetation](#) species listed in the Summary of Competing Vegetation (field 110). The maximum and minimum values are based on visual observations.

188. Annual Height Increment (cm): T/T Record, in centimeters, the average annual height increment of each of the species listed in field 185. These are determined by visual observations.

189. Distribution, Current Competition, Potential Competition: L/H Check ‘continuous’, ‘patchy’, or ‘scattered’ when describing the distribution pattern of each of the species listed in field 185. These are determined by visual observations.

Continuous	brush is evenly distributed over the stratum.
Patchy	brush-free areas cover approximately the same percentage of ground as brush-covered areas.
Scattered	brush-free areas are larger than brush-covered areas.

Table 12: Distribution definitions

Check the appropriate field when describing the present impact (high, medium, low or nil) of each of the [competing vegetation](#) species listed in the Summary of Competing Vegetation (field 185). These are determined by visual observations.

Check the appropriate field when describing the potential competition (high, medium, low, and nil) of each of the [competing vegetation](#) species listed in the Summary Competing Vegetation (field 185). These are determined by visual observations.

190. Pest Code: T/H Record pest codes for the seven most severe forest health factors entered into the Forest Health-Pest Code (field 111) of the [FS 658](#) card.

191. Area (ha) if only part of the stratum is affected: H/H Record the amount of area (ha) of the stratum affected by the pest listed in field 111 if it is distributed across a portion of the stratum, but does not fully meet the requirements for stratification.

192. Live trees affected: T/H Record the sum of the live trees affected by each pest code. The number of live trees affected can be found on the Forest Health-Live Trees (field 112) of the [FS 658](#) card.

193. Dead Trees Affected: T/H Record the sum of the dead trees affected by each pest code. The number of dead trees affected can be found in the Forest Health-Dead Trees (field 113) of the [FS 658](#) card.

194. Host Species Comp.: T/H Record the sum of the inventory label species composition of the tree species affected by each pest. This value can be found in fields 164, 165 and 166 and the number is expressed as a decimal (i.e. 60% = 0.6).

195. (REMOVED 2020) % Total Trees Affected: T/H Complete the provided calculations to obtain the percent of total trees affected by each pest.

196. (REMOVED 2020) % Conifers Affected: T/H Complete the provided calculations to obtain the percent of conifers affected by each pest.

197. % Host Trees Affected: T/H Complete the provided calculations to obtain the percent of host trees affected by each pest. This is the number reported in the stocking and free growing reports and entered into RESULTS.

Note: The following rule of thumb applies - if there is 0% of a species showing up in an inventory label, then there should be 0% host pest incidence reported.

However, a possible scenario may occur where complete mortality of a dominant species has resulted from a pest infestation (PI from MPB for example), and therefore does not show up in the inventory label, but the surveyor feels the professional practice would be to report the pest incidence somehow. It is recommended as a best management practice for the surveyor to attach a “Pest Incidence Note” to the opening file report in RESULTS to identify the presence of the pest, but still resulting in no incidence value into the database directly.

198. Primary Treatment Recommendations and Considerations: H/H

When completing treatment recommendations, include specifics such as treatment method, season and year, and follow-up activities for the recommended treatments. For guidance on completing treatment recommendations see [Framework for Effective Silviculture Treatment Recommendations](#) course.

Provide a summary of the treatment recommendations, including the time frames in which they should occur. Follow the silviculture plan or prescription for any recommendations. If there are recommendations in the silviculture plan or prescription that should not be there, bring this to the attention of the agency responsible for the opening. An amendment to either the silviculture plan or prescription may be required. Any treatment that will overcome the site limiting factors should be considered at this stage. Social or economic factors should be secondary to the biological concerns. All recommendations should be specific, reasonable, timely and legal.

It is important that treatment recommendations be directed to establish and encourage preferred species and target stocking standards.

199. Alternate Treatment Recommendations and Considerations: H/H Provide additional treatment regimes to be applied in the event that the primary treatment recommendations cannot be implemented.

8.1.1 Statistics

Silviculture surveys collect information so that **decisions** can be made on the stocking or free growing status of a stand and so that realistic, sound recommendations can be made for future treatments. **Statistics** enable surveyors to determine how precisely the survey data describes the status of an opening.

The system is designed only as a sample of a population and is a rigorous survey process intended to **aid in making the best decision** on a stratum's status. It is intended for use when an unbiased sampling methodology has been selected.

A “borderline fail” in the statistics of an SU targeted for a declaration **may** mean the need to move to a discussion and/or field trip with joint parties to seek another resolve. The individuals making the declaration need to satisfy themselves that the area will stand up to the test of another survey(s) returning the same decision - especially in highly variable areas.

The statistical calculations are only necessary when plots are established. Since formal plots are not established during visual assessments, statistical evaluations are not required for visual assessments. Statistics applied to representative sampling is also of limited value as bias is introduced when establishing the plots.

The section below discusses mostly statistics on free growing tree data. However, these statistical procedures are equally applicable to well-spaced trees. They could also be applied to plantable spots or preparable spots by substituting the corresponding data.

The density and distribution of trees within a stratum varies. Surveyors sample only a portion of that stratum's population. A statistical analysis must be completed in order to obtain an indication of the variability of the sample population and to provide a measure of the confidence of the average number of well-spaced or free growing trees.

For surveys completed on homogenous strata, the statistical requirements can often be met with as few as five plots per stratum. **The MoFLNRORD has determined that five plots per stratum is the minimum required.**

Non-homogeneous strata require more than the minimum number of plots to meet statistical precision. *The higher the variability in the population - the more plots that are required.* Establishing more plots however should not be a substitute for proper stratification.

In strata where the distribution of free growing trees is variable and the free growing status is not clear, calculation of statistics is extremely important. Calculating confidence intervals for the survey data provides a measure of the variability in the sample population, and therefore a measure of the relative confidence that the decision made will be correct 95% of the time and the results of the survey accurately representing a particular stratum.

8.1.1.1 Definitions Used in Statistics

- n number of plots established
- $\bar{X}$ sample mean or average
- s standard deviation of the mean
- pm [plot multiplier](#)
- s/ha stems per hectare (may also be referred to as tr/ha)
- se $\bar{x}$ standard error (may also be referred to as se)
- t90 t value, found on the FS 1138B or figure 13 on the [FS 660](#). Choose the value with the degrees of freedom equal to the number of plots established minus one for calculations
- CI confidence interval, with repeated surveys of a stratum, 90% of the time the confidence interval will contain the population mean.
- [LCL](#) lower confidence limit. There is a 90% chance that the actual number of well-spaced or free growing trees is above the lower confidence limit.
- [MSS](#) minimum stocking standard
- e desired survey precision

8.1.1.2 Desired Precision - e

Precision is a measure of the variability around the mean. Variability is inherent in sampling, as only part of the population is being measured. In order for survey results to have a degree of reliability and to be representative of the entire population being sampled, there must be a sufficient number of plots within each stratum.

For stocking and free growing surveys, the desired survey precision has been set by the MoFLNRORD.

Where the average number of well-spaced or free growing trees per hectare is:

- Less than or equal to 1000 trees per hectare, the precision is +/- 100 trees per hectare
- OR
- More than 1000 trees per hectare, the precision is 10% of the average number of well-spaced or free growing trees per hectare. **i.e.** (For Example: If the mean number of free growing trees per hectare is 1125 then, the $\bar{X}$ is 5.625 trees per plot, therefore e is, 0.5625 trees per plot or 112.5 trees per hectare.

8.1.1.3 Use of the FS 1138 A, Calculation Card for Silviculture Survey Confidence Limits

The [FS 1138A](#) card is designed to provide a format for a methodical approach to the calculation of statistics. Those less fluent with statistical evaluation often find the card provides a more complete flow of data analysis. The use of this card is optional, since the statistical results can be recorded on the FS 659 card.

However, when additional plots are required to meet statistical precision, the 1138A will show the statistical calculations from the “first pass” or first set of calculations. The FS 659 will show final confidence limits after the additional plots have been established. The 1138A can also be used for the “second pass” or second set of calculations once more plots have been established.

8.1.1.4 Use of the FS 1138 B

The card [FS 1138B](#) includes a glossary of common statistical terminology. It describes the step-by-step approach to calculating statistics, and it provides a table that lists the number of plots established to the corresponding t value. The t value table is also found in the [FS 660](#). This card also describes the testing procedures to follow when measuring the difference between two means.

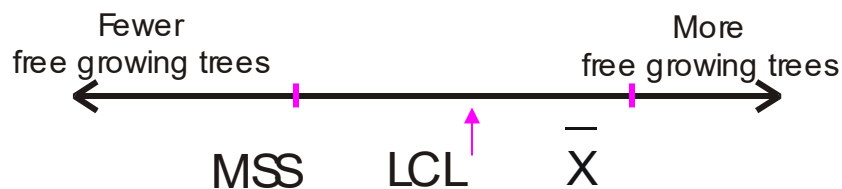
8.1.1.5 Statistical Analysis

The statistical calculation **MUST** be done in the field to determine the need for additional plots.

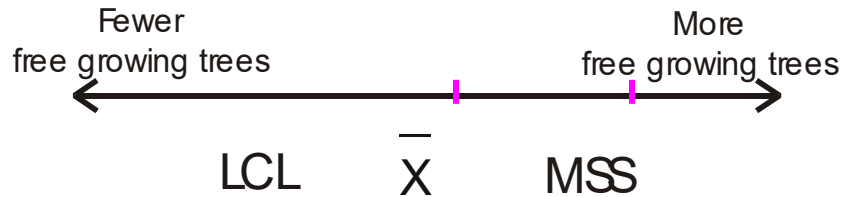
There is no statistical analysis required for preferred species alone, only for the combination of preferred and [acceptable species](#).

Where plots have been established, a minimum of five plots per stratum is required. More plots, may be required to meet the 90 % low confidence interval (LCI). The following decision rule steps and illustrated scenarios - **performed in the order as presented below** - are to be completed when determining statistical achievement of [stocking](#) or free growing:

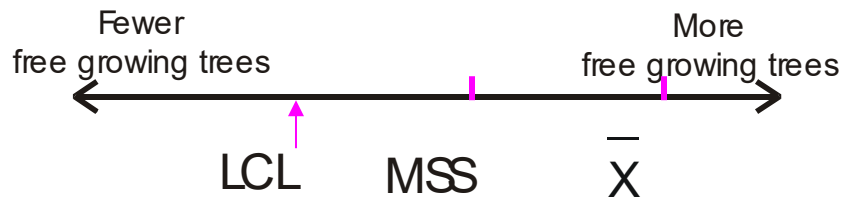
1. If the mean ($\bar{X}$) number of free growing trees per hectare and its 90 % lower confidence limit ([LCL](#)) are greater than the minimum stocking standard, the area is considered free growing. No further plots are required. There is no need to proceed any further. It would be considered free growing or, if evaluating stocking information: satisfactorily restocked.



2. If the mean ($\bar{X}$) number of free growing trees per hectare is less than the minimum stocking standard (MSS), the area is considered not free growing. No further plots are required. There is no need to proceed any further. It would be considered not free growing or, if evaluating stocking information: not satisfactorily restocked.



3. If the $\bar{X}$ is greater than the minimum stocking standard (MSS), but the [lower confidence limit](#) is less than the minimum stocking standard then the stocking decision is uncertain.



4. If there is an uncertain stocking decision (as per step 3.) and the maximum number of plots have been established, then there is no further need for calculation. The stratum is free growing or SR (depending on whether the data being evaluated is free growing or stocking data).

5. If the decision is uncertain, and maximum plots have not been established, then the desired level of precision should be compared with the confidence interval to see if the desired level of precision has been met. If the confidence interval per hectare is less than the e value per hectare, then the desired level of precision has been met, and no further calculations are required. The strata may be considered free growing or stocked, again depending on what data is being evaluated.

If, however, the desired level of precision has **not** been met ($CI > e$), then additional plots are required (see step 6.)

For an explanation of Desired Precision, see section 8.1.1.2

6. If the $CI > e$, then more plots are required to meet statistical precision.

To determine the number of additional plots required, use the following formula:

$$(t^2 \times s^2) \div e^2 =$$

The number of
plots required to
meet precision

The number of plots required to meet precision - The number of plots already established = The number of additional plots required  **No more than 1.5 plots per hectare are required.**

As some plots have already been established, subtract the number of plots established from the value derived using the formula. The resulting value is the total number of plots that are left to be established.

NOTE: That the establishment of more plots up to the maximum of 1.5 plots per hectare, is a second step only and not a primary step. It should only be implemented once step 6 occurs, due to the first statistical analysis and the failure of the sample meeting the test of LCL and e and assuming the maximum plots have not already been established.

The MoFLNRORD has determined that 1.5 plots per hectare is the maximum required. Therefore, if the formula indicates more than this number, then only enough additional plots to reach 1.5 plots per ha are required. Conversely if the value derived from the formula indicates less than 1.5 plots per hectare, establish only the number of plots required by the formula.

Where the initial plots are established on a systematic pattern, it is equally acceptable to establish the additional plots either, along a single diagonal line which extends across the stratum, or between existing plots on a systematic basis.

In the following example, the original plots are circles. The additional plots required to meet statistical precision are squares. All of these are acceptable methods.

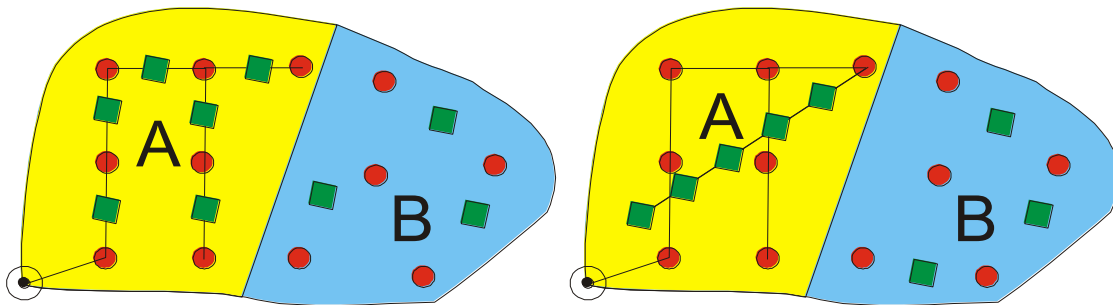


Figure 25 Examples of location of additional plots to meet statistical precision

7. Re-calculate the statistics as a final evaluation of the sample population.

- 1) If maximum plots are not established, and only extra plots, then regular statistical analysis is performed using LCL
- 2) However, if maximum plots were established up to 1.5 plots per hectare, then the stocking/free growing decisions are now completed based on the comparison of the $\bar{X}$ and the [MSS](#) and not by using the LCL. Therefore, if the $\bar{X}$ is greater than or equal to the MSS the stratum is determined to be stocked/free growing. If not, the area is determined to be not stocked/ not free growing.

Figure 25a: Example of a completed 1138A

OPENING NO.	93B023-123	
STRATA NO.	A	
AREA	16	ha
NO. OF PLOTS	5	
$\bar{x}$ WELL-SPACED	$\bar{x} = 4.6$ $\bar{x} \times \text{pm} = 920$ s/ha	
s STANDARD DEVIATION	0.894	
$S_{\bar{x}} = s/\sqrt{n}$	0.894/2.236 = 0.400	

Compare with value on FS 659 to ensure they are the same !!!

t. 90, n-1	2.132
CI ₉₀ = $t s_{\bar{x}}$	CI ₉₀ = 0.853 CI ₉₀ x pm = 171 s/ha
LCL $\bar{x} - CI_{90}$	LCL = 3.747 LCL x pm = 749 s/ha
MSS	700 s/ha
e = .1 $\bar{x}$, 0.5	e = e x pm = s/ha
$n = \frac{t^2 s^2}{e^2}$	n = plots
RECOMMEN- DATION	No Further Plots Required

8.1.1.6 Multi-storey Statistics

Confidence limits do not apply to multi-storey surveys. Some districts request that surveyors calculate statistics and establish additional plots. Surveyors should consult with the district to confirm their requirements. Currently there are no provincially approved or required methods for statistical analysis on multi-storey surveys.

8.1.2 Treatment Recommendations

The *Forest and Range Practices Act* does not require treatment recommendations. However, the agency responsible for the opening is required to produce a free growing stand. Treatment recommendations that aid in achieving this goal will be an important component of most silviculture surveys.

Surveys conducted for government under the FS 925A (*Silviculture Contract for Silviculture Surveys*) do require treatment recommendations. Many licensees use a similar contract.

In order to develop treatment recommendations, one compares the results of the survey to the standards and the management objectives in the silviculture plan or prescription. Where the present opening fails to meet those standards or management objectives, treatments or actions need to be recommended that will enable the opening to meet those objectives. Effective treatment recommendations are ones that are ecologically suited to

the opening, are cost effective, will result in a free growing stand within the prescribed time frames, and will provide for management of preferred and [acceptable species](#) at [target stocking](#). Recommendations may also include suggestions for [amending the silviculture plan or prescription](#) or the silviculture treatment regime. For each opening, an alternative recommendation should be included. Where applicable, treatment recommendations should include a brief explanation supporting the recommendations made.

Several factors should be considered when making treatment recommendations:

- Does the data collected and summarized equate to the visual observations?
- Is a treatment required to meet the regeneration date?
- Is a treatment required to assure a free growing stand within the prescribed free growing time frame?
- Are the recommended treatments biologically suited to the site?
- Are the recommended treatments cost effective?
- Are the recommended treatments feasible?

Treatment recommendations should be SMART:

Succinct

Measurable

Achievable

Relevant

Timebound

The SMART concept is discussed in the [Framework for Effective Silviculture Treatment Recommendations](#) course.

The first step in creating treatment recommendations is to compare the survey data to the standards in the silviculture prescription, site plan or FSP and in the contract. The data collected during the survey should reflect the standards set out in the silviculture prescription, site plan or FSP and in the contract.

The next step is to identify any deficiencies noted in the survey. For example, is the stratum SR, or is it NSR? If there are no treatments required, then there are no recommendations to be made.

Every site has limiting factors such as climate, forest health, [competing vegetation](#), or nutrients. Surveyors must ensure that limiting factors are identified and addressed by the recommendation. The next step is to incorporate the limiting factors into the suggestions.

For each deficiency or limiting factor found in the survey, consider possible solutions. Where a treatment is required to achieve free growing, both a primary and secondary recommendation should be provided. Always aim for the target standards, not the minimum standards. Where possible, try to meet the silviculture prescription, site plan or FSP requirements. This may not always be possible, and [amendments](#) may be necessary.

If the standards in the silviculture prescription, site plan or FSP cannot be met, the surveyor may recommend that an amendment be made to bring the silviculture prescription, site plan or FSP more in line with what is actually on the site. When making recommendations for amendments, be specific as to what needs amending. Only recommend amendments for deficiencies that could not be fixed otherwise. Amendments need to be justified. They are not intended to relieve a licensee of responsibility for an agreed-upon, achievable standard.

Some of the types of treatments that surveyors can recommend include, but are not limited to:

- [Site Preparation](#)
- [Planting](#)
- [Juvenile Spacing](#)
- [Brushing](#)
- [Sanitation](#)

Follow-up surveys should also be scheduled as part of the recommendations.

8.1.3 Reports

Only surveys that are used as the basis for meeting the regeneration date or free growing declaration or activity reported (as per government funded programs like FFT or FIA) need to be formally reported in RESULTS. Other intermediate surveys are not required to be reported according to legislation.

It is essential to keep a written record of the survey (e.g. the FS657, 658 and 659) and the results and provide these to the District Manager if requested.

There are a few different categories of survey reports to consider:

- Regeneration Delay Surveys
- Free growing Surveys
 - With regeneration objectives (most common)
 - Without regeneration objectives
- Compliance Report Required by the Government

8.1.3.1 Report Contents

The Forest and Range Practices Act and its Regulations do not explicitly state the individual components of a report.

Historically, reports have required the list of items below. It is realistic to expect reports will likely have the similar components. The items can be expected to include:

- identification of the area under the obligation (Licence, cutting permit, block, opening number where available)
- the agreement and name of the holder of the agreement (where applicable)
- the standards unit boundaries and their areas
- the survey strata and their areas
- the biogeoclimatic ecosystem classification
- the incidence of forest health
- the inventory label, including species composition, ages, heights, crown closure, total tree density, site index, site index method and survey year
- the silviculture label, including the number of preferred and acceptable trees per hectare
- number of countable conifers, if near maximum density thresholds

8.1.3.2 Regeneration Delay and Free Growing Survey Reports

A regeneration delay and free growing survey report has very few mandatory items. FRPA requires polygon, inventory and silviculture label.

The silviculture survey cards, summaries or other data gathering methods (i.e. video recordings, photographs and aerial photos) kept on file and shall be made available for audit purposes at the request of the District Manager.

8.1.3.3 Regeneration Delay Survey Reports on Woodlots

The WLPPR specifies that a survey be undertaken if the minister believes that the woodlot licence holder has not met the regeneration delay requirements. The details of such a survey are not specified but one can expect the process discussed earlier in this document would be reasonable.

8.1.3.4 Free Growing Surveys for Intermediate Cuttings on Woodlots

Between 1 and 3 years following the completion of harvesting, the woodlot licence holder is responsible to conduct a survey of the following:

- the identification of the area
- the inventory label, including species component, age, height, density and [site index](#), and
- the incidence of damage by forest health factors affecting trees

The report is submitted as part of the annual report.

8.1.3.5 Free Growing Surveys on Woodlots

The free growing assessment requirements are quite similar to those of the major licence holders.

- identification of the area
- the number of healthy well-spaced free growing preferred and acceptable trees per hectare
- the number of healthy well-spaced free growing preferred trees per hectare
- the total number of countable coniferous trees per hectare for the purpose of determining compliance with the maximum number of coniferous trees allowed per hectare under the prescription

- the inventory label and silviculture labels including species, age, height, density and [site index](#), and
- identification of areas that are:
 - satisfactorily stocked (SR)
 - not satisfactorily restocked (NSR)
 - free growing (FG)

The report is submitted as part of the annual report.

8.1.3.6 SU Nomenclature when stratifying and ultimately reporting survey compilations into RESULTS

The following is a best practice procedure recommended by practitioners in order to keep reporting nomenclature consistent, when a surveyor is first stratifying and then reporting Polygons within established SUs.

The recommended process would be to always start with the identifier established for a specific SU. The surveyor is limited by the legal documentation as to what the SU is designated as initially (either numeric or alphabetical). Keeping track of the strata/polygon within each SU should follow a sequential pattern, be it numeric or alphabetical.

Therefore, the first stratum or polygon within that SU, should be labeled “1” or “A”. Then the second stratum within that SU should be labeled “2” or “B” and so on. The result is that the SU and the strata/polygon designations **are joined** to form the Strata/Polygon label (e.g. SU 1 and Strata/polygon A is known as Strata 1-A).

The following Figures illustrate this best practice.

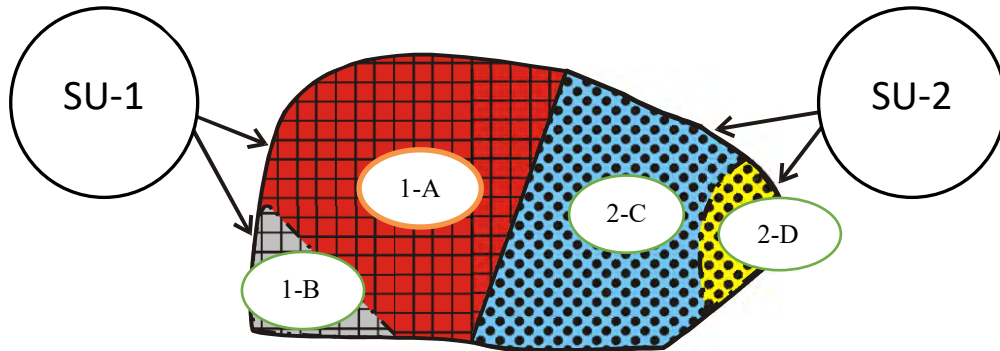


Figure 25a Examples of SU Nomenclature – Numeric/Alpha

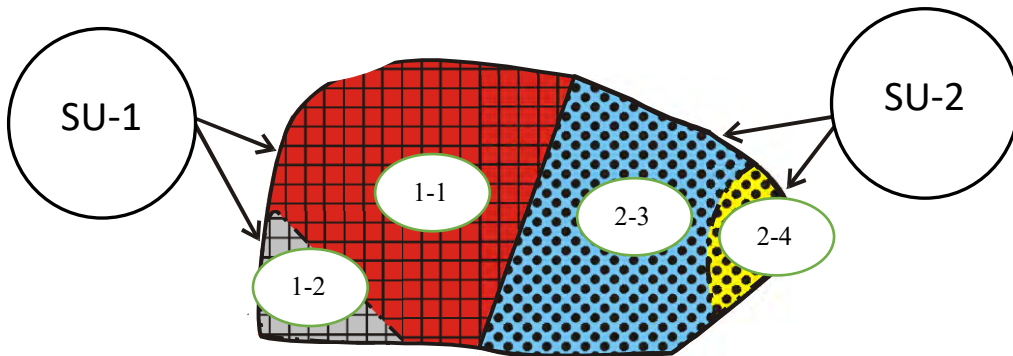


Figure 25b Examples of SU Nomenclature – Numeric/Numeric

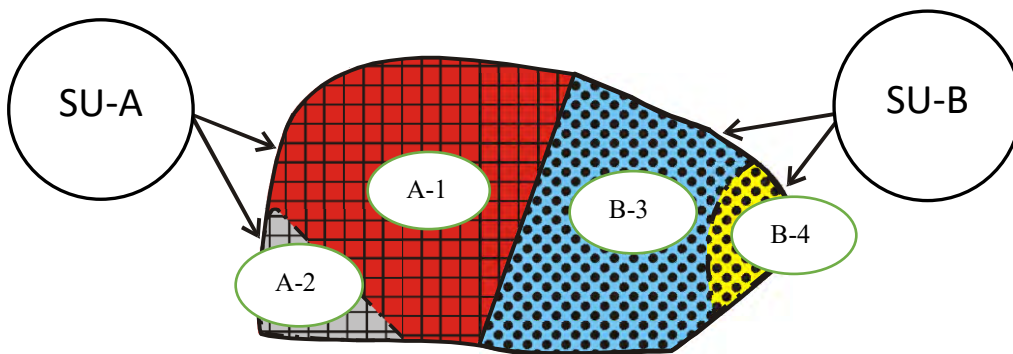


Figure 25c Examples of SU Nomenclature – Alpha/Numeric

Note: It would not be incorrect to denote the strata in SU-B as B-1 and B-2, however, strata numbering or lettering is generally not duplicated as this avoids confusion on stratum identification within an opening with multiple SU's.

8.1.4 Inventory Label - Polygon

An inventory label is a standardized method of describing the commercial tree species growing on a polygon (traditionally called a stratum). Surveyors make ocular estimates of the species composition (to the nearest ten percent) and the average height and age of the [dominant](#) and [co-dominants](#) of the leading and second species and [crown closure](#). In practice this means surveyors will visually gather this data from within the polygon as they conduct the survey. These estimates are collected at the first and every fourth plot thereafter. If a low number of plots are required within a stratum or polygon, then it is recommended that a minimum of three inventory samples be collected. Where few plots are established in a large polygon, inventory label data should be recorded more often.

The density is based on plot data. [Site Index](#), based on the method described on the FS 657, may (growth intercept) or may not (SIBEC) be based on plot information.

Note: The percent leading species will be based on [Volume](#) for predominantly Layer 1 and 2 polygons and on relative [Density](#) of stems per ha. for younger Layer 3 and 4 dominated polygons.

The sample inventory label below describes a stratum with the following characteristics:

Sx₄₀Fdi₃₀Ac₂₀Bl₁₀ – 13/12 - 1.7/1.6 – 18/I – 19 - 12520(18)

- species composition of the total trees is spruce 40 percent, Douglas-fir 30 percent, cottonwood 20 percent and subalpine fir 10 percent.
- average age of dominant and co-dominant spruce is 13 years and the Douglas-fir is 12 years
- average height of [dominant](#) and [co-dominants](#) spruce is 1.7 meters and the Douglas-fir is 1.6m
- [site index](#) of the leading species, spruce, is 18 meters at 50 years
- [site index](#) I is growth intercept
- crown closure of all the commercial tree species is 19 percent
- total trees per hectare is 12520
- year of the survey is 2018

8.1.5 Silviculture Label - SU

A silviculture label is a standardized format of the string of data that describes the well-spaced or free growing component of a stratum. Most of the data items are selected from the FS 659 summary card when plots are established. When no plots are established the entire label can be generated from visual observations, but should be done with extreme caution and only by very experienced surveyors. If the information is submitted to meet legal requirements, it is expected to meet precision standards as well. If not, it will need to meet contract requirements.

The sample silviculture label below describes a SU with the following characteristics:

FG-Fd₅₆Sx₂₂Bl₁₃Cw₉ - 12 -2.4- 21/E - 920(20)

Note: this example is free growing and therefore free growing values are used (vs. well-spaced values).

- this prefix identifies the stocking status of the SU, NSR, SR or FG. Subsequently the data that follows NSR and SR represent well-spaced trees and following FG represents free growing trees. (Note: This prefix data is for information purposes only and there is no legal reporting requirement into RESULTS).
- species composition of the free growing trees is Douglas-fir 56 percent, spruce 22 percent, subalpine fir 13 percent and western red cedar 9 percent
- average age of all species of free growing trees is 12 years
- average height of all species of free growing tree is 2.4 meters
- [site index](#) of the leading species, Douglas-fir, is 21 meters at 50 years
- [site index](#), E is SIBEC
- free growing trees per hectare is 920 (based on the calculations completed on the FS 659 where plots are completed)
- year of survey is 2020

When completing the silviculture label for a free growing survey, the label components (e.g., species, age, height) refer to free growing trees per hectare only if the stand has achieved free growing status as determined by the survey. Otherwise, the well-spaced values are used in creating the silviculture label.

9 Alternative Survey Methodologies

The following sections refer to alternatives to the basic standard survey techniques (for simpler even-aged clearcut scenarios) previously presented up to Section 8. The application and use criteria of the following alternative methodologies are prefixed at the beginning of each survey method section. Note, that many fundamental aspects of the basic standard survey procedures maybe incorporated into the following alternatives. If reference is made to these basic principles (such as sampling principles), please refer to the appropriate sections of the previous 8 sections for detailed reference.

While it is not the focus of this manual to fully describe these alternative procedures, it is important that surveyors understand the assessment options and their potential applications.

In addition, a Survey Methodology Selection Matrix Table has been provided below to aid as guidance in the selection of an appropriate survey methodology and the appropriate situations and circumstances where an alternative methodology should be used.

In addition, **Appendix 14 – Guidance Matrix for Reporting Retention Openings into RESULTS**, contains the same guidance below regarding Survey Methodologies. However there are more detailed reporting guidance and many illustrations and photos that are intended to aid all practitioners in deciding on the appropriate survey and reporting practice.

It is important to always refer to the approved **silviculture plan and prescriptions** for the opening being surveyed, in order to implement the appropriate survey methodology prescribed for that opening. The methodologies prescribed in these opening prescription documents, would supersede any selection of a survey methodology from the matrix table below.

9.1 Survey Methodology Selection Matrix

	Management Regime		
	Even-aged stand structure		Uneven-aged stand structure
Stocking Standard	One Layer Target & Minimum Stocking Standard		Multiple Layer Target & Minimum Stocking Standards
Silviculture System	Clearcut (CC) <ul style="list-style-type: none"> • $\leq 5 \text{ m}^2/\text{ha}$ BA Dispersed Retention residual stems 	Dispersed Retention of residual stems: <ul style="list-style-type: none"> • $> 5 \text{ m}^2/\text{ha}$ BA & $< 20 \text{ m}^2/\text{ha}$ Interior ($< 40 \text{ m}^2/\text{ha}$ Coast) 	Single tree selection <ul style="list-style-type: none"> • $> 5 \text{ m}^2/\text{ha}$ BA & $< 20 \text{ m}^2/\text{ha}$ Interior ($< 40 \text{ m}^2/\text{ha}$ Coast)
Survey Methodology Options	<ul style="list-style-type: none"> • <u>Standard CC/Even-aged Survey Methodology</u> (up to section 8 in this manual) 	<ul style="list-style-type: none"> • <u>Layered Survey Procedures</u> • <u>DFP related (SEDRSS)</u> Procedures for Salvage or Non-timber objective openings • <u>Mixedwood (Dec/Conifer) Survey Procedures</u> NE Interior and CFR 	<ul style="list-style-type: none"> • <u>Multi-storey Survey procedures</u> – recommended for <u>only IDF zones or small area based tenures such as Woodlots.</u>
Recommended FG Damage Criteria	<ul style="list-style-type: none"> • <u>Use even aged damage criteria</u> 	<ul style="list-style-type: none"> • <u>Layered and DFP (SEDRSS) – Use the SEDRSS Damage Criteria</u> 	<ul style="list-style-type: none"> • <u>Use Multi-storied Damage Criteria</u>

Table 9b – Survey Methodology Selection Matrix

9.2 Complex Vertical Structure Survey Methodologies

9.2.1 Multi storey Survey

Prescribing forest professionals, contract supervisors, and surveyors must know the provincial definition of stand layers, be familiar with basic silvicultural systems and understand which stand types are suitable in order to know when to properly employ the provincial multi-storey silviculture survey methodology. Recognizing the application of other assessment procedures will encourage the use of the multi-storey system where it is best suited.

If a surveyor requires more information and detail then provided in this manual section, please refer to the [Multi-Storey Silviculture Survey Course Workbook](#).



Illustration 3: Multi-storey Uneven-aged Stand Structure

9.2.1.1 Multi-storey Definitions

Forest Practices and Investment and Forest Analysis and Inventory Branches have agreed on layer definitions.

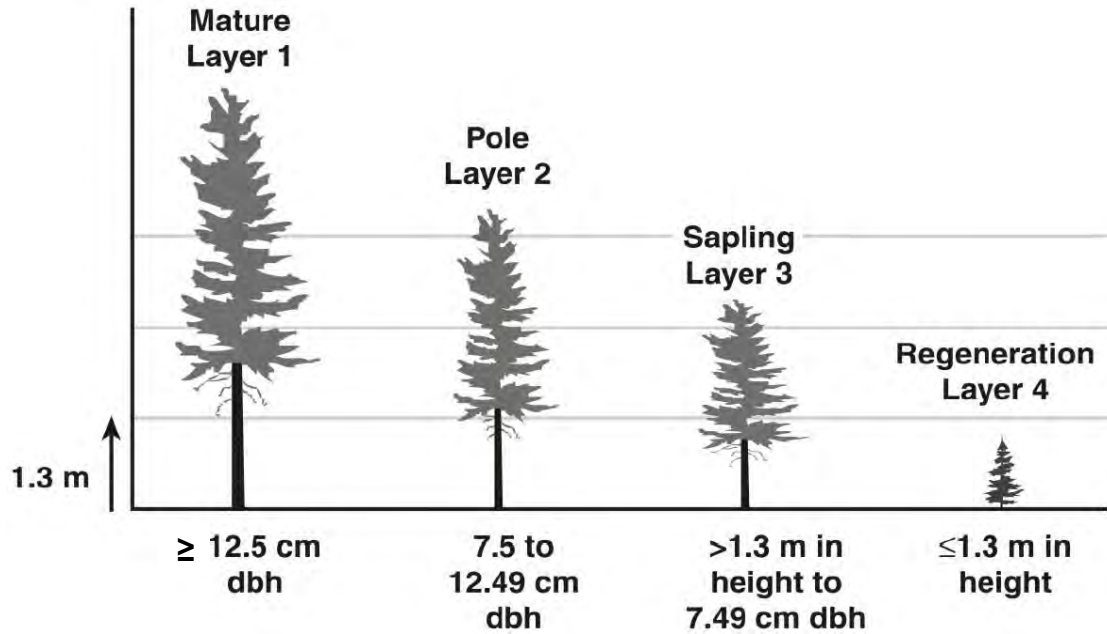


Figure 25c: Multi-storey layer definitions

The multi-storey survey methodology is suitable to assess stands in which all three of the following criteria apply:

- 1) The stand is being managed for single tree selection;
 - 2) Layers one and two combined is either :
 - i) $\geq 6\%$ crown closure, or
 - ii) $> 5 \text{ m}^2/\text{ha}$ of basal area in layer 1; and
 - 3) Layers three and/or four are present.
- Uneven-aged management is defined in FPPR Schedule 1 Sec. 6: “*Uneven-aged means a stand of trees with three or more age classes*”. The uneven-aged system develops or maintains a mixture of three or more distinct layers, with clear differences in height, diameter and age for the entire cutting cycle.
 - The multi-storey survey procedure is best suited to a single tree selection silvicultural system. This is an uneven-aged system, where mature timber is removed either as single stems or in small groups, at relatively short intervals, repeated indefinitely, maintaining an uneven-aged stand. The intent of the system is to recruit trees into successive age classes over time with regeneration occurring in pulses after harvest entries.
 - **Note:** Use of the default Stocking Standards for Single Tree Selection listed on the Reference Guide to Stocking Standards, is only recommended to be used for IDF sub zones within the province or small area based tenures such as Woodlots.
 - “Mark to leave” and “faller selection” are common approaches to single tree selection.

- A single tree selection silvicultural system commonly relies on natural regeneration, however planting may be appropriate where seed supply is questionable.
- The multi-storey survey procedure may be suited to an uneven-aged group selection system where the size of openings is minimal.
- The multi-storey survey procedure may be suited to the irregular shelterwood system. This system is broadly aged and therefore considered to be between an even-aged and an uneven-aged stand. It has an extended regeneration strategy and there is often an extended period of overstorey influence on the regeneration. This is similar to single tree selection, where residual trees are left for long periods beyond the regeneration phase. This system is only acceptable if multiple harvest entries are prescribed as defined above. Other shelterwood systems are not considered to be multi-storey.
- Crown closure is best estimated by a combination of air photo interpretation and ocular ground estimates by experienced, trained personnel. Calculations utilizing stem density and crown radius may also be helpful. See Appendix 9 for additional detail on estimating crown closure.

9.2.1.2 Complex Stands not suited to the Multi-storey Survey System

- Generally stands being managed under an even-aged system are not well suited to the multi-storey survey procedure. These management categories would include clearcut, clearcut with reserves (dispersed or grouped), patch cut, coppice, seed tree and most shelterwood systems.
- Diameter-limit cuts, or selective harvesting, which target high-quality, larger stems for harvest, may not be suited to a multi-storey stocking standard, based on the lack of intent to leave preferred quality stems of all diameter classes.

Where limited prescription information exists (e.g.: Salvage harvest areas), surveyors need to consider what an appropriate silvicultural system is and be prepared to discuss assumptions made in the survey report. Considerations may include species composition, stem density, stem quality and age class distribution. Even or uneven-aged management may be prescribed. An amendment or development of a prescription may be required.

Where the stand is unmanaged, and the intent is single tree selection, the development of a stand table to adequately describe stand dynamics is preferred when developing a prescription.

Properly describing stand structure requires an understanding and consistent use of nomenclature for describing multi-storey stands. (see [Silviculture Systems publication](#)).

9.2.1.3 Uneven-aged Stocking Standards

- **Note:** Use of the default Stocking Standards for Single Tree Selection listed on the Reference Guide to Stocking Standards website, is only recommended to be used for IDF sub zones within the province or small area based tenures such as Woodlots.

The overall goal in making a stocking status decision at regeneration delay or free growing is to determine whether adequate stocking (site occupancy) occurs over the stand.

In order to logically integrate structural diversity and the reality that larger trees occupy more site resources than smaller trees, stocking standards need to be provided by layer.

All four layers in a multi-storey stand occupy and require different amounts of growing space and influence each other.

It is recommended that stocking and survey parameters include preferred and acceptable criteria as well as planned residual basal area per hectare.

Silviculture plans and prescriptions may prescribe standards and survey criteria for a standards unit that deviate from the provincial guidelines: a surveyor must employ those survey criteria when surveying that unit in order to assess whether the SP standards have been met.

All four layers in a multi-storey stand can contribute to the stocking status of the stratum: each layer will have its own Target and Minimum Stocking Standard (TSS and MSS).

As all four layers in a multi-storey stand occupy and require different amounts of growing space and influence each other, each layer can completely stock (i.e. fully occupy the site resources) the stratum on its own, or contribute to the overall stocking.

9.2.1.3.1 Making a stocking status decision using uneven-aged standards

To make a stocking decision, data for all plots in the stratum are summarized. Well-spaced and/or free growing density by layer is calculated. The calculated density is compared to the uneven-aged minimum stocking standard (MSS) starting with layer one. If the layer one density exceeds the MSS for that layer then the stratum is considered stocked or free growing. If however the calculated density is less than the MSS you MUST combine the calculated density for layer one and two and compare it to the MSS for layer two. If need be, the process continues to layer four where the total calculated density for all four layers is compared to the MSS for layer four. This process is referred to as “nesting”. As with even-aged surveys, it may be a requirement to meet both $MSS(p+a)$ and $MSS(p)$.

For this example, assume that the total FG stems are all preferred.

Layer	TSS	MSS(p+a)	MSS(p)	Total FG/ha	“Nested Total”/ha
1	400	200	200	150	150
2	600	300	250	100	250
3	800	400	300	75	325
4	1000	500	400	200	525

In this example it is not until the 4th layer that the total calculated density, or “nested total”, exceeds both the MSS(p+a) and the MSS(p) (i.e. 525/ha > 500/ha).

Refer to the example of a Stocking Decision Key in the [Multi-Storey Silviculture Survey Course Workbook](#).

9.2.1.3.2 Suitable Conversion to Uneven-aged Stocking Standards

Some older silviculture prescriptions for multi-layered stands provided only even-aged (single-storey) stocking standards. If it was prescribed for, or it is suited to, uneven-aged management, it may be necessary to convert from even-aged, single-layered standards to uneven-aged, multi-storey standards. This conversion is not appropriate where a multi-layered stand structure has resulted from poor implementation of the prescription (for example, using the multi-storey survey procedures to accept poor quality residuals where a clear-cut silvicultural system was prescribed).

The Uneven-aged Stocking Standards (Table 10-following page) provide the parameters necessary to conduct a stocking or free growing survey and make a status decision. They should be used for multi-storey stands that have silviculture plans and prescriptions that inadequately provide stocking standards. The contract administrator, prior to start-up, should provide direction to the surveyor regarding the use of these standards. If used, the surveyor must acknowledge the shift from even to uneven-aged standards. The licensee will be responsible for amending prescription documents.

- The minimum inter-tree distance does not apply between layer one well-spaced or free growing trees
- Species: consider even-aged stocking standards. Shade tolerance may impact the species selection decision.
- Minimum height: dry-belt Fdi stands = 40cm; otherwise use even-aged height standards.
- Competing vegetation (as per Appendix 9 of the Establishment to Free Growing Guidebook) applies to layers three and four (unless the prescription indicates otherwise).

Target even-aged stocking standard	Layer	Target stock. stds.	Min stock. stds.	Min pref. Stk. stds.	Max. regen	Early FG** delay*	Late FG	Well-spaced sph post spacing (min/max.) layer 3 only
1200	1	600	300	250	7	12	15	
	2	800	400	300	7	12	15	
	3	1000	500	400	7	12	15	500-1000
	4	1200	700	600	7	12	15	
1000	1	400	200	200	7	12	15	
	2	600	300	250	7	12	15	
	3	800	400	300	7	12	15	400-800
	4	1000	500	400	7	12	15	
900	1	400	200	200	7	12	15	
	2	500	300	250	7	12	15	
	3	700	400	300	7	12	15	400-700
	4	900	500	400	7	12	15	
800	1	300	150	150	7	12	15	
	2	400	200	200	7	12	15	
	3	600	300	300	7	12	15	300-600
	4	800	400	400	7	12	15	
600	1	300	150	150	7	12	15	
	2	400	200	200	7	12	15	
	3	500	300	300	7	12	15	300-500
	4	600	400	400	7	12	15	
400	1	200	100	100	7	12	15	
	2	300	125	125	7	12	15	
	3	300	150	150	7	12	15	150-300
	4	400	200	200	7	12	15	

Table 10: Uneven-aged stocking standards (single-tree selection only)

To make a stocking status decision for a multi-storey stand, relevant stocking standards are required. Where possible, the management objectives, silvicultural system and stocking standards for a multi-storey stand should be reviewed at the pre-work. If the opening lacks a silviculture plan and prescription, or if the relevant document does not provide adequate standards, then from a surveyor's perspective an amendment is preferred. If an amendment is not completed prior to the survey, then standards should be discussed with the client prior to start-up. The Uneven-aged Stocking Standards as per Table 10, above, are often used. Uneven-aged standards use the nesting procedure to determine the stocking status. Basal area is a data requirement when SUs exceed 5m²/ha of BA, and needs to be collected by species, regardless of BA, during all multi-storey survey assessments as a best management practice. RESULTS only requires total BA for layer 1.

In the absence of standards prescribed in a silviculture plan or prescription, the following apply:

- Maximum density of 10000 sph (applicable to conifers in layer three only); 25,000 sph for pine stands in the Southern Interior Region and 20,000 sph for 80% pine stands in the Northern Interior.
- For prescriptions approved before April 1, 1994, maximum density refers to drybelt Douglas-fir and lodgepole pine species only.
- Regen. delay can be met immediately following harvest if the residual stand has no significant damage or pest problems and meets minimum stocking.
- If regeneration is achieved immediately following harvest, earliest free growing date is 12 months after completion of harvest.

9.2.1.4 Silviculture and Inventory Labels

It is essential to properly and adequately describe layers in a multi-storey stand in order to accomplish three main survey objectives. The silviculture related objectives are to make accurate stocking and sound silviculture management decisions while the inventory objective is to collect accurate information for inventory purposes.

Multi-storey stand assessment and data collection are much more complex than those of a single-storey stand. Basal area by species is required to be collected at each plot for layer one trees. Silviculture and inventory information must be collected for each layer.

9.2.1.4.1 Silviculture Labels

Section 9.2.1.1 defined the four layers and how they are used to make a stocking decision. The second silviculture related objective is to make sound management decisions. To accomplish the second objective there may be a need to subdivide one or more of the four layers.

- where management objectives are unclear, collecting diameter class information to produce a stand table will allow a manager to develop a sound prescription.
- recruitment is important in uneven-aged management (the species, quality and quantity), therefore layer four may be subdivided to characterize new regeneration versus advanced regeneration.
- any other management objective indicated on the silviculture plan or prescription may require that enhanced layer data be described in order to assess whether the objective has been met.
- enhanced layer data may provide information for prescribing silviculture treatments (i.e. spacing layer three), or to meet other objectives (ex. hydrological recovery or visual cover).

9.2.1.4.2 Inventory Labels

As with silviculture labels, inventory information is collected by layer. Follow the procedures outlined for even-aged stand inventory labels in Section 8.1.4 and Section 7.3 – data fields 115 to 124.

9.2.1.5 Ghost Trees

Ghost trees are trees that remain on site for a specified reason (e.g. wildlife tree) but do not count towards stocking as they will not be harvested in the future.

- ghost trees should be identified in the silviculture plan or prescription as being reserved: the specifications (i.e. density, distribution, etc.) and rationale should be provided.
- if a silviculture plan or prescription does not exist, or if it does not address trees that have apparently been reserved, then the surveyor should
 - a) consult with the contract supervisor or
 - b) make a judgment call, record it on the 657 and survey accordingly.
- ghost trees have significant implications on long-term management objectives.
- trees within a survey plot that fall within the vertically projected crown (drip-line) of a ghost tree are counted towards the total tree count but should be carefully evaluated before being accepted as crop trees.
- ghost trees need to be accounted for in the inventory label as they occupy growing space and may influence performance of regeneration.

9.2.1.6 Basal Area (BA)

Basal area must be collected by species for layer one during a multi-storey survey. BA is used to make stand management decisions and is an important component of the inventory data submission used to improve growth and yield calculations.

- basal area is determined for layer one only, using a prism size chosen to capture on average 4 to 9 trees per plot.
- if included in the silviculture plan or prescription as a stocking standard, the data collected should be defensible: i.e. measure in/out trees.
- the basal area of layer one is proportional to the amount of growing space taken up by layer one trees and hence provides a means by which stocking may be judged.
- recording "in" trees provides a measured estimate of species composition (by volume) for layer one which is superior to an ocular estimate.

(refer to [Appendix 4](#) for guidance on the use of a prism)

9.2.1.7 Modal Diameter

Definition: Modal Diameter is the most frequently observed diameter in layer one.

- modal diameter is not a RESULTS requirement.
- modal diameter is a useful stand descriptor in management planning for future stand entries: i.e. what would be the most frequent log size.
- average diameters are inadequate in that they may describe a tree size that does not exist in the stand.
- a stand having two distinct groupings of diameters in layer one is called bimodal: both diameters should be recorded.

9.2.1.8 Steps Required to Complete a Multi-Storey Silviculture Survey

The main steps required to conduct a multi-storey survey are no different than that of a typical even-aged survey. Some of the specifics are different and discussed below.

- 1 - Office Review and Pre-Stratification
- 2 - Walk-through and Survey Design
- 3 - Data Collection
- 4 - Data Compilation and Summary
- 5 - Recommendations and Mapping
- 6 - Survey Submission

9.2.1.8.1 Office Review and Pre-stratification

The office review for a multi-storey survey is similar to that of an even-aged one, and should include: a review of the silviculture plan and prescription showing stocking standards, SU typing, previous surveys, ecological classification information, silviculture project reports, forest health information, and history information. Recent imagery is particularly useful when assessing a multi-storey stand. It helps gauge stand structure and crown closure and thereby the block's suitability to the multi-storey survey procedure, as well as pre-stratification. Office pre-stratification using imagery will include dividing areas of varying vertical stand structure into homogenous units - this is in addition to the normal criteria for stratification in a silviculture survey as described in the current [FS 660](#) field cards. The pre-stratification is determined prior to the completion of a survey design. Minimum stratum size was put into legislation in 2007. For a brief summary see the current FS 660. For a detailed discussion see the Ministry of Forests and Range 2007 document "[Forest Cover Stratification](#)".

9.2.1.8.2 Walk-through and Survey Design

The walk-through has particular significance for a multi-storey survey, as it is necessary to confirm that the stand is suited to multi-storey procedures. Optimal prism size is selected in addition to verification of pre-stratification. Other issues to be addressed during the walk-through include: identification of ecological classification, sampling intensity, site index methodology, forest health factors, site limiting factors, survey objectives, and potential treatments.

Typical sampling intensity for a multi-storey survey is one plot per hectare. A grid system is well-suited but not a required design. This relatively high intensity has been practiced as statistics are not required with multi-storey surveys. It may be reasonable to reduce plot intensity on uniform types or excessively large strata when experienced surveyors are employed. Consideration of reduced plot intensity should be discussed with the contract administrator prior to start-up.

9.2.1.8.3 Data Collection

The data collection process is described in a step by step process as follows:

1. Sweep the plot to determine total trees and total conifers for each layer. A 3.99m plot is typically used. In stands where stocking is more dispersed or irregular in distribution, a 5.64m plot may be a more effective plot size.
2. Choose your well-spaced (or free growing) trees by the following rules:
 - a) select the well-spaced trees starting in layer one and "nesting down" to layer four.
"nesting down" means:
 - selecting all acceptable layer one trees up to a maximum of the equivalent M value for layer one, then....
 - selecting well-spaced acceptable layer two trees so that the combined number of well-spaced in layer one and two does not exceed the equivalent M value for layer two, then....
 - selecting well-spaced acceptable layer three trees so that the combined well-spaced in layers one, two and three does not exceed the equivalent M value for layer three, then....
 - selecting well-spaced acceptable layer four trees so that the combined well-spaced in layers one, two, three and four does not exceed the equivalent M value for layer four.
 - b) all acceptable layer one trees in a plot should be recorded in the well-spaced column, but only up to the M value recorded in the Total W column.
 - c) an acceptable well-spaced tree in layers two, three or four must be: a) the MITD (minimum inter-tree distance)- as per the silviculture plans and prescriptions - from **ALL** acceptable layer one trees and b) the MITD from the **SELECTED** acceptable trees in the layers above.
 - d) If you are doing a multi-storey stocking survey, maximize the number of well-spaced trees; if you are doing a free growing survey, maximize the number of free growing trees (i.e. you may select different trees depending upon your objectives). If you are uncertain if the stratum is free growing or not, then collect both sets of data so that you have the correct information to produce a silviculture label.
 - e) All well-spaced, acceptable trees must meet leave tree criteria as described in the prescription and/or [Free Growing Damage Criteria for Multi-layered Conifer Stands](#).
3. Do a prism sweep and record the number of "in" trees in layer one by species. Record the modal diameter. Although not required in RESULTS, recording by species and collection of modal diameter, are best management practices.
4. Record countable conifers for layer three if maximum density in layer three is being approached (all layer three conifers contribute towards maximum density).
5. Record forest health data for each layer. Note new Forest Health rules are available - Appendix 10

6. Targeting every fourth plot, but collecting as required, to obtain a complete data set, collect and record the following three sets of data (a minimum of three data sets per stratum is required):
 - a. Record the competing vegetation in conjunction with silviculture height, age and inventory labels.
 - b. Choose an average well-spaced tree (or FG) for each layer and record the height and age of the samples.
 - c. Record the inventory label data for each layer. Species composition is based on volume for layers one and two, and on density (sph) for layers three and four. Ages and heights are of the average dominant/co-dominant trees for the leading and secondary species.
7. Collect site index information. Generally, single-tree selection does not lend itself to accurate results from the Growth Intercept Method. If the mature trees are vigorous, site index curves may be used. Most commonly, site index information is determined from the SIBEC method for multi-storey surveys. For more detailed discussion, see the 2008 Silviculture Survey Procedures Manual. For current SIBEC tables by region check the web: www.for.gov.bc.ca/hre/sibec/
8. Collect plantable and preparable data every plot. Generally a “drip-line” rule is applied for layer one stems, i.e. spots are not considered plantable or preparable under the crown of a layer one tree. Otherwise the assessment procedure is as per even-aged surveys.
9. Assess and record any other data that is required by the silviculture plan or prescription, or that contributes to assessing the silvicultural management objectives for the stand.

Completing a multi-storey survey follows the same steps and sequence as used in a normal even-aged silviculture survey. However, the complexity and importance of some of the steps is much greater than that of a normal survey. Multi-storey surveys will take more time and cost more money.

9.2.1.8.4 Data compilation and summary

Multi-storey data is summarized by layer, allowing stocking and management decisions as well as providing suitable inventory information. There are two means by which to summarize data from a multi-storey survey. Data may be summarized by hand, a time consuming process prone to error or it may be summarized electronically which is common practice.

Utilizing statistical analysis on a multi-storey survey is difficult due to the nature of how trees are selected during the nesting down process. At this time statistics are not a requirement when completing multi-storey surveys. Since the data collection rules require accepting all layer one trees that qualify, statistics can be meaningfully calculated for this layer. The lower confidence limit for this layer becomes especially important if the stand has been declared stocked or free growing based on the layer one density alone. Statistical analysis of layers two, three or four, or a combination of them would not be meaningful due to nesting down. If a stratum is not declared stocked or free growing until the cumulative well-spaced for layer four, is compared with the MSS for layer four, then

some benefit may be gained by determining the lower confidence limit of the mean of the total number of well-spaced (all four layers) in each plot.

9.2.1.9 Recommendations and Mapping Requirements

Survey recommendations are a key output of the survey. The surveyor is responsible for providing a stocking status determination, as well as recommendations for any treatment or follow-up survey that may be required, to ensure that stand development is consistent with the objectives and requirements set out in the silviculture plan or prescription.

For a regeneration delay or free growing survey, the silviculture and inventory labels, along with spatial data are submitted in RESULTS to the province. The survey report is kept on file by the licensee. Submissions may be made by the SU; however, the ministry will not acknowledge the declaration of the opening until all SUs are declared.

9.2.2 Layered Survey

A second assessment method commonly utilized on layered even-aged stands involves recording the survey information by layer but applying even-aged stocking standards.

Stand structures suitable for Layered Surveys are:

- Stands are managed on an even-aged management regime, with no planned multiple entry system;
- Low BA (suggested < 10m² Interior but may be up to 20m²)
- Stems retained post-harvest (planned or un-planned) are of acceptable health and vigor to contribute to stocking and free growing tallies and the next rotational harvest volumes.



Illustration 4: Layered Even-aged Stand Structure – Layered, DFP or SEDRSS Surveys

Using the “Layered Survey” method, silviculture data is summarized as one layer and compared to the prescribed even-aged stocking standards. Inventory information is recorded by layer. It may be reported by layer, or in some cases, amalgamated into one over-storey and one under-storey layer. Silviculture layers are generally reported by layer. Layered Surveys have the advantage that the standard even-aged statistical calculations can be used on the survey results.

The following is a best management practice procedure to follow for the implementation of a Layered Survey - which would differ from a standard even-aged survey:

Photo Stratification:

- Office pre-stratification from images and/or a map is often difficult in stands where there is a complex residual structure. Recent imagery would be beneficial.
- Attempt to divide the stand into homogenous strata based on varying vertical stand structures.

Walk-through

- Confirm or alter pre-stratification based on the actual stand conditions observed.
- Preliminary assessment of which layers will contribute to overstorey and understorey inventory labels.

Data Collection

- Record the sample plot data using a 3.99 m. plot radius and sweep the plot to determine, for all layers: Total Trees by layer; Total Conifers by layer; Count Conifers all layer 3 stems and all layer 4 stems using Count Conifer procedures as per standard even-aged survey procedures.
- Recording the Basal Area of Layer 1 trees is optional, but recommended, and dependent on the requirements of the approved prescription (SP or FSP) for the opening, however, required as of 2016, if the average BA for the SU is $> 5 \text{ m}^2 / \text{ha}$ it must be reported with inventory attributes as required by [*Submitting Forest Cover to RESULTS for Openings with Treed Retention.*](#)
- Choose Well-spaced (WS) and /or Free Growing (FG) trees with preference given to the most vigorous preferred and acceptable species that can contribute towards the merchantable volume at the time of the next harvest. Layer 1 stems are only selected over stems in lower layers if they are the best candidate to contribute to the next rotation. This is considering all layers at once and not using the nesting procedure used in the multi-storied survey procedure section. The M value, based on the even-aged target stocking standard, is used to cap total plot tallies, considering the well-spaced or free growing trees, regardless of layer. The goal is to maximize the WS and FG trees within the plot. Therefore all layers are considered by using the following criteria:
 - Layer 1 WS/FG trees are acceptable if damage meets or exceeds the free growing damage criteria for even-aged conifer trees – the MITD will be 0 m. for Layer 1 trees or whatever other MITD is prescribed.

- Layers 2, 3 and 4 WS / FG trees are acceptable if damage meets or exceeds the SEDRSS free growing damage criteria in Section 9.2.4.2

Rationale: These SEDRSS Damage Criteria were specifically designed to address even-aged stands with dispersed overstorey retention, that may or may not contribute to stocking for the next full rotation – the criteria are separated by layer 1 stems (not by BA for Layered Surveys – for this method uses a fixed radius plot) and layer 2, 3 and 4 stems being grouped into separate criteria. It was the result of a complete review process of all stakeholders and is a true blend of the even-aged and multi-layered damage criteria, considering layers and length of retention of overstorey stems.

-MITD will be the drip-line (or 2.0 m whichever is the most) between:

- 1) all Layer 1 trees and all lower Layer 2 trees, and;
- 2) all Layer 3 and 4 trees that are shade intolerant (suggested guidance as per [Klinka K.J. - Silvical Characteristics of Tree Species of BC](#)).

-MITD will be 2.0 m (or as prescribed in a SP or FSP) between:

- 1) all Layer 1 trees and all Layer 3 and 4 trees that are highly shade tolerant (suggested guidance as per [Klinka K.J. - Silvical Characteristics of Tree Species of BC](#)), and;
- 2) all Layer 2, 3 and 4 trees.

Data Summarization and Label Generation

- Inventory Layer – This is recorded by layer at every 1st and 4th plot per strata (as per even-aged survey), is usually summarized either by each layer or, in some cases, by amalgamation into one over-storey and one under-storey layer. Guidance to the surveyor for this decision should be founded in the approved prescription.
- WS and FG Obligation Stocking Standard Determination – The WS and FG stems per ha will be tallied and a mean calculated as per the standard procedures for even-aged surveys and confidence limits determined using the same statistical analysis. The prime difference will be the compilation of all WS by Layer together to produce a mean WS and/or FG per ha. Nesting used in multi-storied surveys will not be used.
- Silviculture Label – This will be derived from the WS and FG calculations above. The best management practice is to report the Silviculture Label by each layer into RESULTS. However, in some cases, it is also acceptable to report the Silviculture label as an over-storey and under-storey label.

Note: FFT surveys may have different standards.

9.2.3 Deviation from Potential Survey-Interior DFP Method

DFP (deviation from potential) is an approach to regeneration stocking assessment in partially cut stands in the BC interior. It is an alternative survey method to the layered survey system, and is especially relevant to stands with substantial variation in the size and spatial arrangement of live trees retained after harvest with **an even aged management regime**. DFP is not a stocking standard, but rather a survey methodology that can be used with stocking standards that have been approved in a Forest Stewardship Plan (FSP) or Silviculture Prescription, or accepted as district approved default stocking standards given the stand suitability criteria defined in [Sec. 9.2.3.1](#). Use of DFP as a survey methodology would only be applicable in specific situations such as:

- The harvesting of a Standards Unit with an even aged management regime has resulted in partial cutting due to:
 1. management of forest health issues; or
 2. retention of crop trees is required to achieve a result or strategy in the FSP to address a land use order objective.
- Previously disturbed or salvaged areas lacking full prescriptions (i.e. post-wildfire rehabilitation) or;
- Areas with moderate or high retention of live residual stems for non- timber objectives.

This survey approach is designed to deal with high levels of stocking diversity, particularly with respect to the density, size and distribution of retained stems within a stratum or Standards Unit. An index, or deviation from potential, is derived from the combination of a stem count of small well-spaced healthy crop trees and a basal area measurement of larger stems. This deviation from potential is a measure of site occupancy and is used as the yardstick to determine if stocking objectives have been met. The derived information is also used to assist in the identification of suitable silvicultural treatments where required. This system was developed with MPB salvage assessments in mind. Surveyors should check with prescriptions and survey administrators to determine if this assessment procedure is an acceptable option in their respective contract.

A complete background of the Deviation from Potential concept can be found in [Section 9.2.4.3.1](#). As well, the website [Stocking in Partial Cut Stands](#) provides further information.

9.2.3.1 Interior DFP Methodology Suitability

This proposed survey methodology is meant for stands that are to be managed under an even aged regime – a *hybrid type of Silvicultural System* - defined as a partial cut harvest entry where retained overstorey stems contribute towards a regen and free growing obligation. Crop tree suitability in the retained overstorey, and associated stocking standards are enabled through an approved FSP, Silviculture Prescription, or district specific stocking standard defaults. Please confirm with the contract administrator if stand conditions and circumstances are appropriate for the use of DFP as a survey methodology.

Interior DFP Suitable Stand Criteria:

1. **Dispersed Retention Residual Basal Area (RBA) ranging from 5 to 19 m²/ha** (Note this range is an interim guideline and is subject to revision for specific situations) and,
2. **Stands that meet the specific Situations and Circumstances**

Interior DFP is not intended for a broad application across managed landscapes but rather is intended to be a tool to address specific management concerns within a local management unit.

Stratification Criteria for Stands Unsuitable for Interior DFP:

1. **Areas ≥ 1.0 ha with < 5m²/ha of Dispersed Retention (1)** (*Open stands, clearcuts or stands with low levels of dispersed retention*): Remove as a separate stratum, and survey conventionally with the same even-aged stocking standard;
2. **Areas ≥ 1.0 ha with ≥ 20 m²/ha of Dispersed Retention** (*full stocking of ecologically suitable species with no openings > 0.1 ha in size*): Defined as an **Intermediate cut** (with no regeneration obligations) requiring a separate stocking standard;
3. **Areas ≥ 0.25 ha Uncut**: (*large areas of reserved stems where no harvested or disturbance has occurred*): Remove from SU and map as a **Grouped Retention** SU, classify as **Group Reserve**, removed from NAR and report in RESULTS;
4. **Areas ≥ 1.0 ha Broadleaf leading**: Interior DFP is designed for conifer management only.

- (1) **Note:** That all stands that have > 5 m² of Dispersed Retention, including Interior DFP suitable stands of between 5 and 19 m², require that the overstorey retention inventory labels be reported appropriately into RESULTS as per the document: [Submitting Forest Cover to RESULTS for Openings with Treed Retention.](#)

9.2.3.1.1 Situations and Circumstances for Interior DFP Surveys

The Forest Stewardship Plan (FSP) **must** specify the situations and circumstances where the DFP survey methodology will be applied. The stocking standards approved in a Forest Stewardship Plan (FSP) or Silviculture Prescription, or accepted as district approved

default stocking standards provide the linkage from stand level to forest level management. This type of survey methodology is generally **only applicable** where retention of dispersed stems is required to achieve non-timber FRPA management objectives.

9.2.3.2 Sampling Plot Intensity and Survey Design

Although a statistical analysis is not required to address potential stocking variability in DFP suitable stands, rigorous plot intensity is recommended.

The DFP survey methodology can be used to survey a separate stratum within a Standards Unit, or the entire SU, given the DFP suitability criteria is met for these areas. **The best management practice for sampling intensity is determined by the size of the stratum or Standards Unit as follows:**

- < 5 hectares: a minimum of 5 plots must be established;
- 5 to 20 hectares: one plot per hectare must be established;
- > 20 hectares: one plot per hectare for the first 20 hectare and then 1 plot per 2 hectares for the remaining area.

The recommended fixed radius plot sizes and prism sizes (for layer 1) are as follows:

- **Plot Size:** To tally understorey stems use a 3.99 m or 5.64 m (larger mature stems retained) radius plot for the entire stratum or Standards Unit;
- **Prism size:** Choose a prism that captures approximately 4-8 trees per plot and does not capture trees more than 12 m from plot center (BAF 2-5 prisms are reasonable).

9.2.3.3 Interior DFP Survey Sampling Procedures

This approach uses the DFP table (developed for the interior by Martin 2005) solely as the basis for the stocking decision. The resultant DFP derived from the Dispersed Retention BA and present understorey stocking levels at each plot produces an averaged DFP value for the stratum or SU, which must meet the obligation standards in **Table 10aa: Interior DFP Regen and FG Obligation Criteria** below. In addition, two other thresholds must be met by the stratum or SU in order to achieve the obligation (a threshold percent of the plots in each stocking class of the DFP table must be met - refer to Table 10aa below).

Field Survey

- **Measurements:** Determine the Dispersed Retention BA per plot and assess regen stocking using criteria for WS stems from the stocking standard. Use the acceptable **overstorey crop trees BA only**, and tally non crop BA separately. The non-crop

tally may be used to identify the need for additional harvesting if non crop trees are found to be fully occupying the site. In some cases the stand may have been dominated by trees of non-crop status and this should be identified prior to assessment to address what should be tallied.

- **Data Collection procedures (using the modified FS 658 survey card):**
 - Set up the card similar as one would while collecting data for an even aged or a layered even-aged survey with two rows (i.e. one row for each layer 1 and then another row for understorey /regen – layers 2, 3 and 4 combined)
- **Tally of Residual Overstorey Layer 1**
 1. Start with fixed radius plot tallies for **Residual Layer 1** in the first row:
 - a. **Layer 1** = all stems ≥ 12.5 cm DBH
 - b. TT and TC;
 - c. **Number of Crop stems by species** (crop stems are preferred, acceptable, or commercially valuable conifer species-all crop stems are recorded, for there is no MITD)
 - d. in GI column record **Total # of L1's** in prism sweep regardless if crop or non-crop stem;
 - e. in the plantable/in column record **Crop # of L1's** in prism sweep;
 - f. in the preparable column record **Crop BA** (crop # in prism sweep x BAF). **This is the BA value to be used in the left column of the DFP table.**
 2. Record Tree Cover Pattern during the full survey data collection.
Estimate the overall Tree Cover Pattern for the stratum or SU being surveyed, based on the diagram in Section 9.3.4.1 of the Silviculture Survey Manual. Write the corresponding Tree Cover Pattern number in the comments section of the FS 658.
- **Tally of Regeneration Understorey Layers 2, 3 and 4 in fixed radius plot**
 1. Tally and combine the remaining **Regeneration Layers 2, 3 and 4** in a separate row below Layer 1's row (no nesting of Layers, but use 2.0 m MITD or 'dripline', whichever is greater, from ***ALL Layer 1 stems regardless if Crop or Non-Crop trees are inside or outside of the plot (influence layer 1 trees are considered)*** – and use MITD from the FSP for all other trees between Layers 2, 3 and 4):
 - a. TT and TC for each regeneration layer;
 - b. **Number of WS stems by species** in the preferred and acceptable species columns relative to MITD criteria;
 - c. In the total W column total **all WS for all species (use M-value);**
 - d. In the total FG column total **all FG for all species (use M-value);**

- e. Record the DFP for that plot using the DFP table below (a copy of this table is required to be included in the surveyors note book or loaded into their handheld program).
- 2. Tally **Plantable Spots, Preparable Spots and Competing Vegetation** as regular surveys for the combined Regeneration Layer row and tally **Forest Health Agents** as they apply specifically to layers described in the *Free Growing Damage Criteria for Single Entry Dispersed Retention Stocking Standards (SEDRSS) Managed Stands in Coastal B.C. and for Interior DFP and Layered Surveys*);
 - **Record Inventory Label Data**
 - An **Inventory Label** is recorded every 1st and 4th plot as regular surveys for each layer. This can be located at the bottom of the FS 658 comprised of a line per layer 1 and a line for the combined regen layer.
 - The best way to estimate **Site Index** for Interior DFP stands is to use the SIBEC methodology – accessible from the following [SIBEC website](#). Specifically the 1st approximation SIBEC (if available for the site series) would be best used for the Layer 1 overstorey SI and the 2nd approximation SIBEC for the other Layers in the understorey labels.

NOTE: The 1st approximation SIBEC Site Indexes are identifiable by the listing of WHOLE numbers with no decimal places and no Standard Error (SE) value in the SIBEC Table for the species and sites series referenced. In contrast, the 2nd approximation SIBEC Site Indexes are identifiable by the listing of FRACTIONS with decimal places and SE values in the SIBEC Table for the species and sites series referenced.

Data Summary

The field survey results are tallied and the following thresholds are calculated:

1. **The average DFP value** from all individual plots.
2. **The percent of the total plots established per stocking class** from the plot data and a value generated for each class – stocked; partial stocked; and open.
3. **Inventory and Silviculture Labels** will be generated individually for **Layer 1** and all other regen layers – **Layer 2, 3, and 4, will be combined and reported into the most appropriate layer.** The Inventory Label will be generated from the data collected in the field every 1st and 4th plot for total species %, crown closure and from the mean TT summary for all layers. The Silviculture Label will be generated from the tally totals for WS and FG values and species percentages.

Stocking Decision for Interior DFP:

The stratum or Standards Unit is found to have met its **Regen Obligation or Free Growing Obligation** if the following table's criteria have been met.

Table 10aa: Interior DFP Regen and FG Obligation Criteria

DFP Threshold Value	Obligation Standard: Interior DFP
Average DFP	0.20 or less
Proportion of plots in “open” class (shaded red on DFP table)	≤ 20%
Proportion of plots in “stocked” class (shaded green on DFP table)	≥ 60%

Table 10a: Interior DFP-Overstorey Basal Area and WS/FG stems per plot.

(Note: Red cells: “open”, yellow: “partially stocked”, and green: “stocked” categories).

BA of Crop* Overstorey trees ≥ 12.5 cm dbh	Understorey - well-spaced or free growing stems per plot								
	0	1	2	3	4	5	6	7	8
0	1.00	0.76	0.52	0.34	0.22	0.13	0.07	0.03	0.00
1	0.98	0.74	0.51	0.34	0.21	0.13	0.07	0.03	0.00
2	0.96	0.73	0.50	0.33	0.21	0.13	0.07	0.03	0.00
3	0.93	0.71	0.49	0.32	0.20	0.12	0.07	0.03	0.00
4	0.90	0.68	0.47	0.31	0.20	0.12	0.06	0.03	0.00
5	0.86	0.65	0.45	0.30	0.19	0.11	0.06	0.02	0.00
6	0.82	0.62	0.43	0.28	0.18	0.11	0.06	0.02	0.00
7	0.77	0.58	0.40	0.27	0.17	0.10	0.05	0.02	0.00
8	0.72	0.55	0.38	0.25	0.16	0.09	0.05	0.02	0.00
9	0.67	0.51	0.35	0.23	0.15	0.09	0.05	0.02	0.00
10	0.62	0.47	0.32	0.21	0.14	0.08	0.04	0.02	0.00
11	0.57	0.43	0.30	0.20	0.12	0.07	0.04	0.02	0.00
12	0.52	0.39	0.27	0.18	0.11	0.07	0.04	0.01	0.00
13	0.47	0.35	0.24	0.16	0.10	0.06	0.03	0.01	0.00
14	0.42	0.32	0.22	0.15	0.09	0.05	0.03	0.01	0.00
15	0.38	0.28	0.20	0.13	0.08	0.05	0.03	0.01	0.00
16	0.33	0.25	0.17	0.11	0.07	0.04	0.02	0.01	0.00
17	0.29	0.22	0.15	0.10	0.06	0.04	0.02	0.01	0.00
18	0.26	0.19	0.13	0.09	0.06	0.03	0.02	0.01	0.00

19	0.22	0.17	0.12	0.08	0.05	0.03	0.02	0.01	0.00
20	0.19	0.14	0.10	0.07	0.04	0.02	0.01	0.01	0.00
21	0.16	0.12	0.08	0.06	0.04	0.02	0.01	0.00	0.00
22	0.13	0.10	0.07	0.05	0.03	0.02	0.01	0.00	0.00
23	0.11	0.08	0.06	0.04	0.02	0.01	0.01	0.00	0.00
24	0.09	0.07	0.05	0.03	0.02	0.01	0.01	0.00	0.00
25	0.07	0.05	0.04	0.02	0.02	0.01	0.00	0.00	0.00
26	0.05	0.04	0.03	0.02	0.01	0.01	0.00	0.00	0.00
27	0.04	0.03	0.02	0.01	0.01	0.00	0.00	0.00	0.00
28	0.02	0.02	0.01	0.01	0.01	0.00	0.00	0.00	0.00
29	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00
30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Footnote to Table 10a:

***Basal Area of Crop Overstorey:** to be considered eligible as contributing BA in the first column of the DFP table above, L1's must meet any combination of the following:

- Preferred or acceptable species in the applicable stocking standards, in addition to any other commercially valuable conifer species, all of which meet the *Free Growing Damage Criteria for Single Entry Dispersed Retention Stocking Standards (SEDRSS) Managed Stands in Coastal B.C. and for Interior DFP and Layered Surveys*;
- Any mature tree specifically reserved to address a result or strategy in the FSP (*i.e. planned retention to meet visual quality objectives, cultural heritage objectives, or other non-timber objectives*).

9.2.3.4 RESULTS Data Entry

The [RESULTS Information Submission Specifications](#) document has a recent supplement document (dated July 28, 2010) called - *Procedures for Submitting Forest Cover to RESULTS for Openings with Treed Retention*. This document clearly provides the content requirements for reporting SUs with Dispersed and Grouped Tree Retention.

Basically, the reporting of Polygon, Inventory and Silviculture components are the same as reporting an even-aged clear cut stand with < 5m² of retained BA, **except** for the following additional information:

Polygon Component

- Reserve Type: Enter **Dispersed**.

- b. Reserve Objective: Enter **TIM** (for timber objective, for the retained stems are contributing to the stocking and the next harvest).
- c. Tree Cover Pattern: Enter the **Tree Cover Pattern Number** for the pattern observed and recorded on the field card that best represented the pattern of the layer 1 residuals.

2. Inventory Component

- a. Layers: Report individually for layer 1, and report the combined values for all other regen layers – layer 2, 3, and 4, as explained in the data summary section above.
- b. Basal Area: Enter the **Total BA m²/ha** value including crop (preferred, acceptable, commercially valuable stems) and non-crop stems for the Residual Layer – *but not just the crop BA*.

3. Silviculture Component

- a. Layers: As for the Inventory Component, report individually for layer 1 and report the combined values for all other regen layers – layer 2, 3, and 4, as explained in the data summary section above.
- b. Well-spaced or Free Growing: Enter the mean WS or FG/ha value from the summary data (whichever is being reported).
- c. Free Growing: Enter the mean FG /ha value from the summary data.
- d. Basal Area: enter the **Crop BA m²/ha** value including preferred, acceptable, and commercially valuable stems for the Residual Layer – *not the total BA as for the Inventory Label*.

4. Add Comments regarding Interior DFP use

- a. In the comments field next to a milestone declaration, include a comment on the Interior DFP methodology used. Include the mean DFP value and the % stocking classes.

9.2.4 Single Entry Dispersed Retention (SEDRSS) Survey 2014

Recently, partial cutting approaches have been more widely used on the B.C. Coast. In most cases, where a partial cut system has been applied it has been incorrectly described as a Single Tree Selection Silvicultural System and subsequently used the Multi-storey Survey methodology, which assumes multiple harvest entries. The following sections represent an alternative approach to assessing single entry Coastal partial cutting and are direct excerpts from an Implementation Guide Paper - **Single Entry Dispersed Retention Stocking Standard – Feb. 14, 2014** – originally presented to the Coastal Region FRPA Implementation Team (CRIT) from the Coastal Silviculture Working Group.

9.2.4.1 Single Entry Dispersed Retention System Suitability

This proposed stocking standard framework is meant for stands managed with a Single Entry Dispersed Retention – *hybrid type of Silvicultural System* - defined as a partial cut harvest entry where retained overstorey stems contribute towards a regen and free growing obligation. This stocking standard is meant to replace the multi-storied stocking standard, referenced in the Ministry of Forests, Lands, Natural Resource Operations and Rural Development publication titled: Reference Guide to Forest Development Plan Stocking Standards. It is therefore assumed that future stand entries are not required to meet prescribed long term stand structural objectives. The intent of this standard and subsequent survey methodologies **are for guidance purposes and represent suggested best management practices**. The CRIT silviculture working group would like to highlight for forest professionals that the DFP tables within this SEDRSS methodology have been calibrated only for old growth Coastal Hemlock / Cedar stands. When applying the proposed methodology to other stand types, new tables will need to be developed and calibrated for these new conditions. We suggest that the proposed survey methodology may be used in all circumstances when coupled with the appropriate stand specific stocking tables.

SEDRSS Suitable Stand Criteria:

1. **Dispersed Retention Residual Basal Area (RBA) ranging from 9 to 39 m²/ha** (Note this range is an interim guideline and is subject to revision for specific situations) and,
2. **Stands that meet the specific Situations and Circumstances - Section 2.0 below** (SEDRSS is not intended for a broad application across managed landscapes but rather is intended to be a tool to address specific management concerns within a local management unit)

Stratification Criteria for Stands Unsuitable for SEDRSS:

1. Areas ≥ 1.0 ha. with $\leq 8\text{m}^2/\text{ha}$ of Dispersed Retention (1) (*Open stands, clearcuts or stands with low levels of dispersed retention*): Remove from the SU and treat with an Even-aged Stocking Standard;
2. Areas ≥ 1.0 ha with $\geq 40\text{m}^2/\text{ha}$ of Dispersed Retention (*full stocking of ecologically suitable species with no openings > 0.1 ha. in size*): Defined as an **Intermediate cut** (with no regeneration obligations) requiring a separate stocking standard;
3. Areas ≥ 0.25 ha Uncut: (*large areas of reserved stems where no harvested or disturbance has occurred*): Remove from SU and map as a **Grouped Retention** SU, classify as **Group Reserve**, removed from NAR and report in RESULTS;
4. Areas ≥ 1.0 ha. Broadleaf leading: SEDRSS is designed for conifer management only.

- (1) **Note:** That all stands that have $> 5\text{m}^2$ of Dispersed Retention, including SEDRSS suitable stands of between 8 and 39m^2 , require that the overstorey retention inventory labels be reported appropriately into RESULTS as per the document: [Submitting Forest Cover to RESULTS for Openings with Treed Retention.](#)

9.2.4.1.1 Situations and Circumstances for SEDRSS

The stocking standard provides the linkage from stand level to forest level management. This type of standard is generally **only applicable** where retention of dispersed stems is required to achieve non- timber FRPA management objectives. The Forest Stewardship Plan (FSP) **must** specify the situations and circumstances where the stocking standard will be applied.

Complexes

SEDRSS is best applied to only one site series - meaning the dominant site series for an SU- For example: An SU for an 01₈ 12₂ complex should just have the 01 site series standards applied, and not a 01/12 blend of the TSS and MSS threshold values. The SEDRSS standard is best applied to the dominate site series as long as the appropriate stratification practices are used (i.e. 1 ha. contiguous areas of minor 12 site series are not lumped in with 01 site series areas).

Low Productivity Sites

SEDRSS is not applicable for site series that would not be capable of achieving a closed canopy stand – like very poor sites of low productivity where the TSS for even-aged is 400 sph or less (e.g. CWHvh1 12 or 02 sites series). The rationale is that these sites have very low stocking standards already and the application of the DFP concept is unworkable once the BA increases in the SEDRSS tables. It is recommended provincially that where possible harvesting or even partial harvesting with retention should be avoided on these sites. Most likely these sites will represent minor inclusions within a stratum

within a dominant site series and areas greater than 1 ha of these sites series where SEDRSS will be applied will likely be very small.

9.2.4.1.2 SEDRSS Regen and Free Growing Obligation Criteria

The following table matrix identifies the application of each obligation criteria relative to the SEDRSS standard (for both SEDRSS methodology options):

Layer	COMMON Criteria (REGEN & FG)			REGEN Criteria	FREE GROWING (FG) Criteria			
	Spp ⁽¹⁾	MITD	BA & Density (SEDRSS Tabular only)	REGEN Delay (Max Years)	FG Declaration (Min Yrs)	Comp. Brush Factor ⁽⁴⁾	Min Ht ⁽⁵⁾	Damage Criteria
Residual Overstorey Layer 1 ≥ 12.5cm DBH	As per FSP or SEDRSS Tabular	0 meters	BA as per SEDRSS Tabular	As per FSP or SEDRSS Tabular	2 ⁽³⁾	N/A	N/A	As per SEDRSS Damage Criteria for Layer 1
Understorey (Advanced or Artificially Established) Layers 2, 3 & 4 < 12.5cm DBH	As per FSP or SEDRSS Tabular	From Layer 1: Dripline ⁽²⁾ Between Layers 2, 3 & 4: 2.0 meters or as per FSP	Minimum Stocking as per SEDRSS Tabular			As per FSP	As per FSP or SEDRSS Tabular	As per SEDRSS Damage Criteria for Layers 2, 3 & 4

Footnotes:

- 1) Preferred and Acceptable species by site series. Option 1): As identified in the MFR publication titled: *Reference Guide to FDP Stocking Standards*. Option 2): Individual FSP authors may prefer to use the guidance in the above mentioned document as a good starting point for identifying one list of ecologically suitable species, and a species composition range for retained layer 1 trees that are based on the pre-harvest conditions. New emerging information, especially as it relates to shade tolerance, contained within published literature, research or data regarding species acceptability will aid FSP authors with this option.
- 2) The Dripline is defined as “the vertical boundary of the outside of the outer live foliage of the overstorey tree”. An understorey tree is considered outside the Dripline if “the main stem pith of the understorey stem is outside of the

Dripline as defined above”. Overstorey stems (regardless if counted as a crop tree) inside and *outside* of survey plots are used to determine the Dripline.

- 3) Declaration of the Free Growing Obligation is recommended to be two years or greater after the completion of harvest. Although the date specified under *Forest Planning and Practices Regulation* (FPPR) 44 (1) (b) for which a person who has an obligation to establish a free growing stand must meet the applicable stocking standards and free growing criteria is no more than 20 years from the commencement date, for SEDRSS after two years the stand could be considered having met the Free Growing Criteria if the overstorey trees and understorey of advanced regeneration meet the minimum criteria set out in the standard. This is considered as sufficient time for wind throw to be expressed in the residual stand. However, two years post-harvest will often be insufficient to allow for expression of added growth or release.
- 4) As required by legislation, a free growing stand must not be impeded by competing plants, shrubs or other trees.
- 5) Acceptable guidance is to list the minimum heights as 75% of the heights listed in the MFR publication titled: *Reference Guide to FDP Stocking Standards* for each species on a given site series unless certified under FPPR 22.1. There may be situations where this reduced minimum height has not been achieved, but the understorey stems meet all other criteria. In this situation a forest professional can use *Forest Planning and Practices Regulation* (FPPR) section 97.1 to indicate the obligation has been met and provide a rationale that indicates the crop trees are well established, free from vegetative competition and are not expected to be impacted by a forest health agent.

9.2.4.2 SEDRSS, Interior DFP and Layered Surveys Damage Criteria

All stems considered to be crop trees in SEDRSS, Interior DFP, and Layered Surveys methodologies, must meet or exceed the following damage criteria for both Layer 1 stems and Layers 2, 3, and 4 stems (separate damage criteria tables have been developed for each stand structure component).

FINAL

Updated May 1, 2018

FG DAMAGE CRITERIA FOR SINGLE ENTRY DISPERSED RETENTION STOCKING STANDARD (SEDRSS) MANAGED STANDS IN COASTAL B.C.

and for INTERIOR DFP and Layered Surveys

Note: this table overrides all other damage criteria for SEDRSS managed stands**TABLE A- Layer 1 - ≥ 12.5 cm DBH. SEDRSS and Interior DFP damage criteria**

Location of Damage	Type of Damage	Tree being assessed is UNACCEPTABLE if:		Possible damage agents & codes	Comments
		Hw, Ba, Bg, Bl, Cy, Fd, Ss, Pw, Pl, Lw, Sx, Py	Cw		
Stem	Wound	<ul style="list-style-type: none"> Wound girdles $>33\%$ stem circumference, or One wound $>400 \text{ cm}^2$ on stem, or Wound on major root within 1 m of stem, or Tree has gouge in stem. 	<ul style="list-style-type: none"> No criteria 	fire NB, windthrow NW, sunscald NZ, logging TL, mechanical TT.	A wound is defined as an injury in which the cambium is dead (e.g., sunscald) or completely removed from the tree exposing the sapwood. Measure the wound across the widest point of the exposed sapwood (or dead cambium when the tree is damaged by sunscald). Healed over wounds (=scars) are acceptable.
Stem	Decay	<ul style="list-style-type: none"> Any pathological indicator(s) are present. This may include conk, blind conk, frost crack, or rotten branches. 	<ul style="list-style-type: none"> No criteria 	various decay fungi DD.	
Stem	Bark Mining	<ul style="list-style-type: none"> Any of the following signs are visible: pitch tubes, boring dust, exit holes on bark surface, galleries under the bark. 	<ul style="list-style-type: none"> No criteria 	Douglas-fir beetle IBD, Ips pini IBI, Pityogenes & Pityophthorus IBP	<p>Note: pitch tubes can be associated with trees that have successfully repelled bark beetles, bark must be removed above pitch tube to confirm successful attack (successful galleries will be filled with frass and not pitch, contain adult beetles and/or larval galleries).</p> <p>Stressed trees are susceptible to secondary bark and twig beetles.</p>
Stem	Deformation (including crook, fork and dead or broken top)	<ul style="list-style-type: none"> A crook displaces the portion of the stem above the defect by $>50\%$ from the line of growth formed by the stem below the point of defect in the bottom 2/3rds of the stem only. A fork occurs above stump height in the bottom 2/3rds of the stem only. A dead or broken top extends more than 20% of the stem length or the live crown is removed. 	<ul style="list-style-type: none"> No criteria A dead tree with no live foliage the stem is unable to produce $> 50\%$ merchantable volume. 	frost NG, hail NH, snow NY, drought ND, logging TL, mechanical TT, dwarf mistletoes (see below).	<p>Cw: Unacceptable as a contributing Crop Tree if assessed as unable to produce $> 50\%$ Merchantable Volume in the first 10 m. log length – defined as either: 1. <u>Utility Grade</u> – At least a solid 8 inch shell – Shake and Shingle and /or 2. <u>Higher Grade</u> – Complete solid wood – Saw Logs</p> <p>Note: Field guidance procedures and photo examples for the estimation of merchantable Cw volume are identified in Appendix BB.</p>

Location of Damage	Type of Damage	Tree being assessed is UNACCEPTABLE if:		Possible damage agents & codes	Comments
		Hw, Ba, Bg, Bl, Cy, Fd, Ss, Pw, Pl, Lw, Sx, Py	Cw		
Stem	Dwarf Mistletoe Infection	<ul style="list-style-type: none"> Hawksworth rating >3, or severe stem infections (major swelling or deformity) present. 	<ul style="list-style-type: none"> No criteria 	hemlock dwarf mistletoe DMH; lodgepole pine dwarf mistletoe DMP; Douglas-fir dwarf mistletoe DMF; Larch dwarf mistletoe DML;	The Hawksworth rating system is described in the FPC <i>Dwarf Mistletoe Management Guidebook</i> (or refer to Appendix AA of this document) For DFP and SEDRSS, this rating system will only apply to the tree/plot assessment level, and not at the stand level.
Foliage	Defoliation	<p>For defoliating insects:</p> <ul style="list-style-type: none"> > 80% of foliage has been removed, lost or damaged due to insect defoliation. <p>For foliar diseases:</p> <ul style="list-style-type: none"> > 50% of foliage has been removed, lost or damaged 	<ul style="list-style-type: none"> No criteria 	defoliators ID, foliage diseases DF	
Foliage	Live Crown Vigour	<ul style="list-style-type: none"> Stems < 17.5 cm dbh - < 30% live crown due to poor vigour. Stems ≥ 17.5 cm dbh - < 20% live crown due to poor vigour. 	<ul style="list-style-type: none"> A dead tree with no live foliage 		Percent live crown is the length of continuous green foliage on a tree expressed as a percentage of its total height.

Location of Damage	Type of Damage	Tree being assessed is UNACCEPTABLE if:			Possible damage agents & codes	Comments	
		Hw, Ba, Bg, Bl, Cy, Fd, Ss, Pw, Pl, Lw, Sx, Py	Cw				
Roots	Root Disease	<ul style="list-style-type: none">Sign(s) or definitive combinations of symptoms of root disease are observed	<ul style="list-style-type: none">For Cw, there is no criterion for net down calculation - considered not susceptible or low susceptibility.		armillaria root disease DRA, laminated root rot DRL, annosus root disease DRN.	Signs are direct evidence of the pathogenic fungus including fruiting bodies, distinctive mycelium or rhizomorphs. Symptoms include foliar thinning or chlorosis, pronounced resin flow near the root collar, reduced recent leader growth, a distress cone crop, and wood decay or stain. Symptoms alone are not usually sufficient to identify root disease. Both signs and symptoms may be detected from old stumps, root balls, or other post-harvest remains.	
		<ul style="list-style-type: none">Infected conifer or stump found in plot. See Table Y for well-spaced tree net down calculation by layer.					
		TABLE Y. Deductions from numbers of acceptable well-spaced uninfected stems for trees infected by root disease in layered stands.			Example: How to apply net down for root disease. If root disease-infected trees are found in the plot: 1. Determine the number of healthy, well-spaced trees in each layer using the prescribed minimum inter-tree distance (MITD) (e. g., 3 layer 1, 3 layer 3 and 4 layer 4 = 10 healthy, well-spaced) ignoring the M-value; 2. Count the number of infected trees (e. g., 1 layer 1 tree and 1 layer 3 tree); 3. Working from the uppermost layer down, apply the multiplier in Table Y to each lower layer. Subtract the resultant from each layer in turn, for susceptible species only (e. g., if all trees are susceptible, 1 infected layer 1 tree removes 1 healthy, well-spaced layer 1 tree plus 3 layer 3 trees plus 4 layer 4 trees). Note the effects are cumulative, not exclusive and lower layers do not affect higher layers; Calculate the remaining healthy, well-spaced trees once all removals due to infected trees are completed (e. g. 10 – 8 = 2). The result is the maximum number of free growing trees tallied for the plot.		
Tree layer with infected tree(s) or stumps	Multiplier used to determine number of acceptable trees to be deducted from:						
	Layer 1	Layer 2	Layer 3	Layer 4			
Layer 1	Deduct BA of infected layer 1 from Crop BA	2	3	4			
Layer 2		2	2	3			
Layer 3			2	2			
Layer 4				2			

TABLE B- Layers 2, 3 & 4 - < 12.5 cm DBH. SEDRSS and Interior DFP damage criteria

Location of Damage	Type of Damage	Tree being assessed is UNACCEPTABLE if:	Host Species	Possible damage agents & codes	Comments
Stem	Wound	<ul style="list-style-type: none"> Wound girdles >25% stem circumference, or One wound >10% the length of stem 	All	fire NB, windthrow NW, sunscald NZ, logging TL, mechanical TT.	A wound is defined as an injury in which the cambium is dead (e.g., sunscald) or completely removed from the tree exposing the sapwood. Measure the wound across the widest point of the exposed sapwood (or dead cambium when the tree is damaged by sunscald). Healed over wounds (=scars) are acceptable.
Stem	Decay	<ul style="list-style-type: none"> Any pathological indicator(s) are present. This may include conk, blind conk, frost crack, or rotten branches. 	All	various decay fungi DD.	
Stem	Bark Mining	<ul style="list-style-type: none"> Any of the following signs are visible: pitch tubes, boring dust, exit holes on bark surface, galleries under the bark. 	All	Douglas-fir beetle IBD, Ips pini IBI, Pityogenes & Pityophthorus IBP	<p>Note: pitch tubes can be associated with trees that have successfully repelled bark beetles, bark must be removed above pitch tube to confirm successful attack (successful galleries will be filled with frass and not pitch, contain adult beetles and/or larval galleries).</p> <p>Stressed trees are susceptible to secondary bark and twig beetles.</p>
Stem	Deformation (including crook, fork and dead or broken top)	<ul style="list-style-type: none"> The pith is horizontally displaced more than 30 cm from the point of defect and originates above 30 cm from the point of germination 	All	defoliators ID, white pine (spruce) weevil IWS, lodgepole pine terminal weevil IWP, cattle AC, deer AD, elk AE, moose AM, frost NG, hail NH, snow NY, drought ND, logging TL, mechanical TT, Dwarf mistletoes (see below).	
		<ul style="list-style-type: none"> The tree leader has been killed three or more times in the last 5 years (weevil only) 	Ss, Sx		This criterion applies only for terminal weevil damage.
		<ul style="list-style-type: none"> The tree has two or more leaders with no dominance expressed after five years growth and the fork originates above 30 cm from the point of germination. The tree has a dead or broken top at a point that is > 3cm in diameter. The tree has a flat top (umbrella like) form and no distinct leader. 	All		Leader dominance occurs when the tallest leader is at least 5 cm taller than the second tallest leader. See Appendix AA on Damage Types.
Stem	Lean and Sweep	<ul style="list-style-type: none"> The tree leans >30° from the vertical with or without growth correction. 	All	Flooding NF, snow NY, slides NS, wind NW, mechanical TM	

Location of Damage	Type of Damage	Tree being assessed is UNACCEPTABLE if:	Host Species	Possible damage agents & codes	Comments
Stem	Infection (includes cankers and galls)	<ul style="list-style-type: none"> Any infection occurs on the stem. 	All	white pine blister rust DSB, atropellis canker DSA, dwarf mistletoes (see below).	Note: Wounds caused by rodent feeding around rust cankers should have stem rust recorded as the causal agent.
Branch	Infection (cankers)	<ul style="list-style-type: none"> An infection occurs on a live branch less than 60 cm from the stem. 	Pw, Pl, Py	white pine blister rust DSB, comandra blister rust DSC, stalactiform blister rust DSS.	
Branch	Galls	<ul style="list-style-type: none"> A gall rust infection occurs on a live branch less than 5 cm from the stem. 	Pl, Py	western gall rust DSG.	
Foliage	Defoliation	<ul style="list-style-type: none"> >60% tree foliage has been removed by hemlock looper 	Hw	Hemlock looper IDL	
		<ul style="list-style-type: none"> > 80% of foliage has been removed, lost or damaged due to insect defoliation. 	All other	defoliators ID	
		<ul style="list-style-type: none"> > 50% of foliage has been removed, lost or damaged due to foliar disease. 	All	foliage diseases DF	
Foliage	Live Crown Vigour	<ul style="list-style-type: none"> <30% live crown present due to poor vigour. 			Percent live crown is the length of continuous green foliage on a tree expressed as a percentage of its total height.
Stem or Branch	Adelgid Gouting	<ul style="list-style-type: none"> Any adelgid gouting occurs on a stem or branch. 	Ba, Bg, Bl	balsam woolly adelgid IAB.	Gouting is defined as excessive swelling on a branch or shoot caused by balsam woolly adelgid, and is often accompanied by misshapen needles and buds. It is most common on branch tips and at nodes near the ends of branches. Consult a recent distribution map to identify the geographic extent of this pest.
Stem or Branch	Dwarf Mistletoe Infection	<ul style="list-style-type: none"> Any infection occurs on the stem or a live branch, or A susceptible tree is located within 10 m of the bole of a higher layer tree that is infected with dwarf mistletoe. 	Hw, Pl, Fd, Lw	hemlock dwarf mistletoe DMH; lodgepole pine dwarf mistletoe DMP; Douglas-fir dwarf mistletoe DMF; Larch dwarf mistletoe DML	Note: To confirm infection, the surveyor must observe mistletoe aerial shoots or basal cups on regeneration or on live or dead fallen brooms.

Location of Damage	Type of Damage	Tree being assessed is UNACCEPTABLE if:	Host Species	Possible damage agents & codes	Comments
Roots	Root Disease	<ul style="list-style-type: none"> Sign(s) or definitive combinations of symptoms of root disease are observed 	All	armillaria root disease DRA, laminated root rot DRL, annosus root disease DRN.	Signs are direct evidence of the pathogenic fungus including fruiting bodies, distinctive mycelium or rhizomorphs. Symptoms include foliar thinning or chlorosis, pronounced resin flow near the root collar, reduced recent leader growth, a distress cone crop, and wood decay or stain. Symptoms alone are not usually sufficient to identify root disease. Both signs and symptoms may be detected from old stumps, root balls, or other post-harvest remains.
		<ul style="list-style-type: none"> Infected conifer or stump found in plot. See Table Y for well-spaced tree net down calculation by layer. 	All	armillaria root disease DRA.	Example: How to apply net down for root disease. If root disease-infected trees are found in the plot: 4. Determine the number of healthy, well-spaced trees in each layer using the prescribed minimum inter-tree distance (MITD) (e. g., 3 layer 1, 3 layer 3 and 4 layer 4 = 10 healthy, well-spaced) ignoring the M-value; 5. Count the number of infected trees (e. g., 1 layer 1 tree and 1 layer 3 tree); 6. Working from the uppermost layer down, apply the multiplier in Table Y to each lower layer. Subtract the resultant from each layer in turn, for susceptible species only (e. g., if all trees are susceptible, 1 infected layer 1 tree removes 1 healthy, well-spaced layer 1 tree plus 3 layer 3 trees plus 4 layer 4 trees). Note the effects are cumulative, not exclusive and lower layers do not affect higher layers; Calculate the remaining healthy, well-spaced trees once all removals due to infected trees are completed (e. g. $10 - 8 = 2$). The result is the maximum number of free growing trees tallied for the plot.
		<ul style="list-style-type: none"> Infected conifer or stump found in plot. See Table Y for well-spaced tree net down calculation by layer. 	Fd, Ba, Bg	laminated root rot DRL.	Note: Bl, Cw, Pl, Pw, and broadleaf species are considered not susceptible for survey purposes only
		<ul style="list-style-type: none"> Infected conifer or stump found in plot. See Table Y for well-spaced tree net down calculation by layer. 	Ba, Hw, Ss	annosus root rot DRN.	Note: Bg, Bl, Cw, Cy, Fd, Hm, Pl, Pw, and broadleaf species are considered not susceptible for survey purposes only.

Appendix AA Damage Types

23d. Damage types
Crooks (old stems)
A crook is unacceptable if it is displaced more than 30 cm and originates above 30 cm.

Defoliation, general
Defoliation is unacceptable if more than 80% of the needles are removed due to insects or disease.

Defoliation, for determinate growth species, (e.g. true firs, Douglas fir, spruces, pines)
Determine the % live crown.
2. Determine how many of the most recent 4 nodes have >50% of their foliage, express it as a %.
3. Step 1% x Step 2%
- for Dothistroma, in ICH, CWH and SBS
>50% = acceptable
- all other causes and biogeoclimatic zones
>20% = acceptable

a) 70% Live Crown
4/4 Healthy Nodes
70% x 100% = 70%

b) 50% Live Crown
4/4 Healthy Nodes
50% x 100% = 50%

c) 50% Live Crown
2/4 Healthy Nodes
50% x 50% = 25%

d) 50% Live Crown
1/4 Healthy Nodes
50% x 25% = 12.5%

Forks

1 2 3 4 5
5 years since damage occurred
Unacceptable

1 2 3 4 5
5 years since damage occurred
Acceptable

1 2 3 4 5
5 years since damage occurred
Acceptable

1 2 3 4 5
5 years since damage occurred
Acceptable

Wounds
Damage to the cambium or deeper is unacceptable where it is:
- more than one-third the circumference, or
- more than 20% of the height of tree.

l = length of wound
h = total tree height

Gall and Canker
Distance measurement from point of infection by canker or gall to main stem (measured along the branch).

l = length

Instructions		Example
Step 1 Divide live crown into thirds.		
Step 2 Rate each third separately. Each third should be given a rating of 0, 1, or 2 as described below: (0) no visible infections (1) light infection (1/2 or less of total number of branches in the third infected) (2) heavy infection (more than 1/2 total number of branches in the third infected).		<p>If this third has no visible infections, its rating is (0).</p> <p>If this third is lightly infected, its rating is (1).</p> <p>If this third is heavily infected, its rating is (2).</p>
Step 3 Add ratings of thirds to obtain rating for total tree.		The tree in this example gets a rating of: 0 + 1 + 2 = 3.

Figure 4. The Hawksworth six-class dwarf mistletoe rating system.

Appendix BB: SEDRSS Field Guidance Procedures for the Estimation of Cw Merchantable Volume

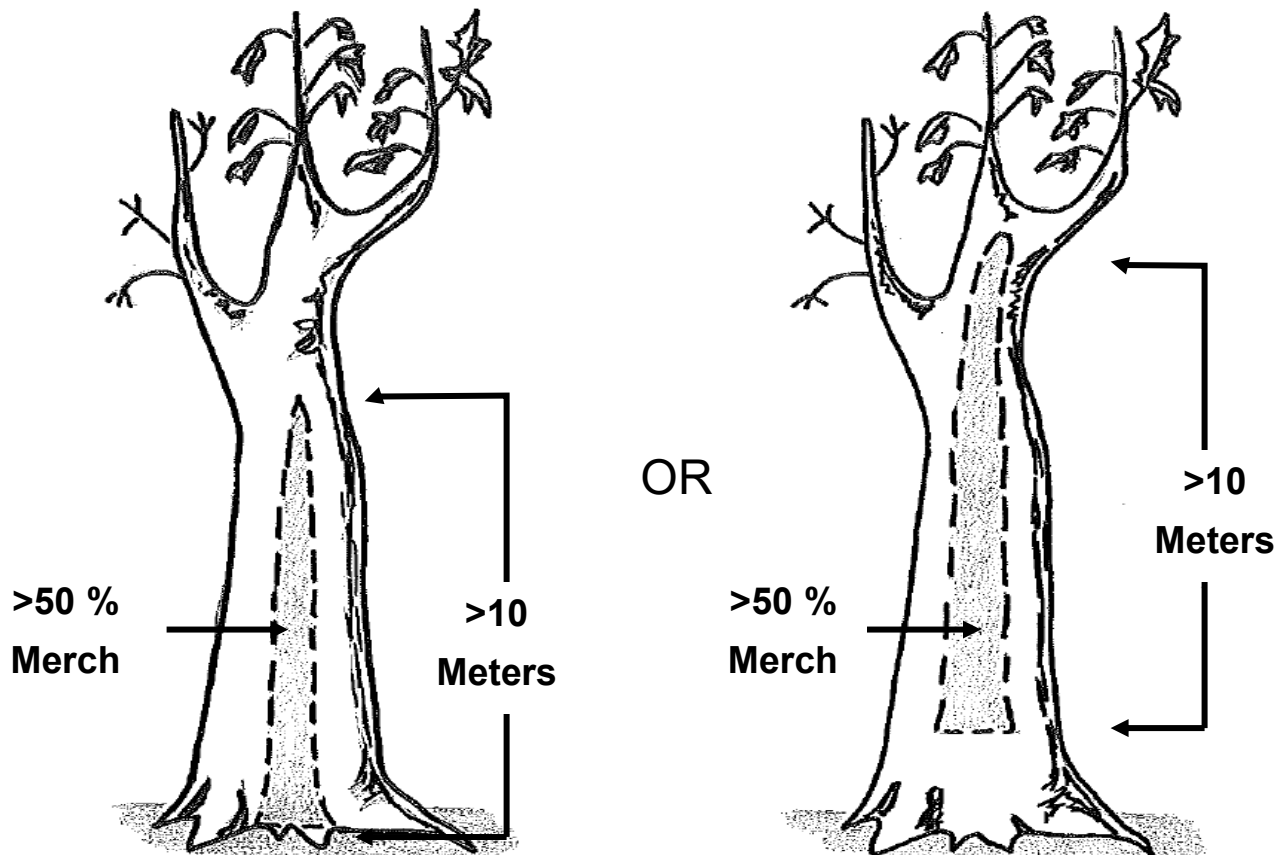
1. Cw Stem Merchantability Criteria

Criteria Definition: A Cw tree being assessed is Unacceptable as a contributing Crop Tree if –

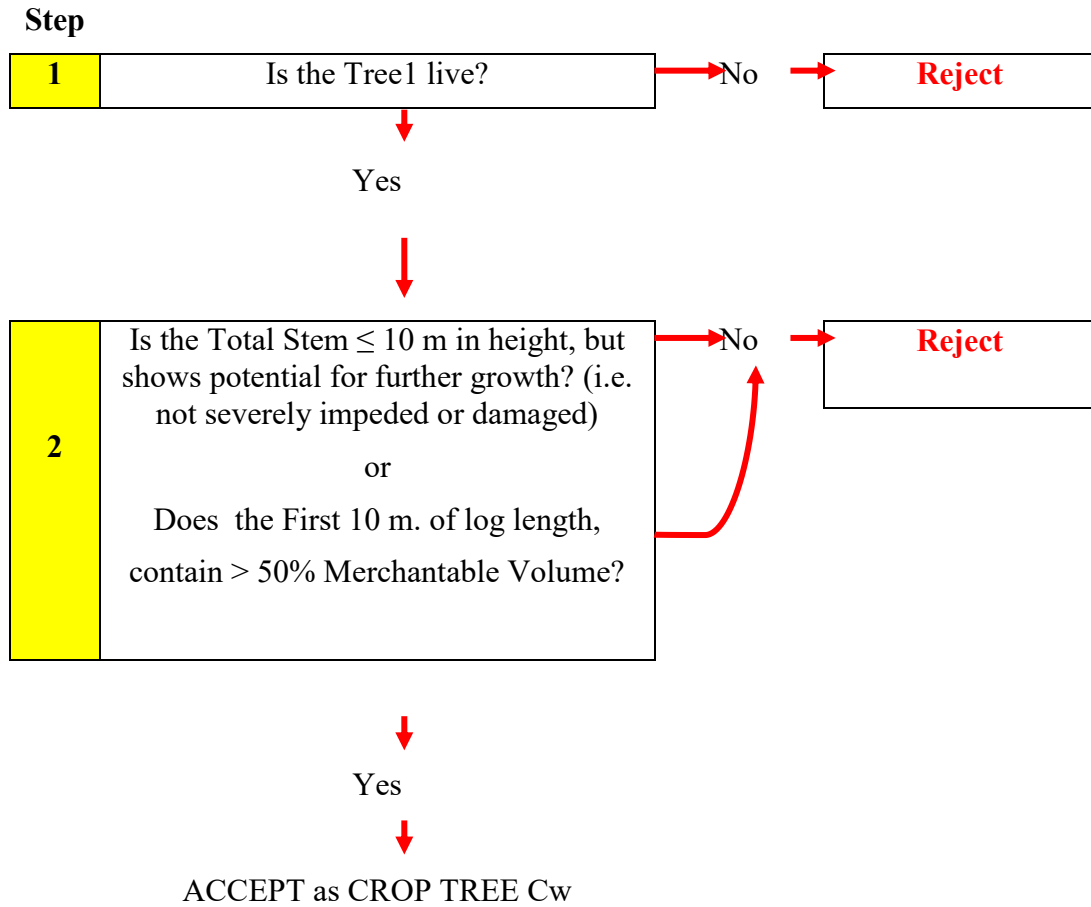
unable to produce > 50% Merchantable Volume in the first 10 m. of log length, either:

1. Utility Grade – At least a solid 8 inch shell – Shake and Shingle and /or
2. Higher Grade – Complete solid wood – Saw Logs

Figure 1: Visual Graphic Examples of Cw Stem Merchantability Criteria



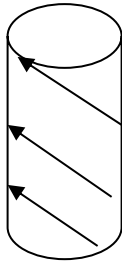
Suggested Assessment Key Steps



¹ Live tree means a tree has at least 1 live branch with green foliage.

2. Significant Visible Defect Indicators - Representing Unmerchantable Conditions

1. Significant Butt Rot as to produce a complete “see through gap” in the flared butt of a Cw – above the root collar.
2. Woodpecker Holes around the complete circumference of the first and second 10 m. length of the stem.
3. Excessive Grain Twist to the Left² for the entire first and second 10 m. length of the stem.



4. Large Branches $\geq$ the diameter of sound bole wood around the complete circumference of the first and second 10 m. length of the stem.
5. Excessive Sun Check on “grey ghost” upper segment of dead top on a Cw – for sun checks will penetrate twice the visible distance into sound wood to create unacceptable splitting.

² Twist to the left extends into the heartwood significantly degrading the log quality and value.

3. Example Photos of Acceptable and Unacceptable Cw Trees

Acceptable Cw Trees

	<p>Acceptable Butt Rot</p> <p>Note: Butt rot does not extend completely through the tree.</p>
	<p>Acceptable Forking and form</p> <p>Live tree with first 10 meters containing > 50 % merchantable volume</p>

	<p>Live tree</p> <p>First 10 meter log shows contains > 50 % merchantable volume</p>
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Unacceptable Cw trees

	<p>Catface and live fork</p> <p>First and second 10 meters of stem contain < 50 % merchantable volume due to large catface.</p>
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9.2.4.3 SEDRSS Methodologies – Two Options: 1) SEDRSS DFP or 2) SEDRSS Tabular

9.2.4.3.1 Background DFP Concept

The Deviation From Potential (DFP) method of stocking assessment recognizes two stand components: overstorey trees - those trees greater than a designated DBH (e.g., 12.5cm) - and understorey trees, those less than the designated diameter. The DFP method focuses on the future yield from the understorey component. The underlying concept is that understorey yield varies based on understorey density and the amount of overstorey.

To calibrate the concept, Martin et al (2005)³ used TIPSy and TASS to relate understorey density to future yield. Without an overstorey, as understorey density increases, future yield increase rapidly and then level off. Predictions from TASS and other published research on the growth impact of retained overstorey were used to relate overstorey basal area to understorey yield reduction. With increased overstorey basal area, understorey yield potential decreases.

The DFP combines the two relationships providing future understorey yield over a range of understorey density and overstorey basal area. Since the DFP is constructed from these fundamental relationships, it provides a solid biological basis for stocking assessments and standards.

Deviation From Potential ranges from 0 to 1. A DFP of 0 at a sample point indicates that the sample point is fully stocked - that is there is no additional space available for added stocking at that point. At the other end of the spectrum a DFP of 1 (or 100%) indicates the point has no stocking and has a 100% deviation from the potential.

This concept is a significant departure from historic forest stocking evaluation processes. Two implementation protocols are presented for SEDRSS to aid in clarifying the concept. Evaluation and survey approaches are presented based on either 1) the **DFP** model or 2) the **Tabular** integrated approach (available for Coastal SEDRSS only at this time). These alternative approaches are presented to show how the stocking standard could be developed for an FSP submission. The working group members and resource specialists involved in the design and testing of this protocol strongly recommend forest professionals adopt option 2, the **Tabular** approach. Of the two methodologies the Tabular approach is considered as being the most accurate and practical methodology for use within a Forest Stewardship Plan.

9.2.4.3.2 Common Methodologies for Options 1) and 2)

9.2.4.3.2.1 Survey Design

- **Pre-stratification:** Identify the areas suitable for SEDRSS as per the criteria listed in Section 9.2.4.1

³ Martin, P.J., Bancroft, B., Day, K., and Peel, K. 2005. A new basis for understory stocking standards for partially harvested stands in the British Columbia Interior. West. J. Appl. For. 20(1): 5–12.

- **Plots:** Establish 1 plot per ha within SU (stratum) or a minimum of 5 plots per SU (stratum).
- **Plot Size:** To tally understorey stems use a 3.99m. or 5.64m. radius plot depending on stand condition. Use the same plot size throughout the entire SU.
- **Prism size:** Choose a prism that captures a minimum of 4 trees per plot from the pre-harvest condition (in cut areas this would be a combination of standing trees and stumps).

9.2.4.3.2.2 *RESULTS Data Entry*

The [*RESULTS Information Submission Specifications*](#) document has a recent supplement document (dated July 28, 2010) called - *Procedures for Submitting Forest Cover to RESULTS for Openings with Treed Retention*. This document clearly provides the content requirements for reporting SU's with Dispersed and Grouped Tree Retention.

Basically, the reporting of Polygon, Inventory and Silviculture components are the same as reporting an even-aged clear cut stand with < 5m² of RBA, *except* for the following additional information:

5. Polygon Component

- a. Reserve Type: Enter **Dispersed**.
- b. Reserve Objective: Enter **TIM** (for timber objective, for the retained stems are contributing to the stocking and the next harvest).
- c. Tree Cover Pattern: Enter the **Tree Cover Pattern Number** for the pattern observed and recorded on the field card that best represented the pattern of the layer 1 residuals.

6. Inventory Component

- a. Layers: Report for layers 1 and individually for all other regen layers – layer 2, 3, and 4, as explained in the data summary section below.
- b. Basal Area: Enter the **Total BA m²/ha** value (including crop and non-crop stems) for the Residual Layer – *but not just the Crop BA*.

7. Silviculture Component

- a. Layers: As for the Inventory Component, report for layers 1 and individually for all other regen layers – layer 2, 3, and 4, as explained in the data summary section below.
- b. Well-spaced or Free Growing: Enter the mean WS or FG/ ha. value from the summary data (whichever is being reported).
- c. Free Growing: Enter the mean FG/ha value from the summary data.

- d. Basal Area: enter the **Crop BA m²/ha** value for the Residual Layer – *not the total BA as for the Inventory Label*.

8. Add Comments regarding SEDRSS use

- a. In the comments field next to a milestone declaration, include a comment on the SEDRSS methodology used. Specifically for the SEDRSS DFP method, include the mean DFP value and the % stocking classes.

9.2.4.3.3 Option 1) SEDRSS DFP– Survey Sampling Procedures

This approach uses the DFP table (developed for the interior by Martin 2005) solely as the basis for the stocking decision. The resultant DFP derived from the Dispersed Retention BA and present understorey stocking levels at each plot produces an averaged DFP value for the SU, which must meet a standards threshold value. In addition three other thresholds must be met by the SU in order to achieve the obligation (a threshold percent of the plots in each stocking class of the DFP table must be met - refer to the decision table below).

Field Survey

- **Measurements:** Determine the Dispersed Retention BA per plot and assess regen stocking using criteria for WS stems from the stocking standard. Use the **overstorey crop trees BA only**, and tally non crop BA separately. The non-crop tally may be used to identify the need for additional harvesting if non crop trees are found to be fully occupying the site. In some cases the stand may have been dominated by trees of non-crop status and this should be identified prior to assessment to address what should be tallied.
 - **Plot card data field modifications (use of modified FS 658 – Example shown in Figure 25d - *without the WS and FG M values*):**
 - **Data Collection procedures (using the modified FS 658 above):**
 - Set up the card similar as one would while collecting data for a multi-storey or a layered even-aged survey (i.e. one row for each layer 1 and then another line for understorey /regen – layers 2, 3 and 4 combined)
 - **Tally of Residual Overstorey Layer 1**
- 3. Start with tallies for **Residual Layer 1** in the first row:
 - a. **Layer 1** = all stems ≥ 12.5 cm. DBH
 - b. **TT and TC;**
 - c. **Number of Crop stems by species** (all stems are recorded, for there is no MITD)

- d. in GI column record **Total # in sweep** regardless if crop or non-crop stem;
 - e. in the plantable/in column record **Crop #in sweep**;
 - f. in the preparable column record **Crop BA** (crop # in sweep x BAF)
 - g. Record the DFP for that plot using the DFP table below (a copy of this table is required to be included in the surveyors note book or loaded in their handheld program).
- 4. Record Tree Cover Pattern during the full survey data collection. **Estimate** the overall Tree Cover Pattern for the SU being surveyed, based on the diagram in Section 9.3.4.1 of the Silviculture Survey Manual. Write the corresponding Tree Cover Pattern number in the comments section of the FS 658.
- **Tally of Regeneration Understorey Layers 2, 3 and 4**
 - 3. Tally the remaining **Regeneration Layers 2, 3 and 4** in separate rows below Layer 1's row (no nesting of Layers, but use drip line MITD from ***ALL Layer 1 stems regardless if Crop or Non-Crop trees or inside or outside of the plot (influence layer 1 trees are considered)*** – and use MITD from the FSP for all other trees between Layers 2, 3 and 4):
 - a. **TT and TC** for each regeneration layer;
 - b. **Number of WS stems by species** in the preferred and acceptable species columns relative to MITD criteria;
 - c. In the total W column total **all WS per each Regeneration Layer for all species**;
 - d. In the total FG column total **all FG per each Regeneration Layer for all species**;
 - 4. Tally **Plantable Spots, Preparable Spots and Competing Vegetation** as regular surveys for each Regeneration Layer row and tally **Forest Health Agents** as regular surveys for each Regeneration Layer.
- **Record Inventory Label Data**
- An **Inventory Label** is recorded every 1st and 4th plot as regular surveys for each layer. This can be located at the bottom of the FS 658 comprised of a line per layer 1 and a line for each regen layer. If the leading species changes per layer, additional leading species can be listed in the additional inventory table to the right.
- The best way to estimate **Site Index** for SEDRSS and Interior DFP stands is to use the SIBEC methodology – accessible from the following [SIBEC website](#). Specifically the 1st approximation SIBEC (if available for the site

series) would be best used for the Layer 1 overstorey SI and the 2nd approximation SIBEC for the other Layers in the understorey labels.

NOTE: The 1st approximation SIBEC Site Indexes are identifiable by the listing of WHOLE numbers with no decimal places and no Standard Error (SE) value in the SIBEC Table for the species and sites series referenced. In contrast, the 2nd approximation SIBEC Site Indexes are identifiable by the listing of FRACTIONS with decimal places and SE values in the SIBEC Table for the species and sites series referenced.

Data Summary

The field survey results are tallied and the following thresholds are calculated:

4. **The average DFP value** from all individual plots.
5. **The percent of the total plots established per stocking class** from the plot data and a value generated for each class – stocked; partial stocked; and open.
6. **Inventory and Silviculture Labels** will be generated for **Layer 1** and individually for all other regen layers – **Layer 2, 3, and 4**. The Inventory Label will be generated from the data collected in the field every 1st and 4th plot for total species %, crown closure and from the mean TT summary for all layers. The Silviculture Label will be generated from the tally totals for WS and FG values and species percentages.

Stocking Decision for Coastal SEDRSS:

The Standards Unit is found to have met its **Regen Obligation or Free Growing Obligation** if the following table's criteria have been met.

Table 10b: DFP Regen and FG Obligation Criteria

DFP Threshold Value	Obligation Standard: Coastal SEDRSS
Average DFP	0.32 or less
Proportion of plots in “open” class (shaded red on DFP table)	≤ 25%

Table 10c DFP COASTAL 2013 version 2 *- Basal Area and WS/ha. (Note: 1. Guidance for this table application is only recommended for cedar/ hemlock stands of SI₅₀ for Cw between 18 to 30m; if used below SI 18, provide rationale; 2. Red shaded areas are “open” and green shaded are “stocked” categories).

BA of Overstorey crop trees ≥ 12.5 cm dbh	Understorey density – well-spaced sph. and/or free growing sph.												
	0	100	200	300	400	500	600	700	800	900	1000	1200	1400
0	1.00	0.81	0.65	0.51	0.41	0.32	0.25	0.20	0.15	0.12	0.09	0.05	0.03
1	0.98	0.79	0.63	0.50	0.40	0.31	0.25	0.19	0.15	0.12	0.09	0.05	0.03
2	0.95	0.77	0.62	0.49	0.39	0.31	0.24	0.19	0.15	0.11	0.09	0.05	0.02
3	0.93	0.75	0.60	0.48	0.38	0.30	0.23	0.18	0.14	0.11	0.08	0.05	0.02
4	0.90	0.73	0.59	0.46	0.37	0.29	0.23	0.18	0.14	0.11	0.08	0.05	0.02
5	0.88	0.71	0.57	0.45	0.36	0.28	0.22	0.17	0.13	0.10	0.08	0.04	0.02
6	0.85	0.69	0.55	0.44	0.35	0.27	0.22	0.17	0.13	0.10	0.08	0.04	0.02
7	0.83	0.67	0.54	0.43	0.34	0.27	0.21	0.16	0.13	0.10	0.08	0.04	0.02
8	0.80	0.65	0.52	0.41	0.33	0.26	0.20	0.16	0.12	0.10	0.07	0.04	0.02
9	0.78	0.63	0.50	0.40	0.32	0.25	0.20	0.15	0.12	0.09	0.07	0.04	0.02
10	0.76	0.61	0.49	0.39	0.31	0.24	0.19	0.15	0.12	0.09	0.07	0.04	0.02
11	0.73	0.59	0.47	0.38	0.30	0.24	0.18	0.14	0.11	0.09	0.07	0.04	0.02
12	0.71	0.58	0.46	0.36	0.29	0.23	0.18	0.14	0.11	0.08	0.06	0.04	0.02
13	0.69	0.56	0.45	0.35	0.28	0.22	0.17	0.14	0.11	0.08	0.06	0.04	0.02
14	0.67	0.54	0.43	0.34	0.27	0.21	0.17	0.13	0.10	0.08	0.06	0.03	0.02
15	0.64	0.52	0.42	0.33	0.26	0.21	0.16	0.13	0.10	0.08	0.06	0.03	0.02
16	0.62	0.51	0.40	0.32	0.25	0.20	0.16	0.12	0.10	0.07	0.06	0.03	0.02
17	0.60	0.49	0.39	0.31	0.25	0.19	0.15	0.12	0.09	0.07	0.05	0.03	0.02
18	0.58	0.47	0.38	0.30	0.24	0.19	0.15	0.12	0.09	0.07	0.05	0.03	0.02
19	0.56	0.46	0.37	0.29	0.23	0.18	0.14	0.11	0.09	0.07	0.05	0.03	0.01
20	0.55	0.44	0.35	0.28	0.22	0.18	0.14	0.11	0.08	0.06	0.05	0.03	0.01
21	0.53	0.43	0.34	0.27	0.21	0.17	0.13	0.10	0.08	0.06	0.05	0.03	0.01
22	0.51	0.41	0.33	0.26	0.21	0.16	0.13	0.10	0.08	0.06	0.05	0.03	0.01
23	0.49	0.40	0.32	0.25	0.20	0.16	0.12	0.10	0.08	0.06	0.04	0.03	0.01
24	0.48	0.39	0.31	0.24	0.19	0.15	0.12	0.09	0.07	0.06	0.04	0.02	0.01
25	0.46	0.37	0.30	0.24	0.19	0.15	0.12	0.09	0.07	0.05	0.04	0.02	0.01
26	0.44	0.36	0.29	0.23	0.18	0.14	0.11	0.09	0.07	0.05	0.04	0.02	0.01
27	0.43	0.35	0.28	0.22	0.17	0.14	0.11	0.08	0.07	0.05	0.04	0.02	0.01

28	0.41	0.34	0.27	0.21	0.17	0.13	0.10	0.08	0.06	0.05	0.04	0.02	0.01
29	0.40	0.32	0.26	0.21	0.16	0.13	0.10	0.08	0.06	0.05	0.04	0.02	0.01
30	0.39	0.31	0.25	0.20	0.16	0.12	0.10	0.08	0.06	0.05	0.04	0.02	0.01
31	0.37	0.30	0.24	0.19	0.15	0.12	0.09	0.07	0.06	0.04	0.03	0.02	0.01
32	0.36	0.29	0.23	0.19	0.15	0.12	0.09	0.07	0.06	0.04	0.03	0.02	0.01
33	0.35	0.28	0.22	0.18	0.14	0.11	0.09	0.07	0.05	0.04	0.03	0.02	0.01
34	0.34	0.27	0.22	0.17	0.14	0.11	0.08	0.07	0.05	0.04	0.03	0.02	0.01
35	0.32	0.26	0.21	0.17	0.13	0.10	0.08	0.06	0.05	0.04	0.03	0.02	0.01
36	0.31	0.25	0.20	0.16	0.13	0.10	0.08	0.06	0.05	0.04	0.03	0.02	0.01
37	0.30	0.24	0.19	0.15	0.12	0.10	0.08	0.06	0.05	0.04	0.03	0.02	0.01
38	0.29	0.24	0.19	0.15	0.12	0.09	0.07	0.06	0.04	0.03	0.03	0.01	0.01
39	0.28	0.23	0.18	0.14	0.11	0.09	0.07	0.06	0.04	0.03	0.03	0.01	0.01
40	0.27	0.22	0.17	0.14	0.11	0.09	0.07	0.05	0.04	0.03	0.02	0.01	0.01

*(The development of this new 2013 table involved growth models assuming Cw and Hw overstorey and understorey; SI 24 of the overstorey and a rotation of 100 years.)

9.2.4.3.4 Option 2) SEDRSS Tabular - Survey Sampling Procedures

This approach integrates the overstorey and understorey aspects of the DFP approach and presents them in a tabular format. The working group members and resource specialists involved in the design and testing of this protocol strongly recommend that forest professionals adopt the **Tabular** approach. Of the two methodologies, the tabular approach is considered as being the most accurate and practical for use within a Forest Stewardship Plan.

The DFP Table has been consolidated by grouping basal area (BA) and listing the density groups into a table (an example is shown below in Table 4). The tabular format is designed to match as close as possible, the current stocking standard tables found in the MFR publication titled: Reference Guide to FDP Stocking Standards – at the following link:

http://www.for.gov.bc.ca/ftp/hfp/external!/publish/Stocking%20Standards%20for%20FDPs/Reference_Guide.xls

Target and minimum Well-spaced (WS) density standards are listed for each BA grouping in the table. These values were derived from the original DFP table and correspond to the open and stocked threshold lines used in the DFP approach above. The primary difference in using this Tabular approach versus the DFP approach above is the concept of a maximum (**M value**) for BA and for target WS stems. For example, if the maximum overstorey BA is set at 40 m²/ha, for a plot with more than 40 m²/ha, the value would be capped at 40 m²/ha with the understorey contributing “0” WS. Correspondingly, the WS density has an **M** value depending on the BA grouping.

The intention is for FSP licensees to develop stocking standard tables' **specific** to their coastal BEC Subzones and site series (or grouping of site series) for Single Entry Dispersed Retention management regimes.

Table 10d: SEDRSS Tabular Method (derived from the DFP Table – table 10b) - COASTAL 2013

Showing grouped BA Categories and corresponding MSS (red) threshold and TSS (green) threshold.

(Note: The red shaded area is the MSS threshold & less; the green shaded area is the TSS & more; the yellow shaded area is the management area in-between the MSS and TSS thresholds)

BA of Overstorey crop trees ≥ 12.5 cm dbh	Understorey density – well-spaced sph.												
	0	100	200	300	400	500	600	700	800	900	1000	1200	1400
0	1.00	0.81	0.65	0.51	0.41	0.32	0.25	0.20	0.15	0.12	0.09	0.05	0.03
1	0.98	0.79	0.63	0.50	0.40	0.31	0.25	0.19	0.15	0.12	0.09	0.05	0.03
2	0.95	0.77	0.62	0.49	0.39	0.31	0.24	0.19	0.15	0.11	0.09	0.05	0.02
3	0.93	0.75	0.60	0.48	0.38	0.30	0.23	0.18	0.14	0.11	0.08	0.05	0.02
4	0.90	0.73	0.59	0.46	0.37	0.29	0.23	0.18	0.14	0.11	0.08	0.05	0.02
5	0.88	0.71	0.57	0.45	0.36	0.28	0.22	0.17	0.13	0.10	0.08	0.04	0.02
6	0.85	0.69	0.55	0.44	0.35	0.27	0.22	0.17	0.13	0.10	0.08	0.04	0.02
7	0.83	0.67	0.54	0.43	0.34	0.27	0.21	0.16	0.13	0.10	0.08	0.04	0.02
8	0.80	0.65	0.52	0.41	0.33	0.26	0.20	0.16	0.12	0.10	0.07	0.04	0.02
9	0.78	0.63	0.50	0.40	0.32	0.25	0.20	0.15	0.12	0.09	0.07	0.04	0.02
10	0.76	0.61	0.49	0.39	0.31	0.24	0.19	0.15	0.12	0.09	0.07	0.04	0.02
11	0.73	0.59	0.47	0.38	0.30	0.24	0.18	0.14	0.11	0.09	0.07	0.04	0.02
12	0.71	0.58	0.46	0.36	0.29	0.23	0.18	0.14	0.11	0.08	0.06	0.04	0.02
13	0.69	0.56	0.45	0.35	0.28	0.22	0.17	0.14	0.11	0.08	0.06	0.04	0.02
14	0.67	0.54	0.43	0.34	0.27	0.21	0.17	0.13	0.10	0.08	0.06	0.03	0.02
15	0.64	0.52	0.42	0.33	0.26	0.21	0.16	0.13	0.10	0.08	0.06	0.03	0.02
16	0.62	0.51	0.40	0.32	0.25	0.20	0.16	0.12	0.10	0.07	0.06	0.03	0.02
17	0.60	0.49	0.39	0.31	0.25	0.19	0.15	0.12	0.09	0.07	0.05	0.03	0.02
18	0.58	0.47	0.38	0.30	0.24	0.19	0.15	0.12	0.09	0.07	0.05	0.03	0.02
19	0.56	0.46	0.37	0.29	0.23	0.18	0.14	0.11	0.09	0.07	0.05	0.03	0.01
20	0.55	0.44	0.35	0.28	0.22	0.18	0.14	0.11	0.08	0.06	0.05	0.03	0.01
21	0.53	0.43	0.34	0.27	0.21	0.17	0.13	0.10	0.08	0.06	0.05	0.03	0.01

22	0.51	0.41	0.33	0.26	0.21	0.16	0.13	0.10	0.08	0.06	0.05	0.03	0.01
23	0.49	0.40	0.32	0.25	0.20	0.16	0.12	0.10	0.08	0.06	0.04	0.03	0.01
24	0.48	0.39	0.31	0.24	0.19	0.15	0.12	0.09	0.07	0.06	0.04	0.02	0.01
25	0.46	0.37	0.30	0.24	0.19	0.15	0.12	0.09	0.07	0.05	0.04	0.02	0.01
26	0.44	0.36	0.29	0.23	0.18	0.14	0.11	0.09	0.07	0.05	0.04	0.02	0.01
27	0.43	0.35	0.28	0.22	0.17	0.14	0.11	0.08	0.07	0.05	0.04	0.02	0.01
28	0.41	0.34	0.27	0.21	0.17	0.13	0.10	0.08	0.06	0.05	0.04	0.02	0.01
29	0.40	0.32	0.26	0.21	0.16	0.13	0.10	0.08	0.06	0.05	0.04	0.02	0.01
30	0.39	0.31	0.25	0.20	0.16	0.12	0.10	0.08	0.06	0.05	0.04	0.02	0.01
31	0.37	0.30	0.24	0.19	0.15	0.12	0.09	0.07	0.06	0.04	0.03	0.02	0.01
32	0.36	0.29	0.23	0.19	0.15	0.12	0.09	0.07	0.06	0.04	0.03	0.02	0.01
33	0.35	0.28	0.22	0.18	0.14	0.11	0.09	0.07	0.05	0.04	0.03	0.02	0.01
34	0.34	0.27	0.22	0.17	0.14	0.11	0.08	0.07	0.05	0.04	0.03	0.02	0.01
35	0.32	0.26	0.21	0.17	0.13	0.10	0.08	0.06	0.05	0.04	0.03	0.02	0.01
36	0.31	0.25	0.20	0.16	0.13	0.10	0.08	0.06	0.05	0.04	0.03	0.02	0.01
37	0.30	0.24	0.19	0.15	0.12	0.10	0.08	0.06	0.05	0.04	0.03	0.02	0.01
38	0.29	0.24	0.19	0.15	0.12	0.09	0.07	0.06	0.04	0.03	0.03	0.01	0.01
39	0.28	0.23	0.18	0.14	0.11	0.09	0.07	0.06	0.04	0.03	0.03	0.01	0.01
40	0.27	0.22	0.17	0.14	0.11	0.09	0.07	0.05	0.04	0.03	0.02	0.01	0.01

Table 10e Example SEDRSS Tabular Method Coastal 2013 for CWHvh1 01 (based on table 10c)

		Regeneration Guide								Free Growing Guide	
		Species	Site Occupancy					Regen Delay (max yrs)	MIT D		
BGC U	Layer		All BA combinations are applicable to survey plots							Species	Height (m)
			Only used during plots	One of these 4 BA combinations are applicable to final SU REGEN / FG SEDRSS obligations			Only used during plots				
CWH vh1 01	Residual Layer (L1) (≥ 12.5 dbh) (BA m ² /ha)	Cw, Hw, Cy, Pl	0-8 m ² /ha	9-15 m ² /ha	16-22 m ² /ha	23-28 m ² /ha	29-39 m ² /ha	≥ 40 m ² /ha	3	N/A	N/A
	Regen Layer (L2-L4) (WS / ha. TSS – Target MSS - Minimum)	Cw, Hw, Cy, Pl	900 TSS 500 MSS	800 TSS 400 MSS	700 TSS 300 MSS	500 TSS 200 MSS	400 TSS 100 MSS	0 0	3	L1 Drip line or 2.0 m (L2-L4)	Cw, Yc, Pl Hw 1.5 2.0

Field Survey

- Measurements:** Determine BA per plot and assess regen stocking using the obligation criteria for WS and/or FG stems from stocking standard (Insure to reference all possible BA range columns regardless of the level of dispersed retention – for all ranges can be present within any Stratum being sampled – but overall the resultant average BA for the Stratum will be within one level of dispersed retention – Moderate or High).
 - Plot card data field modifications (use of modified FS 658 – Example shown in Figure 25d):**
 - Within Column Heading Boxes across the top of the data entry section, modify: Count Conifer column to **TSS**; Count Height to **MSS**
 - Data Collection procedures (using the modified FS 658 above):**
 - Set up the card similar as one would while collecting data for a multi-storey or a layered even-aged survey (i.e. one row for each layer 1 and then another line for understorey /regen – layers 2, 3 and 4 combined)
 - Tally of Residual Overstorey Layer 1**
 - Start with tallies for **Residual Layer 1** in the first row:
 - Layer 1** = all stems ≥ 12.5 cm. DBH
 - TT** and **TC**;

- c. **Number of Crop stems by species** (all stems are recorded, for there is no MITD)
 - d. in GI column record **Total # in sweep** regardless if crop or non-crop stem;
 - e. in the plantable/in column record **Crop # in sweep**;
 - f. in the preparable column record **Crop BA** (crop # in sweep x BAF)
6. Using **Crop BA** determined above and the DFP tabular table, enter the **TSS M value and MSS M value** for the plot in the columns as modified above (example: If using a 5.64 m radius plot [1/100 ha.], and the BA is 20 m², then the **TSS** is 400 or **4 M** value and **MSS** is 200 or **2** stems per plot). Note: Cap determination of BA at **40 m²** when entering plot data – i.e. if 50m² recorded in plot, 40 m² is entered.
 7. Record Tree Cover Pattern during the full survey data collection. **Estimate** the overall Tree Cover Pattern for the SU being surveyed, based on the diagram in Section 9.3.4.1 of the Silviculture Survey Manual. Write the corresponding Tree Cover Pattern number in the comments section of the FS 658.
- **Tally of Regeneration Understorey Layers 2, 3 and 4**
 8. Tally the remaining **Regeneration Layers 2, 3 and 4** in separate rows below layer 1's row (no nesting of Layers, but use drip line MITD from ***ALL layer 1 stems regardless if Crop or Non-Crop trees or inside or outside of the plot - influence layer 1 trees are considered*** – and use the MITD from the table or FSP for all other trees between layers 2, 3 and 4):
 - a. **TT** and **TC** for each regeneration layer;
 - b. **Number of WS stems by species** in the preferred and acceptable species columns relative to MITD criteria;
 - c. In the total W column total **all WS per each Regeneration Layer for all species**, if the sum exceeds the M value for that plot, enter the **M value**;
 - d. In the total FG column total **all FG per each Regeneration Layer for all species**, if the sum exceeds the M value for that plot, enter the **M value**;
 9. Tally **Plantable Spots, Preparable Spots and Competing Vegetation** as regular surveys for each Regeneration Layer row and tally **Forest Health Agents** as regular surveys for each Regeneration Layer.
 - **Record Inventory Label Data**
 1. An **Inventory Label** is recorded every 1st and 4th plot as regular surveys for each layer. This can be located at the bottom of the FS 658 comprised of a line per layer 1 and a line for each regen layer. If the leading species

2. The best way to estimate Site Index for SEDRSS stands is to use the SIBEC methodology. Specifically the 1st approximation SIBEC (if available for the site series) would be best used for the layer 1 overstorey SI and the 2nd approximation SIBEC for the other layer understorey labels.

[illegible]

The field survey results are tallied and the mean calculated using the following test steps:

- 170

Note: Statistical analysis is not applicable, due to the lower stocking values used in this methodology.

4. **Inventory and Silviculture Labels** will be generated for **Layer 1** and individually for all other regen layers – **Layer 2, 3, and 4**. The Inventory Label will be generated from the data collected in the field every 1st and 4th plot for total species %, crown closure and from the mean TT summary for all layers. The Silviculture Label will be generated from the tally totals for WS and FG values and species percentages.

Stocking Decision

The SU is found to have met its **Regen Obligation or Free Growing Obligation** if:

1. **the mean Regen or FG sph** $\geq$ **the MSS sph**
for the corresponding **Average Crop BA** from the table.

9.2.5 Boreal Mixedwood Stand Structures Survey– NI Forest Region

Presently a **draft** for Mean Stocked Quadrants (MSQ) and Boreal Mixedwood surveys have been provided here **for discussion purposes and reference only.**



Illustration 5: Boreal Mixedwood Intimate Stand Structures

9.2.5.1 Mean Stocked Quadrant Survey (MSQ)

9.2.5.1.1 Office Procedures

9.2.5.1.1.1 *Map & Previous Data*

A Silviculture Prescription (SP) map (or equivalent) should be used to develop the plot locations of the stand survey and should be updated following each survey. This map should show block boundaries, non-productive (NP), non-commercial cover (NCC), wildlife tree patches (WTP), riparian management areas (RMA), permanent access structures (PAS), and temporary roads. The surveyor should also be familiar with the block history.

9.2.5.1.1.2 *Office Stratification*

Each block map should be stratified prior to field sampling to show areas included in the volume estimate (the area equivalent to the current definition of NAR), and areas to be netted-out. Sample plots should only be located in the NAR. Stratification of the surveyed area should then be updated in the field after the survey is complete.

Prior to field sampling, the following information should be added to the survey map:

- i) Transfer NAR boundary to the survey map
- ii) Transfer the Standard Unit boundaries from the SP to the survey map

9.2.5.1.1.3 *Plot Locations*

Sample plots are located on a 100 m grid (or 50 m grid for strata less than 5 ha) using UTM NAD 83 coordinates. Plot locations should be marked on the map prior to field sampling. All grid points within the NAR of each block should be sampled.

9.2.5.1.1.4 *Sample Size*

The sample in each stratum includes full measure plots located on the 100 m grid points. This gives a sample intensity of one plot/ha. If strata are smaller than 5 ha, the sample size should be increased by adding plots on a 50 m grid between the 100 m grid points. No fewer than 5 plots should be established in any stratum. If a multi-block reforestation approach is employed increasing plot density on smaller strata may not be necessary. Also, in multi-block surveys the minimum 5 plots per strata could be applied across multiple blocks containing the same stratum type.

9.2.5.1.2 Field Sampling

9.2.5.1.2.1 *Field Stratification*

Field stratification consists of the following components.

- i) The NAR must be clearly defined and the map updated if necessary.
- ii) Map inventory polygons. Follow current procedures to map inventory polygons using species composition, site productivity, and stand density. It is critical to distinguish between areas considered SR and NSR. Areas to update and identify on maps include:

- a) NP (swamps, rocks, shallow soil, etc.) 0.25 ha.
 - b) NC brush.
 - c) Roads (permanent and temporary).
 - d) WTPs.
 - e) Partially-cut areas.
 - f) RMAs (reserves and management zones as necessary).
 - g) Strata based on site index or site series, leading species, and density.
- iii) Map potential treatment units. If cutblocks contain a viable treatment unit, add to the map the approximate location of the treatment unit and describe the treatment opportunity.

The updated block maps will provide better information for volume and product modeling, and will help identify areas where additional silviculture treatments may increase volume production or improve product quality.

9.2.5.1.2.2 Measure Plots

Each full measure plot includes a 50 m² (3.99 m radius) plot divided into quadrants along cardinal directions to measure tree attributes and, at every 2nd plot, a 100 m² (5.64 m radius) plot to collect site tree data (located at the same plot center). Site index should be estimated for each species in the site index plot where suitable site trees of each species have three or more year's height growth above breast height.

9.2.5.1.2.3 Main Plot - 50 m²

Quadrant Information - Record each quadrant as stocked if it contains at least one healthy tree of an acceptable species that is free of brush competition (according to current free growing regulations). If a non-stocked quadrant could support tree growth, comment on why there are no trees (e.g., type of non-productive ground, missed plantable spots, brush competition, health problems).

Tree Information - Data for each tree in the plot includes:

- i) Quadrant number (1-4).
- ii) Tree species.
- iii) Height (measure some for reference and visually estimate others).
- iv) Forest health codes – use the same codes used in other silviculture surveys.

Brush Information - In each quadrant record percent cover and average height of brush by species. If brush coverage and height is consistent, brush information may only need to be collected every fourth plot.

NP Area Information - In each quadrant record the type and percent cover of NP area (e.g., rock, water).

9.2.5.1.2.4 Site Index Plots - 100 m²

Record site index information for one tree of each species from the site index plot (5.64 m radius) located at each plot center. Site trees are:

- i) The largest diameter (dbh) tree in the 100 m² plot for that species.
- ii) Undamaged (stem damage resulting in less than 5% reduction in height growth).
- iii) Not overtopped by other trees or competing vegetation where height growth may be affected.

The second tallest tree can be measured for site index if the tallest is not suitable. This must be noted on the field card. Information collected for each tree should include:

- i) Total height
- ii) Age at breast height (yrs)
- iii) Total age (yrs)
- iv) Rank in height relative to other trees in the plot of that species (e.g. tallest, 2nd tallest, etc.)

9.2.5.1.2.5 Compilation

Each stratum identified within a standard unit must have a separate compilation of the results of the survey.

Information in this methodology has been adapted from:

J.S. Thrower and Associates Ltd. 2002. Stand Survey & Growth Modeling for the TFL 49 Results-Based Pilot Project: Final Report. FRBC/Riverside Forest Products Ltd.

J.S. Thrower and Associates Ltd. 2003. Stand Survey & Growth Modeling for the Fort St. John TSA. CANFOR.

9.2.5.2 Boreal Mixedwood Survey Procedures

The plot radii for stocking assessment is 3.99 meters and the stocked quadrant approach applies. The plot is divided into quarters along N-S and E-W axes. Once the plot orientation is established it is “fixed” for the entire survey, i.e. the quadrant orientation cannot be rotated differently in individual plots. The surveyor counts the number of plot quarters (quadrants) stocked with at least one acceptable tree. So, there may be 0, 1, 2, 3, or 4 stocked quadrants in a plot. The average of the plot tallies is Mean Stocked Quadrants (MSQ). MSQ ranges from 0 to 4.0. One plot per hectare is required.

1. If a quadrant is occupied by an acceptable *At* and there are no *Sw* present that are greater than the minimum height then the quadrant is recorded as stocked with aspen. For the regeneration date assessment a minimum of 3 *At* are required in a quadrant to tally 1 *At*. For assessments at free growing the ratio is 1:1.

- ❖ The proposal of a ratio of 3 *At* to tally 1 *At* at regen date is intended to reflect the risk associated with relying on too low an initial *At* density given the damaging events that can significantly impact young *At* stand stocking levels. This ratio requires further evaluation.
- 2. If one or more *Sw* greater than the minimum height are present in a quadrant then the following procedure applies.
 - i. First a one-meter radius is assessed around the *Sw* tree as per the standard free growing assessment procedure. To be tallied as free growing the one meter radius around the *Sw* tree cannot contain overtopping branches from non *At* or *Ac* competitors in more than 1 quadrant. This assessment applies to all potential competing vegetation (e.g. *Ep*, willow, calamagrostis). This one-meter radius can be rotated to minimize the number of quadrants overtopped.
 - ii. If the *Sw* tree does not meet the one meter radius requirement then it cannot be tallied as “free growing” or “well growing” in that quadrant of the 3.99 meter radii stocking assessment plot. If there are no free growing *Sw* in a quadrant of the stocking assessment plot then the quadrant is assessed for *At*. If one or more *At* stems are in the quadrant and meet the provincial free growing standards then the quadrant is recorded as stocked with *At*. (At the regeneration date assessment a minimum of 3 *At* are required in a quadrant to tally 1 *At*. At free growing the ratio is 1:1.) Regardless of the number of acceptable *At* in a given quadrant only 1 *At* stem is tallied in the quadrant.
 - iii. If the *Sw* tree meets the one meter radius (i.e. standard free growing) requirement then a further assessment of the *Sw* tree is undertaken to determine if it can be classified as likely to remain “well growing” as follows:

For intimate mixedwoods

- a. First the BA around the potentially well/free growing is determined. If the BA is 8 m² or less then the *Sw* can be classed as well/free growing.
- b. If the BA around the potentially well/free growing *Sw* is > 8 m² then its Relative-Height-in-the-Canopy (RHC) is determined.
- c. To determine RHC:
 - i. First the height of the *Sw* is determined. Then the top height and crown bottom of the *At* stand is determined.
 - ii. *At* crown depth is determined by subtracting the *At* top height from the height of the *At* crown base.
 - iii. Subtract the height of the *At* crown base from the *Sw* height. Divide this number by the *At* crown depth to determine RHC
 - iv. If the RHC is less than 0.5 then the *Sw* cannot be considered well/free growing.
- d. If the *Sw* RHC is greater than 0.5 then *Sw* crown length within the canopy is determined.

- i. The length of the *Sw* crown is determined by subtracting top height from the height of the *Sw* crown base and dividing by 3.
- ii. The resulting number is then compared to the result of subtracting the height of the *At* crown base from the *Sw* height.
- iii. If this number is greater than 1/3 the *Sw* crown depth then the *Sw* can be considered well/free growing.
- e. To be considered well/free growing in intimate mixtures with *At* BA > 8m² the RHC must be greater than 0.5 and the *Sw* crown length within the *At* canopy must be greater than 1/3 *Sw* crown length.

For successional mixedwoods

- a. Determine if *Sw* height is greater than 2m.
- b. Determine if the average leader length for the past 3 growing seasons is 20 cm or greater.
- c. Divide *Sw* height by DBH and determine if the height-to-diameter ratio (HDR) is 1.0 or less.
- d. To be determined well/free growing the *Sw* must be > 2m in height, have a 20 cm or greater average leader length for the past 3 growing seasons, and have a HDR of 1.0 or less.

For macro, meso, and micro-patch mixedwoods

- a. The individual *Sw* tree to be assessed now becomes the plot center for a 5-metre radius assessment plot.
- b. To be assessed as likely to remain well growing there must not be any *At* within 2 meters of the *Sw* tree (measured stem to stem) in 2 quadrants of the 5 meter radius plot and 2 quadrants must be free of *At* for 5 meters (measured stem to stem).
- c. The 5-metre plot can be rotated to optimize the arrangement of the quadrants. Unlike the standard free growing assessment procedure, the 5-metre radius plot considers *At* both within and outside of the 3.99 radii plot. The 5-metre quadrant can cover any portion of the 3.99 meter radii plot (i.e. it could be oriented either away or towards the plot center).
- ❖ The proposal of the 5522 meter opening is tentative. Ongoing research may indicate the need to adjust this specification.

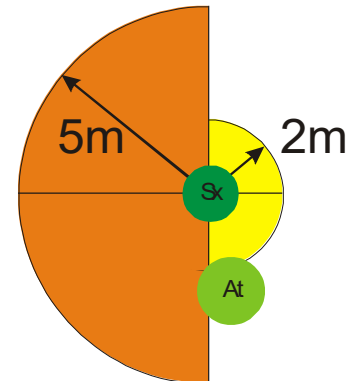


Figure 28: 2255 Concept Diagram

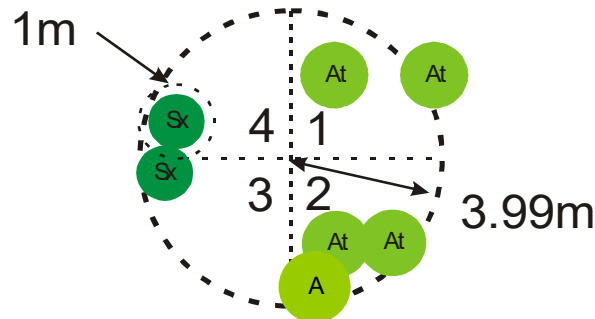
- d. A *Sw* tree meeting these criteria as well as the free growing criteria (as verified in step 2ii above) is tallied in the quadrant. If there are also one or more *At* occupying the quadrant and recorded as in step 2 ii above, then the quadrant is tallied as $\frac{1}{2}$ *Sw* and $\frac{1}{2}$ *At*. (At the regeneration date assessment a minimum of 3 *At* are required in a quadrant to tally 1 *At*. At free growing the ratio is 1:1.) The maximum stem count for any 3.99 meter radii stocking assessment plot cannot exceed 4.

9.2.5.2.1 Example Plots

Plot samples modified from

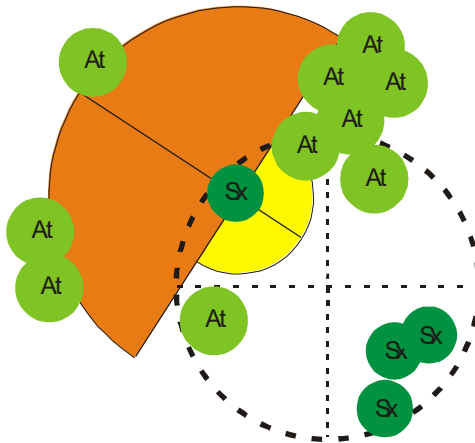
Schaad, A. 2006. Mixedwood Survey Investigation – The 2255 Method. MoFR. Victoria.

9.2.5.2.1.1 Quadrant Plot Sample 1-regeneration:



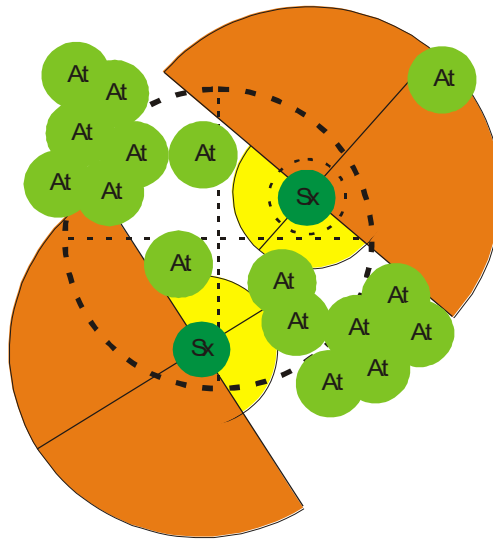
Quadrant	Tally	Comments
1		<ul style="list-style-type: none"> 1 <i>At</i> in the quadrant, one outside with a crown extending inside the quadrant. Do not record as being stocked with <i>At</i>
2	<i>At</i>	<ul style="list-style-type: none"> 3 <i>At</i> present in the quadrant, recorded as stocked with <i>At</i>
3	<i>Sx</i>	
4	<i>Sx</i>	<ul style="list-style-type: none"> 1m dotted line provided for example only.

9.2.5.2.1.2 Quadrant Plot Sample 2 – Free/Well growing - 5522:



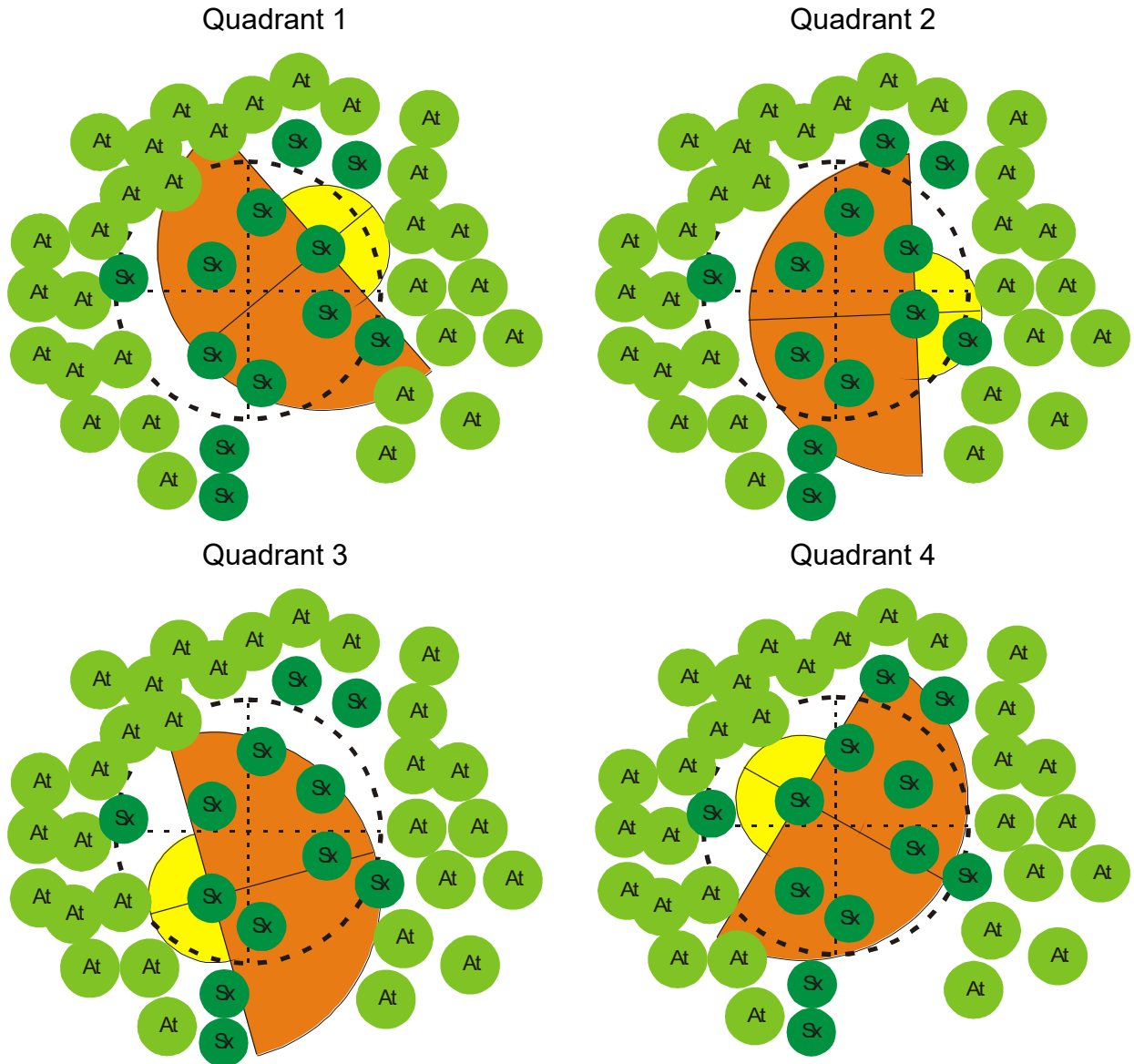
Quadrant	Tally	Comments
1	At	
2	Sx	<ul style="list-style-type: none"> 3 Sx present but recorded as 1 quadrant stocked with Sx
3	At	
4	Sx	<ul style="list-style-type: none"> The aspen stems are outside the quadrant and outside the 5522 area.

9.2.5.2.1.3 Quadrant Plot Sample 3 - Free/Well growing - 5522:



Quadrant	Tally	Comments
1		<ul style="list-style-type: none"> The Sx meets the 1m but not the 5522 requirements. The Sx could be made free growing if the At in the 5m quadrant were removed. This is an understorey spruce over 1m tall and it is “brushable”.
2	At	<ul style="list-style-type: none"> Multiple At in the quadrant.
3	$\frac{1}{2} + \frac{1}{2}$	<ul style="list-style-type: none"> The Sx meets the 1m and the 2255 requirements <u>and</u> there is a well growing At in the quadrant too.
4	At	<ul style="list-style-type: none"> Multiple At in the quadrant.

9.2.5.2.1.4 *Quadrant Plot Sample 4 - Free/Well growing - 5522:*



Quadrant	Tally	Comments
1	Sx	<ul style="list-style-type: none"> The Sx meets the 1m and the 5522.
2	Sx	<ul style="list-style-type: none"> The Sx meets the 1m and the 5522.
3	Sx	<ul style="list-style-type: none"> The Sx meets the 1m and the 5522.
4	Sx	<ul style="list-style-type: none"> The Sx meets the 1m and the 5522.

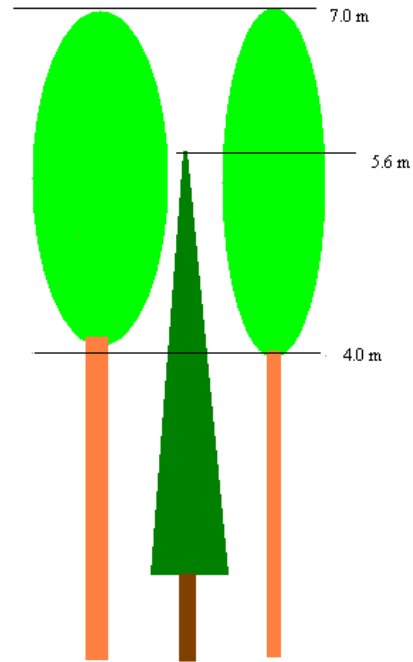
9.2.5.2.1.5 Plot Sample 5 - Free/Well growing – intimate mix:

Sw height: 5.6 m
 At top height: 7.0 m
 At bottom live crown: 4.0 m
 At crown depth (ACD): $7.0 - 4.0 = 3.0$ m
 Sw height into crown (SHC): $5.6 - 4.0 = 1.6$ m
 RHC: $SHC/ACD = 1.6/3.0 = 0.53$

Sw exceeds the 0.5 RHC requirement

Sw crown length (SCL): 4.5 m
 Sw crown in At canopy: $SCL/3 - SHC = 4.5/3 - 1.6 \leq 0$
 Sw exceeds the Sw crown in At canopy requirement.

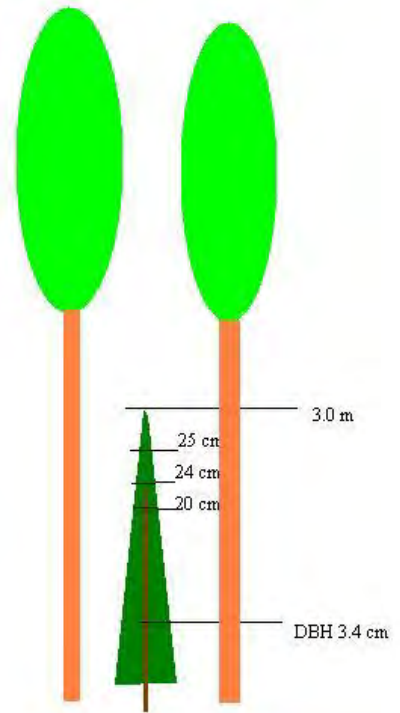
Sw is Free/Well growing



9.2.5.2.1.6 Plot Sample 6 - Free/Well growing – successional mix:

Sw height: 3.0 m
 Last 3 growing season leader length average:
 $(25 + 24 + 20)/3 = 23$ cm
 DBH: 3.4 cm
 Sw Height to Diameter ratio: $3.0/3.4 = 0.88$
 Sw exceeds the 2.0 m height criteria
 Last 3 growing season leader length average exceeds 20 cm
 Sw HDR is ≤ 1.0

Sw can be considered as Free/Well growing



9.3 Complex Horizontal Structure Survey Methodologies

9.3.1 Even-aged Clustered Stand Structures Survey

Cluster treatments result in groups of trees that do not have a relatively even spatial distribution. Cluster treatments can increase biodiversity, while reducing [planting](#) and vegetation management costs. Cluster treatments may also be used on openings that have a reduced number of microsites suitable for tree survival and growth. Examples of these treatments are cluster planting and cluster [juvenile spacing](#). The silviculture plan or prescription sets a minimum [inter-tree distance](#) that is commonly lower than the minimum inter-tree distance used on non-cluster treated openings.

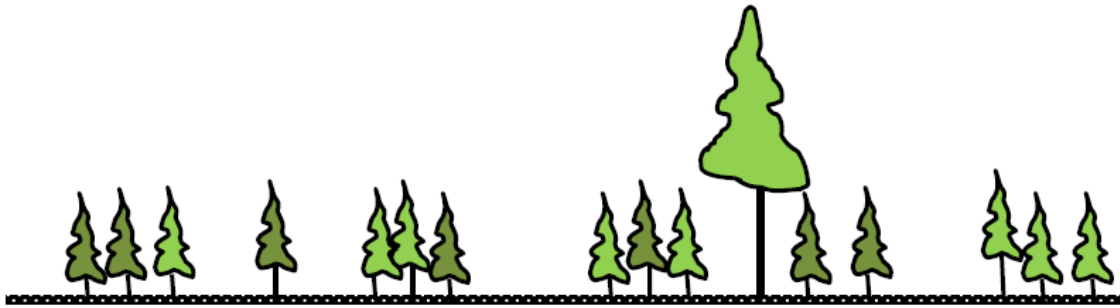


Illustration 6: Even-aged Clustered Stand Structures

The stand level objectives of the cluster treatment must be clearly defined prior to beginning the survey. Objectives may include:

- total trees per hectare
- number of trees per cluster
- minimum inter-tree spacing
- maximum inter-tree spacing
- total clusters per hectare
- target inter-cluster spacing
- cluster “design.”

The survey data collected may change depending on the objective of the survey, but the data and recording techniques will be consistent with other survey types. For example, when determining [planting](#) quality, the conventional planting criteria will be assessed (e.g., plantable spots, number of trees planted, excess trees, satisfactorily planted trees)

with the addition of cluster spacing and/or clusters per hectare.

Establishment of plots will follow the same procedures as other silviculture surveys, except that a larger plot radius is recommended. A 5.64 meter radius plot is recommended to be used where there are more than 100 clusters per hectare. Openings having fewer than 100 clusters per hectare may require an even larger plot.

At each plot, the surveyor should record the number of cluster centers that fall within the plot radius and the number of trees that fall within the plot radius. Regardless as to whether the cluster center falls within the plot radius or not, the trees that fall within the plot should be tallied.

9.3.2 Intermediate Cuts – Commercial Thinning Survey (Openings without regeneration objectives)

Openings without regeneration objectives are most often areas of commercial thinning, removal of individual trees or other types of intermediate cutting. The [Forest Planning and Practices Regulation](#) requires, for openings without regeneration objectives, a survey to be completed twelve months after the completion of harvesting. The survey enables the District Manager to determine that the requirements of the silviculture plan or prescription and stocking standards have been met.

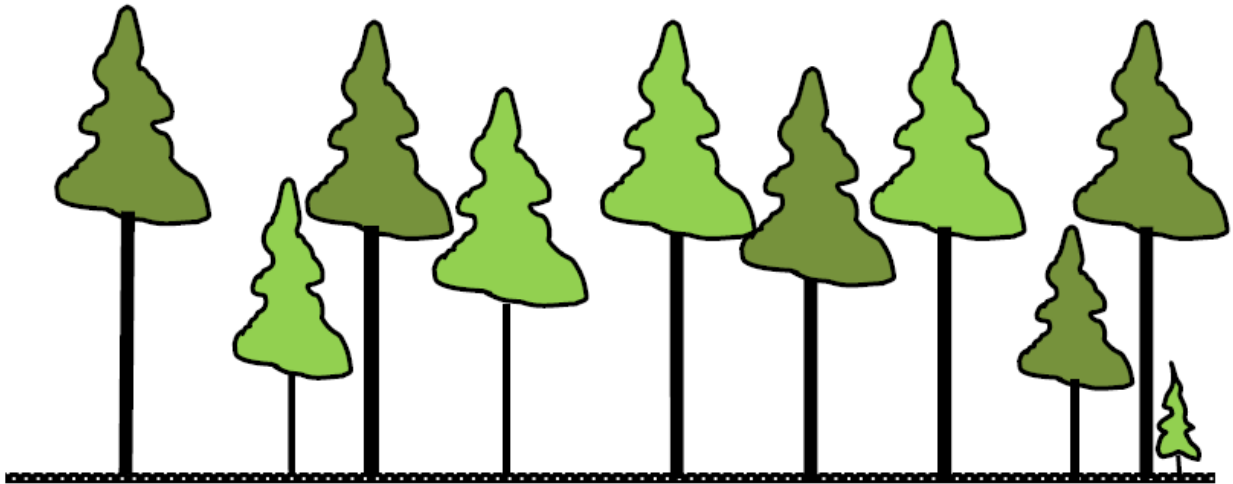


Illustration 7: Intermediate Cuts – Commercial Thinning Even-aged Stand Structures

9.3.2.1 Commercial Thinning Survey Procedures

The majority of the survey components for the commercial thinning survey are the same as for other forms of silviculture surveys. Stratification is completed for all of the reasons applied to other silviculture surveys. There are a few notable differences. These are:

- identification of gaps;
- determination of plot method (prism or fixed radius);
- number of sample trees;
- [site index](#) method;
- forest health damage criteria for scars; and
- data collection in 5 cm diameter classes.

Identification of gaps in the stocking are particularly important, since there is no intent to regenerate the opening, existing gaps will persist through to the next harvest. The walk-through should pay particular attention to gaps or voids produced during the commercial thinning operations.

During the walk-through the surveyor will have to determine the form of sample plots that will be established. If during the walk-through it is determined that 4 to 8 trees will be found in each of the prism sweeps using a BAF 5 prism, (or larger for the coast) then prism plots should be used to survey the stand. The plots should be measured carefully as they would be during timber cruising.

If less than 4 to 8 trees would be found in the BAF 5 prism plots (or larger for the coast) then fixed radius plots should be used. The plot radius is selected based on the table 3. below to ensure the survey plots will identify 6 or more crop trees in each fixed radius plot.

Estimated Crop Tree Density (tr/ha)	Fixed Radius Plot (m)
>1200	3.99
900-1200	5.05
600-899	5.64
350-599	6.31
<350	7.98

Table 10f: Plot Radius to Crop Tree Densities Relationship

A minimum number of 5 crop trees should be sampled for their age and height rather than the minimum three used during other stocking and free growing surveys.

[Site index](#) will usually be determined using the site index (height/age) curve method, since the stand will likely be taller than can be surveyed using the growth intercept

method.

The forest health damage criteria have been adjusted to reflect the known harvesting damage potential in commercial thinning as well as the older nature of the candidate stands when compared to the typical free growing stand upon which the [free growing damage criteria](#) are applied. Individual wounds may have a maximum size of 400 cm² (20 x 20 cm). Multiple wounds may have a maximum cumulative area of 900 cm². Any single wound may not extend more than 1/3rd of the circumference of the crop tree.

The plot data to be collected is similar to a pre and post stand tending survey; data is collected in 5 cm diameter classes.

Where an experienced surveyor is confident during the walk-through that there are no concerns present, the visual assessment survey method may be a suitable alternative to the formal plot establishment process.

9.3.3 Coastal Mixedwood Stand Structure Survey – Coastal Forest Region

This section is an excerpt from the discussion paper - **Hardwood Management in the Coast Forest Region** – published in April 2008. The paper outlines the strategic plan for the management of hardwoods in several management regimes and how achievement of those stocking standards will be measured. This section focuses on the Mixedwood Management Regime, regarding the management of primarily Red Alder in patch mixtures with conifers (not intimate mixtures).

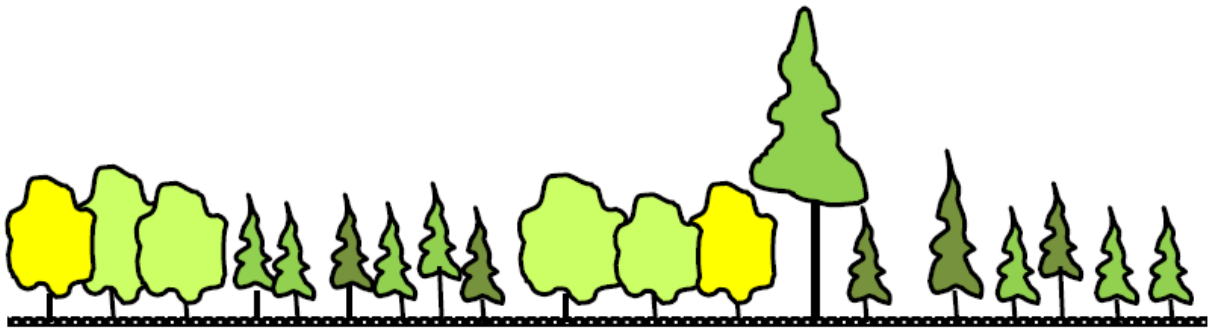


Illustration 8: Coastal Mixedwood - Patch Mixtures – Stand Structures

9.3.3.1 Mixedwood Management Strategy

Under a mixedwood management regime, with either natural or artificial regeneration, the target rotation age to produce a hardwood and a conifer sawlog with minimum size characteristics is 50-70 years.

Under this regime there is an anticipated reduction to Allowable Annual Cut (AAC) when compared to conifer management. This regime is complex to model; the magnitude of the

reduction is anticipated to be similar to the extensive management regime.

The regime is sub-divided into forest types or land classes based on the leading species component.

- Conifer leading (C): >80% basal area is conifer
- Conifer leading mixedwood (CD): > 50% but < 80% basal area is conifer
- Deciduous leading mixedwood (DC): > 50% but < 80% basal area is deciduous hardwoods
- Deciduous leading (D): > 80% B=basal area is deciduous broadleaf.

The mixed designations, CD and DC, are recognized to have differentiations based on structural attributes. These classes can be broken into:

- Stratified mixtures: where one component (usually deciduous) makes up the overstorey and the other is in the understorey
- Intimate mixtures: where both components share dominance on the site and each are within the overstorey.
- Mosaic mixtures: where each component is a distinct separate patch.

A mixedwood strategy should outline:

- The objectives for mixedwood management (e.g. products, yield, stand and landscape diversity, etc.)
- The method for classifying and tracking the forest types or land classes (CD, DC)
- The ecosystems where mixedwood management will achieve the desired rotation lengths and product values ((BEC zone/subzone site series)
- The types of mixedwood strategies being pursued
- The stocking standards and free growing criteria associated with each type.

9.3.3.1.1 Types of Mixedwood Strategies

The potential mixedwood strategies are

- Macro patch mixedwood (large distinct and discrete patches of pure hardwood and pure conifer – e.g. one block hardwood – one conifer, or one half a block as hardwood the other 1/2 conifer)
- Meso patch mixedwood (medium sized distinct and discrete patches of pure hardwood and pure conifer – e.g. a stratum divided into one portion hardwood and the rest conifer)
- Micro patch mixedwood (small distinct and discrete patches >1/2ha - of pure conifer and hardwood intermixed throughout the stratum)
- Intimate mixedwood (intermixing of both conifer and hardwood throughout with the intention of producing a crop of both at the same time in the future)
- Successional mixedwood (intermixing of both conifer and hardwoods but stratifying based on canopy level with the intent of sequentially harvesting one then the other)

At this point the main focus of the Coastal Mixedwood Strategy is on management of **Red Alder** with conifers on similar rotations. The only feasible mixedwood strategies for this focus, given the growth requirements, are the **patch mixedwood strategies** (macro, meso, and micro).

Example regime: Patch mixedwood management

Strategy Option	Site Preparation	Planting density	Final Harvest (technical rotation)	Comments
Patch mixedwood (macro, meso, micro)	Optional - mechanical	1000 -1200sph of conifer Natural regeneration of hardwoods (Alder)	Target Hardwood diameter 30 cm Rotation 50-70 years Target hardwood volume 300 m ³ per ha	-Natural regeneration of hardwoods may be managed for if various criteria are met; (appropriate density and tree distribution, > minimum patch, appropriate ecosystem)

9.3.3.1.2 Stocking standards and free growing criteria

Every mixedwood structural class will have associated with it unique stocking standards and free growing criteria. A definition of what constitutes a free growing tree in each of these structural classes is required to ensure that the desired future conditions are achieved. A free growing Fdc in a large patch mixedwood will look considerably different than a free growing (or well growing) Fdc in an intimate mixture. In a mixedwood scenario the free growing criteria should describe the attributes of the target tree that indicate that it is currently growing, and is anticipated to continue to grow, at a rate that is consistent with achieving the targeted future land classification and yield targets.

Within each broad land class designation there is a range of potential combinations of broadleaf and coniferous species, as such the management strategy undertaken and the resultant species mix within each stand will have different impacts on the future realized yield. If a landscape level approach is taken in the management of the mixedwood resource, determination of future yield targets for each component (broadleaf and coniferous) should be determined and managed for.

9.3.3.1.3 Target rotations and mixedwood strategies

A critical component of mixedwood management is making allowance for the rotation

length target for each stand and each component of the stand. Depending on how rotation length is to be defined (e.g. economic, max Mean Annual Increment (MAI), target diameter, etc.) broadleaf and coniferous species can have different rotation lengths. As such, prescribing the desired rotation length for the stand, or the components of that stand, can influence the choice of stocking standards and configuration of the mixedwood strategy undertaken. If a significant difference in rotation length for the desired components of the mixedwood is anticipated, or deliberately targeted, it may result, depending on strategy chosen, in different stocking standards and free growing criteria. It may also limit the configuration of the mixedwood (i.e. the pattern and size of patches) on the unit being managed. The main reason for this consideration of mixedwood configuration and standards in relation to rotation length is to be able to effectively and efficiently access each component at the anticipated harvest time and not foreclose on future harvest options on the site.

9.3.3.1.4 Patch mixedwood stocking standards (Macro, Meso, and Micro patches)

Stocking standards for the patch mixedwood strategy should consider developing complementary standards that will be applied depending on the land class that the survey plot falls within. In areas designated as CD or DC, survey plots that fall within conifer dominated portions of the opening will have a coniferous stocking standard applied and survey plots that fall within broadleaf dominated portions will have the broadleaf stocking standard applied.

In order to focus on the management of target species within each of these patches, the use of coniferous species as acceptable in broadleaf standards or broadleaf species as acceptable in coniferous standards should be avoided. It is assumed that in these situations where lone individuals or groups of individuals of the non-target species occur within a patch that the tolerance allowances outlined in the Free Growing criteria will compensate for their presence. Inclusion of the non-target species in the stocking standards may cloud the actual achievement of the land class designation on the unit as a whole.

In all patch mixedwood cases, the complementary conifer stocking standard should reflect those developed for the applicable site series the unit falls within for even aged conifer reforestation. A stocking standard combining both the deciduous and coniferous portion could be presented.

Example: **patch mixedwood** stocking standard, deciduous portion only (CWH mm1 – 05)

Preferred	Accept	Stocking density (stems per ha)		Mitd	Regen delay	Free growing (years)		% Ht above brush	Min. Ht.
Species	Species	Preferred	p&a	(m)	(Years)	Early	Late		(m)
Dr		1200	700	2.0	3	5	20	150	4.0

Example: **patch mixedwood** combined deciduous and conifer stocking standard (CWH mm1 – 05)

Class	Preferred	Accept	Stocking density (stems per ha)			Mitd	Regen delay	Free growing (years)		% Ht above brush	Min. Ht.
	Species	Species	Preferred	p&a	Min p	(m)	(Years)	Early	Late		(m)
D	Dr		1200	700		2.0	3	8	20	150	Dr4.0
C	Fd Cw	Pw ³¹	900	500	400	2.0	3	8	20	150	Fd3.0 Cw1.5 Pw2.5

9.3.3.1.5 Free Growing Criteria

All coniferous free growing criteria will be as per Appendix 9 Free from brush – free growing criteria in the *Establishment to Free Growing Guidebook* version 2.3 (May 2000 – revised October, 2007).

Broadleaf free growing criteria should include the appropriate height-above- brush ratio for the ecosystem being managed and include considerations for the relationship between the target tree and surrounding vegetation.

9.3.3.1.6 Free Growing Damage Criteria

All coniferous free growing damage criteria will be as per appendix 5 Free growing damage criteria for British Columbia in the *Establishment to Free Growing Guidebook* version 2.3 (May 2000 – revised October, 2007).

Unless otherwise stated in regulation or an approved FSP stocking standard, an acceptable broadleaf crop tree must:

- Not have a tree pith that is laterally displaced more than 30 cm from the location of the root-crown pith.
- Not originate from a cut stump⁴.

⁴ Stems originating from the sides or cut surface of stumps are very susceptible to breakage at the coppice point, exception may be Big leaf maple

- Have one dominant live leader⁵.
- Not have a wound that is greater than 10% of the stem circumference nor is greater than 10% of the total length of the stem.⁶
- Not have any fungal infections or insect infestations affecting tissues below the bark surface, visible without destructive sampling⁷.
- Not be browsed so as to limit its ability to become a crop tree.

9.3.3.1.7 Free growing Survey System

- Pre-stratify the block into appropriate polygons assigning land class designations of C, D, CD, or DC.
- In each unit identified as being managed for patch mixedwood strategies establish a grid of plots based on 1 plot per ha to a minimum of 5 plots per polygon. At each plot identify the leading land class designation, and then utilize the applicable broadleaf or coniferous stocking standard for that unit.
- Tally the number of plots falling into each land class category and determine the percentage of the plots as either D or C. Determine the overall mixedwood land class designation based on the proportion of the area comprised of both D and C classes. For example, if 60% of the plots are classified as C and 40% of the plots are classified as D the land class for the polygon will be CD.
- All C and D plots will be tallied separately to determine overall achievement of stocking and reporting of inventory labels for each land class within the mixedwood identified polygon.

9.3.3.1.8 Minimum patch size

The establishment of a minimum patch size is essential to ensure that each species being managed for within the mixedwood achieves the desired volume and product value targets. Patch size should be large enough to ensure adequate growth rates and the development of acceptable tree form, so that desired rotation lengths are achieved and so that product value is maximized for each species.

Regarding coastal Red Alder /conifer mixed woods, in order to achieve optimal growth rates it is recommended that patches not be smaller than ½ ha. Any patch smaller than these sizes should not be tallied as achieving the targeted land class.

⁵The objective is that the tree has a single stem that will develop into a healthy crop tree. Accordingly, a healthy, free growing broadleaf tree must have an identifiable live leader. It is not important if a portion, but not all, of the leader is browsed or killed for example by venturia blight.

⁶ A wound is defined as an injury in which the cambium is dead or completely removed from the tree exposing the sapwood. Measure the wound across the widest point of the exposed sapwood. Healed-over wounds (= scars) are acceptable. Fire or sunscald damage can also cause wounds.

⁷ Visible stem infections include cytospora canker or sooty-bark canker, and visible insect infestations, such as poplar borer. The significance of some diseases, such as armillaria root disease, to broadleaves is unknown or uncertain, and several cannot be feasibly identified by visual features during free growing surveys.

9.3.4 Clearcut with Reserves Survey Data

Reserves are forested patches or individual trees retained during harvesting or other forestry operations to provide habitat, scenic values, biodiversity, or other values. They are long-term retention areas generally left one rotation or longer. Trees retained for a short term, such as seed or shelterwood trees, are not reserve trees, and are described in conjunction with the description of the silvicultural system on the silviculture plan or prescription.

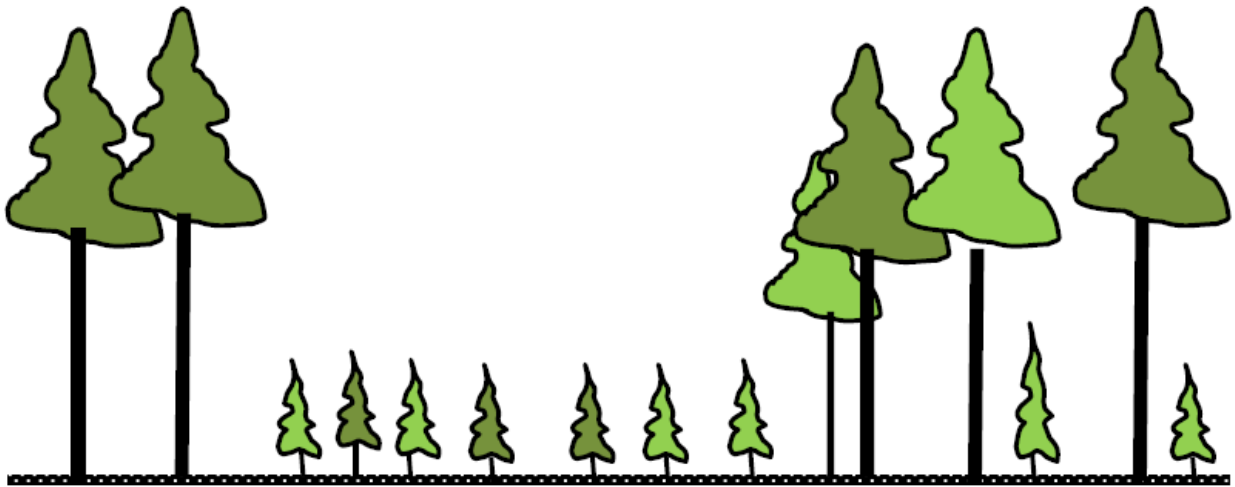


Illustration 8: Clearcut with Reserves Stand Structures

Reserve patches do not normally have harvest entries. However, entries may occasionally be required to address safety concerns or a management objective such as forest health. Where a harvest entry occurs, a standards unit must be delineated for that reserve and the licensee may have reforestation responsibilities. Where removals are very light, there may not be any regeneration objectives. If the licensee has reforestation responsibilities, surveys must be conducted on these areas.

No silviculture responsibilities are associated with reserve patches that have no harvest entries.

9.3.4.1 Reserve Data to Collect During the Silviculture Survey

Reserve Data for Un-harvested Areas: Ground surveys are performed only in those reserves in which harvesting has occurred. For reserves in which harvesting has not occurred, the reserve can be described on the forest cover RESULTS entry based on pre-harvest stand information (e.g., from older forest cover maps or from timber cruise information), plus the addition of a reference year.

Reserve Data for Harvested Areas: Recording ground surveyed openings' forest cover

for harvested areas with reserved treed retention is fully described in the [RESULTS Information Submission Specifications \(RISS\)](#) located on the [RESULTS](#) website and further examples are presented in a supplement to this document on the same web link – *Submitting Forest Cover to RESULTS for Openings with Treed Retention*. This document provides examples of how to prepare RESULTS forest cover submissions for harvesting associated with silvicultural systems that contain some kind of retention in the form of long term treed residuals (reserves for the entire rotational planning cycle) or short term treed residuals (with anticipated subsequent harvest removals prior to the end of the rotational planning cycle). The examples span a range of retention levels from low basal area (BA) retention to high BA retention.

Inventory Label and Crown Closure%: When submitting an inventory label for various layers of retention, it is important for surveyors to be aware that the uppermost layer present will be selected first to update inventories – as long as the crown closure is $\geq 10\%$. If the upper most layer has a crown closure of $< 10\%$ - the next lowest layer will be selected for inventory update, as long as its crown closure is $\geq 10\%$.

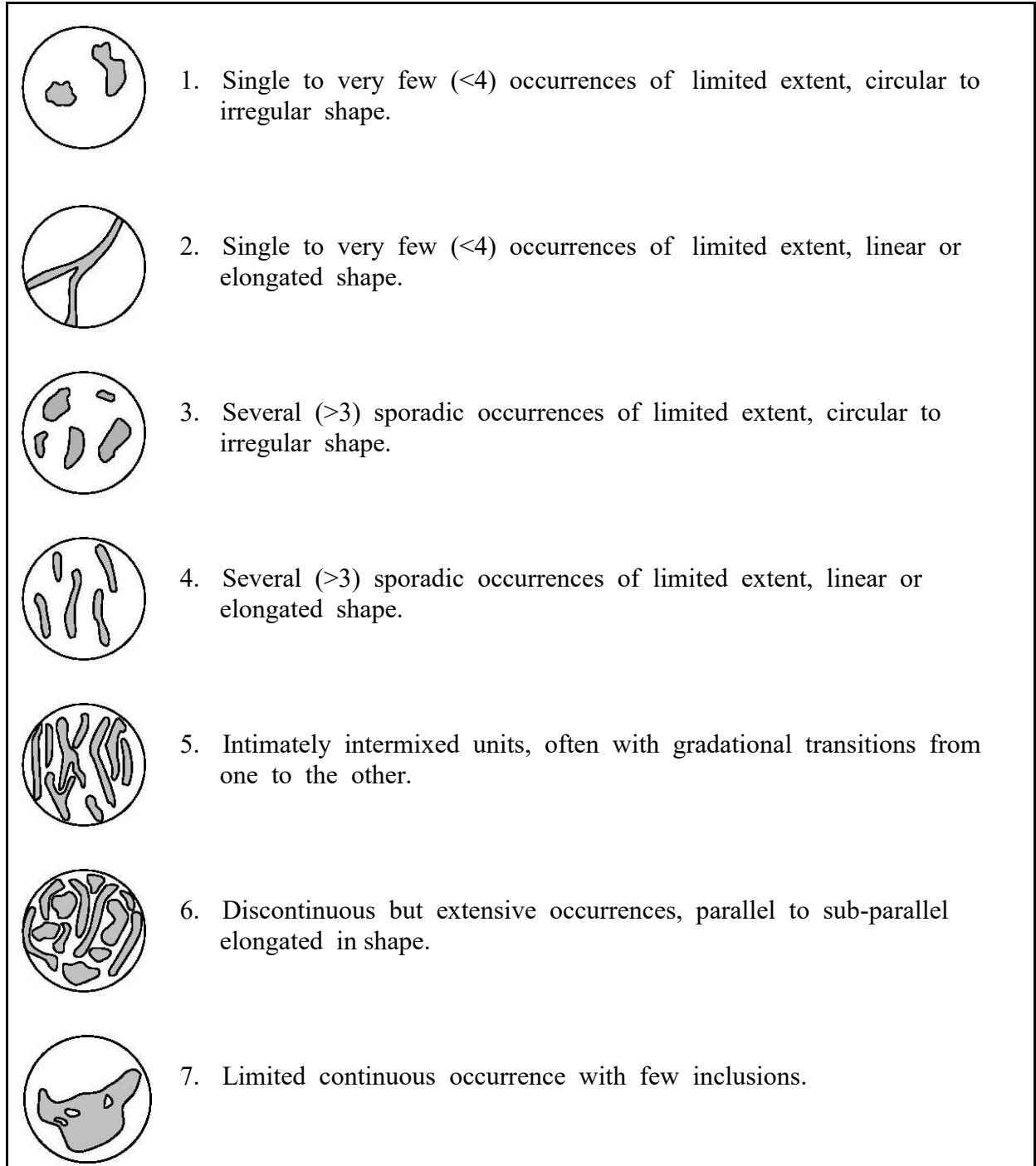
Note: The percent leading species will be based on [Volume](#) for predominantly Layer 1 and 2 SU's and on relative [Density](#) of stems per ha. for younger Layer 3 and 4 dominated SU's.

Survey Data Collection in Treed Retention Openings: In order to report retention within a surveyed opening, it is recommended that the surveyor adhere to the following process, to report the data points (Reserve Type; Reserve objective; and Tree Cover Pattern) for the opening to be entered into RESULTS under forest cover polygon component:

- 1) Identify Reserve Type and Objective:** Identify if the opening has a prescribed retention type and objective within the silviculture plan or prescription for the opening. The options for Reserve Type are Grouped or Dispersed. Grouped reserves would be areas not harvested and would be described as above and removed from the survey area. Dispersed reserves would be scattered un-mappable residual stems purposely left post harvest (as per the silviculture plan or prescription). The options for the Reserve Objective would vary, depending on the value being represented – for example: TIM for timber production and they contribute to the opening's stocking standards; WTR for wildlife habitat; or VIS for a visual quality objective; etc.
- 2) Record Reserve Type and Objective:** Record the type and object (if applicable) on the back of the FS 657 under other resource values and with further explanation if needed in the comment section.
- 3) Record the Basal Area:** If the retained overstorey of Layer 1 stems that are $> 5 \text{ m}^2/\text{ha}$. a complete inventory must be reported into RESULTS, including the ave. BA in m^2/ha . for the Layer 1 overstorey layer. Best practice procedures for measuring basal area are contained in [Appendix 4](#)
- 4) Record Tree Cover Pattern:** During the initial walk-through and/or during the full survey data collection, **estimate** the overall Tree Cover Pattern for the SU being

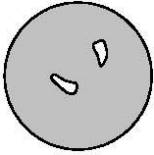
surveyed, based on the following diagram (originally from page 61 in the vegetation Resource Inventory Photo Interpretation Procedures). Write the corresponding Tree Cover Pattern number in the comments section of the FS 658.

Figure 28a Tree Cover Pattern





8. Continuous occurrence with several inclusions.



9. Continuous occurrence with very few inclusions.

5) Reporting the Reserve Type, Reserve Objective, BA and Tree Cover

Pattern: When entering the final survey compilation into RESULTS for an activity record or milestone declaration, enter the appropriate codes for these 3 values into the inputs for the forest cover polygon component of the SU's with dispersed retention. Follow the examples within the document - *Submitting Forest Cover to RESULTS for Openings with Treed Retention* - to aid in coding the specific retention situation observed during the field survey.

9.3.5 Small Scale Harvested Openings Survey– Small Scale Salvage (SSS) or Helicopter Harvested Units.

The following is a suggested methodology to perform a stocking survey of SSS or helicopter harvested openings resulting from harvesting very small openings which are:

- usually < 1 ha. in size, and;
- scattered in close proximity across a localized landscape (approximately in an area less than 4 square kilometres - to make it operational).

This suggested survey method is a blend of Representative Sampling and Visual Assessments and should therefore best be performed by experienced surveyors only. A full grid pattern survey design is not recommended for these openings.

SSS / Small Helicopter Harvested Units - Survey Procedure Steps

1) Opening Identification: Locate all of the openings on a digital map or if unavailable, on orthophotos at a minimum.

2) Pre-stratification and Grouping: Stratify or group the tiny openings into common BEC Subzones - either by overlapping a BEC layer from MapView or referring to the BEC map for your area. If Predictive Ecosystem Maps (PEMs) are available, these will facilitate the grouping of openings further by site series for the openings. Label these groups of openings into pre-stratified sampling strata.

3) Stocking Standard Reference from Prescription or Default Determination:

Reference the existing Stocking Standards if they exist on file. If there are no existing Stocking Standards in an approved silviculture plan or prescription, locate the applicable regional stocking standards for the BEC Subzones and site series in order to establish baseline species and stocking levels needed to declare the openings stocked (SR) or not satisfactorily regenerated (NSR).

4) Visual Assessment Survey of Grouped Openings: An experienced surveyor is recommended to walk-through most of the individual openings within each grouped strata as determined from the previous steps (some openings may be visually assessed from a distance if they appear similar to the adjacent opening). The goal of this assessment survey would be to collect critical data in order to determine the stocking status. A visual assessment collects the information listed below for each opening and target establishing at least one representative plot per final treatment unit (common site series and stocking status) in order to physically confirm the treatment unit status on the ground. Collect the following critical data for each opening and ultimately for each grouped opening treatment unit strata:

- i) Inventory Label and Silviculture Label
- ii) BEC Subzone and site series
- ii) if NSR plantable spots per ha and species prescription
- iv) present brush species and levels and anticipated future levels
- v) one photo per treatment type, showing any significant differences observed.

5) Compilation of Grouped Strata and Treatment Units: Compile grouped openings into common treatment units and draft prescriptions for planting/brushing for NSR areas. Enter SR areas into RESULTS (following recommended procedures for entry of SSS into RESULTS – via the guidance document on RESULTS website) as stocked and schedule further treatments ,surveys or free growing surveys when appropriate.

9.4 Other Alternative Survey Methodologies

9.4.1 Green-up (Adjacency) Survey

9.4.1.1 Objective of a Green – up Survey

The objective of a green-up survey is to determine whether or not a cut block is greened-up as specified in a silviculture plan or prescription (FDP or FSP), or as specified in the appropriate Regulation – depending if the proposed new cut block is under a Forest Development Plan or Forest Stewardship Plan. In general for both regulation requirements, the surveyor must at least assess the following:

1. **Area Achieving Green-up Height**: Determine the **proportion of the net area** to be reforested, **meeting Density and Green-up Height requirements** below;
2. **Density**: Estimate the total density of commercially valuable species (TCV)– **Total Conifer count of preferred and acceptable species including other commercially valuable species if present – that are > 1.3 m. in height**;
3. **Green-up Height**: Estimate the **average height of the tallest 10%** of the above identified trees (**tallest trees in a 1/100 of a ha. plot – in a 5.64 m. radius plot**).

Prior to commencing green-up data collection, a surveyor must determine if cut block adjacency and green-up status, is an issue for the opening being assessed. Both FPC and FRPA have potential exemptions to green-up requirements, as well higher level plans may have approved exemptions and different value criteria for achievement of green-up. Therefore it is recommended for the surveyor to seek direction from the contract and/or licensee administrators regarding these specifics and requirement of data collection.

9.4.1.2 FPC – Forest Development Plan (FDP) and FRPA – Forest Stewardship Plan (FSP) New Cut Block’s Adjacency Assessment Requirements

The following are the general criteria for new cut blocks proposed under a FDP and FSP, required to achieve adjacency provision:

<u>New Cut Block Plan</u>	<u>1. Area Achieving Green-up Height:</u>	<u>2. Density</u>	<u>3. Green-up Height</u>
FDP	75%	800 TCV ₍₁₎ Coast 1000 TCV Interior	3 m.
		500 TCV Coast 700 TCV Interior	3.5 m.
FSP	75%	500 TCV Coast 700 TCV Interior	3 m.

- (1) **Commercially Valuable Species.** This is not defined in legislation – either in the old FPC or in the current FRPA and FPPR. Therefore as guidance, the use of the default definition in the “Green-up Guidebook” from the FPC era is recommended practice: ***“Commercially valuable species” would generally include the species listed in applicable Establishment to Free Growing guidebooks (currently the default Stocking Standards on the Stocking Standard website), regional mixed wood and hardwood stocking standards, and species included in the timber supply review as contributing to allowable annual cut (AAC).”***

9.4.1.3 Data Collection Method Options.

If a surveyor is assessing green-up for a new FDP cut block, more specific detail on data collection options and methodologies are contained in the FPC *Green-up Guidebook*. Note, that the sampling intensity of a minimum of 10 green-up plots per opening is only a guideline and not a requirement.

9.4.1.3.1 During a Free Growing Survey

The use or collection of green-up data from or during a free growing survey is the preferred options for surveyors. This is the most efficient opportunity to assess if green-up has been achieved or when one can forecast green-up achievement and prescribe a

verification recce survey.

Four scenarios are proposed for using or collecting green-up data from free growing data and procedures:

1. Free Growing Survey Recently Completed:

- a. With High FG Density and Height Data: The results can be used, as long as the FG trees on all of the strata (at least 75% of the net area) meets or exceeds the densities listed above for the plan for the cut block and that the FG height of the FG stems exceeds the required green-up heights to the corresponding densities.
- b. With Lower FG Density Data then required criteria: If FG trees alone are insufficient to meet the density requirement, the data could be mined (depending on the collect method – cards or data loggers) to extract just the well-spaced trees, regardless if they meet forest health criteria. As well total trees in surplus of the well-spaced and free growing trees (that are still preferred and acceptable species) could be added to the total density tally – for green-up trees need not be well-spaced. However the green-up height may not be reflected in the data or maybe lower than required. With this scenario, depending on the depth and reliability of the data mining, an on-site reassessment of the opening to verify the green-up criteria maybe required.

2. Additional Data to be Collected during a planned Free Growing Survey:

- a. With Apparent Adequate Density and Green-up Heights: Tally two addition data points per plot:
 - i. Total number TCV per plot - if different then total conifer (TC) count;
 - ii. Determine the height of the tallest preferred and acceptable species per plot, based on a 5.64 meter radius sweep.
- b. Without Obvious Adequate Density and/or Green-up Heights: If it is relatively clear after a walkthrough or walk-by prior to the establishment of plots, that the opening would not achieve green-up, tally only the following data, in order to roughly project when the opening could be expected to achieve green-up height and when to schedule a subsequent recce walkthrough to confirm green-up achievement:
 - i. Collect an average of the current leader lengths of the total preferred and acceptable species per plot.

9.4.1.3.2 During a Recce Walkthrough

When there is no reliable free growing data, or it is not obvious from the mined survey data that the opening is greened-up, an onsite inspection will be required. It is recommended that an initial ground or aerial inspection recce be performed to determine

if the opening is potential greened-up or not. If it appears potentially greened-up, then it is recommended to perform a recce walkthrough survey that could resemble the sampling design of a combination of a vector, representative or visual assessment of the opening. Sample points or plots can be established along the sampling transects, if desired and as required. Required data to be collected either at each plot or data point or for the complete summary for the opening are:

1. Tally of TCV species per ha. > 1.3m.;
2. The average height of the TCV trees per 5.64 plot and/or the average height of 10% of the preferred and acceptable species for the opening;
3. The % of the total strata NAR that has achieved green-up.

Note, that this sampling method is only recommend for experienced surveyors familiar with the local management issues in the survey area and they would be confident that their determination of green-up status, could be duplicated by another similarly experienced forest professional.

9.4.2 Use of Planting Quality Inspection plots (FS 704) to meet Regen Delay Declaration Survey

Under the *Forest Practices Code of British Columbia Act and FRPA*, stocking establishment can be achieved through [planting](#). Certain conditions must be met in order for the stocking requirements to be fulfilled at time of planting:

1. Less than 10 percent of the total trees after planting are natural regeneration or previously planted trees. (i.e., silviculture label = inventory label).
2. The minimum planting [inter-tree distance](#) must equal or exceed the minimum inter-tree distance specified in the silviculture prescription, site plan or FSP.
3. FS 704 plots are properly stratified (by standards unit) and evenly distributed over the opening.
4. All the species planted are listed as preferred for the applicable stratum in the silviculture plan or prescription. (On the rare occasion where both preferred and [acceptable species](#) are planted, the FS 704 plots are not sufficient.)
5. The well-spaced trees in the FS 704 plots are tallied to a maximum of the 'M' value for the target stocking standards (not the planting target stocking standard) in order to show that the minimum stocking has been met or exceeded. The total number of well-spaced trees (trees planted >minimum inter tree distance) should also be recorded and reported.

If all of the above conditions exist, the data from the FS 704 plots is adequate evidence that regeneration obligations have been met. The data should be compiled in the same format as a stocking survey report and requirements as outlined in regen milestone

declaration in RESULTS information submission specifications.

If more than 10% of the total trees after [planting](#), are naturally regenerated or previously planted trees, or any of the other conditions above do not exist, then a stocking survey must be carried out. The stocking survey can be completed in conjunction with the planting quality inspection or separately.

9.4.3 Use of Juvenile Spacing Quality Inspection plots (FS 749) to meet Free Growing Declaration Survey

[Juvenile spacing](#) quality inspection plots can be used to declare an opening free growing if all of the requirements of a [free growing survey report](#) are met, and submitted to the District Manager.

Additional data that is not normally collected as part of the juvenile spacing quality inspection plots will be required. The most thorough method to meet the reporting requirements is to complete a minimum number of five free growing plots while collecting the desired number of FS 749 plots.

The visual assessment sampling method is often suitable to collect the needed free growing data following spacing treatments.

10 Provincial Surveys

Accreditation and Training

In the 1980's a silviculture survey certification and training process was developed for British Columbia with the goal of ensuring quality silvicultural surveys. However, surveyors and survey contractors were dissatisfied with the process of certification and with the structure of the intensive five-day training course, followed by an exam. In 1995, the certification process changed to an accreditation process. This separated the training components from the examination.

There are no pre-requisites for the silvicultural surveyor accreditation exam. However, the average surveyor requires considerable field experience working under the guidance of experienced accredited surveyors before he or she can successfully complete the exam. To pass the examination, a person will need to meet a range of performance expectations as outlined in the [Silviculture Survey Accreditation](#) brochure produced by the Ministry of Forests, Lands, Natural Resource Operations and Rural Development.

To ensure that surveyors have sufficient opportunity to acquire the needed skills and knowledge required for accreditation, training modules will be available through educational institutes throughout the province. Refer to the Resource Practices Branch [silviculture surveys website](#) for an updated list of available training.

Accreditation exams are usually offered at the beginning and at the end of each field season. Dates and locations of the exams will be advertised on the Ministry of Forests, Lands, Natural Resource Operations and Rural Development [silviculture surveys website](#).

There is no expiry date for the silviculture surveyor accreditation certificate. Therefore, it is the responsibility of each surveyor to keep informed of any changes to standards and procedures.

The accreditation process provides no assurance that the survey work completed by any one person, or that any particular survey, is done to the recommended standard. It is not a replacement for diligent supervision and auditing.

In the fall of 2008, the Association of BC Forest Professionals (ABCFP) passed a bylaw to include Accredited Silviculture Surveyors as potential individuals eligible for Associated Member Status. This means that surveyors, who are not already members of the ABCFP as a RPF or RFT, can join this organization as an Associate Member. As an Associate Member of the ABCFP, one would have all of the benefits available to all other members and would have to abide by all of the professional and ethical conduct bylaws of all other members. The only difference in this Associate Membership is that the new member would only vote on items pertaining to this Associate Member class and would not be subject to random practice reviews. The cost of joining the ABCFP as an Associate Member is considerably less than registered members. The benefit to an individual accredited surveyor to join the ABCFP as an Associate Member depends on their current professional status and goals.

For more information on the silviculture surveyor accreditation process, contact the silviculture surveys program administrator at the MoFLNRORD office: Greg Jorgenson (778) 974-5622 or email <mailto:greg.jorgenson@gov.bc.ca>.

11 Appendices

Appendix 1: Glossary

Acceptable species: Acceptable species are ecologically suited to the site, but management activities are not aimed at establishing them. The reasons for including a species in this category may be increased site limitations, such as pest risk, for biodiversity.

Activity treatment unit (ATU): An area of land upon which a silviculture activity is planned and carried out, usually within the boundary of an opening (also see Treatment Unit).

Advance regeneration: Regeneration that was present on an opening prior to harvesting. Advance regeneration, if present, should be carefully evaluated to determine its potential for future management. This term was formerly known as advanced regeneration.

Age class: Any interval into which the age range of trees, forests, stands or forest types are divided for classification and use. Age class is defined by Resource Inventory Branch as groups of 20 years: 1 = 1-20, 2 = 21-40, etc.

Aspect: The direction toward which a slope faces.

Backlog area: The Forest Practices Code of British Columbia Act defines a backlog area as “an area, from which timber was harvested, damaged or destroyed before October 1, 1987, and that, in the District Manager’s opinion, is insufficiently stocked with healthy well-spaced trees of commercially valuable species”. See also [Backlog Reforestation Publications](#).

Bareroot seedling: Seedlings that are grown in nursery seedbeds, prior to [planting](#).

Basal area (BA): The cumulative cross sectional area of trees as measured at breast height. The calculation of the basal area can be derived using the following formula:

Average number of trees per plot found “in” a prism sweep × BAF of the prism used

Basal area factor (BAF): The factor used to multiply the number of trees found “in” during the prism sweep to yield the basal area per hectare. For example, with a BAF of 5, each tree found within the prism sweep represents 5 m²/ha of cumulative cross sectional area.

Basal resinosis: Large exudations of pitch at the base of the stem, found at or below the root collar. This symptom is often associated with Armillaria root disease or Warren’s root collar weevil.

Basic silviculture: The silviculture treatments that are carried out to ensure regeneration to the free growing stage.

BCTS: [British Columbia Timber Sales](#). Formerly known as the Small Business Forest Enterprise Program. BC Timber Sales is an independent organization within the B.C. Ministry of Forests created to develop Crown timber for auction to establish market price

and capture the value of the asset for the public.

Biodiversity: The full spectrum of flora and fauna that occurs in a geographic area. Biodiversity includes species diversity, genetic diversity and ecosystem diversity.

Biogeoclimatic classification: Ecosystem classification on the basis of vegetation, soils, topography and climate.

Biogeoclimatic zone: A geographic area having similar patterns of energy flow, vegetation and soils as a result of a broadly homogenous macroclimate. Biogeoclimatic zones are typically named after one or more [dominant](#) climax tree species occurring on zonal sites. The names often include a geographic or climatic modifier using the terms subzone, variant, site series, site type and site phase.

Breast height (b.h.): The standard height (1.3 meters above the point of germination) at which the diameter of a standing tree is measured.

Brush blade: A straight blade with curved teeth extending below the blade like a rake. The blade is mounted on the front of a prime mover, such as a crawler tractor or a skidder, for use in mechanical [site preparation](#).

Brush: This refers to competing vegetation, such as broadleaf species, shrubs or herbs.

Brushing: A silviculture treatment to remove broadleaf species, shrubs or herbs that compete with conifers for sunlight, water and soil nutrients.

Buffer strip: A strip of land where disturbance is either not allowed or the disturbance is closely monitored to preserve or enhance aesthetic and other qualities along or adjacent to roads, trails, watercourses and recreation sites.

Cartographic Manual: The Ministry of Forests [Cartographic Manual](#) document is no longer a current reference source, however many contracts refer to this document for guidance related to survey mapping.

CASI: Compact Airborne Spectral Imagery.

Chlorosis or chlorotic: Blanched or yellowish coloring of normally green foliage in plants, caused by a variety of factors, including nutrient or light deficiencies.

Clearcut: A silviculture system resulting in the harvesting of all trees from an area of forest land in a single cut.

Clinometer: An instrument for measuring vertical angles or slopes commonly used to calculate tree heights.

Co-dominant: In upper stands with a closed canopy, those trees whose crowns form the level of the canopy and receive full light from above, but comparatively little from the sides. In young stands, co-dominant trees have above average height growth.

Commencement Date: This term is defined by Section 70(1) of the Forest Practices Code. There are specific interpretations of the definition suited to the context where it is being applied. The two most common definitions are described below.

1. The date when harvesting, excluding road and landing construction, begins on the area

under the silviculture plan or prescription.

2. In the case of silviculture prescriptions on [backlog](#) areas, the commencement date is defined as the date any silviculture treatment, (i.e. [site preparation](#)); under the backlog silviculture prescription begins. Section 23 of the Forest Practices Code.

Commercial thinning: The thinning of older immature stands where trees have reached merchantable size, to provide an interim harvest and a financial return while maintaining or restoring a higher rate of growth on well-spaced, better quality final crop trees.

Competing vegetation: Vegetation that competes for the limited common resources (space, light, water and nutrients) of a forest site that are otherwise needed for survival and growth by commercially valuable preferred trees.

Conifer: Cone bearing tree having needles or scale-like leaves, usually evergreen and producing wood known commercially as softwood.

Container seedling: Seedling grown in small containers in a controlled nursery environment.

Countable conifer: Conifers meeting or exceeding a minimum countable height and counted towards the maximum density determination during a free growing survey. See also [Maximum density](#).

Countable height: The height above which all trees are tallied and considered as countable conifers

Crop tree: A tree in a young stand selected to be retained until final harvest.

Crown closure: The stand condition resulting in the crowns of trees touching and effectively blocking sunlight from reaching the forest floor. Crown closure is expressed as a percentage.

Cut block: A specific area with defined boundaries authorized for harvest.

Danger tree: Any tree that is hazardous to people or facilities because of it's location, degree of lean, physical damage, overhead hazards, limb, stem, top or root system deterioration, or a combination of any of these. If work in a forestry operation will expose a worker to a dangerous tree, the tree must be removed.

DBH (diameter at breast height): The stem diameter of a tree measured at breast height, 1.3 meters above the point of germination.

DIB (diameter inside bark): The diameter of a tree or log excluding bark thickness.

Decay: The disintegration of plant tissue. The process by which sound wood is decomposed by the action of wood-destroying fungi and other micro-organisms.

Deciduous: Term applied to trees, commonly broadleaf trees, which usually shed their leaves annually. Also known commercially as hardwoods.

Declination (magnetic): The angle between true north and magnetic north. Declination varies from place to place and can be set on a compass for a particular location.

Defoliator: An agent that damages trees by destroying leaves or needles.

DFP (Deviation from potential): A new approach to regeneration stocking assessment

in partially cut stands in the BC interior.

Disc trencher: A machine designed for mechanical [site preparation](#). Disc trenchers consist of rotating scarifying steel discs equipped with teeth that create rows. The discs are attached to the rear of a prime mover such as a skidder.

Dominant: Trees with crowns extending above the general level of the canopy and receiving full light from above and partly from the side. Dominant trees are taller than the average trees in the stand, with well-developed crowns.

Drag scarification: A method of [site preparation](#). The objective of drag scarification is to disturb the forest floor and to prepare harvested areas for natural regeneration. Drag scarification is done with anchor chains or sharkfin barrels. These tools are large, specially constructed steel chains that are dragged behind a prime mover such as a skidder.

Dripline: It is a visual boundary for assessing understorey tree's minimum distance from an overstorey tree. The boundary is defined by where the main stem of the understorey tree is **outside** of the outer foliage of the overstorey tree.

DSH (Diameter at stump height): The diameter of a tree, as measured at 30 cm above the point of germination. Also referred to as DBHg, diameter at ground.

Ecosystem: The sum of plants, animals, environmental influences and their interactions within a particular habitat.

EDT: Electronic data transfer.

Even-aged: A forest stand or a forest type in which relatively small (10 - 20 year) age differences exist between individual trees. Even-aged stands are often the result of fire, or a harvesting method such as [clearcutting](#), or the shelterwood method.

FCAPS: Forest Cover Attribute Processing System

Fertilization: The addition of fertilizer to promote tree growth on sites deficient in one or more soil nutrients. Commonly used to improve the vigor of crop trees following [juvenile spacing](#) or commercial thinning.

FC1: The digital map files of forest cover maps, i.e. 93B035 FC1. This file contains the forest cover map data for map sheet 093B035.

FG: Free growing

Fill planting: Supplementary [planting](#) required to augment poorly stocked natural regeneration or to replace seedlings that have died on previously planted sites.

FIP (Forest Inventory Polygon): This is a digital file containing the information that describes the forest resource growing on each polygon on a forest cover map.

Forest and Range Practices Act: The 2004 replacement to the Forest Practices Code. The [Forest and Range Practices Act](#) is the most current form of forest management legislation in British Columbia.

Forest cover inventory: This means “a survey of trees and tree-related matters in an area that includes information required by the minister”.

Forest cover labels: A combination of letter and number codes in a sequential order that describes the forest cover characteristics.

Forest cover map: A map showing relatively homogenous forest stands or cover types produced from the interpretation of aerial photos and from information collected from field surveys. Commonly includes information on species, [age class](#), [height class](#), site and stocking level.

Forest Development Plan: An operational plan under the Forest Practices Code containing a licensee's plans for harvesting, road construction and silviculture activities.

Forest ecology: The relationship between forest organisms and their environment.

Forest health factor: Biotic or abiotic influences on the forest that are usually naturally occurring components of forest ecosystems. Biotic influences include fungi, insects, plants, animals, bacteria and nematodes. Abiotic influences include frost, snow, fire, wind, sun, drought, nutrients and mechanical human caused injury.

Forest health pest: A [forest health](#) that limits the ability to meet resource management objectives.

Forest Licence (FL): A forest licence is a form of tenure which allows the orderly timber harvest over a portion of a sustained yield management unit. The forest licence provides for the timely reforestation of these harvested areas according to a strategic resource management plan prepared by the Ministry of Forests, Lands, Natural Resource Operations and Rural Development for each timber supply area. The licence commonly has a term of 15 to 20 years, generally replaceable every five years (some are non-replaceable) and operating areas that shift over time. A forest licence specifies an annual allowable cut, requires a management and working plan and specified management activities.

Forest Practices Code (FPC): The Forest Practices Code is a term commonly used to refer to the Forest Practices Code of British Columbia Act. This also includes regulations by Cabinet under the Act and the standards established by the Chief Forester of BC. The term may sometimes be used to refer to Guidebooks. It should be remembered that unlike the Act, the Regulations and the Standards, Guidebooks are not legally enforceable. See also [Forest and Range Practices](#).

Forest Stewardship Plan: A plan (or document) that is (a) required under section 3 of the Forest and Range Practices Act or (b) approved under section 16[1] of the Forest and Range Practices Act.

Fork: A deformation of the main stem resulting in two or more leaders.

FPC: Forest Practices Code.

Free growing height: The minimum height that a crop tree must attain before it forms part of a free growing stand.

Free growing tree: A healthy, preferred or [acceptable](#) well-spaced tree that is at least the minimum height and is at least the minimum size relative to [competing vegetation](#) within the effective growing space.

Free growing stand: A stand of healthy trees of a commercially valuable species, the growth of which is not impeded to an unacceptable level by competition from plants, shrubs or other trees.

Fruiting body: The reproductive part of a fungus that contains or bears spores.

Gall: Nodule or lump of malformed bark or woody material caused by a variety of factors such as western gall rust or insects.

Galleries: Passages carved out under bark or in wood by insects feeding or laying eggs.

Ghost tree: Trees that, for a specified reason, will not count towards the stocking of the stand but has an impact on the development of the regeneration.

GI: Growth intercept

Girdling: To kill a tree by severing or damaging the cambium layer and interrupting the flow of nutrients between the leaves and the rest of the tree. Girdling is carried out using a hatchet or special tool to cut through the bark and the cambium.

Global Positioning System (GPS): A navigational tool that allows the user to determine their location on the surface of the earth. The location is determined using a hand held or aircraft mounted instrument and the radio signals from several satellites.

Gouting: Excessive swelling of a branch or shoot, often accompanied by misshapen needles and buds. Gouting is most common at nodes or on branches and is frequently caused by balsam woolly adelgid on *Abies* species.

Growing season: The period of active growth from the start of bud elongation until bud set.

ha: Hectare

Hack and squirt: A method of killing a tree. The bark of the tree is cut (hack) and herbicides are injected into the wound (squirt).

Height class: Any interval into which a range of tree heights is divided for classification and use.

Herbicide: Chemical substances or living organisms that are used to kill or to control vegetation such as brush, weeds and competing or undesirable trees.

Immature: Trees or stands that have grown past the regeneration stage, but are not yet mature.

Incidence: The proportion (0 to 1) or percentage (0 to 100) of entities (normally a tree) affected by [forest health](#) within a sample unit. This can easily be referred to as the proportion or percentage of forest health factors present within an opening.

INCOSADA: Integrated Corporate Spatial and Attribute Database.

Incremental silviculture: Refers to treatments carried out to maintain or to increase the yield and the value of forest stands. Treatments include site rehabilitation, conifer release, spacing, pruning and fertilization.

Indicator species: Plant species used to predict site characteristics with respect to site

moisture and site nutrients in the biogeoclimatic classified system.

Infections: Characterized by lesions on the stem and/or branches, or characterized by swellings around the point of entrance of a pathogen.

Influence trees: Trees growing outside the plot radius whose effective growing space projects inside the plot radius.

Injury: Damage to a tree by a biological, physical or chemical agent.

Inter-tree distance: The horizontal distance between two trees on a center to center basis. Inter-tree distance is calculated or measured to the nearest 1/10 of a meter, unless otherwise specified. See also [Minimum Horizontal Inter-tree Distance Section](#).

Intermediate Cut: Stand entries to remove (usually merchantable) trees prior to the final harvest or regeneration cut phase. Usually designed to modify the stand so that continued stand development enhances the quality or growth of established trees.

ISIS: Integrated Silviculture Information System. Replaced by [RESULTS](#)

Juvenile spacing: A silviculture treatment resulting in the reduction in density of young stands, preferably between 3 meters to 5 meters in height, to control stocking, prevent stagnation and improve crop tree quality so that at final harvest end-product quality and value is increased.

Landing: The area where logs are collected for loading.

Layered: A stand is considered layered if the stand is being managed as an even-aged system, where a single harvest entry is planned for all layers within longer rotation cycles (>50 years), and layer 1 and/or 2 are dominant and one of these two layers is considered in combination with 3 and/or 4. (an even aged system)

LCL: see [Lower Confidence](#).

Leader: The annual growth of the apical meristem of a tree. It is the extension of the main stem.

Leave trees: Trees selected to be left on an area following harvesting, [juvenile spacing](#) or commercial thinning.

LFH (Litter-Fermentation-Humus): The accumulation of organic material over mineral soil. L, F, and H refer to litter, fermentation and humus respectively.

Licensee: Tenure holder. See Tenure.

Lower Confidence Limit: This statistical value indicates the lowest average number of well-spaced trees per hectare that another survey on the stratum would be expected to find, nine times out of ten.

The LCL of 90 percent must be attained before the opening can be considered satisfactorily restocked or free growing.

Mature: Trees or stands that have sufficiently developed to be harvested.

Maximum density: The maximum allowable stand density of total countable conifers, above which openings must be spaced down to a specified density of well-spaced

preferred and/or acceptable stems in order to achieve free growing status. See also [Maximum Density](#).

Median Height: The middle height. Used in the countable conifers and countable broadleaf determination. Refer to [Figure 6](#) and [Figure 7](#) for illustrations of this concept.

Mesic: Within the biogeoclimatic classification system, mesic sites are those that are most common (average) within a single zone. It may also be referred to as zonal.

Microclimate: The climate of small areas, especially if it differs significantly from the climate of the region.

Microsite: A small area exhibiting specific characteristics that are different from the surrounding area. During [planting](#) projects, microsite is commonly referred to as ‘acceptable microsite’. Acceptable microsites are those spots that are best suited for the optimum survival and growth of the planted tree.

Milestone Survey: There are two important reporting points and as a result two milestone surveys. These are the regeneration delay survey and the free growing survey. Stocking surveys are not milestone surveys.

Minimum height at free growing: The minimum height that a healthy, well-spaced tree must attain in order to be considered free growing. On areas for which a silviculture plan or prescription was approved on or after April 1, 1994, minimum heights vary by species, biogeoclimatic zone and site series.

Minimum inter-tree distance (MITD): The minimum horizontal distance between two trees on a center-to-center basis. [Inter-tree distance](#) is calculated or measured to the nearest 1/10 of a meter, unless otherwise specified. See also [Minimum Horizontal Inter-tree Distance](#).

Minimum preferred stocking standard (MSSp): The minimum number of well-spaced trees per hectare, of preferred species only, that must be present for the stratum to be considered satisfactorily restocked or free growing.

Minimum stocking standard (MSS, MSSp+a): The minimum number of well-spaced trees per hectare, of [preferred](#) and [acceptable species](#), that must be present for the stratum to be considered satisfactorily restocked or free growing.

MLSIS: Major Licensee Silviculture Information System, in the late 1990’s. This system was integrated into ISIS then RESULTS.

Moder: A humus form characterized by a greater than 1 centimeter thick F horizon and an Ah layer. Typically soil organisms are responsible for the intermediate decomposition rates through soil mixing.

MOF, M of F, MOFLNRORD: Ministry of Forests, Lands, Natural Resource Operations and Rural Development.

Monoculture: Cultivation of a single tree species.

Mor: A humus form characterized by a greater than 1 centimeter thick F horizon and an absent Ah layer. Typically, decomposition is slow due to a lack of soil organism.

Mosaic: Distinct strata that occur in a dispersed manner.

MSS: Minimum stocking standards.

Mull: A humus form developing under conditions that favor rapid decomposition of organic matter. F layers are generally less than 1 centimeter thick, Ah layers are greater than 2 centimeters thick and extensive soil mixing is caused by soil organisms.

Multi-storey: A stand is considered multi-storied if layer 1 and/or layer 2 have a [crown closure](#) greater than 6 percent and one of these two layers is considered in combination with layer 3 and/or layer 4. (an uneven aged system)

M-value: The maximum number of healthy, well-spaced trees that may be tallied in a single plot. This value is calculated by dividing the target stocking standard for the stratum by the [plot multiplier](#). This prevents over-stocking in one plot compensating for under-stocking in others. This is a key concept in the survey system.

NAR: Net area to be reforested.

Natural regeneration: The renewal of a tree crop by natural means.

NCBr: Non-commercial brush.

Net area to be reforested (NAR): The area on which the licensee is responsible for establishing a free growing crop of trees. This figure is the sum of Standard Unit (SU) areas. The NAR does not include any man caused non-productive areas, reserves of immature trees, and natural non-productive areas that are large enough to stratify and map, as well as non-commercial brush areas greater than 4 hectares that are not deemed to be the obligation of the licensee. Non-productive or non-commercial areas that are too small to stratify are included in the SU area.

Node: A joint or portion of a stem from which a leaf or branch has grown.

Non-commercial brush (NCBr): Describes a potentially productive forest site that is occupied by shrubs and other deciduous species that are not utilized commercially.

Non-productive (NP): Land that is incapable of growing a merchantable stand within a reasonable length of time.

Not satisfactorily restocked (NSR): Productive forest land that has been denuded and has not been regenerated to the specified stocking standards for the opening.

No-work zones: Areas in which equipment and people are not allowed during forestry operations, usually for safety or ecological reasons.

NP: Non-productive.

Not FG: Not free growing.

NSR: Not satisfactorily stocked.

Opening: An area denuded of trees by means of harvesting, insects, disease, fire, wind, flooding, landslide or by any other similar events.

Overmature: Those trees or stands past the mature stage, which commonly have a higher level of damage and decay.

Overstorey: Generally layer 1 and/or 2 trees growing that may be as a full or partial canopy over layer 3 and /or 4 trees. These may be conifers and or broadleaf trees.

Overtopping: Vegetation that is taller than the crop species, within a 1 meter radius around the crop species.

Pesticides: A general term for chemicals used to kill either vegetative pests (herbicides) or insect pests (insecticides).

PHSP: Pre harvest silviculture prescription.

Planting (artificial regeneration): Establishing a new stand by [planting](#) seedlings or by direct seeding, as opposed to natural regeneration.

Plantable spot: A suitable microsite on which a seedling could be planted. The suitability of the microsite is dependent on site conditions and limiting factors such as soil moisture, soil temperature, soil nutrients, climatic conditions, tree species and stock type to be planted.

Plantation: A human-made forest, usually established by [planting](#) seedlings.

Plot multiplier: The factor used to multiply the tree count in the survey plot to yield the equivalent stems per hectare. It is calculated by dividing the area of one hectare (10 000 m²) by the area of the sample plot. For example, a plot radius of 3.99 m has an area of 50 m² and a resulting [plot multiplier](#) of 200. ($10\,000\text{m}^2 \div 50\text{m}^2 = 200$)

Plug: A seedling grown in a small container under carefully controlled nursery conditions. When seedlings are removed from containers for [planting](#), the nursery soil remains bound up in their roots.

Point of Commencement (POC, P of C): This term is used to describe “the starting place” of a survey. POCs should be tied into features indicated on the forest cover map or on an air photo (e.g. road junctions, creek crossings or junctions, or block boundaries).

Polygon (or called Stratum): A subdivision of a forest area to be inventoried based on a group of trees with the same or similar species composition, age, and/or [height class](#), (plural = strata).

Population: Consists of the total number of the observations with which we are concerned (e.g., all the well-spaced trees in an opening).

Potential Free Growing Tree: The concept used in the Free Growing Guidelines to identify a tree that may be free growing if there are less than a specified number of countable sized broadleaf trees present in the plot.

Potential Danger Tree: Loosely defined as usually dead trees that may pose a hazard to crews conducting treatments. Wildlife Danger Tree assessment would be necessary to determine it's hazard status. The term snag may have been previously used to describe these.

Preferred species: Those species ecologically suited to the site. Management activities are primarily aimed at establishing preferred species. The characteristics of these species are consistent with the desired timber and non-timber objectives for the opening.

Pre-harvest silviculture prescription (PHSP): A legally binding, site-specific plan describing the nature and extent of any timber harvesting and silviculture activities carried out on an opening. The PHSP outlines the required management objectives, standards and timelines that the owner of the opening must achieve, including reaching a free growing stand. PHSPs are the ‘pre-Forest Practices Code’ equivalent to Silviculture Prescriptions. With the initiation of the Forest Practices Code, all PHSPs will be treated in the same manner as silviculture prescriptions.

Preparable spot: A microsite that is presently unsuitable for [planting](#) but, with [site preparation](#), would become an acceptable [planting](#) microsite.

PRF: plot radius factor

Prime mover: Heavy equipment used to tow other machines such as disc trenchers for [site preparation](#).

Prism: An optical instrument consisting of a thin wedge of glass. The prism creates the appearance that part of the object being looked at is laterally displaced. If the object and the displaced part of the object overlap, the object is “in” the plot, and if there is no overlap, then the object is “out” of the plot. A prism sweep results in the tally of stems based on stand [basal area](#) using a variable radius plot.

Pruning: The removal of the lower branches of crop trees to a pre-determined height, usually correlated to log lengths, to produce clear, knot-free wood. Knot-free wood increases the value of the final wood products.

PSS: [Planting](#) stocking standard

Rank: A term used in inventory labels. It describes the relative position of a layer in its progression toward merchantability. Rank 1, for example, denotes the next potentially harvestable layer of a stand. Rank is no longer used.

Reforestation: The natural or artificial restocking of an area.

Regeneration date / delay: The date by which a minimum number of healthy, well-spaced trees of both the preferred and [acceptable species](#), and the minimum number of preferred species, must be established, and afterwards maintained until the stand is declared free growing.

Reserve: An area of forest land that, by law or by policy, is not available for harvesting. Areas of land and water set aside for ecosystem protection, outdoors and tourism values, preservation of rare species, wildlife protection, etc.

The retention of live or standing dead trees following harvest for purposes other than regeneration that are pole size or larger. Reserves can be uniformly distributed as single trees or left in small groups.

Reserve tree: A tree that is specifically reserved from harvesting and/or silviculture activities.

Reserve zone: The inner portion of a riparian management area situated adjacent to a stream, lake, or wetland. Reserve zones are established to conserve and to maintain the productivity of aquatic and riparian ecosystems.

Residual basal area: The [basal area](#) per hectare left standing after harvest.

Residuals (residual trees): Trees left standing after harvesting.

RESULTS: This is an acronym for Reporting Silviculture Updates and Land status Tracking System. This is the Ministry of Forest's corporate database and application used to track silviculture information on openings. Additional information about [RESULTS](#) can be found at this link.

Riparian: An area of land adjacent to a stream, river, lake or wetland that contains vegetation that, due to the presence of water, is distinctly different from the vegetation of adjacent upland areas.

Riparian Management Area (RMA): An area of specified width surrounding or adjacent to streams, lakes, riparian areas and wetlands. The RMA includes, in many cases, adjacent upland areas. It extends from the top of the stream bank (bank full height) or from the edge of a riparian area or wetland or the natural boundary of a lake, outward to the greater of: 1) the specified RMA distance, 2) the top of the inner gorge, or 3) the edge of the flood plain. Where a riparian area or wetland occurs adjacent to a stream or lake, the RMA is measured from the outer edge of the wetland.

Riparian Reserve: A type of reserve adjacent to a water body.

Rotation: The planned number of years between the formation or regeneration of a tree crop or stand and its final cutting at a specified stage of maturity. Rotation can be based on physical, biological, pathological or economic criteria.

Rotation age: The age at which a stand is considered mature and ready for single entry harvesting under an [even-aged](#) management strategy.

RPF (Registered Professional Forester): A person registered under the Foresters Act who performs or directs works, services or undertakings requiring specialized knowledge, training and experience in forestry.

Sanitation cutting: Improving the growth and health of young stands by removing damaged or diseased stems.

Sapling: A young tree that is larger than a seedling but smaller than a pole. Size varies by region.

Satisfactorily restocked (SR): Productive forest land that has been denuded and subsequently regenerated to the specified stocking standards in the silviculture plan or prescription.

SBFEP: Small Business Forest Enterprise Program. This is now known as BC Timber Sales.

Scalping: A [site preparation](#) method that exposes favorable mineral soil in which tree seedlings can be planted.

Scar: A mark left after re-growth of damaged tissue following an injury.

Scarification: See Drag Scarification.

Screefing: Removing organic material to a specified depth.

Second growth: A second forest that develops after harvest of the original mature forest.

Seed orchard: An area of specially planted trees that have been selected for their superior characteristics to breed genetically improved seed.

Seedbed: In natural regeneration, the soil or forests floor on which seed falls. In nursery practice, a prepared area over which seed is sown.

Seedlot: A quantity of cones or seeds having uniformity of species, source, quality and year of collection.

SEMS: Silviculture Electronic Mapping System.

Seral Species: A tree species (or plant) that is adapted to exist during a specific period of forest succession or seral stage.

Shade-tolerance: The capacity of a tree or plant species to develop and grow in the shade of other trees or plants. Shade tolerance is one trait of the silvics of a species and independent of competition vigor.

SIBEC: An acronym for the method of determining site index which uses biogeoclimatic classification system.

Silviculture: The art and science of managing the establishment, growth, composition, health and quality of forests and woodlands to meet the diverse needs and values of landowners and society on a sustainable basis.

Silviculture plans and prescriptions: The generic term used in this document to describe collectively the documents containing the documents which contain the applicable stocking standards and stand management objectives. Pre-harvest Silviculture Prescription (PHSP), Silviculture Prescription (SP), Forest Development Plan (FDP), Forest Stewardship Plan (FSP) and Site Plan (SP) may all be included under this heading.

Silviculture prescription (SP): A legally binding, site-specific plan describing the nature and extent of any timber harvesting and silviculture activities carried out on an opening. The Silviculture Prescription outlines the required management objectives, standards and timelines that the owner of the opening must achieve, including reaching a free growing stand. Prior to the Forest Practices Code, silviculture prescriptions were known as [pre-harvest silviculture prescriptions \(PHSPs\)](#). The silviculture prescription is one of the many forms of silviculture plans and prescriptions.

Silviculture survey: An examination of an opening for the purpose of providing information to the forest manager on how the site and the stand are progressing relative to the prescribed management objectives.

Silviculture Treatment Regime: A legally required, site-specific list of silviculture treatments that can reasonably be expected to produce the designated stocking levels specified in the site plans by the end of the determined free growing assessment period. Found as a component of a Forest Development Plan and may be part of Forest Stewardship Plan. This regime must be prepared and kept on file by a registered professional forester. Refer to Section 11 of the Silviculture Practices Regulation for

more information.

Site class: The measure of the relative productive capacity of a site. No longer used after approximately 1995. It was replaced by [site index](#).

Site class conversion: The method of determining [site index](#) by estimating the site class then using the table below to convert site class to site index. This method is the least accurate of site index determination methods.

There are very few instances where this method should be used for conifers. Consider why you have not selected one of the more representative methods before selecting to use the site class conversion method to determine site index.

Inventory Label Leading Species	Region	Good	Medium	Poor	Low
Broadleaf Species					
Ac	Province	26	18	9	3
At	Province	27	20	12	4
Dr	Province	33	23	13	6
E, Ea, Ep	Province	27	20	12	4
B, Ba, Bg	Coastal	29	23	14	5
B, Ba, Bg	Interior	18	15	11	5
Mb	Province	33	23	13	6
Conifer Species					
Bl	Province	18	15	11	5
Cw	Coastal	29	23	15	6
Cw	Interior	22	19	13	5
Fd	Coastal	32	27	18	7
Fd	Interior	20	17	12	5
H, Hm, Hw	Coastal	28	22	14	5
H, Hm, Hw	Interior	21	18	12	4
L, La, Lt, Lw	Province	20	18	10	3
Pa, Pf, Pj, Pl	Province	20	16	11	4
Pw	Province	28	22	12	4
Py	Province	17	14	10	4
S	Coastal	28	21	11	4
S	Interior	19	15	10	5
Ss	Province	28	21	11	4
Sb, Se, Sw	Province	19	15	10	5
Yc	Coastal	29	23	15	6
Yc	Interior	22	19	13	5

Table 13: Site Class to Site Index Conversion

Site index: A measure of site growth potential for a given tree species over a fixed time period. It is the average top height of trees of a certain species at fifty years measured at breast height. The top height trees are the 100 largest [DBH](#) trees per hectare of the species being considered. The breast height age is the number of annual growth rings at 1.3 m from the point of germination.

A complete discussion on [site index](#) determination can be found at:

<http://www.for.gov.bc.ca/hfp/training/00011>

Site Plan: The post 2000 Forest Practices Code form of [silviculture prescription](#).

Site preparation: Disturbance of an area's topsoil and ground vegetation to create conditions suitable for regeneration.

Site rehabilitation: The conversion of potentially productive land presently occupied by stands of undesirable species or by brush, back to a condition appropriate for establishing desired coniferous species.

Site series: Subdivisions of site associations. Site series include all sites within a biogeoclimatic subzone that are capable of producing the same climax vegetation unit or plant association.

Skid trail: A roughly formed, temporary forest trail suitable for use by horses or equipment such as skidders in hauling trees or logs from the place of felling to a landing.

Slash: The residue left on the ground after felling, [juvenile spacing](#), [brushing](#), pruning or commercial thinning that includes cut trees, uprooted stumps, branches and broken tops.

Sliding rule: The ability to move the early free growing date earlier an amount of time equal to the amount of time the regeneration requirements were met before the regeneration date. This has no effect on the late free growing date. An amendment or other form of approval is not required. See also [Adjusting the Early Free Growing Date](#).

Slope correction tables: Tables with conversions from slope distance to horizontal distance.

Snag: A historic term for standing dead tree, greater than 3 m in height. These are often used by birds for nesting or by wildlife for refuge. They can be a hazard to forest workers, as they could fall unexpectedly. Terms Danger tree or Wildlife tree are more current.

Spacing: See [juvenile spacing](#).

sph: Stems per hectare. This term is interchangeable with trees per hectare or tr/ha.

Satisfactorily restocked (SR): Productive forest land that has been denuded and has been regenerated to the specified stocking standards for the opening.

Stand density: A relative measure of the amount of stocking on a forest area. Often described in terms of stems per hectare.

Stand management prescription (SMP): A site-specific plan describing the nature and extent of the silviculture activities planned for a free growing stand of trees. SMPs facilitate the achievement of specified social, economic and environmental objectives.

Stand tending: A variety of forest management activities carried out at different stages in the life of a stand. Treatments may include [juvenile spacing](#), [brushing](#), commercial thinning, fertilization, conifer release, site rehabilitation, mistletoe control, seed tree control and pruning.

Standards Unit (SU): An area within a cutblock that is subject to uniform: limits for soil disturbance and regeneration dates, stocking standards, free growing dates and free growing heights.

Statistical sampling: The selection of sample units from a population and the

measurement and/or recording of information on these units to obtain estimates of population characteristics.

Stocking class: A numeric code representing a range of stems per hectare. Example, stocking class 1 is mature, with 76+ stems/ha of > 27.5 cm [dbh](#); stocking class 2 is mature, with < 76 stems/ha; stocking class 0 is immature.

Stocking standards: Stocking standards detail site-specific legal requirements that are stated in a pre-harvest silviculture prescription, silviculture prescription, site plan, Forest Development Plan or Forest Stewardship Plans. They specify the standards required to reforest denuded areas with a healthy new crop of trees within specific time frames. Stocking standards include, but are not limited to, such information as the target and minimum number of healthy, well-spaced, preferred and acceptable trees per hectare, the conifer to brush ratio, the maximum density, the regeneration date and the early and late free growing dates.

Stocking status: Stocking is an indication of growing space occupancy relative to a pre-established standard. Status refers to whether the site has met those standards. Stocking status is most often described as satisfactorily restocked, not satisfactorily restocked, free growing or not free growing.

Stocking survey: A survey used to determine the [stocking](#) of an opening by describing both the preferred and acceptable well-spaced and total trees, and to generate an inventory label for updating the forest cover map.

Stratification: The process of defining and identifying populations with similar characteristics within an opening.

Stratum (or called Polygon): A subdivision of a forest area to be inventoried based on a group of trees with the same or similar species composition, age, and/or [height class](#), (plural = strata).

Suppressed: Trees with crowns entirely below the general level of the crown cover and receiving little or no direct light from above or from the sides.

Survival assessment: A survey that estimates the percentage of trees living after a set period of growth after [planting](#).

Target stocking standard (TSS): The number of well-spaced, preferred and acceptable trees per hectare that will, in normal circumstances, produce an optimum free growing crop. Target stocking standards are those standards that should be achieved through silviculture activities.

Tenure: The holding of a property. Land tenure may be broadly categorized into private lands, federal lands and provincial crown lands. The Forest Act defines a number of forestry tenures by which the cutting of timber and other user rights to provincial crown land are assigned. For example, Forest Licence.

Transplanting: Moving seedlings from one place to another.

Treatment prescription: A legal document describing the operational details required for carrying out individual silviculture activities such as [site preparation](#) and [planting](#).

Treatment Unit (TU): An area of land upon which a silviculture activity is planned and carried out, usually within the boundary of an opening. In old PHSPs, TUs are areas managed through the uniform application of stocking standards. In newer SPs, TUs are now referred to as Standards Units (SUs).

Tree Farm Licence (TFL): A form of tenure agreement which allows the long-term practice of sound forest management and harvesting on Crown land or on a combination of Crown and private land, by private interests under the supervision of the MOF.

TRIM: Terrain Resource Information Management

Understorey: Generally layer 3 and 4 trees growing under the full or partial canopy of layer 1 and 2 trees. These may be conifers and or broadleaf trees.

Uneven-aged: Stands with a wide range of ages and sizes.

Uniform Leave Tree (ULT): A type of reserve where trees are retained in an even pattern of distribution.

Vet (veteran): A living remnant of a former stand. When used in the context of inventory labels, vets must have a combined [crown closure](#) of less than six per cent and must be at least 40 years older and 10 m taller than the main stand. This term is being phased out.

Walk-through: An initial reconnaissance of an opening prior to the onset of a survey.

Well-spaced stems per ha: The number of healthy, preferred and acceptable trees, in one hectare, that are all at least the minimum horizontal [inter-tree distance](#) from one another. The inter-tree distance is specified in the silviculture plan or prescription.

Whorl: An arrangement of branches in a circle around a stem or tree trunk often, but not always, associated with one year's height growth.

Wildlife tree patch (WTP): An area specifically identified for the retention and recruitment of suitable wildlife trees. It can contain a single wildlife tree or many. A wildlife tree patch is synonymous with a group reserve.

Wildlife tree: A standing live or dead tree with special characteristics that provide valuable habitat for the conservation or enhancement of wildlife. Characteristics include large diameter and height for the site, current use by wildlife, a declining or dead condition, value as a species, valuable location, and relative scarcity.

Windrowing: The concentration of slash, branches and debris into rows to clear the ground for regeneration. Windrows are often burned.

Wound: An injury that removes a portion of the bark and cambium from the tree, but does not penetrate into the sapwood. Wounds often serve as entry points for wood decay fungi.

Xeric: The driest site series within each unit of the biogeoclimatic system. Xeric is always referred to as an 02 site series.

Zonal: Within the biogeoclimatic classification system, zonal sites are those that are the most common or average within a single zone. It may also be referred to as mesic.

Appendix 2: Determining area of dispersed strata

For dispersed strata, it is necessary to determine the area represented by each stratum found on an opening. Although the area represented by each stratum may be estimated, a more quantitative measurement may be desired. In this event, there are two methods to consider: Line Intersect and High Intensity Point Sampling.

Option 1: Line Intersect

One method of determining the area represented by each stratum, in dispersed strata, is the line intersect survey. The amount of strip line that crosses each stratum is used to calculate the proportion of the opening that is represented by that stratum. The amount of strip line per hectare required to be sampled on an opening is dependent upon the characteristics of the stratum. An opening with two evenly distributed strata requires less strip line than an opening with more strata or less evenly distributed strata.

Option 2: High Intensity Point Sampling

Another method of determining the area represented by each stratum, in dispersed strata, is the high intensity point sampling survey. The intent of this survey is to tally large quantities of very simple point samples. The data is used to estimate the area of each stratum. This [sampling method](#) provides the same results as the line intersect survey, but uses a less onerous field procedure.

There have been no statistical analyses of these procedures to determine the number of point samples required to calculate the precision of the survey. Initial estimates suggest that 100 point samples is a reasonable preliminary sampling intensity.

The following steps describe the point sampling process:

1. Describe each stratum or forest type.
2. Establish the desired quantity of point samples in a systematic method.
3. At each point sample, mark a ✓ or a ✕ to indicate which stratum or forest type the sample is within.

Plot	Stratum/ Forest Type A	Stratum/ Forest Type B	Stratum/ Forest Type C	Stratum/ Forest Type D	Comments
	SR & FG	SR but not FG	NSR	NP	
1	✓				
2	✓				
3		✓			alder
4	✓				
5	✓				
6			✓		plantable
7	✓				
8			✓		slash, but plantable
9				✓	rock, no stumps
10		✓			alder
11	✓				
12	✓				

# of Point Samples					
100	85	10	4	1	

Stratum A	Stratum B	Stratum C	Forest Type D
SR & FG	SR but not FG	NSR	NP
85%	10%	4%	1%

Figure 24a. High Intensity Point Sample Plot Card

Appendix 3: List of References and Hyperlinks

The following references are useful to silviculture surveyors in British Columbia. This is not an exhaustive list, however.

Acts

[Ministry of Forests Act](#)

<http://www.for.gov.bc.ca/tasb/legsregs/minfor/minfact/mofa.htm>

[Forest Act](#)

<http://www.for.gov.bc.ca/tasb/legsregs/forest/foract/contfa.htm>

[Forest and Range Practices](#)

<http://www.for.gov.bc.ca/tasb/legsregs/frpa/frpa/frpatoc.htm>

[Forest Practices Code](#)

<http://www.for.gov.bc.ca/tasb/legsregs/fpc/fpcact/contfpc.htm>

Regulations

[Forest Planning and Practices Regulation](#)

<http://www.for.gov.bc.ca/tasb/legsregs/frpa/frparegs/forplanprac/fppr.htm>

[Woodlot License Planning and Practices Regulation](#)

<http://www.for.gov.bc.ca/tasb/legsregs/frpa/frparegs/woodlotlicplanprac/wlppr.htm>

Guidebooks

[*Establishment to Free Growing Guidebook Cariboo*](#)

<http://www.for.gov.bc.ca/tasb/legsregs/fpc/FPCGUIDE/FREE/EFG-Car-print.pdf>

[*Establishment to Free Growing Guidebook Kamloops*](#)

<http://www.for.gov.bc.ca/tasb/legsregs/fpc/FPCGUIDE/free/EFG-Kam-print.pdf>

[*Establishment to Free Growing Guidebook Nelson*](#)

<http://www.for.gov.bc.ca/tasb/legsregs/fpc/FPCGUIDE/free/EFG-Nel-print.pdf>

[*Establishment to Free Growing Guidebook Prince George*](#)

<http://www.for.gov.bc.ca/tasb/legsregs/fpc/FPCGUIDE/free/EFG-PG-print.pdf>

[*Establishment to Free Growing Guidebook Prince Rupert*](#)

<http://www.for.gov.bc.ca/tasb/legsregs/fpc/FPCGUIDE/free/EFG-PR-print.pdf>

[*Establishment to Free Growing Guidebook Vancouver*](#)

<http://www.for.gov.bc.ca/tasb/legsregs/fpc/FPCGUIDE/free/EFG-Van-print.pdf>

[*Soil Conservation Guidebook*](#)

<http://www.for.gov.bc.ca/tasb/legsregs/fpc/fpcguide/soil/soil-toc.htm>

[*Soil Conservation Survey*](#)

<http://www.for.gov.bc.ca/tasb/legsregs/fpc/fpcguide/SOILSURV/soil-toc.htm>

[*Soil Rehabilitation Guidebook*](#)

<http://www.for.gov.bc.ca/tasb/legsregs/fpc/FPCGUIDE/soilreha/REHABTOC.HTM>

[*Forest Health Survey*](#)

<http://www.for.gov.bc.ca/TASB/LEGSREGS/FPC/FPCGUIDE/healtttoc.htm>

[*Bark Beetle Management*](#)

<http://www.for.gov.bc.ca/tasb/legsregs/fpc/fpcguide/beetle/betletoc.htm>

[*Defoliator Management*](#)

<http://www.for.gov.bc.ca/tasb/legsregs/fpc/fpcguide/defoliat/defoltoc.htm>

[*Dwarf Mistletoe Management*](#)

<http://www.for.gov.bc.ca/tasb/legsregs/fpc/fpcguide/dwarf/dwarftoc.htm>

[*Management of Terminal Weevils in BC*](#)

<http://www.for.gov.bc.ca/tasb/legsregs/fpc/fpcguide/weevil/we-toc.htm>

[*Pine Stem Rust Management*](#)

<http://www.for.gov.bc.ca/tasb/legsregs/fpc/fpcguide/PINESTEM/PINE-TOC.HTM>

[*Root Disease Management*](#)

<http://www.for.gov.bc.ca/tasb/legsregs/fpc/fpcguide/root/roottoc.htm>

[*Tree Wound and Decay*](#)

<http://www.for.gov.bc.ca/tasb/legsregs/fpc/fpcguide/Decay/Tw-toc.htm>

[*Green-up Guidebook*](#)

<http://www.for.gov.bc.ca/tasb/legsregs/fpc/fpcguide/greenup/index.htm>

[*Sheep Vegetation Management Guidelines*](#)

<http://www.for.gov.bc.ca/hfp/forsite/sheep/guidetoc.htm>

Field Cards

[FS 657](#) Silviculture Survey Card

<http://www.for.gov.bc.ca/isb/forms/lib/fs657.pdf>

[FS 658](#) Silviculture Survey Plot Card

<http://www.for.gov.bc.ca/isb/forms/lib/fs658.pdf>

[FS 659](#) Silviculture Survey Summary Card

<http://www.for.gov.bc.ca/isb/forms/lib/fs659.pdf>

[FS 660](#) Silviculture Survey Reference Card

<http://www.for.gov.bc.ca/isb/forms/lib/FS660.pdf>

[FS 747](#) Damage Agent and Condition Codes Card

<http://www.for.gov.bc.ca/isb/forms/lib/FS747.pdf>

[FS 1138 A](#) Calculation Card for Silviculture Survey Confidence Limits

<http://www.for.gov.bc.ca/isb/forms/lib/FS1138A.pdf>

[FS 1138 B](#) Steps to Calculate Confidence Limits for Silviculture Surveys

<http://www.for.gov.bc.ca/isb/forms/lib/FS1138B.pdf>

FORREX - Stand Establishment Decision Aids (SEDA)

- [Competing Vegetation SEDAs](#)
- [Forest Health SEDAs](#)

Training Materials

[How to Determine Site Index](http://www.for.gov.bc.ca/hfp/training/00011)

<http://www.for.gov.bc.ca/hfp/training/00011>

[Fundamentals of Natural Lodgepole Pine Regeneration and Drag Scarification](http://www.for.gov.bc.ca/hfp/pubs/silvsurveys/NatPlregen.pdf)

<http://www.for.gov.bc.ca/hfp/pubs/silvsurveys/NatPlregen.pdf>

[Juvenile Spacing Quality Inspection](http://www.for.gov.bc.ca/isb/forms/lib/fs251.pdf)

<http://www.for.gov.bc.ca/isb/forms/lib/fs251.pdf>

[Planting Quality Inspection](http://www.for.gov.bc.ca/isb/forms/lib/FS704A.pdf)

<http://www.for.gov.bc.ca/isb/forms/lib/FS704A.pdf>

[Developing Stand Density Management Regimes](http://www.for.gov.bc.ca/hfp/pubs/stand%5Fdensity%5Fmgt/index.htm)

<http://www.for.gov.bc.ca/hfp/pubs/stand%5Fdensity%5Fmgt/index.htm>

[Stocking in Partial Cut Stands - DFP](http://www.for.gov.bc.ca/hfp/silviculture/mpbi/index.htm)

<http://www.for.gov.bc.ca/hfp/silviculture/mpbi/index.htm>

[Silviculture Survey Accreditation Brochure](http://www.for.gov.bc.ca/hfp/silviculture/Silv%20Accred%20Brochure%20DW%20Jan%207,%2009.pdf)

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<http://www.for.gov.bc.ca/hfd/pubs/sicourse/acrobat/gimethod.pdf>

Policies and Other Documents

Backlog Reforestation Publications and Products

<http://www.for.gov.bc.ca/hfp/meta/publications.htm>

Land Management Handbooks

[Forest Science Program - Land Management Handbooks](http://www.for.gov.bc.ca/hfd/pubs/Lmh.htm)

<http://www.for.gov.bc.ca/hfd/pubs/Lmh.htm>

[LMH 02 Identification and Interpretation of Ecosystems of the Western Kamloops Forest Region](#) Identification and Interpretation of Ecosystems of the Western Kamloops Forest Region

[LMH 03 A Guide to Some Common Plants of the Kamloops Region](http://www.for.gov.bc.ca/hfd/pubs/Docs/Lmh/Lmh03.htm),

<http://www.for.gov.bc.ca/hfd/pubs/Docs/Lmh/Lmh03.htm>

[*Abstract for LMH04*](#), A Guide to Some Common Plants of the Skeena Area, British Columbia

<http://www.for.gov.bc.ca/hfd/pubs/Docs/Lmh/Lmh04.htm>

[*Abstract for LMH05*](#), A Guide to Plant Indicators of Moisture for Southeastern British Columbia, with Engineering Interpretations

<http://www.for.gov.bc.ca/hfd/pubs/Docs/Lmh/Lmh05.htm>

[*Abstract for LMH06*](#), Some Common Plants of the Sub-Boreal Spruce Zone

<http://www.for.gov.bc.ca/hfd/pubs/Docs/Lmh/Lmh06.htm>

[*Abstract for LMH07*](#), A Guide to Some Common Plants of the Southern Interior of British Columbia

<http://www.for.gov.bc.ca/hfd/pubs/Docs/Lmh/Lmh07.htm>

[*Abstract for LMH08*](#), Site Diagnosis, Tree Species Selection, and Slash burning Guidelines for the Vancouver Forest Region

<http://www.for.gov.bc.ca/hfd/pubs/Docs/Lmh/Lmh08.htm>

[*Abstract for LMH09*](#), A Preliminary Guide to the Response of Major Species of Competing Vegetation to Silvicultural Treatments

<http://www.for.gov.bc.ca/hfd/pubs/Docs/Lmh/Lmh09.htm>

[*Abstract for LMH10*](#), A Field Guide for Identification and Interpretation of the Sub-Boreal Spruce Zone in the Prince Rupert Forest Region

<http://www.for.gov.bc.ca/hfd/pubs/Docs/Lmh/Lmh10.htm>

[*Abstract for LMH11*](#), Field Handbook for Prescribed Fire Assessments in British Columbia

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[*Abstract for LMH12*](#), A Field Guide for Identification and Interpretation of the Interior Cedar-Hemlock Zone, Northwestern Transitional Subzone (ICHg), in the Prince Rupert Forest Region

<http://www.for.gov.bc.ca/hfd/pubs/Docs/Lmh/Lmh12.htm>

[*Abstract for LMH13*](#), Handbook for Timber and Mule Deer Management Co-ordination on Winter Ranges in the Cariboo Forest Region

<http://www.for.gov.bc.ca/hfd/pubs/Docs/Lmh/Lmh13.htm>

[*Abstract for LMH14*](#), A Field Guide for Identification and Interpretation of the Coastal Western Hemlock Zone, Northern Drier Maritime Subzone (CWHf), in the Prince Rupert Forest Region

<http://www.for.gov.bc.ca/hfd/pubs/Docs/Lmh/Lmh14.htm>

[Abstract for LMH15](http://www.for.gov.bc.ca/hfd/pubs/Docs/Lmh/Lmh15.htm), A Field Guide for Identification and Interpretation of Ecosystems of the Rocky Mountain Trench, Prince George Forest Region
<http://www.for.gov.bc.ca/hfd/pubs/Docs/Lmh/Lmh15.htm>

[Abstract for LMH16](http://www.for.gov.bc.ca/hfd/pubs/Docs/Lmh/Lmh16.htm), A Field Guide for Identification and Interpretation of Seral Aspen Ecosystems of the BWBSc1, Prince George Forest Region
<http://www.for.gov.bc.ca/hfd/pubs/Docs/Lmh/Lmh16.htm>

[Abstract for LMH17](http://www.for.gov.bc.ca/hfd/pubs/Docs/Lmh/Lmh17.htm), A Field Guide for Identification and Interpretation of the Engelmann Spruce-Subalpine Fir Zone in the Prince Rupert Forest Region, British Columbia
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<http://www.for.gov.bc.ca/hfd/pubs/Docs/Lmh/Lmh20.htm>

[LMH 21 \(Northwest Portion of the Prince George Forest Region\)](http://www.for.gov.bc.ca/hfd/pubs/Docs/Lmh/Lmh21.htm) -February 1990
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[LMH 22 \(Northeast Portion of the Prince George Forest Region\)](http://www.for.gov.bc.ca/hfd/pubs/Docs/Lmh/Lmh22.htm) -February 1990
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[LMH 24 \(Southwest Portion of the Prince George Forest Region\)](http://www.for.gov.bc.ca/hfd/pubs/Docs/Lmh/Lmh24.htm) -January 1993
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[LMH 25 Field Manual for Describing Terrestrial Ecosystems](http://www.for.gov.bc.ca/hfd/pubs/Docs/Lmh/Lmh25.htm)
<http://www.for.gov.bc.ca/hfd/pubs/Docs/Lmh/Lmh25.htm>

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<http://www.for.gov.bc.ca/hfd/pubs/docs/lmh/lmh26.htm>

[LMH 28 A Field Guide for Site Identification and Interpretation for the Vancouver Forest Region](http://www.for.gov.bc.ca/hfd/pubs/Docs/Lmh/Lmh28.htm). 1994. ISSN 0229-1622. Ministry of Forests.
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<http://www.for.gov.bc.ca/hfd/pubs/Docs/Lmh/Lmh29.htm>

[Abstract for LMH30](http://www.for.gov.bc.ca/hfd/pubs/Docs/Lmh/Lmh30.htm), A Guide to the Biology and Use of Forest Tree Seeds
<http://www.for.gov.bc.ca/hfd/pubs/Docs/Lmh/Lmh30.htm>

[Abstract for LMH36](http://www.for.gov.bc.ca/hfd/pubs/Docs/Lmh/Lmh36.htm), Silviculture of Temperate and Boreal Broadleaf-conifer Mixtures
<http://www.for.gov.bc.ca/hfd/pubs/Docs/Lmh/Lmh36.htm>

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[LMH 46 Plant Indicator Guide for Northern British Columbia, By Beaudry. L., R. Coupé, C. DeLong, J. Pojar, 1999](#)

<http://www.for.gov.bc.ca/hfd/pubs/Docs/Lmh/Lmh46.htm>

[LMH 47 Silviculture Prescription](#), Interpretive Guide for Data Collection, Site Stratification, and Sensitivity Evaluation for Silviculture Prescriptions

<http://www.for.gov.bc.ca/hfd/pubs/Docs/Lmh/Lmh47.htm>

[LMH 50 The Effects of the Silviculture Survey Parameters on the Free Growing Decision Probabilities and Projected Volume at Rotation](#), by Wendy A. Bergerud, Ministry of Forests, Forest Science Program, ISBN 0-7726-4723-2

<http://www.for.gov.bc.ca/hfd/pubs/Docs/Lmh/Lmh50.htm>

[LMH 51 A field Guide to Site identification and Interpretation for the Southeast portion of Prince George Forest Region](#) C. DeLong, 2003

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[A Guide to Vegetation Control Equipment](#). FRDA Handbook 005. March 1990. ISSN 0835 1929.

<http://www.for.gov.bc.ca/hfp/pubsvegmngr.htm>

[Herbicide Field Handbook](#). FRDA Handbook 006. March 1998. ISSN 0835 1929.

<http://www.for.gov.bc.ca/hfd/pubs/Docs/Frh/Frh006.htm>

[A Guide to the Response of Common Plants in British Columbia to Management Treatments](#) FRDA Handbook 008. ISSN 0835 1929. April 1990. Ministry of Forests.

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[Autecology of Common Plants in British Columbia](#): A Literature Review. December 1990. FRDA Report 158. ISSN 0835 0752. Green, R.N., Trowbridge, R.L., and Klinka, K. 1993.

Operational summaries for Vegetation Management:

[Broom - Putting it in its place](#)

<http://www.for.gov.bc.ca/hfp/publications/00204>

[Dry Alder Complex](#)

<http://www.for.gov.bc.ca/hfp/publications/00044/dryalder.pdf>

[Ericaceous Shrub Complex](#)

<http://www.for.gov.bc.ca/hfp/publications/00045/ericaceo.pdf>

[*Fireweed Complex*](#)

<http://www.for.gov.bc.ca/hfp/publications/00047/fireweed.pdf>

[*Gorse - The spiny competitor*](#)

<http://www.for.gov.bc.ca/hfp/publications/00177/gorse.htm>

[*Managing Vegetation in Provincial Forests*](#)

<http://www.for.gov.bc.ca/hfp/pubs/interest/vegman/vegman.htm>

[*Managing Vegetation with Sheep*](#)

<http://www.for.gov.bc.ca/hfp/pubs/interest/vegman/sheepman.htm>

[*Mixed-shrub Complex*](#)

<http://www.for.gov.bc.ca/hfp/publications/00048/mixshrub.pdf>

[*Pinegrass Complex*](#)

<http://www.for.gov.bc.ca/hfp/pubs/vegmngt/pinegras.pdf>

[*Reedgrass Complex*](#)

<http://www.for.gov.bc.ca/hfp/publicationss/00051/reedgrass.pdf>

[*Wet Alder Complex*](#)

<http://www.for.gov.bc.ca/hfp/publications/00054/wetalder.pdf>

[*Willow Complex*](#)

<http://www.for.gov.bc.ca/hfp/publicationss/00055/willow.pdf>

[*Silviculture Note #26 - Sheep Grazing in Forestry*](#)

<http://www.for.gov.bc.ca/hfp/publications/00127/SN26.pdf>

[*Silviculture Note #25 - Boreal Plant Community Diversity 10 yrs after treatment; a report summary*](#)

<http://www.for.gov.bc.ca/hfp/publications/000126/SN25.pdf>

Miscellaneous Publications

Additional publications may be available from [Crown Publication](#)

<http://www.crownpub.bc.ca/>

[*Ministry of Forest Cartographic Manual*](#)

<http://www.for.gov.bc.ca/hfd/library/documents/bib92326.pdf>

[*Forest Practices Branch*](#)

<http://www.for.gov.bc.ca/hfp/meta/publications.htm>

[*Biogeoclimatic Zones of British Columbia*](#)

<http://www.for.gov.bc.ca/hfd/library/documents/treebook/biogeo/biogeo.htm>

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Indicator Plants of Coastal British Columbia. By K. Klinka, V.J. Krajina, A. Ceska, A.M. Scagel. University of British Columbia Press. 1989

http://www.ubcpres.ca/search/title_book.asp?BookID=1443

Information Management Group

<http://www.for.gov.bc.ca/his/>

Controlling Weeds Using Biological Methods

<http://www.for.gov.bc.ca/hfp/publications/00178/noxtext.htm>

Provincial Seedling Stock Type Selection and Ordering Guidelines.

<http://www.for.gov.bc.ca/nursery/StockSelection/index.htm>

Glossary of Forestry Terms

<http://www.for.gov.bc.ca/hfd/library/documents/glossary/>

Appendix 4: Best Practices in Estimating Basal Area – including the Use of a Prism

[Basal area](#) (BA) is the cumulative cross sectional area, represented in m^2 , of the live trees, that are greater than or equal to 12.5 centimeters in diameter (Layer 1 trees), measured at breast height, that are determined ‘*in*’ using a prism.

BA Forest Cover Reporting Requirements for each Milestone (Regen and Free Growing)

Basal area must be collected and reported (as a legal requirement) into RESULTS for Layer 1 stems, where stocking standards require that a specific basal area per hectare be retained after harvest and for all SUs regardless of the stocking standards, where a retained overstorey of Layer 1 stems are $> 5 \text{ m}^2/\text{ha}$.

Methods of Estimating BA (Layer 1 stems only)

There are 3 acceptable methods of estimating the SU’s average BA:

1. **Hand Prism sweep** per plot or sample center, at a sampling intensity as determined as appropriate by the forest professional at the specific milestone. Each plot BA is determined by multiplying the number of Layer 1 stems “*in*” the sweep by the Basal Area Factor (BAF) of the prism used. *FOR EXAMPLE: If 6 Layer 1 trees were tallied and a BAF 5 was used, then the BA for that plot would be $6 \times 5 = 30 \text{ m}^2/\text{ha}$. The Average BA for the SU’s Forest Cover would be the sum of all BA’s per plot divided by the number of samples;*
2. **Prism App (via tablet or iPad) sweep** per plot or sample center, at a sampling intensity as determined as appropriate by the forest professional at the specific milestone. The same procedure for determining BA would be used as for method 1, hand prism;
3. **A complete DBH measure of all of the Layer 1 stems** in a fixed radius plot (3.99 m radius plot recommended), tallied per plot or sample center, at a sampling intensity as determined as appropriate by the forest professional at the specific milestone. Note, this is the method to use if you are in a survey situation with no Prism or Prism App. *FOR EXAMPLE: At each plot measure the DBH of each Layer 1 tree. Back at the office or once finished in the field, calculate the total BA in m^2 for each plot by using πr^2 for each tree. For the SU, calculate the mean of the BA per plot and multiple that times the plot multiplier to*

determine the BA /ha for the SU. So for an example plot 1 (using a 3.99m radius plot – multiplier 200), if you had 3 Layer 1 trees at 14.0, 15.0 and 16.0 cm DBH, the BA for that plot would be = $3.141 \times (.14\text{m}/2)^2 + 3.141 \times (.15\text{m}/2)^2 + 3.141 \times (.16\text{m}/2)^2 = 0.053\text{m}^2$ for plot 1. Then adding up all of the plots for the SU, say for 10 plots, the total BA is 0.62m^2 . Then the mean for the 10 plots is = $0.62 / 10 = 0.062\text{m}^2$. Then the BA/ha for the SU would be = $0.062\text{m}^2 \times 200 = 12.4 \text{ m}^2/\text{ha}$.

Selection of a Prism

The prism is a tool used to estimate the amount of BA currently present on a SU. It is essential that all prisms used on a single stratum be of the same Basal Area Factor (BAF). The BAF is a number relative to the amount of light refracted by the prism and corresponds to the thickness of the prism. Prisms used in the Interior with smaller stems usually are between 5 and 10 BAF prisms. In contrast on the Coast, 10 BAFs and larger are used due to the larger diameter stems. Using prisms of different sizes on the same SU would have the same effect as using multiple plot radii plots on a single SU. All data collected for a single SU must be gathered using a single BAF.

In order to select an appropriate BAF for a SU survey, it is recommended to choose a prism BAF that captures a minimum of 4 trees per plot from the pre-harvest condition (in cut areas this would be a combination of standing trees and stumps). This will insure that a sufficient amount of stems will be counted "*in*" within the plot centers prism sweep during the survey, in order to achieve a reasonable estimate to the residual BA in the SU.

Use of a Prism

The surveyor should hold the prism directly over and above the plot center and should look at a tree across the upper edge of the prism. The surveyor should see the tree simultaneously above the prism in its natural position, and also through the prism. Since a ray of light is bent upon passing through the prism, the tree image seen through the prism will be horizontally displaced.

If the displacement is greater than the diameter of the tree, the tree is considered "*out*", and therefore not counted. If the displacement is less than or equal to the diameter of the tree, the tree is "*in*", therefore is counted.

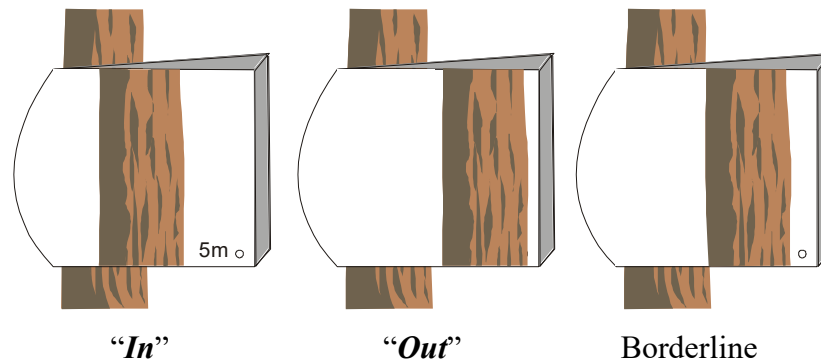


Figure 34: Using a prism to determine if a tree is "*in*", "*out*", or "*borderline*".

This procedure is repeated for each Layer 1 tree in the plot, until a complete sweep from the first tree is completed back to the same first tree. The total number of trees in the sweep that were “*in*” are now tallied for that plot.

Borderline Trees (*Note: this is not timber cruise, this is for forest cover data collection*)

The precision required for determining [basal area](#) is dependant on whether the silviculture plan or prescription for the stratum contains a minimum basal area.

Where a borderline tree is identified:

- Using the prism, confirm that the tree is in fact borderline, then,
- Make an arbitrary decision to record the tree “*in*” or “*out*”. The next time a borderline tree is identified in the stratum, record it opposite to the first. In other words, double check your measurement using the prism, then simply alternate the borderline calls.

Suggested Field Survey Procedures:

- It is recommended for Dispersed Retention stands, due to the inherent wide variability of the resultant stand structural conditions, that a detailed systematic random procedure be used to collect all data - as well as BA. This means a regular interval grid for plot location should be deployed, at an intensity relative to the surveyor’s judgment that sufficient coverage of the variability of the SU has been achieved.
- Then it is recommended to perform a BA estimate at each plot on the grid design and then ultimately use the mean of all the plot BA estimates to determine the BA/ha estimate for the SU. This value would be used for determining if the BA is >5 m²/ha and if so, then this value would be entered into RESULTS for that SU.

Appendix 5: Magnetic Declination and Annual Change

Magnetic declination is the adjustment for the difference between magnetic north and grid north. Correct calibration of the compass used by surveyors is one important factor to ensure the desired accuracies are met. Surveyors should ensure that the proper declination has been set on their compass prior to conducting a survey.

The amount of adjustment varies with current position and over the passing of time. Appendix E of the *Vegetation Resource Inventory Ground Sampling Procedures*, [*Magnetic Declination and Annual Change*](#) provides the adjustment factors. In addition, the web site below provides an automated declination calculator where latitude and longitude are known.

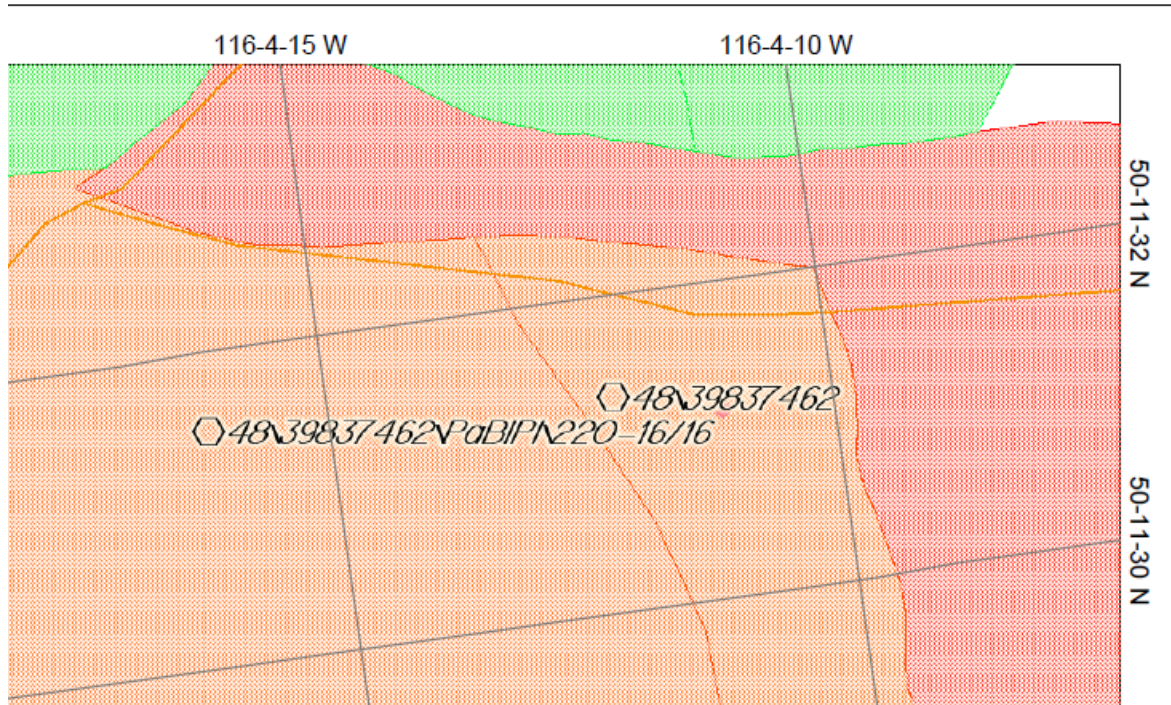
<http://geomag.nrcan.gc.ca/apps/mdcal-eng.php>

Many GPS receivers have the capacity of calculating the declination for ones current location.

Appendix 6 Forest Cover Map Legend

A 6.1 New Forest Cover Label

The following is an example of the New MapView Available legend.



Generally the order of interpretation would be the following for this example map above:

- Silv. Symbol and Opening#..... $\hexagon 48$
- Polygon #..... **39837462**
- Species Comp. in order of %..... **Pa BI PI**
220
- Age Class Code /..... **(2)**
- Height Class Code / **(2)**
- Crown Closure Class Code..... **(0)**
- Calculated Site Index..... **16**
- Estimated Site Index..... **16**

New Legend Description and VRI link to the full explanatory text:

https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/forestry/stewardship/forest-analysis-inventory/data-management/standards/vegetation_map_legends.pdf

VEGETATION LABEL DETAILS

Example of a Vegetation Label:

LINE	DESCRIPTION
1	Silviculture symbol and Opening Number
2	Polygon Number and multi-layer stand indicator (L)
3	Species Composition ex: the most important layer is described as Fd (Douglas Fir) and Hw (Western Hemlock).
4	Age, Height, Crown Closure Class Code - separator Site Index / estimated SI ex: stand is age class 2 (21-40 yrs), height class 1 (0.1-10.4m), crown closure class 1 (6-15%), SI 20m
5	Vegetated Density Class (or Non-Forest/Productive Descriptor) ex: a herb polygon with no distinction between forbs and graminoids, shrubs less than 2m.
6	Disturbance History & year - ex: Logged in 1978

Line 1 - History Record Opening Number

$\emptyset$ 12 - opening number valid for BCGS mapsheet
 $\emptyset$ 12 - opening number valid for adjacent BCGS mapsheet
 $\emptyset$ 12 - opening number valid for NTS mapsheet
 blank - opening number has not been assigned

Line 2 - Polygon No. / Multi-layer

VRIMS Polygon Number - ranging from one to nine digits
 L - Multi-layered stand (a separate description of each layer is available in the data base, i.e. 1,2)

Line 4

4a AGE CLASS		4b HEIGHT CLASS		4c CROWN CLOSURE CLASS	
CODE	LIMITS (years)	CODE	LIMITS (metres)	CODE	LIMITS (percentage)
1	1-20	1	0.1 - 10.4	0	0 - 5
2	21-40	2	10.5 - 19.4	1	6 - 15
3	41-60	3	19.5 - 28.4	2	16 - 25
4	61-80	4	28.5 - 37.4	3	26 - 35
5	81-100	5	37.5 - 46.4	4	36 - 45
6	101-120	6	46.5 - 55.4	5	46 - 55
7	121-140	7	55.5 - 64.4	6	56 - 65
8	141-250	8	65.5 +	7	66 - 75
9	251 +			8	76 - 85
				9	86 - 100

4d SITE INDEX

All SI are shown to the nearest meter referenced at 50 years
 Breast Height Age. SI is based on the age and height of the leading species. When an accurate SI cannot be obtained from age and height, estimated SI is shown after, or replaces the SI.

4e ESTIMATED SITE INDEX

SI is estimated when suitable SI trees are not present, e.g. young stands (<30yrs). It is denoted by a slash which always precedes it. Associated fields in the data base are Inventory Type Group and SI Estimated source code.

A 6.2 Old Forest Cover Legend

HISTORY SYMBOLS						
Disturbance ⊖	CLASS. SYMBOL	CODE	HISTORY			
		<i>B</i>	Wildfire			
		<i>BF</i>	Escaped Burn			
		<i>BG</i>	Ground Burn			
		<i>BR</i>	Range Burn			
		<i>BW</i>	Wildfire Burn			
		<i>D</i>	Disease			
		<i>F</i>	Flooding			
		<i>I</i>	Insect			
		<i>K</i>	Furrie Kill			
		<i>L</i>	Logging			
		<i>Lz</i>	Logged (0% increments)			
		<i>R</i>	Site rehabilitation			
		<i>S</i>	Slide			
		<i>W</i>	Windthrow			
Regeneration ⊕			Artificial Regeneration with year(s) of planting			
Stand Tending ⊖		<i>F</i>	Fertilization			
		<i>H</i>	Hack and squirt			
		<i>J</i>	Juvenile spacing			
		<i>M</i>	Mistletoe control			
		<i>P</i>	Pruning			
		<i>R</i>	Conifer release			
		<i>S</i>	Sanitation spacing			
		<i>T</i>	Commercial thinning			
		<i>W</i>	Brushing and weeding			
Site Preparation ⊕		<i>B</i>	Broadcast burn			
		<i>C</i>	Chemical			
		<i>G</i>	Gross seeded			
		<i>H</i>	Hand preparation			
		<i>RB</i>	Range management burn			
		<i>S</i>	Spot burn			
		<i>M</i>	Mechanical			
		<i>MS</i>	Mechanical and spot burn			
		<i>W</i>	Windrow			
MULTI-LAYER						
<i>L</i> - Multi-layered stand (a separate description of each layer is available in the data base, i.e., 1, 2)						
<i>V</i> - Veteran component						
<i>S</i> - A separate silviculture description is available in the data base						

ENVIRONMENTALLY SENSITIVE AREA (E.S.A.) CATEGORIES

E.S.A. CLASS CATEGORY	E.S.A. DESCRIPTION
High	<i>ES</i> Extremely fragile or unstable soils
	<i>EP</i> Severe regeneration problems caused by geoclimatic factors
	<i>EA</i> Severe snow chute and avalanche problems
	<i>ET</i> Exceptionally high recreational values
	<i>EW</i> Of critical importance to wildlife (with or without species)
Moderate	<i>EH</i> Very high water values and extreme sensitivity to harvesting
	<i>ESs</i> Significantly fragile or unstable soils but less than those for <i>ES</i>
	<i>EPp</i> Severe regeneration problems caused by biotic factors
	<i>ETr</i> High recreational values but less than those for <i>ET</i>
	<i>EW*</i> High value for wildlife but less than that for <i>EW</i> (with or without species)
	<i>ETh</i> Very high water values and high sensitivity but less sensitivity than <i>EH</i>
	<i>EC</i> Specific limitations (forest regeneration, snow avalanche areas, water, and operability) - used from 1975 to 1975 inclusive
Nil	Management practices on these lands are subject only to operational constraints consistent with the policies of the Forest Region.
* Important areas for grizzly bears along salmon-producing streams are identified by <i>EEWb</i>	

QUALIFIERS { /A - Complex stand (all-aged, uneven-aged)
/I - Inoperable

FISHERIES' CONSTRAINTS

SYMBOL	STREAM VALUE TO FISH AND STREAM SENSITIVITY TO HARVESTING
▲	Nil
■	Low
●	Moderate
◆	High

NOTE: Absence of Fisheries Symbols indicates information is not available.

B. FOREST LAND (NON-FORESTED)

NSR - Not satisfactorily restocked (with or without species)
NCR - Non-commercial brush (with or without non-commercial species)
NC - Non-commercial (with species)
C. FOREST LAND (NON-PRODUCTIVE)
A plus Forest description
NP plus Forest description

II. NON-FOREST LAND

A - Alpine
R - Rock
NP - Non-productive burn (NPB)
GB - Non-productive brush
NP - Non-productive non-productive
NP - Miscellaneous non-productive
 Note: Other categories of non-forest land are written in full, e.g. Claybank, Hayfield, Gravel Bar.

III. DATA SOURCES

● 51681 - Temporary ground sample, number (year), pre-1979
 ● 7799G - Permanent growth sample, number (year), pre-1980 and 1989+
 ● 989IT - Permanent Silviculturally treated growth sample, 1989+
 ● 875V - Volume and/or decay sample, pre-1979 and 1988+
 → 18 (79) - Phase 1-70 mm sample
 → 6 (82) - Phase 2-termpory ground sample, 1980-1988
 → 7 (80) - Phase 3-Growth sample, 1980-1985
 → 8 (79) - Phase 3-Decay sample, 1979-1987
 → 9 (86) - Phase 3-Growth sample, 1986-1988
 → 5 (88) - Phase 3-Silviculturally treated growth sample, 1986-1988
 A multi-phase sample is shown by combining any of the above bar symbols:
 → 5 (87) - Phase 1, Phase 2, Phase 3, Growth and Decay sample

NCR GENUS SYMBOLS

D - Alder (Mountain, Green, Sitka)
E - Birch (Water)
W - Willow
G - Dogwood
M - Maple (Vine, Rocky Mountain)
R - Arbutus

○ 7 (80) I - Intensive forestry installation
 ○ 5 (65) R - Rectangular growth sample

○ 703 (72) - Experimental Plot installation - Research
 X 780II - Air call
 XG 68 - Ground observation w/measurements (pre-1979)
 XG 189I - Ground call with measurements (1979+)
 XG 284 (83) - Ground call with measurements
 XE 2-9 (77) - E.S.A. air call
 XGE 50 (76) - E.S.A. ground call
 XGR 110 (83) - Regeneration survey ground call
 XGB 7 (85) - Ecological research ground sample
 XGC 2 (85) - Valuation cruise plots
 XGF 16 (80) - Range ground call
 XL 51-035 (74) - 70 mm photography (pre-1979)
 X → 70 mm photography (1979+)
 L 66-261 (79)

Appendix 7: Table of Age Corrections for Boring Height

The following reference table is provided to correct the counted age. Bore the sample tree at 1.3 meters above the ground and count the number of rings. This number equals the [dbh](#) age. On the table below locate the row corresponding to the species of the sample tree. Locate the corresponding [site index](#) for the strata in which this sample tree is located.

Follow up this column to find the number of years to be added to the dbh age.

Fdi: site index of 25 = 8 years to add

dbh age + age at 1.3 meters = total age

Age at 1.3 meters (add this number of years to the dbh age to determine total age)												
	14	13	12	11	10	9	8	7	6	5	4	3
Interior												
Species												
Pli	5	6	7	8	9-10	11-14	15-22	>=23				
Fdi				14-15	16-18	19-22	23-28	>=29				
Cw			5-10	11-16	17-22	23-28	29-35	>=36				
Bl			17	18-19	20-21	22-23	24-26	27-28	29-31	>=32		
Hw						<=6	7-13	14-20	21-27	28-34	>=35	
Sw			14-15	16-17	18-20	21-25	26-33	>=34				
Py	5	6	7	8	9-10	11-14	15-22	>=23				
Pw			14-15	16-17	18-20	21-25	26-33	>=34				
Lw					13-14	15-16	17-21	22-27	>=28			
At						5	6	7	8-9	10-12	13-17	>=18
Ep						5	6	7	8-9	10-12	13-17	>=18
Coastal												
Species												
Ba	<=12	13-14	15-17	18-19	20-21	22-24	25-26	27-29	30-31	>=32		
Fdc				<=16	17-22	23-28	29-35	36-41	42-47	>=48		
Act	2 years all sites											
Dr												
Cw				<=16	17-22	23-28	29-35	36-41	42-47	>=48		
Hw								<=20	21-27	28-34	35-42	>=43

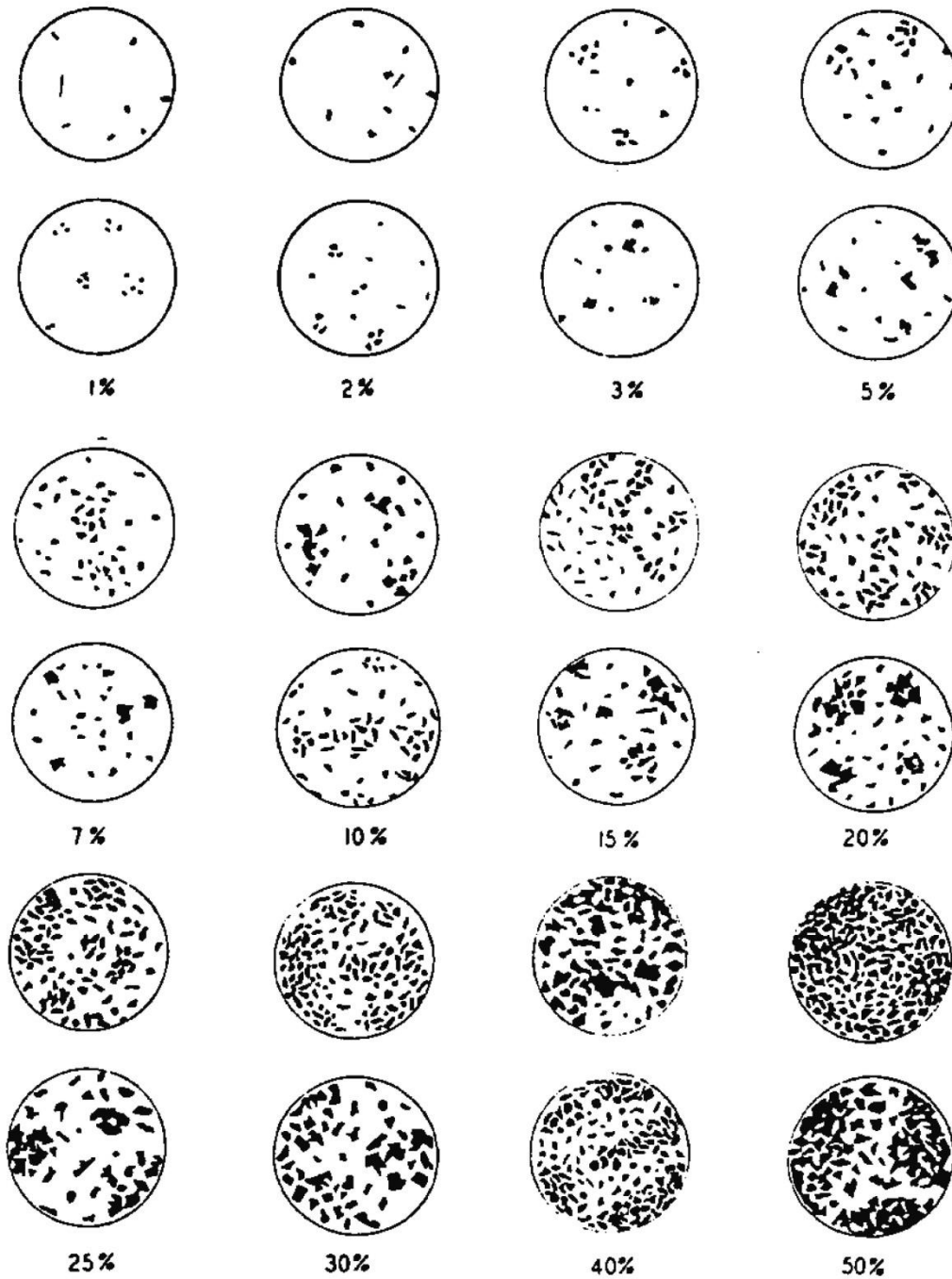
Table 15. Boring Height Age Correction

Appendix 8: Ministry of Forests Field Cards and Forms

FS#	Form Name	Fmt	Paper Supply	Business Area	Version	OPR
1138A	CALCUL.CARD/SILVI.SUR.CONFID	PDF	OPC	Forest Practices	1997/11/17	HFP
1138B	STEPS CALCUL.CONFI.LIM.SIL.S	PDF	OPC	Forest Practices	1997/11/17	HFP
209	MANUAL BRUSHING INSPECTION REPORT	PDF	OPC	Forest Practices	1997/11/16	HFP
251	JUVENILE SPACING QUALITY INSPECTION – DRAFT, 1.7MB	PDF		Forest Practices	2001/08/30	HFP
415A	GROWTH INTERCEPT TABLE- LODGEPOLE PINE-INTERIOR	PDF	HFP	Forest Practices	1997/02/01	HFP
415B	GROWTH INTERCEPT TABLE- INTERIOR SPRUCE-INTERIOR	PDF	HFP	Forest Practices	1995/06/01	HFP
415C	GROWTH INTERCEPT TABLE- WESTERN HEMLOCK-COASTAL	PDF	HFP	Forest Practices	1995/06/01	HFP
415D	GROWTH INTERCEPT TABLE- SITKA SPRUCE-COASTAL	PDF		Forest Practices	1995/11/01	HFP
415E	GROWTH INTERCEPT TABLE- DOUGLAS-FIR-COASTAL	PDF	HFP	Forest Practices	1996/05/01	HFP
415F	GROWTH INTERCEPT TABLE- DOUGLAS-FIR-INTERIOR	PDF	HFP	Forest Practices	1997/02/01	HFP
415G	GROWTH INTERCEPT TABLE- SUBALPINE FIR-INTERIOR	PDF	HFP	Forest Practices	1997/07/01	HFP
415H	GROWTH INTERCEPT TABLE- WESTERN HEMLOCK-INTERIOR	PDF	HFP	Forest Practices	1998/11/01	HFP
415I	AVERAGE SITE INDEX RELATIONSHIP	PDF	HFP	Forest Practices	1998/11/01	HFP
415J	GROWTH INTERCEPT TABLE – WESTERN LARCH	PDF	HFP	Forest Practices	2000/05/01	HFP
415k	GROWTH INTERCEPT TABLE – WESTERN RED CEDAR	PDF	HFP	Forest Practices	2000/05/01	HFP
466	INSECT & DISEASE COLLECTION	PDF	HFP	Forest Practices	1996/08/01	HFP

FS#	Form Name	Fmt	Paper Supply	Business Area	Version	OPR
657	SILVICULTURE SURVEY	PDF	OPC	Forest Practices	2008/03/18	HFP
658	SILVICULTURE SURVEY PLOT	PDF	OPC	Forest Practices	2008/03/18	HFP
659	SILVICULTURE SURVEY SUMMARY	PDF	OPC	Forest Practices	2008/03/18	HFP
660	SILVICULTURE SURVEY REFERENCE (3.36 Mb!)	PDF	OPC	Forest Practices	2008/03/28	HFP
703	PLANTING DIFFICULTY RATING	PDF	OPC	Forest Practices	1997/11/17	HFP
704A	PLANTING QUALITY INSPECTION	PDF	OPC	Forest Practices	1998/06/10	HFP
704	DRY PLANTING INSPECTION REPORT	PDF	OPC	Forest Practices	1997/04/01	HFP
704	WET PLANTING INSPECTION REPORT	PDF	OPC	Forest Practices	1997/04/01	HFP
707	SURVIVAL STAKED PLOTS	PDF		Forest Practices	2001/05/02	HFP
739	PLANTING SITE PRESCRIPTION	PDF	OPC	Forest Practices	1997/11/17	HFP
747	DAMAGE & CONDITION CODES-REF	PDF	OPC	Forest Practices	2005/02/02	HFP
748	PRE-STAND TENDING SURVEY	PDF	OPC	Forest Practices	1997/11/17	HFP
749	POST SPACING EXAMINATION	PDF	OPC	Forest Practices	2001/04/01	HFP
770	PRE-STAND TENDING SITE DESCRIP/PRESCRIPTION	PDF		Forest Practices	1991/07/01	HFP
810A	FOREST COVER DATA ENTRY LIST	PDF		Resources Inventory	11/17/97	HRI
844	SURVIVAL STAKED LINES	PDF	HFP	Forest Practices	1997/11/18	HFP

Appendix 9: Crown Closure Comparative Diagrams



Appendix 10: FS660 Silviculture Reference Card (May 1, 2020)



SILVICULTURE SURVEY REFERENCE

1. Steps to Completing Silviculture Surveys

1. Office review
 - Stocking standards (e.g. MSS, TSS, MITD, pref. & acc. species, regen delay)
 - Map showing standards unit (SU) boundaries
 - Treatment reports and history (e.g. harvest start date, planting date(s))
2. Walk-through of each stratum
 - Determine strata boundaries within standards units
 - Survey objectives, method and sampling intensity
 - Site descriptive items
 - Site index method and species
 - Inventory leading and second species
 - Critical limiting factors and initial treatment recommendation
 - Stand structure (collect layered data?)
 - Near maximum density? (if so collect countable conifers)
3. Data gathering for each stratum
 - Sufficient to produce accurate results and inventory and silviculture labels
 - Competing vegetation
 - Forest health factors
4. Summary of each stratum
 - Mathematical analysis
 - Inventory and silviculture labels
 - Treatment recommendations
5. Reporting of each stratum
 - Mapping
 - Data input to RESULTS (directly or via a corporate database)

2. Stratification

1. The following changes constitute criteria for stratification:
 - standards units
 - stocking status
 - leading species
 - species composition >20%
 - crown closure >20%
 - age class (20 years or less*)
 - height class (10 m or less*)
 - site index (3 m)
 - treatment recommendations
2. In the spring of 2007 strata size and distribution became specified in regulation.
 - Reserves and NP areas: 0.25 hectares (mappable**) the entire SU
 - SUs less than 1 ha: 1 hectare

Milestone Surveys

- Post-harvest / regeneration / free growing 1 hectare
- Mappable Not Free-growing portion of an SU 1 to 2 ha, max. of 5% of the SU NAR

* These are MoF inventory minimums. Licensees may choose a lower threshold.

**Mappable is defined as a polygon greater than 20 m throughout its length. Areas that do not meet the stocking obligations less than 20 m from the nearest NSR or NFG area are considered contiguous units.

3. Natural Resource Region and District Codes

COAST AREA		NORTH AREA		SOUTH AREA	
South Coast Region	RSC	Northeast Region	RNO	Cariboo Region	RCB
Sunshine Coast District	DSC	Fort Nelson District	DFN	100 Mile House District	DMH
Chilliwack District	DCK	Pease District	DPC	Quesnel District	DQU
Sea to Sky District	DSQ	Omenica Region	ROM	Cariboo-Chilcotin District	DCC
West Coast Region	RWC	Mackenzie District	DMK	Kootenay/Boundary Region	RKB
Haida Gwaii District	DQC	Stuart Nechako District	DSN	Rocky Mountain District	DRM
South Island District	DSI	Prince George District	DPG	Selkirk District	DSE
Campbell River District	DCR	Skeena Region	RSK	Thompson/Okanagan Region	RTO
North Island-Central Coast District	DNI	Nadina District	DND	Okanagan/Shuswap District	DCS
		Coast Mountains District	DKM	Thompson Rivers District	DKA
		Skeena-Stikine District	DSS	Cascades District	DCS

4. History Symbol

[illegible]

Add the last two digits of the year to the right of the history code

For treatments completed in multiple years add a comma between the years.

For treatments roughly continuous over multiple years add a dash between the years

5. Stocking and plot factors

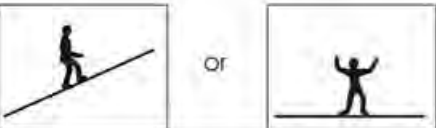
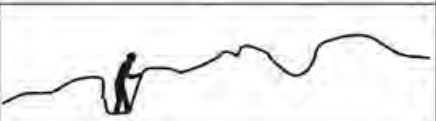
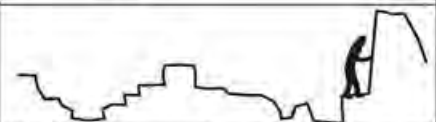
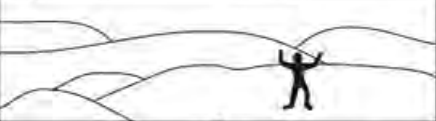
Trees/ha	Plot Radius (m)							Triangular spacing inter-tree distance* (m)
	1.78	2.52	2.82	3.99	5.64	7.98	11.28	
	Plot Area (m²)							
	10	20	25	50	100	200	500	
	Plot Multiplier							
	1000	500	400	200	100	50	20	
	Trees Per Plot							
2500	2.5	5	6.25	12.5	25	50	125	2.15
2400	2.4	4.8	6	12	24	48	120	2.19
2300	2.3	4.6	5.75	11.5	23	46	115	2.24
2200	2.2	4.4	5.5	11	22	44	110	2.29
2100	2.1	4.2	5.25	10.5	21	42	105	2.34
2000	2.0	4	5	10	20	40	100	2.40
1900	1.9	3.8	4.75	9.5	19	38	95	2.47
1800	1.8	3.6	4.5	9	18	36	90	2.53
1700	1.7	3.4	4.25	8.5	17	34	85	2.61
1600	1.6	3.2	4	8	16	32	80	2.69
1500	1.5	3	3.75	7.5	15	30	75	2.77
1400	1.4	2.8	3.5	7	14	28	70	2.87
1300	1.3	2.6	3.25	6.5	13	26	65	2.98
1200	1.2	2.4	3	6	12	24	60	3.10
1100	1.1	2.2	2.75	5.5	11	22	55	3.24
1000	1.0	2	2.5	5	10	20	50	3.40
900	0.9	1.8	2.25	4.5	9	18	45	3.58
800	0.8	1.6	2	4	8	16	40	3.80
700	0.7	1.4	1.75	3.5	7	14	35	4.06
600	0.6	1.2	1.5	3	6	12	30	4.39
500	0.5	1.0	1.25	2.5	5	10	25	4.81
400	0.4	0.8	1	2	4	8	20	5.37
300	0.3	0.6	0.75	1.5	3	6	15	6.20
200	0.2	0.4	0.5	1	2	4	10	7.60
100	0.1	0.2	0.25	0.5	1	2	5	10.74

$$^a \text{ Inter-tree distance} = \sqrt{\frac{11\,547}{\text{trees/ha}}}$$

6. RESULTS consistent tree species abbreviations

Common name of genus/species	Scientific name of genus/species	Species symbol
Poplar	Populus balsamifera	Ac
Balsam poplar	Populus balsamifera ssp. balsamifera	Acb
Black cottonwood	Populus balsamifera ssp. trichocarpa	Act
Aspen	Populus tremuloides	At
Poplar hybrid	Populus spp.	Ax
Amabilis fir	Abies amabilis	Ba
Balsam fir	Abies balsamifera	Bb
Grand fir	Abies grandis	Bg
Subalpine fir	Abies lasiocarpa	Bl
Nobel fir	Abies procera	Bn
Western redcedar	Thuja plicata	Cw
Red alder	Alnus rubra	Dr
Alaska paper birch	Betula neoalaskana	Ea
Common paper birch	Betula papyrifera	Ep
Douglas-fir (coastal)	Pseudotsuga menziesii var. menziesii	Fdc
Douglas-fir (interior)	Pseudotsuga menziesii var. glauca	Fdi
Mountain hemlock	Tsuga mertensiana	Hm
Western hemlock	Tsuga heterophylla	Hw
Alpine larch	Larix lyallii	La
Siberian larch	Larix sibirica	Ls
Tamarack	Larix laricina	Lt
Western larch	Larix occidentalis	Lw
Bigleaf maple	Acer macrophyllum	Mb
Whitebark pine	Pinus albicaulis	Pa
Limber pine	Pinus flexilis	Pf
Jack pine	Pinus banksiana	Pj
Lodgepole pine (coastal)	Pinus contorta var. contorta	Plc
Lodgepole pine (interior)	Pinus contorta var. latifolia	Pli
Red pine	Pinus radiata	Pr
Western white pine	Pinus monticola	Pw
Yellow pine	Pinus ponderosa	Py
Norway spruce	Picea spp.	Sa
Black spruce	Picea mariana	Sb
Engelmann spruce	Picea engelmannii	Se
Sitka spruce	Picea sitchensis	Ss
White spruce	Picea glauca	Sw
Spruce hybrid	Picea spp.	Sx
White x black spruce	Picea spp.	Sxb
Engelmann x sitka	Picea spp.	Sxe
White x sitka spruce	Picea spp.	Sxl
Sitka x unknown spruce	Picea spp.	Sxs
White x engelmann spruce	Picea spp.	Sxw
White x engelmann x sitka spruce	Picea spp.	Sxx
Bitter cherry	Prunus emarginata	Vb
Yellow cedar	Chamaecyparis nootkatensis	Yc

7. Surface expression

Plain (P)		Slope <5%
Undulating (U)		5-25% Non-linear
Ridge(s) (R)		26-70%
Terraces (T)		Step-like
Cone (C)		>26%
Depression (D)		> 2 m
Fan (F)		0-25%
Hummock (H)		26-70%
Rolling (M)		5-25% Linear

8. Vegetation Resource Inventory Consistent vegetation abbreviation system (optional)

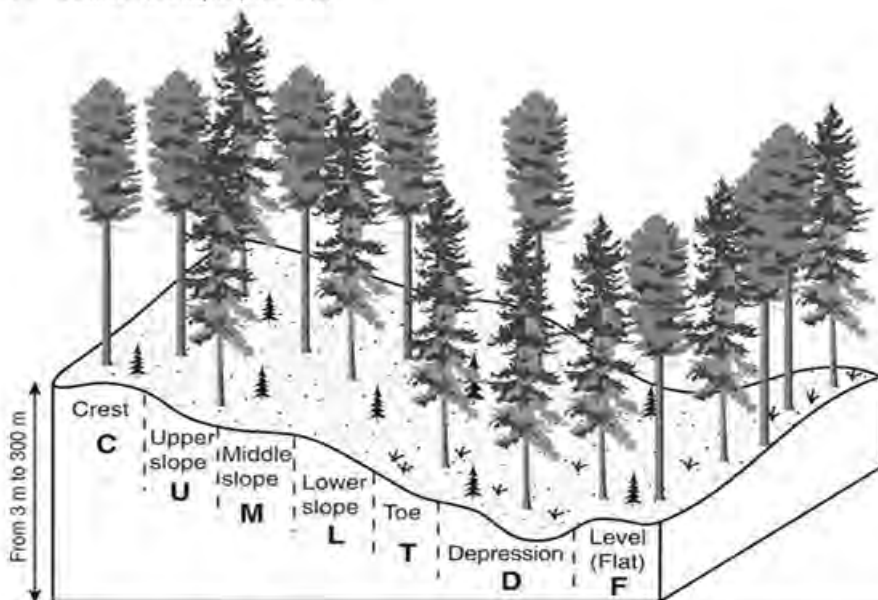
First 4 letters of the genus plus first 3 letters of the species plus a number for variant (if applicable)

aaaa bbb 1

If genus is known, but not species, all characters (up to 7) in the genus are used.

Common name	Latin name	Abbreviation
Palmate coltsfoot	<i>Petasites palmatus</i>	peta pal
White-flowered rhododendron	<i>Rhododendron albiflorum</i>	rhod alb
Scrub birch	<i>Betula glandulosa</i> var. <i>glandulosa</i>	betu gla 1
Willow	<i>Salix</i>	salix

9. Guide to slope position



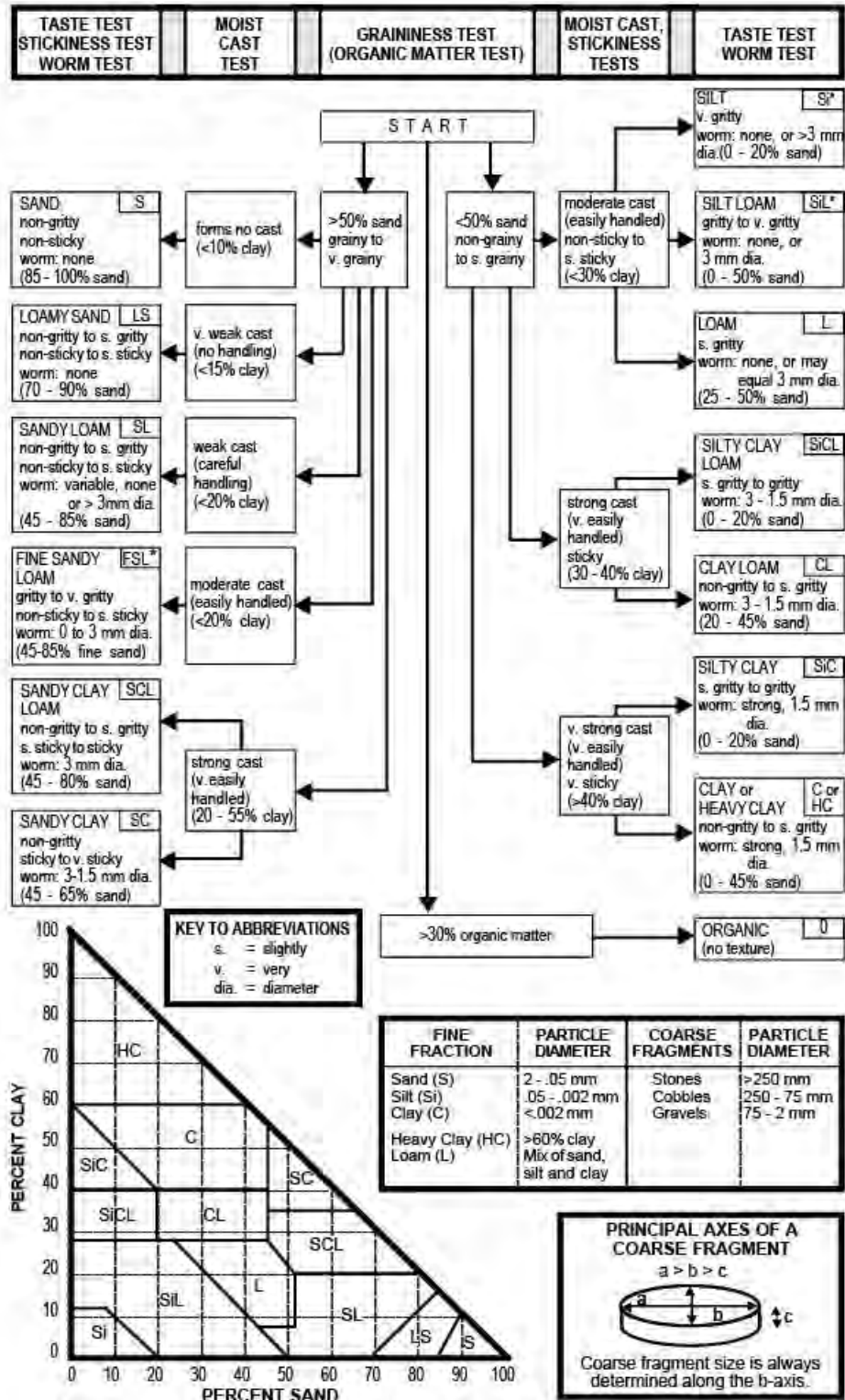
10. Planting difficulty rating

Site characteristics and points rating						
Vegetation	Infrequent grass, herbs and low shrubs	1	Frequent grass patches, herbs, low shrubs, infrequent naturals	3	Continuous grass or other vegetation, naturals, planted trees	6
Thickness of duff or litter	< 5 cm	1	5–20 cm	3	>20 cm	6
Fine debris	Scattered branches and tops	1	Grouped branches and tops, <1 m high, loose arrangement	3	Piled branches and tops >1 m high or in a continuous mat	6
Coarse debris	Scattered logs	1	Frequent logs, some grouped and crossed, <1 m high	3	Frequent logs grouped and crossed, >1 m high	6
Stoniness	Infrequent stones or boulders	1	Frequent stone, boulders or coarse gravel	3	Continuous stoney layer and/or frequent boulders, gravel	6
Compaction	Loose	1	Occasional compact areas, e.g., landings	3	Definite hardpan or compact layer throughout	6
Slope	10–30%	1	0–10%, 30–65%	3	Over 65%	6
Unplantable areas	Infrequent patches of surface water, bedrock, etc.	1	Frequent patches <0.2 ha	3	Frequent patches >0.2 ha	6
Circle one point rating in each of the eight factors.			Planting difficulty class:			
Total = _____ = Planting difficulty rating			Less than 10 points = easy			
			10–20 points = moderate			
			21–30 points = difficult			
			31+ points = severe			

11. Humus form descriptions

Mor	<ul style="list-style-type: none"> • matted F horizon, abrupt transition from organic to mineral soil layers • (slower rate of decomposition)
Moder	<ul style="list-style-type: none"> • loosely structured F horizon, gradual transition from organic to mineral soil layers • (medium rate of decomposition)
Mull	<ul style="list-style-type: none"> • F and H horizons thin or absent, upper mineral soil layer rich with organics • (faster rate of decomposition)

12. Soil hand texturing key



* Silt feels slippery or soapy when wet; fine sand feels stiffer, like grinding compound or fine sandpaper.

13. Soil compaction hazard key

Soil texture ^a (0–30 cm)	Hazard rating ^b moisture regime	
	Xeric–subhygric ^c (H horizons <20 cm)	Subhygric ^d –subhydric (H horizons ≥20 cm)
Fragmental (coarse fragments >70%)	L	M
Coarse fragments (<70%)		VH ^e
Sandy (S, LS)	L	
Sandy loam (SL, fSL)	M	
Silty/loamy (SiL, Si, L)	H	
Clayey (SCL, CL, SiCL, SC, SiC,C)	VH	

^a Use dominant soil texture and coarse fragment content of the upper 30 cm of mineral soil to assess compaction hazard. If a pronounced textural change occurs within the upper 30 cm (e.g., silty over sandy soil), then use the more limiting soil texture, providing it amounts to 5 cm of the top 30 cm.

^b L = Low; M = Moderate; H = High; VH = Very High.

^c Use this column for subhygric sites with forest floor H horizons < 20 cm thick.

^d Use this column for subhygric sites with forest floor H horizons ≥ 20 cm thick.

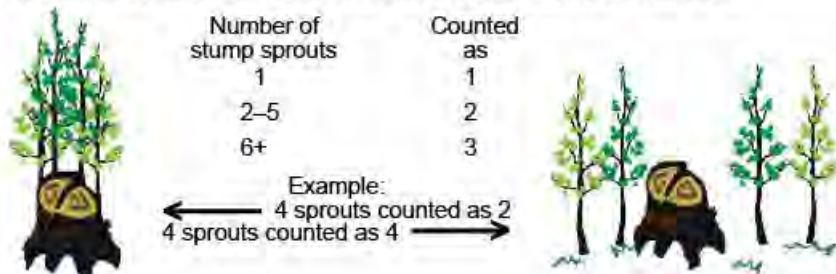
^e Organic soils composed of more than 40 cm of wet organic material, or forest floors >40 cm (including Folisols <40 cm), are susceptible to rutting because their very low load-bearing strength materials make them easy to displace.

14. Number of complete growing seasons suggested as a best management practice following a brushing treatment prior to a free growing survey.

Biogeoclimatic zone	Number of complete growing seasons
ICH, IDF, MS, PP, BG, SBPS, CWH, CDF, MH, and ESSF	2
SBS and BWBS	
• following herbicide treatment	2
• manually or otherwise treated	3

15. Post brushing treatment sprout counting

THIS IS NOT USED FOR TOTAL TREES. Following some vegetation management treatments, broadleaf tree species can sprout from the cut stump. Where this occurs, the multiple sprouts present are recorded based on the table below. The application of this concept applies to all competitive broadleaf tree species that originate from cut stumps above ground. **THIS ONLY APPLIES TO STRATA THAT HAVE HAD ONE OR MORE VEGETATION MANAGEMENT TREATMENTS.**



16. Two Free Growing Methods

It is the responsibility of the surveyor, during the walk-through, to select and record on the FS 657 card the method used for free growing assessments. The surveyor is directed to select the method that will find the greatest number of free growing stems, the method that is the most beneficial to the licence holder.

There are two approved methods to select from:

Silviculture Prescription Standards

- complete the survey using the free growing standards as found in the silviculture prescription/site plan.

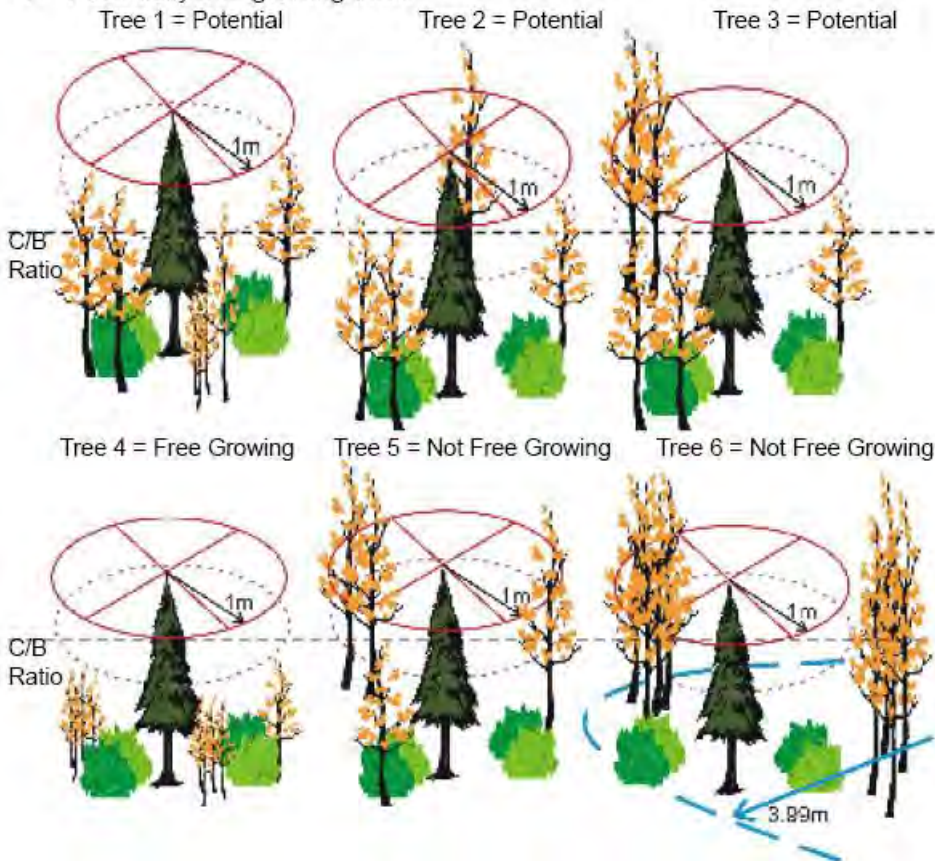
Free Growing Guideline Method*¹ *²

- complete the survey using the free growing standards as found in the silviculture prescription/site plan, except:
 - use 100% conifer to brush ratio for herb and shrub species,
 - add minimum free growing heights from an approved source if they are not already specified in the silviculture prescription/site plan,
 - apply the concepts of "3/4 brush free quadrants" and "potential free growing" as described below.

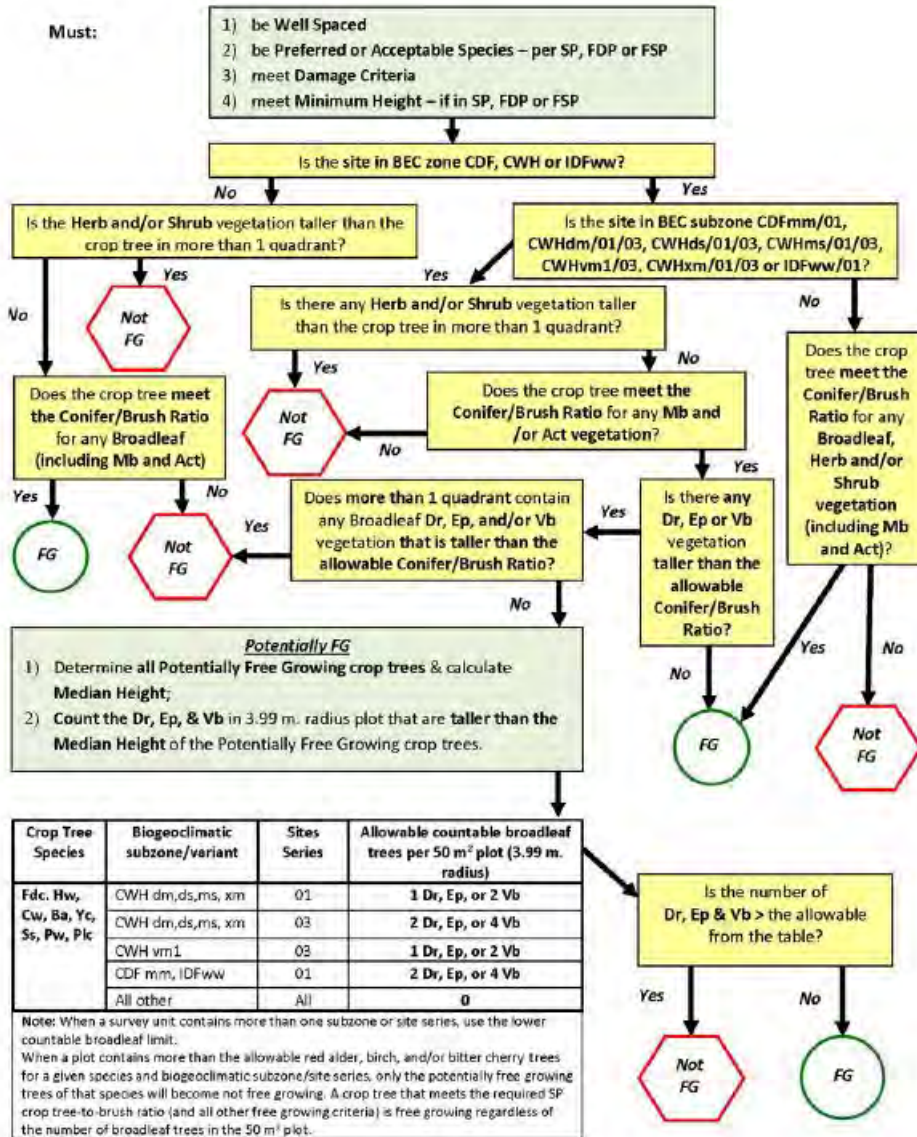
*¹ Also known as Appendix 9 of the Establishment to Free Growing Guidelines and the "Interim Free Growing Guidelines" and "the quadrant method".

*² There are variations to the above for some coastal ecological units and the Interior (Southern Area) **Alternate**.

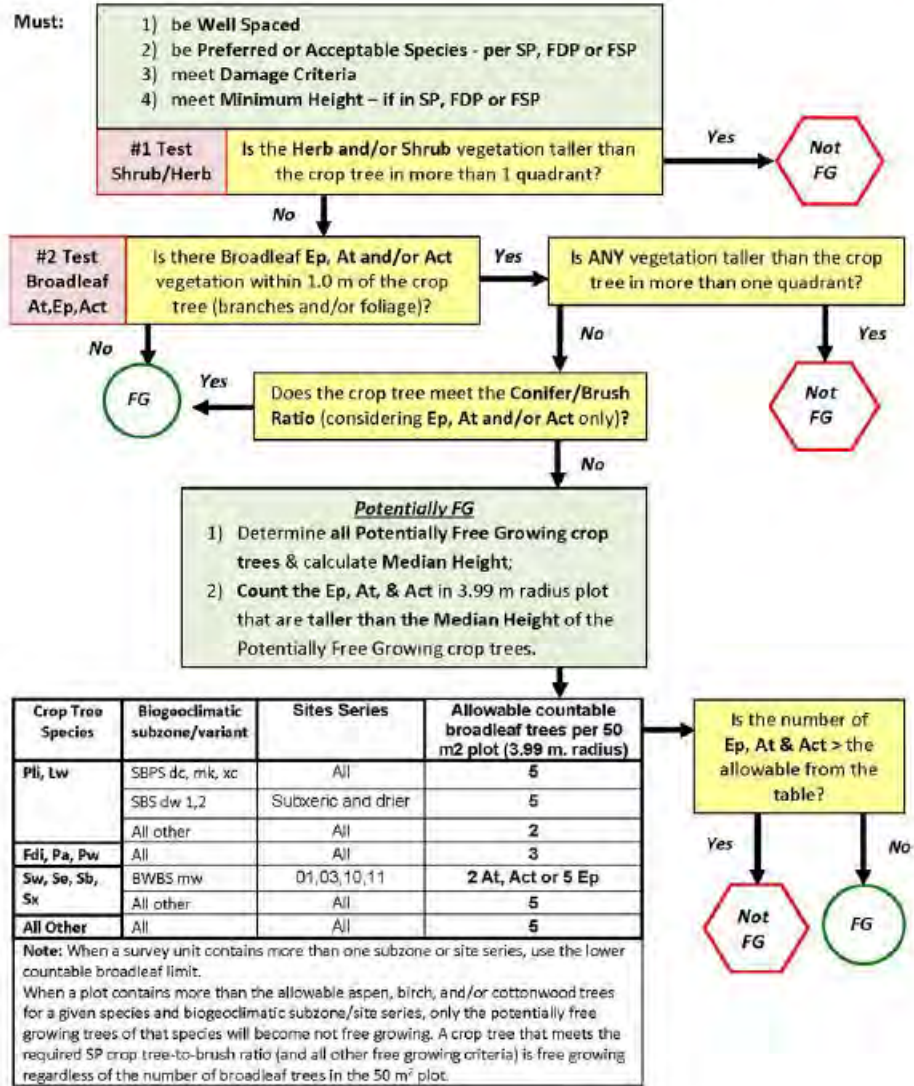
17. Potentially free growing trees



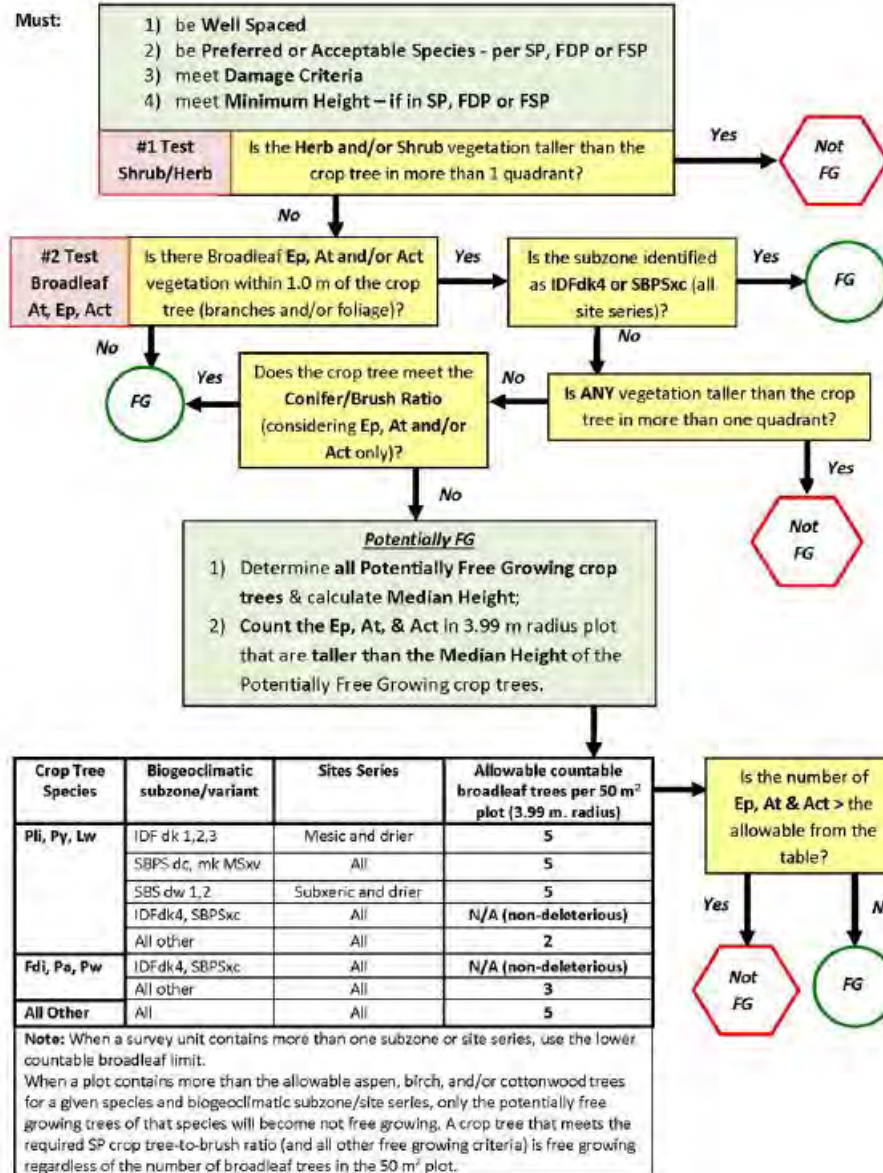
18A. COASTAL Vegetation Competition Decision Key for a Free Growing Crop Tree



18b. INTERIOR (North Area) Vegetation Competition Decision Key for a Free Growing Crop Tree



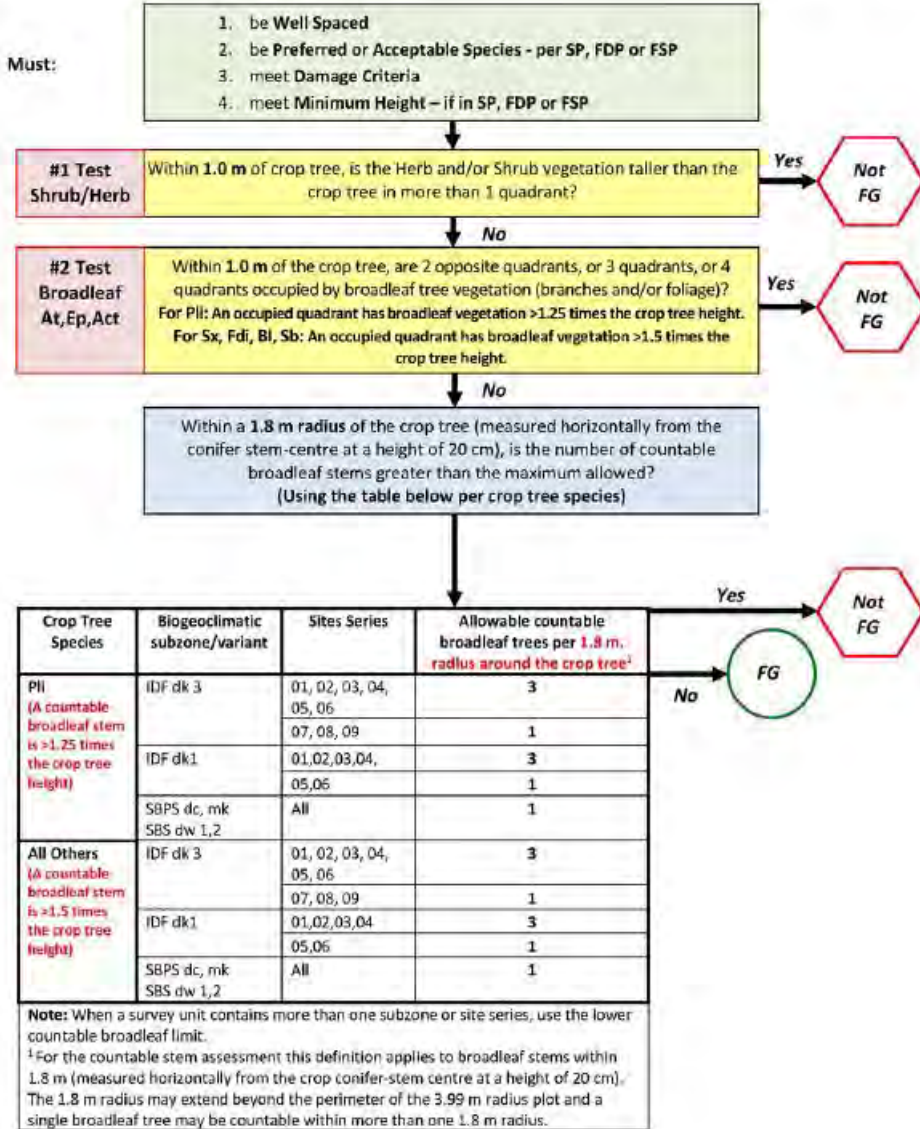
18c. INTERIOR (South Area) Vegetation Competition Decision Key for a Free Growing Crop Tree



18d. INTERIOR (South Area) **ALTERNATE** Vegetation Competition Decision

Key for a Free Growing Crop Tree

Only for Williams Lake, Quesnel, and 100 Mile TSAs alternative guidelines for SBPSmk, SBPSdc, SBSdw1, SBSdw2, IDFdk3, and IDFdk1 (only on sites where there has been NO previous brushing or broadleaf tree spacing activity)



19. Countable conifer principles

The number of countable conifers need only be assessment where the number of total trees per hectare is in excess of the maximum density for the survey standards unit.

- a. All silviculture systems except single tree selection;
 - It is reassessed at each plot.
 - Determine the median (middle) height of the largest well spaced trees to a maximum of the M value.

Where the median height of the well spaced trees is;

<2m, the countable height is 30% of the median well spaced height

≥2m, the countable height is 50% of the median well spaced height

- b. Single tree selection silviculture systems;
 - all layer 3 conifers are considered countable.

20. Free growing acceptability guidelines for layer 3 and 4 advanced regeneration

Species*	Ba, Bl	Cw** Hm, Yc	Hw		Sx, Se, Sw	Fdi, Lw	Pa, Pli, Py
BEC Zones	All***	CWH, CDF, MH, ICH	CWH, CDF, MH, ICH, (Pr. Rup.)	ICH (Other regions)	All*** (except BWBS)	All** *	All** *
Height at release	No height limit				<0.5m	No height limit	
Scars and damage	All species: No open (unhealed) injuries; no closed (healed) injuries with a width at the widest point(s), which is greater than 25% of the circumference of the tree at that point; no closed injuries that exceed 10% of the total length of the stem; no stem infection caused by a stem rust or dwarf mistletoe; no other externally visible pathological indicators including broken top, frost crack, conk, extreme basal sweep or unacceptable forks and crooks (see 23b)						
Continuous live crown	All species: An acceptable tree has greater than 30% continuous live crown. Continuous live crown is the length of continuous green foliage on a tree expressed as a percentage of its total height. Continuous live crown refers to foliage on adjacent live green branches that forms the main part of the crown of a tree and extends over at least half of the circumference of the tree.						
Vigour	All species: Evidence of release (i.e., generally good post-harvest height increment) – Increased leader growth is not a requirement for trees in layer three and four in partial cut situations with low basal area removal where the trees remain heavily shaded by layer one and two trees.						

* For those species not listed here, the normal free growing acceptability criteria apply. At regeneration delay, consider whether naturals will meet these criteria by free growing. If western white pine (Pw) is to be considered, consult the Pine Stem Rust Management Guidebook.

** Beware of sun scald. If advance regeneration western redcedar is to be used, check for incidence of heart rot.

*** "All" refers to zones where these species are acceptable.

21a. Damage agent and condition codes (FS 747 - 2011/10)

FIELD CODES		DESCRIPTION	FIELD CODES	DESCRIPTION	FIELD CODES	DESCRIPTION
A	ANIMAL DAMAGE					
	AB	BEAR	AO	PIKA	DDB	Delphinella tip blight Delphinella spp.
	AC	CATTLE	AP	PORCUPINE	DFC	Large-spored spruce-labrador tea rust Chrysomyxa ledicola
	AD	DEER	AS	SQUIRREL	DFD	Spruce needle cast Lirula macrospora
	AE	ELK	AV	VOLE	DDE	Elytoderma needle and shoot disease Elytoderma deformans
	AH	HARE OR RABBIT	AX	BIRDS	DFH	Larch needle blight Hypodermella larici
	AM	MOOSE	AZ	BEAVER	DFJ	Phaeoseptoria needle cast Phaeoseptoria contortae
					DFL	Pine needle cast Lophodermella concolor
					DFM	Larch needle cast Meria larici
	N	NONBIOLOGICAL			DFN	Leptomelanconium needle blight Leptomelanconium pinicola
	NAV	Avalanche or snow slide	NK	FUMEKILL	DFO	Lophodermium needle cast Lophodermium sedditosum
			NL	LIGHTNING	DFP	Fir-fireweed rust Pucciniastrum epilobii
	NB	FIRE	NN	ROAD SALT	DFR	Douglas-fir needle cast Rhabdochline pseudotsugae
ND	DROUGHT	NR	REDBELT	DFS	Dothistroma (red band) needle blight Mycosphaerella pini	
NE	FLOODING	NS	SLIDE	DFU	Cedar leaf blight Didymascella thujina	
NG	FROST	NW	WINDTHROW	DFW	Swiss needle cast Phaeocryptopus gaeum annii	
NGC	Frost crack	NWS	Windthrow-soil failure	DFX	Brown felt blight Herpotrichia spp.	
NGH	Frost-heaved	NWT	Windthrow-treatment	DFY	Hendersonia needle cast Hendersonia pinicola	
NGK	Shoot/bud frost kill or harvest related	NX	WIND SCARRING OR RUBBING	DFZ	Rhizosphaera needle cast Rhizosphaera kalkhoffii	
NH	HAIL	NY		DL	LEADER OR BRANCH DIEBACKS	
NN	ROAD SALT	NZ	SNOW, ICE, SNOW PRESS SUNSCALD	DLD	Dermia canker Dermia pseudotsugae	
D	DISEASE				DLF	Red flag disease Potebniamyces balsamicola
	DB	BROOM RUST			DLP	Conifer cytospora canker Leucostoma kunzei
	DBF	Fir broom rust Melampsorella caryophyllacearum			DLK	Diaporthe canker Diaporthe lokoyae
	DBS	Spruce broom rust Chrysomyxa arctostaphyli			DLS	Sydowia tip dieback Sclerophoma a pityophila
	DD	STEM DECAYS			DFT	Sirococcus tip blight Sirococcus strobilinus
	DDA	White mottled rot Ganoderma applanatum			DM	DWARF MISTLETOES
	DDD	Sulfur fungus Laetiporus sulphureus			DMF	Douglas-fir dwarf mistletoe Arceuthobium douglasii
	DDE	Rust-red stringy rot Echinodontium tinctorium			DMH	Hemlock dwarf mistletoe Arceuthobium tsugense
	DDF	Brown crumbly rot Fomitopsis pinicola			DMP	Larch dwarf mistletoe Arceuthobium larici
	DDO	Brown cubical butt & pocket rot of cedar Postia sericeomollis			DR	ROOT DISEASES
	DDP	Red ring rot Phellinus pini			DRA	Armillaria root disease Armillaria ostoyae
	DDQ	Brown trunk rot (quinine fungus) Fomitopsis officinalis			DRB	Black-stain root disease Leptographium wageneri
	DF	FOLIAGE DISEASES			DRC	Laminated root rot (cedar form) Phellinus weirii
DFA	Western pine aster rust Coleosporium asterum			DRL	Laminated root rot (F'd form) Phellinus sulphureans	
				DRN	Annosus root disease Heterobasidion annosum	
				DRR	Rhizina root disease Rhizina undulata	

21b. Damage agent and condition codes (FS 747 - 2011/10)

FIELD CODES	DESCRIPTION	FIELD CODES	DESCRIPTION
DRS	Schweinitzii butt rot <i>Phaeolus schweinitzii</i>	IDL	Western hemlock looper <i>Lambdina fiscellaria lugubrosa</i>
DRT	Tomentosus root rot <i>Inonotus tomentosus</i>	IDP	Larch sawfly <i>Pristiphora erichsonii</i>
DS	STEM DISEASE (CANKER OR RUST)	IDS	Conifer sawflies <i>Neodiprion</i> spp.
DSA	Atropellis canker <i>Atropellis piniphila</i>	IDT	Douglas-fir tussock moth <i>Orygia pseudotsugata</i>
DSB	White pine blister rust <i>Cronartium ribicola</i>	IDV	Variiegated cutworm <i>Peridroma saucia</i>
DSC	Comandra blister rust <i>Cronartium comandrae</i>	IDW	Western spruce budworm <i>Choristoneura occidentalis</i>
DFE	Elytoderma needle and shoot disease <i>Elytoderma deformans</i>	IDZ	Western false hemlock looper <i>Nepytia freemani</i>
DSG	Western gall rust <i>Endocronartium harknessii</i>	IS	SHOOT AND STEM INSECTS
DSS	Stalactform blister rust <i>Cronartium coleosporioides</i>	ISB	Western cedar borer <i>Trachykele blondelli</i>
I	INSECTS	ISE	European pine shoot moth <i>Rhyacionia buoliana</i>
IA	APHIDS OR ADELGIDS	ISG	Gouty pitch midge <i>Cecidomyia pinitropis</i>
IAB	Balsam woolly adelgid <i>Adelges piceae</i>	ISP	Pitch nodule moths <i>Petrova</i> spp.
IAC	Giant conifer aphid <i>Cinara</i> spp	ISS	Western pine shoot borer <i>Eucosma sonomana</i>
IAG	Cooley spruce gall adelgid <i>Adelges cooleyi</i>	ISQ	Sequoia pitch moth <i>Synanthedon sequoiae</i>
IAL	Larch cone woolly aphid <i>Adelges lariciatus</i>	IW	WEEVILS
IAS	Spruce aphid <i>Elatobium abietinum</i>	IWC	Conifer seedling weevil <i>Steremnius carinatus</i>
IB	BARK BEETLES	IWM	Magdalis sp.
IBB	Western balsam bark beetle <i>Dryocoetes confusus</i>	IWP	Lodgepole pine terminal weevil <i>Pissodes terminalis</i>
IBD	Douglas-fir beetle <i>Dendroctonus pseudotsugae</i>	IWS	White pine weevil (on spruce) <i>Pissodes strobi</i>
IBE	Silver fir beetle <i>Pseudohylesinus sericeus</i>	IWW	Warren's root collar weevil <i>Hyllobius warreni</i>
IBF	Fir engraver beetle <i>Scolytus ventralis</i>	IWY	Cylindrocopturus weevil <i>Cylindrocopturus</i> spp.
IBH	Hylurgops beetle <i>Hylurgops ventralis</i>	IWZ	Yosemite bark weevil <i>Pissodes schwartzii</i>
IBI	Engraver beetles <i>Ips</i>	M	MITE DAMAGE (TRISETACUS SPECIES)
IBL	Lodgepole pine beetle <i>Dendroctonus murrayanae</i>	T	TREATMENT INJURIES
IBM	Mountain pine beetle <i>Dendroctonus ponderosae</i>	TC	CHEMICAL
IBP	Twig beetles <i>Pityogenes</i> , <i>Pityophthorus</i> spp	TH	HARVESTED
IBS	Spruce beetle <i>Dendroctonus rufipennis</i>	TL	LOGGING
IBT	Red turpentine beetle <i>Dendroctonus valens</i>	TM	OTHER MECHANICAL DAMAGE (NON-LOGGING)
IBW	Western pine beetle <i>Dendroctonus brevicornis</i>	TP	PLANTING
ID	DEFOLIATING INSECTS	TPM	Planting — poor microsite
IDA	Black army cutworm <i>Actebia femica</i>	TR	PRUNING
IDB	Two-year budworm <i>Choristoneura biennis</i>	TT	THINNING OR SPACING
IDC	Larch casebearer <i>Coleophora laricella</i>	V	VEGETATION PROBLEMS
IDDE	Spruce budworm <i>Choristoneura fumiferana</i>	VH	HERBACEOUS COMPETITION
IDG	Green-striped forest looper <i>Melanophila imatata</i>	VP	VEGETATION PRESS
IDH	Western blackheaded budworm <i>Acleris gloverana</i>	VS	SHRUB COMPETITION
IDI	Pine needle sheath miner <i>Zelleria haimbachi</i>	VT	TREE COMPETITION

21c. Damage agent and condition codes (FS Deciduous 747 - 2011/10)

FIELD CODES	DESCRIPTION	FIELD CODES	DESCRIPTION	FIELD CODES	DESCRIPTION
A	ANIMAL DAMAGE			DFG	Cottonwood leaf rust <i>Melampsora occidentalis</i>
		AB	BEAR	DFI	Linospora leaf blotch <i>Linospora tetraspora</i>
		AC	CATTLE	DFK	Septoria leaf spot <i>Septoria populicola</i>
		AD	DEER	DFQ	Ink spot of aspen <i>Ciboria whetzellii</i>
		AE	ELK	DFV	Leaf rust <i>Melampsora</i> spp.
		AH	HARE OR RABBIT	DL	LEADER OR BRANCH DIEBACKS
		AM	MOOSE	DLP	Diaporthe canker <i>Diaporthe lokoyae</i>
				DLV	Aspen & poplar leaf and shoot blights <i>Venturia</i> spp.
				DR	ROOT DISEASES
				DRA	Armillaria root disease <i>Armillaria ostoyae</i>
N	NONBIOLOGICAL	NAV	Avalanche or snow slide	DS	STEM DISEASE (CANKER OR RUST)
		NB	FIRE	DSE	Sooty bark canker <i>Encoelia pruinosa</i>
		NC		DSH	Hypoxyton canker <i>Entoleuca mammatum</i>
		NCA	Aspen decline	DSP	Cryptosphaeria canker <i>Cryptosphaeria populina</i>
		NCB	Birch decline	DSR	Ceratocystis canker <i>Ceratocystis fimbriata</i>
		ND	DROUGHT	DST	Target canker <i>Nectria galligena</i>
		NF	FLOODING	DSY	Cytospora canker <i>Valsa sordida</i>
		NG	FROST		
		NGC	Frost crack		
		NGH	Frost-heaved		
D	DISEASE	NGK	Shoot / bud frost kill or harvest related		
				I	INSECTS
		DD	STEM DECAYS	ID	DEFOLIATING INSECTS
		DDA	White mottled rot <i>Ganoderma applanatum</i>	IDA	Black army cutworm <i>Actebia fennica</i>
		DDB	White spongy trunk rot <i>Formes fomentarius</i>	IDD	Western winter moth <i>Erannis vancouverensis</i>
		DDC	Brown cubical rot of birch <i>Piptoporus betulinus</i>	IDF	Forest tent caterpillar <i>Malacosoma dissitria</i>
		DDD	Sulfur fungus <i>Laetiporus sulphureus</i>	IDJ	Gray forest looper <i>Caripeta divisa</i>
		DDF	Brown crumbly rot <i>Fomitopsis pinicola</i>	IDK	Northern tent caterpillar <i>Malacosoma californicum</i>
		DDG	Sterile conk trunk rot of birch <i>Inonotus obliquus</i>	IDM	Gypsy moth <i>Lymantria dispar</i>
		DDH	Hardwood trunk rot <i>Phellinus ignarius</i>	IDN	Birch leaf miners <i>Fenusa pusilla</i> and <i>Profenusa thomsoni</i>
DF	FOLIAGE DISEASES	DDT	Aspen trunk rot <i>Phellinus tremulae</i>	IDO	Filament bearer <i>Nematocampa fimentaria</i>
				IDR	Alder sawfly <i>Eriocampa ovata</i>
		DDF	Marssonina leaf spots and blights <i>Marssonina</i> spp	IDU	Satin moth <i>Leucoma salicis</i>
				IDV	Variagated cutworm <i>Peridroma saucia</i>
				IDX	Large aspen tortrix <i>Choristoneura conflictana</i>
				IDY	Birch-aspen leafroller <i>Epinotia slandriana</i>
				ID1	Leaf beetles <i>Chrysomela</i> spp.
				ID2	Bruce spanworm <i>Operophtera bruceata</i>

21d. Damage agent and condition codes (FS Deciduous 747 - 2011/10)

FIELD CODES	DESCRIPTION
ID3	Winter moth <i>Operophtera brumata</i>
ID4	Cottonwood sawfly <i>Nematus currani</i>
ID5	Fall webworm <i>Hyphantria cunea</i>
ID6	Aspen leaf miner <i>Phyllocnistis populiella</i>
ID7	Woodly alder sawfly <i>Eriocampa ovata</i>
ID8	Aspen leaf roller <i>Pseudexentera oregonana</i>
ID9	Birch leaf skeletonizer <i>Buccatrix</i> spp.
IEA	Unidentified aspen defoliation
IEF	Cottonwood leaf skeletonizer <i>Phyllonoryctes apparella</i>
IEJ	Willow leafminer <i>Micrurapteryx salicifoliella</i>
IS	SHOOT INSECTS
ISA	Bronze birch borer <i>Agrilus anxius</i>
ISC	Poplar borer <i>Saperda calcarata</i>
ISW	Poplar and willow borer <i>Cryptorhynchus lapathi</i>
T	TREATMENT INJURIES
TC	CHEMICAL
TH	HARVESTED
TL	LOGGING
TM	OTHER MECHANICAL DAMAGE (NON-LOGGING)
TP	PLANTING
TMP	Planting — poor microsite
TR	PRUNING
TT	THINNING OR SPACING
V	VEGETATION PROBLEMS
VH	HERBACEOUS COMPETITION
VP	VEGETATION PRESS
VS	SHRUB COMPETITION
VT	TREE COMPETITION

22a. Free growing damage criteria for even-aged (age class 1) coniferous trees
(pg. 1)

Location of Damage	Type of Damage	Tree being assessed is UNACCEPTABLE if:	Host species	Some possible causes	Comments
Stem	Wound (including sunscald and girdling)	<ul style="list-style-type: none"> the tree has any wound which is greater than 33% of the stem circumference, or the tree has a wound which is greater than 20% of the total length of the stem, or the tree has a wound centred on an infection caused by a stem rust, canker, or dwarf mistletoe (See Note under Stem or Branch: Dwarf Mistletoe infection). The tree is enclosed within a seedling protector (added 2015) Any amount of girdling or damage to the stem caused by seedling protectors (added 2015). 	All	cattle AC, squirrel AS, beaver AZ, vole AV, porcupine AP, hare AH, Warren's root collar weevil IWW, sequoia pitch moth ISQ, fire NB, wind-throw NW, sunscald NZ, logging TL, mechanical TM.	A wound is defined as an injury in which the cambium is dead (e.g., sunscald) or completely removed from the tree exposing the sapwood. Measure the wound across the widest point of the exposed sapwood (or dead cambium when the tree is damaged by sunscald). Healed over wounds (=scars) are acceptable. See "Damage types." Girdling can be caused by seedling protectors.
Stem	Insect mining at root collar	<ul style="list-style-type: none"> the tree is currently attacked by a bark-mining insect such as a weevil or a beetle and exhibits symptoms such as foliage discoloration, thinning, and/or reduced height growth increments 	PI, Sx	Warren's root collar weevil IWW	Only trees that are symptomatic should be checked for insect infestation or mining damage. Non-symptomatic trees are presumed to be unaffected by insect mining.
Stem	Deformation (including crook, sweep, fork, browse, and dead or broken top)	<ul style="list-style-type: none"> the pith is horizontally displaced more than 30 cm from the point of defect and originates above 30 cm from the point of germination. the tree leader has been killed three or more times in the last five years (weevil only). the tree has two or more leaders with no dominance expressed after five years growth and the fork originates above 30 cm from the point of germination. the tree has a dead or broken top at a point that is >2 cm (>3 cm for the coast) in diameter. 	For sweep, all except Cw and Hw Sx, Ss, PI All All	Defoliators ID, white pine (spruce) weevil IWS, lodgepole pine terminal weevil IWP, northern pitch twig moth ISP, cattle AC, deer AD, frost NG, hail NH, snow NY, drought ND, logging TL. White pine (spruce) weevil IWS, lodgepole pine terminal weevil IWP, terminal weevils (IWS, IWP), frost NG, animal damage A.	For horizontal displacement see "Damage types." This criterion applies only for terminal weevil damage. Leader dominance occurs when the tallest leader is at least 5 cm taller than the second tallest leader. See "Damage types."

FS 660 2020/5/1

Page 18 of 38

22b. Free growing damage criteria for even-aged (age class 1) coniferous trees
(pg. 2)

Location of Damage	Type of Damage	Tree being assessed is UNACCEPTABLE if:	Host species	Some possible causes	Comments
Stem	Bark mining	<ul style="list-style-type: none"> Boring dust, pitch tubes, or bark sloughing is visible 	Pl, Sx, Fd	Bark beetles (IB), mountain pine beetle (IBM), Ips pini (IPi), Pityogenes, Pityophthorus (IBP), comandra blister rust DSC, stalactiform blister rust DSS, white pine blister rust DSB, western gall rust DSG.	The mountain pine beetle outbreak has caused unexpected mortality in young pine. Stressed trees are also susceptible to secondary bark and twig beetles.
Stem	Infection (including cankers and galls)	<ul style="list-style-type: none"> any infection occurs on the stem. 	All		Note: To best identify pine rusts, surveys should be scheduled between May and July as a best management practice (Added 2020). Wounds caused by rodent feeding around rust cankers should have stem rust recorded as the causal agent.
Branch	Infection (cankers)	<ul style="list-style-type: none"> an infection occurs on a live branch less than 20 cm from the stem. (added 2015) an infection occurs on a live branch less than 60 cm from the stem. 	Pl, Py	comandra blister rust DSC	
Branch	Galls	<ul style="list-style-type: none"> a gall rust infection occurs on a live branch less than 5 cm from the stem. 	Pl, Py	western gall rust DSG.	
Branch	Gouting	<ul style="list-style-type: none"> any adelgid gouting occurs on a branch. 	Ba, Bg, BI	balsam woolly adelgid IAB.	Note: To best identify pine rusts, surveys should be scheduled between May and July as a best management practice (Added 2020). Gouting is defined as excessive swelling of a branch or shoot caused by balsam woolly adelgid, and is often accompanied by misshapen needles and buds. It is most common on branch tips and at nodes near the ends of branches. Consult a recent distribution map to identify the geographic extent of this pest.
Stem or Branch	Dwarf mistletoe infection	<ul style="list-style-type: none"> any infection occurs on the stem or a live branch, or a susceptible tree is located within 10 m of an overtopping tree, which is infected with dwarf mistletoe. 	Hw, Pl, Lw, Fd	hemlock dwarf mistletoe DMH, PI dwarf mistletoe DMP, larch dwarf mistletoe DML, Fd dwarf mistletoe DMF	To confirm infection, the surveyor must observe mistletoe aerial shoots or basal cups on regeneration or on live or dead fallen brooms. Overtopping tree is a tree that is three or more times taller than the height of the tree being assessed.
Foliage	Defoliation	<ul style="list-style-type: none"> >50% of tree foliage has been removed by Dothistroma in ICH, CVMH and SBS biogeoclimatic zones. (see 23d.) Any defoliation, stunting, or red-brown discoloration in the top 1/3rd of the live crown due to Elytroderma in the IDFdk3, IDFdk4, SBP Smk or SBP Sxc biogeoclimatic subzones (added 2020). >80% of tree foliage has been removed due to insects or disease. 	B, F, P, S	Dothistroma needle blight, DFS	See "Defoliation for Determinate Growth Species."
			Pl	DFE, elytroderma needle and shoot disease	Note: After July 1st Elytroderma can be confirmed by the presence of black lines on the previous year's needles.
			All others	foliage diseases DF, ND drought.	

FS 660 2020/5/1

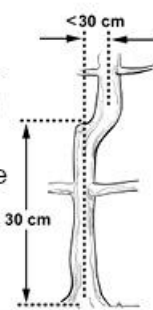
22c. Free growing damage criteria for even-aged (age class 1) coniferous trees

(pg. 3)

Location of Damage	Type of Damage	Tree being assessed is UNACCEPTABLE if:	Host species	Some possible causes	Comments
Roots	Root disease	<ul style="list-style-type: none"> sign(s) or a definitive combination of symptoms of root disease are observed. 	All	armillaria root disease DRA, laminated root rot DRL, tomentosus root rot DRT, annosus root disease DRN, blackstain root disease DRB.	Signs are direct evidence of the pathogenic fungus including fruiting bodies, distinctive mycelium or rhizomorphs. Symptoms include foliar chlorosis or thinning, pronounced resin flow near the root collar, reduced recent leader growth, a distress cone crop, and wood decay or stain. An individual symptom is not sufficient to identify a root disease.
Roots	Root disease (continued)	<ul style="list-style-type: none"> infected tree found in plot. See comments for well-spaced tree net down calculation. The multiplier for DRA is two, except in BEC zones PPdh1 and 2, IDFxh1, IDFdm1 and 2, MSdk1, and MSdm1 where the multiplier is one except for Cw (in all BEC zones) the multiplier is one and only if the Cw is considered preferred or acceptable or species and is performing well within the polygon or stratum being assessed. 	All	armillaria root disease DRA.	Note: All conifer species are considered susceptible. Broadleaf species are considered not susceptible for survey purposes only. Exemplar: How to apply net down for root disease. If root disease-infected trees are found in the plot: 1. In the first sweep, determine the total number of healthy, well spaced trees using the prescribed minimum inter-tree distance (MITD) (e.g., 12 trees) ignoring the M-value; 2. In a second independent sweep, determine the number of infected trees (including the dead infected stumps for DRT) that are the MITD from each other (e.g., 4 infected trees or stumps); 3. Multiply the number from step 2 by the multiplier for the specific root disease and subtract this number from the number of susceptible healthy well-spaced trees found in step 1 (e.g., for DRA: $12-4 \times 2 = 4$). The result is the maximum number of free growing trees that may be tallied for the plot. Next consider competing vegetation. Note: Bl, Cw, Pl, Pw, Py and broadleaf species are considered not susceptible for survey purposes only.
		<ul style="list-style-type: none"> infected conifer found in plot. See comments for well-spaced tree net down calculation. The multiplier for DRL is four. 	Fd, Sx, Se Lw, Ba, Bg	laminated root rot DRL.	Note: Ba, Bl, Cw, Fd, Pl, Pw, Py and broadleaf species are considered not susceptible for survey purposes only.
		<ul style="list-style-type: none"> infected conifer or stump found in plot. See comments for well-spaced tree net down calculation. The multiplier for DRT is two. 	Se, Sx	tomentosus root rot DRT.	
		<ul style="list-style-type: none"> infected conifer found in plot. See comments for well-spaced tree net down calculation. The multiplier for DRN is two. 	Ba, Hw, Ss	annosus root rot DRN.	Note: Bg, Bl, Cw, Cy, Fd, Hm, Pl, Pw, Py, Sx and broadleaf species are considered not susceptible for survey purposes only.

22d. Damage types Crooks (old stems)

A crook is unacceptable if it is displaced more than 30 cm and originates above 30 cm.



Defoliation, general

Defoliation is unacceptable if more than 80% of the needles are removed due to insects or disease.



Defoliation, for determinate growth species, (e.g. true firs, Douglas fir, spruces, pines)

1. Determine the % live crown.

2. Determine how many of the most recent 4 nodes have >50% of their foliage, express it as a %.

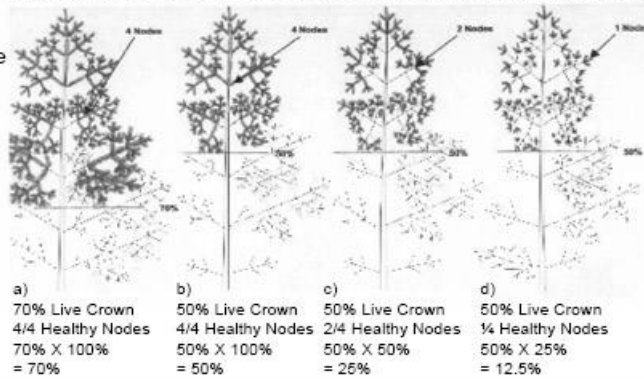
3. Step 1% x Step 2%: The result is the percentage of foliage remaining on the tree.

- for Dothistroma, in ICH, CWH and SBS

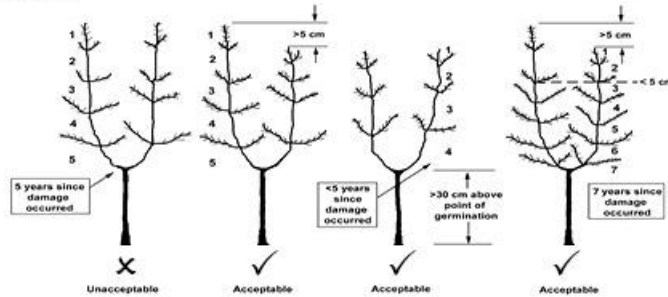
>50% = acceptable

- all other causes and biogeoclimatic zones

>20% = acceptable



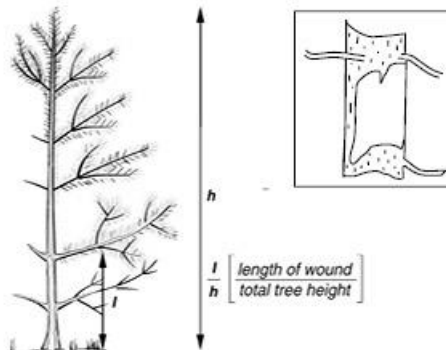
Forks



Wounds

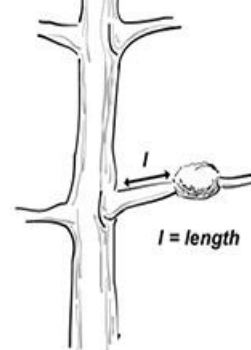
Damage to the cambium or deeper is unacceptable where it is:

- more than one-third the circumference, or
- more than 20% of the height of tree.



Gall and Canker

Distance measurement from point of infection by canker or gall to main stem (measured along the branch).



23. Broadleaf Forest Health Free Growing Damage Criteria

Unless otherwise stated in regulation or an approved FDP or FSP stocking standard, an acceptable hardwood crop tree must:

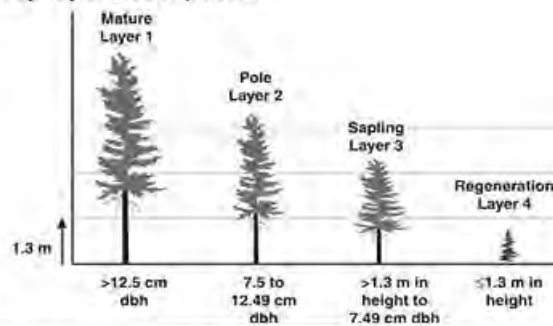
- not have a tree pith that is laterally displaced more than 30 cm from the location of the root-crown pith¹.
- not originate from a cut stump².
- have at least one dominant live leader³.
- not have a wound that is greater than 10% of the stem circumference nor is greater than 10% of the total length of the stem⁴.
- not have any fungal infections or insect infestations affecting tissues below the bark surface,
- visible without destructive sampling⁵.
- not be browsed so as to limit its ability to become a crop tree.

- 1 A requirement of the Establishment to Free Growing Guidebook, Prince George Forest Region, May 2000, Appendix 6, Boreal Broadleaf Stocking Guidelines, BWBS.
- 2 Stems originating from the sides or cut surface of stumps are very susceptible to breakage at the coppice point
- 3 The objective is that the tree has a single stem that will develop into a healthy crop tree. Accordingly, a healthy, free growing broadleaf tree must have an identifiable live leader. It is not important if a portion, but not all, of the leader is browsed or killed for example by venturia blight.
- 4 This criterion is modified from the conifer criterion, and threshold percent values are chosen subjectively. Research is needed to determine more exactly the size of an open wound at free growing assessment that is likely to limit the development of a healthy crop tree. A wound is defined as an injury in which the cambium is dead or completely removed from the tree exposing the sapwood. Measure the wound across the widest point of the exposed sapwood. Healed-over wounds (= scars) are acceptable. Fire or sunscald damage can also cause wounds. Injury of broadleaf stems is considered an important entry court for decay organisms.
- 5 Visible stem infections include cytospora canker or sooty-bark canker, and visible insect infestations, such as poplar borer. The significance of some diseases, such as armillaria root disease, to aspen is unknown or uncertain, and several cannot be feasibly identified by visual features during free growing surveys.

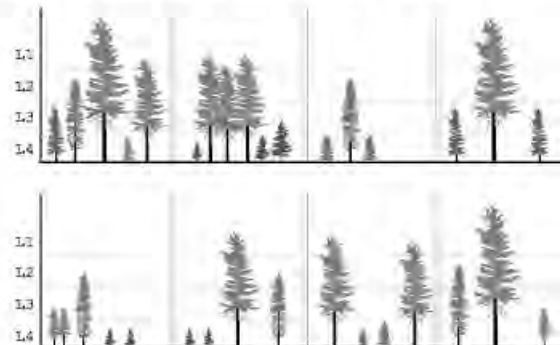
24. The Hawksworth six-class dwarf mistletoe rating system.

Instructions		Example
Step 1 Divide live crown into thirds		
Step 2 Rate each third separately Each third should be given a rating of 0, 1, or 2 as described below:		If this third has no visible infections, its rating is (0)
(0) no visible infections		If this third is lightly infected, its rating is (1)
(1) light infection (1/2 or less of total number of branches in the third infected)		
(2) heavy infection (more than 1/2 total number of branches in the third infected)		If this third is heavily infected, its rating is (2)
Step 3 Add ratings of thirds to obtain rating for total tree.		The tree in this example gets a rating of: $0 + 1 + 2 = 3$.

25a. Multi-storey layer descriptions



25b. Stand structures suitable for multi-storey surveys



* A stand is considered multi-storied (i.e. suitable for using the multi-storey survey methodology) if:

- the crown closure of the trees in layers 1 and 2 is equal to or greater than 6% and
- layers 3 and/or 4 are also present.

26a. Free growing damage criteria for multi-layered conifer stands (pg. 1)

Location of damage	Type of Damage	Tree being assessed is UNACCEPTABLE if:	Host species	Some possible causes	Comments
Stem	WOUND (including sunscald and girdling)	<ul style="list-style-type: none"> Refer to table X for layers 1-4. 	All	squirrel AS, beaver AZ, vole AV, porcupine AP, hare AH, Warrens root collar weevil IWW, fire NB, windthrow NW, sunscald NZ, logging TL, various decay fungi DD.	A wound is defined as an injury in which the cambium is dead (e.g., sunscald) or completely removed from the tree exposing the sapwood. Measure the wound across the widest point of the exposed sapwood (or dead cambium when the tree is damaged by sunscald). Healed over wounds (=scars) are acceptable.
Stem	DECAY	<ul style="list-style-type: none"> Any pathological indicator(s) are present. This may include conk, blind conk, frost crack, or rotten branches. 	All		
Stem	DEFORMATION (including crook, fork, and dead or broken top)	<ul style="list-style-type: none"> These criteria apply to layer 1 & 2 trees only. For layers 3 & 4 use the even-aged damage criteria. A crook displaces the portion of the stem above the defect by >50% from the line of growth formed by the stem below the point of defect in the bottom 2/3rds of the stem only. A fork occurs above stump height in the bottom 2/3rds of the stem only. A dead or broken top extends more than 20% of the stem length or the live crown is removed. 	All	defoliators ID, white pine (spruce) weevil IWS, lodgepole pine terminal weevil IWP, cattle AC, deer AD, elk AE, moose AM, frost NG, hail NH, snow NY, drought ND, logging TL, mechanical TT, Dwarf mistletoes (see below).	
Stem	INFECTION (including cankers, and galls)	<ul style="list-style-type: none"> Any infection occurs on the stem. 	All	comandra blister rust DSC, stalactiform blister rust DSS, white pine blister rust DSB, western gall rust DSG, atropellis canker DSA, exploding canker DSX, Dwarf mistletoes (see below).	Note: Wounds caused by rodent feeding around rust cankers should have stem rust recorded as the causal agent.
Branch	INFECTION (cankers)	<ul style="list-style-type: none"> These criteria apply to layer 2, 3 & 4 trees only. An infection occurs on a live branch less than 60 cm from the stem. 	Pw, Pl, Py	white pine blister rust DSB, comandra blister rust DSC, stalactiform blister rust DSS.	Branch infections on layer 1 trees can be ignored.
Branch	GALLS	<ul style="list-style-type: none"> These criteria apply to layer 2, 3 & 4 trees only. A gall rust infection occurs on a live branch less than 5 cm from the stem. 	Pl, Py	western gall rust DSG.	Branch infections on layer 1 trees can be ignored.

26b. Free growing damage criteria for multi-layered conifer stands (pg. 2)

Location of Damage	Type of Damage	Tree being assessed is UNACCEPTABLE if:	Host species	Some possible causes	Comments
Foliage	DEFOLIATION	For defoliating insects: • > 80% of foliage has been removed, lost or damaged due to foliage disease. For foliar diseases: • > 50% of foliage has been removed, lost or damaged	All	defoliators ID, foliage diseases DF.	
Stem or Branch	ADELGID GOUTING	• Any adelgid gouting occurs on a stem or branch.	Ba, Bg, BI	balsam woolly adelgid IAB.	Gouting is defined as excessive swelling on a branch or shoot caused by balsam woolly adelgid and is often accompanied by misshapen needles and buds. It is most common on branch tips and at nodes near the ends of branches. Consult a recent distribution map to identify the geographic extent of this pest. Note: To confirm infection, the surveyor must observe mistletoe aerial shoots or basal cups on regeneration or on live or dead fallen brooms. The Hawksworth rating system is described on page 24.
Stem or Branch	DWARF MISTLETOE INFECTION	These criteria apply to layer 2, 3 & 4 trees: • Any infection occurs on the stem or a live branch, or • A susceptible tree is located within 10 m of a higher layer tree that is infected with dwarf mistletoe. These criteria apply to layer 1 trees: • Hawksworth rating >3, or severe stem infections (major swelling or deformity) present.	Hw, PI, Lw, Fd	hemlock dwarf mistletoe DMH, lodgepole pine dwarf mistletoe DMP, larch dwarf mistletoe DML, Douglas-fir dwarf mistletoe DMF.	

TABLE X. Tree wounding criteria for layers 1-4. Trees are unacceptable if any ONE criterion is met.

STAND MANAGEMENT OBJECTIVE ¹		LONG-TERM RETENTION ² (Layers 1 & 2)		UNEVEN-AGED ⁴ (Layers 1 & 2)	
TREE SPECIES	SHORT TERM RETENTION ² (Layers 1 & 2)	LONG-TERM RETENTION ² (Layers 1 & 2)		UNEVEN-AGED ⁴ (Layers 1 & 2)	
B, H, Lw, Ss and Cw <60 years	W>33%C., or MRW 1m, or G.	W>33%C., or MRW 1m, or G.	W>33%C., or MRW 1m, or G.	W>33%C., or MRW 1m, or G.	See table 21
Cy, Sx and Cw >60 years	W>33%C., or MRW 1m, or G.	W>33%C., or MRW 1m, or G.	W>33%C., or MRW 1m, or G.	W>33%C., or MRW 1m, or G.	
Fd, Pw	W>50% C.	W>33%C., or MRW 1m, or G.	W>33%C., or MRW 1m, or G.	W>33%C., or MRW 1m, or G.	
PI, Py	W>50% C.	W>50% C.	W>33%C., or MRW 1m, or G.	W>33%C., or MRW 1m, or G.	

¹ The stand management objective should be specified in the site plan. Where it is not, the criteria for uneven-aged management should be applied.
² Where tree will be removed within 20 years.
³ Where tree will be removed in more than 20 years.
⁴ Where stand is managed in a true uneven state.
⁵ A gouge involves a wound where penetration is into the sapwood or deeper.
W = Wound C = Circumference
G = Gouge⁵ MRW = Major Root Wound within 1 m of the stem.

26c. Free growing damage criteria for multi-layered conifer stands (pg. 3)

Location of Damage	Type of Damage	Tree being assessed is UNACCEPTABLE if:	Host species	Some possible causes	Comments
Roots	ROOT DISEASE	<ul style="list-style-type: none"> Sign(s) or definitive combinations of symptoms of root disease are observed. 	All	armillaria root disease DRA, laminated root rot DRL, tomentosus root rot DRT, annosus root disease DRN, blackstain root disease DRB.	Signs are direct evidence of the pathogenic fungus including fruiting bodies, distinctive mycelium or rhizomorphs. Symptoms include foliar thinning or chlorosis, pronounced resin flow near the root collar, reduced recent leader growth, a distress cone crop, and wood decay or stain. Symptoms alone are not usually sufficient to identify root disease. Both signs and symptoms may be detected from old stumps, root balls, or other post-harvest remains. Note: All conifer species are considered susceptible. Broadleaf species are considered not susceptible for survey purposes only. Example: How to apply net down for root disease. If root disease-infected trees are found in the plot: 1. Determine the number of healthy, well-spaced trees in each layer using the prescribed minimum inter-tree distance (MITD) (e.g., 3 layer 1, 3 layer 3 and 4 layer 4 = 10 healthy, well-spaced) ignoring the M-value; 2. Count the number of infected trees (e.g., 1 layer 1 tree and 1 layer 3 tree); 3. Working from the uppermost layer down, apply the multiplier in Table Y to each lower layer. Subtract the resultant from each layer in turn, for susceptible species only (e.g., if all trees are susceptible, 1 infected layer 1 tree removes 1 healthy, well-spaced layer 1 tree plus 3 layer 3 trees plus 4 layer 4 trees). Note the effects are cumulative, not exclusive and lower layers do not effect higher layers; 4. Calculate the remaining healthy, well-spaced trees once all removals due to infected trees are completed (e.g. 10 – 8 = 2). The maximum number of free growing trees that might be tallied is 2. Next consider competing vegetation.
		<ul style="list-style-type: none"> Infected conifer found in plot. See Table Y for well-spaced tree net down calculation by layer. 	All	armillaria root disease DRA	Note: Bl, Cw, Pl, Pw, Py and broadleaf species are considered not susceptible for survey purposes only. Note: Ba, Bl, Cw, Fd, Pw, Py and broadleaf species are considered not susceptible for survey purposes only.
		<ul style="list-style-type: none"> Infected conifer found in plot. See Table Y for well-spaced tree net down calculation. 	Fd, Sx, Se Lw, Ba, Bg	laminated root rot DRL.	
		<ul style="list-style-type: none"> Infected conifer or stump found in plot. See Table Y for well-spaced tree net down calculation. 	Se, Sx, Pl	tomentosus root rot DRT.	
		<ul style="list-style-type: none"> Infected conifer found in plot. See Table Y for well-spaced tree net down calculation. 	Ba, Hw, Ss	annosus root rot DRN.	Note: Bg, Bl, Cw, Cy, Fd, Hm, Pl, Pw, Py, Sx and broadleaf species are considered not susceptible for survey purposes only.

Table Y Deductions from number of acceptable well spaced uninfected stems for trees infected by root disease in unevenaged stand layers.

Infected trees or stumps	Multiplier to determine number of trees to be deducted from:			
	Layer 1	Layer 2	Layer 3	Layer 4
Layer 1	1	2	3	4
Layer 2	-	2	2	3
Layer 3	-	-	2	2
Layer 4	-	-	-	2

27a. Free Growing Damage Criteria for Single Entry Dispersed Retention Stocking Standard (SEDRSS) Managed Stands in Coastal BC and for Interior DFP and Layered Stands (pg 1)

TABLE A-LAYER 1

TABLE A - Layer 1 - ≥ 12.5cm DBH, SEDRSS damage criteria

Note: Table A overrides all other damage criteria for SEDRSS managed stands

Location of Damage	Type of Damage	Tree being assessed is UNACCEPTABLE if:			Some possible causes	Comments
		Hw, Ba, Bg, Bl, Cy, Fd, Ss, Pw, Pl, Lw, Sx, Py	Cw			
Stem	Wound	<ul style="list-style-type: none"> Wound girdles >33% stem circumference, or One wound >400cm² on stem, or Wound on a major root within 1m of the stem, or Tree has gouge in stem. 	<ul style="list-style-type: none"> No criteria 		fire NB, windthrow NW, sunscald NZ, logging TL, mechanical TM	A wound is defined as an injury in which the cambium is dead (e.g. sunscald) or completely removed from the tree exposing the sapwood. Measure the wound across the widest point of the exposed sapwood (or dead cambium when the tree is damaged by sunscald). Healed over wound (=scars) are acceptable.
Stem	Decay	<ul style="list-style-type: none"> Any pathological indicator(s) are present. This may include conk, blind conk, frost crack or rotten branches. 	<ul style="list-style-type: none"> No criteria 		various decay fungi DD	Percent live crown is the length of continuous green foliage on a tree expressed as a percentage of its total height
Stem	Bark Mining	<ul style="list-style-type: none"> Any of the following signs are visible: pitch tubes, boring dust, exit holes on bark surface, galleries under the bark. 	<ul style="list-style-type: none"> No criteria 		Douglas fir beetle IBD, Ips pini IBI, Pityogenes & Pityophthorus IBP	Note: Pitch tubes can be associated with trees that have successfully repelled bark beetles, bark must be removed above pitch tube to confirm successful attack (successful galleries will be filled with frass and not pitch, contain adult beetles and or larval galleries). Stressed trees are susceptible to secondary bark and twig beetles.
Stem	Deformation (including crook, fork, and dead or broken top)	<ul style="list-style-type: none"> Any crook displaces the portion of the stem above the defect by >50% from the line of growth formed by the stem below the point of defect in the bottom 2/3 of the stem only. A fork occurs above stump height in the bottom 2/3 of the stem only. A dead or broken top extends more than 20% of the stem length or the live crown is removed. 	<ul style="list-style-type: none"> No criteria A dead tree with no live foliage the stem is unable to produce >50% merchantable volume. 		frost NG, hail NH, snow NY, drought ND, logging TL, mechanical TT, dwarf mistletoes (see below).	Cw: Unacceptable as a contributing Crop Tree if assessed as unable to produce > 50% Merchantable Volume in the first 10 m. log length – defined as either: 1. Utility Grade – At least a solid 8 inch shell – Shake and Shingle and /or 2. Higher Grade – Complete solid wood – Saw Logs Note: Field guidance procedures and photo examples for the estimation of merchantable Cw volume are identified in Appendix BB in the Surveys Procedures Manual.
Stem	Deformation (including crook, fork, and dead or broken top)	<ul style="list-style-type: none"> Any of the following signs are visible: pitch tubes, boring dust, exit holes on bark surface, galleries under the bark. 	<ul style="list-style-type: none"> No criteria 		hemlock dwarf mistletoe DMH, PI dwarf mistletoe DMP, larch dwarf mistletoe DML, Fd dwarf mistletoe DMF	The Hawksworth rating system is described on page 23. For SEDRSS, this rating system will only apply to the tree/plot as assessment level, and not at the stand level.

27b. Free Growing Damage Criteria for Single Entry Dispersed Retention
Stocking Standard (SEDRSS) Managed Stands in Coastal BC and for
Interior DFP and Layered Stands (pg 2)

Note: Table A overrides all other damage criteria for SEDRSS managed stands

TABLE A - Layer 1 - $\geq 12.5\text{cm DBH}$, SEDRSS damage criteria (cont'd)		Tree being assessed is UNACCEPTABLE if:		Some possible causes	Comments
Location of Damage	Type of Damage	Hw, Ba, Bg, Bl, Cy, Fd, Ss, Pw, Pl, Lw, Sx, Py	Cw		
Foliage	Defoliation	<ul style="list-style-type: none"> For defoliating insects: <ul style="list-style-type: none"> > 80% of foliage removed, lost or damaged due to insect defoliation. For foliar diseases: <ul style="list-style-type: none"> > 50% of foliage removed, lost or damaged. 		<ul style="list-style-type: none"> No criteria 	defoliators ID, foliage diseases DF.
Foliage	Live Crown Vigour	<ul style="list-style-type: none"> Stems < 17.5 cm dbh - < 30% live crown due to poor vigour. Stems ≥ 17.5 cm dbh - < 20% live crown due to poor vigour. 		<ul style="list-style-type: none"> A dead tree with no live foliage. 	Percent live crown is the length of continuous green foliage on a tree expressed as a percentage of its total height.
Roots	Root Disease	<ul style="list-style-type: none"> Sign(s) or definitive combinations of symptoms of root disease are observed. Infected conifer or stump found in plot. <p>See Table Y for well-spaced tree net down calculation by layer.</p>	<ul style="list-style-type: none"> For Cw, there is no criterion for net down calculation - considered not susceptible or low susceptibility. 	armillaria root disease DRA, laminated root rot DRL, annosus root disease DRN.	<p>Signs are direct evidence of the pathogenic fungus including fruiting bodies, distinctive mycelium or rhizomorphs. Symptoms include foliar thinning or chlorosis, pronounced resin flow near the root collar, reduced recent leader growth, a distress cone crop, and wood decay or stain. Symptoms alone are not usually sufficient to identify root disease. Both signs and symptoms may be detected from old stumps, root balls, or other post-harvest remains.</p>
		TABLE Y. Deductions from numbers of acceptable well-spaced uninfected stems for trees infected by root disease in layered stands.		armillaria root disease DRA, laminated root rot DRL, annosus root disease DRN.	<p>Example: How to apply net down for root disease. If root disease-infected trees are found in the plot:</p> <ol style="list-style-type: none"> Determine the number of healthy, well-spaced trees in each layer using the prescribed minimum inter-tree distance (MITD) (e. g., 3 layer 1, 3 layer 3 and 4 layer 4 = 10 healthy, well-spaced) ignoring M-value, tree); Count infected trees (e. g., 1 layer 1 tree and 1 layer 3 tree); Working from the uppermost layer down, apply the multiplier in Table Y to each lower layer. Subtract the resultant from each layer in turn, for susceptible species only (e. g., if all trees are susceptible, 1 infected layer 1 tree removes 1 healthy, well-spaced layer 1 tree plus 3 layer 3 trees plus 4 layer 4 trees). Note the effects are cumulative, not exclusive and lower layers do not affect higher layers; Calculate the remaining healthy, well-spaced trees once all removals due to infected trees are completed (e. g. 10 - 8 = 2). The maximum number of free growing trees that might be tallied is 2. Next consider competing vegetation.

27c. Free Growing Damage Criteria for Single Entry Dispersed Retention
Stocking Standard (SEDRSS) Managed Stands in Coastal BC and for
Interior DFP and Layered Stands (pg 3)

TABLE A - Layer 1 - ≥ 12.5 cm DBH, SEDRSS damage criteria (cont)

Note: Table A overrides all other damage criteria for SEDRSS managed stands

Location of Damage	Type of Damage	Tree being assessed is UNACCEPTABLE if:			Some possible causes	Comments
		Hw, Ba, Bg, BI, Cy, Fd, Ss, Pw, Pl, Lw, Sx, Py	Cw			
Stem	Wound	<ul style="list-style-type: none"> Wound girdles > 25% stem circumference, or One wound > 10% the length of stem. 	All		fire NB, windthrow NW, sunscald NZ, logging TL, mechanical TM	A wound is defined as an injury in which the cambium is dead (e.g., sunscald) or completely removed from the tree exposing the sapwood. Measure the wound across the widest point of the exposed sapwood (or dead cambium when tree is damaged by sunscald). Healed over wounds (scars) are acceptable.
Stem	Decay	<ul style="list-style-type: none"> Any pathological indicator(s) are present. This may include conk, blind conk, frost crack or rotten branches. 			various decay fungi DD	
Stem	Bark Mining	<ul style="list-style-type: none"> Any of the following signs are visible: pitch tubes, boring dust, exit holes on bark surface, galleries under the bark. 	All		Douglas fir beetle IBD, Ips pini IBI, Pityogenes & Pityophthorus IBP	Note: Pitch tubes can be associated with trees that have successfully repelled bark beetles, bark must be removed above pitch tube to confirm successful attack (successful galleries will be filled with frass and not pitch, contain adult beetles and/or larval galleries). Stresses trees are susceptible to secondary bark and twig beetles.
Stem	Deformation (including crook, fork, and dead or broken top)	<ul style="list-style-type: none"> The pith is horizontally displaced more than 30 cm from the point of defect and originates above 30 cm from the point of germination. 	All		defoliators ID, white pine (spruce) weevil IWS, lodgepole pine terminal weevil IWP, cattle AC, deer AD, elk AE, moose AM,	This criterion applies only for terminal weevil damage.
		<ul style="list-style-type: none"> The tree leader has been killed three or more times in the last 5 years (weevil only). 	Ss, Sx		frost NG, hail NH, snow NY, drought ND, logging TL, mechanical TT, Dwarf mistletoes (see below).	Leader dominance occurs when the tallest leader is at least 5 cm taller than the second tallest leader. See Appendix AA in Surveys Procedures Manual on Damage Types.
		<ul style="list-style-type: none"> The tree has two or more leaders with no dominance expressed after five years growth and the fork originates above 30 cm from the point of germination. The tree has a dead or broken top at a point that is > 3cm in diameter. The tree has a flat top (umbrella like) form and no distinct leader. 	All			
Stem	Lean and Sweep	<ul style="list-style-type: none"> The tree leans >30 degrees from the vertical with or without growth correction. 	All		flooding NF, snow NY, slides NS, wind NW	

FS 660 2020/5/1

Page 29 of 38

28a. Free Growing Damage Criteria for Single Entry Dispersed Retention Stocking Standard (SEDRSS) Managed Stands in Coastal BC and for Interior DFP and Layered Stands (pg 1)

TABLE B - Layer 2, 3 & 4 - ≥ 12.5 cm DBH, SEDRSS damage criteria

Note: Table B overrides all other damage criteria for SEDRSS managed stands

Location of Damage	Type of Damage	Tree being assessed is UNACCEPTABLE if:			Some possible causes	Comments
		Hw, Ba, Bg, Bl, Cy, Fd, Ss, Pw, Pl, Lw, Sx, Py	Cw			
Stem	Wound	<ul style="list-style-type: none">Wound girdles > 25% stem circumference, orOne wound > 10% the length of stem.	All		fire NB, windthrow NW, sunscald NZ, logging TL, mechanical TM	A wound is defined as an injury in which the cambium is dead (e.g., sunscald) or completely removed from the tree exposing the sapwood. Measure the wound across the widest point of the exposed sapwood (or dead cambium when tree is damaged by sunscald). Healed over wounds (scars) are acceptable.
Stem	Decay	<ul style="list-style-type: none">Any pathological indicator(s) are present. This may include conk, blind conk, frost crack or rotten branches.			various decay fungi DD	
Stem	Bark Mining	<ul style="list-style-type: none">Any of the following signs are visible: pitch tubes, boring dust, exit holes on bark surface, galleries under the bark.	All		Douglas fir beetle IBD, Ips pini IBI, Pityogenes & Pityophthorus IBP	Note: Pitch tubes can be associated with trees that have successfully repelled bark beetles, bark must be removed above pitch tube to confirm successful attack (successful galleries will be filled with frass and not pitch, contain adult beetles and or larval galleries). Stresses trees are susceptible to secondary bark and twig beetles.
Stem	Deformation (including crook, fork, and dead or broken top)	<ul style="list-style-type: none">The pith is horizontally displaced more than 30 cm from the point of defect and originates above 30 cm from the point of germination.	All		defoliators ID, white pine (spruce) weevil IWS, lodgepole pine terminal weevil IWP, cattle AC, deer AD, elk AE, moose AM, frost NG, hail NH, snow NY, drought ND, logging TL, mechanical TT, Dwarf mistletoes (see below).	This criterion applies only for terminal weevil damage.
		<ul style="list-style-type: none">The tree leader has been killed three or more times in the last 5 years (weevil only).	Ss, Sx			Leader dominance occurs when the tallest leader is at least 5 cm taller than the second tallest leader. See Appendix AA in Surveys Procedures Manual on Damage Types.
		<ul style="list-style-type: none">The tree has two or more leaders with no dominance expressed after five years growth and the fork originates above 30 cm from the point of germination.The tree has a dead or broken top at a point that is > 3cm in diameter.The tree has a flat top (umbrella like) form and no distinct leader.	All			
Stem	Lean and Sweep	<ul style="list-style-type: none">The tree leans >30 degrees from the vertical with or without growth correction.	All		flooding NF, snow NY, slides NS, wind NW	

28b. Free Growing Damage Criteria for Single Entry Dispersed Retention Stocking Standard (SEDRSS) Managed Stands in Coastal BC and for Interior DFP and Layered Stands (pg 2)

TABLE B - Layer 2, 3 & 4 - ≥ 12.5 cm DBH, SEDRSS damage criteria (cont'd) Note: Table B overrides all other damage criteria for SEDRSS managed stands

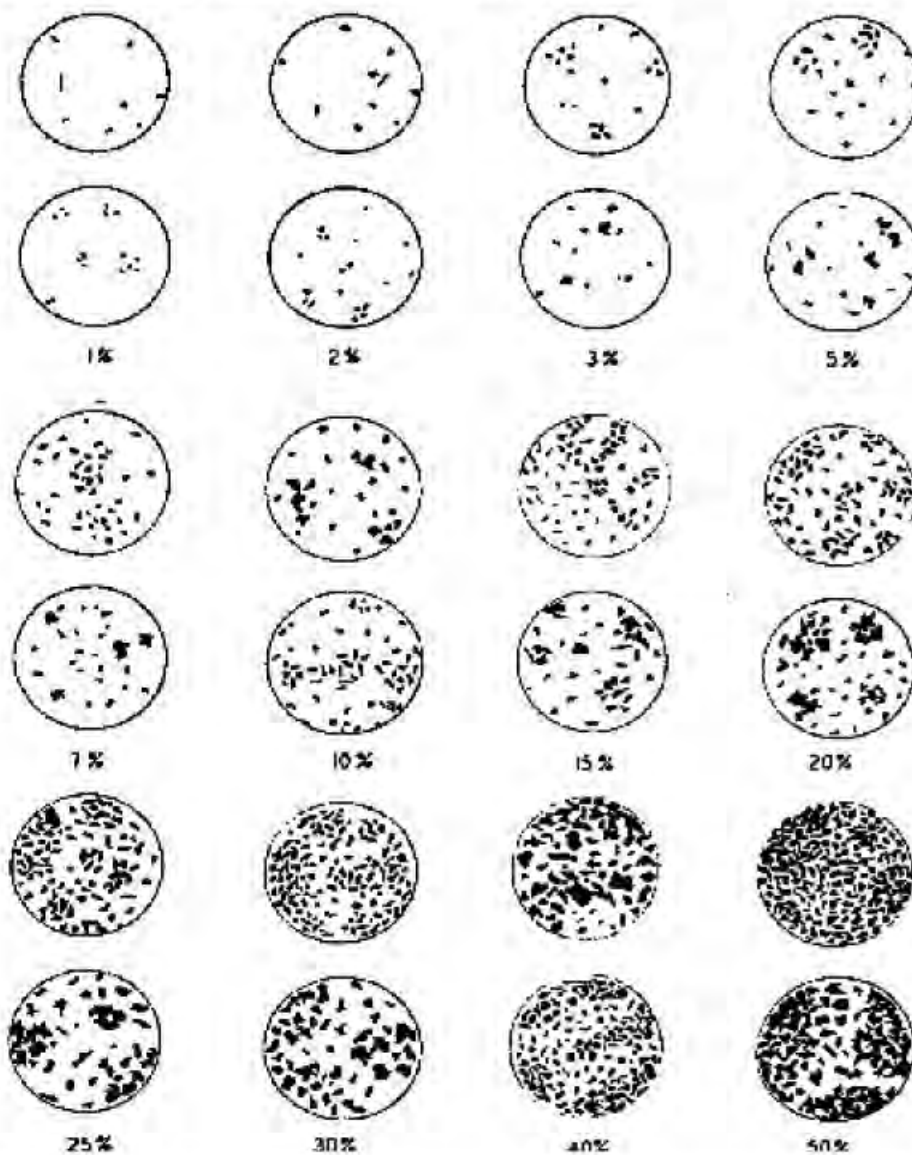
Location of Damage	Type of Damage	Tree being assessed is UNACCEPTABLE if:	Host Species	Some possible causes	Comments
Stem	Infection (includes cankers and galls)	<ul style="list-style-type: none"> Any infection occurs on the stem. 	All	white pine blister rust DSB, atropellis canker DSA, dwarf mistletoes (see below).	Note: Wounds caused by rodent feeding around rust cankers should have stem rust recorded as the causal agent.
Branch	Infection (cankers)	<ul style="list-style-type: none"> An infection occurs on a live branch less than 60 cm from the stem. 	Pw, Pl, Py	white pine blister rust DSB, comandra blister rust DSC, stactiform blister rust DSS,	
Branch	Galls	<ul style="list-style-type: none"> A gall rust infection occurs on a live branch less than 5 cm from the stem. 	Pl, Py	western gall rust DSG.	
Foliage	Defoliation	<ul style="list-style-type: none"> > 60% tree foliage has been removed by hemlock looper. 	Hw	hemlock looper IDL.	
		<ul style="list-style-type: none"> > 80% of foliage has been removed, lost or damaged due to insect defoliation. 	All Other	defoliators ID.	
		<ul style="list-style-type: none"> > 50% of foliage has been removed, lost or damaged due to insect defoliation. 	All	foliage diseases DF.	
Foliage	Live Crown Vigour	<ul style="list-style-type: none"> < 30% live crown present due to poor vigour. 			Percent live crown is the length of continuous green foliage on a tree expressed as a percentage of its total height.
Stem or Branch	Adelgid Gouting	<ul style="list-style-type: none"> Any adelgid gouting occurs on a stem or branch. 	Ba, Bg, Bl	balsam woolly adelgid IAB.	Gouting is defined as excessive swelling on a branch or shoot caused by balsam woolly adelgid, and is often accompanied by misshapen needles and buds. It is most common on branch tips and at nodes near the ends of branches. Consult a recent distribution map to identify the geographic extent of this pest.
Stem or Branch	Dwarf Mistletoe Infection	<ul style="list-style-type: none"> Any infection occurs on the stem or a live branch, or A susceptible tree is located within 10 m of the bole of a higher layer tree that is infected with dwarf mistletoe. 	Hw, Pl, Lw, Fd	hemlock dwarf mistletoe DMH, Pl dwarf mistletoe DMP, larch dwarf mistletoe DML, Fd dwarf mistletoe DMF.	Note: To confirm infection, the surveyor must observe mistletoe aerial shoots or basal cups on regeneration or on live or dead fallen brooms.

28c. Free Growing Damage Criteria for Single Entry Dispersed Retention Stocking Standard (SEDRSS) Managed Stands in Coastal BC and for Interior DFP and Layered Stands (pg 3)

TABLE B - Layer 2, 3 & 4 - $\geq 12.5\text{cm DBH}$, SEDRSS damage criteria (cont'd) Note: Table B overrides all other damage criteria for SEDRSS managed stands

Location of Damage	Type of Damage	Tree being assessed is UNACCEPTABLE if:	Host Species	Some possible causes	Comments
Roots	Root Disease	<ul style="list-style-type: none"> Sign(s) or definitive combinations of symptoms of root disease are observed. 	All	<p>armillaria root disease DRA, laminated root rot DRL, annosus root disease DRN.</p>	<p>Signs are direct evidence of the pathogenic fungus including fruiting bodies, distinctive mycelium or rhizomorphs. Symptoms include foliar thinning or chlorosis, pronounced resin flow near the root collar, reduced recent leader growth, a distress cone crop, and wood decay or stain. Symptoms alone are not usually sufficient to identify root disease. Both signs and symptoms may be detected from old stumps, root balls, or other post-harvest remains.</p> <p>Example: How to apply net down for root disease. If root disease-infected trees are found in the plot:</p> <ol style="list-style-type: none"> Determine the number of healthy, well-spaced trees in each layer using the prescribed minimum inter-tree distance (MITD) (e. g., 3 layer 1, 3 layer 3 and 4 layer 4 = 10 healthy, well-spaced) ignoring the M-value; Count the number of infected trees (e. g., 1 layer 1 tree and 1 layer 3 tree); Working from the uppermost layer down, apply the multiplier in Table Y to each lower layer. Subtract the resultant from each layer in turn, for susceptible species only (e. g., if all trees are susceptible, 1 infected layer 1 tree removes 1 healthy, well-spaced layer 1 tree plus 3 layer 3 trees plus 4 layer 4 trees). Note the effects are cumulative, not exclusive and lower layers do not affect higher layers; <p>Calculate the remaining healthy, well-spaced trees once all removals due to infected trees are completed (e. g. $10 - 8 = 2$). The maximum number of free growing trees that might be tallied is 2. Now consider competing vegetation.</p> <p>Note: Bl, Cw, Pl, Pw, and broadleaf species are considered not susceptible for survey purposes only.</p>
		<ul style="list-style-type: none"> > 60% tree foliage has been removed by hemlock looper. 	All	<p>armillaria root disease DRA.</p>	
		<ul style="list-style-type: none"> Infected conifer or stump found in plot. See Table Y for well-spaced tree net down calculation by layer. 	Fd, Ba, Bg	laminated root rot DRL	
		<ul style="list-style-type: none"> Infected conifer or stump found in plot. See Table Y for well-spaced tree net down calculation by layer. 	Ba, Hw, Ss	annosus root rot DRN.	<p>Note: Bg, Bl, Cw, Cy, Fd, Hm, Pl, Pw, and broadleaf species are considered not susceptible for survey purposes only.</p>

29a. Estimating Crown Closure via visual observation



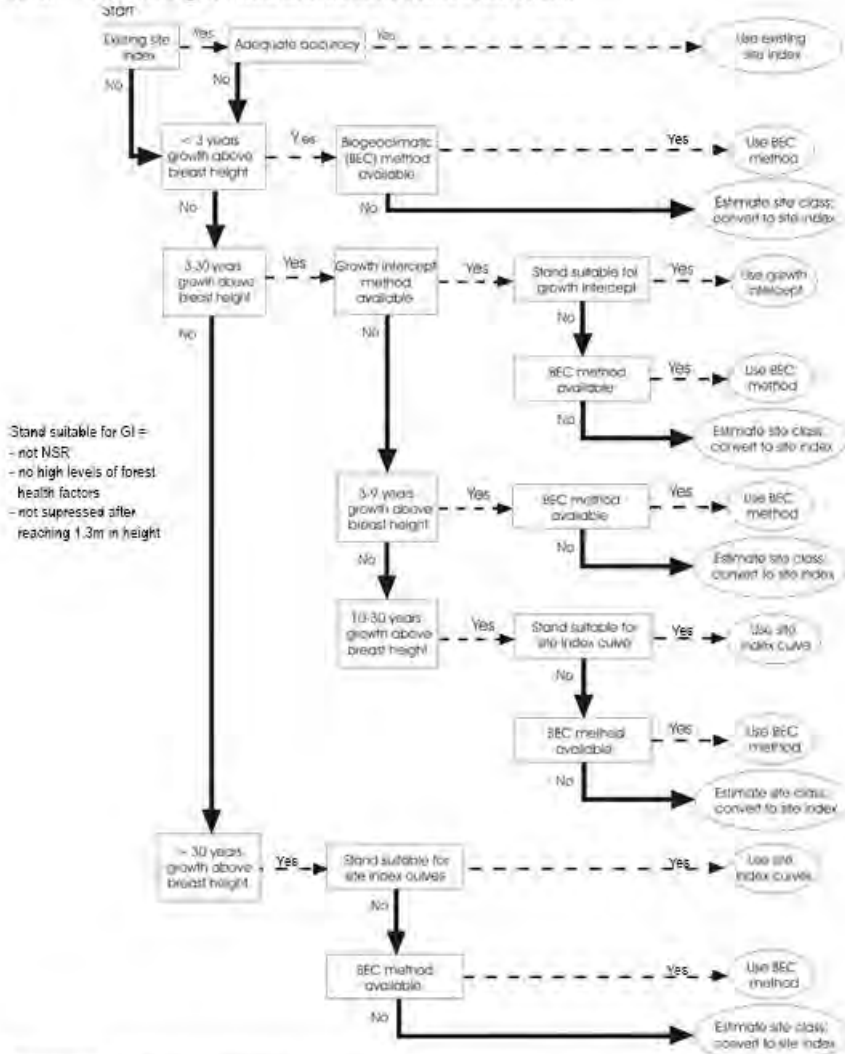
29b. Average crown radius, area, and number of trees equal to 6% crown closure

Average crown radius (m)	Area (m ²)	Number of trees/ha for 6% C/C
2.0	12.6	48
2.5	19.6	31
3.0	28.3	21
3.5	38.5	16
4.0	50.2	12
4.5	63.6	9
5.0	78.5	8

30. Steps to calculate confidence limits for silviculture surveys

df	95% (.05, 1 TAILED)	# of PLOTS	STEPS TO CALCULATE CONFIDENCE LIMITS The methods below may be applied equally for well spaced or free growing trees.
	90% (.05, 2 TAILED)		
4	2.132	5	n = # of plots
5	2.015	6	x _i = # of well-spaced trees in plot
6	1.943	7	Σ = summation of
7	1.895	8	pm = plot multiplier
8	1.860	9	$\bar{x}$ = average
			LCL = lower confidence limit
			MSS = minimum stocking standard
			'e' = desired precision level
9	1.833	10	1. Calculate mean of well-spaced trees ($\bar{x}$).
10	1.812	11	2. Calculate standard deviation (S).
11	1.796	12	
12	1.782	13	$S = \sqrt{\frac{\sum x_i^2 - (\sum x_i)^2/n}{n - 1}}$
13	1.771	14	
14	1.761	15	3. Calculate standard error of mean
15	1.753	16	$s_{\bar{x}} = s/\sqrt{n}$
16	1.746	17	4. Find t value for 90% & n - 1 df.
			5. Multiply t value by $s_{\bar{x}}$ which equals the Confidence Interval (CI)
17	1.740	18	This can be expressed as average per plot or multiplied
18	1.734	19	by 200 (plot multiplier for 50m ² plots) to convert to
19	1.729	20	stems/ha.
20	1.725	21	6. Compare $\bar{x}$ and CI to the following decision rules:
			(a) If $\bar{x} - CI \geq MSS$, then the area is considered SR.
21	1.721	22	No further plots are required.
22	1.717	23	(b) If $\bar{x} < MSS$, then the area is considered NSR. No
23	1.714	24	further plots are required.
24	1.711	25	(c) If $\bar{x} > MSS$ and $\bar{x} - CI < MSS$, check e value (as
			outlined below). If the desired level of precision
			'e' has not been met <u>or</u> maximum plots have
			already been established then no more plots
25	1.708	26	required, and if $\bar{x} \geq MSS$, then the area is con-
26	1.706	27	sidered SR. Otherwise, determine the number of
27	1.703	28	plots required.
28	1.701	29	'e' value = if $\bar{x} \geq 1,000$ tr/ha, $e = 0.1 \times \bar{x}$
			(This $\pm 10\%$ of the average.)
			if $\bar{x} < 1,000$ tr/ha for 50 m ² plots $e = 0.5$.
			(This is $\pm$ half a tree per 3.99m plot).
29	1.699	30	
30	1.697	31	New n = $\left[\frac{t \times s}{e} \right]^2$
40	1.684	40	
60	1.671	60	
120	1.658	120	The number of additional plots required equals,
∞	1.645	∞	New n - n, to a maximum of 1.5 x the stratum area in ha

31a. Selecting a method to estimate site index



31b. Site Index Source Codes

A	Site index from adjacent stand, (rarely used)
I	Site index growth intercept
O	Site index from the November 1998 SIBEC rollover, (not used by surveyors)
C	Site index from height age reference curves
H	Site index from stand before harvest, (rarely used)
E	Site index from SIBEC, biogeoclimatic classification
M	Site index converted from site class, ('last resort')
S	Site index assigned by District Silviculture. Section

31c. Site Class to Site Index Conversion for Broadleaf Tree Species

	Good	Medium	Poor	Low
	G	M	P	L
Ac	26	18	9	3
Act	27	20	12	4
Dr	33	23	13	6
E, Ea, Ep	27	20	12	4
Mb	33	23	13	6

32. Average site index relationship¹

The species
that can be
predicted

Average site index (m) relationship

	When you know interior BI site index										
	10	12	14	16	18	20	22	24	26	28	30
Interior PI	10	13	15	17	19	21	23	26	28	30	32
Interior Sw	10	12	14	17	19	21	24	26	28	31	33

¹ Example: If you have data that were gathered on interior BI that indicates a site index of 22, it can be used to predict the site index of interior white spruce as 24.

	When you know interior Fd site index										
	10	12	14	16	18	20	22	24	26	28	30
Interior PI	10	12	14	16	19	21	23	25	27	29	31
Interior Sx	7	10	13	15	18	21	23	26	29	32	34
Interior Hw	6	8	11	13	15	17	20	22	24	27	29
Interior Lw	11	13	15	17	19	21	23	25	27	29	31

	When you know interior Hw site index										
	10	12	14	16	18	20	22	24	26	28	30
Interior Fd	13	15	17	19	21	22	24	26	28	29	31

	When you know interior Lw site index										
	10	12	14	16	18	20	22	24	26	28	30
Interior PI	8	10	13	15	17	19	21	23	25	27	29
Interior Fd	9	11	13	15	17	19	21	23	25	27	29

	When you know interior Sx site index										
	10	12	14	16	18	20	22	24	26	28	30
Interior BI	10	12	14	15	17	19	21	22	24	26	27
Interior Fd	12	14	15	17	18	19	21	22	24	25	27
Interior PI	11	13	15	17	19	20	22	24	26	28	30

	When you know interior PI site index										
	10	12	14	16	18	20	22	24	26	28	30
Interior BI	10	12	13	15	17	19	21	23	24	26	28
Interior Fd	10	12	14	16	18	19	21	23	25	27	29
Interior Lw	12	13	15	17	19	21	23	25	27	29	31
Interior Sx	9	11	13	15	18	20	22	24	26	28	31

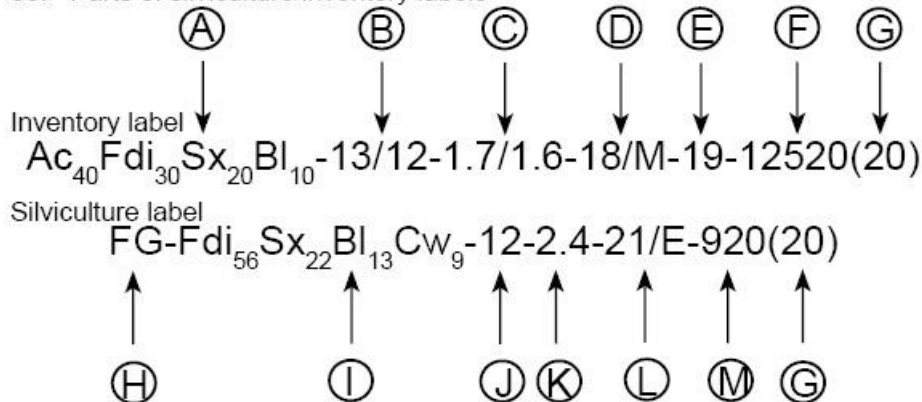
	When you know coastal Ba Site Index										
	15	18	21	24	27	30	33	36	39	42	
Coastal Hw	17	20	23	26	29	32	35	39	42	45	

	When you know coastal Fd site index										
	15	18	21	24	27	30	33	36	39	42	
Coastal Hw	13	16	18	21	24	27	29	32	35	37	

	When you know coastal Hw site index										
	15	18	21	24	27	30	33	36	39	42	
Coastal Ba	13	16	19	22	25	28	31	34	36	39	
Coastal Fd	17	20	24	27	30	34	37	40	44	47	
Coastal Ss	14	18	21	25	29	33	36	40	44	48	

	When you know coastal Ss site index										
	15	18	21	24	27	30	33	36	39	42	
Coastal Hw	16	18	21	23	26	28	30	33	35	38	

33. Parts of silviculture/inventory labels



These are mandatory specification. If you feel it does not adequately describe the stratum do so in the notes and treatment recommendations.

- A Roughly averaged species composition to the nearest 10% based on visual observations recorded on the FS 658. The leading and second species are particularly important to be correct.
- B Using the FS 658 data, roughly average the age of the dominant and co-dominant leading (13 years) and then repeat for the second species (12 years).
- C Using the FS 658 data, roughly average the height of the dominant and co-dominant leading species (1.7 m) and then repeat for the second species (1.6 m).
- D Site index of the leading species in the label. The Ac is predicted to be 18 m tall at 50 years after 1.3 m in height is reached. In this example the method used to determine the site index is site class conversion. (see Table 30)
- E Crown closure estimated by visual observation of aerial photograph. Ground observation is possible but commonly less accurate (see Table 27 a, b). The trees described in A and F have a crown closure of 19%.
- F The average number of total trees of commercial species per hectare. 12520 total trees per hectare.
- G The last 2 digits of the year the survey was conducted. 2020 = (20).
- H This prefix identifies the stocking status NSR, SR or FG. Subsequently the data that follows NSR and SR represent well spaced trees and following FG represents free growing trees.
- I The calculated species composition of the well-spaced trees present, recorded to the nearest 1%. *See Note
- J Using the FS 658 data, average the well spaced sample ages. 12 years. *See Note
- K Using the FS 658 data, average the well spaced sample heights. 2.4 m. *See Note
- L Site index of the leading species in the label. The Fdi is predicted to be 21 m tall at 50 years after 1.3 m in height is reached. E in this example indicates the method used to determine the site index is SIBEC. (see Table 30)
- M The average number of 920 well-spaced trees per hectare. *See Note

* Note: When the results of a free growing survey indicate that the stratum is free growing, all of the components of the label above that describe well spaced trees are replaced with the values that represent free growing trees.

[illegible]

Appendix 10: Free-Growing Damage Criteria for Even-Aged (Age Class 1) Coniferous Trees (rev. 6, July 2014)

****New additions to this version of the manual are identified in red text****

INTRODUCTION

Before a stand can be declared free growing it must have an adequate stocking of healthy, well-spaced trees of a preferred or acceptable species. These free-growing damage criteria can help users employ their professional judgement in identifying ‘healthy’ trees. The criteria are based on professional opinion, and on the most current knowledge of forest-damaging agents. The criteria are designed to determine the acceptability of **individual trees** (conifers only) across the province. Acceptability of a stand depends on thresholds of damage

(<http://www.for.gov.bc.ca/tasb/legsregs/fpc/fpcguide/guidetoc.htm#ForestHealth>) and on stocking standards agreed to in the applicable Forest Stewardship Plans.

The criteria list various types of damage, causal agents and species of trees. Damage and casual agents are referred to by their codes

(<http://www.for.gov.bc.ca/hfp/health/fhdata/FS747%20conifer%2020111003.pdf> - on the *Conifer Damage Agent and Condition Codes* [FS 747 Conifer] field form). Tree species abbreviations are found here

(<http://www.for.gov.bc.ca/hfp/silviculture/Surveys/FS660final2011.pdf>)

There are several points to keep in mind when using these criteria:

1. They apply **only** at the time the free-growing survey is conducted and are specific to even-aged, age class 1 stands that are being regenerated primarily to coniferous species for the production of timber. The assumptions made on the impact of pest damage to potential crop trees are founded on these factors.
2. Broadleaf species are noted in these criteria (usually as non-susceptible host species) but damage criteria are not listed since the characteristics of most broadleaf species (e.g., pests, growth habits, etc.) are sufficiently different from those of conifers. (Damage criteria for broadleaf species can be found here <http://www.for.gov.bc.ca/hfp/silviculture/Broadleaf%20damage%20criteria%20Dec%2009.pdf>).
3. A Delegated Decision Maker (DDM) may allow or require deviations from these criteria, as long as the legal requirement <http://www.for.gov.bc.ca/hfp/health/FHintro/fppr.htm#sec26> to produce a healthy tree is met. These free growing damage criteria are not legislated regulations.

The free-growing damage criteria are expected to be revised in the future as knowledge and information becomes available.

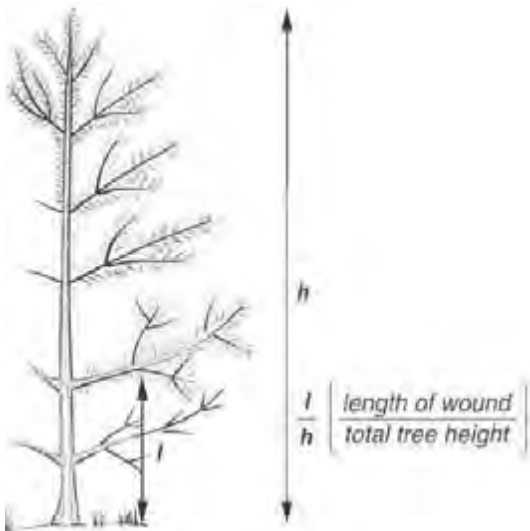
Location of damage	Type of damage	Tree being assessed is UNACCEPTABLE if:	Host Species	Damage agent codes & damage agents	Comments
Stem	Wound (including sunscald and girdling)	<ul style="list-style-type: none"> The tree has any wound which is greater than 1/3 of the stem circumference, or The tree has a wound which is greater than 20% of the total length of the stem, or The tree has a wound centred on an infection caused by a stem rust, canker, or dwarf mistletoe (See Note under Stem: Infection and Stem or Branch: Dwarf mistletoe infection). The tree is enclosed within a seedling protector (added 2015) Any amount of girdling or damage to the stem caused by seedling protectors (added 2015). 	All	AC, cattle; AH, hare; AP, porcupine; AS, squirrel; AV, vole; AZ, beaver; ISQ, sequoia pitch moth; IWW, Warren's root collar weevil; NB, fire; NW, wind-throw; NZ, sunscald; TL, logging; TM, mechanical.	A wound is defined as an injury in which the cambium is dead (e.g., sunscald) or completely removed from the tree exposing the sapwood. Measure the wound across the widest point of the exposed sapwood (or dead cambium when the tree is damaged by sunscald). Healed over wounds (=scars) are acceptable. See Figure 1 Girdling can be caused by seedling protectors.
Stem	Insect mining at root collar	<ul style="list-style-type: none"> The tree is currently attacked by a bark-mining insect such as a weevil or a beetle and exhibits symptoms such as foliage discoloration, thinning, and/or reduced height growth increments 	Pl, Sx	IWW, Warren's root collar weevil.	Only trees that are symptomatic should be checked for insect infestation or mining damage. Non-symptomatic trees are presumed to be unaffected by insect mining.
Stem	Bark mining	<ul style="list-style-type: none"> Boring dust, pitch tubes, or bark sloughing is visible 	Fd, Pl, Sx	IB, bark beetles; IBM, mountain pine beetle; IBI, <i>Ips pini</i> ; IBP, <i>Pityogenes</i> and <i>Pityophthorus</i> spp.	The mountain pine beetle outbreak has caused unexpected mortality in young pine. Stressed trees are also susceptible secondary bark and twig beetles.
Stem	Deformation (including crook, sweep, fork, browse, and dead or broken top)	<ul style="list-style-type: none"> The pith is horizontally displaced more than 30 cm from the point of defect and originates above 30 cm from the point of germination. 	For sweep, All except Cw and Hw	ID, defoliators; ISP, northern pitch twig moth; IWP, lodgepole pine terminal weevil; IWS, white pine (spruce) weevil; AC, cattle; AD, deer; AE, elk; AM, moose; ND, drought; NG, frost; NH, hail; NY, snow; TL, logging; TM, mechanical.	For horizontal displacement. See Figure 2.
		<ul style="list-style-type: none"> The tree leader has been killed three or more times in the last five years (weevil only). 	Pl, Ss, Sx	IWP, lodgepole pine terminal weevil; IWS, white pine (spruce) weevil.	This criterion applies only for terminal weevil damage.
		<ul style="list-style-type: none"> The tree has two or more leaders with no dominance expressed after five years growth and the fork originates above 30 cm from the point of germination. 	All	A, animal damage; IWP, lodgepole pine terminal weevil; IWS, white pine (spruce) weevil; NG, frost.	Leader dominance occurs when the tallest leader is at least 5 cm taller than the second tallest leader. See Figure 3
		<ul style="list-style-type: none"> The tree has a dead or broken top at a point that is >2 cm (>3 cm for the coast) in diameter. 	All	A, animal damage; UBT, unknown broken top	
Stem	Infection (including cankers and galls)	<ul style="list-style-type: none"> Any infection occurs on the stem. 	Pl, Pw, Py	DSB, white pine blister rust; DSC, comandra blister rust; DSG, western gall rust; DSS, stalactiform blister rust.	Note: To best identify pine rusts, surveys should be scheduled between May and July as a best management practice (Added 2020). Wounds caused by rodent feeding around rust cankers should have stem rust recorded as the causal agent.
Branch	Infection (cankers)	<ul style="list-style-type: none"> An infection occurs on a live branch less than 20 cm from the stem. (added 2015). 	Pl, Py	DSC, comandra blister rust;	To best identify pine rusts, surveys should be scheduled between May and July as a best management practice (Added 2020). See Figure 4.
		<ul style="list-style-type: none"> An infection occurs on a live branch less than 60 cm from the stem. 	Pl, Pw, Py	DSB, white pine blister rust. DSS, stalactiform blister rust.	To best identify pine rusts, surveys should be scheduled between May and July as a best management practice (Added 2020). See Figure 4.
Branch	Galls	<ul style="list-style-type: none"> A gall rust infection occurs on a live branch less than 5 cm from the stem. 	Pl, Py	DSG, western gall rust.	To best identify pine rusts, surveys should be scheduled between May and July as a best management practice (Added 2020). See Figure 4.

Branch	Gouting	<ul style="list-style-type: none"> Any adelgid gouting occurs on a branch. 	Ba, Bg, Bl	IAB, balsam woolly adelgid.	Gouting is defined as excessive swelling of a branch or shoot caused by balsam woolly adelgid, and is often accompanied by misshapen needles and buds. It is most common on branch tips and at nodes near the ends of branches. Consult a recent distribution map to identify the geographic extent of this pest.
Stem or Branch	Dwarf mistletoe infection	<ul style="list-style-type: none"> Any infection occurs on the stem or a live branch, or A susceptible tree is located within 10 m of an overtopping tree, which is infected with dwarf mistletoe. 	Fd, Hw, Lw, Pl	DMF, douglas-fir dwarf mistletoe; DMH, hemlock dwarf mistletoe; DML, larch dwarf mistletoe; DMP, lodgepole pine dwarf mistletoe.	Note: To confirm infection, the surveyor must observe mistletoe aerial shoots or basal cups on regeneration or on live or dead fallen brooms. Overtopping tree is a tree that is three or more times taller than the height of the tree being assessed.
Foliage	Defoliation	<ul style="list-style-type: none"> >50% of tree foliage has been removed by Dothistroma in ICH, CWH and SBS biogeoclimatic zones. 	B, F, P, S	DFS, dothistroma needle blight.	See Figure 5.
		<ul style="list-style-type: none"> Any defoliation, stunting, or red-brown discoloration in the top 1/3rd of the live crown due to Elytroderma in the IDFdk3, IDFdk4, SBPSmk or SBPSxc biogeoclimatic subzones (added 2020). 	Pli	DFE, elytroderma needle and shoot disease	Note: After July 1 st Elytroderma can be confirmed by the presence of black lines on the previous year's needles.
		<ul style="list-style-type: none"> >80% of tree foliage has been removed due to defoliating insects or foliage disease. 	All others	DF, foliage diseases; ID, defoliators.	See Figure 5.
Roots	Root disease	<ul style="list-style-type: none"> Sign(s) or a definitive combination of symptoms of root disease is observed. 	All	DRA, armillaria root disease; DRB, blackstain root disease; DRL, laminated root rot; DRN, annosus root disease; DRT, tomentosus root rot.	Signs are direct evidence of the pathogenic fungus including fruiting bodies, distinctive mycelium or rhizomorphs. Symptoms include foliar chlorosis or thinning, pronounced resin flow near the root collar, reduced recent leader growth, a distress cone crop, and wood decay or stain. An individual symptom is not sufficient to identify a root disease.
		<ul style="list-style-type: none"> Infected tree found in plot. The multiplier for DRA is two; except in BEC zones PPdh1 and 2, IDFxh1, IDFdml and 2, MSdk1, and MSdm1 - the multiplier is one. Except for Cw (in all BEC zones) the multiplier is one. <p>• See comments for well-spaced tree net down (multiplier) calculation.</p>	All	DRA, armillaria root disease.	<p>Note: All conifer species are considered susceptible. Broadleaf species are considered not susceptible for survey purposes only.</p> <p>Example: How to apply net down for root disease.</p> <p>If root disease-infected trees are found in the plot:</p> <ul style="list-style-type: none"> In the first sweep, determine the total number of healthy, well-spaced /free growing trees using the prescribed minimum inter-tree distance (MITD) (e.g., 12 trees) ignoring the M-value; In a second independent sweep, determine the number of infected trees (including dead infected trees and for DRT only, infected stumps) that are the MITD from each other (e.g., 4 infected trees or stumps); Multiply the number from step 2 by the multiplier for the specific root disease and subtract this number from the number of susceptible healthy well-spaced /free growing trees found in step 1 (e.g., for DRA: 12-4(2) = 4). The result is the maximum number of free growing trees tallied for the plot.
		<ul style="list-style-type: none"> Infected conifer found in plot. The multiplier for DRL is four. 	Ba, Bg, Fd, Lw, Se, Sx	DRL, laminated root rot.	Note: Bl, Cw, Pl, Pw, Py and broadleaf species are considered not susceptible for survey purposes only.
		<ul style="list-style-type: none"> Infected conifer found in plot. The multiplier for DRN is two. 	Ba, Hw, Ss	DRN, annosus root rot.	Note: Ba, Bl, Cw, Fd, Pl, Pw, Py and broadleaf species are considered not susceptible for survey purposes only.
		<ul style="list-style-type: none"> Infected conifer or stump found in plot. The multiplier for DRT is two. 	Se, Sx	DRT, tomentosus root rot.	Note: Bg, Bl, Cw, Cy, Fd, Hm, Pl, Pw, Py, Sx and broadleaf species are considered not susceptible for survey purposes only.

WOUND

A tree is **unacceptable** where damage to the cambium is more than 1/3 of the circumference of the stem, or the wound is greater than 20% of the total length of the stem.

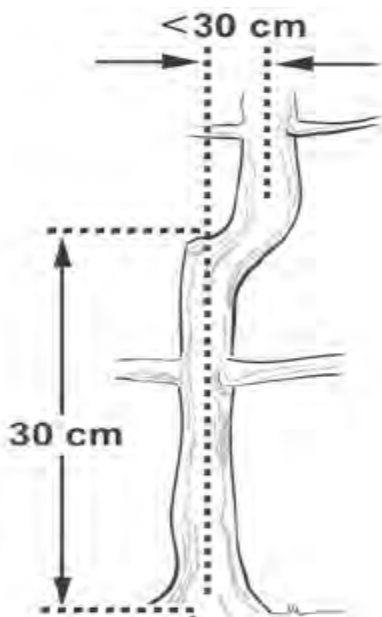
Figure 1



HORIZONTAL DISPLACEMENT (CROOKS)

A tree is **unacceptable** if a crook displaces the pith more than 30 cm from the point of defect, and it must occur 30 cm above the point of germination.

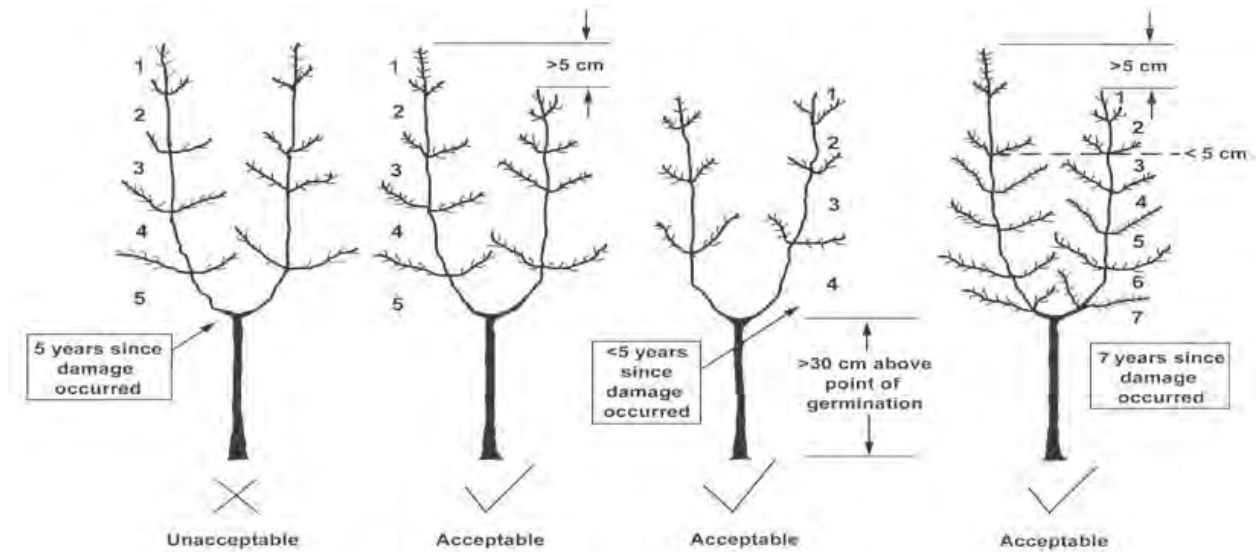
Figure 2



FORKS

The tree is **unacceptable** if it has two or more leaders with no dominance expressed after five years growth and the fork originates above 30 cm from the point of germination.

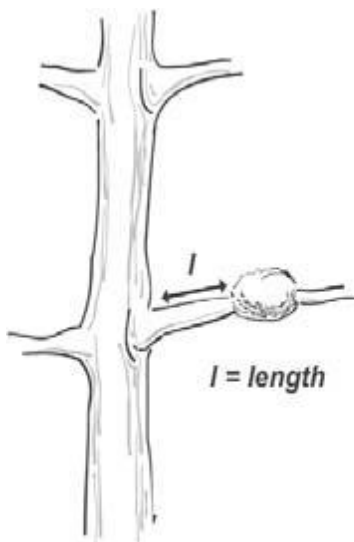
Figure 3



GALL or CANKER ON A BRANCH

A tree is **unacceptable** if the gall occurs less than 5 cm from the stem for DSG, or if the canker occurs less than 20 cm from the stem for DSC or DSS, or if the canker occurs less than 60 cm on the stem for DSB.

Figure 4



DEFOLIATION

General Defoliation - A tree is **unacceptable** if more than 80% of the leaves or needles are removed because of insects or disease.

If defoliation is wide-spread, it might be a '*one off*' insect or disease occurrence; consider a resurvey at a later date.

Figure 5



Definitions

basal resinosis (pitching): copious exudation of pitch at the base of the stem at or below the root collar. This symptom often is associated with Armillaria root disease or attack by Warren's root collar weevil.

decay: the disintegration of plant tissue. The process by which sound wood is decomposed by the action of wood-destroying fungi and other microorganisms.

fork: two or more leaders have originated from the loss of a leader or apical shoot. At free-growing age, a fork is considered persistent if it has not differentiated in height between competing leaders by more than 5 cm after five years of growth since the leader damage occurred. Forks may provide entry points for decay fungi, are points of weakness during felling, and may create waste in the highest value first log.

gall: nodule or lump of malformed bark or woody material caused by a variety of damaging agents, such as western gall rust and some insects.

girdling: A transversal cut across the phloem in a stem so that downward transport of substances is unable to occur within the plant.

gouting: excessive swelling of a branch or shoot, often accompanied by misshapen needles and buds. Most common at nodes on branches and frequently caused by balsam woolly adelgid on true firs (*Abies* spp).

infection: characterized by a lesion or canker on stem or branches or by swelling around the entrance point of a pathogen.

injury: damage to a tree by a biological, physical or chemical agent.

scar: a wound completely healed-over by callus tissue

wound: an injury where cambium is dead (e.g., sunscald) or completely removed. Wounds often serve as entry points for decay fungi.

(July 2013)

Appendix 11: Broadleaf Forest Health Free-Growing Damage Criteria as a supplement to the FS 660 (Oct 2011)

BROADLEAF FOREST HEALTH FREE-GROWING DAMAGE CRITERIA

Introduction

Broadleaves are a common component of the forest landscape and recognition of their role in maintaining biodiversity and habitat values, as well as concerns about timber supply, have stimulated interest in their management (Chief Forester memo on *Incorporation of mixedwood and broadleaves into Forest Stewardship Plan stocking standards, Hardwood Management in the Coast Forest Region SP amendments and TSR regeneration assumptions*, May 01, 2008). Since the growth habits and pests of broadleaves are different than conifers, they require a separate set of damage criteria. The free-growing damage criteria outlined in the attached table are based on the best available data and professional opinion, and are expected to be revised in the future when new knowledge or information becomes available. The goal of these damage criteria is to establish forest health threshold tolerances that will help users exercise their professional judgment in identifying "healthy" and merchantable broadleaf trees. Note: The following are guidelines only and are not embedded in regulation.

The broadleaf damage criteria apply to,

- Red Alder (Dr), Birch (Ep), Big Leaf Maple (Mb), Poplar (Cottonwood [Act], Balsam poplar [Acb], Aspen [At],
- of even-aged, age class 1 stands
- at the time of a free-growing assessment,
- province-wide.

Unless otherwise stated in regulation or an approved Forest Development Plan (FDP) or Forest Stewardship Plan (FSP) stocking standard, a broadleaf tree is unacceptable for the following issues;

Condition	Unacceptable if;	Broadleaf host species	Comments
<i>Regeneration</i>	<i>Stems originate from the sides or cut surface of a stump</i>	<i>Applies to all species except Maple (Mb)</i>	<i>Stems originating from the sides or cut surface of a stump are susceptible to breakage (Coppice is at this time an acceptable form of regeneration for all species where it occurs)</i>
<i>Dead branches</i>	<i>At least one major dead branch exists in the live crown</i>	<i>all species</i>	
<i>Broken stems, torn branches Sapwood penetration; (frost crack, broken stems, gouges, torn branches)</i>	<i>a branch is torn from the point of attachment to the main stem. The main stem is broken anywhere along its length.</i>	<i>Applies to all species</i>	
<i>Stem Wounds(Cambial damage; Exposed wood, sunscald Bark removal</i>	<i>a wound occupies more than 10% the circumference of the stem, or is longer than 15 centimeters.</i>	<i>Applies to all species</i>	.

Condition	Unacceptable if;	Broadleaf host species	Comments
Stem damage from diseases or insects	<i>cankers or fungal infections or insect damage is present</i>	<i>Applies to all species</i>	<p>There are many different types of cankers; refer to <i>Diseases of Populus in British Columbia</i> by B Callan - http://cfs.nrcan.gc.ca/publications?id=5119</p> <p>Examples of visible disease damage includes swellings or depressions on stems.</p> <p>Some cankers can have liquid discharge.</p> <p>Insect damage includes signs of insect frass.</p>
Animal damage	<p><i>the main stem has been repeatedly browsed.</i></p> <p><i>the main stem has been abraded from antler rubbing or claw marks over half the circumference of the stem and greater than 50 cm in length.</i></p> <p><i>the trees are trampled by an animal.</i></p>	<i>Applies to all species</i>	<p>Browsing damage by animals can affect growth rate and form of trees. A main stem if repeatedly browsed it would have multiple leader or growing tips.</p>

Condition	Unacceptable if;	Broadleaf host species	Comments
<i>Sweep</i>	<i>a stem is displaced more than 30 cm from the center of the root crown pith, within 1 m of the ground</i>	<i>Applies to all species</i>	<i>Sweep is not an issue in merchantable hardwood provided an 8 to 10 ft length can be cut from the tree.</i>
<i>Forks</i>	<i>If the tree has two or more leaders with no dominance expressed</i>	<i>Applies to bigleaf Maple</i>	<i>Poplar displays more apical dominance than other broadleaves and therefore less readily develops multiple stems</i>

Appendix 12: Technology in Silviculture Surveys

Lidar and Drone Use

The Use of Lidar Remote Sensing

Lidar is a light detection and ranging system which provides exceptionally accurate spatial data of forest structure. It combines three complementary technologies:

1. A laser mounted on an aircraft or unmanned aerial vehicle (UAV), commonly referred to as a drone;
2. An inertia guage that measures and records the pitch, yaw and roll of the aircraft;
3. A global positioning system capable of measuring an aircraft's x, y and z coordinates within several centimetre degree accuracy.

The result is a tremendous amount of 3-dimensional vegetation structure and terrain information. Lidar is capable of accurately measuring vegetation. The active remote sensing can simultaneously map terrain and vegetation height with vertical and horizontal accracy of <1.0m.

There are many applications for Lidar in forestry. Initially, the primary applications included: forest inventory assessment, determination of fuel load to aid in fire management, terrain modelling, and forest engineering and road development. More recently, the uses have broadened to include many more applications including vegetation mapping, forest health assessments and silviculture surveys.

The Use of Unmanned Aerial Vehicles (UAVs)

Unmanned aerial vehicles (UAVs), commonly referred to as drones, typically have a camera which operates on 3 axes, spinning 360° to allow for imagery from various angles and heights. The images can be high definition and may incorporate Lidar.

As of the last few years, drone use in silviculture has increased substantially to assist traditional ground procedures in the completion of stocking and free growing surveys. Even without Lidar, the imagery is helpful for pre-stratification. With the use of Lidar, algorithms are being developed to produce georeferenced, scaled maps which identify areas of different density to locate NSR areas. Additional work is ongoing to address other important issues including species identification and forest health.

Some of the advantages of drones would include:

- A reduced risk to the surveyor due to slips, trips and falls.
- The potential to save time and/or money

- Being especially helpful for stratification

It should be noted that a qualified surveyor is still required to complete on-site ground truthing, any necessary measurement calibrations and to collect the required data for reporting purposes. In many cases, even with drone use, plotting intensity may still need to be high to satisfy traditional summary requirements. It should also be noted that drone use is limited somewhat by weather.

Drones have a few different types of available imagery that have applications in silviculture:

- Orthomosaic generation will produce a single georeferenced image that is helpful for measuring distances and areas;
- 3D point cloud analysis can be used to produce height and volume estimates;
- Spectral analysis can be used to distinguish between vegetation species and to identify major forest health problems;

End products from this technology may include:

- Density estimates using nadir (straight down camera angle);
- Crop tree and brush height estimates using an oblique (side view) camera angle.

In future years we may see Lidar replace a large component of ground surveys if it can be fully integrated to address forestry regulation. In particular, forest damage criteria and competing vegetation rules may be challenging to address. Eventually, with technology, assessments may move towards total inventory numbers for an opening.

Global Positioning System Use and Mapping Software for Tablets

Handheld GPS units have largely been replaced by tablets with mapping software (most commonly Avenza Maps). The surveyor must meet the contract requirements but otherwise may choose to use: paper map and compass, a handheld GPS unit, or a tablet with built-in GPS and mapping software. At this time, a tablet with Avenza Maps is likely the easiest for most surveyors to use.

For safety reasons, a surveyor must not be entirely reliant on technology. As surveyors generally work independently, and handhelds or tablets may break or lose battery, it is very important to have a back-up to this technology. Usually this would include a paper map, a compass, and an ongoing awareness of location in relation to the vehicle.

If the surveyor is expected to use unbiased grid or vector sampling to provincial standards, they should make every effort to be entirely unbiased with plot location, regardless of how the plots are established (compass, Handheld GPS or tablets). Normally, selecting or moving plot location is an approach limited to representative sampling, where the surveyor is attempting to choose a plot location that represents the stratum. Any exception to this should be carefully discussed with the contract administrator.

The use of Global Positioning Systems (GPS) is completely optional within the field of silviculture surveys. Recreational grade GPS receivers are both affordable and accurate, and remain to be an invaluable tool for many forestry professionals. The fact that silviculture surveys are conducted under limited canopy further supports this. For handheld GPS users, this section below remains as a best practices suggestion.

What is GPS

The GPS receiver continually answers the question “where am I”. GPS employs a constellation of satellites in orbit around the earth and the user receivers. Each satellite has a very accurate clock and a radio transmitter. Each satellite transmits repeatedly a digitally coded data string, something like “satellite #1 is sending this beep at exactly 12:34:45.678, BEEP”. The speed of that radio signal traveling toward earth is a known constant, the speed of light. The GPS receiver “hears” the messages from multiple satellites simultaneously and uses this data to trilaterate (to calculate a position based on three or more distances) its position on the earth.

The system was originally developed by the US military in the 1960s. It was opened to public use in the late 1980s and early 1990s. At that time there was a randomly induced error called selective availability that made the system intentionally inaccurate to limit the system from being used by enemies of the developers. In 2000 selective availability was turned off, removing that induced error making it practical for consumer use

The satellite constellation is the group of satellites present overhead at any one time. This arrangement and number of satellites is constantly changing as they orbit around the earth. The GPS is repeatedly recalculating, some the current position, once per second, as new data is received. As a result, the current position coordinates continually change even when you are not moving. This is known as position drift or creep.

GPS Data Management

Features are surveyed using GPS as either points or lines. Some receivers allow lines to be closed to create polygons. Point features are typically referred to as Waypoints and linear features as Tracks.

Waypoints

The GPS receiver can save its current location at any time as a waypoint. This becomes especially useful to capture the location of point features found while completing the walk-through or during the survey such as plot locations which are represented by a single set of coordinates. They can be assigned a name, (Plot #4), and a symbol. Waypoints are stored in a list on your receiver and can be displayed on your screen, recalled at any time for navigation purposes, or transferred to and from a computer to prepare a map.

Tracks

Tracks are used to map linear features such as the path walked between plots. Tracks are made up of 'track points' which are the individual GPS 'fixes' that are connected together to make the track line. Some people think of this as a digital "bread crumb trail". The surveyor has the freedom to wander as they choose and investigate anomalies like forest health factors located off the strip line with minimal loss in productivity. It is important to configure your GPS receiver's track logging function for how frequently it records. It is recommended that you collect as much detail possible within the memory limitations of your GPS unit.

Preloading Data

The greatest benefits of using these GPS based solutions is that they can be preloaded with the opening and standards unit boundaries or complete maps allowing the surveyor a method for locating the target opening and working within it.

The tablet method involves loading a georeferenced file, (PDF file) produced by such GIS software as ESRI Arcmap and others. Handheld GPS allows the importing of common point, line and polygon files such as ESRI Shape files. These provide georeferenced background imagery and your onsite collected data (waypoints and tracks) appear as an overlying layer. It answers the common question, "where am I in relation to the target survey area".

Sampling designs such as the grid pattern of points can be efficiently created in the office and transferred to your chosen GPS capable receiver. These become waypoints that can be used as navigation targets.

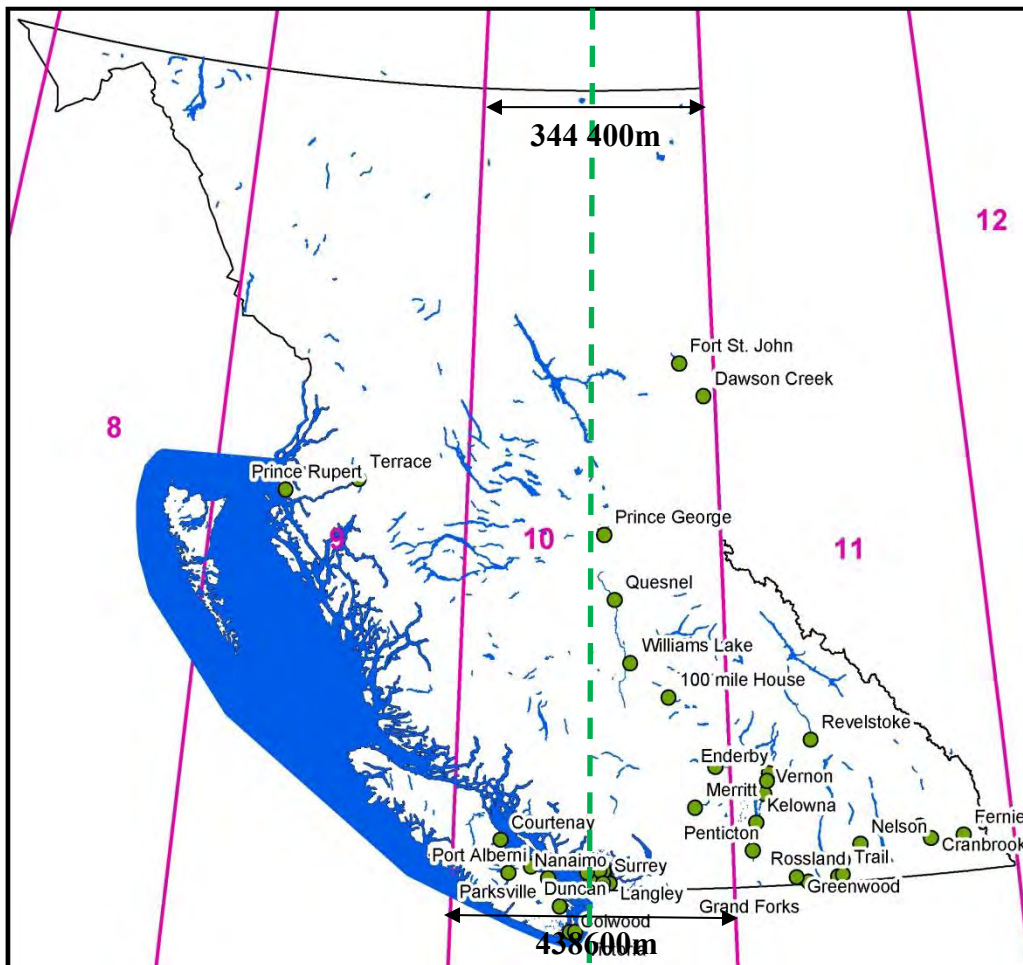
As with the opening boundaries, GPS receivers can be preloaded with plot locations allowing the surveyor to navigate from one plot to the next, in any order without following straight strip

lines or leaving hip chain thread trailing through the forest. When features such as strata boundaries are located, waypoints can be created.

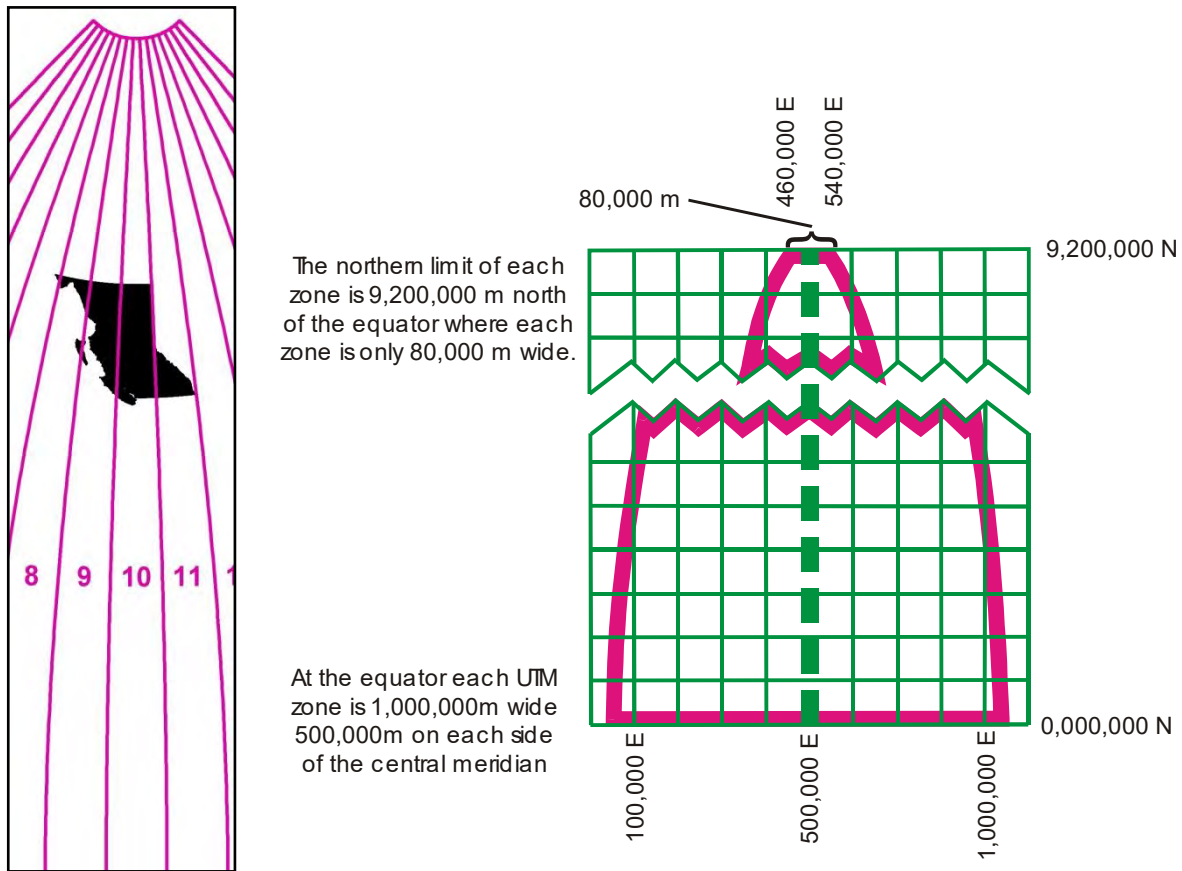
When using the representative sampling method, a waypoint can be created to document the actual location of the sample plots.

UTM – Universal Transverse Mercator

Projections are means of displaying the curved surface of the earth on a flat map. The UTM (Universal Transverse Mercator) projection is a commonly used, orthogonal, metric coordinate system. It is divided into numbered UTM zones 6 degrees longitude wide. BC is covered by portions of five UTM zones, from UTM zone 7 in the far NW corner of the province to UTM zone 11 covering the SE corner of the province. Coordinate pairs consist of a seven-digit northing representing the distance in meters north of the equator, and a six digit easting with the line of longitude at the center of the UTM zone (central meridian) being assigned 500,000m E.



Appendix 12, Figure 3: UTM Zones in British Columbia



Appendix 12, Figure 4: UTM Detail

The systematic format of grid sampling can be maintained in two methods, pre-established waypoints as described earlier, or “00 UTM coordinates” method. This method requires the establishment of procedures or conventions to maintain the systematic pattern. The following is proposed for use with 1 plot per hectare, 100 x 100m, grid sampling as an example. Set a convention that the plots will be established at UTM coordinates ending in 00 to the left of the decimal point (if your receiver shows decimals). There are many ways to do this in the field depending on the particular hardware selected.

With both of the above methods use the “go to” function to navigate from your current location to the desired plot location. Some GPS receivers have an audible warning to notify you as you approach the desired location. The user would continue to travel toward the intended plot location and watch the GPS receiver display indicates the surveyor’s current position is equal to or less than the allowable tolerance from the target location. This can also be done by watching the UTM display until the easting or northing indicate the current position is less than the acceptable tolerance.

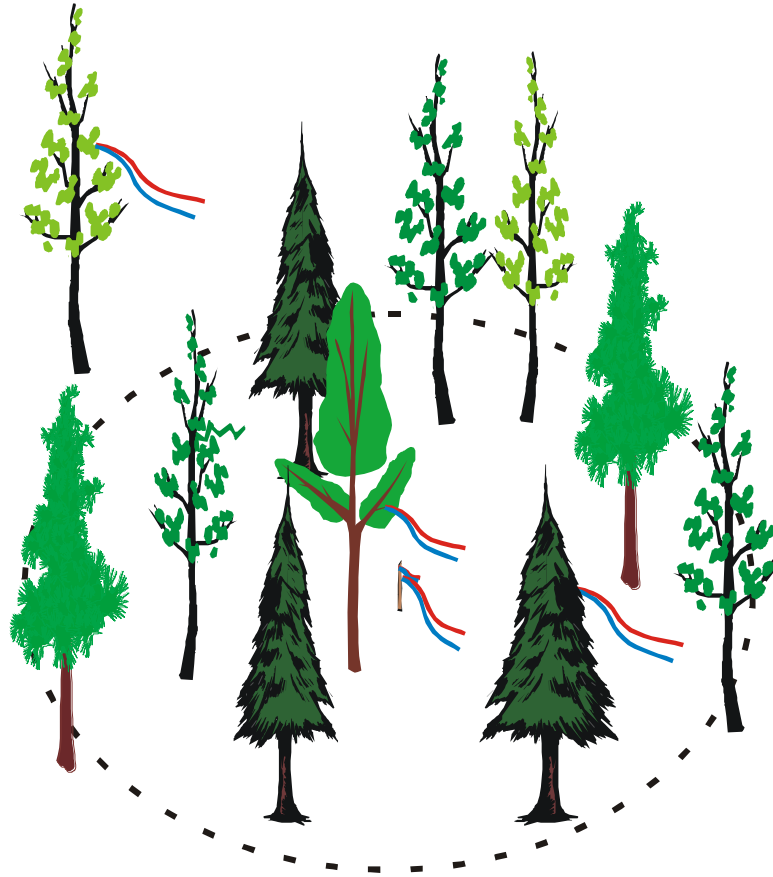
This raises a question of integrity and professionalism. As with conventional hip chain and hand compass methods, the plot placement can easily be manipulated by an unethical surveyor. Unlike with representative sampling, the surveyor must establish the plot center without consideration for the data that will be gathered from within the plot to be established.

GPS Established Strip and Plot Marking

With GPS navigation the surveyor is traveling between plots without the need for carefully following a bearing in a straight line. They will travel where the brush, slash and other obstacles are at a minimum thus reducing travel time between plots. The plot locations are determined by coordinate location and the GPS is documenting the route traveled, therefore there is no need to mark the route traveled by hanging flagging tape. This is another cost saving of time and supplies and a reduction of environmental debris.

The plots on the other hand must be marked more thoroughly than with conventional methods. Anyone wishing to travel back to a previously established plot has no strip line ribbon to follow. The only option is to use the previously collected coordinates to relocate the plots. The coordinates of the original plots would be loaded into a GPS receiver as waypoints. The surveyor or survey inspector uses the “go to” function to navigate to the plot. Consider that there was some error in the accuracy of the original coordinates. There will also be some error in the data position in the returning navigation. For example if the original coordinates indicate the plot is 5 m north of the actual location and the current position of the returning surveyor is indicating a position 5 m to the south of the actual position, then the plot could, in this extreme case, be as much as 10 m away. The returning surveyor will have a difficult time relocating the plot. For this reason, plots must be marked more thoroughly.

The goal of plot marking is to make the plot center easier to find. Two additional pairs of ribbon tied as high as the available vegetation allows are recommended. These ribbons should be located near the edge of the plot boundary and preferable on opposite sides of the plot. However, remember the intent of these additional ribbons is to allow the plot to be found when a GPS is used to navigate to the vicinity of the plot.



Appendix 12, Figure 2: Example of plot marking methods with GPS use

Recommendations for GPS Use in Silviculture Surveys

If one chooses to use GPS receivers as part of a silviculture survey program the following topics should be addressed at the planning stage. Surveyors should discuss with their employers or project administration a number of issues to ensure compatibility and efficiency.

- Preloading opening and standards unit boundaries is preferred with either handheld GPS or tablet hardware
- Use the receivers track function to document the walk-through path for all survey methods. This provides assurance that the walk-through is completed, as well as aids in the efficiency and accuracy of determining strata boundaries.
- Use WAAS or an alternative source or real-time differential correction.
- Adjust the GPS receiver position format to UTM (Universal Transverse Mercator).
- Create waypoints for strata boundary reference to assist with accurate mapping strata edges. Create waypoints where noteworthy anomalies are identified (e.g. patches too small to stratify).

- The surveyor should provide digital data files for point, line and any area features, in particular plot locations and path of travel. Select one or more data file formats for the point, line and polygon features that are compatible with the various hardware and software to be used throughout the project. Consider conventions for a file naming format. Consider whether the files will be cumulative or individual. One point file and one line file per opening, or all points related to the project into one file and all the lines for the project in another. Many other variations are also acceptable.
- Tabular documentation of the plot center coordinates in printed reports or maps are recommended.
- When using these GPS methods, there is no need for a point of commencement, subject to survey contract specifications.
- Mark the plot center location more thoroughly with two or more additional ribbon pairs and as high as possible to assist in them being found in the future. Only the ribbon at the center need be marked with the plot number etc.
- Select an acceptable tolerance value to be used where position drift/creep occurs. Two (2) m is suggested at this time but higher or lower values may also be suitable.
- Do not use recreational grade GPS receivers to determine payment area for treatments or reporting treatments into [RESULTS](#).

Appendix 13: Local Geographic Free Growing Competition Assessment Criteria

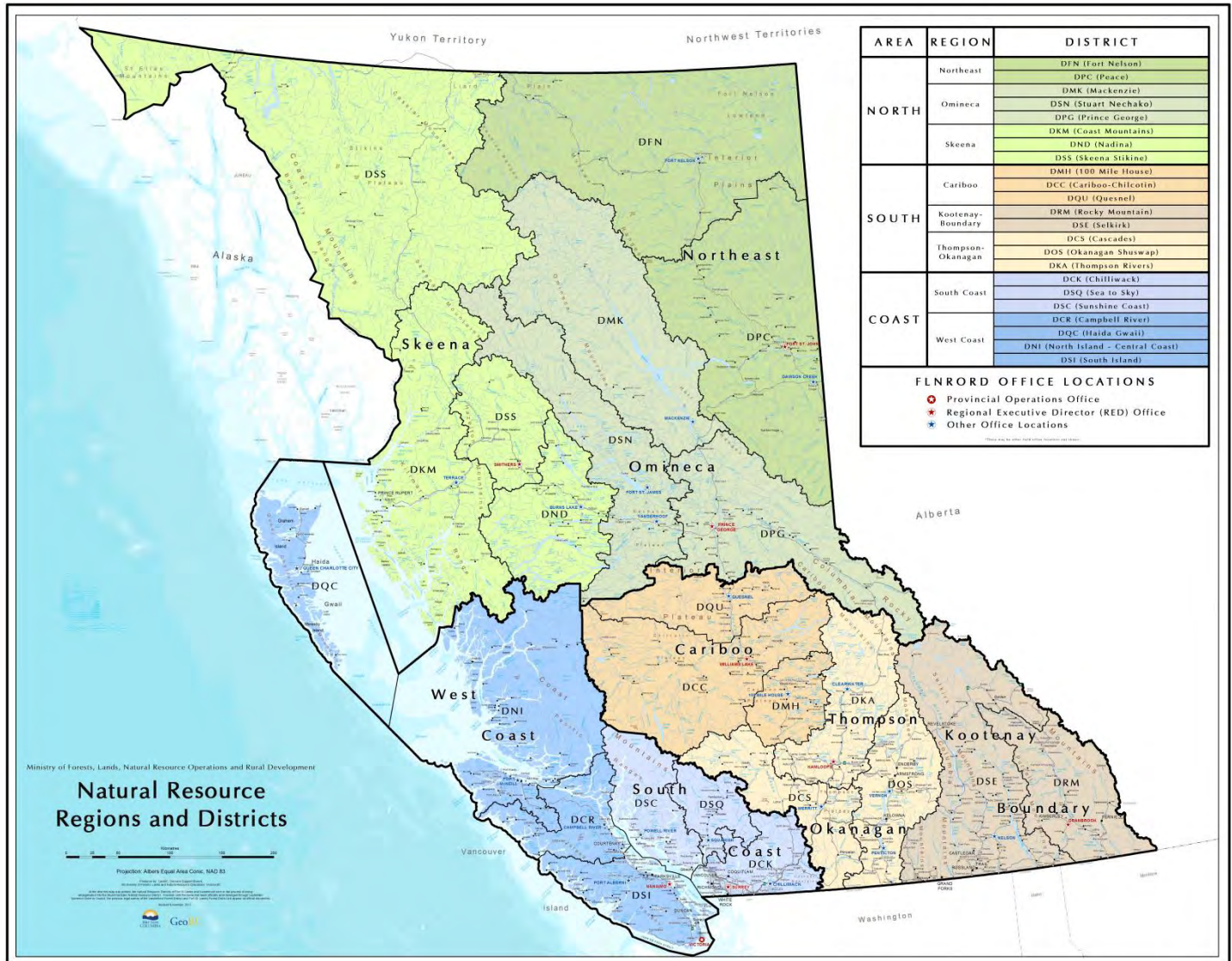


Figure 1: Map of 3 Geographic Areas – Coast, North and South Areas.

A 13.1 – Coast Area FG Guidance

1) Coast Area Description

The following TSA's are assessed according to guidelines described in Figure 2 (including all area based tenures within the gross areas of these TSA's, regardless of Natural Resource District boundaries):

- Queen Charlotte TSA; Kingcome TSA; Strathcona TSA; Arrowsmith TSA; Fraser TSA; Soo TSA; Sunshine TSA; Mid-Coast TSA; **North Coast TSA; Kalum TSA** – (*Note: Additions from administrative Coastal Area.*)

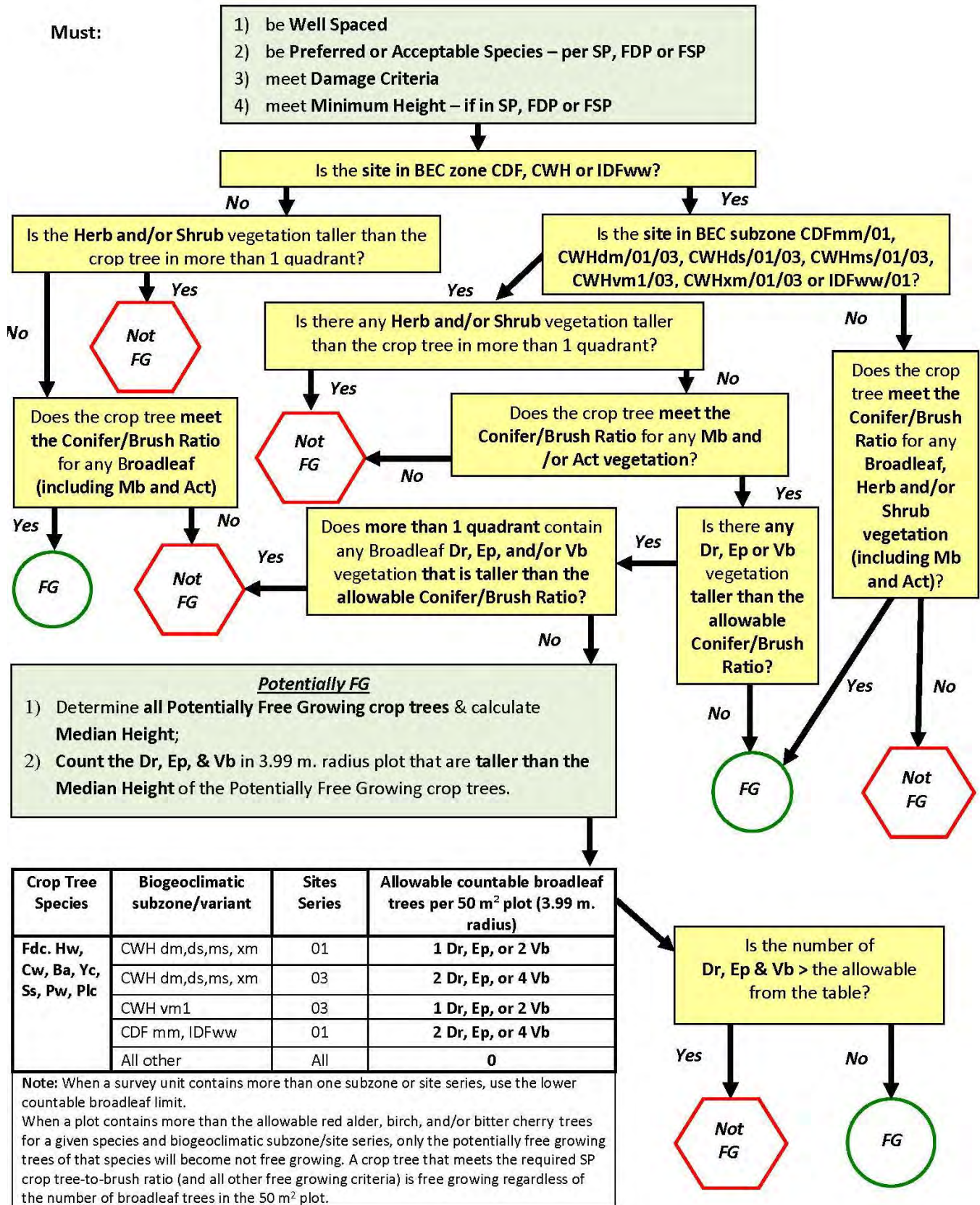


Figure 2.Coast Vegetation Competition Decision Key for a Free Growing Crop Tree

A 13.2 – North (Northern Interior) Area FG Guidance

1) **North Area Description**

The following TSA's are assessed according to guidelines described in Figure 3 (including all area based tenures within the gross areas of these TSA's, regardless of Natural Resource District boundaries):

- Cassiar TSA; Nass TSA; Kispiox TSA; Bulkley TSA; Morice TSA; Lakes TSA; Prince George TSA; Mackenzie; Robson Valley TSA; Dawson Creek TSA; Fort St. John TSA; Fort Nelson TSA.

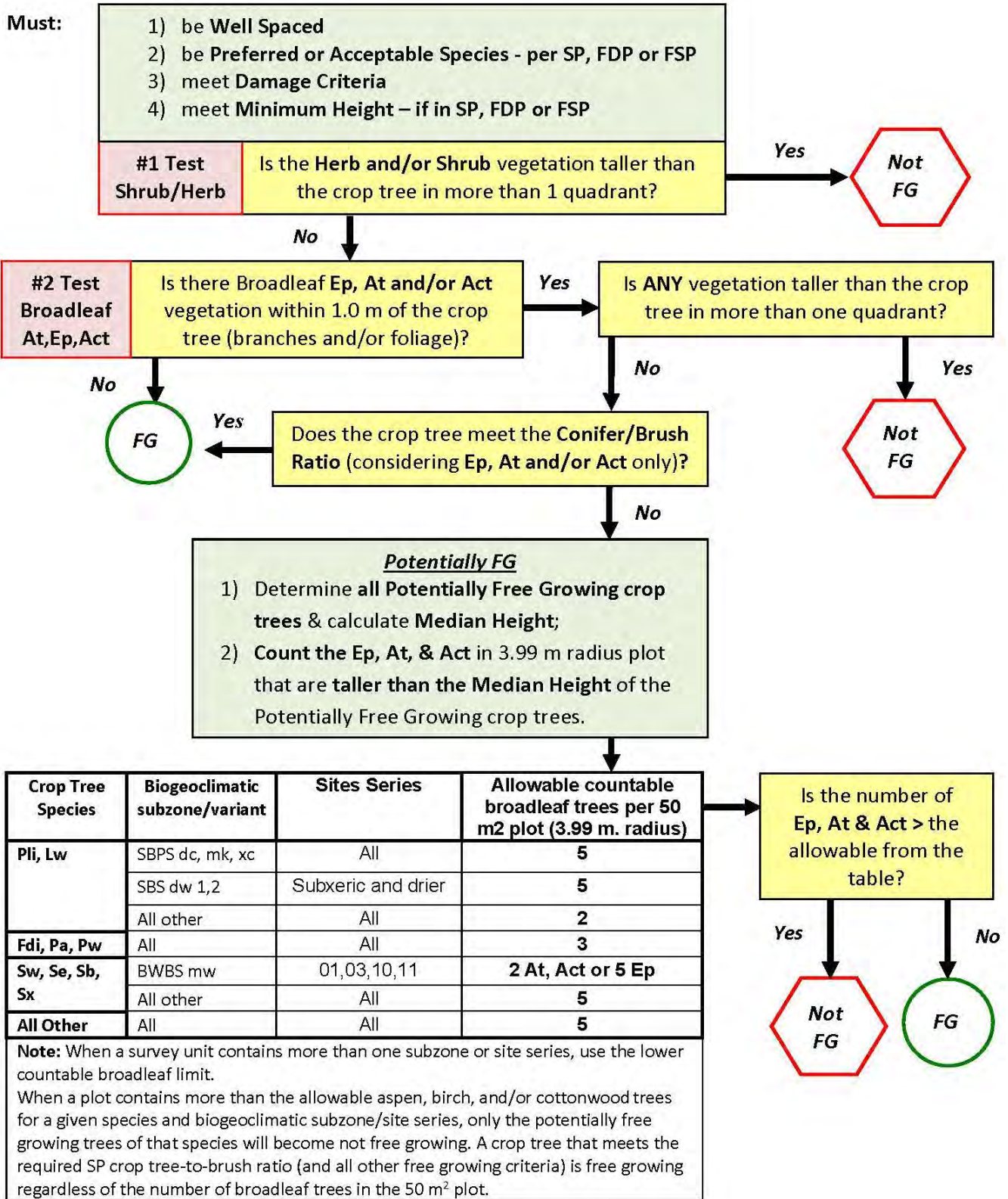


Figure 3. North Vegetation Competition Decision Key for a Free Growing Crop Tree

A 13.3 – South (Southern Interior) Area FG Guidance

1) South Area Description

The following TSA's are assessed according to guidelines described in Figure 4 (including all area based tenures within the gross areas of these TSA's, regardless of Natural Resource District boundaries):

- Kamloops TSA; Merritt TSA; Lillooet TSA; Okanagan TSA; Golden TSA; Revelstoke TSA; Invermere TSA; Cranbrook TSA; Kootenay Lake TSA; Arrow TSA; Boundary TSA; Williams Lake TSA; Quesnel TSA; and 100 Mile TSA
- Within the Williams Lake TSA; Quesnel TSA; and 100 Mile TSA, there is additional guidance in Fig 4. for all sites in the **IDFdk4 and the SBPSxc subzones** to consider broadleaf competition as non-deleterious at the plot level if, in the opinion of the professional, the established conifers are not deemed to be suppressed by competing broadleaf competition.
- **Approved Alternative** for Williams Lake TSA; Quesnel TSA; 100 Mile TSA:
 - For sites in the **SBPSmk, SBPSdc, SBSdw1, SBSdw2, IDFdk3, and IDFdk1** where **NO** brushing or broadleaf tree spacing activities have previously been carried out, the alternative guidance in **Section A13.3.1** may be used.

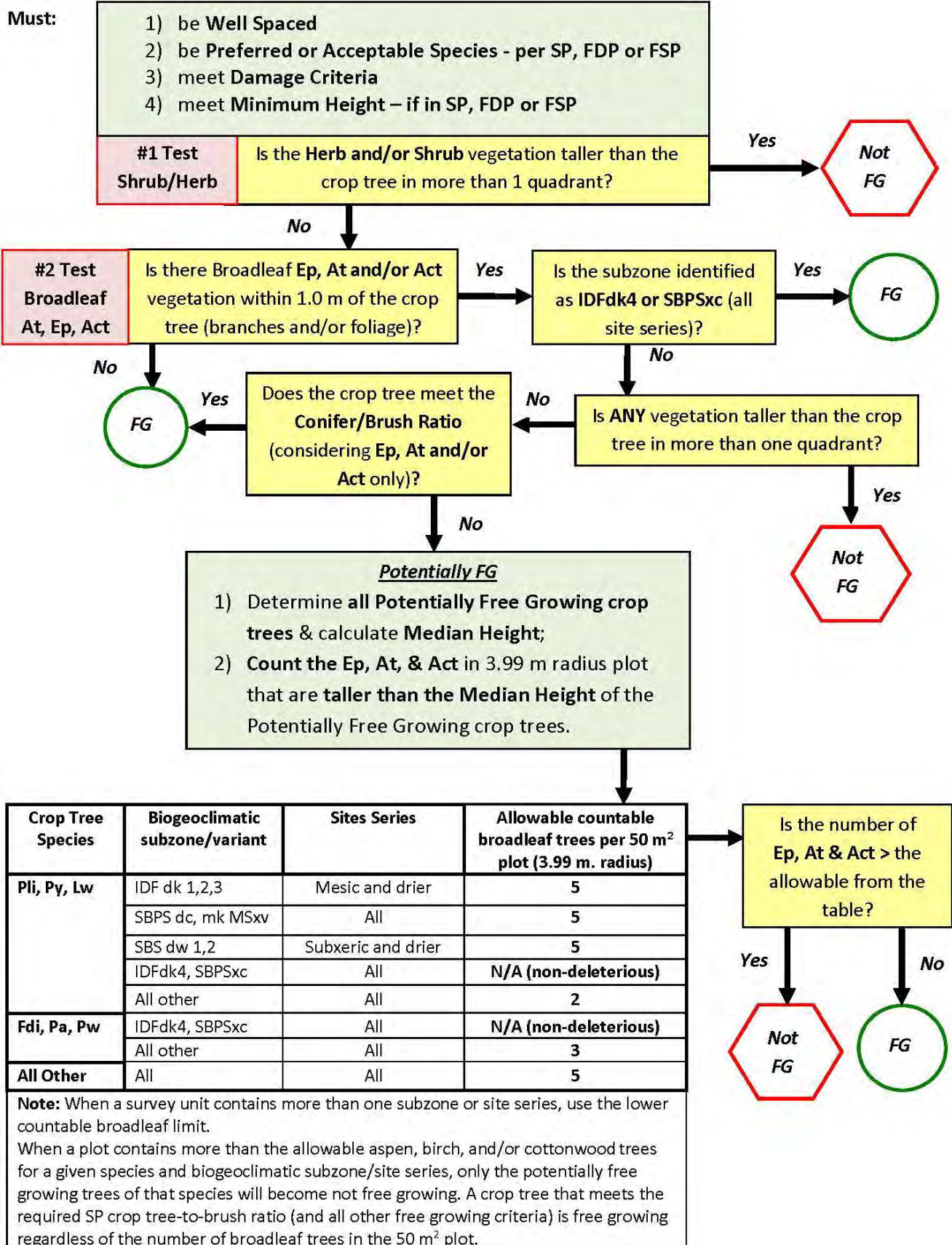


Figure 4. South Vegetation Competition Decision Key for a Free Growing Crop Tree Standard Guidance

A 13.3.1 – South Area – Williams Lake, Quesnel and 100 Mile TSA's (SBPSmk, SBPSdc, SBSdw1, SBSdw2, IDFdk3, and IDFdk1 only) Alternative FG Guidance

Acceptable alternative FG guidance, applied using a new survey procedure, is presented in this section for the following subzones/variants in the Williams Lake, 100 Mile, and Quesnel TSA's:

- **SBPSmk, SBPSdc, SBSdw1, SBSdw2, IDFdk3, and IDFdk1**

This alternative FG guidance (described in Figure 5) may be applied **only on sites where there has been NO previous brushing or broadleaf tree spacing activity**.

The alternative FG guidance and survey procedure were developed by the Cariboo Region silviculture research section. All BEC subzones/variants and site series included in this section represent ecosystems where research and/or expert opinion have been used to revise thresholds for broadleaf retention to levels that are more biologically appropriate to conifer tolerances (and not in conflict with conifer growth objectives) than those used in previous guidelines. The new survey procedure is intended to simplify the current approach by eliminating the "potential free growing tree" concept.

Significant changes to individual FG criteria used in the previous standard South Area guidelines are:

- The **Conifer/Brush Ratio** expressed as a percentage has been replaced with a **Brush/Conifer Ratio** expressed as a decimal. In the former guidelines, conifers meeting the Conifer/Brush Ratio had to be 150% or 125% (depending on BEC variant) taller than surrounding vegetation within a 1-m cylinder. With the new Brush/Conifer Ratio, broadleaf trees must be > 1.25 times the height of pine or > 1.5 times the height of other conifer species before they are counted as occupying quadrants within the 1-m cylinder or as countable stems.
- Previously, only one quadrant within the 1-m cylinder was allowed to be occupied by overtopping broadleaf trees. Now, 0, 1, or 2-adjacent quadrants are allowed to be occupied (2-opposite quadrants, 3 quadrants, and 4 quadrants are not acceptable).
- Allowable numbers of countable broadleaves have been adjusted, but are now assessed within a 1.8 m radius of individual crop conifers rather than within the 3.99 m plot (as described below).

Using the new survey procedure (presented in Figure 5):

- Well-spaced trees are still selected in a 3.99 m plot using the same spacing, preferred or acceptable species, minimum height, and damage criteria used in the standard guidelines.
- Test #1 regarding overtopping Shrub and Herb vegetation is unchanged.
- The new survey procedure uses a “**neighbourhood concept**” as opposed to the “**potentially FG concept**” used in other Decision Keys in this Appendix. There are two tests included in the new survey procedure, and a well-spaced tree must meet **BOTH** criteria to be FG:
 - **Occupied Quadrant Test** – within a 1.0 m radius around each crop conifer, the number of quadrants occupied by broadleaf vegetation exceeding the new **Brush/Conifer Ratio** is assessed. It is allowable for 0, 1 or 2-adjacent quadrants to be occupied. It is not acceptable for 2-opposite quadrants, 3 quadrants, or 4 quadrants to be occupied.

- Countable Broadleaf Test – within a 1.8 m radius around each crop conifer, the number of countable broadleaf stems is tallied and must not exceed allowable densities (as defined by BEC subzone/variant, site series, and conifer species). **The 1.8 m radius is measured horizontally outward from the conifer stem-centre at a height of 20 cm above ground.**
 - Making judgement calls for broadleaf trees at the periphery of the 1.8 m radius:
 - For single broadleaf (At, Ep, Act) stems: the stem is considered to be "in" when its centre at ground level is visually judged, based on the horizontally held plot cord or tape, to fall within the 1.8 m radius.
 - For broadleaf clumps, the number of countable stems is defined as described in Section 3.4.2.5, Figure 6c. For At stems that fork above the ground, the stem is considered to be "in" if the centre of the fork is visually judged, based on the horizontally held plot cord or tape, to fall within the 1.8 m radius.
 - For Ep clumps originating from cut stumps, the clump is considered to be "in" if the centre of the cut stump is visually judged, based on the horizontally held plot cord or tape, to fall within the 1.8 m radius. The number of countable stems in the clump is defined in Section 3.4.2.5 Table 1a.
 - Countable broadleaf trees within 1.8 m of well-spaced conifers may fall outside the 3.99 m plot radius, and a single countable broadleaf tree may affect the status of more than one crop conifer where the 1.8 m radius circles overlap.
- If a well-spaced conifer meets **BOTH** the quadrant test and the countable broadleaf test it is FG. If it fails either test, it is **NOT** FG. A decision as to FG or not FG can therefore be made quickly, on a tree-by-tree basis.

Explanatory notes

- With the new survey procedure, countable broadleaves are assessed only within a 1.8 m radius of each candidate well-spaced conifer. They are not assessed in the 3.99 m plot and there are no "potentially free growing trees". This eliminates the problem of having a clump of broadleaf trees on one side of the plot resulting in failure of trees as much as 7-8 m away.
- A 1.8 m radius circle covers approximately 10 m² and six well-spaced 1.8 m circles occupy approximately the same area as a 3.99 m plot (Figure 6).

IMPORTANT: It is advisable for survey contractors to receive training prior to using the alternate FG guidance and the new survey procedure described in Section A 13.3.1.

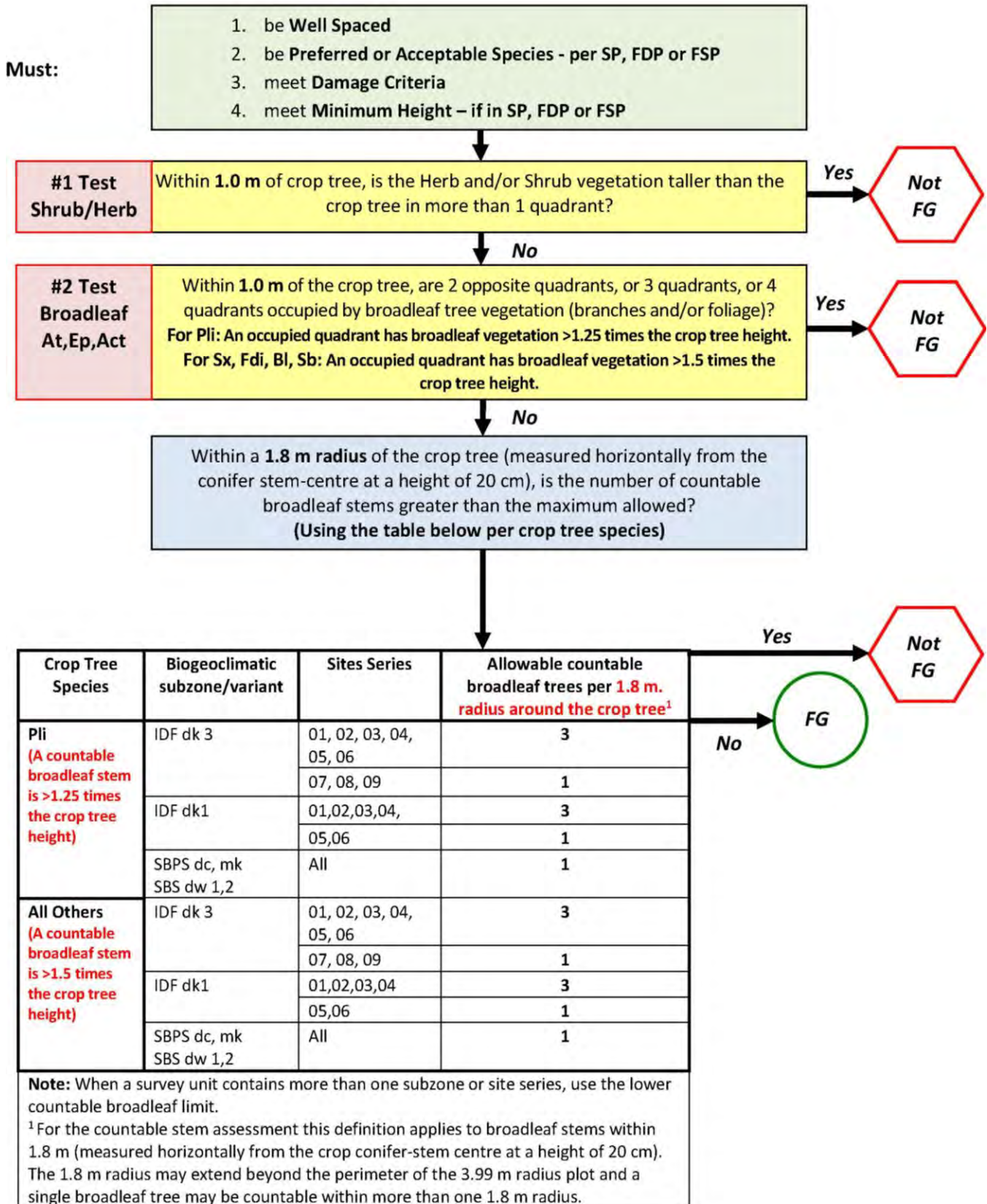


Figure 5: Williams Lake, Quesnel, and 100 Mile TSAs Vegetation Competition Decision Key for a Free Growing Crop Tree using alternative guidelines for SBPSmk, SBPSdc, SBSdw1, SBSdw2, IDFdk3, and IDFdk1 (only on sites where there has been NO previous brushing or broadleaf tree spacing activity).

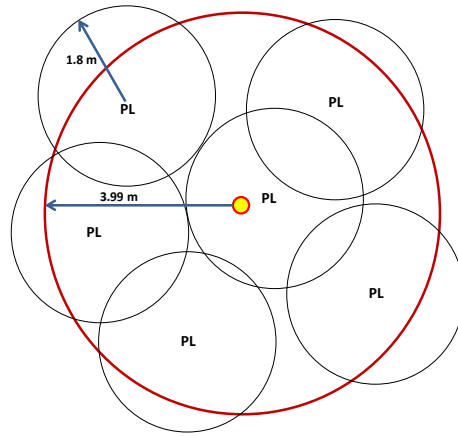
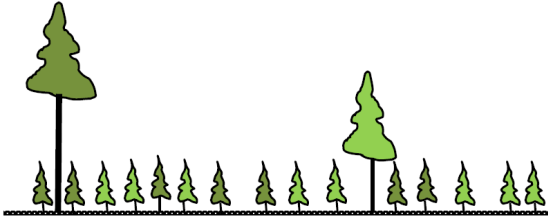


Figure 6: Example of what six 1.8 m radius neighborhoods around well-spaced trees in a 3.99 m radius plot look like.

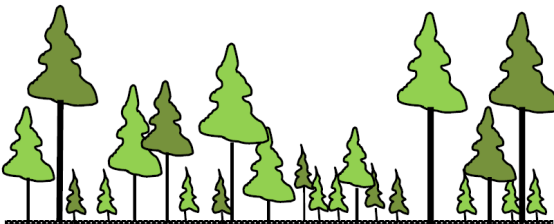
Appendix 14a: Stand Structures

The following is a summary of illustrations found throughout the document that depict the type of **Stand Structure** relative to the survey methodology described in each of the corresponding sections of the surveys manual:

I) Standard Clearcut Even-aged Stand Structure



II) Complex Vertical Stand Structure



Multi-storey – Uneven-aged

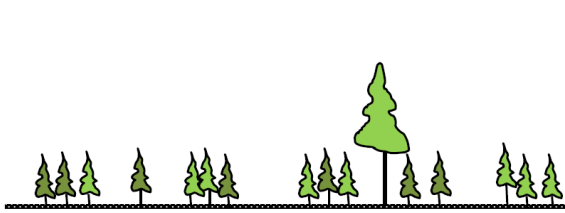


*Layered Even-aged – Layered & Deviation
From Potential (DFP)*

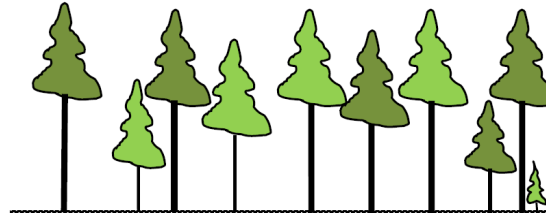


Boreal Mixedwood Intimate Mixture

III) Complex Horizontal Stand Structure



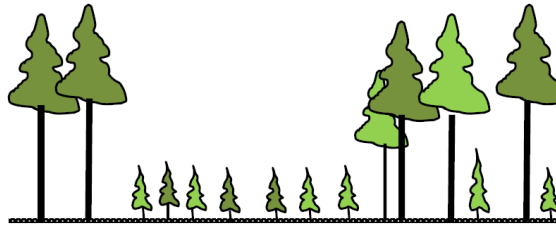
Even-aged Clustered



Intermediate Cut – Commercial Thinning



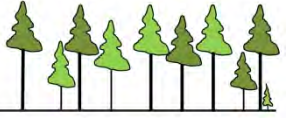
Coastal & Interior Mixedwood – Patch Mixtures



Clearcut with Reserves

Appendix 14b: Guidance Matrix for Reporting Retention Openings into RESULTS

RETENTION OPENINGS – with > 5 m ² / ha. Basal Area Retention						
<u>Silviculture Survey Manual Guidance</u> <i>Section referenced below in red</i>				<u>Treed Retention Submission into RESULTS Guidance (ii)</u> <i>Section referenced below in red</i>		
Steps	1 →	2 →		3 →	4a or 4b	
	Conifer Management Regime	Planned &/or Resultant Stand Structure <i>Sec 1.2</i>	Stand Structure Example Illustrations	Recommended Survey Methodology	Long Term Retention ⁵ – Reserves <i>Sec 4.1</i>	Short Term Retention ⁶ – part of a Silv System <i>Sec 4.2</i>
	1a Obligation <i>Timber Priority</i>					
	i) Single Entry Even –Aged	Complex Vertical Structure Dispersed Retention ³ - <i>Low BA only</i> <i>< 10m² Interior</i>	 Photo Images 1	Layered <i>Sec 9.2.2</i>	Dispersed <i>Sec 4.1.2 & 4.1.3</i>	Unharvested Stems <i>Sec 4.2.4</i>
	Multiple Entry Uneven-Aged					
	ii) Single Tree Selection	Complex Vertical Structure Dispersed Retention <i>IDF only</i>	 Photo Images 2	Multi-storey <i>Sec 9.2.1</i>		Single Tree <i>Sec 4.2.1</i>
	iii) Group Selection	Complex Horizontal Structure Group Retention ⁴ – <i>Clear Cut Openings¹</i>		Clearcut Method <i>Sec 7 & 8</i>		Group Selection <i>Sec 4.2.2</i>

iv) Group Selection	Complex Horizontal Structure Group Retention – <i>Small Patch</i> ↑ <i>Edge Effect</i> ²	 Photo Images 3	Small Scale Openings Method <i>Sec 9.3.5</i>		Group Selection <i>Sec 4.2.2</i>
1b Obligation <i>Non-Timber Priority</i>					
i) Single Entry Even -Aged	Complex Vertical Structure Dispersed Retention < 20 m ² Interior < 40 m ² Coast	 Photo Images 4	SEDRSS or DFP <i>Sec 9.2.3 & 9.2.4</i>	Dispersed <i>Sec 4.1.2 & 4.1.3</i>	Unharvested Stems <i>Sec 4.2.4</i>
Multiple Entry Uneven-Aged					
ii) Single Tree Selection	Complex Vertical Structure Dispersed Retention (<i>IDF only</i>)	 Photo Images 4	Multi-storey <i>Sec 9.2.1</i>		Single Tree <i>Sec 4.2.1</i>
iii) Group Selection	Complex Horizontal Structure Group Retention	 Photo Images 5	Clearcut Method <i>Sec 7 & 8 OR</i> Small Scale Opening <i>Sec 9.3.5</i>		Group Selection <i>4.2.2</i>
1c No Regen Obligation ≥ 20 m ² Interior ≥ 40 m ² Coast					
i) Intermediate Cut, (WF Interface & Ecosystem Restoration)	Complex Horizontal Structure Dispersed Retention	 Photo Images 6	Commercial Thin <i>Sec 9.3.2.1</i>		No Regen Objectives <i>Sec 4.2.3</i>
ii) Commercial Thin	Complex Horizontal Structure Dispersed Retention	 Photo Images 7	Commercial Thin <i>Sec 9.3.2.1</i>		No Regen Objectives <i>Sec 4.2.3</i>

Footnotes:

- 1) Definition of Clearcut: *Openings are at least two tree heights in width (i).*
 - 2) Definition of Edge Effect: *Is the forest influence (where openings are less than two tree heights in width, but > 10 m in wide) that occurs along the forest edge and produces an intermediate (or modified) microclimate (i).*
 - 3) Definition of Dispersed Retention: *Residual treed portions with usually individually separated stems and are not independently mapped (< 0.25 ha. If aggregated)(ii).*
 - 4) Definition of Grouped Retention: *Unharvested residual treed patches of aggregated individuals that are mappable (≥ 0.25 ha.) (ii).*
 - 5) Definition of Long term Residuals: *Residual trees with a reserve objective code other than Timber (i.e. WTP or CMT) and not available for a subsequent harvest entry until after the next rotational planning cycle – referred to as “reserves”(ii).*
 - 6) Definition of Short term Residuals: *Residual trees with a reserve objective code of only Timber and available for a subsequent harvest entry prior to the end of the current rotational planning cycle (whether or not they are actually harvested) – referred to as “retention”(ii).*
- (i) [*Silviculture Systems Handbook of BC - MoF 2003*](#)

Photo Images 1

Obligation Timber Priority **Single Entry Even –Aged** Complex Vertical Structure - **Dispersed Retention**





Photo Images 2

Obligation Timber Priority **Multiple Entry Uneven-Aged Single Tree Selection** Complex Vertical Structure - **Dispersed Retention - IDF only**



Image © 2014 Province of British Columbia



Photo Images 3

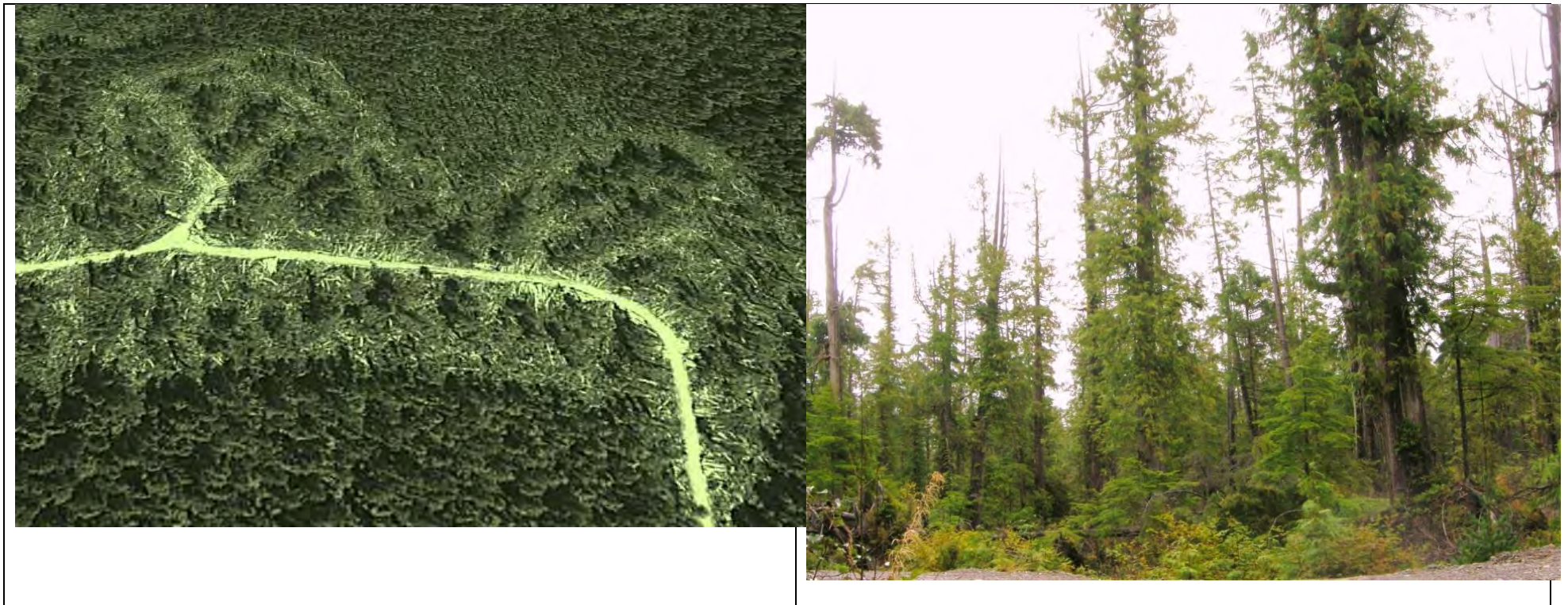
Obligation Timber Priority Multiple Entry Uneven-Aged Group Selection Complex Horizontal Structure - **Group Retention**
– **Small Patch ↑Edge Effect**



Photo Images 4

Obligation Non-Timber Priority Single Entry Even-Aged **Complex Vertical Structure** - Dispersed Retention

Coastal SEDRSS



Interior DFP



Photo Images 5

Obligation Non-Timber Priority **Multiple Entry Uneven-Aged Group Selection** Complex Horizontal Structure - **Group Retention**
Clear Cut Openings

-



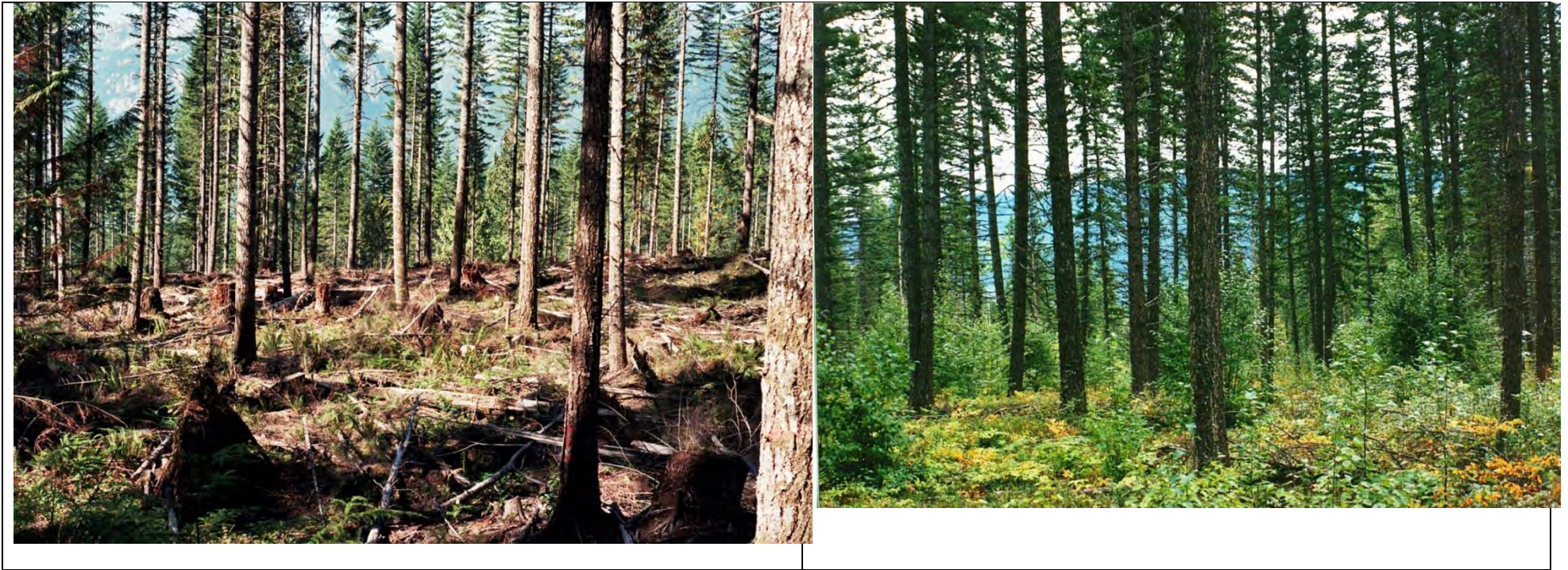
Photo Images 6

No Regen Obligation **Intermediate Cut** Complex Horizontal Structure - Dispersed Retention



Photo Images 7

No Regen Obligation **Commercial Thinning** Complex Horizontal Structure - Dispersed Retention



Appendix 15: The Forest and Range Practices Act and the Regulatory Framework (additional details)

15.1 [Forest and Range Practices Act](#)

In its most simplistic form, the Forest and Range Practices Act, requires the establishment of a free growing stand. The Planning and Practices Regulation and the Woodlot Licence Planning and Practices Regulation requires a forest inventory be completed. This inventory, simply by the nature of the required timing, is the combined regen delay and free growing surveys for most licenses and the free growing survey only for woodlot licenses.

These are a few relevant highlights of FRPA that guide silviculture surveys:

- Part 1 defines the terms of forest practice and a free growing stand.
- Part 2 includes a discussion of Forest Stewardship Plans (sec 3 and 5), Site Plans (sec 10) and Woodlot Licence Plans (sec 13).
- Part 3, sections 25-27 discuss forest health and pests on Crown and private land.
- Part 3 sections 29 and 30 discuss the subject of free growing stands. Here the requirement to establish a free growing stand is established for 4 groups: major licence holders, timber sales manager, woodlot licence holders and non-replaceable licence holders. The use of suitable seed is required.
- Part 3 section 31 is to ensure that seed use conforms to the prescribed requirements.
- Part 7 section 107 discusses declaration of obligations. Section 107 (5) (b) indicates the District Manager must not give written notice that an obligation has not been met unless he/she has determined the stand is under threat from competing vegetation or forest health factors or is unlikely to remain free growing without a further treatment.
- Part 9 Section 157 states: “The Lieutenant Governor in Council may make regulations respecting silvicultural systems and silviculture treatments.”
- Part 9 section 169 provide the Chief Forester authority to, among other things, make standards regarding tree seed and stocking standards.
- Part 11 - The Transition, section 177 defines silviculture plans and prescriptions as the collective term for pre-harvest silviculture prescriptions, silviculture prescriptions and site plans.

15.2 [Forest Planning and Practices Regulation](#)

In Section 1, a number of terms are defined such as standards units, stocking standards, regeneration date, free growing date, forest health factors, net area to be reforested, primary forest activity and silviculture treatment. One that is of particular importance to silviculture surveyors is “forest cover inventory”. This means “a survey of trees and tree-related matters in an area that includes information required by the minister”.

- Section 16 deals with stocking standards in a forest stewardship plan.
- Section 26 discusses the Minister's consideration of stocking standards (i.e., approval tests).
- Section 34 describes the content requirements for site plans.
- Section 43 describes the use of seed.
- Sections 44, 45 and 46 discuss free growing stands.
- Sections 85-88 describe the requirements for annual reporting, including the precision standards that define ‘form and manner that is satisfactory to the minister’. The timing of the requirements is noteworthy. Each report covering the period of April 1 through March 31 of each year is due before June 1 of each year. Section 87 describes the details of reporting and mapping.
- Sections 97 and 97.1 discuss declarations.
- Section 111 deals with amalgamating obligations to establish a free growing stand.
- Schedule 1 section 6 discusses factors relating to stocking specifications.

15.3 [Woodlot Licence Planning and Practices Regulation](#)

This regulation only applies to woodlots. All relevant terms are defined in Part 1.

- Sections 8, 9, 34 and 35, describe the requirement to produce a Woodlot Licence Plan, map, objectives, free growing stands and stocking standards.
- Section 12 deals with stocking information for specified areas.
- Section 13 discusses alternative performance requirements.
- Section 33 covers pre harvest mapping.
- Section 75 identifies surveys are specifically required.
- Section 76 states annual reports are required before April 30 of each year.
- Section 84 discusses declarations.

15.4 Forest Practices Code Guidebooks

With the transition from the Forest Practices Code era to the current Forest and Range Practices era the status of the Forest Practices Code Guidebooks has been reduced. The Guidebooks are not referenced in legislation; therefore there is no legal obligation to follow the advice provided within them. However, they were created by individuals knowledgeable of the subjects discussed. They form a collection of advice, suggested procedures and reference sources that continues to be valuable. The term of “best practices” has been used to describe them. Most are still available online. [Links to Guidebooks](#) are provided in Appendix 3.