Ministry of Forests

Silviculture Survey Procedures Manual

Forest Science, Planning and Practices Branch
4-8-2026

Table of Contents

List of Figures

List of Tables

Introduction

This manual explains how to complete silviculture surveys in British Columbia. It provides easy-to-use, step-by-step instructions on how to collect, compile, and review survey data for regeneration delay, stocking, and free growing surveys.

You may use different tools or data-collection methods, including electronic systems, but the results must be consistent with the outcomes you would obtain by following the procedures in this manual.

Note: If the survey methods or stocking standard format in an approved forest stewardship plan (FSP) or Forest Operations Plan (FOP) differ from those in this manual, follow the FSP/FOP.

This manual follows the steps of a typical silviculture survey. It starts with preparing for the survey and completing the walk-through. It then moves into designing the survey and recording the site description and survey parameters. Then it explains how to establish plots, collect plot data, and compile and report the results. After the core survey procedures are discussed, the manual presents field techniques, followed by guidance on surveying stands with complex vertical or horizontal stand structures, or with alternative objectives.

Supporting information

For survey cards, information on the silviculture survey accreditation program, and additional reference documents, visit the Silviculture Surveys and Silviculture Surveys Reference Documents webpages.

For demonstration videos and training materials, visit the BC Silviculture Surveys YouTube channel.

Reaching out

If you have questions about silviculture surveying, identify errors in this manual, have suggestions for improvements, or would like to request a training topic, please reach out to silvsurveys@gov.bc.ca. You can also use this contact to request archived versions of the *Silviculture Survey Procedures Manual* for reference.

Chapter 1: Introduction to Silviculture Surveys

1.1 Role of Silviculture Surveys

Silviculture surveys are used to collect data on forest stands. That information is used to:

- assess stand condition, growth, and development;
- confirm that legal obligations for reforestation are being met;
- plan treatments, like planting, brushing, or thinning;
- assess the effectiveness of treatments;
- monitor the progress of stands toward achieving the management objectives;
- update government databases, like RESULTS[1] and the Vegetation Resource Inventory (VRI); and
- create yield curves for timber supply review and carbon modelling.

It is critical that you collect accurate survey data. Inaccurate data can lead to bad decisions, extra costs, and delays in meeting reforestation goals.

1.2 Types of Surveys

Different survey types are used to assess different milestones (legal and non-legal) of reforestation:

Regeneration Delay Survey

- Purpose: to confirm that regeneration requirements have been met within a specified time after harvesting.
- Timing: completed shortly after planting or natural regeneration. May coincide with planting inspections. Must be completed on or prior to the regeneration delay date.

Stocking Survey

- Purpose: to monitor stand development and assess the need for treatments.
- Timing: conducted after regeneration delay and before the free growing stage.

[1] The Reporting Silviculture Updates and Land Status Tracking System (RESULTS) is used to record and track silviculture information on such things as openings, disturbances, silviculture activities, and legal obligations.

Free Growing Survey

- Purpose: to determine if a stand has reached the free growing stage, where trees are healthy, well-spaced, and free from significant competition.
- Timing: completed when the stand is expected to meet free growing criteria, often 9–15 years after establishment. Must be completed on or prior to the free growing date.

1.3 Professional Responsibility

Licensees are legally responsible for completing silviculture surveys on harvested areas. Those surveys may be carried out by:

- non-accredited surveyors
- Accredited Silviculture Surveyors (ASSs)[2]
- Silviculture Accredited Surveyors (SASs)[3]
- Registered Forest Technologists
- Registered Professional Foresters

Note: Silviculture surveys fall under the practice of professional forestry as defined in the Forest Professionals Regulation under the *Professional Governance Act*. Surveys must be done by, or under the supervision of, a registered member or special permit holder of Forest Professionals British Columbia (FPBC).

1.4 Legal and Planning Framework

Silviculture surveys are done to meet various legal obligations, including:

- **Forest Planning and Practices Regulation:** requires updates on forest cover to prove that forest stands meet regeneration and free growing obligations.
- **Forest stewardship plan:** outlines the results and strategies for managing stands, including stocking standards and survey requirements.

[2] Accredited surveyors may choose to use the acronym BCASS instead of ASS.
[3] An Accredited Silviculture Surveyor (BCASS) has passed the provincial accreditation exam. A Silviculture Accredited Surveyor (SAS) is an Accredited Silviculture Surveyor who has registered with FPBC as an Associate Member. A Silviculture Accredited Surveyor may conduct surveys independently; an Accredited Silviculture Surveyor may not.

- **Site plan:** implements the results and strategies set out in the forest stewardship plan at the block and standards unit level. It also establishes the standards units and the site-specific stocking standards.
- **Reporting requirements:** data collected during surveys must be submitted according to the RESULTS Information Submission Specifications (RISS).

Note 1: This manual is written for silviculture surveys conducted in areas with a regeneration obligation, where stocking standards are established through forest stewardship plans and associated site plans. References to legislation and legal plans throughout this manual reflect this framework and may differ for woodlots, openings under forest operations plans, or legacy *Forest Practices Code* blocks.

Note 2: The Woodlot Licence Planning and Practices Regulation applies to woodlot licences. Site plans are not required because stocking standards are set in the woodlot licence plan. Additional information on the Woodlot Licence Planning and Practices Regulation is provided in Appendix 5.

1.5 Core Survey Concepts

This section introduces key technical terms used throughout this manual. You must have a clear understanding of these terms before conducting a survey.

1.5.1 Well-Spaced Trees

Well-spaced trees are a subset of all trees. They are expected to develop into free growing trees and contribute to the managed portion of the stand. Only well-spaced trees are used to assess regeneration obligations.

To be considered well-spaced, a tree must:

- be a **preferred or acceptable or ecologically suitable species**, as listed in the site plan; and
- meet the **minimum inter-tree distance** from any other well-spaced trees in the plot (Figure 1).

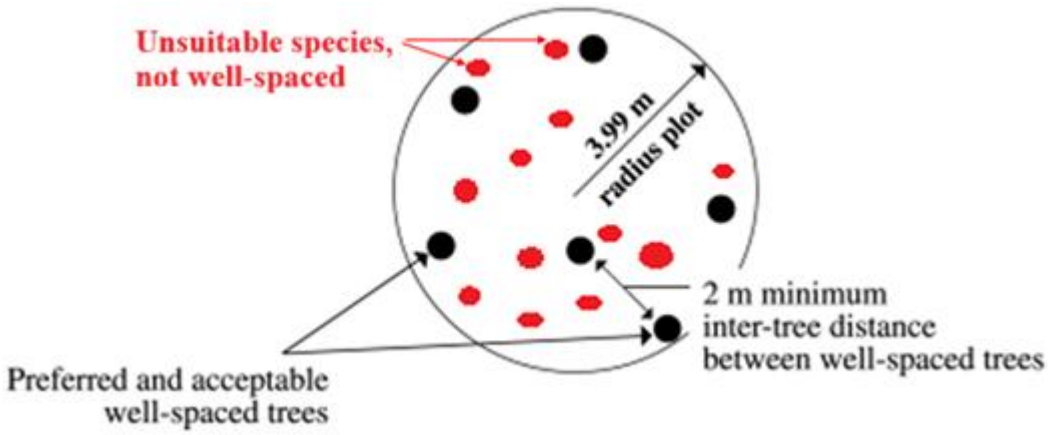


FIGURE 1. Example plot showing well-spaced trees.

1.5.2 Free Growing Tree

A free growing tree is a well-spaced tree that also meets these criteria:

- it must reach the **minimum free growing height** specified in the stocking standards;
- it must be **free of unacceptable damage** from forest health factors; and
- it must be free **from significant vegetation competition**, including herbaceous, shrub, or broadleaf cover.

Only free growing trees contribute to meeting the free growing obligation.

1.5.3 Stocking Standards

Stocking standards define what is required for a stand to be considered successfully regenerated or free growing. Standards are included in the site plan and forest stewardship plan,[4] and are normally applied at the standards unit[5] level. They guide the survey design, data interpretation, and legal assessment of whether reforestation obligations have been met.

Stocking standards typically include the following:

- **Species requirements:** only tree species listed in the stocking standard can be counted toward the minimum stocking standard. Standards may specify preferred, acceptable, or ecologically suitable species. The order of species in the standard has no relevance.

[4] British Columbia is moving toward using forest landscape plans. Where a forest landscape plan is approved, stocking standards will be included in site-level plans and forest operation plans.
[5] A standards unit is a mapped area of a cutblock that has uniform soil disturbance limits and stocking standards.

- **Target Stocking Standard (TSS):** the density of free growing trees that will achieve the target stand conditions at the expected harvest age.
- **M-value:** the maximum number of well-spaced or free growing trees in a single plot that may contribute to the stocking status determination. It is calculated by dividing the TSS by the plot multiplier.[6]
- **Minimum Stocking Standard (MSS, MSSp, MSSpa):**[7]
    - MSS or MSSpa: the minimum number of well-spaced or free growing trees of preferred and acceptable species required per hectare to meet reforestation requirements.
    - MSSp: the minimum number of preferred well-spaced or free growing trees required per hectare to meet reforestation requirements.
- **Minimum inter-tree distance:** Trees counted as well-spaced must meet the minimum inter-tree distance from other well-spaced trees. They may be closer than this distance to non-well-spaced trees (Figure 1).

  Note: The minimum inter-tree distance is measured as horizontal distance, not slope distance.[8]
- **Maximum density thresholds:** Some standards include a maximum number of countable trees per hectare. If this threshold is exceeded, a juvenile spacing treatment may be required before a free growing declaration can be made. Surveys must tally countable trees to assess this requirement.

Additional elements:

- **Height requirements:** For a tree to be considered free growing, it must be as tall or taller than the minimum free growing height. Minimum heights are specified for each listed species.

[6] The plot multiplier is 200 when a 3.99-m radius plot is used, or 100 when a 5.64-m radius plot is used. Refer to Table 5 of the FS 660 for other plot multipliers.
[7] Most stocking standards use well-spaced and free growing density as the metric; however, this is not a legal requirement. Stocking standards may instead use other measurable metrics such as percent stocking, percent gaps, mean stocked quadrant, or projectable metrics such as basal area or volume at a specified age.
[8] Horizontal distance is the flat, level distance between two trees, regardless of elevation change. Slope distance is the length measured directly along the surface of a slope.

- **Free growing damage criteria:** A tree cannot be considered free growing if it has unacceptable levels of forest health damage. Most forest stewardship plans specify that this should be assessed using the free growing damage criteria on the FS 660 field card.
- **Competing vegetation criteria:** A free growing tree must not be significantly impeded by competition from other vegetation. Most standards:
    - outline competition criteria and procedures; or
    - indicate that surveyors will use the Local Geographic Competition Assessment Criteria in the FS 660 field card.
- **Regeneration date:** This is the deadline for declaring that a stand is regenerated (that is, it meets the stocking standards based on well-spaced trees).
- **Free growing date:** This is the deadline for declaring that a stand is free growing (that is, it meets the stocking standards based on free growing trees).

Figure 2 provides an example of a stocking standard to meet a conifer sawlog objective in the CWH mm2.

Regime Name	*BGC Classification*		*Regeneration and Free Growing Stocking Standard*								
	Zone/SZ	Site Series	Preferred (p) Species	Acceptable (a) Species	Density Target (well-spaced/ha)	Density MIN pa (well-spaced/ha)	Density MIN p (well-spaced/ha)	Regen. Delay (max yrs)	Free Growing Assessment Period Earliest (yrs)	Free Growing Assessment Period Latest (yrs)	Minimum Height at Free Growing Species-Height (m)
Conifer-Sawlog objective	CWHmm2[47]	08	Ba[47] Cw Yc	Hw[2] Fd[9]	900	500	400	3	8	11	Fd-3.0, Hw-1.75, Cw-1.25, Yc-1.25, Ba-1.0

FIGURE 2. Example stocking standard.

Chapter 2: Preparing for a Survey

This chapter outlines how to prepare for a silviculture survey. It stresses the importance of doing a thorough office review and preliminary stratification. It also highlights why you need to plan the survey type and timing carefully so that you collect accurate data efficiently.

2.1 Purpose of the Office Review

The office review will help you:

- understand the site's history and management objectives;
- identify the stocking standards and upcoming survey milestones (regeneration delay, free growing); and
- plan the fieldwork efficiently and safely.

You must review all available information about a block before collecting any field data.

2.2 Information to Gather

In the office, gather and review:

- **Forest stewardship plan**: Review the stocking standard section of the forest stewardship plan for information on surveying, general standards, and variances from general standards.
- **Site plan** (including approved amendments): Review this document for information on the management objectives, silvicultural system, residual stand structure (if applicable), and stocking standards.
- **Silvicultural plan[9]:** Review this document for information on the stand development pathway, including the stand objectives, desired stand structural condition, site description, and planned interventions.
- **Site plan map**: Use this map to locate the standards units within the opening.
- **Biogeoclimatic (BEC) map**: Consult this map for information on the ecological classification of the site.

[9] For more information on silvicultural plans and stand development pathways, refer to the 2025 Silvicultural Systems Handbook.

- **Treatment history** (site preparation, planting, brushing, thinning, etc.): Review past treatments to predict the current stand condition and assess treatment efficacy.
- **Past survey results**: Review previous survey data to get insights into the stand's development and identify any issues that need to be addressed.
- **Forest health**: Identify common and new forest health issues in the district to anticipate risks and adjust survey timing or methods. Review SEDA forest health hazard ratings, incidences of forest health issues in adjacent stands, and adjacent stand treatment history.
- **Recent imagery** (e.g., LiDAR, UAV, Google Earth, satellite): Use recent imagery to identify areas of concern or differences in site or stand conditions, including differences in vegetation cover, stand density, tree species, or levels of dispersed retention.
- If relevant: Check for overlaps with Government Action Regulation orders that may add more stocking requirements (e.g., Cariboo Government Action Regulation).

Tip: General standards or variances from general standards apply to many standards units. They may allow for reduced minimum inter-tree distance, changes in species suitability, alternative survey methodologies, or exceptions from competing vegetation criteria under certain conditions. These standards do **not** transfer to electronic data collection apps, so you must review the site plan and forest stewardship plan to see if they apply.

2.3 Preliminary Stratification

Preliminary stratification involves identifying areas of the opening that have similar characteristics so they can be surveyed separately from areas that differ.

When you group similar areas together, there is less variation within each group than across the whole block. This improves the accuracy of the survey, and fewer plots are needed to get reliable results. Treatment recommendations are also more accurate.

Stratify based on differences you expect to see in:

- tree species composition
- stand density
- tree basal area
- site conditions (wet pockets, rocky areas)

- forest health factors (insects, disease, abiotic damage)
- vegetation cover (brushy areas)

Step 1: Use the site plan to identify the standards units. Each standards unit must be surveyed separately.

Step 2: Within each standards unit, look for areas that have obvious differences. These areas may need to be stratified into sub-areas. These sub-areas are called strata. You will confirm or adjust this stratification during your field walk-through.

Example: If the aerial imagery suggests that the west side of the block is much greener and thicker than the east side, verify these differences during your field walk-through. Then decide whether the two areas should be surveyed as separate strata.

2.4 Planning Survey Timing

Based on your office review, determine:

- what type of survey is needed: regeneration delay, stocking, free growing;
- the survey objective: regen delay, stocking, plantability, free growing, brushing, maximum density, green-up, other; and
- the best time of year to complete the survey. Consider snow cover, vegetation competition, and site accessibility.

Timing tips:

- **Regeneration delay surveys:** Plan these surveys before the regeneration delay date and conduct them during any snow-free time. Where possible, do these surveys when brush is low, especially on high-brush hazard sites, so it is easier to spot small seedlings.
- **Regeneration delay surveys and planting inspections:** Avoid combining these surveys and inspections if seedling survival is expected to be poor. Also avoid combining them if the forest cover is likely to change significantly—for example, due to high levels of natural infill, shifts in species composition, or forest health damage.
- **Stocking and free growing surveys:** Conduct these surveys between full leaf-out and leaf-fall to properly assess vegetation competition. This timing is less important on low-brush hazard sites.

- **Early stocking surveys:** Use these surveys to identify issues sooner and allow time to manage them before the free growing assessment is done.
- **Free growing surveys:** Conduct these surveys when minimum free growing heights have been met. They must be completed on or before the free growing date, which can be amended up to a maximum of 20 years.
- **Post-treatment:** Wait two full growing seasons after brushing treatments have been applied before you complete a free growing survey. This applies to all BEC zones, except the SBS and BWBS. In those zones, you should wait three full growing seasons after treatments other than herbicide have been applied.
- **Forest health:** Conduct free growing surveys when you can identify as many forest health factors as possible. Consider tree age and season. For example, if rust is a concern, survey when it is at its peak. For help with timing, contact your regional forest health specialist.

Timing matters: Poor timing can cause you to miss trees, underestimate vegetation, or overlook forest health problems. Use proper timing to ensure you collect accurate data and effective management decisions are made.

Chapter 3: Conducting the Field Walk-Through

After completing the office review, do a field walk-through of the opening. A walk-through gives you a broad understanding of site and stand conditions and helps you finalize the survey plan before you start collecting data.

A walk-through is not required, but it is recommended for most openings. The level of detail depends on the complexity of the opening, the quality of the initial information, your familiarity with the site, and the method and intensity of the survey.

A walk-through is different from an ocular assessment.

- **Walk-through:** a reconnaissance of the entire opening used to confirm stratification, plan sampling, and identify key stand features. It may be done on foot or using all-terrain vehicles, drones, or aircraft.
- **Ocular assessment:** a sampling method based on visual estimates rather than plot measurements (see Section 4.5).

3.1 Purpose of the Walk-Through

Use the walk-through to:

- confirm the ecological classification of the opening
- confirm or adjust the preliminary stratification
- identify an area as a dispersed type, and define the characteristics of each stratum
- determine the survey objectives, sampling methods, and sampling intensity for each stratum
- determine the plot radius and/or basal area factor
- determine what data you need to collect for each stratum
- determine if dispersed retention is greater than 5 m^2/ha
- identify the leading and second inventory species for each stratum
- identify the leading silviculture species for each stratum
- confirm the site index method for each stratum
- complete a preliminary assessment of forest health factors

- make preliminary treatment recommendations

Note: Complete the walk-through **before** you establish the survey plots. Do not establish any plots during the walk-through.

3.2 Stratification

Stratification is one of the most important steps in the survey. Good stratification ensures that the survey accurately reflects stand conditions, meets legal requirements, and supports clear treatment recommendations.

Stratification groups parts of the opening that share similar characteristics into strata. When strata are well defined, there is less variation within each stratum, which increases sampling precision and reduces the number of plots required. Strata also help ensure that survey results align with the standards units and objectives in the site plan.

3.2.1 Confirming and Adjusting Stratification

During the walk-through, confirm that your preliminary stratification reflects actual field conditions. If it does not, adjust it as needed.

- If standards units have different stocking standards, keep them separate, even if stand conditions are similar. Standards unit boundaries are fixed unless they are amended by an approved change to the site plan.
- If mapped standards unit boundaries in the site plan do not align with conditions you observe in the field, update the survey mapping to reflect those conditions. Record all variations in case the site plan needs to be amended.
- Within each standards unit, confirm that each preliminary stratum is clearly distinct.
- **Create a new stratum if you observe:**
    - stocking status differences (e.g., not satisfactorily restocked, satisfactorily restocked, free growing)
    - basal area differences (e.g., more than or less than 5 m^2/ha)
    - tree species composition differences greater than 20%
    - age class differences greater than 20 years
    - height class differences greater than 10 m
    - crown closure differences greater than 20%

  - site index differences greater than 3 m
  - changes in the leading inventory species
  - a forest health problem that is limited to a specific area
  - conditions that would result in different treatment recommendations
- Mark the boundary of each stratum on a map. Record the reason for the stratification.

Minimum Stratum Size

Follow these minimum size rules when creating strata:

Stratum type	Minimum size
Reserves or non-productive areas	0.25 ha[10] (must be mappable)
Entire standards unit less than 1 ha	Survey as a single stratum
Regeneration/free growing	1 ha
Non- free growing areas (within free growing standards units)	1–2 ha (max 5% of the standards unit's net area)

To define an understocked or non- free growing stratum, make sure it:

- meets the applicable minimum size;
- is at least 20 m wide throughout; and
- is at least 20 m away from other understocked or non- free growing areas (if it is closer, treat it as one continuous patch).

Note: Stratifying based on stocking status differs between regeneration delay and free growing obligations. For example, small non-free growing areas (1–2 ha) may be acceptable at free growing if together they make up less than 5% of the standards unit's net area and the standards unit meets the stocking standards overall.

Refer to the following for detailed guidance:

- Forest Cover Stratification and Milestone Declaration (2007)

[10] Where the exact locations of reserves ≥ 0.1 ha are known, it is recommended that they be stratified and reported to RESULTS.

- Using Stratification to Achieve Non-Timber Objectives (2022)
- Silviculture Surveys YouTube channel (presentation available)

3.2.2 Dispersed Types

Sometimes an opening contains small patches that have distinctly different characteristics. If those patches are too small, too numerous, or too intermixed to map as separate strata, you can survey them as dispersed types.

Use dispersed types when:

- each patch is less than 1 ha, but together they make up a total area that is typically around 2 ha or more, and
- the conditions may affect stocking status or treatment recommendations (e.g., there are numerous NSR areas, pockets of heavy brush, wet depressions).

Identifying a dispersed type does not replace standard stratification. Use dispersed types only when it is not possible to map a separate stratum.

Using dispersed types is most helpful during regeneration delay or stocking surveys. Variability at free growing is usually addressed by increasing plot intensity, not by using dispersed types.

If dispersed strata are not identified in the site plan and using them would change the stocking standards for part of the standards unit, the site plan may need to be amended. However, in most cases, dispersed types are used only to summarize survey results and to help make treatment decisions (e.g., fill plant, brushing), not to modify stocking standards.

Surveying dispersed types

When dispersed types are used:

- clearly define the characteristics of each stratum,
- establish the number of plots in each stratum that are needed to meet the desired statistical precision,
- move plots, if needed, in 10-m increments along the strip line to ensure they are fully within a single stratum,
- assign each plot to the appropriate stratum based on the conditions at plot centre,
- collect and summarize data separately for each stratum, and
- estimate the proportion of the standards unit represented by each stratum.

Chapter 4: Designing the Survey

After completing the walk-through, you must:

- confirm the survey objective(s) for each stratum;
- determine what data to collect;
- determine the required sampling intensity;
- select the appropriate plot radius, and if applicable, the basal area factor; and
- choose the sampling method (grid, vector, representative, ocular).

This will ensure that the data you collect will be precise, legally defensible, and appropriate for both silviculture and inventory reporting requirements.

4.1 Selecting the Survey Objective

Objectives define the purpose of the survey. The following are some examples:

Objective	Description
Regeneration Delay	Confirm that regeneration requirements have been met
Stocking	Evaluate the density and distribution of trees to determine if the stand meets the stocking standards
Free Growing	Assess whether the stand has reached the free growing stage, where trees are healthy, well-spaced, and free from significant competition
Treatment Planning	Identify areas that require treatments such as site preparation, planting, brushing, spacing, etc.

Tip: Clearly define the survey objectives before you start fieldwork to ensure all required data are collected and unnecessary data are not.
Note: A survey may have multiple objectives.

4.2 Type of Data to Collect

The data you collect during a survey must support the survey objectives. Collecting data that are not related to the objective is inefficient and makes data compilation more difficult.

General Principles:

- Collect data that are required to meet legal reporting requirements.
- Collect supplemental data only if this directly supports the objective or has been specifically requested.

Examples of supplemental data collected when treatment planning is an objective:

Treatment type	Supplemental data
Plantability	Number of plantable spots[11], number of preparable spots[12], planting difficulty, acceptable planting medium, LFH depth (cm), humus form, coarse fragments, slash cover and distribution, number of germinants[13]
Brushing	Diameter of broadleaf stems, percent cover of broadleaf trees, conifer height-to-diameter ratios (under broadleaves versus in open areas), broadleaf heights by species, leader growth by species
Maximum density	Countable height measurements, countable conifers, or countable trees

4.3 Determining the Sampling Intensity

Sampling intensity refers to the number of plots established within a survey area. The number of plots used should be based on the variability of the stand and the survey objectives.

[11] A plantable spot is a suitable microsite on which a seedling could be planted.
[12] A preparable spot is a microsite that is presently unsuitable for planting but, with site preparation, could be an acceptable planting microsite.
[13] A germinant is a naturally established tree that is 5 cm tall or less, excluding any reduction in height caused by forest health damage. Age is not a consideration.

General Guidelines:

- You need a minimum of **five plots per stratum** to do a statistical analysis.
- If the inventory or silviculture characteristics are highly variable, you must increase the sampling intensity to achieve the desired precision.
- One plot per hectare is considered the norm, but it is not a legal standard.
- There is no fixed maximum number of plots. However, 40 plots per stratum is usually considered a reasonable upper limit; adding more plots generally does not improve accuracy.
- There is no expectation to establish more than 1.5 plots per hectare unless the stratum is less than 3 hectares.
- More plots do not make up for poor stratification. Increasing the number of plots will not improve data quality if the stratification is weak.

Your sampling intensity must ensure the forest cover characteristics meet the Ministry's precision standards outlined in the RESULTS Information Submission Specifications.

Note: Additional plots may be needed if the initial sampling does not meet statistical precision targets or the RISS precision standards.

4.4 Selecting the Plot Size

Plot size affects the accuracy of the data you collect. Plot size must be consistent across a stratum. It must not change based on variations in tree density within the stratum.

Select a plot radius that will typically include four or more well-spaced crop trees at target stocking:

- Common plot radius: 3.99 m (50 m^2 area, plot multiplier of 200)
- Alternative plot sizes:
  - Larger plots (e.g., 5.64-m radius) should be used for strata with low density or highly variable stand conditions (e.g., complex vertical or horizontal stands).
  - Smaller plots (e.g., 2.52-m radius) may be suitable for broadleaf or mixedwood stands with high crop densities.

4.5 Choosing the Sampling Method

Choose the sampling method that is most appropriate for the opening layout, stand variability, legal threshold risk, contract requirements, and your experience level (Table 1).

TABLE 1. How to choose a sampling method

Sampling method	**When to use**
Grid sampling	• you are less experienced, • stand conditions are variable, • many plots are required, **or** • statistical analysis is needed
Vector sampling	• you are less experienced, • standards units are small (< 10 ha), narrow, or irregularly shaped, • only a few plots are required, **or** • statistical analysis is needed
Representative sampling	• you have 5+ years of experience, • stand conditions are uniform, • only a few plots are required, **and** • stocking status is obvious
Ocular assessment – walk-through	• you have 5+ years of experience, • stand conditions are uniform, • stocking status is obvious, **and** • statistical analysis is not needed
Ocular assessment – aerial	• you have 5+ years of experience, • stand conditions are uniform, • stocking status is obvious, • no forest health issues are expected, **and** • statistical analysis is not needed; **or** • safety or access makes ground-based surveys impractical

Hybrid ocular assessment – LiDAR or UAV-based photogrammetry[14]	• stocking status is obvious, **and** • no forest health or vegetation issues are expected; • highly suited for alternative survey methods (e.g., green-up surveys, commercial thinning, clustered stand structures)

Detailed procedures, considerations, and best practices for each sampling method are provided in Sections 4.5.1 through 4.5.5.

4.5.1 Principles of Sampling Design

The method you use to sample a stratum must provide survey results that are defensible, reproducible, and appropriate for the risk level and variability of the stand.

There are two broad categories of sampling methods:

1. Statistical (Structured) Methods: Grid and Vector Sampling

These methods are based on principles of statistical sampling. They:

- give all potential plot locations in the stratum an equal chance of being selected, and
- provide data that can be analyzed statistically (mean, standard deviation, standard error, and confidence limits).

Structured methods reduce bias, provide complete and even coverage of the stratum, and are generally required in variable or higher-risk strata, especially for free growing surveys.

2. Judgement-Based (Unstructured) Methods: Representative Sampling and Ocular Assessments

These methods do not use randomized or systematic plot selection and do not support statistical analysis. Their use depends on your professional judgement.

Use judgement-based methods only in low-risk, uniform strata, such as those with:

- a recent plot survey,

[14] This is emerging technology. If you plan to use LiDAR or UAV-based photogrammetry, contact silvsurveys@gov.bc.ca to discuss opportunities for its use, as well as its limitations and best practices. For more information, refer to Appendix 3.2 Hybrid Ocular Assessments.

- low forest health incidence and hazard,
- low basal area (< 5 m^2/ha),
- low species diversity, and
- consistent stocking.

Judgement-based methods are also appropriate for conducting non-legal surveys to:

- map brushing or juvenile spacing treatment areas,
- check the efficacy of brushing or juvenile spacing treatments, and
- confirm that an opening is on track for meeting free growing and the long-term objectives, and to schedule a final free growing survey.

Do not use judgement-based methods in strata that:

- are near minimum stocking thresholds
- have significant forest health concerns
- have highly variable inventory or silviculture attributes

These methods are also not suitable for less-experienced surveyors because there is higher risk of unintentional bias and misclassification.

Requirements when Using Judgement-Based Methods

If you use judgement-based methods, they must meet two conditions:

- A knowledgeable forest practitioner, using a different but appropriate sampling method, should reach the same conclusion you made about the stocking status and forest cover attributes of the stratum.
- The outputs must meet the RESULTS Information Submission Specifications, including the forest cover reporting requirements, precision standards, and stratification criteria.

If either of these conditions cannot be reliably met, you must use a structured sampling method instead.

4.5.2 Grid Sampling

Grid sampling is the most structured and commonly used sampling method. It provides systematic coverage of a stratum, sampling can be easily repeated, and the results can be defended statistically.

Key characteristics

- Plot locations are determined ahead of time.
- Systematic coverage of the stratum reduces the risk of bias.
- The surveyor can demonstrate full coverage of the stratum.
- Both low- and high-intensity sampling can be used.

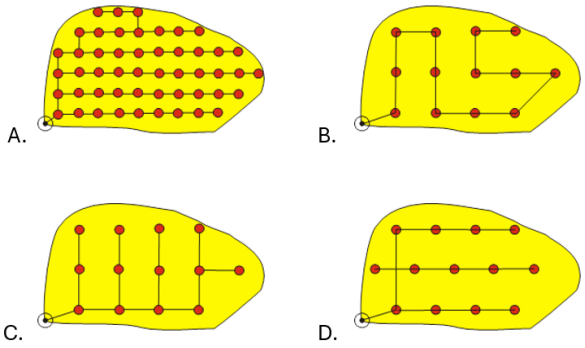


FIGURE 3. Examples of locating plots in a grid pattern.

4.5.3 Vector Sampling

Vector sampling is less structured than grid sampling. It is ideal for long, narrow, or irregular strata.

Key characteristics

- One or more straight-line “vectors” are established across the stratum.
- Plot spacing is determined based on the total length of the line.

Procedural summary

1. Complete the walk-through and stratification.
2. Estimate the required number of plots based on stocking and forest cover variability.
3. Draw vector lines on the map with as few direction changes as possible (≤ 2 changes are preferred).
4. Measure the total length of all vectors.
5. Calculate the distance between plots (total line length ÷ number of plots).
6. Establish plots at that fixed interval.

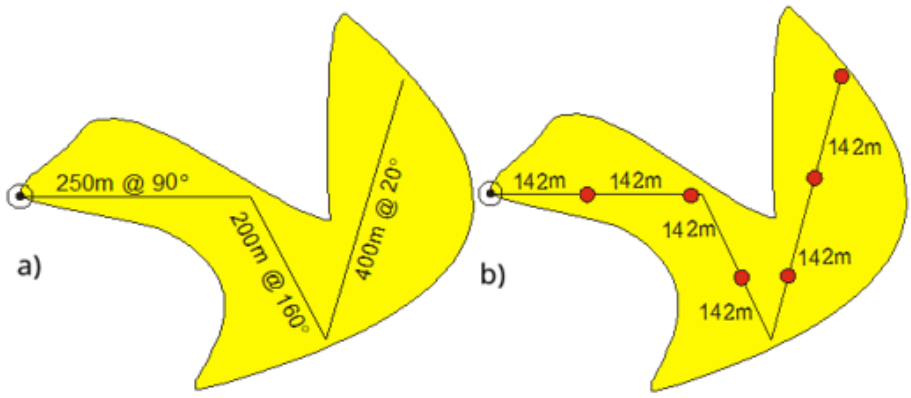


FIGURE 4. (a) Bearings and distances of plots along vectors; (b) locations of plots along vectors.

4.5.4 Representative Sampling

With representative sampling, the surveyor selects plot locations that they believe represent the stratum's conditions.

Procedural summary

1. Complete the walk-through and stratification.
2. Traverse the stratum.
3. Stop periodically and evaluate whether a plot at that location would represent the stratum.
    - If yes, establish the plot.
    - If no, continue.
4. If the plots repeatedly do not appear to be representative of the stratum, switch to grid or vector sampling.
5. Once at least five representative plots have been sampled, compile the results normally.

Note: Because plots are not placed randomly or systematically, you must avoid unconsciously selecting well-stocked or "easy" areas (e.g., open, low-brush, accessible terrain) or avoiding poorly stocked or challenging areas (e.g., rocky patches, dense brush, steep slopes). This can introduce bias and make it difficult for you to defend the survey results.

4.5.5 Ocular Assessments

Ocular assessments (also referred to as visual assessments) are a distinct sampling method. They should not be confused with the walk-through that is done before plot-based silviculture

surveys are conducted. Ocular methods rely primarily on visual estimation of forest cover attributes. No plots, or only a few, are established. These assessments can be conducted by walking the opening, using a drone (UAV), or flying over the area in a helicopter. Statistical validation is not applicable.

Sampling Suitability Matrix

When ocular assessments are completed by helicopter or drone, the accuracy of stocking determinations and forest covers can be reduced. To determine whether these aerial methods are suitable for a free growing assessment, the signing professional should complete the Aerial Assessment Suitability Matrix.

This tool assigns point values for access, safety, and stand conditions. It also helps professionals demonstrate due diligence when selecting a non-structured sampling method. The total score indicates whether it is reasonable to conduct an aerial ocular assessment or whether a structured (grid/vector) survey should be considered instead.

Watch the training video for instructions on how to complete the suitability matrix.

Recommended Best Management Practices (BMPs)

The following BMPs apply to ocular assessment methods. Their purpose is to reduce bias, increase reliability, and ensure surveys meet regulatory expectations.

Most recent survey

For the most recent legal or non-legal survey on the stratum:

- follow the “British Columbia Silviculture Survey Procedures Manual”;
- record forest health information; and
- meet the Results Information Submission Specifications (RISS) precision standards, reporting standards, and stratification criteria.

Surveyor qualifications

The surveyors should:

- have 5+ years of recent survey experience;
- be familiar with the region; and
- complete the latest “What’s New” training, either in-person or through online videos.

Office preparation

- Prepare a survey package that includes:
  - an inventory and silviculture label from the last survey
  - previously identified forest health factors and incidence
  - stocking standards
  - treatment history
  - ecology information
  - georeferenced block maps with standards units and survey strata
- If available, review recent imagery or a crown height model to identify low-stocking areas and predict tree heights.

Survey planning

- Do not complete free growing ocular surveys immediately after brushing treatments. Vegetation must recover before meaningful assessments can be made.
  - Wait 2 complete growing seasons: CWH, CDF, MH, ICH, IDF, MS, PP, BG, SBPS, ESSF
  - Wait 2 complete growing seasons after herbicide treatments/3 after manual treatments: SBS, BWBS
- For helicopter surveys, choose clear or high-cloud days. Avoid days with low cloud, high fog, or rain—these conditions reduce visibility and may prevent access to portions of the block.

Process

- If stocking is low (within 10% of the minimum stocking standard), forest health concerns are identified, or the forest cover cannot be confidently determined, switch to a grid or vector sampling method.
- Confirm the previous stratification. Is FPPR 46.11(2)(b) required?
- When estimating tree heights, consider:
  - average stump height
  - average brush height for the BEC subzone/variant
  - tree heights from the previous survey
  - average growth rates, by species, for the BEC subzone/variant

- Where possible, use drone surveys rather than helicopter surveys. Drones can fly at lower altitudes without disturbing herbaceous vegetation. As a result, species identification and visibility of smaller trees is better. Drones also capture high-quality imagery across the entire survey stratum. This allows stratification to be precise, and multiple surveyors can review images when making difficult decisions. Additionally, if issues such as low stocking, forest health concerns, or brush competition are identified, the survey crew is typically on-site, so they can verify results and collect ground-based data if needed.
- Complete a slow, low-altitude flight above each stratum.
    - If using a helicopter, ensure the pilot has prior experience completing silviculture survey flights.
- Take photos and/or video of each stratum.
    - For helicopter surveys, use an extension pole or handle grip to extend the camera or GoPro outside the helicopter. This minimizes window glare and blur.
- Mark photo numbers and directions on a paper map. Or, take a screenshot of the helicopter's location and direction using a digital mapping app before taking the stand photos.

Calibration: helicopter surveys

- The surveys should be conducted by two experienced, qualified surveyors to reduce individual bias.
- The surveyors should:
    - complete a visual assessment of a stratum that has undergone a recent plot survey to compare and calibrate data;
    - land in and walk through different survey strata with distinct subzone variants to calibrate the assessment, by checking densities and measuring tree and brush heights;
    - repeat calibration periodically, especially at the beginning of each survey day.
- If contracting aerial assessments to a consultant, specify the required calibration frequency in the bid package and the contract's schedule of services.

Calibration: drone surveys

- The surveyors should:
  - complete a visual assessment of a stratum that has undergone a recent plot survey to compare and calibrate data;
  - For planned sample blocks:
    - Fly over features of known sizes (e.g., surveyor, truck).
    - Field verify areas with potential issues.
    - Complete a brief walk-through.
    - Measure heights of representative trees for the leading and secondary inventory and silviculture species.

Review

- Review the collected data:
  - How does total density compare to the last survey?
    - If there has been a significant increase, have you noted natural ingress of a size and age that would make this reasonable?
    - If there has been a significant decrease, is it possible that you missed smaller trees that were obscured by larger trees? Or was there mortality? If yes, did you record the forest health information?
  - How does the inventory species composition compare to the last survey and the planting information? If there have been significant changes, can they be explained by:
    - natural ingress
    - mortality
    - changes in sampling procedures
    - species misidentification
    - species missed due to size
  - Do the silviculture and inventory ages seem reasonable, given the planting and harvest dates, and the ages collected during the last survey?
  - Are the tree heights reasonable, given regional growth rates, site index, and species?

    - Is the estimate of crown closure reasonable, given the heights, density, and crown size?
- Review the photographs/videos:
    - Are the collected data supported by the photographs/videos?
    - Does the previous stratification need to be modified?
- If the data do not seem reasonable, complete a ground check. Based on the outcome, a structured, formal ground survey may be required.

Audit

- For areas without significant safety or access concerns, complete an audit of 10% of the annual ocular assessment area using grid or vector sampling. Additional ground truthing is required if discrepancies exceed the precision standards outlined in the RISS.
- Ask other qualified professionals to review the visual assessment to confirm its accuracy.

Records

- Retain the photos, survey map, data, suitability matrix, etc. after the declaration and forest cover submission.
- Submit the silviculture survey activity to RESULTS. For helicopter or drone surveys, the Silv_Method_Code should be “HELI.”

Chapter 5: Documenting the Survey Setup (FS 657)

5.1 Recording Survey Data

Note: The guidance in this section applies to all silviculture survey forms used in this manual, including:

- **FS 657** — Survey Setup (Chapter 5)
- **FS 658** — Plot Data (Section 6.2.2)
- **FS 659** — Survey Summary (Section 7.2.2)

You can record survey data using an electronic data collection app, a spreadsheet, a field notebook, or the standard Ministry of Forests field cards. Regardless of the method you use, the results must meet the reporting and precision standards outlined in the RESULTS Information Submission Specifications.

If you use paper field cards, you must complete all required fields and calculations legibly and accurately. If a field does not apply, mark it with a "–" dash to show that you considered it and did not miss it.

You can buy the Ministry field cards through the Distribution Centre website or by calling 1-800-282-7955. The cards will be available through Supply BC in the near future.

The next pages describe what information to record on the field cards. Each field has a number that matches the headings that follow. Next to each field name, you'll see two letters separated by a slash ("/"). These letters show the importance of that field for each survey type: the letter on the left applies to regeneration delay surveys; the letter on the right applies to free growing surveys.

Example: H/L means the item is required—or is very important to record accurately—in a regeneration delay survey. In a free growing survey, it is not important and can be omitted.

TABLE 2. Importance ratings, by abbreviation

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 influences treatments being prescribed	% coarse fragments where site preparation is being recommended
L	Useful for a complete description of a stratum, but not necessary	Project identification; access (km)
O	Optional data; field provided for your convenience	Growth intercept sample data
N	Not required	Basal area factor for single-layered surveys; soil depth during a free growing survey

5.2 Filling out the FS 657

After completing the walk-through and finalizing the survey design, fill out the FS 657 Silviculture Survey General Site Info Card or equivalent fields in an electronic data collection app.

Many FS 657 fields can be completed using information from the site plan, opening file, corporate database, forest cover map, topographical map, biogeoclimatic map, regional field guide, and contract specifications.

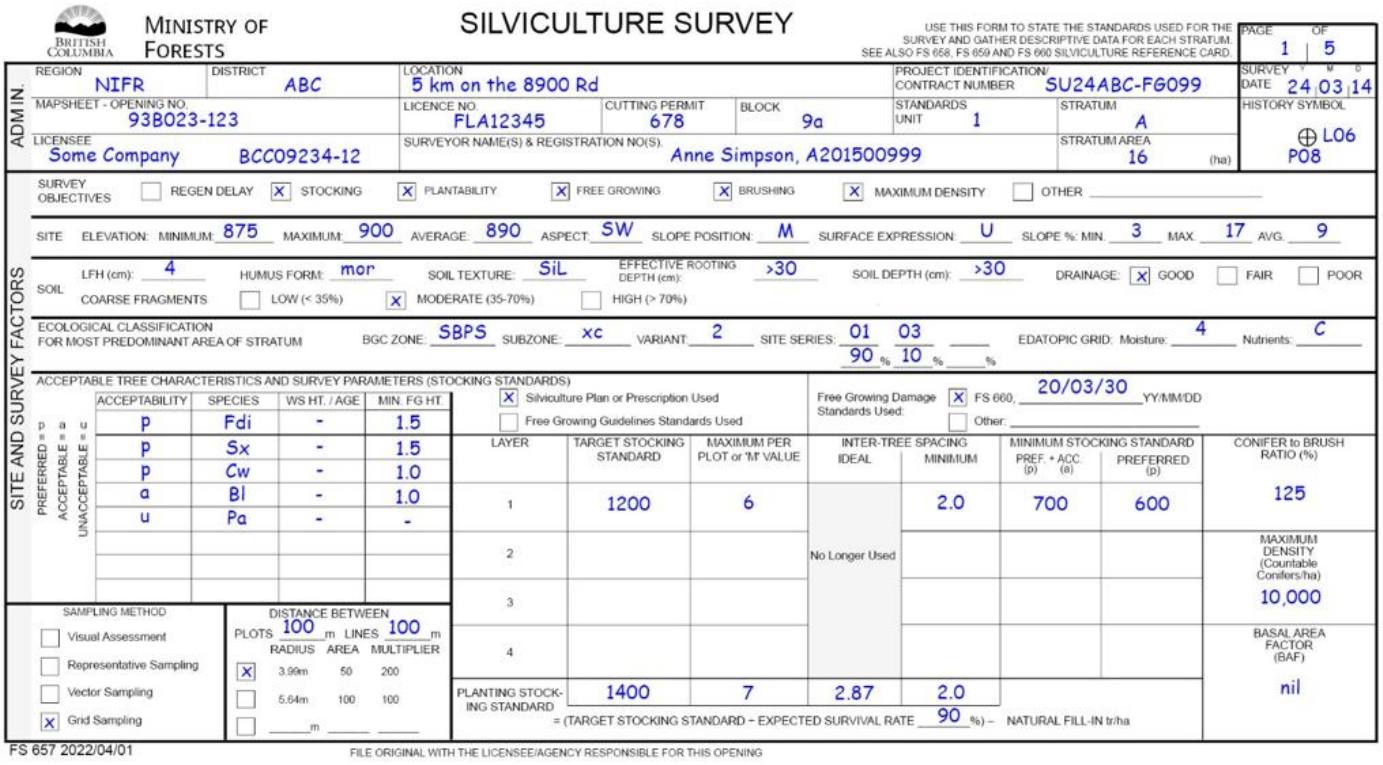
Some fields—such as brush, slash, site series, drainage, and soil properties—require confirmation or direct measurement during the walk-through. Use field checks to verify or update information when conditions have changed or source documents are incomplete.

Fields that must be completed include the block identifier, standards unit, stratum, stratum area, stocking standards, survey objectives, ecological classification, plot size, and basal area factor (if applicable).

Survey contracts may require extra fields. You may also need to record extra site details to support your recommendations for the standards unit.

When filling out the FS 657, you can use full terms or standard abbreviations.

Figures 5 and 7 show sample data. Figures 6 and 8 show the numbered fields.



MINISTRY OF FORESTS — 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

ADMIN.

REGION: NIFR	DISTRICT: ABC	LOCATION: 5 km on the 8900 Rd			PROJECT IDENTIFICATION/ CONTRACT NUMBER: SU24ABC-FG099	SURVEY DATE: 24 03 14
MAPSHEET - OPENING NO.: 93B023-123		LICENCE NO.: FLA12345	CUTTING PERMIT: 678	BLOCK: 9a	STANDARDS UNIT: 1	STRATUM: A
LICENSEE: Some Company BCC09234-12		SURVEYOR NAME(S) & REGISTRATION NO(S.): Anne Simpson, A201500999				STRATUM AREA: 16 (ha)

HISTORY SYMBOL: ⊕ L06 P08

SURVEY OBJECTIVES: [ ] REGEN DELAY [X] STOCKING [X] PLANTABILITY [X] FREE GROWING [X] BRUSHING [X] 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: [X] GOOD [ ] FAIR [ ] POOR

COARSE FRAGMENTS: [ ] LOW (< 35%) [X] 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

SITE AND SURVEY FACTORS

ACCEPTABLE TREE CHARACTERISTICS AND SURVEY PARAMETERS (STOCKING STANDARDS)

ACCEPTABILITY (p = PREFERRED, a = ACCEPTABLE, u = UNACCEPTABLE)	SPECIES	WS HT. / AGE	MIN. FG HT.
p	Fdi	-	1.5
p	Sx	-	1.5
p	Cw	-	1.0
a	Bl	-	1.0
u	Pa	-	-

[X] Silviculture Plan or Prescription Used
[ ] Free Growing Guidelines Standards Used

Free Growing Damage Standards Used: [X] FS 660, 20/03/30 YY/MM/DD [ ] Other:

LAYER	TARGET STOCKING STANDARD	MAXIMUM PER PLOT or 'M' VALUE	INTER-TREE SPACING IDEAL	INTER-TREE SPACING MINIMUM	MINIMUM STOCKING STANDARD PREF. + ACC. (p) (a)	MINIMUM STOCKING STANDARD PREFERRED (p)	CONIFER to BRUSH RATIO (%)
1	1200	6	No Longer Used	2.0	700	600	125
2							MAXIMUM DENSITY (Countable Conifers/ha)
3							10,000
4							BASAL AREA FACTOR (BAF)
PLANTING STOCKING STANDARD	1400	7	2.87	2.0			nil

= (TARGET STOCKING STANDARD − EXPECTED SURVIVAL RATE 90 %) − NATURAL FILL-IN tr/ha

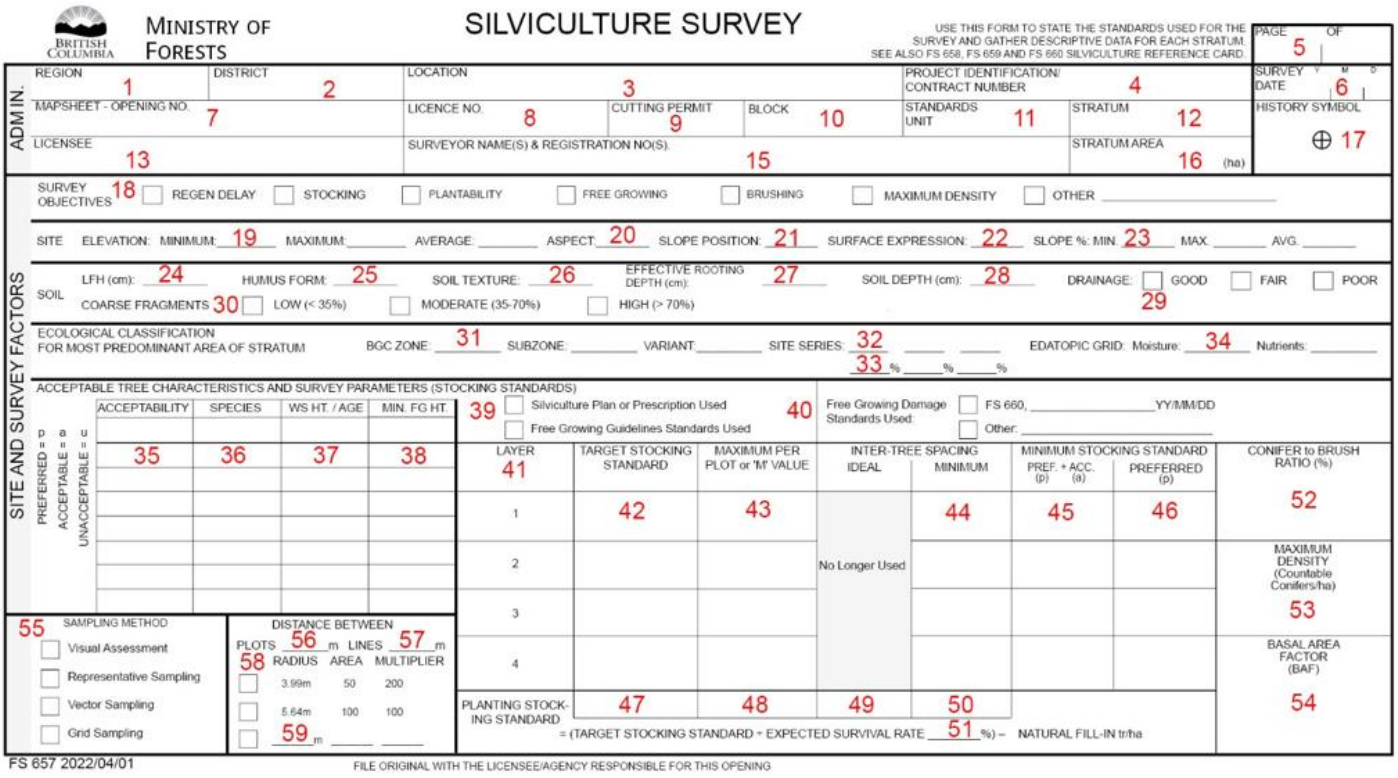
SAMPLING METHOD: [ ] Visual Assessment [ ] Representative Sampling [ ] Vector Sampling [X] Grid Sampling

DISTANCE BETWEEN PLOTS 100 m LINES 100 m

	RADIUS	AREA	MULTIPLIER
[X]	3.99m	50	200
[ ]	5.64m	100	100
[ ]	____m	____	____

FS 657 2022/04/01 — FILE ORIGINAL WITH THE LICENSEE/AGENCY RESPONSIBLE FOR THIS OPENING

FIGURE 5. FS 657 Silviculture Survey card, front side, with sample data.



MINISTRY OF FORESTS — 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

ADMIN.

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

HISTORY SYMBOL: ⊕ 17

SURVEY OBJECTIVES: 18 [ ] 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 29

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 ____ ____ 33 % ____ % ____ % EDATOPIC GRID: Moisture: 34 Nutrients: ____

SITE AND SURVEY FACTORS

ACCEPTABLE TREE CHARACTERISTICS AND SURVEY PARAMETERS (STOCKING STANDARDS)

ACCEPTABILITY (p = PREFERRED, a = ACCEPTABLE, u = UNACCEPTABLE)	SPECIES	WS HT. / AGE	MIN. FG HT.
35	36	37	38

39 [ ] Silviculture Plan or Prescription Used
[ ] Free Growing Guidelines Standards Used 40

Free Growing Damage Standards Used: [ ] FS 660, ____ YY/MM/DD [ ] Other:

LAYER 41	TARGET STOCKING STANDARD	MAXIMUM PER PLOT or 'M' VALUE	INTER-TREE SPACING IDEAL	INTER-TREE SPACING MINIMUM	MINIMUM STOCKING STANDARD PREF. + ACC. (p) (a)	MINIMUM STOCKING STANDARD PREFERRED (p)	CONIFER to BRUSH RATIO (%)
1	42	43	No Longer Used	44	45	46	52
2							MAXIMUM DENSITY (Countable Conifers/ha)
3							53
4							BASAL AREA FACTOR (BAF)
PLANTING STOCKING STANDARD	47	48	49	50			54

= (TARGET STOCKING STANDARD + EXPECTED SURVIVAL RATE 51 %) − NATURAL FILL-IN tr/ha

55 SAMPLING METHOD: [ ] Visual Assessment [ ] Representative Sampling [ ] Vector Sampling [ ] Grid Sampling

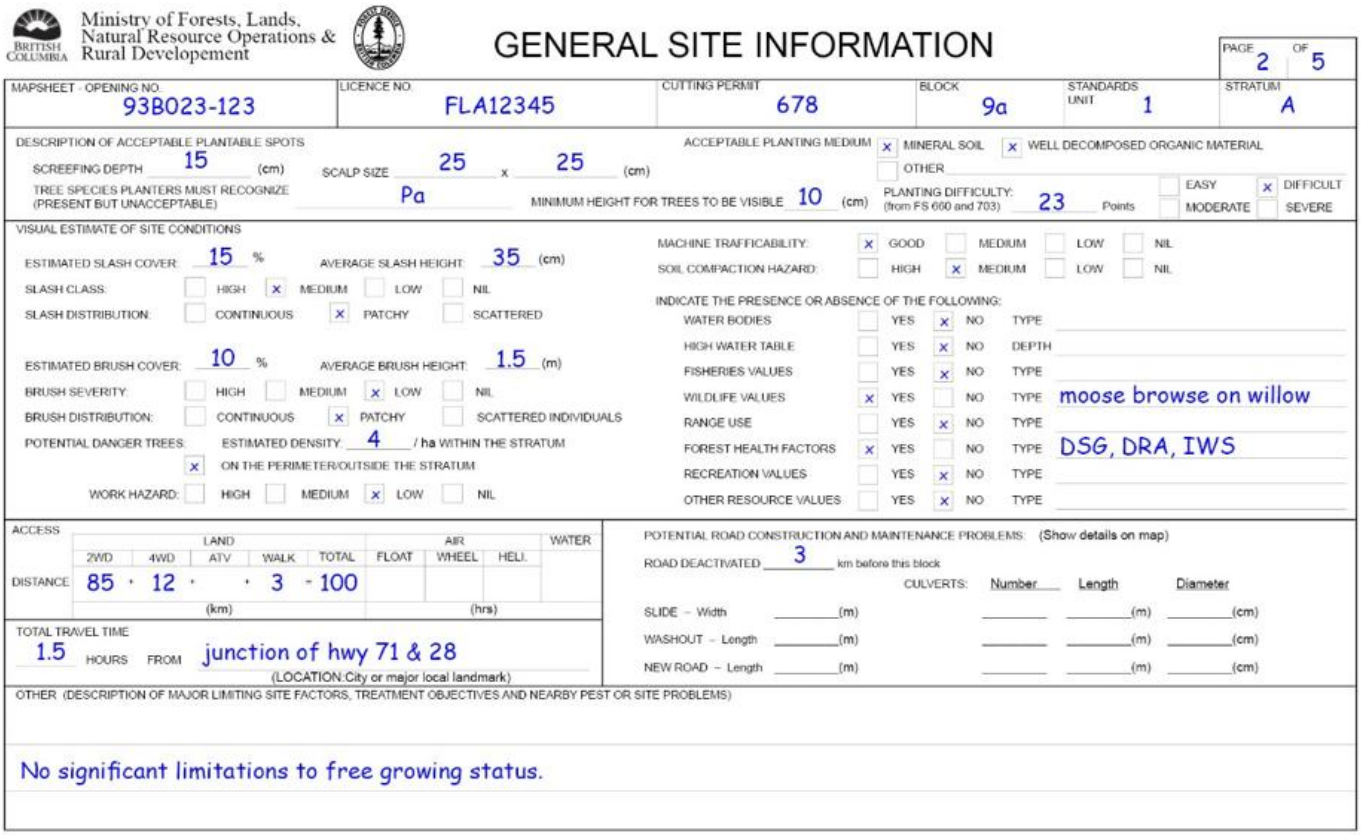
DISTANCE BETWEEN PLOTS 56 m LINES 57 m

58

	RADIUS	AREA	MULTIPLIER
[ ]	3.99m	50	200
[ ]	5.64m	100	100
[ ]	59 m	____	____

FS 657 2022/04/01 — FILE ORIGINAL WITH THE LICENSEE/AGENCY RESPONSIBLE FOR THIS OPENING

FIGURE 6. FS 657 Silviculture Survey card, front side, with field numbers.



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

GENERAL SITE INFORMATION

PAGE 2 OF 5

MAPSHEET - OPENING NO.	LICENCE NO.	CUTTING PERMIT	BLOCK	STANDARDS UNIT	STRATUM
93B023-123	FLA12345	678	9a	1	A

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 [x] MINERAL SOIL [x] WELL DECOMPOSED ORGANIC MATERIAL [ ] OTHER
PLANTING DIFFICULTY: (from FS 660 and 703) 23 Points [ ] EASY [x] DIFFICULT [ ] MODERATE [ ] SEVERE

VISUAL ESTIMATE OF SITE CONDITIONS
ESTIMATED SLASH COVER: 15 % AVERAGE SLASH HEIGHT: 35 (cm)
SLASH CLASS: [ ] HIGH [x] MEDIUM [ ] LOW [ ] NIL
SLASH DISTRIBUTION: [ ] CONTINUOUS [x] PATCHY [ ] SCATTERED

ESTIMATED BRUSH COVER: 10 % AVERAGE BRUSH HEIGHT: 1.5 (m)
BRUSH SEVERITY: [ ] HIGH [ ] MEDIUM [x] LOW [ ] NIL
BRUSH DISTRIBUTION: [ ] CONTINUOUS [x] PATCHY [ ] SCATTERED INDIVIDUALS
POTENTIAL DANGER TREES: ESTIMATED DENSITY: 4 / ha WITHIN THE STRATUM
[x] ON THE PERIMETER/OUTSIDE THE STRATUM
WORK HAZARD: [ ] HIGH [ ] MEDIUM [x] LOW [ ] NIL

MACHINE TRAFFICABILITY: [x] GOOD [ ] MEDIUM [ ] LOW [ ] NIL
SOIL COMPACTION HAZARD: [ ] HIGH [x] MEDIUM [ ] LOW [ ] NIL

INDICATE THE PRESENCE OR ABSENCE OF THE FOLLOWING:

WATER BODIES	[ ] YES	[x] NO	TYPE	
HIGH WATER TABLE	[ ] YES	[x] NO	DEPTH	
FISHERIES VALUES	[ ] YES	[x] NO	TYPE	
WILDLIFE VALUES	[x] YES	[ ] NO	TYPE	moose browse on willow
RANGE USE	[ ] YES	[x] NO	TYPE	
FOREST HEALTH FACTORS	[x] YES	[ ] NO	TYPE	DSG, DRA, IWS
RECREATION VALUES	[ ] YES	[x] NO	TYPE	
OTHER RESOURCE VALUES	[ ] YES	[x] NO	TYPE	

ACCESS

	LAND 2WD	4WD	ATV	WALK	TOTAL	AIR FLOAT	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)

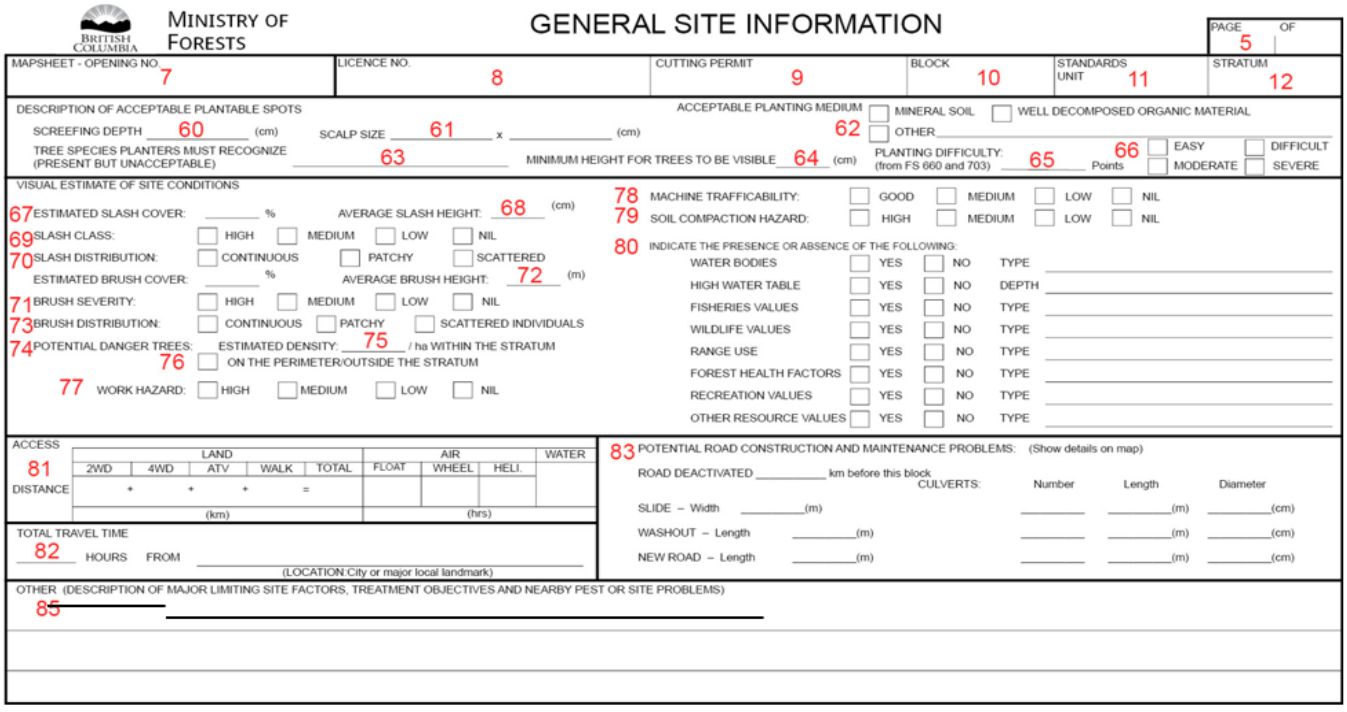
POTENTIAL ROAD CONSTRUCTION AND MAINTENANCE PROBLEMS: (Show details on map)
ROAD DEACTIVATED 3 km before this block

CULVERTS:	Number	Length	Diameter
SLIDE – Width		(m)	(cm)
WASHOUT – Length		(m)	(cm)
NEW ROAD – Length		(m)	(cm)

OTHER (DESCRIPTION OF MAJOR LIMITING SITE FACTORS, TREATMENT OBJECTIVES AND NEARBY PEST OR SITE PROBLEMS)

No significant limitations to free growing status.

FIGURE 7. FS 657 Silviculture Survey card, back side, with sample data.



MINISTRY OF FORESTS

GENERAL SITE INFORMATION

PAGE 5 OF

MAPSHEET - OPENING NO.	LICENCE NO.	CUTTING PERMIT	BLOCK	STANDARDS UNIT	STRATUM
7	8	9	10	11	12

DESCRIPTION OF ACCEPTABLE PLANTABLE SPOTS
SCREEFING DEPTH 60 (cm) SCALP SIZE 61 x (cm)
TREE SPECIES PLANTERS MUST RECOGNIZE (PRESENT BUT UNACCEPTABLE) 63 MINIMUM HEIGHT FOR TREES TO BE VISIBLE 64 (cm)

ACCEPTABLE PLANTING MEDIUM 62 [ ] MINERAL SOIL [ ] WELL DECOMPOSED ORGANIC MATERIAL [ ] OTHER
PLANTING DIFFICULTY: (from FS 660 and 703) 65 Points 66 [ ] EASY [ ] DIFFICULT [ ] 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
ESTIMATED BRUSH COVER: % AVERAGE BRUSH HEIGHT: 72 (m)
71 BRUSH SEVERITY: [ ] HIGH [ ] MEDIUM [ ] LOW [ ] NIL
73 BRUSH DISTRIBUTION: [ ] CONTINUOUS [ ] PATCHY [ ] SCATTERED INDIVIDUALS
74 POTENTIAL DANGER TREES: ESTIMATED DENSITY: 75 / ha WITHIN 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

	LAND 2WD	4WD	ATV	WALK	TOTAL	AIR FLOAT	WHEEL	HELI.	WATER
81 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)	(cm)
WASHOUT – Length		(m)	(cm)
NEW ROAD – Length		(m)	(cm)

OTHER (DESCRIPTION OF MAJOR LIMITING SITE FACTORS, TREATMENT OBJECTIVES AND NEARBY PEST OR SITE PROBLEMS)
85

FIGURE 8. FS 657 Silviculture Survey card, back side, with field numbers.

1. Region: L/L Record the region name or abbreviation. Consult the Forest Regions and Natural Resource Districts map.

2. District: L/L Record the district name or abbreviation.

3. Location: L/L Record the geographic location of the opening.

4. Project Identification/Contract Number: L/L If the survey is completed under a contract, record the project ID or contract number.

5. Page: L/L Record the page number. Use a clear, logical numbering sequence for all survey cards so the final report forms an organized package.

6. Survey date: H/H Record the date you collected the field data.

7. Mapsheet–Opening No.: H/H Record both the mapsheet number and the opening number. Together, they make up the full opening identifier.

8. Licence No.: H/H Record the licence number for the opening.

9. Cutting permit: H/H Record the cutting permit number assigned to the opening. Not every area has a cutting permit number.

10. Block: H/H Record the cut-block number assigned to the opening.

11. Standards Unit: H/H Enter the standards unit identifier (number or letter) exactly as shown in the site plan.

12. Stratum: H/H Use capital letters, numbers, or a combination of both. If the stratum matches the standards unit, use the same identifier to avoid confusion.

13. Licensee: H/H Record the name of the tenure holder responsible for reforestation.

15. Surveyor Name(s) & Registration No(s): H/H Record the name(s) of the surveyor(s) who completed the fieldwork. Include their Ministry of Forests silviculture survey accreditation number(s), if applicable.

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

17. History Symbol: L/L Record the stand-level treatment history using the symbols shown in Table 3. Add the last two digits of the year beside each code letter. For treatments completed in multiple years, add a comma between the years. For treatments occurring over multiple yeas, add a dash between the years. For example, L’12-13 P’13 RP’15,16.

TABLE 3. History symbols

Class symbol	Code	History or treatment
Disturbance	B	Wildfire/burn
	D	Disease
	F	Flooding
	I	Insect
	K	Fume kill
	L	Logging
	L%	Logged (10% increments)
	R	Site rehabilitation
	S	Slide
	W	Windthrow
Regeneration	P	Planted
	PL	Plant
	FP	Fill plant
	RP	Replant
	N	Natural
Stand Tending	F	Fertilization
	H	Hack and squirt
	J	Juvenile spacing
	M	Mistletoe control
	P	Pruning
	R	Conifer release
	S	Sanitation spacing
	T	Commercial thinning
	W	Brushing and weeding
Site Preparation	B	Broadcast burn
	C	Chemical
	G	Grass seeded
	H	Hand preparation
	RB	Range management burn
	S	Spot burn
	M	Mechanical
	MS	Mechanical and spot burn
	W	Windrow

18. Survey Objectives: H/H Check the box next to the applicable survey objective(s) for the survey.

19. Elevation: T/L Record the minimum, maximum and average elevation of the stratum in metres above sea level.

20. Aspect: T/L Record the direction the slope faces using any accepted format (abbreviation, degrees, or full term).

TABLE 4. Aspect and associated abbreviations

Abbreviation	Description	Approximate range of bearings
N	North	337.5–22.5º
NE	Northeast	22.5–67.5º
E	East	67.5–112.5º
SE	Southeast	112.5–157.5º
S	South	157.5–202.5º
SW	Southwest	202.5–247.5º
W	West	247.5–292.5º
NW	Northwest	292.5–337.5º
F	Flat	No identifiable aspect; associated with 0% slope
V	Variable	No consistent aspect; associated with rolling and broken topography

21. Slope Pos.: T/L Record the slope position. Use Table 9 in the FS 660 to identify the correct slope position from the visual example.

TABLE 5. Slope position abbreviations

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

22. Surface Expression: T/T Record the surface expression. Use Table 7 in the FS 660 to identify the correct surface expression from the visual examples.

TABLE 6. Surface expression abbreviations

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

23. Slope %: T/T Record the minimum, maximum, and average slope percentage.

24. LFH (cm): T/L Record the average LFH depth (from mineral soil to top of litter).

25. Humus Form: T/L Record the humus form of the organic layer: mor, moder, or mull.

26. Soil Texture: T/L Record the soil texture of the upper 10–30 cm. Use the texturing key in Section 12 of the FS 660.

27. Effective Rooting Depth (cm): T/L Record the depth of soil that is available for root development. Confirm by digging a soil pit, looking at road cuts, or observing root mats of wind thrown trees.

28. Soil Depth (cm): T/N Record the depth to bedrock or parent material.

29. Drainage: T/L Select the drainage class that best describes water movement through the soil.

TABLE 7. Drainage definitions

Good	• water freely drains into the soil profile • generally associated with coarse-textured soils
Fair	• intermediate

Poor	• water is likely to accumulate on the surface and/or result in surface flow • generally associated with fine-textured soils

30. Coarse Fragments: T/L Select the estimated percent of coarse fragments greater than 2 mm.

31. BGC Zone, Subzone and Variant: H/H Record the biogeoclimatic zone, subzone, and variant. If the field classification differs from the site plan and affects the stocking standards or site productivity, an amendment may be required.

32. Site Series: H/H Record the 1° (primary) site series that covers most of the stratum. Record the 2° (secondary) and 3° (tertiary) if present.

33. Site Series %: H/H If more than one site series occurs, assign a percent to each. Round to the nearest 10 percent. The total must equal 100 percent.

34. Edatopic Grid: L/L Record the moisture and nutrient coordinates using the edatopic grid of the corresponding biogeoclimatic subzone and site series.

35. Acceptability: H/H Enter P, A, or U for preferred, acceptable, or unacceptable species.

If there is no site plan, use the stocking standards provided by the District Manager. These may be set in a district species selection guideline.

36. Species: H/H List the species that correspond to the preferred, acceptable, and unacceptable categories in the stocking standards.

Include unacceptable species only when they appear to have potential as an acceptable species but are not currently listed as preferred or acceptable in the site plan. You do not need to list all unacceptable species —only those that could realistically be mistaken for acceptable species.

37. WS Ht./Age: H/N Record the minimum height and/or minimum age of well-spaced trees that count toward stocking at the regeneration date. These values are typically set by the district or licensee; they may not exist in all districts.

38. Min. FG Ht: L/H Record the minimum height a healthy, competition-free, well-spaced tree must attain to be considered free growing.

39. Silviculture Plan or Prescription Used/Free Growing Guidelines Standards Used: N/H Check the box for the standards used to assess competition. Select Free Growing Guidelines when using the Local Geographic Competition Assessment Criteria.

40. Free Growing Damage Standards Used: L/H Record the date or version number of the provincial Free Growing Damage Criteria or other standards used.

41. Layer: H/H For a single-layered stand with a regeneration obligation, enter stocking standards in Layer 4. For a single-layered stand without a regeneration obligation (e.g., commercial thinning), enter standards in Layer 1. For a multi-layer stand, enter standards by layer.

42. Target Stocking Standard/ha: H/H Record the target number of well-spaced or free growing trees per hectare.

43. Target Maximum/Plot: H/H Record the M-value calculated as the target stocking standard per hectare, divided by the plot multiplier.

44. Minimum Inter-Tree Spacing: H/H Record the minimum horizontal distance required between well-spaced or free growing trees.

45. Minimum Stocking Standard Preferred + Acceptable: H/H Record the minimum number of preferred and acceptable, well-spaced or free growing trees per hectare (MSSpa).

46. Minimum Stocking Standard Preferred: H/H Record the minimum number of healthy, preferred well-spaced or free growing trees per hectare (MSSp).

47. Planting Stocking Standard/ha: T/N Record the target number of planted trees per hectare. Calculate using the FS 657 formula near Field 51 or as directed by district or licensee policy. Round up to the next hundred. The contract should provide the number for the expected natural fill-in rate.

48. Planting Maximum/Plot: T/N Record the maximum number of plantable spots per plot. Calculate as planting stocking standard per hectare divided by the plot multiplier.

49. Planting Ideal Inter-Tree Spacing: T/N Record the ideal inter-tree spacing for planting.

50. Planting Minimum Inter-Tree Spacing: T/N Record the minimum inter-tree distance between planted and/or well-spaced trees. For fill plants or replants, the planting MITD will typically align with the minimum inter-tree spacing in the stocking standards.

51. Expected Survival %: T/N Record the expected survival of the planted species or combined mix. Use contract or district guidance, or local 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.

52. Conifer to Brush Ratio (%): N/H Record the conifer-to-brush ratio[15]. If there is no ratio, ask the project manager how to assess competition at free growing.

53. Maximum Density (countable conifers/ha): T/H Record the maximum allowable density of countable conifers. Refer to the Maximum Density section.

54. Basal Area Factor (BAF): H/H Record the BAF used for prism or angle gauge sweeps.

55. Sampling Method: H/H Check the sampling method used in this stratum.

56. Distance between Plots (m): H/H Record the average distance between plots in metres. This is required only for grid and vector sampling.

57. Distance between Lines (m): O/O Record the average distance between strip lines in metres, if hanging strip lines.

58. Plot Radius (m), Area, Multiplier: H/H If you are not using a 3.99-m or 5.64-m radius plot, enter the plot radius you are using. Record the corresponding plot area and plot multiplier.

59. Plot Radius (m), Area, Multiplier: H/H If you are using a standard plot size, check the box for 3.99 m or 5.64 m. The associated plot area and plot multiplier are pre-defined on the FS 657.

60. Screefing Depth: T/N Record the maximum depth required for the planter to remove organic matter from a spot to prepare it for planting.

61. Scalp Size: T/N Record the maximum scalp size required for the planter to remove organic matter from a spot to prepare it for planting. Consider vegetation competition and soil nutrient status.

62. Acceptable Planting Medium: T/N Record the acceptable planting medium.

63. Tree Species Planters Must Recognize: T/N Record the tree species that planters must recognize and space off or plant near, as directed.

64. Minimum Height for Trees to be Visible: T/N Record the minimum tree height that planters are expected to see and potentially space off during planting. Consider the height of the surrounding vegetation.

65. Planting Difficulty Points: T/N Record the planting difficulty points for the stratum. This can be calculated using Table 10 on the FS 660 card.

[15] If using the South Interior alternate competition assessment criteria, record the brush-to-conifer ratios.

66. Planting Difficulty: T/N Check the average planting difficulty class.

67. Estimated Slash Cover %: T/T Record the estimated percent of ground covered by slash and debris, averaged across the stratum.

68. Average Slash Height (cm): T/T Record the average slash height.

69. Slash Class: T/T Check the appropriate slash class.

70. Slash Distribution: T/T Record whether slash is continuous, patchy, or scattered.

- 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 cover of competing vegetation.

72. Average Brush Height (m): T/H Record the average brush height.

73. Brush Severity: T/H Check the appropriate brush severity category.

74. Brush Distribution: T/H Record brush distribution as continuous, patchy, or scattered.

- Continuous*:* brush is spread evenly over the stratum.
- Patchy*:* brush-free areas cover roughly 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 that are more than 5 metres tall per hectare.

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

77. Work Hazard: T/T Record the estimated hazard that danger trees pose to workers. Add a brief note on danger tree distribution if useful; for example, “south corner only,” “none in block,” or “many on perimeter.”

78. Machine Trafficability: T/T Check the machine trafficability class. Consider slope, slash, soil moisture, residuals, and drainage patterns.

79. Soil Compaction Hazard: T/T Record the soil compaction hazard rating. Use the soil compaction hazard key in Section 13 of the FS 660 card.

80. Resource Values: T/T Check the presence or absence of listed resource values.

81. Access: T/T Record the distance in kilometres or travel time from a known location. List each mode of travel.

82. Total Travel Time: T/T Record the total travel time in hours to the nearest quarter hour. Identify the nearest readily recognizable location, such as a town, village, camp, or similar.

83. Potential Road Construction and Maintenance Problems: T/T Record any observed or anticipated issues for upgrading, construction, or reconstruction of access. If the access road is deactivated, check the box and estimate the deactivated length from the start of deactivation to the opening.

85. Other: L/L Use this field for general comments about the stratum; for example:

- defining characteristics
- key limiting factors for free growing;
- average snow depth at survey time;
- ribbon colours used; and
- preliminary treatment recommendation(s).

Chapter 6: Establishing Plots and Collecting Data

6.1 Establishing Plots

6.1.1 Plot Types

There are two types of plots: count plots and full measure plots.

Count plots are simpler and happen more frequently (e.g., Plots 2, 3, 4, 6, 7, 8, 10).

The following data attributes are collected at count plots:

- Total stems by species
- WS by species
- FG by species
- Forest health (if applicable)
- Number “In” (if applicable)
- Countable height/conifers (if applicable)
- Germinants (if applicable)
- Plantable spots (if applicable)
- Preparable spots (if applicable)

Full measure plots capture the attributes of a count plot, plus:

- Inventory heights
- Inventory ages
- Crown closure
- Silviculture height(s)
- Silviculture age(s)
- Ground vegetation
- Swiss needle cast data (Coast region, if applicable)
    - Leader growth
    - Needle retention by year

Full measure plots happen at the first plot and every fourth plot thereafter (e.g., Plots 1, 5, 9, 13).

Height and age measurements will sometimes happen at count plots when the target species is not present at the full measure plot.

6.1.2 Rules for Plot Placement

- You must establish your plots entirely within the net area to be reforested, as defined by the site plan and any approved amendments. Mappable reserves or retention areas, and non-productive[16] areas are excluded from the net area to be reforested.
- If a pre-established plot centre falls outside the net area to be reforested, is on non-productive ground, or cannot be safely established, you must relocate the plot or eliminate it.
- If you need to relocate a plot, offset it once by 10 m on a north bearing, or as specified in the contract.
- If there is still a placement issue after you have applied this offset, drop the plot. Continue surveying using the original sampling design. Do not survey from the offset plot location.

6.2 Plot Data Collection

6.2.1 Step-by-step procedure

After filling out the FS 657, establish survey plots in the field.

Steps 1–4 must be completed at every plot.

1. **Set up the plot**
   - Go to the plot location.
   - Mark the centre of the plot with a shovel, hiking pole, or other sturdy marker.
   - Swing the plot cord[17] for the chosen radius.
2. **First pass around the plot: count all trees**

   Count all living trees in the plot by species.
   - Include:
     - all conifer and broadleaf tree species listed in the FS 660 or RESULTS tree list

[16] Land that is incapable of growing a merchantable stand within a reasonable length of time; e.g., roads, quarries, pipelines, rock outcrops, swamps.

[17] Periodically measure the plot cord length using a measuring tape to confirm it is accurate. Plot cords can stretch or shrink over time, which can affect plot size and survey results.

- both acceptable and unacceptable quality trees

- Exclude:
  - germinants
- Special cases:
  - If a germinant is counted as a well-spaced tree, record it in the total tree tally. Do not record the same tree under the germinant field.
  - Broadleaf stump sprouts: count each stem originating from the stump as a separate tree.
  - Forked trees (see Section 9.5 of this manual):
    - fork below breast height → count as 2 trees
    - fork at or above breast height → count as 1 tree
    - If the pith intersects below the point of germination, count as 2 trees (this is not a fork).

3. Record forest health factors[18] by tree species and status (live/dead)

Check every tree in the plot for damage from biotic[19] and abiotic[20] factors. If there is damage from more than one factor, record only the most damaging factor for each tree.[21] The damage you should record depends on the survey type:

Free growing surveys:

- Record forest health damage that meets the "unacceptable" threshold from the FS 660 free growing damage criteria[22].
- Do not record damage that does not meet the unacceptable threshold.

[18] Use forest health codes from Table 21 of the FS 660.
[19] Biotic factors include fungi, insects, plants, animals, bacteria, and nematodes.
[20] Abiotic factors are caused by non-living factors, including drought, wildfire, wind, hail, frost, mechanical damage, extreme temperatures and snow-press.
[21] Refer to Section 9.13 for guidance on ranking forest health factors.
[22] There are different damage criteria for: even-aged conifer stands, advance regeneration, broadleaf trees, multi-layered stands managed under selection systems, and multi-layered stands surveyed using CEDR, DFP, Layered, or Commercial Thinning/Intermediate Cut methods. Select and use the appropriate criteria for the tree and stand conditions.

Regeneration delay surveys:

- Do not use the free growing damage criteria.
- All damage is reportable, unless it is very minor.
- A tree has very minor damage only if it meets all of the following:
  - no wounds, galls, cankers, root damage, or mistletoe,
  - good foliage colour and normal needle retention for its species and age,
  - normal growth (both height and diameter for its age), and
  - a living leader.

Trees with reportable damage may still be counted as well-spaced. However, do not count a tree as well-spaced if the damage is likely to prevent it from reaching free growing (e.g., a rust canker or gall on the main stem).

4. **Second pass around the plot: well-spaced and free growing**
   - Tally the number of well-spaced trees by species (including trees above the M-value[23]).
   - Tally the number of free growing trees by species (including trees above the M-value).
5. **Third pass around the plot: other tallies (if survey objectives require them)**
   - Tally the number of germinants.
   - Tally the number of plantable spots.
   - Tally the number of preparable spots.
   - Tally the number of countable conifers (refer to Section 9.2 of this manual).

Step 6 is completed only at every fourth plot (Plots 1, 5, 9, 13…)

6. **Additional measurements**
   - Inventory heights and ages (refer to Section 9.6 and 9.7 of this manual): Measure the height and age of the tallest[24] living tree (excluding residuals[25]) in the plot for the stratum's leading inventory species[26] and the second inventory species.

[23] M-value = target stocking standard/plot multiplier.

[24] Determine the tallest tree visually; do not measure every tree.

[25] Residuals are trees that have been left standing post harvest.

[26]The leading and second inventory species are determined at the stratum level. For Layers 2–4 (understorey), they are based on total density. For Layer 1 (overstorey), they are based on total basal area.

- Silviculture heights and ages (refer to Section 9.6 and 9.7 of this manual):
  - Regeneration delay or stocking survey: measure the height and age of one representative[27] well-spaced tree of the stratum's leading well-spaced species.
  - Stocking or free growing survey: measure the height and age of one representative free growing tree of the stratum's leading free growing species.
- Estimate crown closure for all living trees (refer to Section 9.10 of this manual).
- Estimate percent cover and average height for herb, shrub, and broadleaf species that could affect crop species.
- If requested, estimate percent cover of all specified forage, invasive, edible, or culturally important species.

7. **Mark the plot centre (**refer to Section 9.14 of this manual)
   - Flag in two places:
     - at the exact centre used to measure the plot radius (e.g., place the flagging tape in the shovel slit and/or tie it to a stick inserted into the shovel slit), and
     - on a high point to provide visibility (e.g., tied to a nearby tree or shrub).
   - Record the GPS coordinates for the plot centre and label the point with the plot name.
8. **Move to the next plot**

   Repeat Steps 1–7.
9. **Take photos**
   - Take photos according to the contract requirements. This generally includes photos that show:
     - representative stratum conditions
     - anything that may require later identification, such as unknown forest health factors
     - the treatment area and performance of the crop trees if treatments like brushing have been prescribed.
   - Label the photos with the block, stratum, and plot number, where possible.

[27] The silviculture sample tree should be representative of the well-spaced or free growing trees within the plot and immediate area. If no representative well-spaced or free growing tree of the leading species is present in the plot, select one within 10 m of plot centre. If none are available, skip the measurement and complete it at the next plot.

6.2.2 FS 658 Fields

Enter data in the FS 658 Silviculture Survey Plot Card, an Excel template, or a data collection app. Figures 9 and 10 show sample data and field numbers.

MINISTRY OF FORESTS — SILVICULTURE SURVEY PLOT CARD

SURVEYOR NAME(S) & REGISTRATION NO(S): Anne Simpson, A201500999 | SURVEY DATE Y 23 M 02 D 16 | PAGE 3 OF 5

MAPSHEET-OPENING NO.: 93B023-123 | LICENCE NO.: FLA12345 | CUTTING PERMIT: 678 | BLOCK: 9a | STANDARDS UNIT: 1 | STRATUM: A

PLOT NO.	STRATUM	DATA TYPE OR LAYER	COUNT CON.	COUNT HEIGHT (m)	Fdi p	Sx p	Cw p	Bl a	Pa u	At u	TOTALS	STRATUM'S INV/SILV SPP #1	INV / SILV SPP #1 HT	INV/ SILV SPP #1 AGE	STRATUM'S INV SPP #2	INV/ SPP #2 HT	INV/ SPP #2 AGE	INV CRWN CLSR	PLANTABLE	PREPARABLE	GERMINANTS "N" NUMBER	GROUND VEGETATION SPECIES	% COVER	HT (m)	FOREST HEALTH PEST CODE	TREE SPECIES AND # AFFECTED LIVE TREES	DEAD TREES
1	A	T	36	1.3	29	2	15	9	-	26	81	Fdi	1.7	12	At	1.6	11	21	1	-	6	At	23	2.0	DRA	1Fdi, 1Bl	1Fdi
		W			3	1	-	1	-	-	5	-	-	-	-	-	-	-	-	-	-	Rubu par	10	1.5	AD	1Fdi	-
		F			3	1	-	Br	-	-	4	Fdi	1.6	12	-	-	-	-	-	-	-							
2	A	T	29	0.8	21	12	2	6	-	17	58	-	-	-	-	-	-	-	1	1	0	At	50	2.2	IWW	1Sx	-
		W			1	1	2	-	-	-	4	-	-	-	-	-	-	-	-	-	-				DRA	-	1Sx
		F			1	1	2	-	-	-	4	-	-	-	-	-	-	-	-	-	-						
3	A	T	41	1.1	21	12	12	1	-	15	61	Fdi	1.6	12	At	1.6	11	20	1	-	0	Sali spp.	15	2.0	DRA	1Fdi, 1Sx	1Fdi
		W			3	1	2	1	-	-	M	-	-	-	-	-	-	-	-	-	-						
		F			2 & 1Ht	1	1 & 1Ht	-	-	-	4	Fdi	1.5	12	-	-	-	-	-	-	-						
4	A	T	38	1.5	22	11	1	5	-	16	55	-	-	-	-	-	-	-	1	-	3	At	40	2.1	DRA	1Fdi, 1Sx	-
		W			3	2	1	-	-	-	M	-	-	-	-	-	-	-	-	-	-				AD	1Fdi	-
		F			3	1 & 1Ht	1	-	-	-	5	-	-	-	-	-	-	-	-	-	-						
5	A	T	32	1.3	27	1	5	6	1	19	59	Fdi	1.7	14	At	1.7	13	15	1	-	2	Sali spp.	20	2.4	DRA	1Fdi, 1Bl	1Fdi
		W			4	1	1	1	1	-	<- 1 nice looking Pa is u	M	-	-	-	-	-	-	-	-	-	Rubu par	20	1.4			
		F			4	1	Br	1	-	-		M	Fdi	1.5	12	-	-	-	-	-	-						

Notes: Plot 1-The well spaced are clusted to one side so there is still one plantable spot. Plot 2-no signs of repression in the conifers.
Plot 5-Willow is being browsed. The remaining well spaced Fdi and Sx will outgrow the minor willow competition in 2 or 3 years. Pa looks good but is unacceptable species.
FS 658 2023/04/01 A brushing treatment is not required. Moose browse on the willow.

FIGURE 9. FS 658 Silviculture Survey Plot card, with sample data.

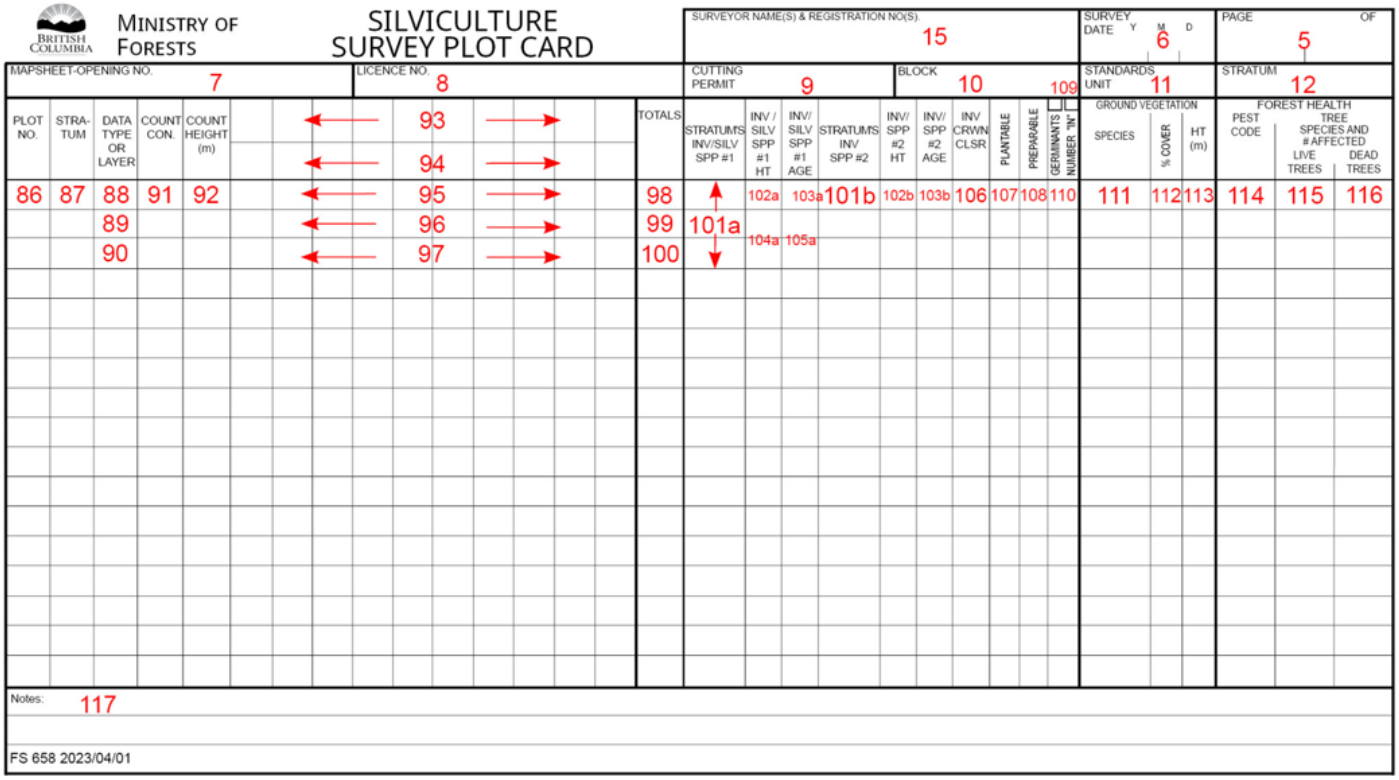


FIGURE 10. FS 658 Silviculture Survey Plot Card, with field numbers.

86. Plot No.: H/H Record the plot number.

87. Stratum: H/H Identify the stratum the plot is located in.

88. Data Type or Layer - "T": H/H Enter "T" for total trees. If the plot has multiple layers, enter a separate row for each applicable layer (e.g., T1, T2, T3, T4).

89. Data Type or Layer - "W": H/H Enter "W" for well-spaced trees. If the plot has multiple layers, enter a separate row for each applicable layer (e.g., W1, W2, W3, W4).

90. Data Type or Layer - "F": L/H Enter "F" for free growing trees. If the plot has multiple layers, enter a separate row for each applicable layer (e.g., F1, F2, F3, F4).

91. Count. Conifers: T/H Record the number of countable conifers in the plot (refer to Section 9.2).

92. Count. Height: T/H Record the height of countable conifers in the plot (refer to Section 9.2).

93. Blank (no title): H/H List all tree species present within the stratum. Prepare all cards for the stratum using the same column order to avoid data summary errors.

94. Blank (no title): H/H For each tree species listed in Field 93, enter P, A, or U (preferred, acceptable, or unacceptable), as defined in Field 35 of the FS 657. For any species not listed under Field 35, enter U.

95. Total Trees: H/H Tally the total number of living trees, by species, in the plot. Include all conifer and broadleaf species listed in Table 6 of the FS 660 or in the RESULTS tree list. Count both acceptable and unacceptable quality trees.

96. Well-spaced trees: H/H Tally the total number of well-spaced (WS) trees, by species, in the plot.

- Preferred (P) versus acceptable (A): First, ensure the plot meets the MSSp[28] with P trees, then select P and A species interchangeably to maximize WS.
- Maximize WS: In regeneration delay and stocking surveys, maximize the number of WS trees in each plot. Record all WS trees, even if the count exceeds the M-value for the plot.
- Unacceptable (U) species: You may tally U species as WS, but they do not count toward WS statistics. Tally them after maximizing with P and A; these data support treatment recommendations or potential amendments to add the species as acceptable.

97. Free Growing Trees: L/H Tally the free growing trees, by species, in the plot. Apply the same selection rules as Field 96 (P versus A, maximizing counts, U species) but to FG trees.

98. Totals (Total Trees): H/H Record the sum of the total tree tallies, by species (Field 95).

99. Totals (WS): H/H Record the sum of well-spaced trees in the plot, up to the M-value. If the total meets or exceeds the M-value, record “M”. Do not include unacceptable species in this field.

100. Totals (FG): N/H Record the sum of free growing trees in the plot, up to the M-value. If the total meets or exceeds the M-value, record “M”. Do not include unacceptable species in this field.

[28] If there is no MSSp or MSSpa = MSSp, select P and A interchangeably to maximize WS.

101a. Stratum's INV/SILV SPP #1: O/O Record the stratum's leading species for the applicable data type (T, W, F) and layer (1, 2, 3, 4).

If the leading silviculture species for the stratum is unclear during your walk-through, collect silviculture heights and ages for each of the potentially leading species. Average these measurements by species and report to RESULTS.

If the leading or secondary inventory species for the stratum is unclear during your walk-through, collect inventory heights and ages for each of the potentially leading and secondary inventory species. Average these measurements by species and report them to RESULTS.

While optional, collecting and reporting silviculture heights and ages for non-leading species has several benefits. Species-specific height and age information can be used to:

- compare free growing heights to the minimum height requirements in the stocking standards
- predict when each species is likely to reach free growing
- better understand growth rates by species

Use the same sample tree for both the height and age measurement.

102a. Inv SPP #1 Height (m): H/H Select the tallest living tree (excluding residuals) of the stratum's leading inventory species within the plot. Measure and record its height. Refer to Section 9.6 of this manual.

103a. Inv SPP #1 Age: H/H Record the age of the same tree used in Field 102a. Refer to Section 9.7 of this manual.

101b–103b. Stratum's Secondary Species: O/O Follow the same instructions as above for the second most abundant species in the stratum.

104a. Silv SPP #1 Height (m): H/H Record height as follows:

- Regeneration delay or stocking surveys: measure one representative well-spaced tree of the stratum's leading WS species.
- Free growing surveys: measure one representative free growing tree of the stratum's leading FG species.

The sample trees should be representative of the well-spaced or free growing trees within the plot and immediate area. If no representative well-spaced or free growing tree of the leading species is present in the plot, select one within 10 m of plot centre. If none are available, skip the measurement and complete it at the next plot.

105a. Silv SPP #1 Age: H/H Record the age of the same tree used in Field 104a.

106. Crown Closure (%): H/H Record crown closure of the living trees. Refer to Section 9.10.

107. Plantable: T/N Record the number of plantable spots in the plot—that is, microsites that are suitable for planting without site preparation. If the count meets the planting M-value (Field 48), enter M.

Use the same criteria that planters will use (Fields 60–62 on FS 657), and consider soil moisture, soil temperature, soil nutrients, LMH type and depth, climatic conditions, tree species, and the stock type to be planted.

108. Preparable: T/N Record the number of preparable spots—that is, microsites that are not suitable at present but will be acceptable with site preparation. Preparable spots are tallied separately from plantable spots.

109. Germinants/Number "In" Check Box: T/N or H/H Check Germinants or Number "In":

If germinants is checked, record the number of germinants in the plot. A germinant is a $\leq$ 5 cm natural (disregarding the loss of height due to a forest health factor). Age is not a consideration. Planted seedlings that are less than 5 cm, or well-spaced trees of any size, are counted under total trees (Field 95), not germinants (Field 110).

If Number "In" is checked, record the number of Layer 1 trees "In" the prism or angle gauge sweep. This is required when basal area is part of the stocking standard or Layer 1 retention is > 5 m^2/ha.

111. Ground Vegetation—Species: T/H Record herb, shrub, and broadleaf species in and around the plot. At minimum, list competing vegetation and invasive species. You may also record forage, edible, medicinal, or culturally important species if relevant to the survey objectives.

Section 8 of the FS 660 outlines a vegetation-abbreviation system that is consistent with the Vegetation Resources Inventory. The use of this system is recommended but not required. Under this convention, the abbreviation includes the first four letters of the genus, followed by the first three letters of the species. E.g., Rubus spectabilis becomes Rubus spe.

112. Ground Vegetation—% Cover: T/H Record the average percent cover of each vegetation species (visual estimate).

113. Ground Vegetation—Height (m): T/H Record the average height (visual estimate) for each vegetation species.

114. Forest Health—Pest Code: H/H At **every** plot, record pest/damage codes for the forest health factors observed in the plot (free growing: only those meeting the unacceptable threshold; regeneration delay: all damage unless very minor). Consider forest health damage on **all** trees within the plot, not just well-spaced or potentially free growing trees.

If there are multiple forest health factors on the same tree, record only the one with the longer-term and/or more damaging impact (refer to Section 9.13).

Use the damage agent code table for the full list of forest health factors and their corresponding codes.

There is a key reporting difference between free growing and regeneration delay.

Free growing surveys: Tally only those forest health factors that meet the unacceptable threshold in the free growing damage criteria (see FS 660). Do not tally damage that does not meet the unacceptable threshold.

Regen delay surveys**:** The free growing damage criteria do not apply. Tally all forest health factors (maximum of one per tree) except where damage is very minor. Damage is “very minor” only if all of the following are true: no wounds, galls, cankers, root damage, or mistletoe; good foliage colour and normal needle retention for the species and tree age; normal height and diameter growth for the tree age; and a living leader is present. If any condition is not met—or is unclear—record the damage.

Trees with reportable damage may still be counted as well-spaced unless the damage will prevent the tree from attaining free growing (e.g., a rust canker or gall on the main stem). Do not tally forest health damage on germinants.

Examples:

Browse does not need to be recorded for a 4-year-old Fdc with a single browsed branch and otherwise normal growth and colour, and a normal leader.

IWC damage must be recorded for a 2-year-old Fdc that is partially girdled by the conifer seedling weevil (IWC) and has chlorosis and poor leader growth.

Stocking surveys: If the stand is at an age/height where it could be free growing, record only unacceptable damage per the free growing criteria (as in free growing surveys). If free growing trees will not be tallied, record all forest health factors (as in regeneration delay surveys).

115. Forest Health—Live Trees: H/H Record the number of live trees affected by the forest health factor listed in Field 114.

116. Forest Health—Dead Trees: H/H Record the number of dead trees affected by the forest health factor listed in Field 114.

117. Notes: L/L Record any site-specific information relevant to the survey or treatment recommendations. Examples include: tree cover pattern, leader height, local anomalies.

Chapter 7: Compiling the Data

After you have finished collecting the field data, compile and summarize the survey results to determine whether the stand meets stocking standards, and to complete the required reporting.

7.1 Wrapping Up the Block

Before compiling the data:

1. Compare maps across surveyors. Was there complete coverage? Were any areas missed?
2. If stratification or treatments are required, have they been mapped out?
3. Have you completed the minimum required number of plots per stratum to do the statistical analysis?

7.2 Compiling the Data

7.2.1 Step-by-Step Compilation Procedure

For each stratum, calculate the following:

1. Inventory species composition: Sum the total tree counts by species across plots. For each species, divide the species sum by the total tree count (all species, all plots) and multiply by 100.
2. Silviculture species composition, well-spaced: Sum the well-spaced tree counts (disregarding M-value) by species across plots. For each species, divide the species sum by the total well-spaced count (all species, all plots) and multiply by 100.
3. Total trees per hectare: Sum the total tree counts across species and plots. Multiply the sum by the plot multiplier and divide by the number of completed plots.
4. Total basal area: Sum the number “In” Layer 1 trees across species and plots. Multiply the sum by the plot multiplier and divide by the number of completed plots.
5. Total well-spaced per hectare: Sum the total well-spaced (disregarding the M-value) counts across plots. Multiply the sum by the plot multiplier and divide by the number of completed plots.

6. Total free growing: Sum the total free growing (disregarding the M-value) counts across plots. Multiply the sum by the plot multiplier and divide by the number of completed plots.
7. Well-spaced per hectare: Sum the well-spaced (M-capped) counts across plots. Multiply the sum by the plot multiplier and divide by the number of completed plots.
8. Well-spaced preferred per hectare: Sum the well-spaced percent preferred, divide by 100, and multiply by the number of well-spaced per hectare.
9. Free growing per hectare: Sum the free growing (M-capped) counts across plots. Multiply the sum by the plot multiplier and divide by the number of completed plots.
10. Free growing preferred per hectare: Sum the free growing percent preferred, divide by 100, and multiply by the number of free growing per hectare.
11. Plantable spots per hectare: Sum the number of plantable spots across plots. Multiply the sum by the plot multiplier and divide by the number of completed plots.
12. Preparable spots per hectare: Sum the number of preparable spots across plots. Multiply the sum by the plot multiplier and divide by the number of completed plots.
13. Germinants per hectare: Sum the number of germinants across plots. Multiply the sum by the plot multiplier and divide by the number of completed plots.
14. Countable conifers per hectare: Sum the number of countable conifers across plots. Multiply the sum by the plot multiplier and divide by the number of completed plots.
15. Crown closure (%): Sum the crown closure samples. Divide by the number of crown closure samples.
16. Inventory height #1: Sum the inventory height samples for the leading inventory species. Divide by the number of inventory height #1 samples.
17. Inventory height #2: Sum the inventory height samples for the second inventory species. Divide by the number of inventory height #2 samples.
18. Silviculture height: Sum the silviculture height samples for the leading silviculture species. Divide by the number of silviculture height samples for the leading silviculture species.
19. Inventory age #1: Sum the inventory age samples for the leading inventory species. Divide by the number of inventory age #1 samples.

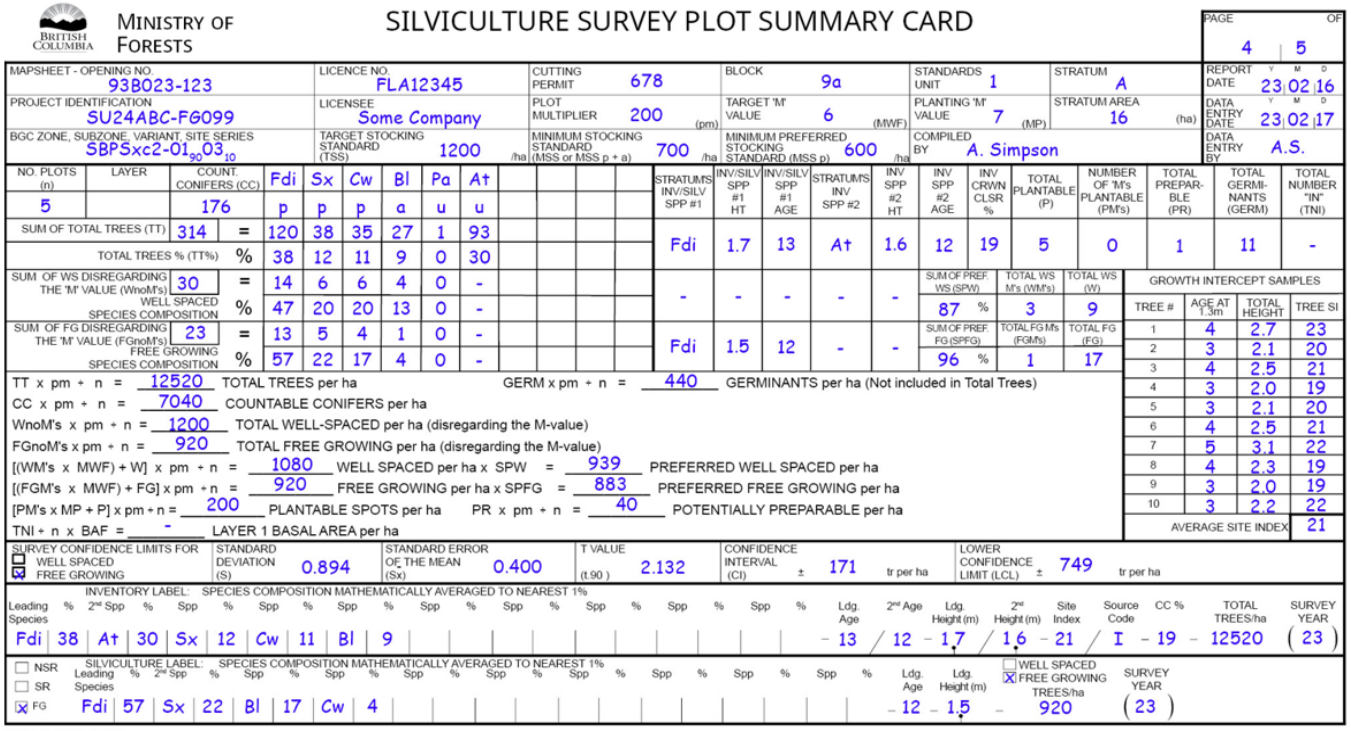
20. Inventory age #2: Sum the inventory age samples for the second inventory species. Divide by the number of inventory age #2 samples.
21. Silviculture age: Sum the silviculture age samples for the leading silviculture species. Divide by the number of silviculture age samples for the leading silviculture species.
22. Estimated % cover: Sum the % cover samples by brush species. Divide by the number of plots with brush samples.
23. Estimated brush height (m): Sum the brush height samples by brush species. Divide by the number of plots with brush samples.
24. % host trees affected. For each pest code:
    a. Sum the living affected trees.
    b. Sum the dead affected trees.
    c. Sum the living and dead affected trees.
    d. Sum the % inventory composition of host species.
    e. Multiply the total trees tallied in the stratum by the percent composition of the host species and then add the sum of the dead affected trees.
    f. Divide c. by e. and multiply by 100.

Note: If you are using an electronic data collection app or an automated template, confirm that the calculations match the procedures in this chapter.

7.2.2 FS 659 Fields

When using paper cards, summarize the FS 658 data on the FS 659 Silviculture Survey Plot Summary Card.

Figures 11 and 13 show sample data in the FS 659, and Figures 12 and 14 show field numbers.



MINISTRY OF FORESTS

SILVICULTURE SURVEY PLOT SUMMARY CARD

PAGE 4 OF 5

MAPSHEET - OPENING NO. 93B023-123	LICENCE NO. FLA12345	CUTTING PERMIT 678	BLOCK 9a	STANDARDS UNIT 1	STRATUM A	REPORT DATE Y M D 23 02 16
PROJECT IDENTIFICATION SU24ABC-FG099	LICENSEE Some Company	PLOT MULTIPLIER 200 (pm)	TARGET 'M' VALUE 6 (MWF)	PLANTING 'M' VALUE 7 (MP)	STRATUM AREA 16 (ha)	DATA ENTRY DATE 23 02 17
BGC ZONE, SUBZONE, VARIANT, SITE SERIES SBPSxc2-01$_{90}$03$_{10}$	TARGET STOCKING STANDARD (TSS) 1200 /ha	MINIMUM STOCKING STANDARD (MSS or MSS p + a) 700 /ha	MINIMUM PREFERRED STOCKING STANDARD (MSS p) 600 /ha	COMPILED BY A. Simpson		DATA ENTRY BY A.S.

NO. PLOTS (n)	LAYER	COUNT. CONIFERS (CC)	Fdi	Sx	Cw	Bl	Pa	At
5		176	p	p	p	a	u	u
SUM OF TOTAL TREES (TT)		314 =	120	38	35	27	1	93
TOTAL TREES % (TT%)		%	38	12	11	9	0	30
SUM OF WS DISREGARDING THE 'M' VALUE (WnoM's)		30 =	14	6	6	4	0	-
WELL SPACED SPECIES COMPOSITION		%	47	20	20	13	0	-
SUM OF FG DISREGARDING THE 'M' VALUE (FGnoM's)		23 =	13	5	4	1	0	-
FREE GROWING SPECIES COMPOSITION		%	57	22	17	4	0	-

STRATUM'S INV/SILV SPP #1	INV/SILV SPP #1 HT	INV/SILV SPP #1 AGE	STRATUM'S INV SPP #2	INV SPP #2 HT	INV SPP #2 AGE	INV CRWN CLSR %	TOTAL PLANTABLE (P)	NUMBER OF 'M's PLANTABLE (PM's)	TOTAL PREPARABLE (PR)	TOTAL GERMINANTS (GERM)	TOTAL NUMBER "IN" (TNI)
Fdi	1.7	13	At	1.6	12	19	5	0	1	11	-
-	-	-	-	-	SUM OF PREF. WS (SPW) 87 %	TOTAL WS M's (WM's) 3	TOTAL WS (W) 9				
Fdi	1.5	12	-	-	SUM OF PREF. FG (SPFG) 96 %	TOTAL FG M's (FGM's) 1	TOTAL FG (FG) 17				

TT x pm ÷ n = 12520 TOTAL TREES per ha — GERM x pm ÷ n = 440 GERMINANTS per ha (Not included in Total Trees)

CC x pm ÷ n = 7040 COUNTABLE CONIFERS per ha

WnoM's x pm ÷ n = 1200 TOTAL WELL-SPACED per ha (disregarding the M-value)

FGnoM's x pm ÷ n = 920 TOTAL FREE GROWING per ha (disregarding the M-value)

[(WM's x MWF) + W] x pm ÷ n = 1080 WELL SPACED per ha x SPW = 939 PREFERRED WELL SPACED per ha

[(FGM's x MWF) + FG] x pm ÷ n = 920 FREE GROWING per ha x SPFG = 883 PREFERRED FREE GROWING per ha

[PM's x MP + P] x pm ÷ n = 200 PLANTABLE SPOTS per ha — PR x pm ÷ n = 40 POTENTIALLY PREPARABLE per ha

TNI ÷ n x BAF = - LAYER 1 BASAL AREA per ha

GROWTH INTERCEPT SAMPLES

TREE #	AGE AT 1.3m	TOTAL HEIGHT	TREE SI
1	4	2.7	23
2	3	2.1	20
3	4	2.5	21
4	3	2.0	19
5	3	2.1	20
6	4	2.5	21
7	5	3.1	22
8	4	2.3	19
9	3	2.0	19
10	3	2.2	22
AVERAGE SITE INDEX			21

SURVEY CONFIDENCE LIMITS FOR ☐ WELL SPACED ☒ FREE GROWING | STANDARD DEVIATION (S) 0.894 | STANDARD ERROR OF THE MEAN (Sx) 0.400 | T VALUE (t 90) 2.132 | CONFIDENCE INTERVAL (CI) ± 171 tr per ha | LOWER CONFIDENCE LIMIT (LCL) ± 749 tr per ha

INVENTORY LABEL: SPECIES COMPOSITION MATHEMATICALLY AVERAGED TO NEAREST 1%

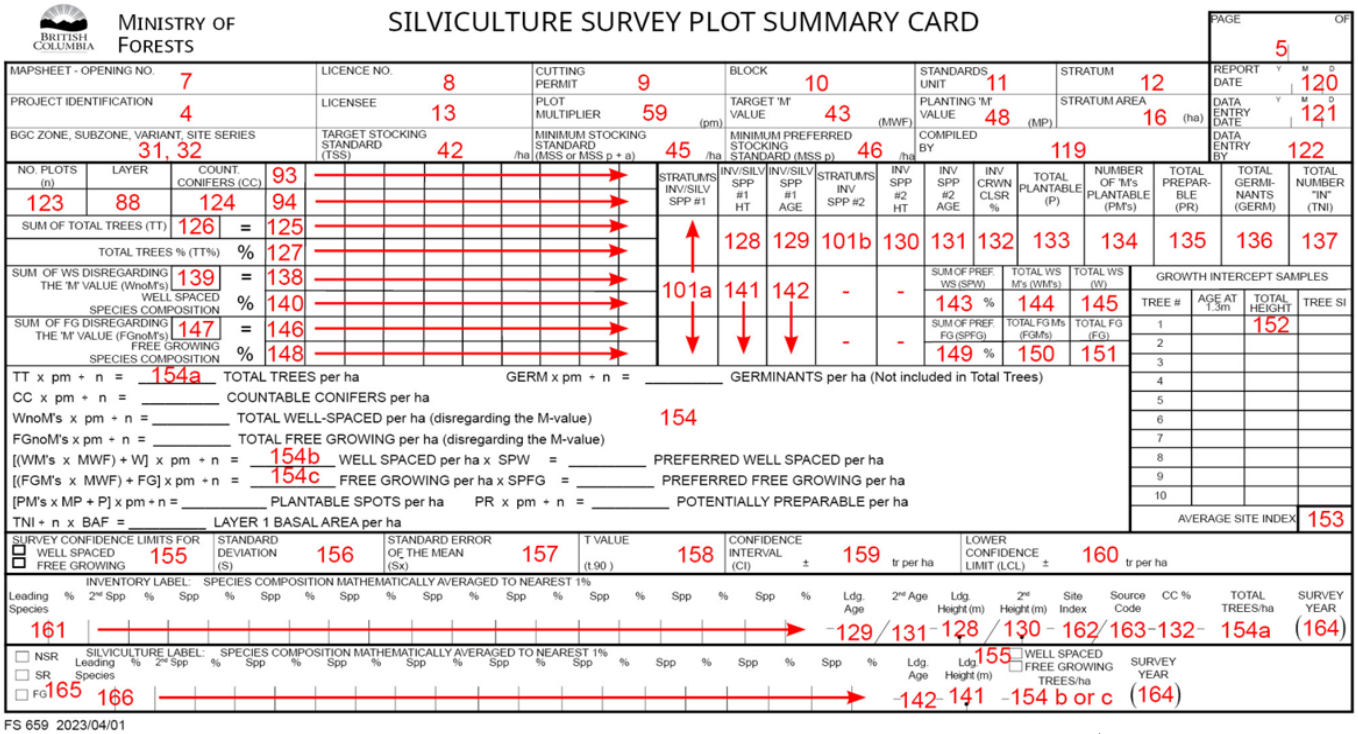
Leading Species	%	2nd Spp	%	Spp	%	Spp	%	Spp	%	Spp	%	Spp	%	Spp	%	Spp	%	Spp	%	Ldg. Age	2nd Age	Ldg. Height (m)	2nd Height (m)	Site Index	Source Code	CC %	TOTAL TREES/ha	SURVEY YEAR
Fdi	38	At	30	Sx	12	Cw	11	Bl	9											13	12	1.7	1.6	21	I	19	12520	(23)

SILVICULTURE LABEL: SPECIES COMPOSITION MATHEMATICALLY AVERAGED TO NEAREST 1%

☐ NSR ☐ SR ☒ FG	Leading Species	%	2nd Spp	%	Spp	%	Spp	%	Spp	%	Spp	%	Spp	%	Spp	%	Spp	%	Ldg. Age	Ldg. Height (m)	☐ WELL SPACED ☒ FREE GROWING TREES/ha	SURVEY YEAR
	Fdi	57	Sx	22	Bl	17	Cw	4												12	1.5	920	(23)

FS 659 2023/04/01

FIGURE 11. FS 659 Silviculture Survey Summary card, front side, with sample date.



MINISTRY OF FORESTS

SILVICULTURE SURVEY PLOT SUMMARY CARD

PAGE 5 OF

MAPSHEET - OPENING NO. 7	LICENCE NO. 8	CUTTING PERMIT 9	BLOCK 10	STANDARDS UNIT 11	STRATUM 12	REPORT DATE 120
PROJECT IDENTIFICATION 4	LICENSEE 13	PLOT MULTIPLIER 59 (pm)	TARGET 'M' VALUE 43 (MWF)	PLANTING 'M' VALUE 48 (MP)	STRATUM AREA 16 (ha)	DATA ENTRY DATE 121
BGC ZONE, SUBZONE, VARIANT, SITE SERIES 31, 32	TARGET STOCKING STANDARD (TSS) 42 /ha	MINIMUM STOCKING STANDARD (MSS or MSS p + a) 45 /ha	MINIMUM PREFERRED STOCKING STANDARD (MSS p) 46 /ha	COMPILED BY 119		DATA ENTRY BY 122

NO. PLOTS (n)	LAYER	COUNT. CONIFERS (CC)																
123	88	124	93	94														
SUM OF TOTAL TREES (TT)		126 =	125															
TOTAL TREES % (TT%)		%	127															
SUM OF WS DISREGARDING THE 'M' VALUE (WnoM's)		139 =	138															
WELL SPACED SPECIES COMPOSITION		%	140															
SUM OF FG DISREGARDING THE 'M' VALUE (FGnoM's)		147 =	146															
FREE GROWING SPECIES COMPOSITION		%	148															

STRATUM'S INV/SILV SPP #1	INV/SILV SPP #1 HT	INV/SILV SPP #1 AGE	STRATUM'S INV SPP #2	INV SPP #2 HT	INV SPP #2 AGE	INV CRWN CLSR %	TOTAL PLANTABLE (P)	NUMBER OF 'M's PLANTABLE (PM's)	TOTAL PREPARABLE (PR)	TOTAL GERMINANTS (GERM)	TOTAL NUMBER "IN" (TNI)
101a	128	129	101b	130	131	132	133	134	135	136	137
	141	142	-	-	SUM OF PREF. WS (SPW) 143 %	TOTAL WS M's (WM's) 144	TOTAL WS (W) 145				
			-	-	SUM OF PREF. FG (SPFG) 149 %	TOTAL FG M's (FGM's) 150	TOTAL FG (FG) 151				

TT x pm ÷ n = 154a TOTAL TREES per ha — GERM x pm ÷ n = _____ GERMINANTS per ha (Not included in Total Trees)

CC x pm ÷ n = _____ COUNTABLE CONIFERS per ha

WnoM's x pm ÷ n = _____ TOTAL WELL-SPACED per ha (disregarding the M-value) 154

FGnoM's x pm ÷ n = _____ TOTAL FREE GROWING per ha (disregarding the M-value)

[(WM's x MWF) + W] x pm ÷ n = 154b WELL SPACED per ha x SPW = _____ PREFERRED WELL SPACED per ha

[(FGM's x MWF) + FG] x pm ÷ n = 154c FREE GROWING per ha x SPFG = _____ PREFERRED FREE GROWING per ha

[PM's x MP + P] x pm ÷ n = _____ PLANTABLE SPOTS per ha — PR x pm ÷ n = _____ POTENTIALLY PREPARABLE per ha

TNI ÷ n x BAF = _____ LAYER 1 BASAL AREA per ha

GROWTH INTERCEPT SAMPLES

TREE #	AGE AT 1.3m	TOTAL HEIGHT	TREE SI
1		152	
2			
3			
4			
5			
6			
7			
8			
9			
10			
AVERAGE SITE INDEX			153

SURVEY CONFIDENCE LIMITS FOR ☐ WELL SPACED ☐ FREE GROWING 155 | STANDARD DEVIATION (S) 156 | STANDARD ERROR OF THE MEAN (Sx) 157 | T VALUE (t 90) 158 | CONFIDENCE INTERVAL (CI) ± 159 tr per ha | LOWER CONFIDENCE LIMIT (LCL) ± 160 tr per ha

INVENTORY LABEL: SPECIES COMPOSITION MATHEMATICALLY AVERAGED TO NEAREST 1%

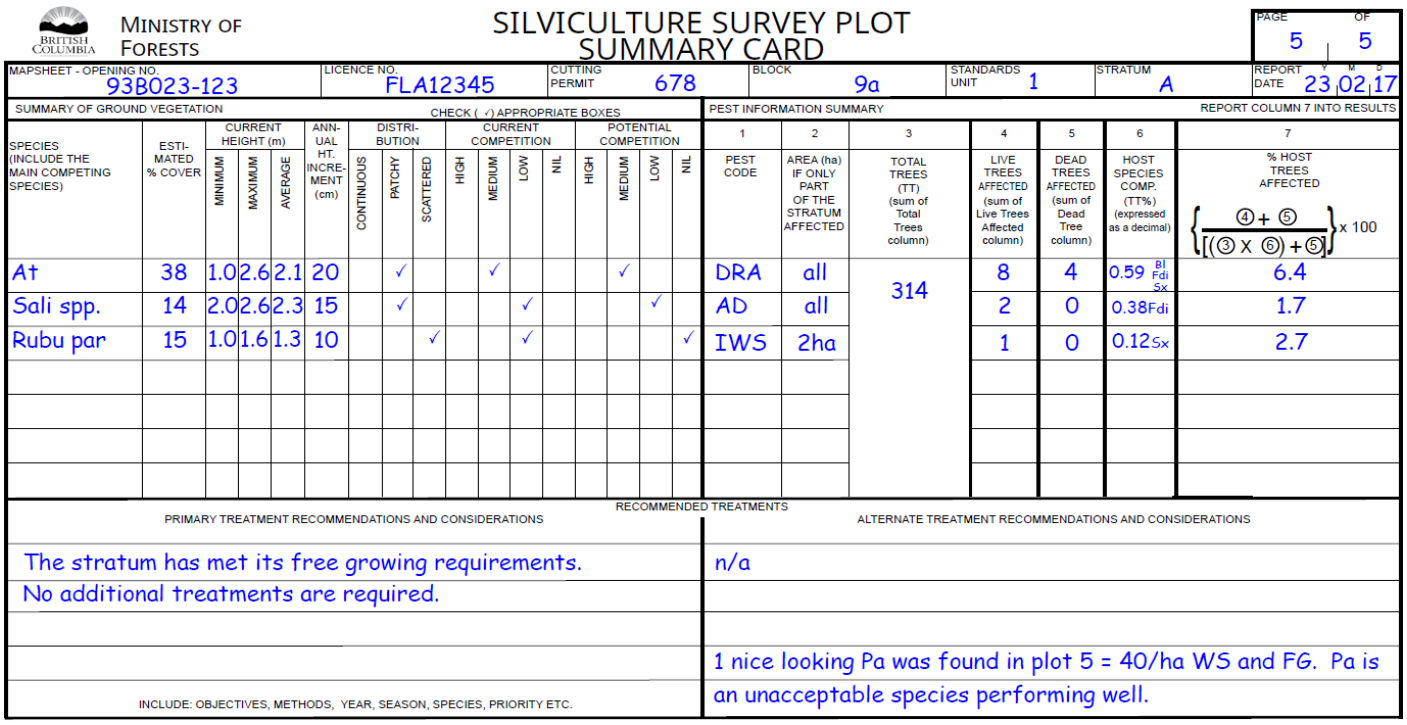
Leading Species	%	2nd Spp	%	Spp	%	Spp	%	Spp	%	Spp	%	Spp	%	Spp	%	Spp	%	Spp	%	Ldg. Age	2nd Age	Ldg. Height (m)	2nd Height (m)	Site Index	Source Code	CC %	TOTAL TREES/ha	SURVEY YEAR
161																				129	131	128	130	162	163	132	154a	(164)

SILVICULTURE LABEL: SPECIES COMPOSITION MATHEMATICALLY AVERAGED TO NEAREST 1%

☐ NSR ☐ SR ☐ FG	Leading Species	%	2nd Spp	%	Spp	%	Spp	%	Spp	%	Spp	%	Spp	%	Spp	%	Spp	%	Ldg. Age	Ldg. Height (m)	☐ WELL SPACED ☐ FREE GROWING TREES/ha	SURVEY YEAR
	165		166																	142	141	154 b or c	(164)

FS 659 2023/04/01

FIGURE 12. FS 659 Silviculture Survey Summary card, front side, with field numbers.



MINISTRY OF FORESTS

SILVICULTURE SURVEY PLOT SUMMARY CARD

PAGE 5 OF 5

MAPSHEET - OPENING NO.	LICENCE NO.	CUTTING PERMIT	BLOCK	STANDARDS UNIT	STRATUM	REPORT DATE (Y M D)
93B023-123	FLA12345	678	9a	1	A	23 02 17

SUMMARY OF GROUND VEGETATION — CHECK (✓) APPROPRIATE BOXES

SPECIES (INCLUDE THE MAIN COMPETING SPECIES)	ESTIMATED % COVER	CURRENT HEIGHT (m) MINIMUM	MAXIMUM	AVERAGE	ANNUAL HT. INCREMENT (cm)	DISTRIBUTION CONTINUOUS	PATCHY	SCATTERED	CURRENT COMPETITION HIGH	MEDIUM	LOW	NIL	POTENTIAL COMPETITION HIGH	MEDIUM	LOW	NIL
At	38	1.0	2.6	2.1	20		✓			✓				✓		
Sali spp.	14	2.0	2.6	2.3	15		✓				✓				✓	
Rubu par	15	1.0	1.6	1.3	10			✓			✓					✓

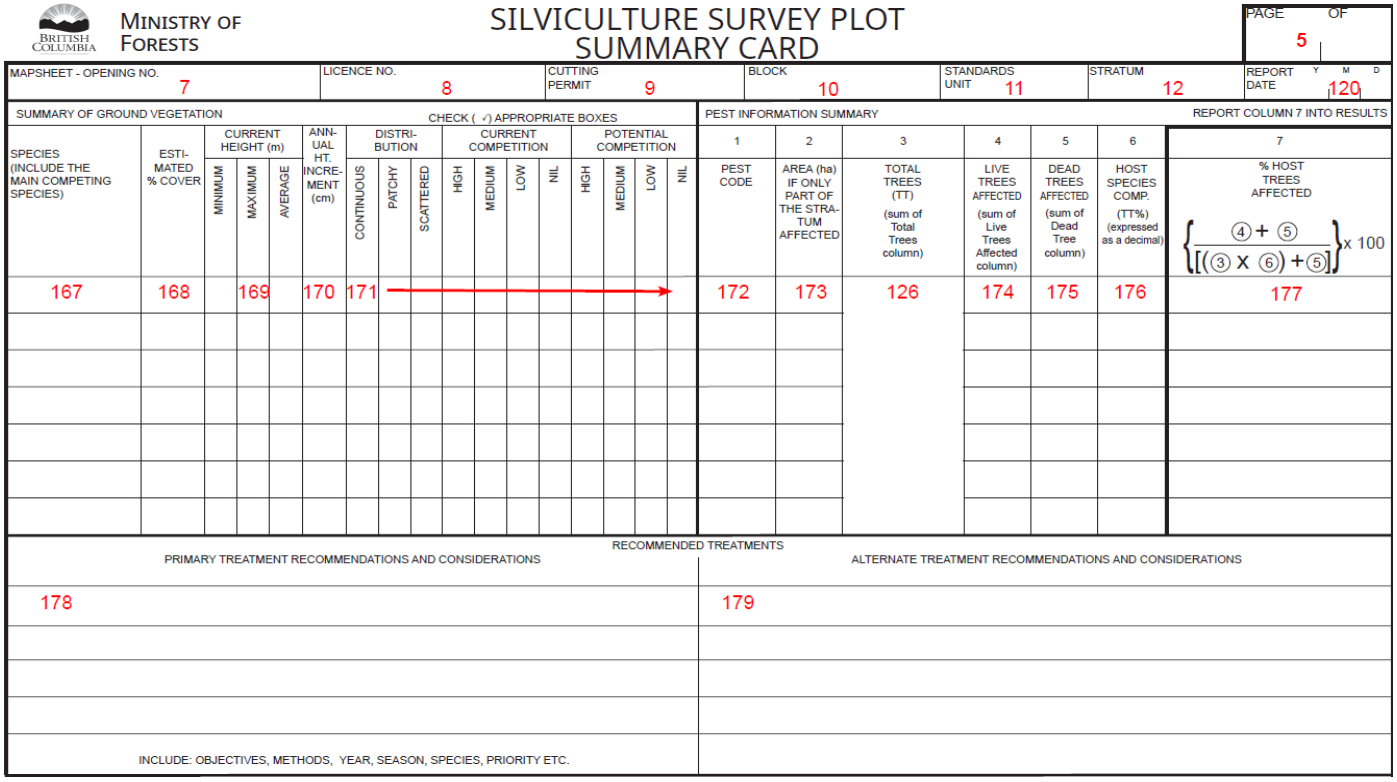
PEST INFORMATION SUMMARY — REPORT COLUMN 7 INTO RESULTS

1 PEST CODE	2 AREA (ha) IF ONLY PART OF THE STRATUM AFFECTED	3 TOTAL TREES (TT) (sum of Total Trees column)	4 LIVE TREES AFFECTED (sum of Live Trees Affected column)	5 DEAD TREES AFFECTED (sum of Dead Tree column)	6 HOST SPECIES COMP. (TT%) (expressed as a decimal)	7 % HOST TREES AFFECTED {④+⑤ / [(③ X ⑥)+⑤]} x 100
DRA	all	314	8	4	0.59 Bl Fdi Sx	6.4
AD	all		2	0	0.38 Fdi	1.7
IWS	2ha		1	0	0.12 Sx	2.7

RECOMMENDED TREATMENTS

PRIMARY TREATMENT RECOMMENDATIONS AND CONSIDERATIONS	ALTERNATE TREATMENT RECOMMENDATIONS AND CONSIDERATIONS
The stratum has met its free growing requirements.	n/a
No additional treatments are required.	
	1 nice looking Pa was found in plot 5 = 40/ha WS and FG. Pa is
INCLUDE: OBJECTIVES, METHODS, YEAR, SEASON, SPECIES, PRIORITY ETC.	an unacceptable species performing well.

FIGURE 13. FS 659 Silviculture Survey Summary card, back side, with sample data.



MINISTRY OF FORESTS

SILVICULTURE SURVEY PLOT SUMMARY CARD

PAGE 5 OF

MAPSHEET - OPENING NO.	LICENCE NO.	CUTTING PERMIT	BLOCK	STANDARDS UNIT	STRATUM	REPORT DATE (Y M D)
7	8	9	10	11	12	120

SUMMARY OF GROUND VEGETATION — CHECK (✓) APPROPRIATE BOXES

SPECIES (INCLUDE THE MAIN COMPETING SPECIES)	ESTIMATED % COVER	CURRENT HEIGHT (m) MINIMUM	MAXIMUM	AVERAGE	ANNUAL HT. INCREMENT (cm)	DISTRIBUTION CONTINUOUS	PATCHY	SCATTERED	CURRENT COMPETITION HIGH	MEDIUM	LOW	NIL	POTENTIAL COMPETITION HIGH	MEDIUM	LOW	NIL
167	168		169		170	171	→									

PEST INFORMATION SUMMARY — REPORT COLUMN 7 INTO RESULTS

1 PEST CODE	2 AREA (ha) IF ONLY PART OF THE STRATUM AFFECTED	3 TOTAL TREES (TT) (sum of Total Trees column)	4 LIVE TREES AFFECTED (sum of Live Trees Affected column)	5 DEAD TREES AFFECTED (sum of Dead Tree column)	6 HOST SPECIES COMP. (TT%) (expressed as a decimal)	7 % HOST TREES AFFECTED {④+⑤ / [(③ X ⑥)+⑤]} x 100
172	173	126	174	175	176	177

RECOMMENDED TREATMENTS

PRIMARY TREATMENT RECOMMENDATIONS AND CONSIDERATIONS	ALTERNATE TREATMENT RECOMMENDATIONS AND CONSIDERATIONS
178	179
INCLUDE: OBJECTIVES, METHODS, YEAR, SEASON, SPECIES, PRIORITY ETC.	

FIGURE 14. FS 659 Silviculture Survey Summary card, back side, with field numbers.

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

124. Countable conifers (CC): N/H Sum the number of countable conifers (Field 91).

125. Blank: H/H Sum the number of total trees (Field 95) by species (Field 93).

126. Sum of Total trees (TT): H/H Sum the number of total trees using either the species totals (Field 125) or the plot totals (Field 98). (Using both is a good accuracy check).

127. Total trees species composition (TT%): H/H For each species, divide the species sum (Field 125) by the total tree count (Field 126) and multiply by 100. Record to the nearest 1%.

128. Inventory height #1 (m): H/H Sum the height measurements (Field 102a) for the leading inventory species. Divide by the number of height samples collected for this species. Round the result to the nearest 0.1 m.

129. Inventory age #1 (years): H/H Sum the age measurements (Field 103a) for the leading inventory species. Divide by the number of age samples collected for this species. Round the result to the nearest whole year.

130. Inventory height #2 (m): H/H Sum the height measurements (Field 102b) for the second inventory species. Divide by the number of height samples collected for this species. Round the result to the nearest 0.1 m.

131. Inventory age #2 (years): H/H Sum the age measurements (Field 103b) for the second inventory species. Divide by the number of age samples collected for this species. Round the result to the nearest whole year.

132. Crown closure %: H/H Sum the crown closure estimates (Field 106). Divide by the number of crown closure samples collected. Record the average value.

133. Total plantable (P): T/N Sum the number of plantable spots (Field 107), excluding any “M” entries.

134. Number of M’s plantable (PM’s): T/N Sum the number of plots with “M” in Field 107.

135. Total preparable (PR): T/N Sum the number of preparable spots (Field 108).

136. Total germinants (GERM): T/N If tallied, sum the number of germinants (Field 110). Note: Do not confuse this value with Total “In.”

137. Total Number “IN” (TNI): H/H If collected, sum the number of “in” trees (Field 110). Note: Do not confuse this value with the germinants data.

138. Blank: H/H Sum the number of well-spaced trees (Field 96) by species (Field 93), disregarding the M-value.

139. Sum of WS disregarding the 'M' value (WnoM): H/H Sum the number of well-spaced trees across plots, disregarding the M-value (Field 138).

140. Well-spaced Species Composition: H/H For each species, divide the value from Field 138 by the value in Field 139 and multiply by 100. Record to the nearest 1%.

141. Silviculture Tree Height (m): H/H Record the average height of the sample well-spaced or free growing trees of the leading species. This is the sum of the heights (Field 104a) from the FS 658 card divided by the number of sample heights recorded. This number must be rounded to the nearest tenth of a metre.

If you collected well-spaced heights, record the silviculture tree height in the row associated with well-spaced data. If you collected free growing heights, record the silviculture tree height in the row associated with free growing data.

If you collected heights on multiple species, assess Field 140 to determine the leading well-spaced species or Field 148 to determine the leading free growing species. Enter the average of the sample heights in Field 141 for the leading species.

142. Silviculture Tree Age (years): H/H Record the average age of the sample well-spaced or free growing trees of the leading species. This is the sum of the ages (Field 105a) from the FS 658 card divided by the number of sample ages recorded. This number must be rounded to a whole number.

If you collected well-spaced ages, record the silviculture tree age in the row associated with well-spaced data. If you collected free growing ages, record the silviculture tree age in the row associated with free growing data.

If you collected ages on multiple species, assess Field 140 to determine the leading well-spaced species or Field 148 to determine the leading free growing species. Enter the average of the sample ages in Field 142 for the leading species.

143. Sum of Preferred (SPW): H/H Sum the percentages from Field 140 (WS composition) for all columns marked "p" in Field 94.

144. Total WS M's (WM's): H/H Sum the total number of plots with "M" entered in Field 99.

145. Total (W): H/H Sum the number of well-spaced trees from Field 99, excluding "M" entries.

146. Blank: H/H Sum the number of free growing trees (Field 97) by species (Field 93), disregarding the M-value.

147. Sum of FG disregarding the 'M' value (FGnoM): H/H Sum the number of free growing trees, disregarding the M-value (Field 146).

148. Free Growing Species Composition: H/H For each species, divide the value from Field 146 by the value in Field 147 and multiply by 100. Record to the nearest 1%.

149. Sum of Preferred (SPFG): H/H Sum the percentages from Field 148 (FG composition) for all columns marked "p" in Field 94.

150. Total M's (FGM's): L/H Sum the number of plots with "M" entered in Field 100.

151. Total (FG): L/H Sum the number of free growing trees from Field 100, excluding "M" entries.

152. GI Sample & Data Spp.: N/H If using the growth intercept (GI) method to estimate site index, record age at breast height (1.3 m) and total tree height for the GI sample trees. Determine site index for each tree using FS 415 cards or using SiteTools. Refer to Section 9.1.2.

153. Average Site Index: N/H Record the average site index calculated from the individual GI sample trees.

154. Calculations: H/H Use the formulas on the field card or follow the instructions in Section 7.2.1.

Statistical Calculations (Field 155-160): These fields summarize the statistical checks required for regeneration delay and free growing surveys. Methods are described in the Statistics section, and the FS 1138A may be used. A statistical calculator is typically used.

155. Survey Confidence Limits for Well-spaced/Free Growing: H/H Check the box to indicate whether you completed confidence limit calculations for well-spaced or free growing trees.

156. Standard Deviation (S): H/H Record the standard deviation of the well-spaced or free growing trees per plot.

157. Standard Error of the Mean ($S\bar{x}$): H/H Record the standard error of the mean for well-spaced or free growing trees per plot.

158. T-value (t90): H/H Look up the t-value from Table 30 of the FS 660.

159. Confidence Interval (CI): H/H Calculate the confidence interval by multiplying the standard error (Field 157) by the t-value (Field 158) by the plot multiplier (Field 59).

160. Lower Confidence Limit (LCL): H/H Record the LCL by subtracting the CI (Field 159) from well-spaced per hectare (Field 154b) or free growing per ha (Field 154c), depending on what you selected in Field 155.

161. Species & %: H/H List the inventory species composition in order of abundance. Use the percentages from Field 127, rounded to the nearest 1%, and ensure the total equals 100%. If rounding produces 99% or 101%, adjust the leading species to correct the total.

If more than 10 species are present, group the least common species with the leading species for reporting.

Note: Species percentages are based on basal area for Layer 1 inventory and density for Layers 2-4.

162. Site Index: H/H Record the site index for the leading inventory species. If you used the GI method, enter the average SI from Field 153.

163. Source Code: H/H Enter the site index method code. Use an abbreviation from Table 31b from the FS 660.

164. Survey Year: H/H Record the last two digits of the survey year (e.g., 2026=26).

165. Stocking Status: H/H Check the correct stocking status based on your calculations (e.g., NSR, SR, FG).

166. Silviculture Label Spp & %: H/H Use the well-spaced species composition (Field 140) when the status is SR or NSR. Use the free growing species composition (Field 148) when the status is FG. List the species in order of abundance, reported to the nearest 1%. Percentages must total 100% and must not be adjusted beyond rounding.

167. Species (including the main competing species): T/T List up to seven of the most common or competitive herb, shrub, or broadleaf species recorded in Field 111 on the FS 658.

168. Estimated % Cover: T/T For each species listed in Field 167, records it average percent ground cover, using the values from Field 112 on the FS 658 card.

169. Current Height (m)—Minimum, Maximum, and Average: T/T Record the average height for each vegetation species using Field 113 from the FS 658. Estimate maximum and minimum heights visually.

170. Annual Height Increment (cm): T/T Record the estimated average annual height growth (in cm) for each species listed in Field 167. This is a visual estimate and is most useful for competing or invasive vegetation.

171. Distribution, Current Competition, Potential Competition: L/H

For each species listed in Field 167, record brush distribution as continuous, patchy, or scattered.

- Continuous*:* brush is spread evenly over the stratum.
- Patchy*:* brush-free areas cover roughly the same percentage of ground as brush-covered areas.
- Scattered*:* brush-free areas are larger than brush-covered areas.

For each species listed in Field 167, select the current competition level (high, medium, low, or nil), based on how strongly the species is affecting crop tree vigour or free growing potential. Select the potential competition level based on expected impact as the stand develops.

- High: The brush is significantly impacting crop tree vigour, as evidenced by crop tree mortality, poor crop tree growth, and/or unacceptable crop tree form; or preventing the stratum from achieving free growing.
- Medium: The brush is moderately impacting or will increasingly affect crop tree vigour, as evidenced by decreasing crop tree growth or decreasing crop tree to brush height ratio; or the stratum's ability to achieve free growing.
- Low: The brush is having little impact on crop tree vigour, is not likely to cause future impacts, and is unlikely to prevent the stratum from achieving free growing.
- Nil: No brush hazard present.

172. Pest Code: H/H Record the pest codes for up to seven of the most significant forest health factors tallied in Field 114 of the FS 658 card.

173. Area (ha) if only part of the stratum is affected: H/H If the pest occurs only in part of the stratum, record the estimated area affected. Note: This value is required for RESUTLS, even if some data-collection apps do not include this field.

174. Live trees affected: H/H Record the number of live trees affected by each pest, using totals from Field 115 on the FS 658 card.

175. Dead Trees Affected: H/H Record the number of dead trees affected by each pest, using totals from Field 116 on the FS 658 card.

176. Host Species Comp.: H/H Record the inventory species composition (as a decimal) for the host species affected by each pest. Use inventory composition values from Field 127.

177. % Host Trees Affected: H/H For each pest code:

a. sum the living affected trees (Field 174)

b. sum the dead affected trees (Field 175)

c. sum the living and dead affected trees

d. sum the % inventory composition[29] of host species (Field 176)

e. multiply the total trees tallied in the stratum (Field 126) by the percent composition of the host species (Field 176) and then add the sum of the dead affected trees (Field 175).

f. Divide c. by e. and multiply by 100.

178. Primary Treatment Recommendations and Considerations: H/H

Provided clear, practical recommendations based on the survey findings. State what, when, and how treatments should be carried out. Recommendations should address limiting factors and support achieving free-growing stocking standards.

For detailed guidance on writing treatment recommendations, see Section 8.1.2.

Note: If the recommendation relates to a drought or frost-related replant or fill plant, include the required RESULTS objective codes (NG for frost, ND for drought).

179. Alternate Treatment Recommendations and Considerations: H/H Provide a feasible backup option in case the primary recommendation cannot be implemented.

7.3 Calculating Statistics

Use the FS 1138A (Figure 15) to calculate statistics for each stratum. Do not combine plots across strata.

If the objective is free growing, calculate statistics using free growing tallies. If the objective is regeneration delay or stocking, calculate statistics using well-spaced tallies.

[29] In rare cases, complete mortality of a species may result in the species being absent from the inventory label. If the surveyor determines that it is professionally appropriate to report the pest's presence, it is recommended to attach a "Pest Incidence Note" to the opening file in RESULTS.

For each stratum, calculate the following:

1. Well-spaced or free growing average across plots **using M-capped counts**
2. Standard deviation
3. Standard error
4. Confidence interval
5. Lower confidence interval

Enter these values in the FS 659 card.

Note: You need at least **five plots per stratum** to calculate statistics.

To learn how to complete the FS 1138A, watch the FS1138A: Statistics for Silviculture Surveying video.

MINISTRY OF FORESTS

CALCULATION CARD FOR SILVICULTURE SURVEY CONFIDENCE LIMITS

OPENING NUMBER	82B2985	82B2985
STRATUM NUMBER OR LETTER	A	B
AREA	16 ha	14 ha
n = NUMBER OF PLOTS	5	6
$\bar{X}$ = AVERAGE trees/ha	$\bar{X}$ = 4.6 $\bar{X}$ x pm = 920 tr/ha ☐ Well Spaced ☒ Free Growing	$\bar{X}$ = 3 $\bar{X}$ x pm = 600 tr/ha ☐ Well Spaced ☒ Free Growing
S = STANDARD DEVIATION	0.894	1.4142
STANDARD ERROR $S_{\bar{X}} = S/\sqrt{n}$	0.894/2.236=0.400	1.4142/2.449=0.5775
t Value t_{90} for n See FS660	2.132	2.015
CONFIDENCE INTERVAL for t_{90} $CI_{90} = S_{\bar{X}} \times t$	CI_{90} =0.853 CI_{90} x pm =171 tr/ha	CI_{90} =1.163 CI_{90} x pm =233 tr/ha
LOWER CONFIDENCE LIMIT LCL = $\bar{X}$ - CI_{90}	LCL= 3.747 LCL x pm = 749 tr/ha	LCL= 1.837 LCL x pm = 367 tr/ha
MSS p+a trees/ha	700 tr/ha	500 tr/ha
Desired Precision if $\bar{X} \leq 1000$tr/ha e = 0.5 or, if $\bar{X} > 1000$tr/ha e = 0.1 x $\bar{X}$	e = e x pm = tr/ha	e = 0.5 e x pm = 100 tr/ha CI>e
New n = $\left[\frac{t \times S}{e}\right]^2$	n = plots	n = 33 21 plots
	New n - n = number of additional plots to max. of 1.5 x Area.	
RECOMMENDATION	No further plots	Do 15 more plots

FS 1138A 2023/04/01

TSS=1200
MSS=700

TSS=1000
MSS=500

FG #s= 4, 2, 5, 3, 3, 1

FIGURE 15. Example of a completed FS 1138A.

7.4 Analyzing the Statistics

Statistical analysis is used to decide whether a stratum meets regeneration or free growing requirements based on the plot data collected. It helps determine how much confidence there will be that the results represent the entire area and whether more plots are needed.

Statistical analysis is required only when formal plots have been established. It is not needed for ocular assessments or representative sampling. In both these cases, bias may affect the results.

This section shows how to analyze the plot data, especially for free growing or well-spaced trees, but you can apply the same steps to other tallies (e.g., plantable or preparable spots).

Note: Statistical analysis is not required for preferred species alone, only for the combination of preferred and acceptable species.

7.4.1 Statistical Analysis Process

Step 1: Evaluate the mean and lower confidence limit

Compare the mean[30] ($\bar{X}$) and lower confidence limit[31] (LCL) to the minimum stocking standard (MSS):

Condition	Decision
$\bar{X} \geq$ MSS **and** LCL $\geq$ MSS	Pass – No more plots needed
$\bar{X} <$ MSS	Fail – No more plots needed
$\bar{X} \geq$ MSS **and** LCL $<$ MSS	Uncertain – Proceed to Step 2

Step 2: Determine if the maximum number of plots have been established

- If 1.5 plots per hectare have already been established in the stratum, and the mean is greater than the minimum stocking standard, then the stratum passes. No more plots are needed.

[30] The mean is the average of a sample. It is calculated by dividing the sum of all values by the sample size.
[31] There is a 90% chance that the actual number of well-spaced or free growing trees is above the lower confidence limit.

- If less than 1.5 plots per hectare have been established, proceed to Step 3.

Step 3: Check the statistical precision

Compare the confidence interval (CI) to the desired precision (e):

Condition	Action
CI ≤ e	Precision is acceptable – pass
CI > e	Precision not met – proceed to Step 4

- If the mean is ≤ 1000 trees per hectare (well-spaced or free growing): the required precision is 100 trees per hectare or 0.5 trees per plot (if using a 3.99-m radius plot).
- If the mean is > 1000 trees per hectare (well-spaced or free growing): the precision must be within 10% of the mean.

Step 4: Calculate the number of additional plots needed

- Use the following formula to calculate the total number of plots required:

$$\mathbf{n} = \left(\frac{\mathbf{t\ x\ s}}{\mathbf{e}}\right)^{\mathbf{2}}$$

  Where:
  - t is the t value at 90% confidence
  - s is the standard deviation of the plot data
  - e is the required precision in trees per plot
- Subtract the number of plots you have already surveyed from this total to determine how many additional plots you need to establish.
- Do not complete more than the maximum of 1.5 plots per hectare. If the calculation suggests more are required, add only enough plots to reach 1.5 plots per hectare.

Step 5: Establish additional plots (if required)

- Lay out new plots (Figure 16):
  - along a diagonal line across the stratum, or
  - systematically, between existing plots.
- Complete additional plots and update your summary.

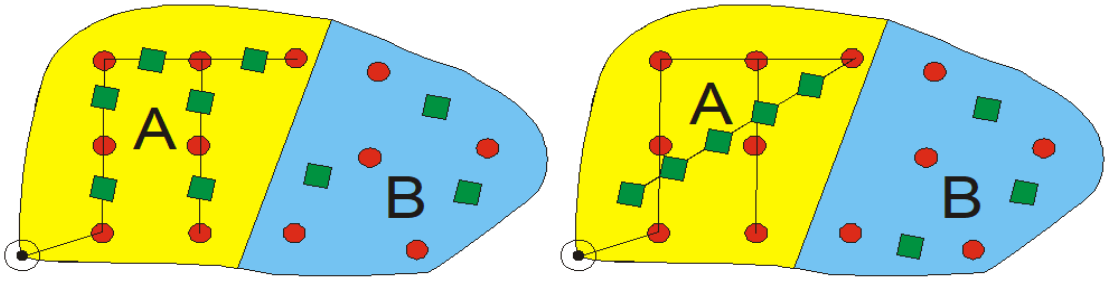


FIGURE 16. Examples of acceptable additional plot placement.

Step 6: Recalculate and make a final decision

After adding plots:

- Recalculate the mean and lower confidence limit.
- If there are less than 1.5 plots per hectare: start Step 1 again with the new values.
- If 1.5 plots per hectare were established: use only the new mean to make the final decision.

7.5 Determining Stocking Status

At regeneration delay, you must ask:

- Is there a sufficient number of well-spaced preferred trees plus acceptable trees per hectare? (stats required)
- If specified in the site plan, is there a sufficient number of well-spaced preferred trees per hectare? (stats not required)

At free growing, you must ask:

- Is there a sufficient number of free growing preferred trees plus acceptable trees per hectare? (stats required)
- If specified in the site plan, is there a sufficient number of free growing preferred trees per hectare? (stats not required)
- If specified in the site plan, is there less than the maximum density of countable trees?

7.6 Creating Forest Cover Labels

After compiling the data and calculating the statistics, you must create forest cover labels. They are used in survey reports, RESULTS submissions, and inventory updates. Two distinct label types are required:

7.6.1 Inventory Label

The inventory label is a single-line summary of key inventory characteristics. It describes the composition and structure of all living trees in the stratum.

Each component is explained in the example below:

Example: Fdi38At30Sx12Bl20 – 13/12 – 1.7/1.6 – 21/I – 20 – 12520 (26)

- **Species composition (Fdi38At30Sx12Bl20)**: the calculated species composition of all living broadleaf and conifer species, arranged in descending order and recorded to the nearest 1%.
  - Layer 1 (overstorey): species composition is based on total basal area.
  - Layers 2–4 (understorey): species composition is based on total tree density.
- **Ages (13/12)**: the average of age samples for the stratum's leading and second inventory species.
- **Heights (1.7/1.6)**: the average of height samples for the stratum's leading and second inventory species.
- **Site index (21)**: the site index of the stratum's leading inventory species.
- **Site index source (I)**: the method for determining the site index.
- **Crown closure (20)**: estimated crown closure of all living broadleaf and conifer trees.
- **Density (12520)**: the average number of total living broadleaf and conifer trees per hectare, excluding germinants.
- **Year (26)**: the last two digits of the survey year.

7.6.2 Silviculture Label

The silviculture label is a single-line summary of key silviculture characteristics. It describes the well-spaced or free growing component of a stratum.

Each component is explained in the example below:

Example: FG – Fdi56Sx22Bl13Cw9 – 12 – 1.5 – 920 (26)

- **Stocking status (FG)**: the prefix identifies the stocking status. Data following NSR or SR represent well-spaced trees. Data following FG represent free growing trees.
- **Species composition (Fdi56Sx22Bl13Cw9)**: the calculated species composition of well-spaced or free growing trees, arranged in descending order and recorded to the nearest 1%.
- **Age (12)**: the average of age samples for the stratum's leading silviculture species.
- **Height (1.5)**: the average of height samples for the stratum's leading silviculture species.
- **Density (920)**: the average number of well-spaced or free growing trees (M-capped).
- **Year (26)**: the last two digits of the survey year.

7.7 Precision Standards and Allowable Errors

Precision standards describe how close survey results must be to Ministry results when the same area is assessed. The standards apply to averages and totals (not to individual trees or single plots) for key attributes like species composition, density, age, and height (Table 8). Use these standards as a benchmark when reviewing your final summary, especially when submitting to RESULTS or working under contract.

Note: The Ministry may consider results that are outside these standards to be non-compliant with Section 86(6) of the Forest Planning and Practices Regulation.

TABLE 8. Precision standards (RISS) and common contract thresholds (shown in *italics*)

Characteristic	Allowable Error
Inventory species composition	± 20%, must correctly identify the leading inventory species
Silviculture species composition	± 20%, only species listed in the stocking standards may be included
Total trees per hectare	± 20%
Well-spaced or free growing per hectare	± 10%
Total basal area per hectare	*± 20%*
Crop basal area per hectare	*± 20%*

Age	± 20%
Heights	± 20%
Site index	± 3 m
Pest infection	≥ 10% absolute difference
Crown closure	± *10%*
All plot centres and tie points	± *2% of horizontal distance*
Countable conifers per hectare	± *20%*
Plantable spots per hectare	± *20%*
Stratum area (ha)	± *10%*

Chapter 8: Creating the Survey Report

8.1 Survey Reports

After completing the survey and compiling the results, prepare a survey report that meets the client's requirements.

A typical report includes:

- a survey map that shows strata boundaries, plot locations,[32] and prescribed treatment areas
- information by stratum:
  - ecology (BEC zone, subzone, site series, soil information)
  - disturbance and treatment history
  - inventory label
  - silviculture label
  - forest health information
  - number of countable conifers or countable trees (if near maximum density thresholds)
  - stratum comments
  - stratum recommendations
  - photos

8.1.1 Stratum Comments

Provide clear, concise comments for each stratum. They should explain the conditions you observed and justify the survey decisions you made.

Avoid repeating the plot data or the data that have already been presented in the survey report. Instead, focus on:

- how the stand is performing between plots,

[32] Plot locations can be symbolized based on stocking status or the number of well-spaced or free growing trees; e.g., red = 0, orange = 1, yellow = 2, green = 3, blue = 4, purple = 5+.

- information that was not gathered during the data collection procedure, and
- the reasons for the treatment recommendations you made.

Note: Comments should support the recommendations but should not include detailed prescriptions or instructions.

Consider organizing your comments by topic, using the following guidance:

Stratification

- Why was stratification needed?
- What criteria separated one stratum from another?

Stocking

- What is the stocking status (not satisfactorily restocked, satisfactorily restocked, free growing)?
- How are total, well-spaced, and free growing trees distributed (even, clumped, random)?
- Are there non-stratifiable not satisfactorily restocked, or non- free growing patches?
- What is the amount, distribution, and species of natural infill?
- Will germinants contribute to future stocking?
- How well are planted trees surviving and performing?

Forest health

- What forest health factors are present?
- What is their degree of severity (light, moderate, severe)?
- Which species are affected?
- Is the damage recent or historical?
- Does the damage impact survival, growth, or form of the trees?
- Will the damage impact free growing status?
- Is the issue localized or present across the stratum?
- If the damage appears to be nursery-related (e.g., *Cylindrocarpon,* DSG at root collar), what is the seedling request key?
- For rusts or weevil damage, what is the seedlot?

Brush

- What are the dominant brush species?
- How dense is the brush? What is its distribution?
- How tall is the brush? For broadleaf species, what is the stem diameter?
- Is brush affecting crop tree growth or survival?
- Will the brush affect free growing status?
- Are the brush species beneficial to other values? (e.g., significant moose browse)
- Are invasive species present? If yes, which species and where?

Access

- What method(s) did you use to access the site? (e.g., 2WD, 4WD, ATV, walk-in, helicopter, boat)
- If the access road was inaccessible, why? (e.g., downed tree, bridge removed, road deactivated, road grown-in)
- If you walked in, what was the distance? How long did it take? Was it on roads, through cutblocks, or through mature forests?
    - Is the route shown on the survey map?
- Were there any road maintenance concerns? (e.g., plugged culverts, slumps, washouts)
- For helicopter-logged blocks:
    - What condition are the heli pads in?
    - What is the brush level around the pads?
    - If planting is planned, where are suitable staging areas?

Safety

- Were danger trees present? If yes, how many and where (block interior or edges)?
- Are there any safety issues that will affect future surveys or silviculture treatments?
- Did safety issues force any plots to be eliminated or moved?

8.1.2 Recommendations

Most survey contracts require that treatment recommendations be made for each stratum. They are especially important when the stand has not met stocking standards or where follow-up action may be needed to reach long-term objectives.

Tip: Always aim to achieve the target stocking standard—not the minimum—unless there is a clear reason not to (e.g., site limiting factors, competing values).

Tip: Most clients will expect you to provide an alternative treatment recommendation in case the primary recommendation cannot be implemented.

8.1.2.1 Developing Treatment Recommendations

Follow these steps to develop clear recommendations:

Step 1: Compare the survey results to the standards

- Compare well-spaced, free growing, and preferred counts to the stocking standards.
- Identify any areas where stocking, height, health, or competition criteria have not been met.
- Compare countable tree density to maximum density (if applicable).

Step 2: Identify limiting factors

- Will the standards unit meet regeneration delay or free growing without intervention?
- Is the stand on track to meet the long-term objectives?
- If well-spaced or free growing numbers are less than desired or the crop trees are growing sub-optimally, what is the cause?
    - density
    - heights
    - vegetation competition
    - forest health
    - site factors (e.g., presence of slash, wet soils, rock, high coarse fragments)

Step 3: Recommend appropriate actions

Once you understand why the stand does not meet or may not meet the stocking standards or long-term objectives, decide what action is needed.

There are two types of recommendations:

- treatment recommendations: actions taken to improve the stand condition (e.g., planting, brushing, spacing, pruning)
- non-treatment recommendations: administrative actions or monitoring steps (e.g., surveys, site plan amendments)

Each recommendation must be clear, possible to achieve, and tied directly to the observed stand conditions. It must also comply with the site plan and other legal obligations.

For each recommendation, specify:

- **What** treatment is needed (e.g., site preparation, brushing)
- **How** to do it (e.g., method, species, spacing)
- **When** to do it (season and year)
- **What** follow-up is required (e.g., post-treatment survey)

8.1.2.2 Types of Treatments

Each type of treatment should be a direct response to a stand's condition and stocking requirements or long-term objectives. Table 9 lists common silviculture treatments and when to recommend them.

TABLE 9. Silviculture treatments: purpose, timing, and documentation requirements

Treatment type	Purpose	Used when	Details to include
Site preparation	Create or improve suitable microsites	There are few plantable spots; site limiting factors need to be addressed (wet/cold/dry soils, competition, deep LFH[33])	Type (e.g., mounding, disc scarification, scalping), spacing of rows/mounds
Planting	Increase stocking in understocked areas	Well-spaced/free growing counts are below standards; natural	Species, target density (number of trees per hectare), stock type, spacing, microsites,

[33]The LFH is the forest floor and includes litter, fermented, and humus layers.

Treatment type	Purpose	Used when	Details to include
		infill is unlikely to be sufficient; different species are desired or required to deal with forest health concerns	objective code (for FP/RP), fertilization ATOP[34]
Protector (cone/cage) installation, maintenance, and removal	Protect crop trees from animal damage	Trees are unable to establish or reach free growing status due to animal damage (browsing, trampling, plug extraction)	Protector type (e.g., cage, cone) and size, species to protect, tree height for protector removal
Brushing	Reduce competition or damage from vegetation	Competition is impacting survival, growth, or health of crop trees, is limiting the availability of plantable spots, or is preventing free growing status	Method, target vegetation species, retention expectations
Juvenile spacing	Reduce overstocking or create gaps	Countable density is greater than the maximum density threshold; stand shows signs of repression	Final target density (number of trees per hectare), species to retain or remove, crop tree selection criteria (e.g., health, spacing)
Pruning	Reduce potential infection sites (DSB[35]) or increase log/lumber value	Required by the forest stewardship plan; aligned with stand development pathway	Pruning density, lift height, preferred species, crop tree characteristics

[34] ATOP = at time of planting

[35] DSB= white pine blister rust. The best time to prune is when trees are 1-2 m tall, followed by a second lift when trees reach 4-5 m.

8.1.2.3 Non-treatment Recommendations

Table 10 provides examples of non-treatment recommendations. They are meant to help you decide where administrative or monitoring actions may be appropriate, and how to clearly communicate them. The table does not cover every possible situation.

TABLE 10. Non-treatment recommendations: use and documentation requirements

Recommendation type	When to use	What to include
Survey	• Well-spaced densities are close to the minimum stocking standard (MSS) and natural infill is likely • To check progress before the free growing survey • To monitor forest health • To map brushing areas • To assess treatment outcomes • To assess free growing status	• Year, season, objective, any specific data to collect or task to do
Site plan amendment	• To change stocking standards to match updated ecological classification • To add an acceptable species • To adjust the minimum inter-tree distance (MITD) or reduce the MSS due to site limiting factors • To correct spatial information • To align stocking standards with the silvicultural system and stand structure	• Proposed amendment (e.g., new site series, added species, revised MITD, revised MSS) • Justification based on current field observations, research, references • Any supporting data (e.g., soil conditions, plant information, leader growth on tree species, stump count) • GPS track (if relevant)
Approved variation	• When the situation meets the conditions of an approved forest stewardship plan; and • the variation is needed or would help meet objectives	• State that an approved variation should be completed in RESULTS • Identify what the variation refers to (e.g., species, MITD, broadleaf competition criteria)

Recommendation type	When to use	What to include
		• Confirm that the conditions of the approved variation have been met

Declaration	• When survey results show that the standard has been met
	• For free growing declarations, you must reasonably believe the stand will remain free growing:
	  ○ until 20 years after the harvest start date; or
	  ○ for 5 years after the last brushing/spacing treatment if it occurred more than 15 years after the start date
		• State whether to declare regen delay or free growing
		• Provide any required comments to attach to the declaration in RESULTS (e.g., “using 46.11(2)(b)), FPPR[36] 86(3)(d)(iii) applies”)

8.2 Report Review (Quality Assurance)

Surveys are professional forestry work. They must be completed by, or under the supervision of, a Registered Professional Forester, Registered Forest Technologist, or Silviculture Accredited Surveyor.

An individual who passes the provincial accreditation exam becomes qualified as an Accredited Silviculture Surveyor (BCASS). To work independently, they must apply to register with Forest Professionals British Columbia (FPBC) as a Silviculture Accredited Surveyor (SAS). A SAS may complete surveys independently, but they may not assume professional responsibility for declarations.

Surveys that are associated with a declaration must be reviewed and accepted by an FPBC registered member. They assume full professional responsibility for the work and declaration. A SAS may complete and review surveys that are not associated with declarations.

[36] FPPR = Forest Planning and Practices Regulation

If a survey is completed by a non-registered individual or trainee, an FPBC registered member or SAS must review the work and assume full professional responsibility for it. This includes reviewing the plots and the survey report for accuracy, completeness, and correctness.

To help guide the review, an FPBC registered member can ask the following questions:

General Survey Setup

- Are the correct standards applied? (check the site plan)
- Are all obvious strata identified?
- Are strata supported by field justification (e.g., species composition, stocking, basal area)?
- Was the minimum number of plots established (≥ 5 per stratum)?
- Does the sampling intensity and method meet the contract requirements?

Data Collection

- Are all well-spaced/free growing species listed in the stocking standard? If not, has an amendment been proposed?
- Are there any data entry errors (e.g., 41 m versus 4.1 m)?
- Are all free growing height measurements greater than the free growing minimum heights?
- Do the inventory and silviculture ages/heights make sense given the species, site index, disturbance date, and treatment history?
- Do the species make sense given the BEC subzone and planting history?
- Do the collected data align with the stratum comments and photos?
- If a treatment is prescribed, were data on the relevant variables collected (e.g., number of plantable spots, germinants, and preparable spots; height/diameter of broadleaf species)?

Site Index

- Was SI determined for the leading inventory species?
- Was the source reasonable?
- If SIBEC was used and the stratum has multiple site series, was a proportional average calculated?

Statistical Analysis

- Is the lower confidence limit greater than the minimum stocking standard?
  - If not, is the confidence interval less than the desired precision?
    - If not, is the stratum maximum plotted (1.5 plots per hectare)?
- Has the minimum number of preferred trees been met?

Forest Health

- Are there inconsistencies between this survey and previous surveys?
- How do the reported forest health factors compare to those identified in the site plan?
- If previously identified issues are not present, is there an explanation (e.g., treatment, natural recovery, surveyor misidentification, low sampling intensity)?
- Were photographed forest health factors correctly identified?
- If damage was localized, was the area stratified (e.g., high-incidence root disease stratum)?
- If root disease was identified, was the netdown process applied correctly?

Note: The root-disease netdown process was substantially revised in 2026. Make sure you are using the current procedure outlined in the 2026 FS 660. For detailed instructions and examples, watch this training video.

Multi-layer Stratum

- If there is > 5 m^2/ha dispersed retention and a regeneration obligation, is there a separate Layer 1 inventory with total basal area?
- Have the following been reported for the polygon:
  - tree cover pattern
  - reserve type
  - reserve objective
- Does the reserve objective align with the site plan?
- Does the tree cover pattern and reserve type align with available imagery and the site plan?

- Will the site index reported to RESULTS reflect the leading inventory species for the layer that is expected to have the highest volume at the next rotation?

Report

- Are the inventory and silviculture labels complete and correctly formatted?
- Do the final comments address stocking, forest health, brush, access, and safety?

Recommendations

- Is a treatment required to meet the stocking standard by the regeneration date or free growing date? Is a treatment required to meet the long-term objectives?
- Are prescribed treatment areas shown on the survey map?
- Are all recommendations supported by plot data, notes, and photos?
- Are the recommended treatments specific, cost-effective, possible to achieve, and biologically suited to the site? Do they align with legal time frames and stocking standards?
- Do the recommendations clearly state what to do, how and when to do it, and what follow-up is required?
- Do the recommendations aim to meet the target stocking standard, not just the minimum?

8.3 RESULTS Reporting

After a survey is completed for regeneration delay or free growing, a forest cover report[37] is submitted to RESULTS. It includes up to four components (Figure 17):

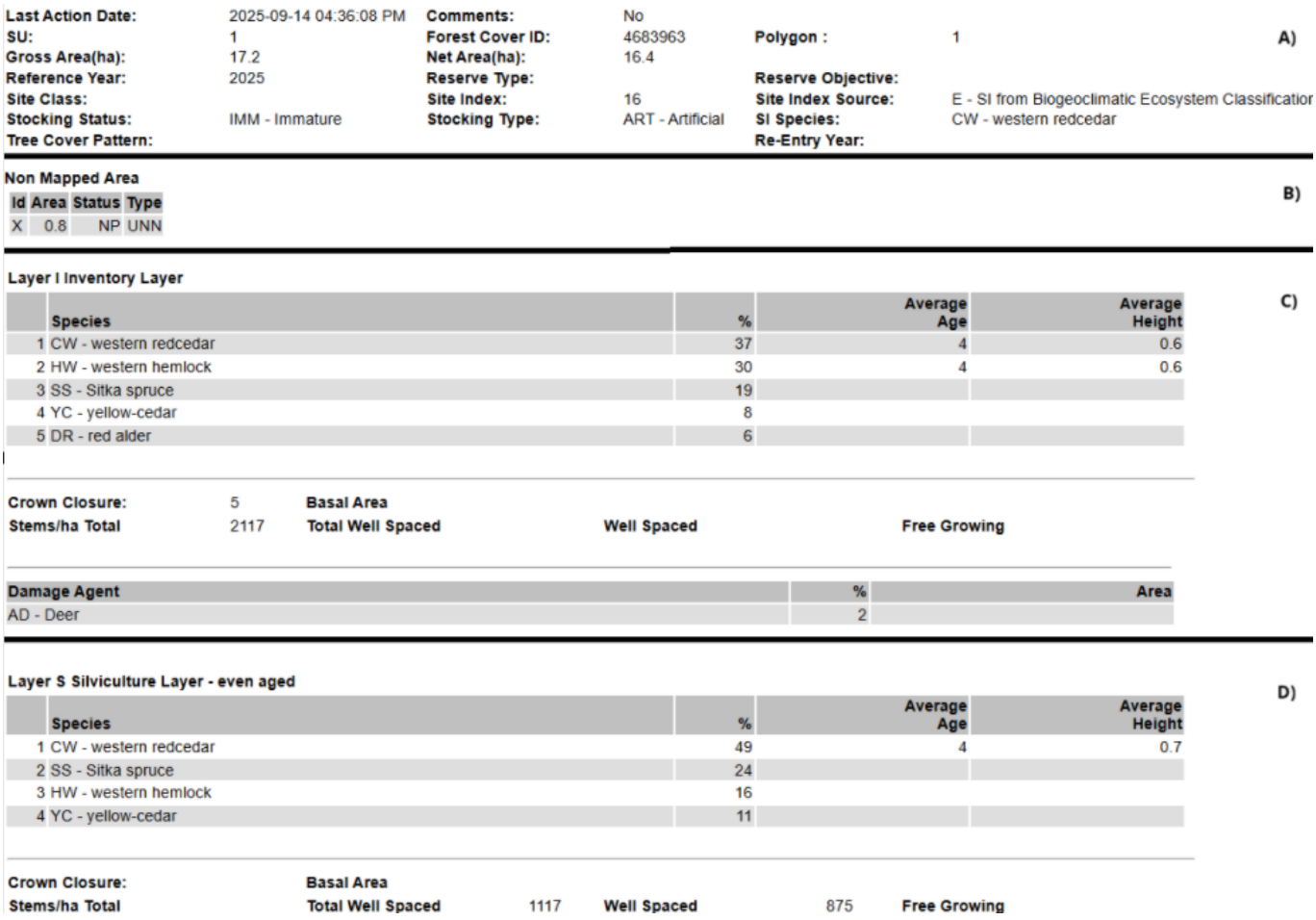
- **Polygon**: the spatial unit being reported, equivalent to a survey stratum. Key fields are stocking status, stocking type, reserve type, reserve objective, tree cover pattern, site index, and site index source.
- **Non-mapped**: used to remove non-productive areas from the net area reported (e.g., roads, landings, pipelines).

[37] A forest cover update submitted with a milestone declaration must be “current”, as required under FPPR s.97(7). “Current” can be interpreted as meaning the survey was completed within the last 18 months.

- **Inventory**: reflects all trees in the stratum. The same information as the inventory label is provided, plus total basal area, damage agent and incidence, and incidence area.
- **Silviculture**: reflects crop trees in the stratum. The same information as the silviculture label is provided, plus total well-spaced density and crop basal area (if applicable).

Note: The survey contract will specify whether you are expected to submit the forest cover report to RESULTS.

Review the RISS for more information on RESULTS reporting. Make sure you are using the version that applies to your situation, because reporting requirements are not the same across all tenures or funding sources.



Last Action Date:	2025-09-14 04:36:08 PM	**Comments:**	No			
SU:	1	**Forest Cover ID:**	4683963	**Polygon :**	1	**A)**
Gross Area(ha):	17.2	**Net Area(ha):**	16.4			
Reference Year:	2025	**Reserve Type:**		**Reserve Objective:**		
Site Class:		**Site Index:**	16	**Site Index Source:**	E - SI from Biogeoclimatic Ecosystem Classificatior	
Stocking Status:	IMM - Immature	**Stocking Type:**	ART - Artificial	**SI Species:**	CW - western redcedar	
Tree Cover Pattern:				**Re-Entry Year:**		

Non Mapped Area **B)**

Id	Area	Status	Type
X	0.8	NP	UNN

Layer I Inventory Layer **C)**

	Species	%	Average Age	Average Height
1	CW - western redcedar	37	4	0.6
2	HW - western hemlock	30	4	0.6
3	SS - Sitka spruce	19		
4	YC - yellow-cedar	8		
5	DR - red alder	6		

Crown Closure:	5	**Basal Area**			
Stems/ha Total	2117	**Total Well Spaced**	**Well Spaced**		**Free Growing**

Damage Agent	%	Area
AD - Deer	2	

Layer S Silviculture Layer - even aged **D)**

	Species	%	Average Age	Average Height
1	CW - western redcedar	49	4	0.7
2	SS - Sitka spruce	24		
3	HW - western hemlock	16		
4	YC - yellow-cedar	11		

Crown Closure:		**Basal Area**				
Stems/ha Total		**Total Well Spaced**	1117	**Well Spaced**	875	**Free Growing**

FIGURE 17. Example forest cover submission to RESULTS showing a) the polygon component b) the non-mapped area c) the inventory component d) the silviculture component.

Chapter 9: Additional Concepts and Field Techniques

The following sections describe independent field techniques, not sequential steps. You must select and use only the techniques required by the survey objectives, stand conditions, stocking standards, and site conditions. Not all sections in this chapter apply to every survey.

If you need to...	Use this section
Determine site index	9.1
Check if density exceeds limits	9.2
Measure basal area	9.3
Speed up tallies in dense regen	9.4
Decide how to count forks	9.5
Measure tree heights	9.6
Determine tree age	9.7
Assess competition	9.8
Determine area of dispersed strata	9.9
Estimate crown closure	9.10
Collect Swiss needle cast data	9.11
Measure infection distance	9.12
Rank forest health factors	9.13
Mark plots, POCs, or strip lines	9.14

9.1 Estimating Site Index

Site index (SI) is a measure of how productive a site is for growing trees. It indicates the average height that dominant trees of a given species will reach at 50 years of age, measured from breast height (1.3 m above the ground).

For silviculture surveys, record and report SI for the leading inventory species. For multi-layer strata, the SI species is the leading inventory species in the stratum for the layer that is expected to have the highest volume at the next rotation.

Licensees may also choose to record SI for the leading silviculture species, but this information is not reported to RESULTS.

During the walk-through, decide which SI method to use for each stratum. Choose the most accurate method available. The two most common methods used in silviculture surveys are:

- SIBEC (site index by BEC classification)
- growth intercept

If neither method is suitable, consider using the:

- site index curve method (for stands with between 30 and 140 years of growth above breast height)
- site class conversion (last resort)

For more detailed instructions, refer to How to Determine Site Index in Silviculture.
For help choosing a method, see the SI method flowchart in Section 31a of the FS 660.
To determine the site index source code, see Section 31b of the FS 660.

9.1.1 SIBEC

Best for:

- young stands (with less than 3 years of growth above breast height)
- older stands for which other methods are not suitable

Limitations:

- not available for all species or site series
- accuracy depends on correct ecological classification

How it works:
Use the site series and subzone (BEC unit) to look up a site index value for the leading inventory

species in the SIBEC table. If the stratum includes more than one site series, calculate a weighted average based on percent area.

Example:
A Douglas-fir stratum in the CWHxm includes:

- 60% site series 01 → SI = 32 m
- 30% site series 03 → SI = 27 m
- 10% site series 05 → SI = 22 m

Weighted SI = (0.6 × 32) + (0.3 × 27) + (0.1 × 22) = 29.5

SIBEC tables: https://www2.gov.bc.ca/assets/gov/environment/plants-animals-and-ecosystems/ecosystems/sibec-documents/sibec2013approx_final.xlsx

9.1.2 Growth Intercept Method

Best for:

- even-aged Pli, Sx, Hw, Ss, Fdc, Fdi, Bl, and Hwi stands, aged 3 to 30 years at breast height

Limitations:

- Growth intercept tables are not available for all species.
- Data collection for the growth intercept method is slow and may damage crop trees.
- Cannot be used if:
  - trees are overtopped, suppressed, diseased, or damaged
  - the stand has received treatments that affect growth (e.g., fertilization) or density (e.g., brushing, spacing)
  - there are fewer than 500 trees per hectare, or there is an uneven distribution
  - trees are too young (less than 3 years at breast height)

How it works[38]:

- Complete 10 growth intercept plots per stratum or up to a maximum of 1 growth intercept plot per hectare.

[38] For more detailed instructions, refer to Growth Intercept Method for Silviculture Surveys.

- Use the same plot centre as your silviculture plots, and complete an overlapping 5.64-m radius plot for growth intercept data collection.

1. Select the largest diameter-at-breast-height (dbh) tree of the stratum's leading inventory species in the 5.64-m plot.
2. If the tree is acceptable, continue with the measurements. If it is not, continue to the next plot. Sample trees should have the following characteristics (Figure 18):

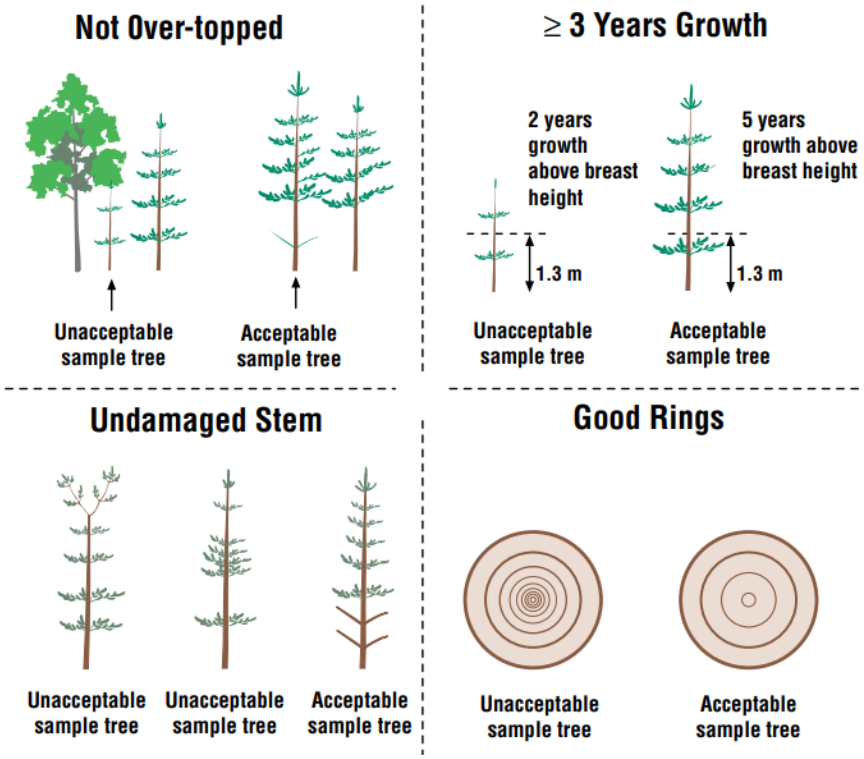


FIGURE 18. Characteristics of acceptable and unacceptable growth intercept sample trees.

For each acceptable sample tree:

- Record the species.
- Measure the total tree height (m).
- Determine the age at breast height (1.3 m).

3. Look up the growth intercept in the growth intercept tables[39] or use the SiteTools software:

[39] The FS 415 cards include procedure summaries and growth intercept tables by species; however, some tables are outdated.

- Interior tables
- Coast tables

4. Calculate the average site index.

Note: To learn how to access SiteTools through TIPSY 4.6 and format growth intercept tables for maximum accuracy, watch this video.

9.1.3 Site Class Conversion

Use site class conversion only when the site index cannot be determined using more accurate methods.

Normally, you:

1. Estimate the site class for the stratum and the leading inventory species, and
2. Use Table 11 to look up the corresponding site index.

To estimate site class, consider:

- site series (BEC)
- indicator plant species
- topographic position
- soil moisture/nutrient regime
- local climate information

If the site class is uncertain:

- use SIBEC to determine a site index for an available species,
- match that value to the closest site class category in Table 11, and
- use that category to determine the site index for the leading inventory species.

TABLE 11. Site class to site index conversion

Inventory label leading species	Region	Good	Medium	Poor	Low
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
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

9.2 Assessing Maximum Density

Maximum density is the threshold for how many countable conifers are allowed in a stand. If the number of countable conifers is higher than this threshold, the stand may need juvenile spacing before it can be declared free growing.

When to Check Maximum Density

Assess maximum density only if:

- a maximum density is listed in the stocking standards, and
- the total number of conifers is above that threshold.

If no maximum density is listed, or the conifer density is clearly below the threshold, you do not need to tally countable conifers.

Tallying Countable Conifers

In Even-Aged Stands

1. Find the median height of the well-spaced trees in your plot:
    - Select the tallest well-spaced trees (up to the M-value).
    - Measure their heights and arrange them from shortest to tallest.
    - If you have an odd number of trees, the median height is the middle one. If you have an even number, average the two middle heights.
2. Calculate the countable height:
    - If the median height is **2 m or less**, multiply it by **30%**.
    - If the median height is **more than 2 m**, multiply it by **50%**.
3. Count all conifers taller than the countable height. They are your countable conifers.

In Single-Tree Selection Stands

1. Count all conifers in Layer 3 (trees taller than 1.3 m but with a diameter less than 7.49 cm at breast height).

Example: In the first example shown in Figure 19, the countable height is 50% of tree #4's height: 2.1 m x 0.5 = 1.05 m. All trees taller than 1.05 m are countable.

In the second example, there is an even number of well-spaced trees. The countable height is 30% of the average height of trees #2 and #4: (2.1 m + 1.8 m)/2 x 0.3 = 0.58 m.

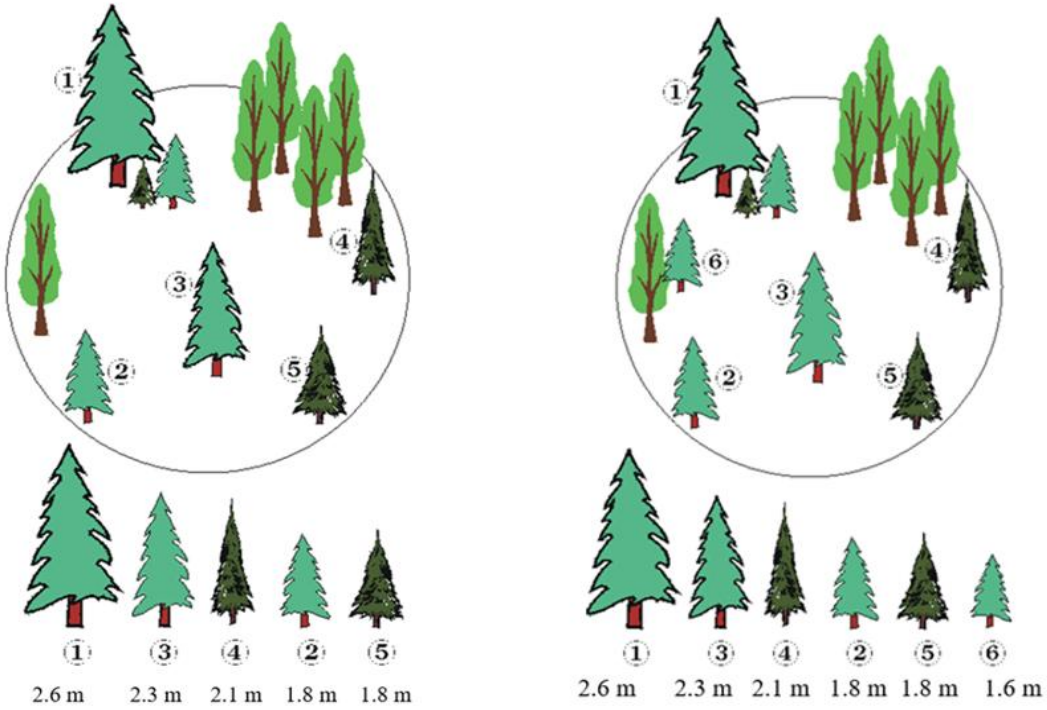


FIGURE 19. Examples of median height determination in an even-aged stand, with an odd number of well-spaced trees and with an even number of well-spaced trees.

9.3 Estimating Basal Area

Basal area is estimated using either a variable-radius or fixed-radius plot.

9.3.1 Variable Radius Methods

Basal area can be estimated in a variable-radius plot using a prism or angle gauge. Both tools classify trees as “in”, “out”, or borderline based on stem width at breast height (1.3 m) and a known basal area factor (BAF).

Use the same tool and basal area factor throughout the stratum.

Assess only trees that meet the minimum size and layer criteria required for the survey. Trees below the minimum size do not need to be checked with a prism or an angle gauge.

Prism method

Rule: The prism stays over plot centre. You move around it.

1. Stand at plot centre.

2. Hold the prism vertically at eye height, directly above plot centre.
3. Keeping the prism fixed over plot centre, rotate your body in a full circle, and assess each candidate tree.
4. Compare the displaced image seen through the prism with the true stem image at breast height (Figure 20):
    - Overlapping images = “in”
    - Clear gap between images = “out”
    - Displaced image equal to stem = borderline
5. Count all “in” trees and multiply by the prism basal area factor (m^2/ha).

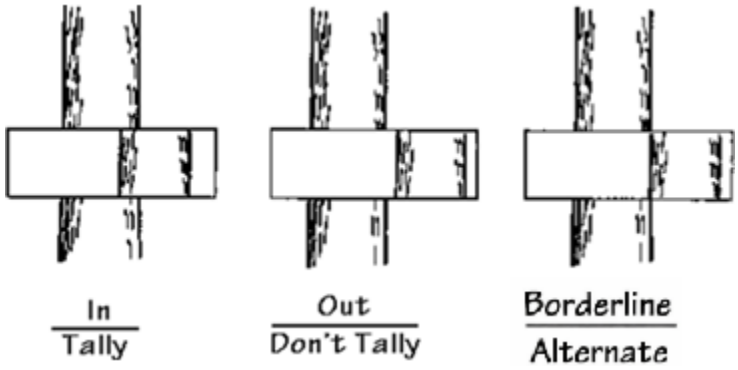


FIGURE 20. "In", "out", and "borderline" trees

Angle gauge method

Rule: Your eye stays over plot centre. The gauge moves around it.

1. Insert a stick at plot centre. Keep your eye fixed over it.
2. Hold the ring at the end of the chain to your eye, over the plot centre. Extend the gauge to the full length of the chain.
3. Keeping your eye stationary, sweep the gauge 360° around the plot, and assess each candidate tree.
4. For each tree at breast height:
    - stem wider than the gauge opening = “in”
    - stem narrower than the gauge opening = “out”
    - stem equal to the gauge opening = borderline
5. Count all “in” trees and multiply by the gauge basal area factor (m^2/ha).

Borderline Trees

A tree is borderline when its in/out status is uncertain using a prism or angle gauge.

When this occurs:

- Double-check your call.
- If still unsure, alternate your calls (first borderline = “in”, next = “out”, and so on).

9.3.2 Fixed-Radius Methods

Use this method when a prism or angle gauge is not available.

1. Establish a 5.64-m radius plot (or another approved plot size).
2. Measure dbh for all Layer 1 trees in the plot.
3. Divide each dbh measurement by 2 and convert it to metres; this is the tree’s radius.
4. Calculate each tree’s basal area:

$$BA = \pi r^2$$

5. Sum all tree basal area values to obtain the plot basal area.
6. Calculate the average plot basal areas of all plots, then multiply by the plot multiplier to estimate m^2/ha.

9.4 Estimating Tree Tallies in High-Density Plots

A 3.99-m plot that contains more than 50 trees (all species combined, not including germinants) is considered a high-density plot. In these plots, you can estimate tree numbers by species instead of counting each stem.

Estimation method:

1. Split the plot into an east half and a west half. Use your plot number to choose which half to assess (Table 12).
2. Estimate the number of trees in that half. If there are fewer than 50 trees, count each tree by species and multiply by 2 to estimate the number of trees in the whole plot.
3. If the half has more than 50 trees, divide it again into quarters. Use Table 12 to identify which quarter to assess.

4. Count each tree by species in that quarter and multiply by 4 to estimate the number of trees in the whole plot.

This method reduces the time needed to tally trees in high-density plots. It also provides a reasonable estimate of species composition and overall density.

TABLE 12. Plot division method for plots with a high density of trees (> 50 trees)

Plot number	Selected half	Selected quarter
Even	East half	Northeast quarter
Odd	West half	Southwest quarter

9.5 Counting Trees with Forking

When tallying trees, it is important to decide whether a forked stem counts as 1 tree or 2 trees.

You can use the pith intersection to decide if the tree is forked, and if it should be counted as 1 or 2 trees. The pith intersection is the point where the centre lines (piths) of the stems meet inside the tree.

How to Count Forked Trees

1. If the pith intersects below 1.3 m and above the point of germination (ground level) (Figure 21a):
   → count as 2 trees
2. If the pith intersects above 1.3 m (Figure 21b):
   → count as 1 tree
3. If the pith intersects below the point of germination (Figure 21c):
   → count as 2 trees. This is not considered a fork.

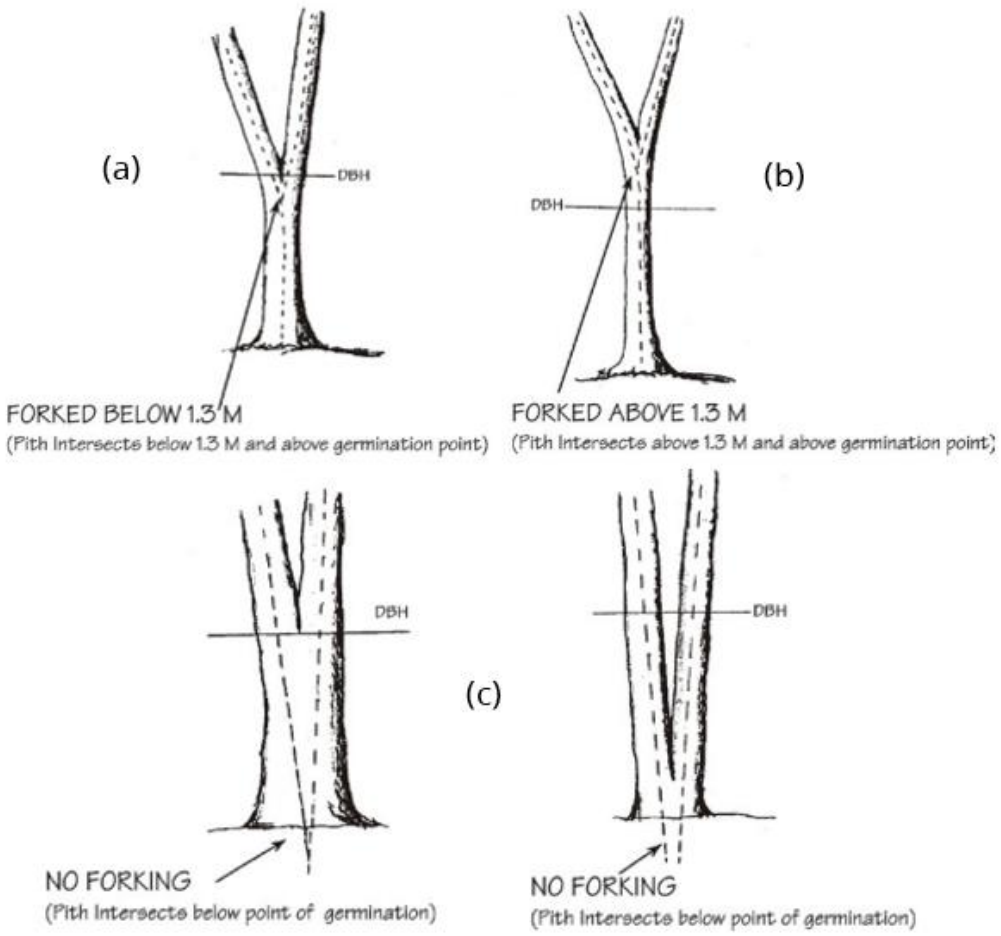


FIGURE 21. Counting trees with and without forks: (a) count as 2 trees, (b) count as 1 tree, (c) count as 2 trees.

9.6 Measuring Tree Heights

- Record tree height in metres to one decimal place (e.g., 4.2 m).
- Measure total tree height from the point of germination (ground level) to the top of the live leader.
- On slopes, measure height from the uphill side of the tree.
- Use a measuring tape, telescopic height pole, clinometer, or hypsometer, depending on tree size.

> **Tip**: Some free apps can function as a clinometer and may be suitable for measuring mature tree heights. These apps measure the angles to the top and bottom of the tree and calculate tree height using a horizontal distance you enter.

- For leaning or sweeping trees, measure vertically from the point of germination to the level of the live leader tip. Do not follow the curve of the stem or measure along the lean. The red line in Figure 22 shows how to measure height on a sweeping tree.

FIGURE 22. Measuring height on a sweeping tree.

9.7 Determining Tree Ages

You can use different methods to determine tree age. The method used will depend on the species growth pattern, the size or maturity of the tree, and whether the tree was planted. Use the least destructive method wherever possible.

Planted Trees

Calculate age as the nursery age plus the number of completed growing seasons since planting.

- Count only completed growing seasons.
- Do not count partial growth from the current year.

Examples:

- Survey June 2026, 1+0 planted September 2023: 3 years old
- Survey June 2026, 1+0 planted April 2023: 4 years old
- Survey September 2026, 1+0 planted September 2023: 4 years old
- Survey September 2026, 1+0 planted April 2023: 5 years old
- Survey September 2026, 2+0 planted April 2023: 6 years old

Counting Whorls (Determinate Species)

Use this method for species that form a distinct whorl of branches each year (e.g., Douglas-fir and lodgepole pine):

1. Locate the lowest whorl of live branches above the ground.
2. Count each complete whorl upward to the current year's leader.
    - Each whorl equals 1 year of growth.
    - Do not count the current year's leader until growth is complete.
3. Add the nursery age for planted stock.

Tip: Ignore epicormic shoots or abnormal branch clusters. Count only true whorls.

Destructive Sampling (Indeterminate Species)

Use this method only when whorls are not distinct (e.g., western hemlock) and other methods are not suitable:

1. Cut the tree at the base of the stem.
2. Count annual growth rings outward from the pith. Do not count the pith (Figure 23).

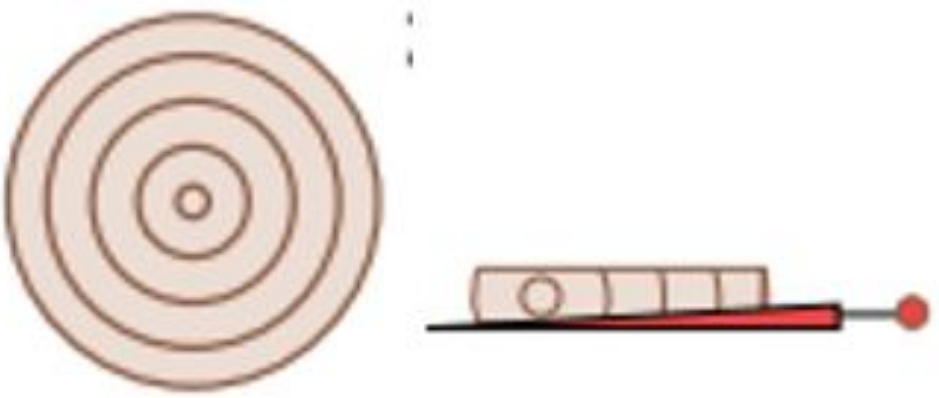


FIGURE 23. A cut stem and an increment core of a 4-year-old tree.

Coring Trees

Use this method for older trees:

1. Bore the tree at breast height (1.3 m).
2. Extract the core and ensure it reaches the pith.
3. Count annual rings outward from the pith. Do not count the pith.
4. Add years for growth below breast height using the FS 660 correction table (Table 34), based on species and site index.

   Example: For a Fdi on a site with a site index of 24 m, add 8 years to the annual ring count.

9.8 Assessing Competing Vegetation

9.8.1 Purpose of Assessing Competing Vegetation

Under the *Forest and Range Practices Act* (FRPA), a free growing stand is defined as:

> "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."

This definition applies to the stand, not to individual trees. However, in most silviculture surveys, competing vegetation around individual crop trees is assessed as a practical way of determining whether the stand meets this requirement.

The assessment of competing vegetation is intended to confirm that the stand can meet the legal free growing obligation and is developing in a way that supports its intended stand structure and management objectives at maturity. It also helps in assessing whether the stand can reach this condition without significant additional intervention, representing an acceptable level of long-term risk to the Crown.

9.8.2 Competition Criteria to Use

Assess competing vegetation using one of the following:

- the competition criteria specified in the site plan or forest stewardship plan, or

- the default crop-to-brush ratios in the Reference Guide for FDP Stocking Standards (used when the site plan or forest stewardship plan does not specify stocking standards or competition criteria for a standards unit), or
- the local geographic competition assessment criteria in the FS 660 and Appendix 2.2.
    - Use the crop-to-brush or brush-to-crop ratios specified in the site plan or forest stewardship plan.
    - If ratios are not specified, use the default ratios from the Reference Guide for FDP Stocking Standards.

Local Geographic Criteria Regions

The local geographic competition assessment criteria are divided into four regions (Appendix 2.1). Use the correct set of criteria based on region, timber supply area, biogeoclimatic subzone, site series, and site history:

- Coast: West Coast and South Coast regions
- North Interior: Northeast, Omineca, and Skeena regions
- South Interior – Standard: Cariboo, Kootenay-Boundary, Thompson-Okanagan regions
- South Interior – Alternate: SBPS mk, SBPS dc, SBS dw 1, SBS dw 2, IDF dk 3, IDF dk 1 for the Williams Lake, Quesnel, and 100 Mile timber supply areas, on sites without prior broadleaf brushing or spacing

9.8.3 Core Concepts

Quadrant Method

Create a vertical cylinder with a 1-m radius around the crop tree. Divide the cylinder into four equal quadrants (Figure 23).

- Quadrants cannot be split.
- You may rotate the cylinder to minimize the number of quadrants that contain vegetation taller than the crop tree.

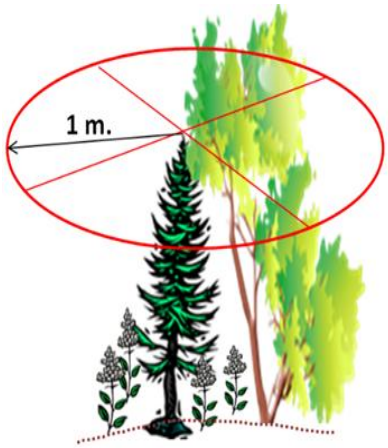


FIGURE 24. The free growing crop tree is taller than the shrubs and herbs in three of the four quadrants.

Conifer-to-Brush Ratio

Divide the height of the crop tree by the height of the tallest competing vegetation or broadleaf within the 1-m radius cylinder, then multiply by 100. Compare this value to the conifer-to-brush ratio in the site plan or forest stewardship plan (Figure 25). If it is not listed, use the default ratios from the Reference Guide for FDP Stocking Standards:

- **125%:** BG, ESSF, IDF, MH, MS, and PP zones
- **150%:** all other zones

Note: The competing vegetation does not need to originate inside the 1-m radius cylinder (Figure 24).

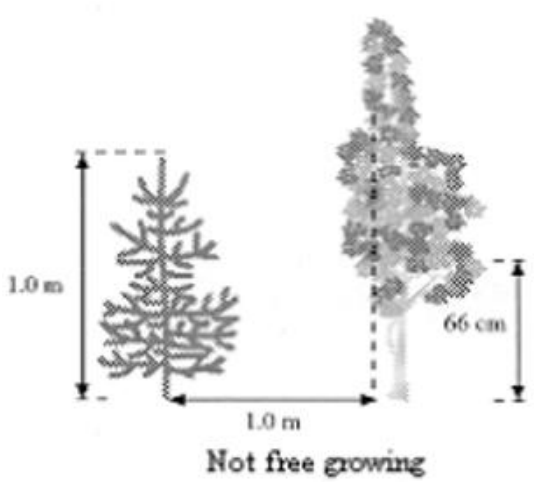


FIGURE 25. Example of a tree that is not free growing. The conifer tree is not 150% or more the height of the tallest competing vegetation within a 1-m radius.

Potentially Free Growing Crop Trees

Count crop trees that are well-spaced and that meet minimum height and damage criteria, as well as the quadrant and conifer-to-brush ratio requirements outlined in the local geographic decision keys.

Countable Broadleaf Trees

Determine the median height of the potentially free growing crop trees. Count all broadleaf trees in the 3.99-m plot that are taller than the median height of the potentially free growing crop trees.

For this step only, broadleaf trees that originate from cut stumps due to vegetation management or harvesting are counted as shown in Table 13.

TABLE 13. Number of broadleaf trees growing from cut stumps, and the countable number for free growing assessment

Number of stems	Countable broadleaf stems
1	1
2–5	2
6+	3

This rule applies only when determining countable broadleaf stems using the local geographic decision keys. It does not apply to inventory tallies by species (Figure 26).

FIGURE 26. Counting and tallying broadleaf stems originating from a stump and from below-ground root suckers.

Allowable Number of Countable Broadleaf Trees

Look up the allowable number of countable broadleaf trees for the crop species, biogeoclimatic subzone and variant, and site series. If the number of countable broadleaf trees is greater than the allowable number for a given species, then the potentially free growing crop trees of that species are not free growing.

Note: This step does not affect trees that have already been identified as free growing using the decision key.

9.8.4 Special Cases, Timing, and Exceptions

The following guidance applies only in specific situations, and it modifies how competing vegetation is assessed.

Layer 1 Broadleaf Trees

Mature Layer 1 broadleaf trees (dbh = 12.5 cm or greater) are considered non-competitive when using the quadrant method to assess free growing conifers if their combined basal area is less than 8 m^2/ha.

Timing after Vegetation Management

Do not complete a free growing survey immediately after a vegetation management treatment. Vegetation must be given time to recover before a realistic assessment can be made.

Recommended number of full growing seasons to wait before surveying:

- ICH, IDF, MS, PP, BG, SBPS, CWH, CDF, MH, and ESSF: 2
- SBS and BWBS:
  - following herbicide treatment: 2
  - following manual or other treatments: 3

Mixedwood or Broadleaf Stocking Standards

The concepts of potentially free growing and allowable countable broadleaf trees do not apply in standards units where broadleaf species are listed as acceptable or preferred.

In these units:

- The conifer-to-brush ratio applies only to conifers.
- The requirement to be free from brush does not apply to broadleaf trees.

- Preferred or acceptable broadleaf trees are free growing if they are:
  - well-spaced, and
  - meet the minimum heights and broadleaf damage criteria.

9.9 Determining the Area of Dispersed Strata

You can estimate the area of dispersed strata using one of the following methods:

- visual estimate,
- photo interpretation,
- line-intersect sampling, or
- high-intensity point sampling.

Visual estimates or photo interpretation are the simplest methods used for estimating the area of dispersed strata, but they are typically the least accurate.

Instructions for high-intensity point sampling and line intersect sampling are provided below. Both methods give the percent of the standards unit that is within each stratum.

High-Intensity Point Sampling

1. Describe each stratum you will be sampling.
2. Lay out points in a systematic pattern across the standards unit. A 100-point sample is a good starting intensity.
3. At each point, record which stratum the point lands in. Assign only one stratum per point.
4. Tally the number of points in each stratum.
5. Calculate the area of each stratum.

$$\text{Area of stratum} = \left(\frac{\text{no. points in stratum}}{\text{total points}}\right) \text{ x SU area}$$

TABLE 14. Example of high-intensity point sampling

Stratum	No. points	Percent (%)	Area (ha)
SR & FG	78	74	12.6
SR, not FG	17	16	2.7
NSR	7	7	1.2
NP	3	3	0.5
Total	105	100	17.0

Line Intersect Sampling

1. Describe each stratum you will be sampling.
2. Lay out transect lines in a systematic pattern across the standards unit.
3. Walk each line and record where each stratum begins and ends.
4. Measure the length of line that is within each stratum.
5. Add up the total line length in each stratum.
6. Calculate the area of each stratum.

$$\text{Area of stratum} = \left(\frac{\text{line length in stratum}}{\text{total line length}}\right) \text{ x SU area}$$

9.10 Estimating Crown Closure

Crown closure is the percentage of ground area covered by the vertical projection of live crowns of living trees, including broadleaf and conifer species. Record crown closure to the nearest 5% (for example, 5, 10, 15, 20).

The preferred time to estimate crown closure is during full leaf flush. Estimates are not reliable for broadleaf species or larch when they have no leaves.

Preferred Method

- Use recent aerial photography (e.g., UAV imagery) whenever available.
- Calibrate visual estimates by comparing imagery to:
  - FS 660 speckle diagrams (Table 29a),
  - image analysis apps (e.g., Canopeo), and
  - observed ground conditions.

Ground-Based Estimates

If aerial imagery is not available, estimate crown closure from the ground using one or more of the following:

- Fraction of plot: estimate whether crown cover would fit within one-half, one-quarter, or one-eighth of the plot area.
- Reference area: use a known reference area within the plot to estimate how much ground is covered by crowns, then sum the total covered area. For example, a 1-m^2 quadrat in a 3.99-m radius plot is 2% of the plot.

- Estimated crown area: estimate the average crown area of a representative tree, multiply by the number of trees, and compare the result to the total plot area.
- Height and density: use the average tree height and total density with Table 29b of the FS 660.

Note: When crowns are open or have gaps, estimate only the portion of each crown that covers the ground.

9.11 Collecting Swiss Needle Cast Data (Coast region only)

Applicability: This procedure applies to all strata in the Coast region where Douglas-fir (Fdc) was the intended crop species. The presence or absence of Swiss needle cast signs or symptoms does not affect whether data are collected—collection is required in all applicable strata.

Timing: Complete data collection for Swiss needle cast during any survey type and in any season, once the Fdc is at least 5 years old.

Importance: Swiss needle cast poses an increasing threat to the long-term growth and productivity of coastal forests in British Columbia. Greater monitoring and adaptive strategies are needed to mitigate potential impacts.

Field Procedure:

At each full measure plot:

1. Select the tallest Fdc within the 3.99-m plot. Exclude residual trees.
2. Measure the tree's total height from ground level to the top of the dominant live leader.
3. Record the tree's age.
4. Measure current leader growth, in centimetres.
5. On the south side of the tree, select a branch from the fourth whorl up from the bottom of the live crown.
6. Confirm that the main axis of the branch has four internodes. If it does not, select a branch from the next lower whorl that does.
7. For each of the four most recent internodes, rate needle retention on the main axis using a value from 0.0 (0% retention) to 1.0 (100% retention).

Note: Year 1 represents the most recent (outer crown) growth; Year 4 represents the oldest (inner crown) growth.

8. Add the four internode ratings to obtain a total score between 0.0 and 4.0.

Data Handling

- Record all measurements in the Swiss Needle Cast Data Collection spreadsheet, including:
  - opening number,
  - survey date,
  - BEC subzone, variant, and site series, and
  - standards unit.
- Submit all Swiss needle cast data to the Coastal pathologist at the end of the field season.
- For a field demonstration and a detailed training video, go to the BC Silviculture Survey YouTube channel.

9.12 Measuring Infection Distance

When checking if an infection or gall rust meets the free growing damage criteria:

1. Locate the branch collar (where the branch joins the stem).
2. Measure along the branch from the outer edge of the stem at the branch collar to the closest outer edge of the infection or gall.
   - Keep the tape straight along the branch.
   - If there are multiple infections or galls, measure the one closest to the stem on a living branch.

9.13 Ranking Forest Health Factors

Trees may have more than one forest health factor, but you should record only the most serious factor for each tree. Follow the steps below to rank all observed forest health factors.

Step 1: Identify all forest health factors on the tree.

Check the full stem, crown, and root collar for damage from biotic and abiotic factors.

Step 2: Rank the factors by likely outcome of damage.

Record the factor with the highest expected impact. Use the following order (worst to least severe):

mortality > **non-merchantability** > **wood quality loss** > **growth loss**

Use Table 15 as a general guide. It was developed for young stand monitoring (stands 15-50 years), so use your judgement when applying the rankings in younger stands.

Note: Severe decay and severe quality impacts may both affect merchantability.

TABLE 15. Common conifer forest health factors for stands > 15 years: (a) interior BEC zones, (b) coastal BEC zones

a) Interior BEC zones

Biogeoclimatic zone																	
BWBS		**ESSF**		**ICH**		**IDF**		**MS**		**PP**		**SBPS**		**SBS**		**SWB**	
IB*	m	IB*	m	IB*	m	IB*	m	IB*	m	IB*	m	IB*	m	IB*	m	IB*	m
IDE	g	NAV	m	DRA	m,g	NB	m,g	NB	m,g	IBW	m	NB	m,g,q	DRA**	m,g	DSG	m,g
IDB	g	NY	q	DRL	m,g	DRA	m,g	DRA	m,g	NB	m,g	DSC	m	DRL**	m,g	DRT	g,m
IWS	q	DRA	m,g	AB	g,m	DRL	m,g	DRL	m,g	DRA	m,g	IWW	m	DRT	g,m	NY	q
DDP	d	ND	g,m	DRT	g,m	DSB	m	DRT	g,m	DSG	m,q	DSS	m,g	NB	g,m	AP	q
DB	q	DSG	m,q	IWW	m	DSC	m	DSB	m	IDW	g,m	ND	m,g	IWW	m	DB	q
		DDP	d	DSB	m	DSS	m,g	DSC	m	DDP	d	DFE	g,m,q	DSC	m	NG	q
		DDE	d	DSC	m,g	DSG	m,g	DSS	m,g			DSG	m,q	DSB**	m		
		IWS	q	DSS	m,g	IDW	g,m	DSG	m,g			DMP	g,m,q	DSS	m,g		
		DB	q	DSG	m,q	DML	g,m	DMP	g,m			DSA	q,m	DSG	m,q		
				IDL	g,m	DFE	g,m,q	IWS	g,q			DFL	g	DMP	g,m		
				IWS	g,q	DFL	g	DML	g,m			IDI	g	IDB	g		
				DFS	g,m	IDI	g	IDI	g			IWP	q	DFS	g		
				DML	g,m	DFH	g	DFL	g			ISP	q	NY	q		
				DFL	g	DFM	g	DFH	g			DB	q	DFE	g		
				DFH	g	WS	g	DFM	g			AS	q	IWS	g,q		
				DFM	g	DDP	d	WS	g					DFL	g		
				DDE	d	DDQ	d	DSA	q					IDI	g		
				DDP	d	DSA	q	DDP	d					IWP	q		
				DSA	q	ISP	q	IWP	q					DDP	d		
				ISP	q	DB	q	ISP	q					DSA	q		
				DB	q			DB	q					ISP	q		
														DB	q		

b) Coastal BEC zones

Biogeoclimatic zone					
CDF		**CWH**		**MH**	
DRL	m,g	DRL	m,g	DRL	m,g
DRA	m,g	DRA	m,g	DMH	g,m
NW	m	NW	m	NCY	g,m
ND	m	DSB	m	DDP	d
DSB	m	ND	m	DB	q
DMH	g,m	DRN	g,m	NY	q
DFU	g,m	DMH	g,m		
DFW	g	NCY	g,m		
DDP	d	IDH	g		
		IWS	g		
		DFW	g		
		DFU	g		
		DDP	d		
		AB	g,q		
		AE	q		

Notes

1. The forest health factors are listed by BEC zone in order of typical decreasing relative importance. The order may vary depending on severity and prevalence.
2. The two- or three-letter damage codes are followed by impact qualifiers: **m** = mortality; **g** = growth reduction; **d** = decay; **q** = quality.
3. IB* indicates major bark beetle species (IBB, IBD, IBM, IBS).
4. ** indicates the forest health factor is restricted to the southern SBS.

Step 3: Evaluate the severity of damage.

Assess the severity of the damage. A lower-priority factor with high severity may outrank a higher-priority factor with low severity.

Step 4: Evaluate the position of damage.

Determine where the damage occurs. Damage lower on the bole (first 2 m) generally has greater long-term impact than minor foliage or high-crown damage. Above the first 2 m, rank the damage by severity and expected outcome. Significant damage higher on the bole may outrank a higher-priority factor that affects only minor foliage or high branches.

Step 5: Determine primary versus secondary factors.

Decide which factor started the problem and which factors followed. Secondary factors commonly attack trees weakened by primary factors (e.g., drought or root disease). Look for primary factors when secondary factors are observed. Secondary symptoms may be more visible or may mask the primary ones. An example of an association between primary and secondary factors is squirrel damage after a stem rust. Rank the factor that is most responsible for the damage.

Step 6: Consider geographic location.
Adjust the ranking when known BEC- or region-specific patterns change the expected severity or outcomes.

Step 7: Apply pine stem rust and canker order.
When ranking pine stem rusts and cankers, use **DSC > DSS > DSG > DSA**. Rank stem infections higher than branch infections.

Exception: If DSG is on the stem, and a DSC or DSS infection is on a living branch close to the stem, and the DSG stem damage is relatively small, rank DSC or DSS higher because these pathogens can quickly spread from branches to the stem.

Step 8: For dead trees, determine the leading cause of mortality.
When multiple factors are present, follow Steps 2–7 and record the factor most responsible for death.

Examples

Example 1
An interior spruce in the MS shows multiple years of leader damage from white pine weevil (IWS). Armillaria root disease (DRA) is present at the base of the tree and elsewhere in the stand.
Primary forest health factor: DRA
Reason: DRA is more likely to cause future mortality; IWS primarily affects form and growth.

Example 2
A young lodgepole pine in the SBS has several witches' brooms and lodgepole pine dwarf mistletoe (DMP) infections in the crown and on the lower bole. One branch has an inactive western gall rust canker (DSG).
Primary forest health factor: DMP

Reason: The severity of DMP infection and expected impacts on mortality, growth, and quality outweigh the minor DSG branch canker.

Exception: If the DSG canker is on the lower main bole, DSG could be ranked as the primary factor.

Example 3
A young lodgepole pine in the ESSF has a significant bend caused by snow press (NY). Many branches and the leader show hare browsing (AH).
Primary forest health factor: NY
Reason: NY has the greater long-term impact on mortality and form, even though AH is severe.

9.14 Field Marking

Plot Centres

Mark each plot centre so it can be easily found later for monitoring or auditing. Use a marking method that stays visible over time and suits the site conditions. If the ground is frozen or very rocky and you cannot place a stick or other marker directly into the soil, record in the plot comments what you used for the plot centre.

Figure 27 shows several ways to mark plot centres. Use method B only when it will not bias the plot results. Use method D only in areas with low vegetation and low slash.

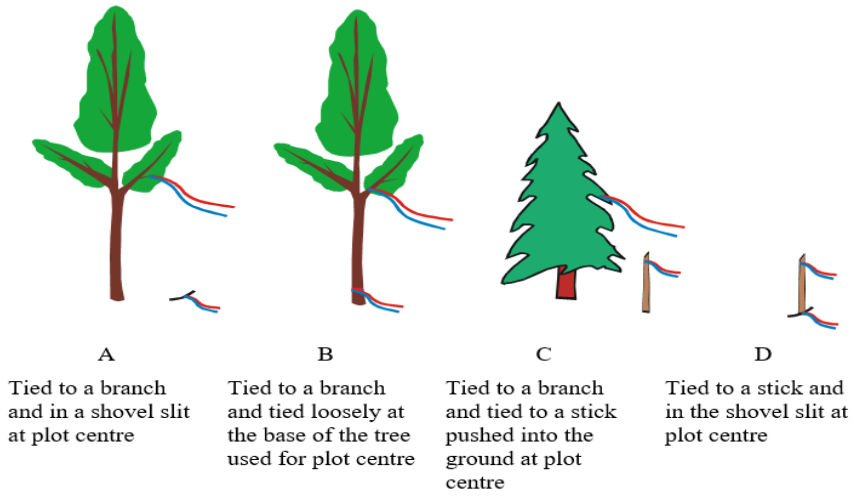


FIGURE 27. Examples of plot marking methods using flagging tape.

Mark each plot in two places using flagging tape:

- tie one ribbon as high as possible so the plot is easy to spot, and

- place one ribbon at the exact plot centre used to measure the plot radius.

If you are navigating with GPS, you may find it helpful to tie one or two extra ribbons high in the surrounding vegetation near the edge of the plot boundary so the plot is easier to spot.

Point of Commencement (POC)

Start your survey at a tie point. A tie point is an easily identifiable feature on the ground—such as road junctions, creek crossings, creek junctions, or block boundaries.

Mark the POC clearly in the field using flagging tape. Mark the same location on your map. Include enough detail in your notes so another surveyor can find the location without guessing.

Note: A POC is not required for representative sampling, visual assessments, or surveys where plot locations are set using GPS coordinates.

Strip Lines

Use strip lines when you are navigating with a map and compass, and are using grid or vector sampling. A strip line is the path you walk between plots while following a straight bearing.

Mark the strip line at regular intervals so other surveyors can follow it and relocate your plots.

Run strip lines up and down slopes so they cross contour lines and the ecological changes that often occur with elevation. This will help you confirm ecological stratification and identify stratum boundaries as you move through the block.

If sampling intensity differs between strata, you may need to adjust the spacing between strip lines or the distance between plots.

Chapter 10: Alternative Survey Methods for Complex Vertical Stands

10.1 Complex Vertical Stands

Alternative survey methods have been designed for complex vertical stands.

Complex vertical stands have at least two distinct age cohorts, with a minimum age difference of 20 years between them. The cohorts contribute to a multi-layered canopy structure and may include trees from different survey layers.

Silviculture surveys recognize four layers based on tree size:

- **Layer 1 (Mature):** dbh ≥ 12.5 cm
- **Layer 2 (Pole):** dbh 7.5–12.49 cm
- **Layer 3 (Sapling):** Height > 1.3 m, dbh ≤ 7.49 cm
- **Layer 4 (Regeneration):** Height ≤ 1.3 m

10.2 Selecting an Alternative Survey Method

Surveying complex vertical stands builds on the standard survey principles covered in Chapters 1–9 of this manual, but it requires specialized approaches to account for multiple layers.

There are four methods for surveying complex vertical stands:

- **Multi-entry** (previously multi-storied[40])
- **Deviation from Potential**
- **Coastal Ecosystem Dispersed Retention** (previously Single-Entry Dispersed Retention[41])
- **Layered**

Note: An alternative survey method must be used when Layer 1 trees contribute to the stocking obligation.

[40]The multi-storied method was easily confused with the layered survey method and was often misapplied to multi-layer stands managed under even-aged silvicultural systems.

[41] Single Entry Dispersed Retention gave the false impression that future harvest entries would not be permitted.

Use the selection matrix (Table 16) and the criteria in Section 10.2.1 of this manual to choose the most suitable method.

Additional guidance is provided in Appendix A4.1. It shows how the management regime and stand condition link to the survey procedures in this manual and to the reporting requirements in the Submitting Forest Cover to RESULTS for Openings with Treed Retention document.

TABLE 16. Survey methodology selection matrix

	Even-aged management regime		**Uneven-aged management regime**
Harvest entries	Single entry planned		Multiple entries planned (e.g., every 20 years)
Silvicultural systems	Clearcut, patch cut, retention system, shelterwood, seed tree, coppice	Retention system with dispersed retention, irregular shelterwood	Single tree selection, irregular shelterwood
Stand characteristics	≤ 5 m^2/ha basal area	Interior: > 5 to < 20 m^2/ha Coast: > 5 to < 40 m^2/ha	Interior: > 5 to < 20 m^2/ha
Stocking standards	Conventional	Conventional, CEDRSS, DFP[a]	Uneven-aged
Survey methodology	Standard even-aged	Layered, DFP CEDR, Standard even-aged with L1 inventory	Multi-entry
Recommended free growing damage criteria	Even-aged damage criteria (Table 22 of FS 660)	Layered/ DFP/CEDR damage criteria (Tables 27 and 28 of FS 660)	Multi-entry damage criteria (Table 26 of FS 660)
Special considerations	A group selection silvicultural system will have multiple entries but should		The uneven-aged stocking standards in the “Reference Guide

	be surveyed with the standard survey method or the small-scale opening method.		for Forest Development Plan Stocking Standards" should be used only in the Interior Douglas-fir zone when managing with a selection silvicultural system that contains at least three layers. Small area-based tenures like woodlots may also use these standards for specified areas.

[a] CEDRSS = Coastal Ecosystem Dispersed Retention Stocking Standards; DFP = Deviation from Potential.

10.2.1 Suitability Criteria

Multi-entry Survey

- Use for stands with > 5 m^2/ha basal area of Layer 1 trees, where Layer 3 and/or Layer 4 trees are also present.
- These stands must be managed using a single tree selection system or irregular shelterwood with multiple (3+) planned harvest entries to maintain or create an uneven-aged stand.
- Applies uneven-aged stocking standards, currently calibrated only for the Interior Douglas-fir zone.

Warning: Uneven-aged standards have been applied to many stands with dispersed retention that are not expected to undergo multiple harvest entries over time. In these cases, the site plan should be amended to use a more appropriate stocking standard and survey method.

Deviation from Potential Survey

- Use for partial-cut stands in the Interior where the post-harvest crop basal area is ≥ 5 m^2/ha and < 20 m^2/ha.

- Designed for even-aged management, where harvesting results in variable tree sizes, spacing, and densities.
- Not intended for stands managed under a selection system with multiple harvest entries prior to a final rotational harvest.
- May only be used where specified in the forest stewardship plan.

Coastal Ecosystem Dispersed Retention (CEDR) Survey

- Use for partial-cut stands on the Coast where CEDR stocking standards apply.
- To date, these standards have been developed for:
  - second-growth Douglas-fir stands with post-harvest crop basal area of ≥ 5 m^2/ha and < 40 m^2/ha.
  - old-growth western redcedar/western hemlock stands with post-harvest crop basal area of ≥ 9 m^2/ha and < 40 m^2/ha.

Layered Survey

- Use for stands managed with an even-aged system where the residual mature trees are healthy and strong enough to contribute toward free growing tallies and the next harvest.
- Use when dispersed crop basal area is below the levels needed for CEDR or Deviation from Potential surveys.

Note: The Layered survey is used when Layer 1 trees contribute to well-spaced or free growing tallies. If Layer 1 trees are not being counted toward well-spaced or free growing, follow the even-aged survey method and report a separate Layer 1 forest cover inventory where dispersed basal area is greater than 5 m^2/ha, in accordance with Section 10.4.1.

10.3 Shared Practices for All Alternative Survey Methods

Use these steps for any alternative survey method:

1. **Office Review**

   Before going to the field:

- Review the site plan, harvest instructions, post-harvest assessment, cut charts, or leave tree tables, and aerial imagery.
- Confirm the silvicultural system, retention objectives, and stocking standards.

2. **Pre-stratification**
   - Stratify the stand using normal criteria (species, density, age, etc.).
   - Look for differences in vertical structure. Use recent high-resolution imagery or Lidar to support this step.
3. **Sampling Method**
   - Use a grid or vector sampling method.
   - Do not use representative or visual (ocular) assessments.
   - Apply the same method throughout the stratum.
4. **Sampling Intensity**
   - Use the minimum sampling intensity in Table 17 as a baseline:

TABLE 17. Minimum recommended number of plots by stratum area

Stratum area (ha)	Minimum number of plots
< 5 ha	5 plots
5–20 ha	1 plot per hectare
> 20 ha	20 plots + ([stratum area – 20] ÷ 2)

Example:

A 36-ha standards unit requires at least 28 plots.

= 20 plots + ((36-20)/2)

= 20 plots + (16/2)

= 20 plots + 8

= 28 plots

Note: These are minimum recommendations. For many strata larger than 20 ha, it will not be appropriate to reduce sampling intensity below 1 plot per hectare due to the variability of stand conditions.

5. **Plot Size**
   - Use a 3.99-m radius plot when crop trees are evenly distributed.
   - Use a 5.64-m radius plot for clumpy, irregular stocking or where large, retained trees are present.
   - For CEDR surveys, use a 5.64-m plot if low M-values are expected based on basal area.
   - Keep the same plot size for all plots within a stratum.
6. **Basal Area Factor**
   - Choose a basal area factor that rarely includes trees more than 12 m from plot centre and gives fewer than 9 “in” trees per sweep.
   - Use lower basal area factors (2–5) in open or small-tree stands.
   - Use higher basal area factors (5–10) in dense or large-tree stands.
   - Use one basal area factor per stratum. Do not adjust between plots.

   Note: When using a prism or angle gauge, “in” trees may be outside the fixed-area plot.
7. **Basal Area Measurement**
   - Measure total basal area with a prism or angle gauge.
   - An angle gauge is a cost-effective alternative to a prism. It contains 3–4 basal area factor options per unit (Figure 28).
   - If the stocking standard specifies basal area, collect crop basal area.

FIGURE 28. Relaskop angle gauge with basal area factor 3, 10, and 30.

8. **Inventory Density**
   - For Layer 1, tally total trees in the fixed-area plot if the layer expected to have the highest volume at the next rotation is currently less than 120 years old. The tally does not need to be by species.
   - For understorey layers (2, 3, 4), tally total trees by species in the fixed-area plot.
9. **Inventory Heights and Ages**
   - For Layer 1, select sample trees identified as “in” during the variable-radius sweep (prism/angle gauge).
   - For understorey layers (2, 3, 4), select sample trees from inside the fixed-area plot.

10. **Forest Health**

- Forest health information should be collected from:
  - Layer 1 trees within the variable-radius plot
  - Layer 2, 3, and 4 trees within the fixed-area plot
- There are different forest health damage criteria for:
  - multi-entry surveys (FS 660 Table 26)
  - Layer 1 trees during Deviation from Potential, CEDR, and Layered surveys (FS 660 Table 27)
  - Layer 2, 3, and 4 trees during Deviation from Potential, CEDR, and Layered surveys (FS 660 Table 28)

11. Plantable and Preparable Spots

- Spots are considered plantable or preparable only if they are outside the crown (dripline) of Layer 1 trees.

12. Extra Data Collection

Licensees may ask for extra data for planning purposes. When required, provide the following:

- Modal diameter: Record the most common diameter class for Layer 1 trees. If the stand is bimodal, record both values.
- Regeneration type: Divide Layer 4 trees into new and advance regeneration[42] categories.
- Stand and stock tables: Record tallies by species, diameter class, and layer.

13. Site Index

- Identify the layer expected to produce the most volume at the next rotation.
- Determine the site index for that layer's leading inventory species using SIBEC.

10.4 Forest Cover Reporting

You must report a stratum as multi-layer with a separate Layer 1 if:

[42] Advance regeneration was established prior to the disturbance that created the opening.

- Retained[43] Layer 1 basal area is greater than 5 m^2/ha, or
- the stocking standards include thresholds for more than one layer.

When either condition applies, follow the reporting rules below:

10.4.1 Layer 1 Reporting

Inventory Component

- Report a full inventory for Layer 1 trees, including species composition, heights, and ages; crown closure; density; total basal area; and forest health damage.
  - Species composition: Calculate species composition using total basal area.
  - Density: Report total density if the layer expected to have the highest volume at the next rotation is currently less than 120 years old.
  - Basal area: Report total basal area (crop and non-crop Layer 1 trees).
  - For Layer 1, the "% Host Trees Affected" calculation uses the sum of "In" trees from variable-radius plots, not the sum of trees tallied in fixed-area plots.

    $$\%\ \text{host affected} = \left(\frac{(\text{Live "in" trees affected} + \text{dead "in" trees affected})}{((\text{Total "in" trees X } \%\ \text{host species}/100) + \text{dead "in" trees affected})}\right) x100\%$$

Silviculture Component

- Report a complete silviculture label for Layer 1 trees if they contribute to the stocking requirements.
  - Species composition: Calculate using well-spaced or free growing tallies, or crop basal area, as defined in the stocking standard.
  - Well-spaced/free growing density:[44] Report if the stocking standard specifies a Layer 1 well-spaced/free growing density threshold.
  - Crop basal area:[45] Report if the stocking standard specifies a crop basal area threshold.

Note: A Layer 1 silviculture component is only required when Layer 1 trees contribute to the stocking obligation (e.g., when Layer 1 trees count as well-spaced or free growing trees, or

[43] Retained refers to residual Layer 1 (≥ 12.5 cm dbh) present after harvest.
[44] Applicable to multi-entry and layered methods.
[45] Applicable to Deviation from Potential, Coastal Ecosystem Dispersed Retention, commercial thinning, and intermediate cut survey methods.

toward crop basal area thresholds). If Layer 1 trees contribute to stocking, you must use an alternative survey method from Chapter 10.

If Layer 1 trees do not contribute to stocking, complete a standard even-aged survey for the understorey layers (Layers 2, 3, and 4) and collect the Layer 1 inventory information separately.

10.4.2 Layers 2, 3, and 4 Reporting

Report understorey layers (L2, L3, and L4) either individually or as a combined understorey layer, depending on the stocking standards:

- Report each layer separately when the stocking standards specify a unique minimum stocking standard for each layer (e.g., L2, L3, and L4).
- Report layers as a combined understorey when the stocking standards allow an aggregate threshold. In this case, report the combined understorey to the most abundant layer (L2, L3, or L4) based on total tree density.

In both cases, compile and report the inventory and silviculture components following the procedures in Chapters 1–9.

10.4.3 Polygon Component Reporting

Each RESULTS forest cover submission includes one polygon component per stratum, not per layer. For multi-layer strata, report the following fields. Some fields differ from standard survey reporting.

Reserve Type

- Enter “Dispersed” if residual trees occur as non-mappable single trees or small clusters associated with the standards unit.

Reserve Objective

- For short-term retention, enter “TIM”.
- For long-term retention, enter the most applicable code (other than TIM).

Tree Cover Pattern

- Select the code that best describes the horizontal arrangement of residual Layer 1 trees (refer to FS 660 for pattern definitions).

Site Index

- Report the site index for the leading inventory species of the layer expected to produce the highest volume at the next rotation.

Stocking Status

- Enter IMM if the layer expected to produce the highest volume at the next rotation is currently less than 120 years old, and the stratum meets stocking requirements.
- Enter MAT if the layer expected to produce the highest volume at the next rotation is currently 120 years old or older, and the stratum meets stocking requirements.
- Enter NSR if the stratum does not meet stocking requirements.

For more information on reporting, refer to the RESULTS Information Submission Specifications and Submitting Forest Cover to RESULTS for Openings with Treed Retention.

10.5 Multi-entry Survey

10.5.1 Survey Steps

Apply the shared practices in Section 10.3 of this manual when using this method.

1. For Layers 2, 3, and 4: Tally total trees by species by layer in the fixed-area plot.
2. For Layer 1: Tally total trees in the fixed-area plot.
3. Count “in” trees by species for Layer 1 using a prism or angle gauge in the variable-radius plot.
4. Record the modal diameter for Layer 1 trees.
5. Tally all preferred and acceptable well-spaced trees by species and layer, including those in excess of the M-value, in the fixed-area plot.

   Select trees sequentially by layer, ensuring each meets the minimum inter-tree distance (MITD) from previously selected trees:

   a. Start with Layer 1. Select all well-spaced trees.
   b. Move to Layer 2. Select all well-spaced trees that meet the MITD from each other and all previously selected Layer 1 well-spaced trees.
   c. Repeat for Layer 3, ensuring each selected tree meets the MITD from each other and all previously selected well-spaced trees in Layers 1 and 2.

d. Assess Layer 4 last. Select all well-spaced trees that meet the MITD from each other and all well-spaced trees in Layers 1–3.

6. If collecting free growing data, repeat Step 5, tallying and maximizing the number of free growing trees.
7. Apply the nesting process to determine the number of well-spaced (or free growing) trees that contribute toward stocking.

   Work from Layer 1 downward, applying each layer's M-value as a limit. The combined number of well-spaced (or free growing) trees from all higher layers counts toward the next layer's M-value.

   a. Layer 1: Record all well-spaced (or free growing) trees in Layer 1, up to the Layer M-value.
   b. Layer 2: Add well-spaced (or free growing) trees from Layer 2.

   - If the combined total from Layers 1 and 2 is less than the Layer 2 M-value, record all Layer 2 well-spaced (or free growing) trees.
   - If the combined total is greater than the Layer 2 M-value, record only the number of Layer 2 trees needed to reach—but not exceed—the Layer 2 M-value.

   c. Layer 3: Repeat the same process using the combined total from Layers 1–3. Record only enough Layer 3 trees to reach—but not exceed—the Layer 3 M-value.
   d. Layer 4: Repeat the process for Layer 4. Record only enough Layer 4 trees to reach—but not exceed—the Layer 4 M-value.

8. Record countable conifers if Layer 3 is nearing maximum density. All Layer 3 conifers are considered countable.
9. Tally the trees that do not meet the free growing damage criteria by damage agent code, tree species, layer, and status (live, dead). Use the damage criteria from Table 26 of the FS 660.
10. On the first plot and every fourth plot thereafter (minimum of three per stratum), collect:
    a. vegetation data
    b. crown closure (by layer)
    c. height and age for a representative well-spaced/free growing tree of the leading silviculture species (by layer)

   d. heights and ages of the tallest living trees of the leading and secondary inventory species (by layer)

11. Collect site index information using SIBEC.
12. Record plantable and preparable spots at every plot (as applicable).

10.5.1 Compiling Data

Compile and summarize inventory and silviculture data **by layer**.

- For Layers 2, 3, and 4, complete the standard calculations described in Chapter 7 of this manual.
- For Layer 1, complete the standard calculations with the following differences:
  - Calculate total basal area using “in” trees from variable-radius plots.
  - Calculate inventory species composition using “in” trees from variable-radius plots, summarized by species. Do not use fixed-area tallies.
  - For percent host trees affected, use the total number of “in” trees from the variable-radius plots as the denominator.

Due to the complexity of the data collected, use electronic compilation to reduce errors. Statistical analysis is not required for multi-entry surveys.

10.6 Deviation from Potential Survey

10.6.1 Survey Steps

Apply the shared practices in Section 10.3 of this manual when using this method.

1. Tally the residual overstorey (residual Layer 1 trees, ≥ 12.5 cm dbh).
   a. Count all residual Layer 1 trees within the fixed-area plot.
   b. Using a prism or angle gauge, tally “in” trees by species (crop and non-crop) in the variable-radius plot.
   c. Using a prism or angle gauge, tally crop “in” trees by species in the variable-radius plot.

Note: Crop Layer 1 trees are preferred or acceptable species that meet the damage criteria in Table 27 of the FS 660. There is no minimum inter-tree distance between Layer 1 crop trees.

d. Multiply the total number of crop "in" trees by the basal area factor to calculate crop basal area.

2. Tally the regeneration understorey (Layers 2, 3, and 4, < 12.5 cm dbh)
    a. Count all living trees by species (exclude germinants).
    b. Tally well-spaced trees by species, including those in excess of the M-value.
    c. Tally free growing trees by species, including those in excess of the M-value.

Note: The minimum inter-tree distance (MITD) between well-spaced or free growing trees in Layers 2, 3, and 4 and any Layer 1 tree (inside or outside the plot; crop or non-crop) is the dripline of the Layer 1 tree or the MITD specified in the forest stewardship plan, whichever is greater. The MITD between well-spaced or free growing trees in Layers 2, 3, and 4 is the MITD specified in the forest stewardship plan.

3. For each plot, look up the Deviation from Potential value and stocking category (e.g., stocked, partially stocked, open) in Table 18. Find the cross-section of the crop basal area and the well-spaced or free growing total (capped at the M-value) to determine the plot's Deviation from Potential.
4. Tally the trees that do not meet the free growing damage criteria by damage agent code, tree species, layer (L1, Layers 2, 3, and 4), and status (live, dead). Use the damage criteria from Tables 27 and 28 of the FS 660.
5. Tally plantable spots, preparable spots, and germinants at each plot, as needed.
6. Record countable conifers[46] if maximum density is being approached.
7. On the first plot and every fourth plot thereafter (minimum of three data sets per stratum):
    a. Record the ground vegetation, including species, percent cover, and average height.
    b. Record the crown closure for Layer 1 and for the combined Layers 2, 3, and 4.
    c. For the overstorey layer:
    - measure the height and determine the age of the tallest "in" tree from the variable-radius plot for the stratum's leading inventory species and secondary inventory species.

[46] Layer 1 and Layer 2 trees are excluded from both the median height calculation and the countable conifer count.

- measure the height and determine the age of a representative crop tree for the stratum's leading silviculture species.

d. For the understorey layer:

- measure the height and determine the age of the tallest tree from the fixed-area plot for the stratum's leading inventory species and secondary inventory species.
- measure the height and determine the age of a representative well-spaced tree (if the stratum is satisfactorily restocked) or free growing tree (if the stratum is free growing) for the stratum's leading silviculture species.

8. Estimate the tree cover pattern for Layer 1 trees in the stratum being surveyed.
9. Identify the layer expected to contribute the most volume at the next rotation. Report the site index for that layer's leading inventory species using SIBEC.
10. Record the reserve type and reserve objective.

10.6.2 Compiling Data and Determining Stocking Status

1. Compile and summarize inventory and silviculture data separately for Layer 1 and the combined Layers 2, 3, and 4.
    - Complete standard calculations, as per Chapter 7 of this manual, for the combined Layers 2, 3, and 4.
    - Complete standard calculations for Layer 1, except:
        - inventory and silviculture species composition for Layer 1 is based on "in" trees from the variable-radius plots, not fixed-area tallies
        - the denominator for the % host trees affected formula uses the total number of "in" trees across all variable-radius plots, not the total tree tally from the fixed-area plots
        - calculate total basal area and crop basal area
2. Calculate the average Deviation from Potential value across plots.
3. Calculate the proportion of plots in the "open" class.
4. Calculate the proportion of plots in the "stocked" class.
5. Compare the average Deviation from Potential, proportion of plots in the "open" class, and the proportion of plots in the "stocked" class to the stocking standard. If all criteria are met, the stratum is satisfactorily restocked or free growing.

Note: For forest stewardship plans (FSPs), forest operations plans (FOPs), or woodlot licence plans (WLPs) approved prior to 2027, where the obligation criteria are not specified within the plan, compare the results to the obligation criteria in Table 19. For FSPs, FOPs, or WLPs approved in 2027 or later, the obligation criteria must be specified within the plan.

TABLE 18. Interior Deviation from Potential values by crop basal area and well-spaced/free growing stems per plot[a]

Basal area of crop residual trees ≥ 12.5 cm dbh	Understorey—well-spaced or free growing stems per plot (capped)								
	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

[a] Red cells: “open”; yellow: “partially stocked’; green: “stocked”.

TABLE 19. Interior DFP regeneration and free growing obligation criteria

DFP Threshold Values	**Obligation Criteria**
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%

10.7 Coastal Ecosystem Dispersed Retention Survey

Enter plot data in the CEDR Data Collection spreadsheet for quick data compilation.

10.7.1 Survey Steps

Apply the shared practices in Section 10.3 of this manual when using this method.

1. Tally the residual overstorey (Layer 1 trees, ≥ 12.5 cm dbh) using a variable-radius plot (prism or angle gauge).
   a. Record “Number In” by species (crop and non-crop).
   b. Tally the crop “Number In” by species.

   Note: A Layer 1 crop tree is an ecologically suitable species that meets the free growing damage criteria. Some of these criteria relate to merchantability, so they may affect crop-tree selection without triggering forest health reporting.
2. Tally the residual overstorey (Layer 1 trees) using a fixed-area plot. This does not need to be done by tree species.
3. Tally the regeneration understorey (Layers 2, 3, and 4, ≤12.5 cm dbh) using a fixed-area plot.

a. Tally all living trees (excluding germinants) by species.
b. Tally well-spaced trees by species, including those in excess of the plot's M-value.
c. Tally free growing trees by species, including those in excess of the plot's M-value.

4. Tally the trees that do not meet the free growing damage criteria, by damage agent code, tree species, layer (Layer 1, Layers 2, 3, and 4), and status (live, dead).
   - Examine all Layer 2, 3, and 4 trees within the fixed-area plot for damage. Examine all Layer 1 trees counted "in" the variable-radius plot.
   - Use the damage criteria in Section 27 of the FS 660 Silviculture Reference Guide for Layer 1 trees and Section 28 for Layer 2, 3, and 4 trees.
5. Tally plantable spots and germinants, as needed.
6. On the first plot and every fourth plot thereafter (a minimum of three data sets per stratum):
   a. Record the crown closure for Layer 1 and for the combined Layers 2, 3, and 4.
   b. Record the ground vegetation, including species, percent cover, and average height.
   c. For the overstorey layer:
      i. measure the height and determine the age of the tallest "in" tree from the variable-radius plot for the stratum's leading inventory species and secondary inventory species.
      ii. measure the height and determine the age of a representative crop tree for the stratum's leading silviculture species.
   d. For the understorey layer:
      i. measure the height and determine the age of the tallest tree from the fixed-area plot for the stratum's leading inventory species and secondary inventory species.
      ii. measure the height and determine the age of a representative well-spaced tree (if the stratum is satisfactorily restocked) or free growing tree (if the stratum is free growing) for the stratum's leading silviculture species.
7. Estimate the overall Layer 1 tree cover pattern for the stratum being surveyed.
8. Record the reserve type and reserve objective.

9. Identify the layer expected to contribute the most volume at the next rotation. Report the site index for that layer's leading inventory species using SIBEC.

10.7.2 Compiling Data and Determining Stocking Status

1. For each plot, compare the well-spaced or free growing tallies to the **plot's** minimum stocking standard. Contiguous areas larger than 1 ha that do not meet their plot's minimum stocking standard must be stratified prior to doing stratum-level calculations.
2. Determine the stratum's status.
    a. Compare the **stratum's** well-spaced density to its minimum stocking standard. If the well-spaced density is greater than the minimum stocking standard, the stratum is satisfactorily restocked; if it is less, the stratum is not satisfactorily restocked.
    b. If applicable, compare the **stratum's** free growing density to its minimum stocking standard. If the free growing density is greater than the minimum stocking standard, the stratum is free growing; if it is less, the stratum is not free growing.
3. Create inventory labels for Layer 1 and the combined Layers 2, 3, and 4.
4. Create silviculture labels for Layer 1 and the combined Layers 2, 3, and 4.

To learn more about surveying and reporting stands under CEDRSS, including forest cover submissions, approved variations, damage criteria, and use of the data collection spreadsheet, refer to the 2026 CEDRSS Implementation Guide.

10.8 Layered Survey

10.8.1 Survey Steps

Apply the shared practices in Section 10.3 of this manual when using this method.

1. Tally the residual overstorey (Layer 1 trees, ≥ 12.5 cm dbh) using a variable-radius plot (prism or angle gauge). Record "Number In" by species.
2. Tally the residual overstorey (Layer 1 trees) using a fixed-area plot. This does not need to be done by tree species.
3. Tally the regeneration understorey (Layers 2, 3, and 4, ≤12.5 cm dbh) using a fixed-area plot. For each layer, tally all living trees (excluding germinants) by species.

4. Select well-spaced trees and/or free growing trees from all layers and record them by layer.

   Continue tallying well-spaced or free growing trees even after the M-value is reached.

   The objective is to maximize the total number of well-spaced or free growing trees, regardless of which layer they are in. There is no nesting. A single M-value applies across all layers.

   Selection criteria:

   - Layer 1 trees must meet the free growing damage criteria in Table 27 of the FS 660 and must be capable of contributing merchantable volume to the next rotation. Trees in Layers 2, 3, and 4 must meet the free growing damage criteria in Table 28 of the FS 660.
   - The minimum inter-tree distance (MITD) between well-spaced or free growing trees in Layers 2, 3, and 4 and any Layer 1 tree (inside or outside the plot; crop or non-crop) is the dripline of the Layer 1 tree or the MITD specified in the forest stewardship plan, whichever is greater (Figure 29). The MITD between well-spaced or free growing trees in Layers 2, 3, and 4 is the MITD specified in the forest stewardship plan.

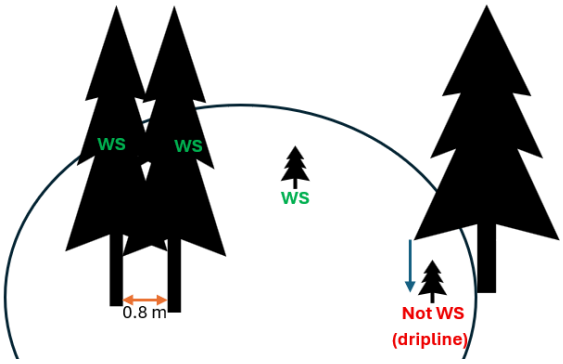


FIGURE 29. Layer 1 trees are well-spaced at any spacing. Understorey trees are not well-spaced if below the dripline of any Layer 1 trees.

5. Tally the trees that do not meet the free growing damage criteria, by damage agent code, tree species, layer, and status (live, dead).
   - Examine all Layer 2, 3, and 4 trees within the fixed-area plot for damage. Examine all Layer 1 trees counted “in” the variable-radius plot.
   - Use the damage criteria in Section 27 of the FS 660 Silviculture Reference Guide for Layer 1 trees and Section 28 for Layer 2, 3, and 4 trees.
6. Tally plantable spots, preparable spots, and germinants, as needed.

7. Record countable conifers[47] if maximum density is being approached.
8. On the first plot and every fourth plot thereafter (minimum of three samples per stratum):
    a. Record the ground vegetation, including species, percent cover, and average height.
    b. For each layer:
        i. record the crown closure.
        ii. choose a representative well-spaced (or free growing) tree of the stratum's leading silviculture species. The leading silviculture species may be different for each layer. Measure heights and ages of the selected trees.
        iii. choose the tallest living tree of the stratum's leading inventory species and the tallest tree of the stratum's secondary inventory species. For Layers 2, 3, and 4, the selected trees should be within the fixed-area plot. For Layer 1, the selected tree should be "in" the variable-radius plot. Measure heights and ages of the selected trees.
9. Estimate the overall Layer 1 tree cover pattern for the stratum being surveyed.
10. Record the reserve type and reserve objective.
11. Identify the layer expected to contribute the most volume at the next rotation. Report the site index for that layer's leading inventory species using SIBEC.

10.8.2 Compiling Data and Determining Stocking Status

1. Compile and summarize inventory data by layer.
    - Layers 2, 3, and 4: Complete standard calculations as described in Chapter 7 of this manual, using tallies by species and measurements from the fixed-area plots.
    - Layer 1: Complete standard calculations with the following differences:
        - Calculate total basal area using "in" trees from the variable-radius plots.
        - Calculate inventory species composition using "in" trees from the variable-radius plots, summarized by species.
        - For percent host trees affected, use the total number of "in" trees from the variable-radius plots as the denominator.

[47] Layer 1 and Layer 2 trees are excluded from both the median height calculation and the countable conifer count.

2. Determine stocking status using well-spaced/free growing counts.
    - For each plot, compile all well-spaced and/or free growing trees from Layers 1–4 into a single total, up to the M-value. Nesting is not used.
    - Average the plots to calculate the number of well-spaced/free growing trees per hectare (capped) for each stratum.
    - Compare the stratum mean (capped) and lower confidence limit to the minimum stocking standard to determine stocking status or next steps.
3. Compile and summarize silviculture data by layer.
    - Calculate silviculture species composition for each layer using uncapped well-spaced/free growing tallies from each plot.
    - Calculate the total well-spaced/free growing averages for each layer across the stratum using uncapped plot totals.
    - If the total number of well-spaced (WS)/free growing (FG) trees across all layers is greater than the M-value, calculate a capped count for each layer based on its proportion of the uncapped total:

      Layer capped count = $\left(\frac{\text{Layer original count}}{\text{Total WS or FG across all layers}}\right) \times \text{M–value}$

Note: In some cases, it may be acceptable to combine the understorey layers (L2, 3, and 4) into a single layer. When doing so, assign the label to the layer with the greatest total tree density.

Chapter 11: Alternative Survey Methods for Non-Standard Objectives and Structures

11.1 Commercial Thinning Survey Method

Commercial thinning is a silvicultural intervention. It is part of a broader silvicultural system. It involves the selective removal of trees, typically dead, damaged, diseased, or lower-vigor, from immature stands to meet a timber flow and/or value objective.

Commercial thinning does not trigger a regeneration obligation. However, a survey must be completed at least 12 months after harvesting has been completed to demonstrate that the requirements of the silviculture plan and stocking standards have been met, and to update the forest cover, including wildlife tree retention.

If the stocking standard is not met, a regeneration obligation is triggered for the non-compliant area. This area must be stratified and amended under appropriate stocking standards (e.g., Deviation from Potential or Coastal Ecosystem Dispersed Retention Stocking Standards).

11.1.1 Survey Method

This survey method has been developed to align with the stocking standard format in Table A1.1 of the 2025 Thinning Guidance for British Columbia.

Plot size: Use a 5.64-m plot.

Basal Area Factor: Select a Basal Area Factor that captures 4–9 trees from plot centre.

Sampling intensity: Use the minimum sampling intensity.

Stratum area (ha)	Minimum number of plots
< 5 ha	5 plots
5–20 ha	1 plot per hectare
> 20 ha	20 plots + ([stratum area – 20] ÷ 2)

More plots may be required if there is high variability in the inventory or silviculture characteristics.

1. Establish plots throughout the standards unit according to a grid or vector sample.[48] Plots will overlap the thinning zones and machine trails. Do not move plot centres.
2. At each plot centre, complete the following:
    a. Determine whether the plot centre is located within:
        - an access trail: any area where tree removal was required mainly to establish, widen, or maintain machine access. This includes the travelled surface, trail shoulders, widened turns, and localized trail expansions.
        - a thinning zone: an area treated by thinning
    b. If the plot centre is located entirely within the access trail or thinning zone, classify the plot accordingly.
    c. If the plot centre overlaps the thinning zone and an access trail:
        - Estimate the proportion of the plot area that overlaps the access trail.
        - The trail proportion values must range from 0.0 to 1.00 (e.g., 60% trail = 0.6).
3. At each plot centre, swing a 5.64-m fixed-area plot.
    a. Tally all trees.
    b. For the largest dbh tree[49] of the leading inventory species in the stratum, measure its total height and age at breast height.[50]
4. Using the same plot centre, swing a variable-radius plot using a prism or angle gauge.
    a. Tally the “in” trees by species (crop and non-crop).
    b. Tally the “in” trees that do not meet the free growing damage criteria by damage agent code, tree species, and status (live, dead). Use the damage criteria specified in the stocking standards.
    c. Tally the crop “in” trees by species.

[48] If the pre-harvest cruise has sufficient sampling intensity, you may choose to use the same grid to compare pre- and post-thinning stand characteristics.
[49] This is the top height tree. These measurements will be used to determine site index, to set the stocking standard thresholds, and for the inventory label. The sample tree must be healthy, have an undamaged stem, be in the dominant or co-dominant crown class, and have vigorous and uniform ring growth.
[50] Age is determined at breast height by counting rings on an increment core taken at 1.3 m above the ground on the high side.

- Crop trees are ecologically suitable species that meet the damage criteria and are above the dbh threshold specified in the stocking standard.

5. On the first plot and every fourth plot thereafter (a minimum of three data sets per stratum):
    a. Record crown closure.
    b. Record the ground vegetation, including species, percent cover, and average height, if relevant.
    c. Measure the height and age of the largest dbh "in" tree of the stratum's secondary inventory species in the variable-radius plot.
    d. Measure the height and age of a representative crop tree of the stratum's leading silviculture species.
6. Estimate the tree cover pattern[51] for the stratum.
7. Record the reserve type (dispersed) and the reserve objective (timber).

11.1.2 Compiling Data and Determining Stocking Status

1. Determine site index for the leading inventory species. Look up the site index for each plot in SiteTools using the top heights and breast height ages. Average the plot site indices to obtain the average site index for the stratum.
2. Compile the inventory information according to Chapter 7, but note the following differences:
    a. Calculate average height from the top height tree samples. This will be reported as the inventory height for the leading inventory species. It will also set the crop basal area thresholds.
    b. Calculate average age from the top height tree samples. This will be reported as the inventory age for the leading inventory species.
    c. Calculate total basal area using the "in" trees from the variable-radius plots.
    d. Calculate species composition using the "in" trees from the variable-radius plots, summarized by species.

[51] VRI specialists recommend code 6 where 5-m trails are cut between 15- to 20-m thinning strips.

e. For percent host trees affected, use the total number of “in” trees from the variable-radius plots as the denominator.

3. Compile the silviculture information according to Chapter 7, but note the following differences:
    a. Calculate crop basal area using the crop “in” trees from the variable-radius plots.
    b. Calculate species composition using the crop “in” trees from the variable-radius plots, summarized by species.
4. Compare the average post-thinning crop basal area to the pre-harvest basal area. Most standards will require more than 50% retention.
5. Compare the average post-thinning crop basal area to the stratum’s post-thinning average residual basal area per hectare range specified in the stocking standard for the associated leading species and top height. The stratum’s average crop basal area must be within or greater than this range.
6. Ensure that no areas greater than 1 ha and that no more than 10% of the net area to be reforested has a post-thinning basal area less than the minimum basal area specified in the stocking standard for the associated leading species and top height.
7. Calculate the access trail proportion[52] of the plots and compare it to the stocking standard threshold.[53]
    a. Sum the trail proportion values across all plots. This represents the equivalent number of full plots occupied by access trails.
    b. Determine the total number of survey plots.
    c. Divide the equivalent number of trail plots by the total number of plots and multiply by 100.
    d. Compare to the stocking standard threshold.
8. Calculate average trail width for the stratum.

[52] If the number of plots is small, this approach may not be accurate. The licensee may use an alternative method to calculate access trail proportion.

[53] Most commercial thinning standards specify that access trails must not occupy more than 25% of the commercially thinned area (excluding reserves and permanent access structures).

11.1.3 RESULTS Reporting

A single-layer forest cover (I/S) can be submitted for commercially thinned stands. The reporting requirements are similar to those for even-aged, single-layer stands with regeneration obligations, but note the following changes:

Polygon Component:

- Reserve Type: Enter Dispersed.
- Reserve Objective: Enter TIM.
- Tree Cover Pattern: Enter the Tree Cover Pattern number that best represents the pattern of residuals.

Inventory Component:

- BA: Enter Total BA (including crop and non-crop stems).
- Species Composition: Based on total BA.

Silviculture Component:

- BA: Enter the crop BA.
- Species Composition: Based on crop BA.

Denudation Activity Comments:

- In the denudation activity comments field, enter the % treatment area occupied by machine trails.

11.2 Intermediate Cut Survey Method

Intermediate cuts are partial-harvest treatments completed without creating a regeneration obligation. Unlike commercial thinning, intermediate cuts are not restricted to young stands, do not require a planned uniform post-harvest density or distribution, and may occur in stands where a future final harvest is not planned because the treatment is intended to meet a non-timber objective (e.g., accelerating old-growth structure or enhancing wildlife habitat).

You can use the Commercial Thinning (CT) survey method to assess intermediate cuts. The CT method provides a consistent way to collect forest cover information and summarize residual stand conditions.

However, not all CT steps may be required for intermediate cuts. Several CT procedures are designed specifically to evaluate compliance with CT stocking standards (such as

trail-proportion thresholds), and these requirements do not apply unless they appear in the stocking standard for the intermediate cut.

You may adjust the CT procedure as follows:

1. **Skip total tree tallies in the fixed area plot if the stand is 120 years or older.**

   Inventory density is not a required reporting element when the stocking status is MAT.

2. **Top-height measurements may not be required.**

   You can omit top-height measurements when the stocking standard does not reference top height, and the stand is not suitable for site index curve method.

3. **Determining site index.**

   If the stand is old-growth, multi-layered, or if the intermediate cut removed the largest trees, do not use the site index curve method. In these cases, determine site index using SIBEC for the stratum's BEC subzone and site series.

4. **Do not classify plots as "access trail" or "thinning zone" unless required.**

   These categories are needed only when the stocking standards includes a threshold for access-trail coverage.

5. **Do not measure trail width unless required.**

   This is mainly relevant when there is a stocking standard threshold for access trail coverage.

6. **Do not compare post-harvest crop basal area to the pre-harvest basal area.**

   This comparison is needed only when the stocking standard includes a basal area retention requirement. If the standard does not reference pre-harvest basal area, you can omit this step.

11.3 Clustered Stand Survey Method

Clustered stands are even-aged stands where trees are intentionally planted or managed in distinct groups rather than being distributed evenly across the opening (Figure 30). Clustered stand structures are created using treatments such as cluster planting or juvenile spacing. They may also occur where microsites that are suitable for regeneration are concentrated in small patches.

Cluster treatments are typically prescribed to achieve non-timber objectives, such as enhancing biodiversity, increasing forage for moose or grizzly bears, or addressing wildfire restoration.

FIGURE 30. Even-aged, clustered stand structures.

The objectives of the cluster treatment must be clearly defined before the survey begins. They 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 you are determining planting quality, use the conventional planting criteria (e.g., plantable spots, number of trees planted, excess trees, satisfactorily planted trees) and record cluster spacing and/or the number of clusters per hectare.

When you establish the plots, follow the same procedures that are used for other silviculture surveys, but a larger plot radius is recommended. A plot radius of 5.64 m is recommended where there are more than 100 clusters per hectare. An even larger plot may be needed in openings that have fewer than 100 clusters per hectare.

Record the number of cluster centres and trees that are within each plot. If the cluster centre is not within the plot, the number of trees should still be tallied.

Note: The current clustered stand survey method has important limitations. It does not present information in a meaningful way for assessing whether gaps are being maintained over time or whether they are achieving their intended non-timber objectives (e.g., increased forage availability, wildlife use, or structural heterogeneity). A revised clustered stocking standard format is planned, along with updated survey procedures that will better evaluate

gap conditions, treatment effectiveness, and long-term outcomes. These changes are intended to support adaptive management and improved decision-making for clustered stand treatments.

11.4 Small Scale Openings Method

This method applies to small-scale salvage and helicopter-harvested openings that are:

- usually less than 1 ha, and;
- scattered across a localized area (usually within a 4-km^2 footprint).

Because these openings are small, numerous, and dispersed, a full grid sampling method is not recommended. Instead, representative sampling combined with visual assessment is often the best method. However, this approach relies heavily on professional judgement; therefore, only experienced surveyors should use it.

11.4.1 Data Collection and Compilation

1. **Identify all openings**
2. **Group openings by BEC subzone and site series**

   Use:

   - Site plan field data, if available
   - BEC subzone/variant (using MapView layers or regional BEC maps)
   - Predictive Ecosystem Maps (PEMs), where available, to refine groupings by site series

   Label each group as a pre-stratified sampling stratum.
3. **Identify the applicable stocking standards**

   Use the stocking standards in the site plans. If none are specified, use the regional standards for the BEC subzone/variant and site series.
4. **Complete a visual assessment of each grouped opening**

   Walk through as many openings in each grouped stratum as possible.

   Establish at least one representative plot per final unit (a unit with similar site series and stocking status) to confirm conditions on the ground.

   Some openings may be assessed by helicopter if they are clearly similar to adjacent openings.

5. **After the field assessment, group openings into final units based on ecology and stocking status.**

   For NSR or NFG units, create draft brushing or planting prescriptions as needed.

   For SR or FG units, create forest cover labels and report to RESULTS.

11.5 Green-up (adjacency) Survey

A green-up survey determines whether a cutblock has achieved the green-up requirements in an approved forest stewardship plan or as required under legislation. These requirements help manage cutblock adjacency and ensure there is adequate stand structure to maintain hydrological and visual quality values.

First, ask the contract administrator if you need to collect green-up data. If you do, use the following procedure.

11.5.1 What You Need to Assess

A green-up survey must assess three key elements:

1. Area that has achieved green-up height

Estimate the proportion of the net area to be reforested (NAR) that meets both the required density and green-up height thresholds.

2. Density

Estimate the density (stems/ha) of commercially valuable species (TCV) that are taller than 1.3 m. TCV includes:

- preferred species
- acceptable species
- other commercially valuable species that are present

3. Green-up height

Estimate the average height of the tallest 10% of the TCV trees. This is normally measured in a 5.64-m radius (1/100 ha) plot.

11.5.2 Data Collection Options

You can gather green-up information in one of four ways:

1. from a recent free growing survey,
2. during a planned free growing survey with additional tallies,
3. during a planned green-up survey, or
4. using remotely-sensed data.

Structured grid surveys are generally not required for green-up assessments. Green-up surveys rely heavily on professional judgement; therefore, they should be completed by experienced surveyors.

11.4.2.1 Using Data from a Recent Free Growing Survey

This is the preferred and most efficient option.

You may use existing free growing (FG) results if:

- FG density across ≥ 75% of the NAR meets or exceeds the required TCV density, and
- FG minimum heights are equal to or greater than the required green-up height.

If the free growing density is lower than the required TCV density, review the total tree tallies, well-spaced tallies, inventory heights, and well-spaced heights. Well-spaced trees or commercially valuable but unacceptable species may increase the TCV count. If the green-up status is unclear after reviewing the plot data, complete a field recce.

11.4.2.2 Collecting Additional Data during a Planned Free Growing Survey

If a free growing survey is already planned, you can add two quick tallies to check green-up:

- total number of TCV trees > 1.3 m per 3.99-m radius plot, and
- height of the tallest TCV tree in a 5.64 m radius sweep.

If a pre-plot walk-through suggests the stand is not yet greened-up, record the average leader growth of commercial tree species in each plot. Use this information to forecast when green-up is likely to be reached and to schedule a future recce.

11.4.2.3 Conducting a Green-up Survey

Use this option when:

- no FG data exists,
- existing FG data are insufficient, or
- there is no planned FG survey.

Choose a sampling method that is appropriate for the conditions (e.g., vector, representative, ocular). Record:

- TCV density (> 1.3 m)
- average TCV height
- average height of the tallest 10% of TCV trees
- proportion of the NAR that meets green-up height

11.4.2.3 Using Remote Sensing

Using remote sensing can be an efficient way of assessing green-up. You can use UAV-based photogrammetry or LiDAR to produce a stem map and a crown-height model for the opening.

You can then use specialized software to:

- identify trees taller than 1.3 m,
- calculate TCV density by height class, and
- determine the height of the tallest 10% of TCV trees.

Use remote sensing only when:

- tree detection is reliable for the stand and site conditions, and
- the signing professional is confident that another practitioner using the same data would reach the same conclusion.

If the results are unclear, complete a field recce to verify green-up status.

11.6 Using Quality Inspection Plots

11.6.1 Planting Quality Inspection Plots

The regeneration delay obligation can be met through planting. In some cases, planting quality inspection plots (FS 704) can be used to meet the reporting requirements for regeneration delay forest cover.
To use FS 704 plots for this purpose, all of the following conditions must be met:

1. Less than 10% of the total trees after planting are natural regeneration or previously planted trees (i.e., the silviculture label and inventory label are the same).
2. The average planting inter-tree distance must be equal to or greater than the minimum inter-tree distance specified in the site plan.

3. Plots must be evenly distributed and properly stratified according to the stratification criteria in Section 3.2.
4. Most trees planted must be listed as preferred for the applicable stratum in the site plan. If both preferred and acceptable species were planted, FS 704 plots may not be sufficient for reporting regeneration delay.

If all of these conditions are met, the FS 704 data will provide adequate evidence that regeneration delay obligations have been met. Compile the data in the same format used for a regeneration delay survey, and ensure it meets all RESULTS Information Submission Specifications requirements.

If any of the conditions above are not met—including if more than 10% of the total trees are natural or previously planted—a regeneration delay survey is required. This survey may be carried out at the same time as the planting quality inspection, or it can be completed separately.

11.6.2 Juvenile Spacing Quality Inspection Plots

You can use juvenile spacing quality inspection plots (FS 749) to declare that an opening is free growing if all the requirements of a free growing survey report are met.

To meet free growing reporting requirements, you will need additional data that are not normally collected as part of the FS 749 inspection. The most reliable approach is to complete at least five free growing plots while also collecting data for the required number of FS 749 plots.

After a spacing treatment, the visual assessment sampling method is often suitable for collecting the additional free growing data.

Appendices

Appendix 1 Accreditation, Staying Current, and Training Resources

A1.1 Provincial Accreditation Program

The silviculture surveyor accreditation program is designed to ensure that surveyors are capable and well-trained, and understand how to conduct good-quality silviculture surveys.

Silviculture surveyors must pass a 2-day provincial accreditation exam that includes a written and field component. Successful candidates must meet a range of performance objectives. The Accreditation Brochure and Performance Objectives document describes the performance objectives and exam criteria.

To prepare for the exam, surveyors can design their training to suit their needs. Most candidates require substantial field experience that has been guided by a highly skilled, accredited surveyor. Many surveyors obtain the skills and knowledge they need by taking courses at educational institutions or studying with provincial trainers. Training courses and exam dates are posted on the silviculture surveys website. Courses and exams are typically offered at the beginning and end of each field season.

The silviculture surveyor accreditation certificate has no expiry date, meaning the exam is taken only once. However, surveyors are still responsible for staying current with any updates to silviculture standards and procedures throughout their careers.

Accreditation confirms that successful candidates have achieved a high standard of competency. However, it does not guarantee that an individual's survey work—or a particular survey—meets the required standards. Accreditation is not a substitute for diligent supervision and auditing.

Accredited Silviculture Surveyors (BCASSs) who are not Registered Professional Foresters (RPFs) or Registered Forest Technologists (RFTs) can join the Forest Professionals of British Columbia (FPBC) as associate members, known as Silviculture Accredited Surveyors (SASs). To apply for membership, an accredited surveyor must provide character references and a resume of their recent silviculture survey experience. They must also complete an open book ethics exam. The benefit of joining the FPBC depends on the surveyor's current professional status and goals.

Unlike BCASSs, SASs may engage independently in aspects of professional forestry. However, their scope of practice is more narrowly defined and focused than that of RPFs or RFTs. The SASs' scope of practice is primarily project preparation, data collection, data compilation and reporting, and quality assurance aspects of silviculture surveying. SASs are required to sign and seal/stamp appropriate professional work products, as per FPBC Bylaw 8; however, they may not assume responsibility and sign declarations.

A1.2 Staying Current

Both accredited and non-accredited silviculture surveyors are expected to stay up to date on silviculture surveying. Here are some suggestions:

1. Join the BC Silviculture Surveyor distribution list: email silvsurveys@gov.bc.ca to receive notifications of new releases, training opportunities, or program changes.
2. Subscribe to the BC Silviculture Surveys YouTube channel and watch the available training videos.
3. Review and download/print the following from the Silviculture Surveys website:
   - BC Silviculture Survey Procedures Manual
   - What's New in Silviculture Surveying
   - FS 657, FS 658, FS 659, FS 660, FS 1138A cards
     If you use paper cards and are a government client, order the latest ones from www.dcv.gov.bc.ca. If you are a non-government client, email dcvcustomerser@gov.bc.ca or call 1-800-282-7955.

     Note: The cards will soon be available for purchase on Supply BC.
4. If you use a survey data collection application, ensure you have the latest version on your mobile device.
5. Review survey reference documents from the Survey Reference Documents webpage.
6. Review the RESULTS Information Submission Specifications, and Submitting Forest Cover to RESULTS for Openings with Treed Retention.
7. Attend forest health training sessions with your district or regional forest health specialists. If a training session is not planned, request one.
8. Access ecology training:

- Attend an ecology training session with your regional ecologists and soil specialists. If a training session is not planned, request one.
- Review free, online BEC training content or register for a course with a college or university: https://www.for.gov.bc.ca/hre/becweb/resources/training/index.html

9. Download district-scale biogeoclimatic field maps and regional field guides.
10. Review forest health hazard ratings, off-site trials, species feasibility, and climate summaries: https://thebeczone.ca/shiny/bybecmap/
11. Sign up for a silviculture survey course:
    - Northern Interior: https://technapro.com/product-category/survey-training/
    - Southern Interior: https://www.wallis-training.ca/courses/
    - Coast: http://silverfir.ca/
12. Attend a silviculture workshop (e.g., NSC, SISCO, CSC) or field tour to learn about current issues, the latest research, and best management practices, and to network with other silviculture surveyors and specialists.

A1.3 Training Resources and References

Many of the references listed below are long-standing training resources that continue to support learning and skill development in silviculture surveys. Users should be aware that portions of these materials may not reflect current policy direction, legislative requirements, or the specific procedures described in this manual. These resources should be used as supplementary material and interpreted in the context of current standards and guidance.

Training Videos[54]

Root Disease: Reporting and NEW Netdown Process (2026)

CEDR: Data Collection Procedure (2026)

2026 CEDR: Data Compilation and Reporting (2026)

Using Ocular Assessments for FG Declarations: Suitability Matrix (2025)

Silviculture Survey Accreditation Exam- Are You Ready? (2025)

[54] Other training videos are available on the BC Silviculture Surveys YouTube channel.

Identification of BC's Major Root Diseases (2025)

FS 1138A: Statistics for Silviculture Surveying (2025)

SiteTools and Growth Intercept Tables (2025)

Swiss Needle Cast Data Collection (2023)

FPPR 46.11(2): Using Stratification to Achieve Non-Timber Objectives (2022)

Survey Training Materials

2026 CEDRSS Implementation Guide (2026)

Data Collection: Swiss Needle Cast (2023)

Using Stratification to Achieve Non-Timber Objectives (2022)

Forest Cover Stratification and Milestone Declarations (2007)

How to Determine Site Index (1999)

Growth Intercept Method for Silviculture Surveys (1999)

Multi-Storey Silviculture Survey Course Workbook (2008)

DFP Training Session Workbook (2004)

Juvenile Spacing Quality Inspection (2001)

Planting Quality Inspection (2012)

Guidance

Thinning Guidance for British Columbia (2025)

Chief Forester Memo- Maximum Density Guidance (2022)

Guidebooks[55]

Establishment to Free Growing Guidebook Cariboo (2002)

Establishment to Free Growing Guidebook Kamloops (2000)

Establishment to Free Growing Guidebook Nelson (2000)

[55] The Forest Practices Code guidebooks are for information only. They are no longer cited in regulation.

Establishment to Free Growing Guidebook Prince George (2000)

Establishment to Free Growing Guidebook Prince Rupert (2000)

Establishment to Free Growing Guidebook Vancouver (2000)

Green-up Guidebook (1999)

Land Management Handbooks

Silvicultural Systems Handbook for British Columbia (2025)

Forest Science Program -Land Management Handbooks

Forest Health

Forest health—Province of British Columbia website

Field Guide to Forest Damage in British Columbia (2014)

Common Tree Diseases of British Columbia (1996)

Managing Root Disease in British Columbia (2018)

LMH 73: Managing Dwarf Mistletoe in British Columbia (2019)

LMH 74: Elytroderma needle cast on lodgepole pine in British Columbia (2020)

Tomentosus Root Rot (2013)

Laminated Root Disease (2011)

White Pine Blister Rust (2009)

Hemlock Dwarf Mistletoe (2004)

Dothistroma (2009)

Warren Root Collar Weevil (2009)

Spruce Weevil & Western Spruce Budworm (2006)

Spruce/White Pine Weevil (2011)

FRDA Handbooks

A Guide to Vegetation Control Equipment (1990)

Herbicide Field Handbook (2002)

A Guide to the Response of Common Plants in British Columbia to Management Treatments (1990)

Effectiveness of Forest Vegetation Control Methods in British Columbia (1996)

Operational Summaries for Vegetation Management

Broom -Putting it in its place

Dry Alder Complex (1997)

Ericaceous Shrub Complex (1997)

Fireweed Complex (1997)

Gorse -The spiny competitor

Mixed-shrub Complex (1997)

Pinegrass Complex (1997)

Reedgrass Complex (2000)

Wet Alder Complex (1997)

Willow Complex (1997)

Managing Vegetation with Sheep

Miscellaneous Publications

Additional publications may be available from Crown Publication:

The Tree Book (1948)

Provincial Seedling Stock Type Selection and Ordering Guidelines (1998)

Glossary of Forestry Terms (2008)

Appendix 2 Local Geographic Competition Assessment Criteria

A2.1 Application of Local Geographic Competition Assessment Criteria

There are four different local geographic competition assessment criteria. Use the correct criteria based on region (Figure A2.1), timber supply area (Table A2.1), biogeoclimatic subzone, site series, and site history.

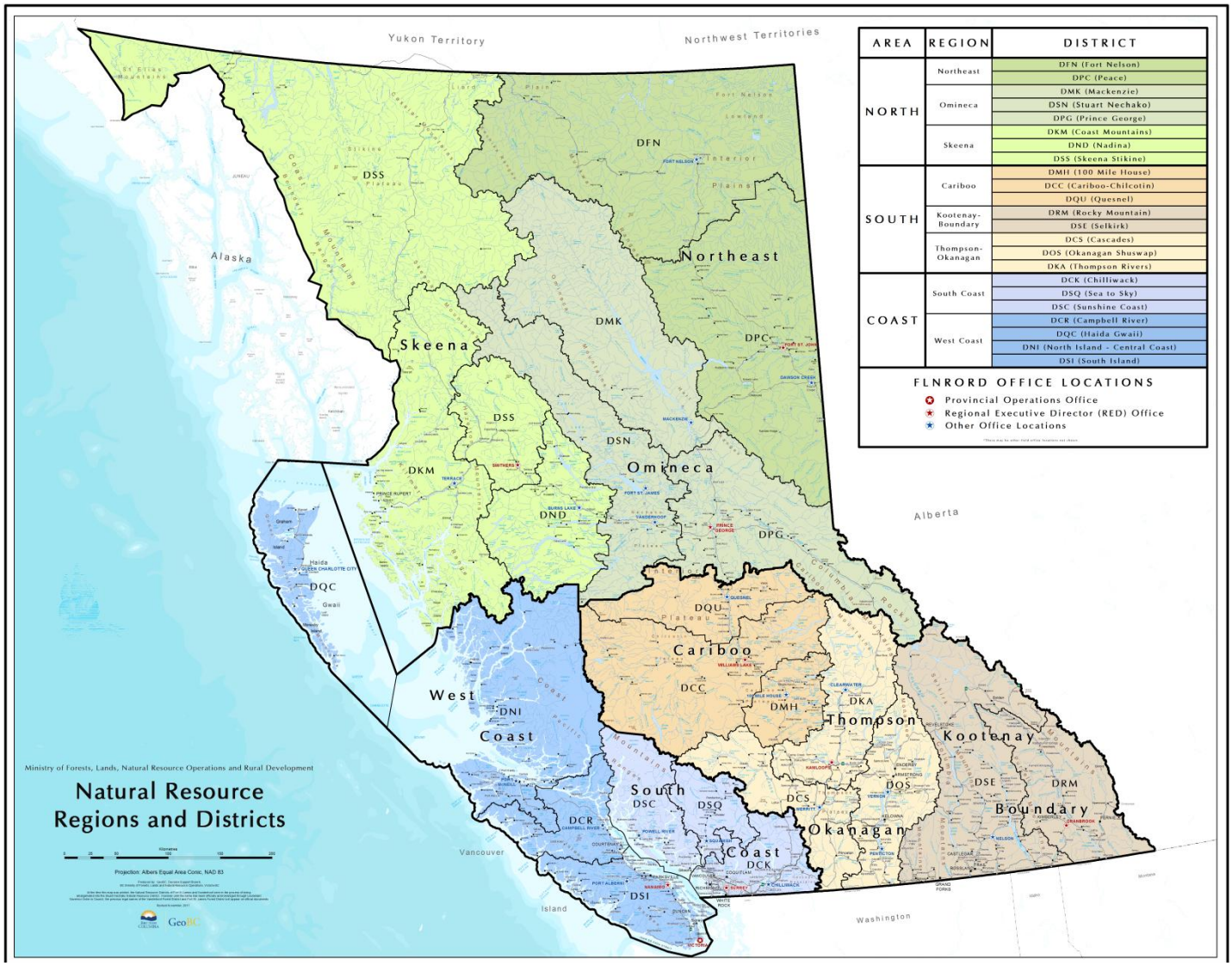


FIGURE A2.1. Natural resource districts, colour-coded by region.

Table A2.1 summarizes where each competition criterion applies.

Note: The criteria apply to all area-based tenures within the gross area of each timber supply area, regardless of natural resource district boundaries.

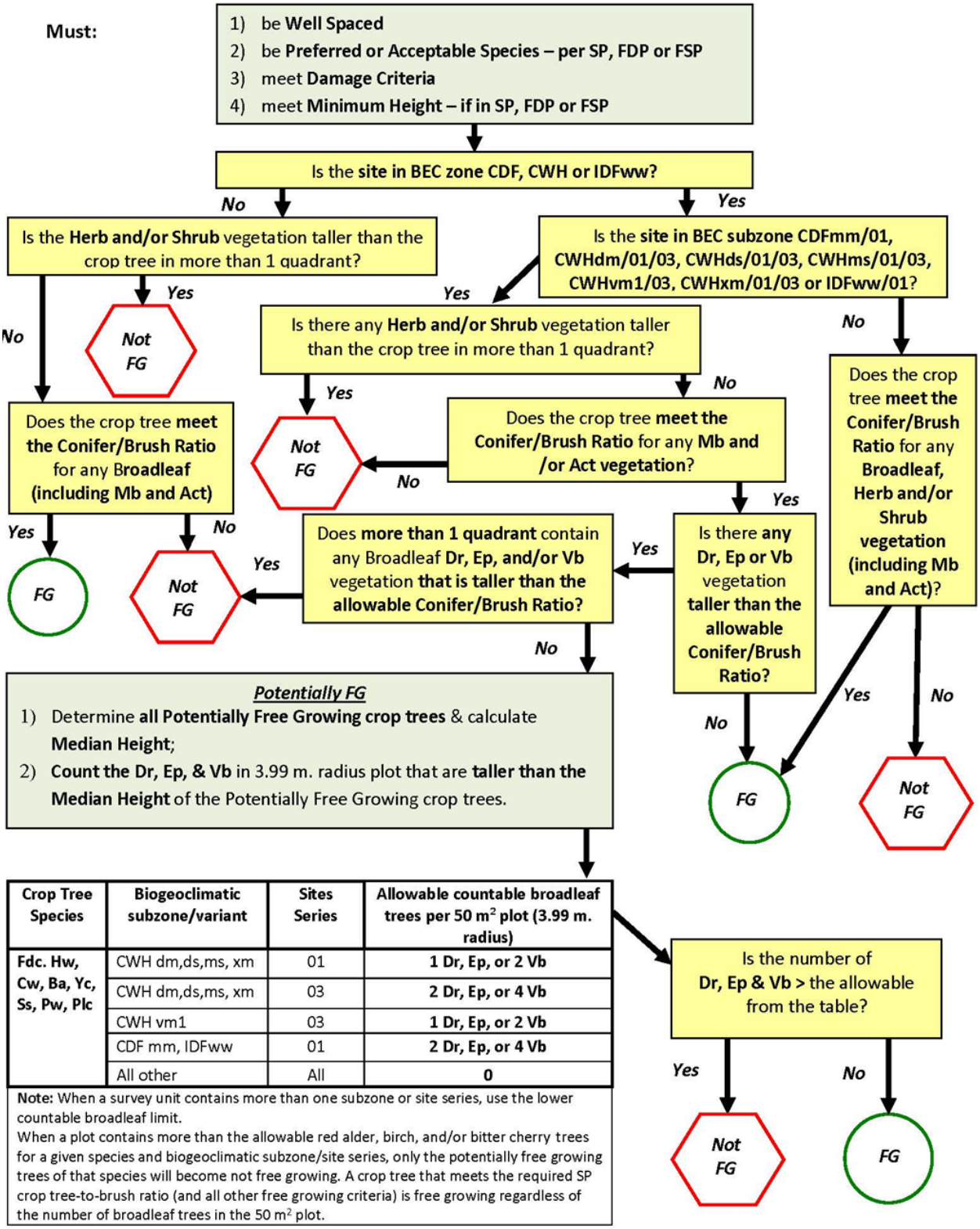
TABLE A2.1. Applicability of local geographic competition assessment criteria, by timber supply area (TSA)

Competition assessment criteria	**Coast** (Figure A2.2)	**North Interior** (Figure A2.3)	**South Interior*** (Figure A2.4)	**Alternate South Interior**** (Figure A2.5) (Appendix 2.3)
TSAs	-Arrowsmith -Fraser -Great Bear Rainforest (GBR) North -GBR South -Pacific (GBR and non-GBR) -Haida Gwaii -Soo -Sunshine Coast -North Island -Kalum	-Cassiar -Nass -Kispiox -Bulkley -Morice -Lakes -Prince George -Mackenzie -Robson Valley -Dawson Creek -Fort St. John -Fort Nelson	-Kamloops -Merritt -Lillooet -Okanagan -Golden -Revelstoke -Invermere -Cranbrook -Kootenay Lake -Arrow -Boundary -Williams Lake -Quesnel -100 Mile	-Williams Lake -100 Mile -Quesnel

* In the IDFdk4 and SBPSxc of the Williams Lake, Quesnel, and 100 Mile TSAs, broadleaf competition may be considered non-deleterious at the plot level if, in the professional's judgement, established conifers are not suppressed by surrounding broadleaf vegetation.

** The Alternate South Interior criteria may apply to sites in the SBPSmk, SBPSdc, SBSdw1, SBSdw2, IDFdk3, and IDFdk1 of the Williams Lake, Quesnel, and 100 Mile TSAs where there has been no previous brushing or broadleaf spacing.

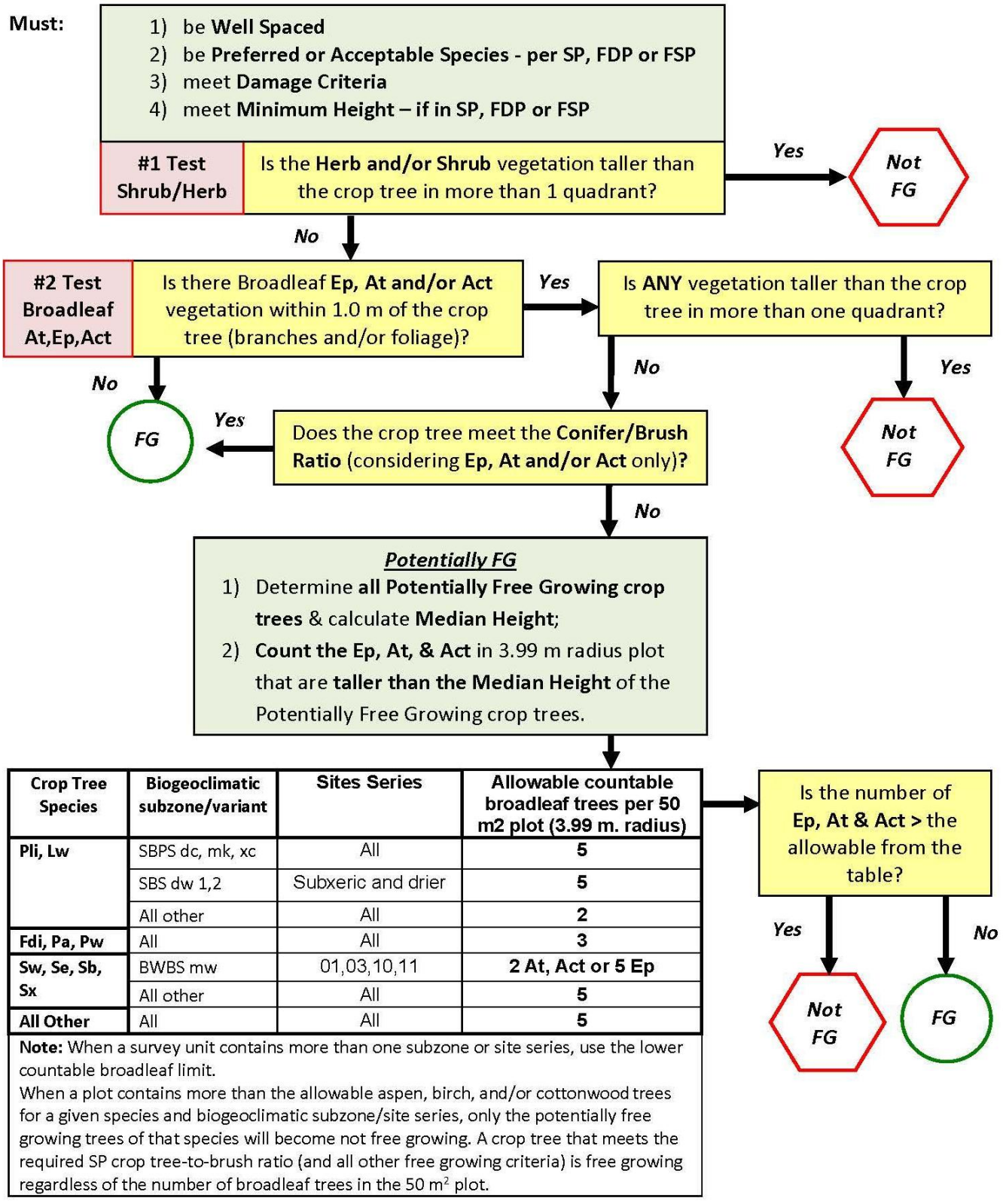
A2.2 Competition Assessment Criteria



Crop Tree Species	Biogeoclimatic subzone/variant	Sites Series	Allowable countable broadleaf trees per 50 m² plot (3.99 m. radius)
Fdc. Hw, Cw, Ba, Yc, Ss, Pw, Plc	CWH dm,ds,ms, xm	01	1 Dr, Ep, or 2 Vb
	CWH dm,ds,ms, xm	03	2 Dr, Ep, or 4 Vb
	CWH vm1	03	1 Dr, Ep, or 2 Vb
	CDF mm, IDFww	01	2 Dr, Ep, or 4 Vb
	All other	All	0

Note: When a survey unit contains more than one subzone or site series, use the lower countable broadleaf limit.
When a plot contains more than the allowable red alder, birch, and/or bitter cherry trees for a given species and biogeoclimatic subzone/site series, only the potentially free growing trees of that species will become not free growing. A crop tree that meets the required SP crop tree-to-brush ratio (and all other free growing criteria) is free growing regardless of the number of broadleaf trees in the 50 m² plot.

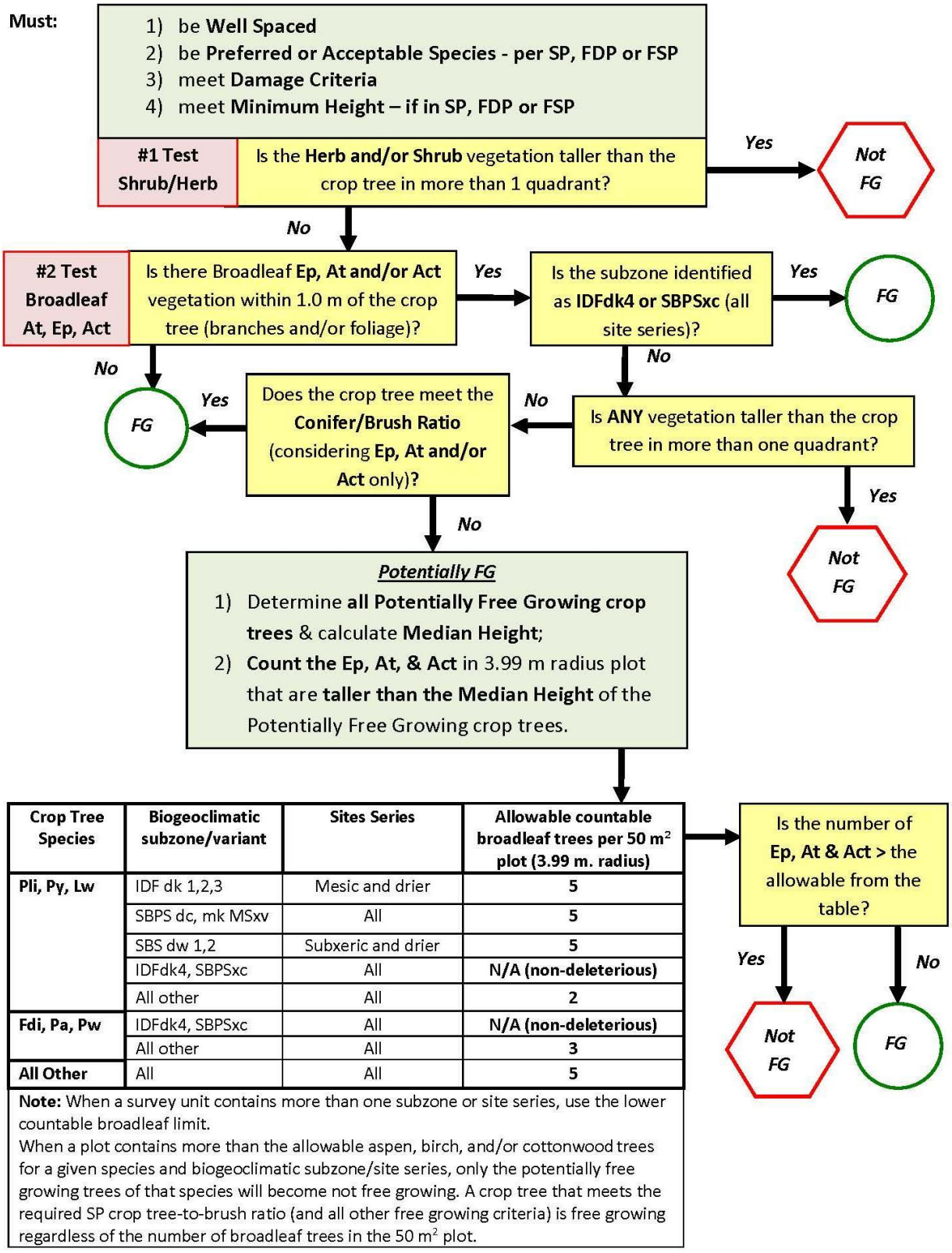
FIGURE A2.2. Coast vegetation competition assessment criteria.



Crop Tree Species	Biogeoclimatic subzone/variant	Sites Series	Allowable countable broadleaf trees per 50 m2 plot (3.99 m. radius)
Pli, Lw	SBPS dc, mk, xc	All	5
	SBS dw 1,2	Subxeric and drier	5
	All other	All	2
Fdi, Pa, Pw	All	All	3
Sw, Se, Sb, Sx	BWBS mw	01,03,10,11	2 At, Act or 5 Ep
	All other	All	5
All Other	All	All	5

Note: When a survey unit contains more than one subzone or site series, use the lower countable broadleaf limit.
When a plot contains more than the allowable aspen, birch, and/or cottonwood trees for a given species and biogeoclimatic subzone/site series, only the potentially free growing trees of that species will become not free growing. A crop tree that meets the required SP crop tree-to-brush ratio (and all other free growing criteria) is free growing regardless of the number of broadleaf trees in the 50 m^2 plot.

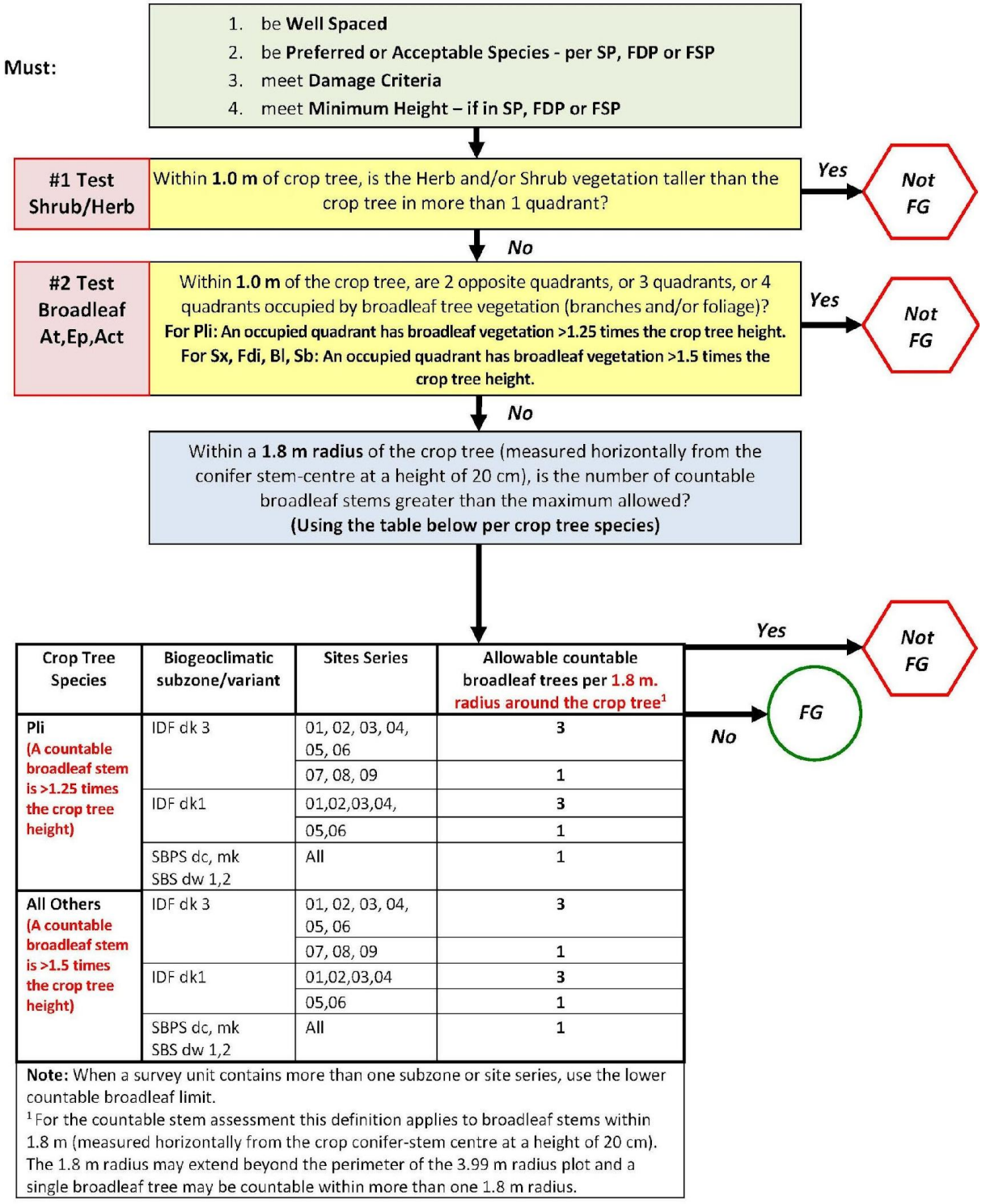
FIGURE A2.3. North Interior vegetation competition assessment criteria.



Crop Tree Species	Biogeoclimatic subzone/variant	Sites Series	Allowable countable broadleaf trees per 50 m² plot (3.99 m. radius)
Pli, Py, Lw	IDF dk 1,2,3	Mesic and drier	**5**
	SBPS dc, mk MSxv	All	**5**
	SBS dw 1,2	Subxeric and drier	**5**
	IDFdk4, SBPSxc	All	**N/A (non-deleterious)**
	All other	All	**2**
Fdi, Pa, Pw	IDFdk4, SBPSxc	All	**N/A (non-deleterious)**
	All other	All	**3**
All Other	All	All	**5**

Note: When a survey unit contains more than one subzone or site series, use the lower countable broadleaf limit.
When a plot contains more than the allowable aspen, birch, and/or cottonwood trees for a given species and biogeoclimatic subzone/site series, only the potentially free growing trees of that species will become not free growing. A crop tree that meets the required SP crop tree-to-brush ratio (and all other free growing criteria) is free growing regardless of the number of broadleaf trees in the 50 m² plot.

FIGURE A2.4. South Interior vegetation competition assessment criteria.



Crop Tree Species	Biogeoclimatic subzone/variant	Sites Series	Allowable countable broadleaf trees per 1.8 m. radius around the crop tree[1]
Pli (A countable broadleaf stem is >1.25 times the crop tree height)	IDF dk 3	01, 02, 03, 04, 05, 06	**3**
		07, 08, 09	1
	IDF dk1	01,02,03,04,	**3**
		05,06	1
	SBPS dc, mk SBS dw 1,2	All	1
All Others (A countable broadleaf stem is >1.5 times the crop tree height)	IDF dk 3	01, 02, 03, 04, 05, 06	**3**
		07, 08, 09	1
	IDF dk1	01,02,03,04	**3**
		05,06	1
	SBPS dc, mk SBS dw 1,2	All	1

Note: When a survey unit contains more than one subzone or site series, use the lower countable broadleaf limit.

[1] For the countable stem assessment this definition applies to broadleaf stems within 1.8 m (measured horizontally from the crop conifer-stem centre at a height of 20 cm). The 1.8 m radius may extend beyond the perimeter of the 3.99 m radius plot and a single broadleaf tree may be countable within more than one 1.8 m radius.

FIGURE A2.5. Alternate South Interior vegetation competition assessment criteria for the Williams Lake, Quesnel, and 100 Mile timber supply areas (sites with no prior brushing or broadleaf spacing).

A2.3 Alternate South Interior Criteria

Scope: These alternate South Interior competition criteria apply to only the following BEC subzones/variants within the Williams Lake, 100 Mile, and Quesnel TSAs: SBPSmk, SBPSdc, SBSdw1, SBSdw2, IDFdk3, and IDFdk1.

Site history prerequisite: Use these criteria only on sites with no prior broadleaf brushing or broadleaf spacing.

Development and intent: The Cariboo Region silviculture research section developed these criteria to reflect more biologically appropriate broadleaf-retention thresholds—levels that are compatible with conifer growth objectives for the ecosystems listed under scope. The accompanying survey procedure simplifies the previous approach by eliminating the “potential free growing” concept.

Significant changes (from the standard South Interior criteria):

- **Brush/conifer ratio replaces conifer/brush ratio.**

  In the former guidance, crop trees had to be 150% or 125% of the height of surrounding vegetation (by BEC) within a 1.0-m radius cylinder. The alternate criteria flip the expression: a broadleaf tree must now exceed a brush/conifer ratio (expressed as a decimal) to be counted as occupying a quadrant.

  - Broadleaf over pine: >1.25 × pine height
  - Broadleaf over other conifers: > 1.5 × conifer height
- **Quadrant occupancy is more flexible (but bounded).**

  Within the 1.0-m radius cylinder around the crop tree, it is acceptable for 0, 1, or 2 adjacent quadrants to be occupied by overtopping broadleaves (i.e., those exceeding the brush/conifer ratio). It is not acceptable for 2, 3, or 4 opposite quadrants to be occupied.
- **Countable broadleaf assessment moves from the plot to the neighbourhood.**

  Countable broadleaves are assessed within a 1.8-m radius around each candidate well-spaced conifer (not within the 3.99-m plot) (see Figure A2.6). This removes cases where a broadleaf clump on one side of the plot causes trees 7–8 m away to fail.

Alternate Survey Procedure:

- Test #1 for overtopping shrubs and herbs is unchanged (see Figure A2.5).

- Brush/conifer ratios:
  - Broadleaf over pine: >1.25 × pine height
  - Broadleaf over other conifers: >1.5 × conifer height
- A well-spaced conifer is free growing only if it passes both the quadrant test and the countable broadleaf test. If it fails either, it is not free growing. Decisions can be made quickly on a tree-by-tree basis.

a. Occupied Quadrant Test (1.0-m radius)

Within 1.0 m of the crop conifer, count the number of quadrants that contain any broadleaf that exceeds the brush/conifer ratio (“occupied quadrants”).

- Allowed: 0 occupied, 1 occupied, or 2 adjacent occupied quadrants
- Not allowed: 2 opposite occupied, 3 occupied, or 4 occupied quadrants

b. Countable Broadleaf Test (1.8-m radius)

Within 1.8 m of the crop conifer, tally all broadleaf stems or clumps that exceed the brush/conifer ratio (“countable broadleaves”). Compare the tally to the allowable limits for the BEC subzone/variant, site series, and conifer species. Measure the 1.8-m radius horizontally from the crop conifer’s stem centre at 20 cm above the ground.

Note: 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 (“neighbourhoods”) overlap (Figure A2.6).

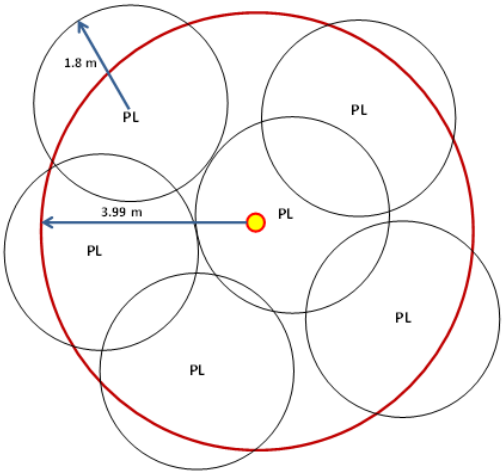


FIGURE A2.6. Examples of six 1.8-m radius neighbourhoods around well-spaced trees in a 3.99-m radius plot.

Appendix 3 Unmanned Aerial Vehicles

A3.1 Ocular Assessments

Unmanned aerial vehicles (UAVs), commonly known as drones, can be used as a visual assessment tool to support silviculture surveys. The surveyor can review the UAV imagery and interpret it in the same manner as an ocular assessment conducted by helicopter.

Currently, they are used for:

- initial reconnaissance
- stratification
- treatment mapping
- post-treatment monitoring
- forest cover updates

There are several potential benefits of using UAVs to conduct ocular assessments:

- There are fewer incidents of slips, trips, and falls compared to conducting assessments on the ground.
- Data collection is faster and field costs are lower compared to ground-based assessments.
- Stratification accuracy is improved.
- The imagery can be reviewed with colleagues in the office.
- The visual information may support contract negotiations (e.g., regarding vegetation management treatments).

A3.2 Hybrid Ocular Assessments

UAV-collected data can be processed using automated software to generate a range of analytical products, reducing reliance on visual interpretation of raw imagery.

The types of UAV-derived products that can be created include orthomosaics, three-dimensional point clouds, stem maps, crown height models, digital surface models, and digital terrain models. These products enable automated estimation of total tree density, heights, crown closure, spatial distribution, gaps, and percent stocking. For certain stand or site

conditions, some software may also support species identification, basal area estimation, site index estimation, and assessment of well-spaced or free-growing densities.

As UAV-derived products become more reliable, stocking standards may evolve to use alternative measurable metrics that align more directly with those outputs. Stocking standards may also incorporate projectable metrics, as stem maps and crown height models could eventually be used to initialize growth and yield models.

UAV-derived products offer unique advantages in situations where spatial pattern, treatment extent, or stand structure are important. For example, they can be particularly useful for green-up surveys and surveying commercially thinned stands or stands managed with clustered distributions of trees to achieve habitat objectives.

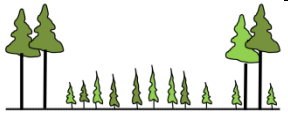
UAV-derived products do not currently provide all the forest cover attributes required to assess compliance with stocking standards, or for RESULTS reporting. Therefore, a hybrid approach is needed: the missing attributes must be obtained through visual assessment of the UAV-derived imagery and/or by targeted field verification. As such, hybrid ocular assessments should be used in low-risk stands, and they are subject to the suitability criteria and conditions of use outlined in Sections 4.5.1 and 4.5.5.

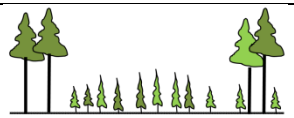
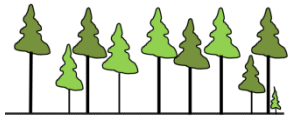
The accuracy and completeness of UAV-derived products are influenced by multiple factors, including the UAV platform, sensor type, flight parameters, terrain, tree species diversity, tree sizes, and total tree density. The types of products that can be generated—and their quality—also vary substantially among software vendors and platforms. Vendors may not produce equivalent outputs, even when working with similar source data, due to differences in processing workflows, classification approaches, and quality control practices. As a result, deliverables from different vendors or processing systems may differ significantly in accuracy, reliability, and operational suitability.

The software provider, analytics platform, or drone services company is not liable for the survey or for any declarations or treatment recommendations based on their outputs. The forest professional is accountable for professional practice. They must exercise due diligence in determining whether UAV-derived products are suitable for the intended use. This includes understanding the capabilities and limitations of the products, confirming their accuracy for the applicable stand and site conditions, and completing field verifications.

Appendix 4 Stand Structures

A4.1 Guidance Matrix for Reporting Retention Openings into RESULTs

	Silviculture Survey Procedures Manual				Submitting Forest Covers to RESULTS for Openings with Treed Retention	
Steps	**1 →**	**2 →**		**3 →**	**4a or 4b**	
	Conifer Management Regime	Planned &/or Resultant Stand Structure	Stand Structure Example Illustrations	Recommended Survey Methodology	Long-Term Retention[4]–Sec 4.1	Short-Term Retention[5]–Sec 4.2
	1a. Regeneration Obligation: Timber Priority					
	Single Entry: Even-Aged Regime	Complex Vertical Structure Dispersed Retention[1] Low BA (< 10 m^2/ha in Interior)		Layered Sec 10.8	Dispersed Sec 4.1.2 & 4.1.3	Unharvested Stems Sec 4.2.4
	Multiple Entry: Uneven-Aged Regime-Single Tree Selection	Complex Vertical Structure Dispersed Retention IDF only		Multi-entry Sec 10.5		Single Tree Sec 4.2.1
	Multiple Entry: Uneven-Aged Regime–Group Selection	Complex Horizontal Structure Group Retention[2]–Clearcut Openings[3]		Clearcut Method Chapters 1-9		Group Selection Sec 4.2.2
	Multiple Entry: Uneven-Aged Regime–Group Selection	Complex Horizontal Structure Group Retention–Small Patch		Small Scale Openings Method Sec 11.4		Group Selection Sec 4.2.2

	1b. Regeneration Obligation: Non-Timber Priority					
	Single Entry: Even-Aged Regime	Complex Vertical Structure Dispersed Retention < 20 m^2 Interior < 40 m^2 Coast		DFP or CEDRSS Sec 10.6 & 10.7	Dispersed Sec 4.1.2 & 4.1.3	Unharvested Stems Sec 4.2.4
	Multiple Entry: Uneven-Aged Regime– Single Tree Selection	Complex Vertical Structure Dispersed Retention **IDF only**		Multi-entry Sec 10.5		Single Tree Sec 4.2.1
	Multiple Entry: Uneven-Aged Regime– Group Selection	Complex Horizontal Structure Group Retention		Clearcut Method Chapters 1-9 or Small Scale Openings Method Sec 11.4		Group Selection 4.2.2
	1c. No Regen Obligation (≥ 20 m^2 Interior, ≥ 40 m^2 Coast)[6]					
	Intermediate Cut	Complex Horizontal Structure Dispersed Retention		Intermediate Cut Sec 11.2		No Regen Objectives Sec 4.2.3
	Commercial Thin	Complex Horizontal Structure Dispersed Retention		Commercial Thin Sec 11.1		No Regen Objectives Sec 4.2.3

[1] Dispersed retention: Residual trees that are retained individually or in unmapped clusters within the boundaries of the net area to be reforested. They are associated with a standards unit.

[2] Group retention: Unharvested residual tree patches that are mappable. They are not associated with a standards unit.

[3] Clearcut: Openings have a width greater than two mature tree-heights and less than 50% of the area is within a tree-length of an edge.

[4] Long-term residuals: Residual trees with a reserve objective code other than Timber (e.g., WTRA) and not available for a subsequent harvest entry until after the next rotational planning cycle—referred to as “reserves.”

[5] Short-term residuals: Residual trees available for a subsequent harvest entry prior to the end of the current rotational planning cycle (whether or not they are harvested)—referred to as “retention.” Associated with the reserve objective code “Timber.”

[6] These are common thresholds above which there is no regeneration obligation. However, always refer to the applicable stocking standards, as different basal area thresholds may apply depending on the stand objectives and site or stand conditions.

For more information, refer to Silvicultural Systems Handbook for BC.

Appendix 5 Legislative Framework for Silviculture Surveys

This appendix summarizes the legislative, regulatory, and historical context that underpins silviculture survey obligations in British Columbia. It provides general guidance and does not replace or interpret the law. Users should consult the applicable Acts, regulations, and approved plans when making professional decisions.

A5.1 Historical Evolution of Silviculture and Survey Requirements

Forest legislation in British Columbia has changed many times over the last 40 years. Surveyors have worked under seven major regulatory eras and are now moving into an eighth. Each legislative shift has introduced additional complexity to the surveyor's role. The following provides a brief historical overview:

Before Oct. 1, 1987

- There was no legal requirement for licensees to reforest harvested areas.
- Government funded all reforestation activities.

Oct. 1, 1987 – Apr. 1, 1994

- Licensees were required to create pre-harvest silviculture prescriptions (PHSPs) and fund their own reforestation.

Apr . 1, 1994 – June 15, 1995

- The Silviculture Practices Regulation replaced earlier rules.
- PHSPs became silviculture prescriptions.

June 15, 1995 – Dec. 17, 2002 (Forest Practices Code era)

- The Forest Practices Code was introduced, along with many regulations and guidebooks.

Nov. 30, 1998 – present (woodlot licensees only)

- The transition was made to woodlot licence plans with default stocking standards.

Dec. 17, 2002 – Jan. 31, 2004

- Site plans replaced silviculture prescriptions, though many operations still followed the Forest Practices Code.
- Stocking standards could be embedded in forest development plans.

Jan. 31, 2004 – Nov. 23, 2021 (FRPA era)

- The *Forest and Range Practices Act* introduced results-based management.

- Site plans were required for most tenure types (not for woodlots).
- Stocking standards were included in site plans and forest stewardship plans.

Nov. 23, 2021 – current

- The *Forest and Range Practices Act* remains in force.
- Stocking standards may appear in site-level plans, forest operations plans, or forest landscape plans.

Key implication:
Regardless of the era, the stocking standards in effect at the time of plan approval remain legally binding until they are fulfilled, amended by agreement, or replaced under an approved forest stewardship plan.[56]

A5.2 Governing Legislation and Regulations

Forest and Range Practices Act

The *Forest and Range Practices Act* (FRPA) requires the establishment of a free growing stand. The Forest Planning and Practices Regulation and the Woodlot Licence Planning and Practices Regulation require that a forest cover inventory be completed. In practice, these inventories are generated though regeneration delay and free growing survey (or free growing surveys alone for woodlots).

Relevant FRPA components include:

- **Part 1** — Defines key terms, including free growing stand.
- **Part 1.1**— Establishes forest landscape plans, forest operations plans, and site level plans.
- **Part 2** — Establishes forest stewardship plans (ss. 3, 5), site plans (s. 10), and woodlot licence plans (s. 13).
- **Part 3 (ss. 25–27)** — Addresses forest health and pests on Crown and private land.

[56] For woodlot licences, old standards can be amended but not replaced with new woodlot licence plan standards, according to s. 202 of the *Forest and Range Practices Act*.

- **Part 3 (ss. 29–30)** — Establishes the requirement to create a free growing stand for major licensees, BCTS, woodlots, and non-replaceable licenses; includes seed use requirements.
- **Part 3 (s. 31)** — Ensures conformance to prescribed seed-use requirements.
- **Part 7 (s. 107)** — Provides declarations of obligations; s. 107(5)(b) directs District Managers not to reject a free growing declaration unless the stand is threatened by vegetation competition or forest health, or is unlikely to remain free growing without treatment.
- **Part 11 (s. 177)** — Defines silviculture plans and prescriptions (PHSPs, SPs, and site plans) collectively.

Forest Planning and Practices Regulation

The Forest Planning and Practices Regulation defines many of the procedural requirements associated with stocking standards, seed use, forest cover reporting, and declarations. Key sections include:

- **Section 1** — Definitions, including standards unit, stocking standard, regeneration date, free growing date, forest health factor, and forest cover inventory.
- **Section 4.14** — Stocking standards in forest operations plans.
- **Section 4.55** — Content requirements for site-level plans.
- **Section 16** — Stocking standards in forest stewardship plans.
- **Section 26** — Minister's considerations for approving stocking standards.
- **Section 34** — Content requirements for site plans.
- **Section 43** — Seed use requirements.
- **Sections 44–46** — Free growing stand requirements.
- **Section 46.11** — Stratification requirements.
- **Sections 85–88** — Annual reporting, including precision standards defining the "form and manner satisfactory to the minister"; reporting period is April 1–March 31, with submissions due before June 1.
- **Section 87** — Details of reporting and mapping requirements.
- **Section 97** — Regeneration and free growing declarations.
- **Section 111** — Amalgamation of free growing obligations.

- **Schedule 1, Section 6** — Factors relating to stocking specifications.

Woodlot Licence Planning and Practices Regulation

The Woodlot Licence Planning and Practices Regulation outlines regeneration obligations and free growing requirements for woodlot licence holders. Key sections include:

- **Sections 8, 9, 34, 35** — Requirements for woodlot licence plans, mapping, objectives, free growing stands, and stocking standards.
- **Section 12** — Stocking information for specified areas.
- **Section 13** — Alternative performance requirements.
- **Section 33** — Pre-harvest mapping.
- **Section 75** — Explicit requirement to conduct surveys.
- **Section 76** — Annual reporting requirements (due April 30 each year).
- **Section 84** — Declarations.

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, or for biodiversity.

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 the Forest Analysis and Inventory Branch as groups of 20 years: 1 = 1–20, 2 = 21–40, etc.

Angle gauge: An instrument used to estimate basal area using a variable-radius plot. Each “in” tree counts as one unit of the basal area factor of the gauge. A tree is “in” if its stem appears wider than the gauge opening, out if it appears narrower, and borderline if it matches the opening exactly.

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”.

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 x 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 m^2/ha of cumulative cross-sectional area.

Biogeoclimatic classification: Ecosystem classification on the basis of vegetation, soils, topography, and climate.

Biogeoclimatic zone: A geographic area that has 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.

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.

CEDRSS (Coastal Ecosystem Dispersed Stocking Standards): Stocking standards used to manage coastal stands under a dispersed or mixed retention silvicultural system, where both the retention and regeneration components contribute to the future stand stocking.

Chlorosis or chlorotic: Blanched or yellowish colouring of normally green foliage in plants, caused by a variety of factors, including nutrient or light deficiencies.

Clearcut: A silvicultural 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 in Forest Planning and Practices Regulation.
"(a) the date on which timber harvesting, other than on road rights of way or landings, begins on a cutblock, or
(b) in the case of timber harvesting carried out in contravention of Section 52 (1) [unauthorized timber harvesting] of the Act, the date a determination under Section 71 [administrative penalties] of the Act takes effect, without any further opportunity for review or appeal in respect of the contravention."

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 that has needles or scale-like leaves, usually evergreen, and producing wood known commercially as softwood.

Countable conifer: Conifers meeting or exceeding a minimum countable height and counted toward 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: Crown closure is the proportion of a stand covered by the crowns of living trees. 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 its location, degree of lean, physical damage, overhead hazards, limb, stem, top or root system deterioration, or a combination of any of these.

Dbh (diameter at breast height): The stem diameter of a tree measured at breast height, metres above the point of germination.

Deciduous: Term applied to trees, commonly broadleaf trees, which usually shed their leaves annually. Also known commercially as hardwoods.

Denuded: The space(s) from which trees were destroyed, felled, and/or removed within a polygon that has been subject to a stand disturbance. Denuded areas are characterized by stumps or fallen dead or standing dead trees.

DFP (Deviation from potential): An approach to regeneration stocking assessment in partially cut stands in the BC interior and coast (CEDRSS).

Dispersed reserves or retention: Residual trees that are retained individually or in unmapped clusters within the boundaries of the net area to be reforested. They are associated with a standards unit.

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.

Dripline: The dripline is defined as a vertical line extending downward from the outermost edge of the living crown of the overstorey tree. It is a visual boundary for assessing understorey tree's minimum distance from an overstorey tree.

Ecosystem: The sum of plants, animals, environmental influences, and their interactions within a particular habitat.

Even-aged: FPPR defines an even-aged stand as a stand of trees consisting of only one or two age classes. *Note*: The age classes are outlined in the Vegetation Label Details.

Fertilization: The addition of fertilizer to promote tree growth on sites deficient in one or more soil nutrients. Commonly used to improve the vigour of crop trees following juvenile spacing or commercial thinning.

FG: Free growing

Fill planting: Fill planting (FP) is a planting activity where the planting/planted density is < 80% of the free growing target stocking standard due to natural ingress, previously planted seedlings, or site limiting factors. The fill planting technique code applies on previously and not previously planted sites.

Forest and Range Practices Act (FRPA): The 2004 replacement for 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 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 (FDP): An operational plan under the *Forest Practices Code* containing a licensee's plans for harvesting, road construction and silviculture activities.

Forest health agent: This term can be used interchangeably with forest health factor. However, forest health factor is the preferred term because it better reflects the full range of biotic and abiotic influences that can affect tree and forest stand development.

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 factor that limits the ability to meet resource management objectives.

Forest Practices Code (FPC): *Forest Practices Code of British Columbia Act*. The Act 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.

Forest stewardship plan (FSP): 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 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.

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.

Gall: Nodule or lump of malformed bark or woody material caused by a variety of factors such as western gall rust or insects.

Germinant: A germinant is a ≤5 cm natural (disregarding the loss of height by a forest health factor). Age is not a consideration.
Note: Planted seedlings under 5 cm or well-spaced trees of any size are counted under total trees (Field 95), not germinants (Field 110).

Example 1: A 2-year-old Pli is 8 cm. It is not a germinant because it is >5 cm.

Example 2: A less than 1-year-old Hw is 7 cm. It is not a germinant because it is >5 cm.

Example 3: A 2-year-old planted Fdc is 4 cm due to elk browse. It is not a germinant because it was planted.

Example 4: A 2-year-old natural Cw is 5 cm and heavily browsed. It is not a germinant because an elk has removed a portion of its height.

Example 5: A 1-year-old Sx is 3 cm. It is a germinant because it is a ≤ 5 cm natural.

Ghost tree: Trees that, for a specified reason, will not count toward the stocking of the stand but have an impact on the development of the regeneration.

GI: Growth intercept

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 handheld or aircraft mounted instrument, and the radio signals from several satellites.

Growing season: The period of active growth from the start of bud elongation until bud set.

ha: Hectare.

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: For RESULTS, the stocking status for the polygon component is recorded as “IMM” if the stratum is stocked, and the layer expected to have the highest volume at the next rotation is currently less than 120 years old.

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.

Infection: Characterized by lesions on the stem and/or branches or characterized by swellings around the point of entrance of a pathogen.

Injury: Damage to a tree by a biological, physical, or chemical factor.

Inter-tree distance: The horizontal distance between two trees on a centre-to-centre basis. Inter-tree distance is calculated or measured to the nearest 1/10 of a metre, 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.

Juvenile spacing: A silviculture treatment resulting in the reduction in density of young stands, preferably between 3 metres to 5 metres in height, to control stocking, prevent stagnation and improve crop tree quality so that at final harvest end-product quality and value is increased.

LCL: see Lower confidence limit.

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 (LCL): 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: For RESULTS, the stocking status for the polygon component is recorded as “MAT” if the stratum is stocked and the layer expected to have the highest volume at the next rotation is currently 120 years old or older.

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.

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.

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 centre-to-centre basis. Inter-tree distance is calculated or measured to the nearest 1/10 of a metre, 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.

Moder: A humus form characterized by prominent L, F, H horizons, a rich, “potting soil” smell, a loose and friable F horizon, and possibly a thin Ah horizon.

Mor: A humus form characterized by a matted F horizon, an unusually abrupt transition to mineral soil, and a “mushroom” smell. 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 characterized by a prominent Ah horizon, a friable F horizon, and a L and H horizons < 2cm. Earthworms often present.

Multi-layered: A stand with two or more distinct vertical layers. Multi-layered stands may be managed under either even-aged or uneven-aged silvicultural systems.

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.

Net area to be reforested (NAR): The area on which the licensee is responsible for establishing a free growing crop of trees.
FPPR defines NAR as:

> ...the portion of a cutblock that remains after the following have been excluded:
> (a) areas occupied by permanent access structures;
> (b) any of the following that are identifiable on a map of a scale 1:10 000:
> (i) areas that, in their natural state, are not capable of supporting a stand of trees that could meet the stocking standards that might otherwise apply, such as areas of rock or wetland;
> (ii) areas of non-commercial forest cover that exist before timber harvesting;
> (iii) areas reserved from timber harvesting;

Node: A joint or portion of a stem from which a leaf or branch has grown.

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.

Not FG: Not free growing.

NP: Non-productive.

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.

Overstorey: Generally, Layer 1 trees growing in full or partial canopy over Layer 2, 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-metre radius around the crop species.

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.

Planting: Establishing a new stand by planting seedlings. The planting (PL) technique code in RESULTS refers to a planting activity with a planting/planted density ≥ 80% of the free growing target stocking standard. It only applies to sites that have not been previously planted.

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 m^2) by the area of the sample plot.

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 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 its hazard status. The term snag may have been previously used to describe these.

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.

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.

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 predetermined height, usually correlated to log lengths, to produce clear, knot-free wood. Knot-free wood increases the value of the final wood products.

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.

Replant: The replant technique code refers to a planting activity on a previously planted site with a planting/planted density ≥ 80% of the free growing target stocking standard.

Reserve: An area of forest land that, by law or by policy, is not available for harvesting. Reserves can be uniformly distributed as single trees or left in small groups.

Residual basal area: The basal area per hectare left standing after harvest.

Residuals (residual trees): Trees remaining, either singly or in groups, after a bounded area has been subject to stand disturbance.

RESULTS: This is an acronym for Reporting Silviculture Updates and Land status Tracking System. This is the Ministry of Forests' corporate database and application used to track silviculture information on openings. Find more information on the RESULTS webpage.

RFT (Registered Forest Technologist): RFTs perform technical forestry functions in four practice areas: silviculture, forest protection, forest operations and forest measurements.

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.

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.

Scar: A mark left after re-growth of damaged tissue following an injury.

Second growth: A second forest that develops after harvest of the original mature forest.

Seedlot: A quantity of cones or seeds that are uniform in species, source, quality, and year of collection.

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 vigour.

SIBEC: An acronym for the method of determining site index which uses the biogeoclimatic ecosystem 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, forest development plan (FDP), forest stewardship plan (FSP), forest

landscape plan (FLP), forest operations plan (FOP), site plan or site-level plan (SP) may all be included under this heading.

Silviculture prescription: 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.

Site class: The measure of the relative productive capacity of a site. No longer used after approximately 1995, when it was replaced by site index.

Site class conversion: The method of determining site index by estimating site class and then using the table below to convert site class to site index.

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 50 years measured at breast height. A top height tree is the largest dbh tree of a given species in a 0.01 ha plot. Breast height age is the number of annual growth rings at 1.3 m from the point of germination.

Site limiting factor: Any factor that negatively affects the survival, growth, or development of trees, including but not limited to forest health agents, competing vegetation, soil conditions (e.g., temperature, moisture, nutrients, compaction, depth), or climatic factors (e.g., frost, cold-air drainage).

Site preparation: Disturbance of an area’s topsoil and ground vegetation to create conditions suitable for regeneration.

Site series: Subdivisions of site associations. Site series include all sites within a biogeoclimatic subzone that can produce the same climax vegetation unit or plant association.

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.

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. The 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.

Stand density: A relative measure of the amount of stocking on a forest area. Often described in terms of stems per hectare.

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, 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.

Stocking standards: Stocking standards detail site-specific legal requirements that are stated in a site plan, site-level plan, forest stewardship plan, forest operations plan, forest landscape plan, pre-harvest silviculture prescription, silviculture prescription, or forest development plan. They specify the standards required to reforest denuded areas with a healthy new crop of trees within specific periods. 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 free growing date.

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 lands. The *Forest Act* defines a number of forestry tenures by which the cutting of timber and other user rights to provincial land are assigned. For example, Forest Licence.

Top height tree: A top height tree is the largest dbh tree of a given species in a 0.01 ha plot.

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.

Tree Farm Licence (TFL): A form of tenure agreement which allows the long-term practice of sound forest management and harvesting on provincial land or on a combination of provincial and private land by private interests, under the supervision of the FOR.

Understorey: Generally, Layers 2, 3, and 4 trees growing under the full or partial canopy of Layer 1. These may be conifers and or broadleaf trees.

Uneven-aged: Stands with a wide range of ages and sizes. FPPR defines an uneven-aged stand as a stand of trees consisting of three or more age classes. *Note*: The age classes are outlined in the Vegetation Label Details.

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: 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.

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.

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.