TIMBER PRICING BRANCH

Cruising Manual

Effective: July 1, 2020

Includes Amendments	Effective Date
Amendment No. 3	February 1, 2025
Amendment No. 2	August 1, 2024
Amendment No. 1	July 1, 2021

Highlights

Section	Description
1.1	Added definitions for Check Cruising, Harvest, Timber Cruising and Uprooted.
2.2	BCTS maintains all cruising related documents on file.
2.3.5	Added BC Timber Sales Managers to approve specific external right of way volume scenario.
2.5.2	Clarify the Area Director approves and does not determine volumes of unsafe to cruise areas.
2.5.3	Updated cruise plan guidelines for patch cut systems.
2.9	Remove references to 'Interior Only' for comparative cruising.
3.1	Clarify BCTS completes check cruising where approved.
3.3.1, 3.8	Check Cruise Submission Form is to be submitted to the District prior to submission of cruise data to ECAS.
3.4	Allow licensees to re-sweep for fire damage code updates.
5.10.1	Added Partial Cut Percent Report, and CP, Block and Type Damage Summary Reports to the list of required if requested by Ministry.
7.6.3	Clarify blowdown code guidelines and updated Figure 7-4.

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1. Introduction

This manual outlines the cruising procedures to be used for stumpage appraisal purposes for timber on the Crown lands of British Columbia. It supersedes previous manuals and instructions.

The sale of Crown timber is a business proposition and both the buyer and the Ministry of Forests (seller) must know an estimate of the quantity and the quality of timber being sold. The cruise provides the essential data for determining stumpage rates, for establishing conditions of sale and for planning of the logging operations by the licensee.

In order to ensure that all purchasers of Crown timber are being treated equally and equitably, the manual sets out the minimum cruising standards that must be met. These include specifications for the statistical design of the cruise, the accuracy of field measurements and standard compilation procedures.

Cruisers and licensees are encouraged to exceed the minimum standards where a higher sampling intensity is desirable. This may include more plots in smaller or more variable types, higher tree counts, and more full measure plots where better DBH data is needed for percent reductions. All stakeholders benefit from better cruise information, which relies on professionalism and thoughtful sampling plans.

Implementation and interpretation of the procedures and standards is an Area responsibility and the manual provides for sufficient flexibility that special circumstances can be accommodated. The appropriate Area office should be consulted periodically for any revisions to the manual, for copies of Area Guidelines, or the issuance of specifications for cruising salvage sales, minor product sales, etc. Refer to Chapter 4 of the Coast Appraisal Manual and Interior Appraisal Manual for further guidance.

The reliability of cruise information is based on statistical concepts and the cruise results provide an estimate of the volume on the area cruised. The reliability of this estimate is a function of the intensity of sampling, the uniformity of the timber on the area cruised and the degree of fit of the volume equation, loss factors, and/or call grade net factoring to the particular stand. It is for these reasons that two cruises of the same stand, carried out to the same standard may yield different volumes. For administrative purposes it is assumed that the calculated volume is the true volume.

Timber cruisers can become accredited through the FPBC. Associate members and registered members are professionally accountable for their work.

Visit https://www.fpbc.ca for more information.

1.1. Definitions

In this manual:

"**100% Cruise**" means a cruise in which every tree is measured.

"**Absolute Variation**" means the difference between two measurements or a standard and a measurement, disregarding the plus or minus sign (e.g., standard of 7 and measurement of 5 gives absolute variation of 2);

"**Accuracy**" means the nearness of a measurement to the actual value of the variable being measured;

"**Area Director**" means the Area Director of Pricing and Tenures for the North or South Areas, the Area Director of Pricing, Tenures and Administration for the Coast Area, and/or their delegates;

"BAF (Basal Area Factor)" means the basal area (m^2) per hectare that each "in" tree represents when using a prism or relaskop. Prisms are sometimes classified as "diopter" size or inscribed with the BAF number. The size denotes the basal area factor (i.e., an 8 BAF prism which tallies 7 trees in a plot would give a basal area (in timber) of 56 m^2/hectare);

"BC Albers" means a map projection that is one of the standard map projections used in British Columbia.

"**BCTS**" means BC Timber Sales;

"**Bias**" means a difference between the sampling result and the actual value due to errors in measurement, sampling procedure or calculations;

"Bole" means the trunk or main stem of the tree and excludes branches and candelabras. The bole of the tree includes merchantable and non-merchantable portions of the trunk of the tree.

"**Boring Height**" means the distance from the ground (high side) up the tree to where an age is taken with an increment borer. It is usually taken at breast height (1.3 m);

"**Breast Height**" means the location on a tree where its diameter (DBH) is measured. It is located exactly 1.3m above "high side". If high side is lower than the point of germination (POG), breast height is 1.3 m above the POG;

"**Cardinal directions**" means North, South, East and West. All references to azimuths or bearings mean the "true" value. For a description of True North, please see True North, Magnetic North and Grid North in the Appendices;

"**CGNF**" or "**Call Grade Net Factor**" means the survey methodology used by timber cruisers to estimate decay, waste and grade for individual logs in a tree;

"Check Cruiser" means a person authorized by the Ministry to assess the veracity of timber cruising data;

"Check Cruising" means an audit of the quality of the design, fieldwork and compilation of a cruise to determine whether it meets Ministry standards;

"CEP" means Circular Error Probability, a measure of precision, defined as the radius of a circle, centered around the mean, which is expected to include 50% of the results.

"**Closure Error**" means the distance between the start and end of the traverse in a closed traverse, divided by the length of the traverse, and is usually expressed in percent;

"**Coast**" or **"Coast Area"** means the area subject to the *Coast Appraisal Manual*;

"**Coefficient of Variation (CV)**" is a relative measure of variation, equal to the sample standard deviation expressed as a percentage of the sample mean $\frac{(SD)}{x\bar{x}}$;

"**Confidence**" means an expression of precision of sample estimates, usually assessed by confidence intervals such as 95 percent, a specified proportion of which contain the true population parameters;

"Correct" is used in this manual in the context of an audit (or check cruise). In this context, correct means the value determined by a check cruiser. This definition recognizes that cruisers and check cruisers are fallible. This underscores the importance respectful communication, extending the benefit of the doubt where there is valid doubt, and dispute mechanisms as a last resort.

"**Count Plot**" means a prism plot where only the number of "in" trees by species and plot slope is noted. No individual tree measurements are recorded;

"**Crown Class**" means one of the four crown classes, which are dominant, co-dominant, intermediate and overtopped (see Figure 6.3 Crown Classes);

"**Cruise-Based**" means a cutting authority where under section 106 of the *Forest Act*, the stumpage payable is calculated using information provided by a cruise of the timber conducted before the timber is cut;

"**Cutblock**" for Interior cruises is as defined as a '*logical unit*' in the *Interior Appraisal Manual*. A coast definition may be provided in a future Coast Appraisal Manual amendment.

"**Cutting Authority Area**" means the area authorized to harvest Crown timber, as provided by the *Forest Act*;

"**Cutting Specifications**" mean the timber merchantability specifications as defined in the *Coast* and *Interior Appraisal Manuals*;

"**DBH (Diameter Breast Height)**" means the outside bark diameter of a tree measured at breast height;

"**Decay, Waste and Breakage (DWB)**" means factors to reduce the gross merchantable volume to a net merchantable volume and to approximate the volume depletion due to decay, firmwood waste and breakage due to harvesting;

"**DIB (Diameter Inside Bark)**" means the diameter of a tree, excluding bark;

"**Diopter**" means a method of denoting prism "size". A value of one diopter represents a right angled deflection of one unit per one hundred units in distance.

The formula for converting diopter size to BAF size (metric) is:

$$\text{BAF-}= 10{,}000 \;/\; \left[1+\left(\frac{200}{\text{diopters}}\right)^{2}\right]$$

"**Double Sampling**" means a method which incorporates a second sampling procedure where only some of the characteristics of the main sampling method are recorded. An example is measure and count plots established on a cutblock;

"**Faller Selection**" means a timber falling technique that applies to selection logging in cutting authorities where the cut and leave trees are not marked and the faller decides which trees to cut or leave. The decision is based on the partial cutting prescription and/or safety considerations;

"**Firmwood**" means the volume remaining after the application of firmwood deductions as defined in the *Scaling Manual*.

"**Fixed Area Plot Sampling**" means a sampling method where a fixed amount of area is sampled in each plot within a stratum. All trees larger than the timber merchantability specifications are tallied if they are within the plot. All plots within a stratum must be the same size and shape;

"**Forest Inventory Zone**" or **"FIZ"** means one of the 12 zones delineated by Forest Analysis and Inventory Branch of the Ministry of Forests.

"**GIS (Geographic Information System)**" means a system designed to capture, manage, analyze, store and present digital geographic data;

"**GMT**" means Greenwich Mean Time, a global time standard. For the most part it is synonymous with UTC, but does not have a precise definition at the sub-second level.

"**GPS (Global Positioning System)**" means a method of determining or relocating a geographic position using a device to transmit and receive signals through a network of satellites;

"**Grid system**" means a method used to locate cruise plots systematically along a grid, usually a predetermined management unit specific GIS grid or a local cutblock level grid;

"**Harvest**" means to cut and remove timber from a cutting authority area;

"**HDOP**" means horizontal dilution of precision, which is a measure of the precision of GPS results related to the satellite positions. As HDOP decreases, the level of precision increases.

"**High Side**" means the position where the ground meets the tree adjacent to highest ground, ignoring any root flare, obstacles, vegetation, and loose matter that has accumulated at the base of the tree;

"**Interior**" means the area subject to the *Interior Appraisal Manual*;

"**Licensee**" means the holder of the cutting authority;

"**Log Grade**" means those log grades that are identified in the Scaling Regulations, Cruise Compilation Grade Algorithms or CGNF Standards and Procedures for the Coast Forest Region, as appropriate;

"**Loss Factor**" means the method used to determine the net volume of a tree. The loss factors were determined as part of the provincial inventory system. Loss factors use a combination of tree maturity, pathological indicators and tree location (FIZ and PSYU or local factors) to determine the percentage of decay, waste and breakage that will be deducted from the gross merchantable volume equally from each log in a tree;

"**Marked to Leave Percent Reduction**" means trees within a cutting authority that are individually marked and measured in the field and adequately mapped prior to harvesting so that they are not felled or damaged during logging. Every leave tree is removed from the compilation by converting the known quantity of leave trees to an equivalent percent reduction;

"**Marked to Leave Selective Cutting**" means trees within a cutting authority that are individually marked in the field prior to harvesting so that they are not felled or damaged during logging. Leave trees that occur within cruise plots are compiled as leave trees in the compilation using the selective cut indicator with an "L" for leave trees in Position 59 of the cruise card;

"**Major Species**" means a species that comprises 20 percent or more of total net merchantable volume in a timber type, cutblock or cutting authority;

"**Mean**" means the sum of all measurement values divided by the number of measurements;

"Mean Difference of Hits" means the average of the absolute variations of each GPS hit or coordinate from the plot reference point (PRP), measured in metres;

"**Merchantable**" means a segment of a tree between 30cm stump height and a top diameter inside bark that is at least 3 metres in length and within the timber merchantability specifications as defined in the *Coast* and *Interior Appraisal Manuals*;

"**Ministry**" means the Ministry of Forests;

"**Minor species**" means a species that comprises less than 20 percent of the total net merchantable volume in a timber type, cutblock or cutting permit;

"Net merchantable area" means net merchantable area as defined in the *Interior Appraisal Manual* and/or harvest area as defined in the *Coast Appraisal Manual*.

"Orphan Tree" means a tree of a certain species that occurs in a count plot but has not been tallied in a measure plot within the same timber type;

"**Partial Cutting**" means silviculture systems in which only some of the trees are felled during the harvesting phase. The selection method may specify "removal" or "leave" trees. Some examples of selection criteria are diameter, species, volume, age, height, disease or other damage. For the "partial cutting" criteria in the interior, please refer to chapter 4 of the *Interior Appraisal Manual*;

"**Pathological Indicators**" means conk, blind conk, scar, fork or crook, frost crack, mistletoe, rotten branch, and dead or broken top;

"PDOP" means positional (3D) dilution of precision, which is a measure of the precision of GPS results related to the satellite positions. As PDOP decreases, the level of precision increases.

"**Percent Reduction**" means a specified percentage reduction of the cruise volume which is targeted to be reserved from harvesting;

"**PRF (Plot Radius Factor)**" means a factor which multiplied by the DBH (cm) of a tree represents the appropriate plot radius (m) for the tree. In variable plot cruising, each tree has its own plot radius. This is a function of tree diameter (DBH) and prism BAF (m^2/ha) size. The PRF formula is: $PRF = 0.5/\sqrt{BAF}$;

"**Plot Sampling**" means the estimation of volumes and grades by species within a cutblock from sample plot measurements, and the determination of the sampling error associated with the plot estimates;

"**Precision**" means the closeness, to each other, of repeated measures of the same quantity, expressed as Sampling Error or Standard Error of the sample estimate;

"PRP" means plot reference point; a GPS waypoint located a short distance (e.g. 15 to 20 m) from the cruise plot. The bearing and distance to the cruise plot are calculated and measured from this point;

"PSYU (Public Sustained Yield Unit)" means a management area of Crown land, with similar forest attributes based on local samples. PSYU always overrides the tables determined by FIZ;

"Residual tree" means a tree which does not bear any of the following external indications of decay on or immediately adjacent to the bole of the tree: conk, blind conk, scar, fork or pronounced crook, frost crack, mistletoe trunk infection, rotten branches, dead or broken top;

"**Risk Group**" means a grouping by expected "risk" or probability of average decay, waste and breakage. A combination of tree class, pathological indicators, Forest Inventory Zone and PSYU determines the Risk Group of an individual tree for volume deduction;

"RMS" means root mean square and is calculated by taking the square root of the average of the squared errors. It is a measure of precision, meaning that there is a 63 to 68% probability that the results will be within the RMS distance;

"**Sampling Error %"** means an expression of the accuracy of the sampling of the cruise, calculated as a percent of an estimated mean to a desired probability;

"**Scale-Based**" means the stumpage payable is based on a scale of the timber harvested from the cutting authority in accordance with Part 6 of the *Forest Act*;

"Single Stem" means the removal of individual trees based on specific tree level criteria, regardless of harvest method. Single stem removal, for the purposes of this manual, does not include the removal of trees based on spatial distribution or for silvicultural purposes, such as commercial thinning.

"**Site Class**" means a set of 4 site quality classes (good, medium, poor, low) which characterize the potential growth capacity of the minerals and moisture in the soil, as measured using tree height (metres) attained at the breast height age of 50 years;

"**Soundwood**" means soundwood as defined in the *Scaling Manual*;

"**Standard Deviation (SD)"** means the square root of variance. It characterizes dispersion of individuals about the mean and gives some idea whether most of the individuals in a population are close to the mean or spread out;

"**Standard Error (SE)**" means an expression of how close the sample mean is to the true mean. Two standard errors (2 SE) means there is a 95% chance that the true mean is within the sampling error of the cruise;

"**Stratification**" means the process of delineating strata boundaries within a population, where each stratum has unique characteristics such as species composition, height, stand volume or age;

"**Stratum**" or "**Strata**" means a delineated portion of a population for which separate volumes and sampling statistics are calculated. A population may be made up of one or many subpopulations or strata. These are commonly known as types, timber types, or timber type polygons;

"**Strip Line**" means a ribboned line located through the forest and tied to the boundary at one or both ends. Cruise plots are located at regular intervals along each strip;

"**Stubbed**" means the practice of harvesting or removing a portion of the tree so that part of the bole (stem) above stump height remains;

"**Stumpage Rate**" means a charge levied by the Crown determined in accordance with the policies and procedures approved by the minister;

"Suspect tree" means a tree which bears one or more of the following external indications of decay on or immediately adjacent to the bole of the tree: conk, blind conk, scar, fork or pronounced crook, frost crack, mistletoe trunk infection, rotten branches, dead or broken top.

"**Tie Point**" means a specific point on the ground whose location is readily identifiable on a digital image, aerial photograph or map (e.g., road intersection, corner of a field or swamp, field located traversed or GPS station);

"**Timber Cruising**" means the estimation of the volume and quality of standing and down timber determined by sampling a cutting authority;

"**Timber Supply Area**" means large contiguous areas of Crown land on which an annual allowable cut is calculated;

"**Tree Class**" means a series of classes (nine) signifying age/maturity, presence of pathological indicators, and live/dead classification. This classification system, in combination with pathological indicators and age in 10's, determines the appropriate risk group for volume deduction;

"UTC" means Coordinated Universal Time, the primary global time standard. It is defined more precisely than GMT as it is defined to the sub-second level;

“UTM” means Universal Transverse Mercator coordinate system, a two dimensional coordinate system that divides the earth into 60 zones;

“Uprooted” means a tree that has fallen over and is not self supporting and the stem is either intact or has a break below stump height;

“**Variable Plot Sampling**” means a method of plot sampling where the trees to be tallied are based on their size and not the frequency or density of trees in the stand. Each tree has its own plot radius and can be assessed with an angle gauge (e.g. prism or relaskop);

“**Variance**” is the mean of squared deviations of observations about a sample mean. (These deviations or differences from the mean are called residuals);

“**Variation**” is the difference, plus or minus, between two measurements or a standard and a measurement (e.g., standard of 7 and measurement of 5 gives variation of -2); and

“**Waste**” is waste as defined in the *Provincial Logging Residue and Waste Measurement Procedures Manual.*

1.2. Terms of Reference

The *Forest Act*, Section 103 to 108 and related regulations provide the statutory authority for the determination of stumpage rates for crown timber.

The *Forest Act*, Section 105, requires an agreement holder to ensure that any document that is submitted to government for use in determining, redetermining, or varying a stumpage rate, or for any purpose under this Act is complete and accurate at the time the information is submitted.

The Forest Professionals of British Columbia code and bylaws dictates standards of professional practise and requires members to maintain competence, independence, integrity, due diligence, stewardship, safety, ethics and professional conduct.

Anyone involved in crown land timber cruising must follow the procedures and intent of this manual. Collaboration between industry and government is strongly encouraged where interpretations are needed, or special circumstances exist. Bias or deviation from these procedures is unlawful.

The Coast Appraisal Manual and Interior Appraisal Manual specify that cruise data must be gathered and compiled according to procedures established in the Cruising Manual and the Cruise Compilation Manual. The Cruising Manual and Cruise Compilation Manual are approved by the Director, Timber Pricing Branch.

1.2.1. Calculation Conventions

Each calculation must be calculated to the nearest tenth. This is consistent with the data precision requirements of the compilation reports.

The rounding rules to be used in this manual are the same as those in the Cruise Compilation Manual (see Appendix 16 of the Cruise Compilation Manual). (i.e., digits 0-4 are rounded down and 5-9 are rounded up).

For example, meeting a check cruise standard:

- 10.03 = 10.0 and does not exceed 10.0%.
- 10.05 = 10.1 and exceeds 10.0%.

For example, meeting a minimum threshold:

- 34.99 = 35.0 and meets the 35.0% threshold.
- 34.94 = 34.9 and does not meet the 35.0% threshold.

2. Cruise Design

2.1. Cruise Objective

The objective of the timber cruise is to obtain an unbiased estimate of the volume and quality of timber on a cutting authority area to a specified confidence interval and/or sampling intensity. The area cruised may be one or multiple cutblocks that will be appraised in one cutting authority and subject to one appraisal.

The information from the cruise is applied as follows:

1. For scale-based cutting authorities, the cruise provides the basis for determining the stumpage rate while the invoice is based on the scale.
2. For cruise-based cutting authorities, both the ~~estimate of the~~ stumpage rate and invoicing are determined by the cruise.

2.2. Cruise Plans

Cruise plans are professional documents and must be:

1. prepared by a qualified registered or associate member (RPF, RFT, ATE) of Forest Professionals British Columbia, or

2. supervised by a registered member (RPF, RFT) of Forest Professionals British Columbia.

It is mandatory for licensees and Timber Sale Managers to submit plans to the District Manager prior to the commencement of a timber cruise. In areas where district staff do not check cruise BCTS, the Timber Sale Manager must maintain the cruise plans and all other cruising related information on file.

Cruise plans must be submitted to Ministry staff to allow for the development of field quality assurance schedules and to provide a basis for comparison against the final cruise submission.

Cruise plans must contain the items specified in:

- Section 3.2.1, and
- Forms section - Figure 7.6 FS 693 - Provincial Cruise Plan (Page 1 of 2).

For an example of a cruise plan map, please see the following link:

Sample_Cruise_Plan_Map.pdf

All forest and non-forest type areas must be identified on the cruise plan prior to field sampling. A non- forest type, as identified on the cruise plan map, is not sampled for appraisal (i.e., rock bluff, swamp, constructed linear tenure, creek, riparian reserve area, slide track and gravel pit). (See Section 2.8)

Timber type polygons must be unique to each cutblock. If forest types are not identified on the cruise plan each cutblock must be compiled as a single forest type.

Timber types that are 1.0 hectare or larger must contain at least 2 full measure plots and timber types that are less than 1.0 hectare must contain at least 1 full measure plot. See Section 2.4.2 for additional information on locating the minimum number of plots.

Each cutblock will be administered as being in the district that contains fifty percent or more of the net merchantable cruise area.

The cruise plan is a professional document and forms the basis for the statistical sample. It must identify the population to be sampled and the design that will be used to meet the minimum cruise standards. The cruise plan is the key document that provides assurances to the Ministry that the data supplied to the appraisal was collected in an unbiased manner.

Changes to a cruise plan must be rare and minor in nature and must only be undertaken to affect unforeseen issues that affect good forest management or other minor operational issues.

An entire timber type may be added or removed without requiring a rationale. However, any modifications that involve altering portions (e.g. adding or deleting of areas) of a cutblock polygon must be supported by a rationale.

This practice allows some flexibility in cutting authority composition, while maintaining the sampling integrity of pre-established timber types.

The submitting forest professional recognizes that changes to a plan, such as a change in area or the removal of a plot(s) is biased and must have assessed the impact of the alterations against the principles of sampling identified in this manual. The submitting forest professional must submit a record of all relevant information that was used to develop the original cruise plan and final cruise map, including a written rationale where changes have been made. This model is consistent with the direction of professional reliance.

For guidance on how to prepare a professional rationale, please refer to the document "Professional Quality Rationales" published by the FPBC and available at:

Professional Quality Rationales

The District Manager will review each proposed change on a case-by-case basis and determine if the change meets the intent of providing good forest management or addressing unforeseen minor operational issues.

A spreadsheet that can be used to assist in cruise design can be accessed at the following website:

Cruising Calculations

2.3. Sampling Error Objectives

Unless otherwise specified, sampling error objectives are based on full measure and count plots and are calculated using the total stand net merchantable volume prior to any percent reductions.

Where minimum sampling intensities are specified, higher intensity sampling intensities and tree count are encouraged. When sampling error requirements were not achieved and additional plots are added later, a combination of superimposed grids with equivalent sampling intensity will be accepted. Count plots in addition to minimum full measure plot requirements are acceptable. Any additional plots must be submitted to the District Manager in a revised cruise plan prior to commencement of fieldwork.

The following standards apply to both clearcut and partial cutting systems:

- For cutting authorities ≥ 250 ha (net merchantable area), the largest grid to be used in each type between full measure plots is a 250 metre square (6.25 ha per full measure plot).
- For cutting authorities < 250 ha (net merchantable area), the largest grid to be used in each type between full measure plots is a 200 metre square (4.0 ha per full measure plot).
- For coastal and interior cruises, a ratio of three (3.0) count plots to one (1.0) full measure plot cannot be exceeded on the cruise plan even if sampling error is achieved.
- For cruises where cruise grades will be used in the appraisal, the minimum tree count must be met even if the sampling error requirement has been achieved.
- For coastal cruises where cruise grades will not be used in the appraisal and for all interior cruises, there is no required minimum number of trees per plot when the sampling error requirement is achieved.
- The minimum tree count requirements include tree classes 1, 2, 3, 5, 7, 8, and 9 (not tree classes 4 or 6).

Do not change count plots to measure plots in the field where measure plots are dropped due to landing outside the boundary in the field. The correct measure to count ratio must be identified on the cruise plan and the minimum number of measure plots per type must be achieved (see Section 2.4.2). If the required minimum number of measure plots is not achieved in the field, as plots are dropped due to landing outside the boundary, moving the measure plot(s) as per section 2.4.2.2 is required.

The following table serves as a guide to the various cruising standards itemized below:

<table>
<tr><th colspan="3">Situation</th><th>Applicable section that details cruising standards</th></tr>
<tr><td colspan="3">Road Right of Way</td><td>2.3.6</td></tr>
<tr><td rowspan="6">Coastal Cutting Authority</td><td rowspan="3">Great Bear Rainforest North (excl. that part of TFL 25 within the Coast Mtn. and North Isl. Central Coast Forest Districts, and Forest Licences A91438 and A94535)</td><td>Cruise Based Cutting Authority</td><td>2.3.5</td></tr>
<tr><td>Cruise Based Road Permit</td><td>2.3.6 (1), 2.3.6(2)</td></tr>
<tr><td>Road Right of Way appraised with adjacent cutblocks</td><td>2.3.6(3)</td></tr>
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<tr><td>Scale Based Cutting Authority</td><td>2.3.1</td></tr>
<tr><td>Road Right of Way appraised with adjacent cutblocks</td><td>2.3.6(3)</td></tr>
<tr><td rowspan="2">Interior Cutting Authority</td><td colspan="2">Cruise Based</td><td>2.3.2</td></tr>
<tr><td colspan="2">Scale Based</td><td>2.3.1</td></tr>
</table>

2.3.1. Scale Based Cutting Authorities

1. Unless otherwise stated, the scale-based cutting authority sampling error objective is ≤15.0% at 2 SE based on the total stand net merchantable volume prior to any percent reductions.
2. Single Stem – the options are:
   a. 100% cruise of the cut trees,
   b. Achieve ≤15.0% sampling error on the cut trees at 2 SE using variable radius plots, or
   c. Sample using at least 2 variable radius measure plots/ha and at least 2.0 cut trees/plot.

The sampling error requirement will be waived if the following three conditions have been met:

1. A systematic square grid of equal intervals and spacing of 100 metre by 100 metre, or less, has been established in each timber type.
2. For cutting authorities:
   a. of 20.0 ha net merchantable area or larger in size, a maximum ratio of 1.0 count plot to 1.0 full measure plot has not been exceeded, or
   b. of less than 20.0 ha net merchantable area in size, only full measure plots are used. (Count plots are acceptable in addition to the required intensity of full measure plots. E.g. A 70 metre by 70 metre grid with alternating full measure and count plots is acceptable.) And
3. An average of at least 4.0 trees per plot per cutblock has been met. If the minimum tree count cannot be achieved with a BAF 2 prism, then the minimum tree count requirement will be waived.

2.3.2. Cruise Based Cutting Authorities – Interior

The following minimum sampling error objectives apply to all cruise based cutting authorities within the Interior as described in the Interior Appraisal Manual:

1. ≤8.0% at 2 SE on all plots, and
2. If count plots are used, a 2 SE of ≤12.0% on full measure plots must be achieved.

All other scale based standards apply, except that the sampling error cannot be waived.

2.3.3. Cruise Based Cutting Authorities – Coast

The following minimum sampling error objectives apply to all cruise based cutting authorities within the Coast area (except road right of way timber to be transported under road timbermark) as described in the Coast Appraisal Manual:

Cutting authorities must:

1. achieve a ≤10.0% sampling error objective at 2 SE using measure and count plots, and an average of at least 4.0 trees per plot per cutblock, or
2. The sampling error will be waived if the following conditions have been met:
    a. For cutting authorities of 40.0 ha net merchantable area or larger in size:
        i. A systematic grid consisting of all full measure plots on a 100m by 100m grid (or higher intensity cruise sample that may include additional count plots or a smaller grid) has been established, and
        ii. An average of at least 4.0 trees per plot per cutblock has been achieved.
    b. For cutting authorities less than 40.0 ha net merchantable area in size:
        i. A systematic grid of equal intervals and spacing of not greater than 70 metres by 70 metres has been established, and
        ii. A maximum ratio of 1.0 count plot to 1.0 measure plot has not been exceeded and an average of at least 4.0 trees per plot per cutblock has been met.
    c. In addition, within any timber type less than 5 ha net merchantable area in size (regardless of cutting authority size) the following requirements must be met:
        i. A systematic grid of equal intervals and spacing of not greater than 70 metres by 70 metres has been established, and
        ii. A maximum ratio of 1.0 count plot to 1.0 measure plot has not been exceeded.

Cruise based cutting authorities under this section, other than BCTS sales, do not require loss factor cruising as Call Grade Net Factor (CGNF) cruising will be used for appraisal purposes. BCTS must continue to collect both loss factor and CGNF cruise data until CGNF is fully implemented across the Coast for appraisal purposes.

Only Marked to Leave Percent Reductions are allowed in cruise based cutting authorities. Other reduction methods (e.g. Faller Select and Marked to Leave Selective Cutting) are not permitted and in those cases the net merchantable volume will be based upon 100% removal of the net merchantable volume in Coastal cruise based cutting authorities.

2.3.4. Cutting Authorities within the Great Bear Rainforest North

The following standards apply to all cruise based cutting authorities, except road permits and road permit amendments, within the Great Bear Rainforest North (GBRN) as defined within the *Coast Appraisal Manual*:

Cutting authorities must:

1. Achieve ≤10.0% sampling error objective at 2 SE using measure and count plots, and an average of at least 4.0 trees per plot per cutblock, or
2. The sampling error will be waived if the following conditions have been met:
    a. For cutting authorities of 40.0 ha net merchantable area or larger in size:

i. A systematic grid consisting of all full measure plots on a 100m by 100m grid (or a higher intensity cruise sample that may include additional count plots or a smaller grid) has been established, and

ii. An average of at least 4.0 trees per plot per cutblock has been achieved.

b. For cutting authorities less than 40.0 ha net merchantable area in size:

i. A maximum ratio of 1.0 count plot to 1.0 measure plot has not been exceeded,

ii. An average of at least 4.0 trees per plot per cutblock has been met, and:

1. A systematic grid of equal intervals and spacing of not greater than 70 metres by 70 metres has been established, or

2. A systematic grid of full measure plots not greater than 100 metres by 100 metres has been established with count plots offset halfway between the measure plots along either the North-South or East-West grid lines. For example, where ‘o’ represents measure plots and ‘x’ represents count plots, the following two designs are acceptable:

```
o   o
x   x
o   o
x   x
o   o            o x o x o x o
x   x
o   o            o x o x o x o
```

Cutting authorities in the GBRN will not require CGNF cruising as loss factor cruising will be used for appraisal purposes. The exception is BCTS who must continue to collect both loss factor and CGNF cruise data until CGNF is fully implemented across the Coast for appraisal purposes.

Only Marked to Leave Percent Reductions are allowed in GBRN cruise based cutting authorities. Other reduction methods (e.g. Faller Select and Marked to Leave Selective Cutting) are not permitted and in those cases the net merchantable volume will be based upon 100% removal of the net merchantable volume in Coastal cruise based cutting authorities.

2.3.5. Right of Way Cruises

1. Cruises of rights of way or cruise based road permits and amendments in the Great Bear Rainforest North (GBRN) must meet the following:

a. ≤10.0% sampling error requirement at 2 SE using variable radius plots, or

b. The sampling error will be waived if the following conditions have been met:

i. An average of at least 4.0 trees per plot per cutblock has been achieved, and

ii. Full measure variable plots have been established along the road centre line using a grid spacing that will achieve a minimum of 2.0 full measure plots per hectare. Timber types less than 1.0 hectare must contain 2 full measure plots. The first plot is to be located at half the calculated grid spacing along the first tributary road that accesses the cutlbock.

In the GBRN, if the minimum tree count cannot be achieved with a BAF of 12.25 (or less), then the minimum tree count requirement will be waived.

When sampling road segments under road permit they must be compiled as cutblocks that are clearly defined on the cruise plan maps. A cutblock may contain multiple road segments.

2. For cruise based road permits or road permit amendments in the Great Bear Rainforest North, where timber on the road right of way within a cutblock is removed under the road permit (RP), instead of the cutting permit, all cruise plots from the timber type within the cutblock containing a road segment must be used in the cruise compilation for the RP. For these segments:
   a. The area of the RP must be removed from the CP's cruise compilation,
   b. Road segments internal to a cutblock or type must be typed separately from the external road segments.
3. Where BCTS or Coastal Cruise Based (see Sections 2.3.4 and 2.3.5) road rights of way external to a cutblock are to be cruised and appraised with the cutblock harvest area, the following three options are available:
   a. Extend the cruise grid of the adjacent timber type through the road right of way and establish any plots that fall within the right of way, or
   b. Identify the road right of way as a separate type at the cruise plan stage, and:
      i. Establish full measure variable plots along the right of way centre line using a grid spacing that will achieve a minimum of 2.0 full measure plots per hectare. Type polygons less than 1.0 hectare must contain 2 full measure plots. The first plot is to be located at half the calculate grid spacing within that type.
   c. Use the cruise data from the cutblock if the District Manager or BC Timber Sales Manager has accepted a written rationale from a qualified registered professional stating why the cruise data from the cutblock is representative of the road right of way area.
4. For scale based cutting authorities, where timber on a road right of way within a cutblock is removed under a road permit (RP) after the cutblock is cruised, the cruise plots that are within the area of the RP shall be included in the cruise compilation for the cutting permit and the area of the RP will be removed from the cruise compilation.
5. Right of way areas not removed under the road permit must be included in the net

merchantable area and must be sampled.

2.4. Sampling Patterns – General Conditions

Plots established within cutblocks from previous operational cruises may be used in new sampling plans if they meet the standards in this manual.

The minimum standards for appraisal cruising require the use of sampling techniques using systematic grids to locate the plots. The exception is a 100% cruise where all trees within the cutblock are measured.

All plots must originate from the net merchantable area. Plots in areas 100 percent reserved from cutting must not be used in the compilation.

Plots can be established using a predetermined management unit specific GIS grid or by using a local cutblock level grid system. Licensees must notify the district of which grid system they will be using. Once a grid system is selected by a licensee, it is to be used on all cruise plans completed by that licensee within an identifiable unit (e.g. a license management unit, operating area or drainage). In addition, the grid system must be consistent in each cutting authority.

The cruise plan must identify a consistent grid interval for each timber type.

The Ministry must be able to replicate the plot establishment process. The District office may request a copy of the grid and/or the method used to create the GIS grid.

2.4.1. Standards for the Location of Plots Using a Grid

The following section describes the types of grids that may be used in a cruise plan:

1. GIS Grid: The grid locations are predetermined by the local management unit GIS grid.

   If count plots are used in the cruise design, the most westerly plot on the most southerly line in the net merchantable area must be a measure plot.

2. Local Grid: A local grid may be established using the following procedure:

   a. Project a line due south from the most western point of the net merchantable area and another line due west from the most southern point of the net merchantable area for each cutblock. Starting at the point of intersection of these two lines, lay the local plot grid on the map oriented in cardinal directions (N-S & E-W) to determine the plot locations (see Figure 2.1 Example of Local Grid Design.).

      Each cutblock must have its own local grid. Timber type polygons within a cutblock may have different grid intervals but must originate from the same point of intersection as the cutblock.

   b. If count plots are used in the cruise design, the most westerly plot on the most southerly line in the net merchantable area must be a measure plot.

All possible sample plots that can be established in the net merchantable area must be cruised, whether or not they were included in the original cruise plan. All plots must originate from the net merchantable area.

Plots cannot be moved within a timber type polygon, except as required in Section 2.4.2 to achieve the minimum number of plots in a timber type polygon.

The grid must be square and of equal interval (rectangular grids are not permitted), the grid spacing selected must be consistent within a timber type.

A “Checkerboard” or equivalent consistent pattern of alternating full measure and count plots will be considered to meet the 1:1 ratio requirements described in Sections 2.3.1, 2.3.3, 2.3.4 and 2.3.5. This is acceptable despite irregular cutblock shapes that may hinder the mathematical achievement of the intended ratio.

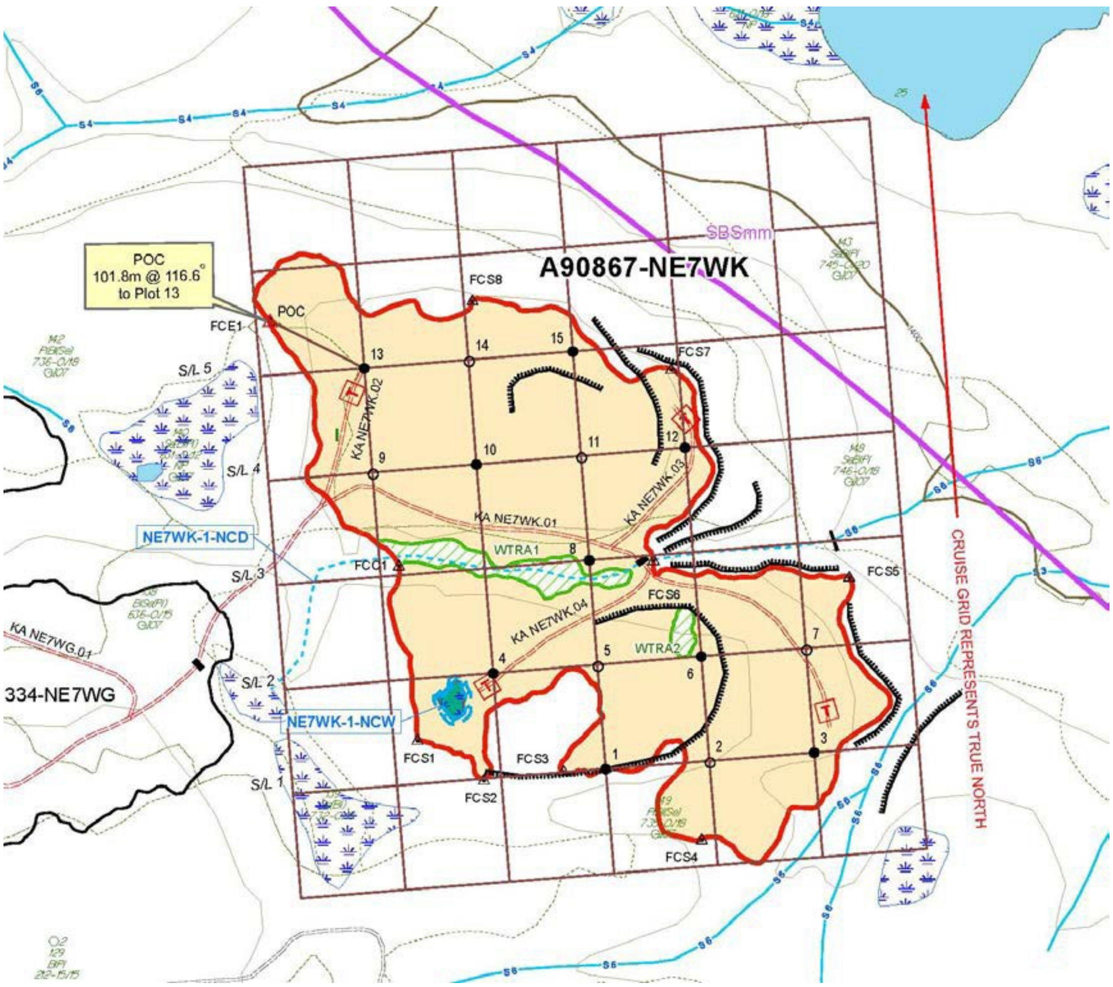


Figure 2-1 Example of Local Grid Design

*** Please note** – This example in Figure 2-1 of a local grid is oriented to true north instead of map north. For a detailed explanation of the difference in these terms, please see True North, Magnetic North and Grid North in the Appendices. Some Districts may prefer for cruise maps to be submitted with grids oriented to grid north – please refer to District or Area contacts for further information.

2.4.2. Standards for the Location of Additional Plots to Meet Section 2.2 Requirements

The following sections describe the situations and procedures to establish additional plots where the grid design does not meet the minimum one or two full measure plot per timber type polygon standard specified in Section 2.2.

2.4.2.1. Office Cruise Plan Procedure

When creating the cruise plan map, reduce the grid interval (using the same grid system) within the desired timber type by increments of 10 metres until the largest grid spacing meets the minimum plot establishment standards is achieved. The grid must be reduced from the point where the grid originates (See Section 2.4.1), but only for the type in which additional plots are needed, not for the entire cutblock or cruise.

2.4.2.2. Field Procedure

In the event that in the field, measure plots fall outside the timber type polygon, then use the procedure in the following table to establish the measure plot(s) inside the timber type polygon:

Sequence	Location	Sequence	Location	Sequence	Location	Sequence	Location
1	1/2 Grid North	2	1/2 Grid East	3	1/2 Grid South	4	1/2 Grid West
5	1/4 Grid North	6	1/4 Grid East	7	1/4 Grid South	8	1/4 Grid West
9	1/8 Grid North	10	1/8 Grid East	11	1/8 Grid South	12	1/8 Grid West
13	1/16 Grid North	14	1/16 Grid East	15	1/16 Grid South	16	1/16 Grid West

The procedure must be applied from the planned measure plot locations that fell outside the timber type polygon in the field. This procedure is used to obtain the required number of measure plots in the timber type polygon. If the plot cannot be established inside the timber type polygon using this procedure, attempt to establish the plot using this procedure with NE, NW, SE or SW bearings.

2.4.3. Standards for the Location of Additional Plots to Meet Sampling Error

Where plots must be added to an existing cruise plan to meet the sampling error requirement, they must be added in a systematic random manner. It is recommended to target the timber type (s) with the greatest variability. Determine the number of plots required using the coefficient of variation statistic for the timber types from the compilation (See Coefficient of Variation in the Appendices).

Where the added plots result in an overall sampling intensity equivalent to a 100m by 100m grid, or a 70m by 70m grid, it will be considered equivalent to that grid spacing. Smaller grids may be used in a sample design at the discretion of the person preparing the cruise plan.

The following procedures will be used where additional plots must be added to an existing cruise to meet the sampling error standard:

1. New Grid Design
   a. Determine a new grid design that will meet the new sample size requirements, using the same cruise grid orientation and grid pattern.
   b. If using a local grid, over-lay the new grid by positioning the new plot grid over top of the original plot grid at the point of intersection (See Section 2.4.1 (2)).
   c. If using a GIS grid, over-lay the new grid by positioning the first plot of the new grid over the most westerly plot on the most southerly line of the original grid (in the net merchantable area). Disregard the overlapping plot.
2. Existing Cruise Design

   Additional plots must be systematically located on the existing cruise grid.

2.5. Other Timber Cruising Conditions

This section describes the timber cruising procedures that are required for situations where timber must be re-cruised, where it is unsafe to cruise, where patch cuts are used and where there is a combination of different land classifications or tenures.

2.5.1. Standards for Re-cruising

Re-cruising is required:

1. If the cruise is of mature timber and 10 years has elapsed since the fieldwork was performed.
2. If the cruise is of immature timber and 5 years has elapsed since the fieldwork was performed.
3. If requested by a statutory decision maker as required in the *Coast* or *Interior Appraisal Manuals*.
4. As required by a check cruise (Chapter 3 Quality Assurance).
5. As determined by the Area Director.

In order to determine the maturity of timber for the purposes of this section, the following procedure will be used:

> Review the Net Immature % of the Block Summary report from the post-reduction compilation. If the Net Immature is >50.0 %, the timber is immature. If the Net Immature is ≤50.0 %, the timber is mature.

2.5.2. Unsafe to Cruise

Where individual plot or tree data are unsafe to cruise the cruiser can estimate the attributes, provided the estimates are signed off by a registered or associate member of the FPBC.

If an individual plot cannot be completed safely, it will be dropped and the reason documented.

If multiple cruise plots cannot be completed safely, all plots that can be cruised must be completed and the methodology of determining the cruise volume and value of the uncruised plots is subject to approval by the Area Director.

Where it is unsafe for cruisers to sample an entire cutblock, or timber type, the methodology of determining cruise volume and value is subject to approval by the Area Director.

As appropriate, the damage codes and slope will be determined by a procedure approved by the Area Director.

2.5.3. Cruising Patch Cut Silviculture Systems – Interior Only

This procedure must be followed for cruising cutblocks with Patch Cut silvicultural systems, as defined in the *Silvicultural Systems Handbook for British Columbia* (https://www.for.gov.bc.ca/hfp/publications/00085/silvsystemshdbk-web.pdf). A patch cut system must include several patches smaller than 1.0 ha and may include interspersed larger patches. The area between patches generally has only incidental harvest related to skid trails and road right of way. This procedure does not apply to salvage operations described in the Interior Appraisal Manual. The sampling error requirements for scale based and general cruise based cutting authorities apply as described in Sections 2.3.1 and 2.3.2. Cutblocks using this procedure must have pre-defined harvest boundaries ribboned in the field and mapped prior to cruising.

1. On the cruise plan map, outline the proposed cutblock to include all patches and the area between them.
2. Establish the POC as in Section 2.4.1. All plot grids in the cutblock must originate from the common POC.
3. All timber types must meet the required minimum number of plots and timber typing rules outlined in Section 2.2.
4. All plots on the grid that can be established within patch boundaries must be cruised. Plots that land outside the patches will be dropped. Some patches may not have any plots, which is acceptable so long as minimum sampling requirements are met.
5. Any square grid spacing may be used to achieve the desired number of plots on the cruise plan. The procedure for reducing grid size in Section 2.4.2.1 does not apply to patch cut cruises.
6. Do not place any plots in the area between patches. This area is part of the merchantable area with partial cutting related to skid trails. This area is to be included as part of the timber type with the largest net harvest area, as a separate treatment unit with a percent reduction.
7. To waive sampling error requirements the cutblock must achieve an average 4.0 trees per plot and each timber type must contain a minimum 1.0 full measure plots per ha of clearcut equivalent area at the cruise plan stage. It is acceptable if the final cruise has less than 1.0 full measure plots per ha due to dropped plots. The equivalent clearcut area must be stated on the cruise plan. See the example below.
8. Use the walkthrough method for plots near any identifiable harvest boundary.

As an alternative to the above procedures, patch cut systems without pre-defined patch boundaries (if and where authorized by the District Manager, Timber Sales Manager or Deputy Minister) must be cruised using the same standards as a clearcut. All plots must be included in the compilation with an appropriate percent reduction applied. This methodology must only be used in an area where an unbiased, geometric harvest pattern is used.

Example of a patch cut cruise. (Refer to Figure 2-2)

This cutblock has been planned with the option of waiving sampling error requirements. Type 6 includes all patches smaller than 1.0 ha and the area between patches. It has a total clearcut equivalent area of 4.4 ha (3.8h in TU A + 0.6 in TU B); therefore this type requires a minimum of 5 plots. With a 75m by 75m grid it achieved 7 plots, despite three polygons that did not get a plot. The grid sizes below are examples only. Actual grid sizes may vary to meet the required number of plots at the cruise plan stage.

Type	**Retention %**	**Area** (ha)	**# Plots**	**Grid**	**Patch Size**	**Notes**
I	0	1.0	2	60m	≥ 1.0ha	
II	0	1.7	3	100m	≥ 1.0ha	
III	0	1.7	2	80m	≥ 1.0ha	
IV	0	1.4	2	90m	≥ 1.0ha	
V	0	1.2	2	70m	≥ 1.0ha	
VI TU A	0	3.8	7	75m	<1.0ha	Aggregate of 10 patches using a common plot grid
VI TU B	96	14.4	0	No plots req'd	Area between patches	0.3 ha skid trails (estimated) 0.3 ha ROW between patches Equivalent Clearcut Area 0.6 ha
Totals		25.2	18			

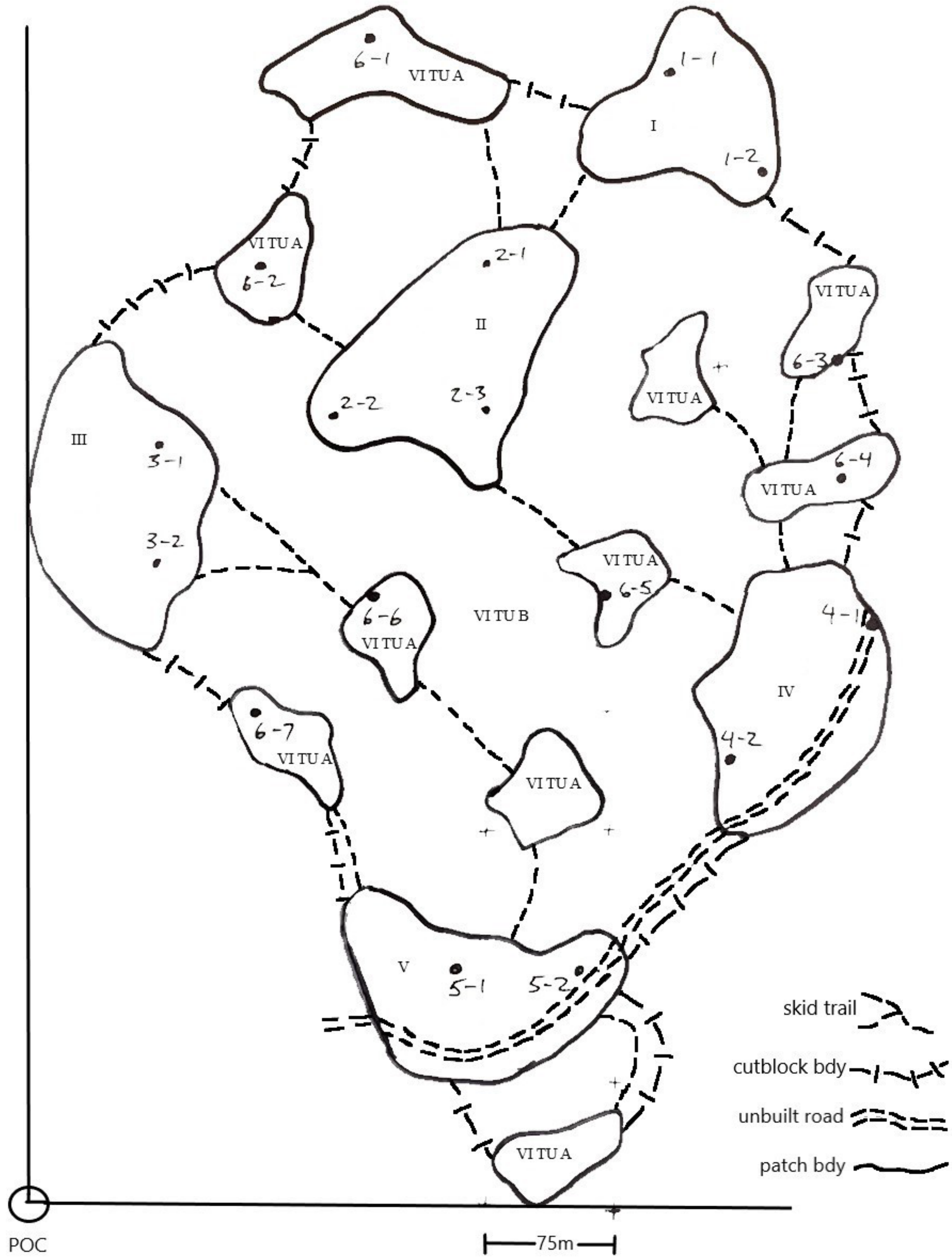


Figure 2-2 Example of Patch Cutblock.

2.5.4. Schedule "A" (Private) and Schedule "B" (Crown) Lands

Cutblocks containing more than one type of land classification or tenure, as per the following table, are to be cruised and compiled as follows:

Cutblock Configuration	Can Be Cruised As One Type?	Additional Compilation Requirements
Schedule A (Private) and Schedule B (Crown) Land	Yes	Schedule A and Schedule B lands are to be compiled separately. *Do not include plots established in Schedule A (private) land in the Schedule B (Crown) compilation if Schedule A lands are typed out separately from Schedule B lands.*
Tree Farm Licence (TFL), Timber Licence (TL), and Forest Licence (FL)	Yes	A separate summary page for each timber mark is required.
Timber Licence and other Crown land not in a TFL (i.e. Forest Licence)	Yes	Timber Licence and other Crown lands are to be compiled and appraised separately. *Do not include plots established in Timber Licence land in the Forest Licence (FL) compilation if TL lands are typed out separately from the FL land.*

For the scenarios listed above, if a timber type includes more than one type of land classification or tenure, all plots must be included in each of the required compilations.

2.6. Types of Cruises

2.6.1. One Hundred Percent Cruise

A 100% cruise requires that all trees to be harvested are measured and recorded as per Section 4.3 and Section 5.2.12 of this manual. Each tree in a 100% cruise cutting authority must be physically numbered and marked as a cut tree.

2.6.2. Fixed Area Plot Sampling (See Section 4.3.1.13)

Fixed area plot sampling is a method of using sample plots with a fixed size (area) for selecting the trees to be tallied. The plots are normally circular or square. It is also known as sampling without replacement since trees are not included in more than one sample plot.

The fixed area plot size must be consistent by timber type and count plots are not permitted in fixed area plots. Border plots are permitted in fixed area plots.

For additional information on fixed area plots and calculating sample size, please see Appendix 1 on Additional Sampling Information.

2.6.3. Variable-Plot Sampling (Prism or Relaskop) (See Section 4.3.1.15)

Variable plot sampling is a method of selecting trees to be tallied based on their size and not the frequency or density of the trees in the stand. The main advantage with using the variable plot instead of the fixed area method is that the probability of tree selection is proportional to the size (basal area at breast height) of the tree. Variable plots are more efficient to measure than fixed area plots because a plot perimeter is not required since every tree has its own plot radius and can be assessed for in/out status with an angle gauge (e.g., prism or relaskop).

For additional information on variable plot sampling, calculating sample size, and calculating coefficient of variation (CV) please see Appendix 1 on Additional Sampling Information.

2.7. Double Sampling (See Section 4.3.1.10)

Double sampling consists of sampling certain characteristics within a sample instead of measuring those characteristics throughout the sample. Double sampling can improve the volume estimate by species.

Double sampling requires the use of two types of variable cruise plots, the measure plot and the count plot. Fixed radius plots are not used in this form of double sampling.

2.7.1. Measure Plots

The measure plots are conventional samples in which all variables for each tree are measured.

2.7.2. Count Plots

Count plots are samples where only the tree species and plot slope are tallied. All live and dead potential trees are tallied. Do not include any trees below the DBH limit or tree class 4 (dead useless) and tree class 6 (live useless) trees. DBH or DBH classes must be recorded where timber merchantability specifications may indicate a different DBH limit level from the field tally level.

Within each timber type, measure tree data is required in the measure plots for each species recorded in the count plots. Occasionally, a species is tallied in a count plot that has not been tallied in a full measure plot. This creates a situation where no measure data is available to compile the tree. This tree is called an 'orphan tree'.

The procedure for dealing with orphan trees in count plots during or because of fieldwork is to record the measure information for the first occurrence (first tree from facing north (0°) and turning clockwise within the count plot) of the orphan species within the first count plot where the orphan species is encountered. If the orphan species is not measured in a measure plot in the same timber type, the data from the orphan species tree will be moved to the nearest measure plot in the same timber type with the same BAF and will be deleted from the count plot. This procedure will be completed after the fieldwork is complete or at the compilation stage. Orphan trees moved from a count plot to a full measure plot should be recorded using tree numbers 99, 98, 97, etc. Consideration will be given to waiving the sampling error if the minimum sampling error requirement is exceeded due to the shift in the tree count.

Where orphan trees are created as a result of boundary changes or an error discovered after the fieldwork, the options for dealing with an orphan species in a count plot are (in order of preference):

- Return to the field and convert the count plot orphan tree to a measure tree and move it to a measure plot, or
- Change the orphan species to a species of similar tree form and value (if available) in that same timber type and move it to the nearest measure plot as stated above, or
- If a similar species is not available in the type, use the average data from the same species in the nearest plot of an adjacent type and move it to the nearest measure plot as stated above, or

- Delete all the count plots in that timber type from the compilation.

<u>Figure 2.3 Sample Cruise Tally Sheet (FS 205) – Card Type 9.</u> illustrates how count plots should be recorded if they are used for cutting authorities that have different appraisal and timber merchantability specifications:

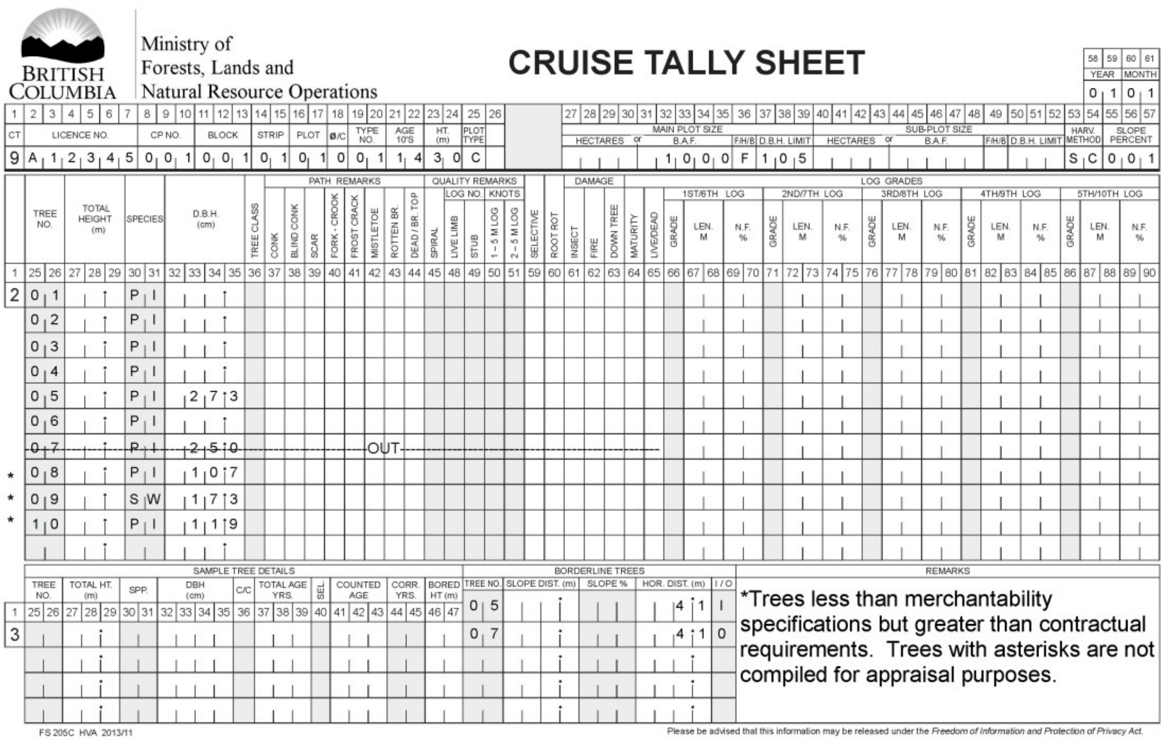


Figure 2-3 Sample Cruise Tally Sheet (FS 205) – Card Type 9

2.8. Forest Typing

Forest types are areas of land identified on a cruise plan map with similar timber characteristics. They are generally identified from aerial photos and may increase sampling efficiency and provide a more accurate estimate of timber volume and value.

For more information on the general principles and procedures that may be used to describe forest types, see the document titled ‘VRI Photo Interpretation Procedures’ at the following web link:

https://www2.gov.bc.ca/gov/content/industry/forestry/managing-our-forest-resources/forest-inventory/forest-cover-inventories/photo-interpretation

Appraisal cruising recognizes four categories of stratification:

1. **Forest Types (Timber Types):** Generally describe areas of similar inventory forest cover composition (e.g., first and second leading species by volume, age, height and site class). These areas contain merchantable timber and are sampled for appraisal. Timber types must be unique to each cutblock.

2. **Non-Forest Types:** These areas are not sampled for appraisal (i.e., rock bluff, swamp, constructed linear tenure, creek, riparian reserve area, slide track and gravel pit). A non-productive area can be less than one hectare in size, but typing out of non-productive areas must be consistent (e.g., if a 0.5 ha non-productive area is typed out then all non-productive areas 0.5 ha and larger must be typed out).

3. **Forest Reserves:** Describe areas reserved from harvest due to forest management purposes (e.g., Goshawk nest, visual quality reserve, wildlife tree patch). These areas may contain merchantable timber but are not sampled for appraisal.

4. **Silviculture Treatment Units:** Describe areas that will receive different forms of silvicultural or harvest treatments. (e.g., stumping for root rot and partial cutting areas). These areas contain merchantable timber and are sampled. Treatment units may consist of an entire timber type, a portion of a timber type or a portion of multiple timber types.

2.9. Comparative Cruises

The Interior and Coast Appraisal Manuals specify the situations when comparative cruise data may be used for appraisal purposes.

The use of comparative cruise data is an exception and must be approved by:

- the Regional Executive Director or BCTS Executive Director when the estimated volume is greater than 5,000 m^3, or
- the District Manager if the estimated volume is 5,000 m^3 or less.

Sample design and methods used in a comparative cruise are subject to approval by the appropriate government representative specified in this section.

3. Quality Assurance

3.1. Introduction

Ministry, including authorized BC Timber Sale Areas, audit~~s~~ timber cruises to ensure all appropriate standards are followed, support revenue objectives, ensure the correct calculation of stumpage rates, and to ensure the consistent application of cruise data in the market pricing system (MPS).

As such, the Ministry is responsible for setting the minimum standards for timber cruising, while licensees are responsible, under contract, to meet these minimum standards. Information from the cruise that meets these standards may be used for appraisal.

The Ministry may consider exceptions to these minimum standards in extenuating circumstances on a case-by-case basis.

For quality assurance purposes, cruising field work will be assessed according to the Cruising Manual in effect at the time the field work was completed.

Objectives

The objectives of the quality assurance review are to ensure:

1. The integrity of the sample design. This is achieved by assessing the cruise plan as specified in section 3.2.
2. The measurements of the tree or site attributes meet the minimum standards. This is achieved by comparing a sample of cruiser's measurements against the check cruiser's measurements as specified in sections 3.3, 3.4, 3.5, and 3.6.
3. The reports generated from the approved cruise compilation program and final cruise submission are consistent with the cruise plan and reflect the data collected in the field. This is achieved by assessing the cruise compilation and final cruise submission as specified in section 3.8.

If any of the preceding components of the cruise are not acceptable, the licensee must undertake corrective actions to ensure the cruise meets the minimum Ministry standards.

In addition, if the cruise is not consistent with the procedures included in this manual the Ministry may require that corrective action be undertaken before the cruise data is used for appraisal purposes.

3.2. Cruise Plan Standards

The cruise plan is a key document that supports the integrity of the sample design.

A cruise plan must include the requirements identified in sections 2.2 and 3.2.1, as well as the cruise plan form (FS 693). If all the required information is included on the cruise plan map, a cruise plan form (FS693) is not required.

The cruise fieldwork and compilation may not be accepted by the Ministry for use in the appraisal if the above conditions are not met.

3.2.1. Cruise Plan Map Standards

1. The cruise plan map must be legible and of good quality 1:5 000 or 1:10 000 scale.
2. The cruise plan map must provide clear and legible lines, lettering and numbers.
3. The cruise plan and/or cruise plan map shall include the items indicated in Table 3-1.

A sample cruise plan map can be seen at the following link:

Sample Cruise Plan Map.pdf

Table 3-1 Requirements for Cruise Plan and Final Cruise Submissions

	Requirements	Cruise Plan Submission	Final Cruise Submission
a	Tenure and Cutting authority	Yes (if known)	Yes
b	Forest Region and District	Yes	Yes
c	Scale	Yes	Yes
d	Timber Supply Area	Not required	Yes
e	North Arrow, Declination, Map base	Yes	Yes
f	Cruise or Scale Base Indicator	Yes	Yes
g	Maturity of forest inventory polygons/cutblocks identified	Yes	Yes
h	Timber type lines and identifier (including a forest cover map of the cruise and adjacent areas for cruises containing Lodgepole Pine)	Yes (Forest Cover map not required for Coast)	Yes
i	Plots identified as measure or count plots and numbered	Yes	Yes
j	Cutblock numbers (including any old numbers if changed)	Yes	Yes
k	Cutblock and type net areas	Yes	Yes

	Requirements	Cruise Plan Submission	Final Cruise Submission
l	Harvest methods and areas	Only required for heli logging areas	Yes
m	Existing and proposed roads	Yes	Yes
n	Forest Inventory Zone	Not Required	Yes
o	PSYU	Not Required	Yes
p	Biogeoclimatic zone(s) and sub zone(s)	Not Required	Interior only
q	Plots used in the compilation are clearly indicated	Not required	Yes
r	Locations of baselines (when used), boundary tie lines, points of commencement and actual strip line location with direction of travel (direction of travel and strip line location not required for GPS located plots)	Not Required	Yes
s	Actual location of plots in field (after fieldwork is completed)	Not Applicable	Yes
t	Physiographic features	Only if they affect sampling	Only if they affect sampling
u	Legal survey features	Only if they affect sampling	Yes
v	Forest and non-forest type boundaries	Yes	Yes
w	Cutting boundaries	Yes	Yes
x	Location of Marked to Leave Percent Reduction Trees	Yes (if known)	Yes
y	Name of person or company who produced map and date map was produced	Yes	Yes
z	Name of person(s) who completed the cruise field work	Yes - proposed	Yes
Aa	Signature of submitting professional	Yes	Yes
Ab	Registration type (ATE, RFT, RPF) and registration number	Yes	Yes
Ac	Indicate if the submission is original or a revision	Yes	Yes

3.3. Principles

The following summary outlines the general principles that guide the check cruising process:

The check cruiser has the necessary experience and knowledge to perform the audit.

The check cruiser will strive to select plots to audit using a random process or by a process agreed to by the cruiser and the check cruiser. The check cruiser must define the sample population prior to auditing and the results will apply to that pre-defined sample population.

In order to accept or reject a cruise on the basis of tree data attributes or plot slopes, the check cruisers will audit at least 10.0% of the plots or 5 plots within the sample population (e.g. submission, cutting authority, cutblock, cruiser), whichever is greater. If a cruise is being rejected for measure plot data, the minimum number of plots must be based on measure plots. Otherwise, the minimum number of check plots can include both count and measure plots. If there are fewer than 5 plots in the population, all plots must be audited. If fewer plots have been audited and there is mutual agreement between the cruiser or licensee representative and the check cruiser, the cruise may be rejected or accepted.

The check cruiser should provide an opportunity for the cruiser or company representative to attend the audit by providing advance notice.

The cruiser must take responsibility for the cruise data in accordance with Section 3.8(5) of this manual.

A copy of the check cruise report will be provided to the cruiser in a format that is acceptable to the respective Area Director.

Benefit of the doubt will be extended to the cruiser. If a call is considered borderline or difficult to discern, a brief rationale should be noted by the cruiser on the cruise card and where appropriate, in the field. The cruiser's decision will be accepted where the decision is reasonable in the particular circumstances.

Plot centres, plot centre reference trees, sample trees and strip lines (where used) must be marked in the field and in a fashion so as to provide a reasonable level of identification to support the audit function.

3.3.1. Check Cruise Submission Form

The Check Cruise Submission Form allows the Ministry to assess the need for a field check cruise. When submitting the form licensees must use the most recent version of the Check Cruise Submission Form. The form must be completed and submitted to the District Manager prior to a field audit of a timber cruise and before the cruise data is submitted into ECAS . A copy of the fillable form can be downloaded on the Ministry's timber cruising website:

Timber Cruising - Province of British Columbia (gov.bc.ca)

If not already submitted, the District Manager may request the submission of the form and associated cruise data anytime after the field work is complete in order to perform a field audit. In these cases licensees must, at a minimum, submit the form and associated cruise data for the requested cutblocks via email within five (5) business days.

The minimum criteria for cutblocks to be included in a Check Cruise Submission Form:

1. All cutblocks must be in the same District,

2. All cutblocks must be for the same licensee, and

3. The form must be endorsed by a forest professional or associate member with the FPBC (RFT, RPF, ATE or AFP-LL) who takes responsibility for all data on the document.

3.4. Tree Data

If the standards in this section are not met, the tree data cannot be used for appraisal.

The following standards define the maximum variations allowed between the cruiser's and check cruiser's measurements.

Western yew is excluded from the tree standards.

1. **Tree Count** (Section 4.3.1.15)

   The maximum number of tree count errors allowed for all merchantable live and dead potential and useless trees are shown in Table 3-2:

Table 3-2 Allowable Tree Count Errors

Number of Merchantable Trees Checked	Allowable Error
1 to 50	plus or minus 1 tree
51 to 100	plus or minus 2 trees
101 to 150	plus or minus 3 trees

   a. This standard applies to measure and count plots.
   b. Trees incorrectly identified as dead potential versus dead useless or live useless versus live potential are considered an incorrect tree count.
   c. Tree count errors are absolute, missed trees do not compensate for trees that should not have been tallied.
   d. If the borderline 'in' or 'out' tree has been measured it will be accepted, provided that the original plot radius calculated for the tree does not exceed one (1.0) percent variation from the check plot radius and the original horizontal distance determined for the tree does not exceed one (1.0) percent variation from the check horizontal distance.
   e. A timber cruise may be rejected if more than two BAFs are used in a timber type polygon.
   f. An error on walkthrough trees that are tallied twice counts as 2 trees (not one).

2. **Species Identification** (Section 4.3.2.4)

   The maximum number of tree species errors allowed for all merchantable live and dead potential trees are shown in Table 3-3:

Table 3-3 Allowable Species Errors

Number of Merchantable Trees Checked	Allowable Error
1 to 50	plus or minus 1 tree
51 to 100	plus or minus 2 trees
101 to 150	plus or minus 3 trees

   This standard applies to both full measure and count plots.

3. **Tree Heights** (Section 4.3.2.3)

   The absolute variation of all tree heights must not exceed 5.0 %. An example of how to calculate this variation is shown in Table 3-4:

Table 3-4 Example Tree Height Variation Calculation

Original – Height (m)	Check – Height (m)	Difference – (m)
40.0	42.0	-2.0
42.0	41.0	1.0
43.0	44.0	-1.0
46.0	44.0	2.0
Sum	171.0	6.0

   Absolute Variation = 6.0/171.0 *100 = 3.51 percent

   All tree heights in the checked plots will be audited.

   The height in metres must be recorded in the plot record (Card Type 9) in the Bowron, Longworth, Monkman, Purden and Robson PSYUs and TFL 30. Tree heights are used to determine mature red cedar loss factors in these PSYUs and TFL (Loss Factor Table 0296). The height in metres in Card Type 9 is not a check cruise item in any other PSYU or TFL. (See 4.3.1.9)

4. **Pathological Indicators** (Section 4.3.2.7)

   No more than 10.0 % of all trees checked can have a risk group change resulting from incorrect pathological indicator records.

5. **Damage Codes** (Section 4.3.2.18)

   The following standards apply to the measurement of damage codes:

   a. No more than 5.0 percent of all trees checked can have an incorrect code.
   b. Incorrect codes that result in a risk group change will contribute to the number of pathological indicators and risk group changes (not applicable to CGNF cruises).
   c. In the case of a reappraisal due to damage as specified in the *Interior Appraisal Manual*, the following standards will apply:
      i. All reclassification of insect damage, fire codes and down tree codes must be based on field data collection.
      ii. In order to provide the Ministry with adequate time to perform check cruises, re-sweep data must be provided to the Ministry at least 10 business days prior to the commencement of any harvest activity, or some other mutually agreed upon time frame. In turn, the Ministry must respond to the licensee within that time frame if there are any concerns with the cruise, otherwise the cruise will be considered acceptable. If re-sweep data is not submitted as required in this section the data may not be included in the appraisal.
      iii. In order to check and verify the re-sweep insect, fire and down tree code data and confirm who performed the cruise, the following information must be made available to the Ministry:

           The date(s) the re-sweep was completed.

           The cruiser must take responsibility for the cruise data in accordance with Section 3.8(5) of this manual.

           The original and the updated damage code for each re-classified tree.
      iv. Due to the rapid nature of change associated with the needle colour attribute versus other timber attributes, insect code classification will only be counted as an incorrect damage code if the cruiser's code is greater than the code determined by the Ministry (e.g., the cruiser called a red attack (code 2) and

the check cruise assessed the tree as green attack (code 1).

v. The intent of allowing licensees to re-sweep for insect, fire and down tree codes is to provide the most recent description of the damage. As such, the Ministry check cruise efforts will focus primarily on the correct determination of the insect, fire and down tree code attribute; however if in the general practice of completing the insect, fire and down tree code assessment, the Ministry becomes aware of other significant inconsistencies with respect to the cruise standards, these issues will be addressed on a case by case basis.

6. **Tree Ages** (Section 4.3.2.6)

The standards applied to the measurement of tree ages are:

a. Tree ages determined by increment boring:

i. The age in 10's and tree classes must be consistent with the Tree Class Modification of Loss Factor Tables (Table 7.5.5 in Appendix 5), where applicable. The age in 10's must reflect the dominant age class by volume (except when age class 13 and 14 trees are present in a plot). See Section 4.3.1.8.

ii. At least ninety-five (95.0) percent of all trees must be placed in the correct age in 10's and tree class, where applicable.

iii. Coast Only - age in 10's of 13 and 14 - all of the tree classes must be verified since tree classes 1, 2, 3, 8 and 9 contribute to the percent second growth reporting.

7. **Diameter at Breast Height** (Section 4.3.2.5)

The height of the diameter line marked at breast height must not exceed plus or minus 5 percent (plus or minus 6.5 cm) from the true breast-height of 1.3 m above high side. When this limit is exceeded, the true position is used for a. and b. below.

The DBH measurement standards are shown in Table 3-5. Both a. and b. must be exceeded before the standard is not met.

Table 3-5 DBH Measurement Standards

Diameter at Breast Height (DBH)		
Live and dead potential trees.	a.	At least 90.0 percent of individual stems checked must be within 2.0 percent of true DBH.
	b.	Average absolute variation of all DBHs checked must be within 2.0 percent of the original DBHs

Dead useless trees should be estimated to the nearest 5cm DBH class.

8. **Quality Remarks** (Sections 4.3.2.8)

   The following standards apply to the assessment of tree quality remarks used in coast appraisals only:

   a. **Pathological indicators:** At least 90.0 percent of the individual indicators that occur in the middle or lower third must be coded in the correct third of the tree.

   b. **Quality indicators:** For All Check Plots – At least 90.0 percent of all quality indicators checked must be correct. Values outside the ranges listed below are counted as errors:

      i. Knot codes 5 and 6 must be correct. Any variation is an error.

      ii. For mature trees, stub codes 1 or 2 must be correct. Any variation is an error.

      iii. Spiral Grain – if the check code is greater than 4 and the original is less than 5, or vice versa, it is an error.

      iv. All other quality indicators are counted as errors if they differ from the correct value by more than 1 (higher or lower).

   c. **Live limb**: Live limb code will not be contested if it is located at a position on the stem that is 38 cm inside bark or less.

3.5. Survey and Area Measurement Standards

This section outlines the distance and area measurement standards that must be used to locate plots and or harvest boundaries. Cruisers or check cruisers may use any appropriate method to measure and or initially verify a distance or area. For audit purposes, the true distance and or area measure must be derived from conventional measurement systems such as a survey chain and compass except when GPS is used to establish cruise plot locations. In these situations, plot location must be audited using a GPS unit that meets the standards specified in this section.

1. **Strip or Tie Lines** (Conventional Methods Only - Sections 4.3.1.4 and 4.3.1.5)

   Strip lines are only used with conventional measurement systems (i.e. without GPS technology).

   The following standards apply to the strip or tie line measurements used to locate the plot centre. These standards apply from plot to plot or for any combined strip interval distance. The check cruiser must follow the same route (i.e. direction of travel) that the original cruiser traversed. The plot will be re-cruised if the plot location is not within the following standards:

   Horizontal distance: plus or minus 2.0 percent (2.0 m per 100m).

   Bearing: plus or minus 2.0 degrees (+/- 3.5 m per 100m).

   Moving plot centres from the measured/ traversed location presents significant bias and is not permitted.

2. **Plot Measurements** (Section 4.3.1.5)

   Establishing Cruise Plots Using Conventional Methods

   The standards applied to the distance measurement used to locate the plot reference tree and the plot are shown in Table 3-6:

Table 3-6 Plot Distance Standards

Attribute	Maximum Variation
Plot centre reference tree to plot centre	Plus or minus 1.0 percent of horizontal distance
Radius - fixed and variable radius plots	Plus or minus 1.0 percent of horizontal distance
Length and width: fixed rectangular plots	Plus or minus 1.0 percent of horizontal distance

Establishing Cruise Plots Using GPS Technology

Cruises may be rejected for not meeting the standards in this section when GPS is used to establish cruise plots.

In order to use GPS technology to establish cruise plots, the GPS receiver must meet the following standards:

- Able to achieve submetre accuracy under ideal conditions (i.e. open area, no interference, good satellite coverage)
- Real time correction system with external antenna
- Minimum satellite elevation angle/mask is 15 degrees above the horizon
- RMS (Root Mean Square) minimum rating of 100 cm

If GPS is used to establish cruise plots, the following data must be submitted to the Ministry in a Plot Reference Point (PRP) table (if requested as per Section 3.8):

- Cutblock ID
- Timber type
- Cruise plot number
- Horizontal Distance (m) from PRP to Cruise plot
- Calculated bearing (degrees) from PRP to Cruise plot
- Average PDOP – *maximum of 6.0*
- Average HDOP – *maximum of 4.0*
- Number of satellites when establishing PRP – *minimum of 4*
- Number of hits received when establishing PRP – *minimum of 50 hits*
- Mean difference of hits in metres (MDH) – *maximum of 1.0*
- Time of PRP establishment – local date and time
- PRP coordinates – specify UTM or BC Albers*
- Cruise plot coordinates - specify UTM or BC Albers*

The required format of the PRP table is shown in Table 3-7.

**The map projection system used (i.e. BC Albers, UTM, etc.) must be consistent with the cruise plan*.

Table 3-7 Sample of Required Format for PRP Table

CB	TYPE	PLOT	HD (m)	BRG (°)	PDOP	HDOP	#SAT	# HIT	MDH (m)	Local Date, Time	PRP Easting UTM	PRP Northing UTM	PT Easting UTM	PT Northing UTM
7	2	1	16.6	110	3.4	1.9	6	50	0.3	13:52:23 8/16/2019	683417.473	5657508.768	683433.292	5657503.723
7	2	2	9.7	329	3.9	2.3	8	50	0.1	14:12:50 8/16/2019	682934.854	5657577.685	682929.529	5657585.834
7	2	3	8.9	157	2.3	2.9	8	50	0.5	15:30:51 8.16.2019	683125.834	5657600.981	683129.624	5657592.922
7	2	4	11.6	063	2.0	1.7	9	50	0.4	16:01:20 8/16/2019	683219.529	5657590.781	683229.672	5657596.466
7	2	5	11.7	349	2.0	2.2	9	50	0.2	16:30:59 8/16/2019	683332.437	5657588.624	683329.720	5657600.010

Cruise plots that are located with GPS must meet the following standards. In order for a cruise to be rejected for cruise plot location data, either both of the first 2 standards (1 and 2) must be exceeded or the last standard (3) must be exceeded:

1. The average absolute variation of all cruise plot locations checked must be within 3.0 m of the check cruise plot locations.
2. Individual variations between check cruise plot locations and the original cruise plot locations must be within 5.0m. A tolerance of one plot location outside of 5.0m will be allowed for every ten (or less) plots checked.
3. The distance and bearing between the cruiser's PRP and cruise plot must meet the same standards as those for conventional methods:
    a. Horizontal distance: plus or minus 2.0 percent
    b. Bearing: plus or minus 2.0 degrees

In order to require a re-cruise based on these standards, a minimum of 5 cruise plot locations or 10% of the cruise plot locations, whichever is greater, must be checked with a GPS unit that meets the aforementioned standards.

For additional information on precision standards for GPS plot locations, please see Circular Error Probability Method in the appendices.

3. Sample Point Integrity Test (SPIT) Plots

The District Manager or Area Director may audit a cruise for basal area bias using sample point integrity test (SPIT) plots.

The process for establishing SPIT plots is to establish four satellite plot centers 10.0m from the original plot center, one in each cardinal direction (North, East, South, West). The SPIT plots will be cruised using the same BAF as the original plot. All merchantable live and dead potential trees within the plots and associated species information will be tallied.

Although more data can be collected at the discretion of the check cruiser, the minimum amount of data collected at SPIT plots will be the same as the information collected in count plots as per section 2.7.2.

If a SPIT plot lands outside the harvest area the plot must be dropped.

The walkthrough method must be used as per section 4.3.1.15 of this manual.

The recommended minimum number of original cruise plots to have SPIT plots established is fifty (50). If there are fewer than fifty (50) original cruise plots in the audit area then all plots in the submission should have SPIT plots established.

The survey results must meet both the following minimum quality assurance standards for SPIT plots:

- The average basal area (m^2/ha) of the checked plots from the original cruise is $\leq$10.0% of the average SPIT plot basal area (m^2/ha), or
- The average basal area (m^2/ha) of each species in the checked plots from the original cruise is within $\leq$20.0% of the average SPIT plot species basal area (m^2/ha).

If quality assurance standards are not met the audit area must be recruised with a new grid and cruise plots. Failure to meet this standard may lead to further inquiries into the integrity of plot locations and resulting appraisal data for both the licensee and cruising agency.

4. Harvest Boundary Traverse

The standards used for the measurements to establish the harvest boundaries are in Table 3-8. This standard applies to original appraisals and reappraisals.

Table 3-8 Harvest Boundary Standards

Boundary Traverse	Cruise-Based	Scale-Based
Closure Error	+ or – 0.7%	+ or – 1.0%
Area Error	+ or – 1.0%	+ or – 1.5%
Inter-station Distance	+ or – 1.0%	+ or – 2.0%

For conventional traverses, both closure error and area error must be exceeded before the traverse is deemed to be incorrect. The closure error standards do not apply to GPS traverses. To calculate closure error for traverses that are a combination of GPS and conventional traverses, refer to the Combined GPS and Conventional Traverse Procedure found in the appendices.

3.6. Plot Slopes (Section 4.3.1.23)

The following standards apply to the measurement of plot slope. To support the audit process, the cruiser may establish flagging tape at the location used to determine the maximum slope at 15m slope distance from plot centre.

Either (a) or (b) must be exceeded before the standard is determined to be incorrect.

a. **Plot slopes:** Individual plots must be within plus or minus 5.0 slope percentage points of the correct slope reading. One plot slope outside this tolerance will be allowed for every ten (or less) plots checked.

b. **Cutblock or Cutting Authority**: the average variation of all slopes checked must be within plus or minus 5.0 slope percent.

3.7. Check Cruise Dispute Mechanism

If the licensee wishes to dispute the result of a rejected check cruise the following process will be followed:

Step	Action
1	The licensee and/or their agent must notify the District Manager in writing and provide a rationale supporting the acceptance of the cruise information.
2	The Ministry check cruiser and licensee and/or their agent attend the site and attempt to resolve the concerns.
3	If the concerns from step 2 are not resolved, the licensee may submit a written complaint to the District Manager within 30 days of the site visit in step 2 requesting further review. The District Manager will forward the written request to the Area Director.
4	The Area Director will review the concerns and respond to the licensee and/or their agent preferably within 30 days of receipt of the written complaint. The Area Director may coordinate a second check cruise.
5	The Area Director will make a decision based on all information, which will be binding and final.

3.8. Cruise Data Submission Standards

The following conditions must be met. If they are not met, the cruise data may not be used for an appraisal:

1. Starting February 1, 2025, a Check Cruise Submission Form(s) must be submitted pre-ECAS as part of a check cruise request.
2. The field data must be consistent with the data used in the appraisal compilation.
3. The field data must be compiled in a manner that is consistent with the cruise plan or final cruise map and changes to the cruise plan in accordance with Section 2.2.
4. When requested by the Ministry, the licensee must submit the original plot cards (in the format requested by the District Manager), traverse notes (if traversed with chain and compass), and raw and corrected GPS files (if traversed with GPS).
5. If GPS is used to establish cruise plots, the following items must be submitted upon request to the Ministry:
    a. PRP Table in pdf format as specified in Section 3.5.
    b. Digital shape file depicting the established GPS cruise plot locations and plot numbers.
6. The cruiser must take responsibility for the cruise data submitted by either:
    a. submitting the original cruise cards and any subsequent changes (including name, date and signature), or
    b. submitting a cover letter (including name, date and signature) with the cruise data indicating which plots they cruised or made subsequent changes to.

    If the cruiser is a registered or associate member of the Forest Professionals British Columbia (FPBC), they must provide their professional designation.

    If the cruiser is not a registered or associate member of the FPBC, an additional cover letter must be submitted with the cruise data signed by a registered member or associate member indicating they supervised the work and are accepting responsibility for the information collected and submitted by the cruiser on that cutting authority. This cover letter is in addition to any letter submitted by a cruiser who is not a registered or associate member of the FPBC.
7. The cruise data must be compiled on an approved version of the compilation software. (See Section 5.10.2)
8. Final cruise maps must accompany the compilation report and the final submission must include the requirements identified in Table 3-1.

4. Field Procedures

4.1. Introduction

This Chapter outlines the general field procedures for timber cruising following the format of the Cruise Tally Sheet (Figure 4.1 Cruise Tally Sheet – FS 205C (front side).).

Cruise measurements taken on samples established in cutting authorities will be recorded on a digital or paper Cruise Tally Sheet that provides the information required in this chapter.

All information identified on the Cruise Tally Sheet is required to meet the Cruising Manual requirements. If scanned copies are submitted and required information (i.e. signatures) is on the back of the Cruise Tally Sheet, both sides must be provided.

Quality remarks and CGNF data is only required for coastal cruises.

The CGNF Standards and Procedures for the Coast Forest Region is available at:

CGNF Standards and Procedures

All cutting permits require a closed or GPS traverse of each cutblock. Stations, tie points, reference points and boundaries must be well established on the ground for permanent future reference and must not be destroyed during or after harvesting operations. Refer to established district policy on boundary marking where the cruise area is located (e.g., *Forest Practices Code Boundary Marking Guidebook*).

https://www.for.gov.bc.ca/ftp/hfp/external/!publish/FPC%20archive/old%20web%20site%20contents/fpc/fpcguide/bound/boundtoc.htm

Traverse notes shall include tie points and other boundary references. Refer to Chapter 3 Quality Assurance for the tolerances. Traverse notes must also include direction of travel between plots and any pertinent information regarding plot location. The original strip line, type line, boundary traverse notes and GPS coordinates must be made available to the check cruisers upon request.

All areas that are inside the cutblock boundary and will be removed from the harvest area must meet the area error standards in Section 3.5.

Columns 64 to 90 are not required for Interior cruises.

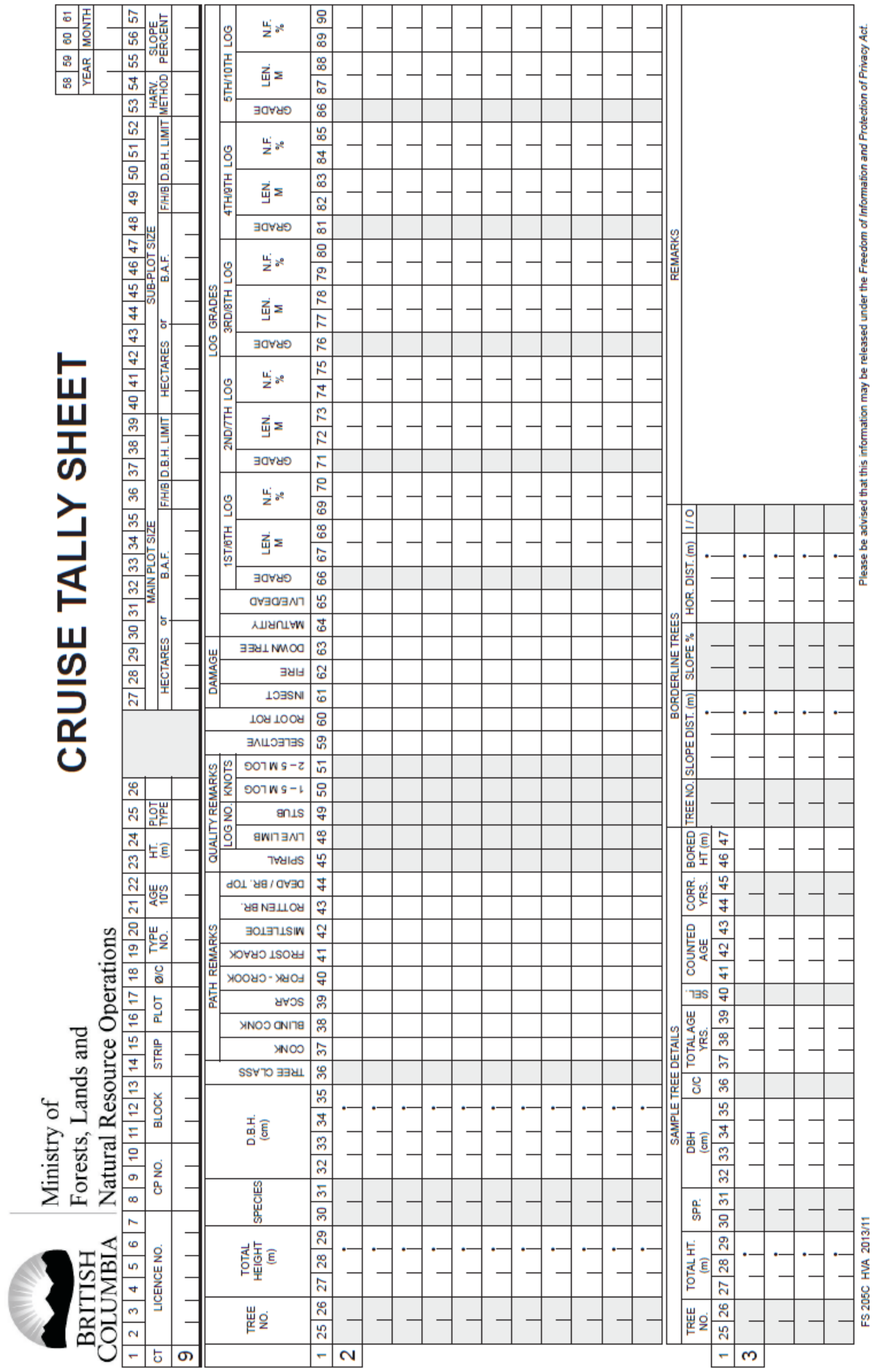
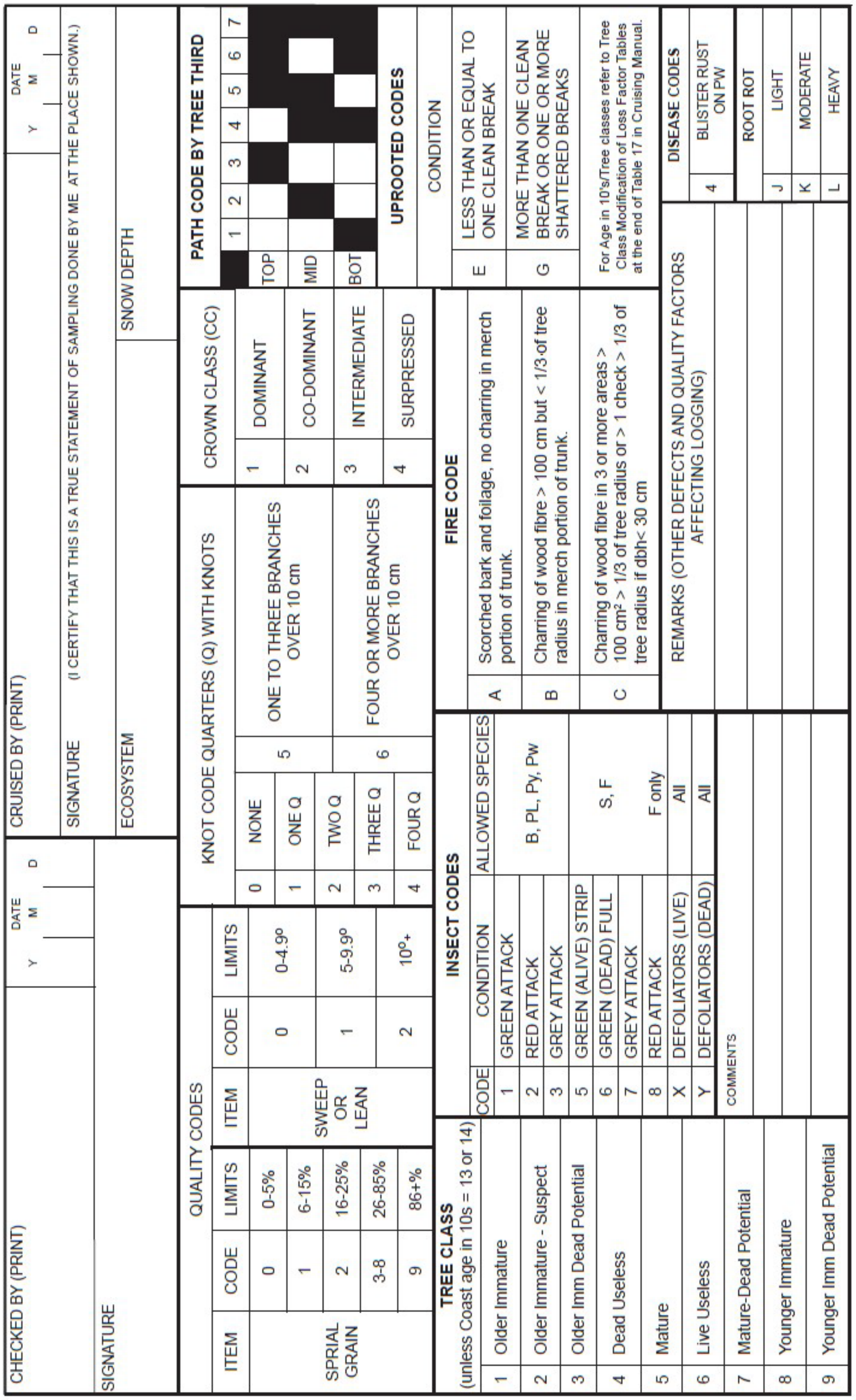


Figure 4-1 Cruise Tally Sheet – FS 205C (front side)



CHECKED BY (PRINT)	DATE Y M D
SIGNATURE	

CRUISED BY (PRINT)		DATE Y M D
SIGNATURE (I CERTIFY THAT THIS IS A TRUE STATEMENT OF SAMPLING DONE BY ME AT THE PLACE SHOWN.)		
ECOSYSTEM	SNOW DEPTH	

QUALITY CODES

ITEM	CODE	LIMITS	ITEM	CODE	LIMITS
SPRIAL GRAIN	0	0-5%	SWEEP OR LEAN	0	0-4.9º
	1	6-15%			
	2	16-25%		1	5-9.9º
	3-8	26-85%			
	9	86+%		2	10º+

KNOT CODE QUARTERS (Q) WITH KNOTS

0	NONE	5	ONE TO THREE BRANCHES OVER 10 cm
1	ONE Q		
2	TWO Q		
3	THREE Q	6	FOUR OR MORE BRANCHES OVER 10 cm
4	FOUR Q		

CROWN CLASS (CC)

1	DOMINANT
2	CO-DOMINANT
3	INTERMEDIATE
4	SURPRESSED

PATH CODE BY TREE THIRD

■	1	2	3	4	5	6	7
TOP			■		■	■	■
MID		■		■	■		■
BOT	■			■		■	■

UPROOTED CODES

CONDITION	
E	LESS THAN OR EQUAL TO ONE CLEAN BREAK
G	MORE THAN ONE CLEAN BREAK OR ONE OR MORE SHATTERED BREAKS

For Age in 10's/Tree classes refer to Tree Class Modification of Loss Factor Tables at the end of Table 17 in Cruising Manual.

TREE CLASS
(unless Coast age in 10s = 13 or 14)

1	Older Immature
2	Older Immature - Suspect
3	Older Imm Dead Potential
4	Dead Useless
5	Mature
6	Live Useless
7	Mature-Dead Potential
8	Younger Immature
9	Younger Imm Dead Potential

INSECT CODES

CODE	CONDITION	ALLOWED SPECIES
1	GREEN ATTACK	B, PL, Py, Pw
2	RED ATTACK	
3	GREY ATTACK	
5	GREEN (ALIVE) STRIP	S, F
6	GREEN (DEAD) FULL	
7	GREY ATTACK	
8	RED ATTACK	F only
X	DEFOLIATORS (LIVE)	All
Y	DEFOLIATORS (DEAD)	All

COMMENTS

FIRE CODE

A	Scorched bark and foliage, no charring in merch portion of trunk.
B	Charring of wood fibre > 100 cm but < 1/3 of tree radius in merch portion of trunk.
C	Charring of wood fibre in 3 or more areas > 100 cm² > 1/3 of tree radius or > 1 check > 1/3 of tree radius if dbh< 30 cm

REMARKS (OTHER DEFECTS AND QUALITY FACTORS AFFECTING LOGGING)

DISEASE CODES

4	BLISTER RUST ON PW

ROOT ROT

J	LIGHT
K	MODERATE
L	HEAVY

Figure 4-2 Cruise Tally Sheet – FS 205C (back side)

The following provides an example of cruise strip line traverse notes:

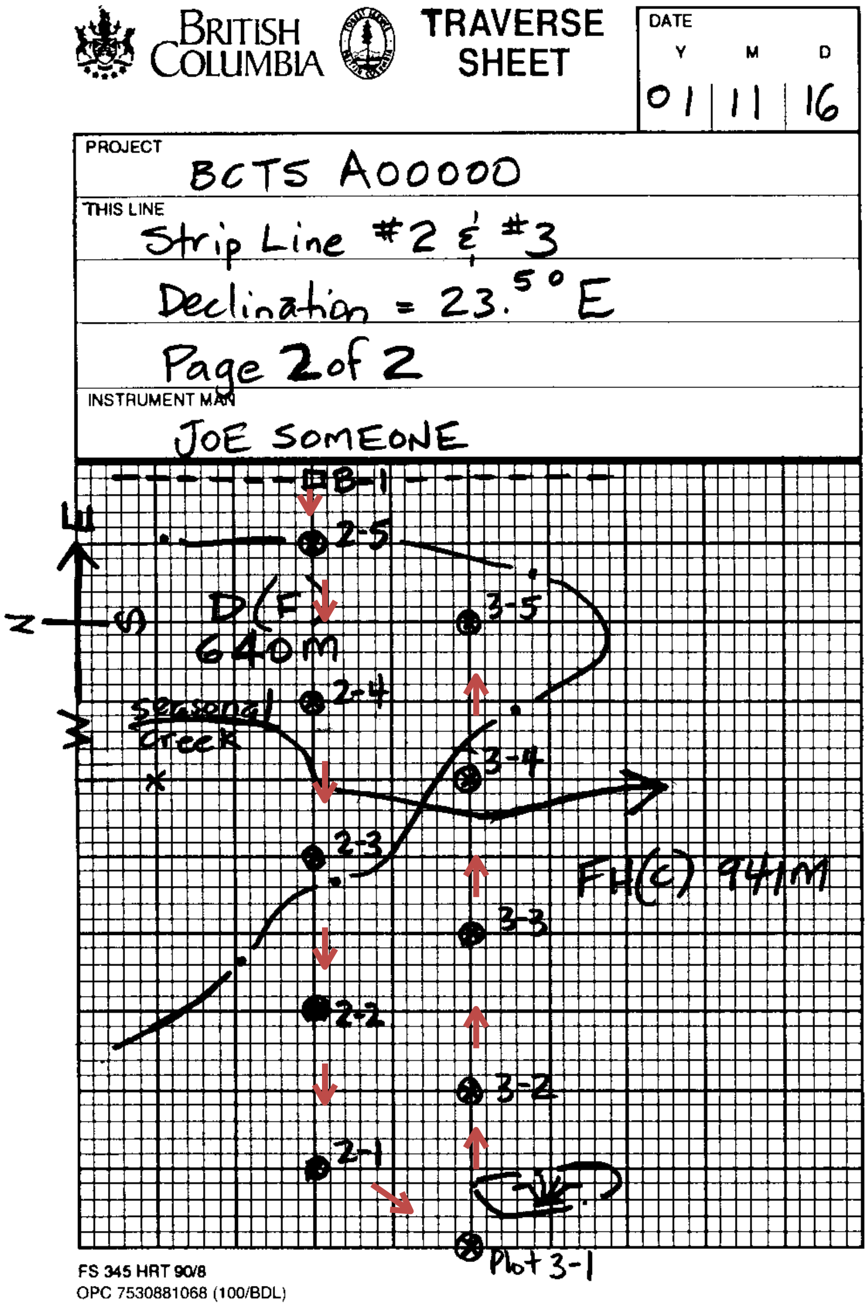


Figure 4-3 Cruise Strip Line Traverse Notes (front)

4.2. Entry of data in divided spaces or numbered columns

Plot cards included in a cruise submission must have alphabetic fields left justified and numeric fields right justified.

4.3. Front Side of Cruise Tally Sheet (FS 205)

The following section identifies the card position and information required following the format of the Cruise Tally Sheet. Where digital data capture software is used, the information collected must follow the format and standards of the Cruise Tally Sheet.

4.3.1. Card Type 9

This card is to be completed for every new plot. The data on this card provides the plot attributes. Optional fields are identified. These fields should be entered if known. Where fields are not identified as optional, they are considered mandatory.

4.3.1.1. Positions 2 to 7 Licence Number (Optional)

Enter the license as provided by the Licensee. This may be Alpha/numeric, and cannot exceed 6 spaces.

4.3.1.2. Positions 8 to 10 Cutting Permit (Optional)

Enter Alpha/Numeric, cannot exceed 3 spaces.

4.3.1.3. Positions 11 to 13 Cutblock ID (within the Cutting Permit)

Enter: Alpha/Numeric, cannot exceed 3 spaces. Enter only 3 spaces for cutblocks with more than 3 digits/letters in the cutblock name. (i.e. cutblock ABC123 may be entered as 123, and identified in its entirety in the compilation program for reporting purposes)

4.3.1.4. Positions 14 to 15 Strip Number (Number of Strip on which Plot is Located, if strips are used).

If no strip lines are used, these two spaces may be utilized in cruises with 3 or 4 digit plot numbers**.**

When using strip lines, they will be run using compass, clinometer and metric surveyor tape or electronic measuring devices. Allowances for slope must be made since all distances must be horizontal. (See Horizontal Distance Correction in Appendices) Strip lines will be marked with survey tape so they can be used to locate plots in the future.

Where used, all of the cruise strip lines must be linked to the boundary. The tie point or reference point of each strip line must be well established on the ground so that it may be found at a future date.

4.3.1.5. Positions 16 to 17 Plot Number or Letter

Will accept alpha/numeric designations.

Plots are to be numbered without duplication on the same strip line (if used).

Three digit plot numbers may be truncated to 2 digits in some compilation software.

Moving plot centres from the measured/traversed location presents significant bias and is not permitted. Plots may only be relocated in accordance with Section 2.4.2. If the plot cannot be completed safely, it will be dropped and the reason documented.

Plot Establishment Procedures for Both Conventional Methods and GPS Technology

The following are the steps to be taken when establishing cruise plots:

1. Travel the distance and bearing identified on the cruise plan or map.
2. When the required distance has been measured, a stake, pin or equally effective marker must be established at the plot centre. If this location is within a tree, mark the plot centre with an “X” at the point on the tree. The plot centre is the point at which the marker enters the ground and not the top of the marker.
3. A reference point (RP) must be established and recorded in the traverse notes or on the cruise tally card. It is acceptable to use a reference tree that is a tallied tree within the plot. The slope or horizontal distance and bearing from plot centre to either a marked point below stump height (preferred) or the nearest point on the tree at breast height must be recorded. The cruiser should record whether they measured slope or horizontal distance and to which part of the tree the measurements were taken (breast height or stump height). The reference point will be used to determine the position of the plot centre if the original plot marker is missing and should be permanent enough to be available at the time of check cruise.

Establishing Cruise Plots using Conventional Methods

For cruises using conventional traverse methods, the cruise must originate from valid tie points such as map locations like road locations, falling corners and field marked GPS positions. The cruise must be tied to at least one (1) and preferably two (2) tie points. Tie points must be linked to the cruise grid with an accurate traverse.

A map feature (falling corner, junction, etc.) or GPS station must be selected to establish the Point of Commencement (POC).

Establishing Cruise Plots using GPS Technology

GPS may be used to establish cruise plots as prescribed in the following procedures. On the Coast, GPS may only be used to establish plot locations with prior approval from the District Manager.

1. Use the GPS to navigate to the cruise plot.

2. Within 20 metres of the cruise plot location, locate a suitable PRP (Plot Reference Point). The most suitable location for the PRP is generally the least obstructed or most open location.

> *NOTE:* The PRP must be a fixed feature that cannot be moved by hand, such as: a small standing tree (< 3m tall), cut stump, broken stump, root wad, fence post, etc. Trees that may be large enough to incur deflection and interference of GPS signals are not acceptable. If using a small tree, hold the antenna directly above the point where the tree enters the ground. If using another fixed object, paint a spot on the object and position the GPS antenna directly above this spot.

3. Review the data displayed on the GPS receiver screen. When the number of satellites, PDOP/HDOP and Mean Difference of Hits are within tolerances (see Section 3.5), establish the PRP using the GPS receiver and software. Collect a minimum of 50 hits or coordinates and record the required data in the PRP table (see Section 3.5).
4. If the default tolerances have been exceeded, the PRP must be re-located. Where GPS coverage is poor or a PRP cannot be established, the cruise plot must be located using conventional traverse methods (e.g. chain and compass) from existing tie point or cruise plot locations.
5. Once the PRP has been established, measure the final horizontal distance and bearing to plot center. Flag the PRP well and label it with the bearing and distance to the cruise plot. Because there is minimal interplot flagging with the use of GPS technology, the flagging at the PRP and cruise plot must be heavy enough to be visible from a reasonable distance and enable Ministry staff to audit plot locations.

Use conventional traverse methods (e.g. chain and compass) to navigate to the cruise plot from the PRP. Establish the cruise plot and record the cruise plot location using the GPS.

4.3.1.6. Position 18 O/C

This field must be entered.

Enter:	O	if original measurements
	C	if check cruise measurements

4.3.1.7. Positions 19 to 20 Type Number (Section 2.8)

Enter the number given to the timber type in which this plot is located (corresponds to positions 14, 15 on Card type C).

4.3.1.8. Positions 21 to 22 Age in 10's (Optional in Interior)

The age in 10's for Interior cruises default is 11.

For Coastal cruises, the age in 10's is recorded as the dominant age class by volume (except when age class 13 and 14 trees are present in a plot). In plots where there are coniferous trees between 121 and 140 years of age (age class 13 and 14), see Section 4.3.1.8(4).

The age in 10's is required for all measure and count plots and is used with the tree class in each measure plot to assign the correct loss factor table and maturity to each tree.

See Section 4.3.2.6 and 4.3.1.8(4) for the coding of the age in 10's in relation to applicable tree class.

Age Limits (years)	Class	Age Limits (years)	Class
21-30	03	91-100	10
31-40	04	101-110	11
41-50	05	111-120	12
51-60	06	121-130	13
61-70	07	131-140	14
71-80	08	141-250	15 to 25
81-90	09	251 plus	26

It is important to select the correct age class limit as they govern the proper selection of loss factors and coastal log grades.

Coast - Second Growth Clarification

The *Coast Appraisal Manual* defines second growth coniferous timber as less than 141 years old for the purposes of timber pricing.

The volume of mature and second growth coniferous timber will be compiled on a tree basis and the percentage of the total coniferous cutting authority area volume represented by the second growth timber will be calculated.

Using this calculated percentage, any cutting authority area that contains 80 percent or greater second growth coniferous timber volume will be appraised as second growth timber using a Second Growth Average Market Value schedule.

Coastal Loss Factor Cruises

The above definition of second growth coniferous timber must not be confused with immature. Only trees less than 121 years old are considered to be immature. Coniferous trees between 121 years and 140 years old, while defined as second growth for appraisal purposes, will remain as mature trees for determination of loss factors, timber merchantability specifications and log grade algorithms.

In order to compile cruise plots correctly, please note the following:

1. All coniferous trees less than 141 years old contribute to the second growth percentage for appraisal purposes.
2. All coniferous trees from 121 to 140 years old will be compiled using mature loss factors.
3. If over 50 percent of the net volume (coniferous and deciduous) in a cutblock is in trees over 120 years old (coniferous) or 40 years (deciduous), it is considered a mature cutblock and will be compiled accordingly (e.g. minimum merchantability of 17.5 cm DBH and 15 cm top).
4. If the plot contains any coniferous trees that are from 121 to 140 years old, record the age in tens as 13 or 14 and:
    a. Record coniferous trees between 121 and 140 years old as tree class 1, 2 or 3.
    b. Record coniferous trees greater than 140 years old as tree class 5 (mature) or tree class 7 (mature dead potential).
    c. Record coniferous trees less than 121 years old as tree class 8 (immature) or tree class 9 (immature dead potential).
    d. Record deciduous trees greater than 40 years old as tree class 1, 2 or 3.
    e. Record deciduous trees younger than 40 years (both older and younger immature) as

tree class 8 (immature) or tree class 9 (immature dead potential).

5. Using the age in tens and appropriate tree class, all coniferous trees less than 141 years old will contribute to the second growth volume. All coniferous trees less than 121 years old will be compiled with older immature loss factors. All coniferous trees over 120 years old will use mature loss factors for determination of net volume.

4.3.1.9. Positions 23 to 24 Height in Metres

This field is only applicable for interior cruises in the Bowron, Longworth, Monkman, Purden and Robson PSYUs and TFL 30. Tree heights in these PSYU's and TFL are used to determine mature red cedar loss factors (Loss Factor Table 0296). Enter the appropriate height class as shown below for the dominant and co-dominant trees of the major species in the plot. This classification is based on tree heights measured at the plot.

Height Class Limits for Height in Threes					
Height Class	Ht. Limits (m)	Height Class	Ht. Limits (m)	Height Class	Ht. Limits (m)
3	0.0-4.4	24	22.5-25.4	45	43.5-46.4
6	4.5-7.4	27	25.5-28.4	48	46.5-49.4
9	7.5-10.4	30	28.5-31.4	51	49.5-52.4
12	10.5-13.4	33	31.5-34.4	54	52.5-55.4
15	13.5-16.4	36	34.5-37.4	57	55.5-58.4
18	16.5-19.4	39	37.5-40.4	60	58.5-61.4
21	19.5-22.4	42	40.5-43.4	63	61.5-64.4

4.3.1.10. Position 25 Plot Type (See Section 2.7)

- Blank or "M" for measure plot,
- "C" for count plot, and
- "S" for stump cruise.

4.3.1.11. Position 26

This column is not in use.

4.3.1.12. Positions 27 to 39 Main Plot Size (not required for 100% Cruise)

These positions describe the plot size of the main stand element being sampled and the minimum DBH.

4.3.1.13. Positions 27 to 30 Hectares (Fixed Plot) (See Section 2.6.2)

Enter the plot size in hectares for circular or rectangular shaped fixed plots. Leave the positions blank if variable plots or a 100% Cruise are used.

Circular Fixed Plots

Having established the plot centre, the plot circumference is then determined and marked with string or plastic flagging tape. More radii measurement will be required when there are many trees on or near the plot boundary. At the end of each radius measurement the tree on the plot circumference or nearest to the circumference within the plot must be marked with plastic flagging tape or paint.

When plots are established, slope allowances must be applied to each radius distance. That is, plots must not be established by assuming an average slope and making one slope correction for all radii. The plot radius slope allowance is added along the same slope in which the plot radius is being measured. Plot radii slope corrections are shown in the Correction Table for Plot Radii (See Appendix 14: Table 7.14.2).

Rectangular Fixed Plots

A tree on the strip line at the start and end of each plot must be blazed on four sides. A metal tag and/or plastic flagging tape, showing strip number, compass bearing, distance on line and plot number must be attached.

The strip line must constitute the centre line of the plot, and slope allowances must be made in measuring this line. Slope allowances for various short distances are shown in the Correction Table for Chaining (See Appendix 14: Table 7.14.1). The plot centre line must be marked with plastic flagging tape every 5 m from the beginning to the end of the plot.

Plot width will be checked along the centre line and the boundary marked with plastic flagging tape. Plot width must be corrected for slope.

Borderline Trees (Fixed-Area Plots)

The horizontal plot radius or plot width must be checked for each borderline tree. A tree will be included "in" the plot if at least half of the diameter of the tree measured at breast height is inside the plot.

Fixed Area Border Plots (Plots Falling On Type or Cutblock Boundaries/ Half Plots)

Fixed area plots which are affected by harvesting boundaries are split through the plot centre parallel to the harvesting boundary. The trees inside the sample area are recorded and the plot recorded as a B for border/half plot. Count plots are not used with fixed area plots.

Fixed area plot centres which fall outside the sample area will be dropped. The following plot sizes are recommended:

Size (hectares)	Circular Plots Radius (metres)	Square Plots One Side (metres)
0.005	3.99	7.07
0.010	5.64	10.00
0.02	7.98	14.14
0.03	9.77	17.32
0.04	11.28	20.00
0.05	12.62	22.36
0.06	13.82	24.49
0.08	15.96	28.28
0.10	17.84	31.62
0.20	25.23	44.72

4.3.1.14. Positions 31 to 35 Basal Area Factor (BAF Variable Plots) m^2/ha (See Section 2.6.3)

Enter the BAF for the main stand element being sampled. It must be entered to three decimal places.

Imperial/Diopter Conversions

BAF (m2/ha) = BAF (sq. ft./acre) x 0.229568 where 1 square foot per acre = 0.229568 m2/ha

BAF (m2/ha) = 10,000/(1+ (200/diopters)2) where 1 diopter represents a right-angled deflection of one unit per one hundred units in distance or 0.5728888° (decimal degrees).

4.3.1.15. Position 36 Prism Sweep

Enter: F for Full Sweep

Enter: B for Border Plot (Fixed plots only)

Variable Plot Cruises (Prism or Relascope)

Having established the plot centre, the prism is used to estimate which trees are "in" the plot. Then species, DBH, pathological remarks and quality are measured or determined for each “in” tree.

Sampling Procedures

The cruiser holds the prism exactly over plot centre and looks at a tree across the upper edge of the prism, and to view it simultaneously above the prism and through the prism. The tree image seen through the prism will be laterally displaced. The prism must be over the sample centre as the prism forms the vertex of the angle being projected.

If the displacement is greater than the diameter of the tree, the tree is "out"; if smaller the tree is "in"; if the same, the horizontal distance to the tree must be measured because it is borderline (see Figure 4.4 "In", "Out" and "Borderline" Trees.). The prism will be "swept" around plot centre and all live and dead trees equal to or larger than the minimum specified size for the "in plot" trees will be recorded.

The cruiser must pay special attention when assessing the trees as “in” or “out”. An oddly shaped tree may appear to be “in” or “out” when viewed through a prism from the plot centre, but may have different results if measured using the borderline measurement method.

If a tree bole is shattered and extends through DBH and either the standing or down portion of the tree fall outside of the plot, use the portion of the tree with greater than 50% of the basal area at breast height to determine if the tree is “in” or “out” and assign applicable damage codes (See Section 7.6.3)

All trees with boundary ribbons or paint attached must be excluded from cruise plots.

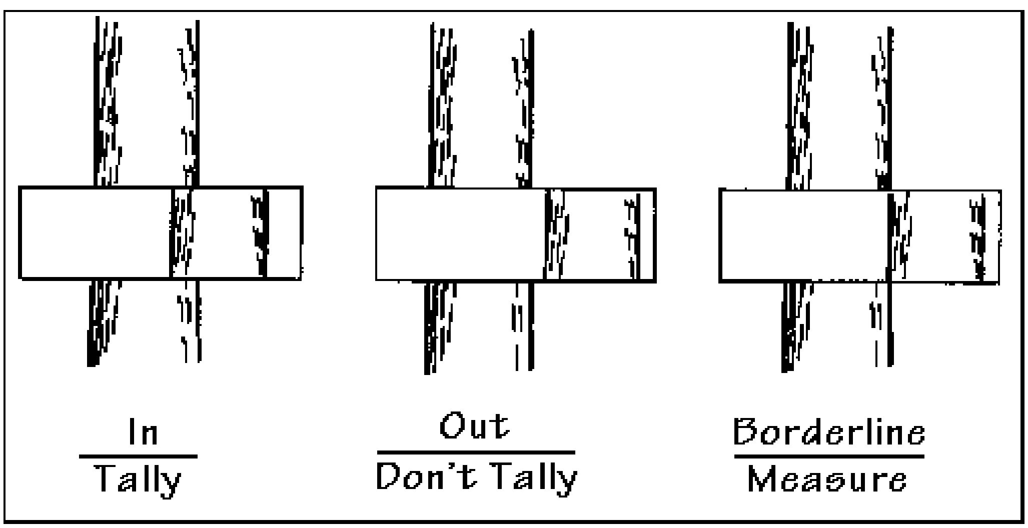


Figure 4-4 "In", "Out" and "Borderline" Trees

BAF Selection

Changing BAFs within a timber type polygon may introduce a bias in the reporting of summary stand statistics. The BAF may be changed once within each timber type polygon. Once the change is made, the BAF cannot be changed again regardless of stand composition. More than one BAF change in a timber type polygon may result in the rejection of the cruise. The determination of the BAF must not be made at plot centre. When a BAF change is made, the location of the BAF change must be noted on the cruise field notes or cruise cards.

The BAF may only be changed to a BAF value within 50% of the original BAF value, unless there are extenuating circumstances and a professional rationale is provided. For example, if the original BAF selected is 10 and a new BAF is selected, the new BAF must be between 5 and 15. If the original BAF selected is 14, the new BAF must be between 7 and 21.

If the minimum tree count requirement for a cutblock is not met after a cruise is completed, all plots within one timber type must be recruised with a smaller BAF in order to meet minimum requirements. The BAF must be the same for all plots within the timber type that is recruised.

Prism Slope Correction

Since each tree on the area may have its own unique slope angle from the centre, each tree must be considered individually in making slope corrections (see Horizontal Distance Correction in Appendix 14). In borderline situations, trees are to be measured as described in the following section.

Borderline Trees (Variable Plot Cruises)

When sighting a tree through a prism or relaskop, the exact in/out status cannot always be determined. The correct status of borderline trees in measure and count plots must be determined by using the following procedure:

1. Determine the horizontal distance from the plot centre to the face of the tree trunk at breast height. The plot centre is the point at which the plot marker (stake, pin, etc.) enters the ground and not the top of the marker.

2. Add one half of DBH to the horizontal distance to determine the horizontal distance from the tree centre to the plot centre.

3. Multiply the plot radius factor times DBH. This represents the plot radius for the tree. In variable cruising every tree has its own plot radius depending on its diameter and the angle of the prism being used (see Variable Plot Sampling in Appendices).

4. If the horizontal distance from the tree to the plot centre is less than or equal to the plot radius, the tree is considered "in". If the horizontal distance from the tree to the plot

centre is greater than the plot radius, the tree is considered “out”.

5. Record the measured slope distance and slope percent on the cruise tally card and run a single pencil line through the tree details if the tree is “out”.

All "borderline" trees must be measured and the measurements recorded for check cruise purposes.

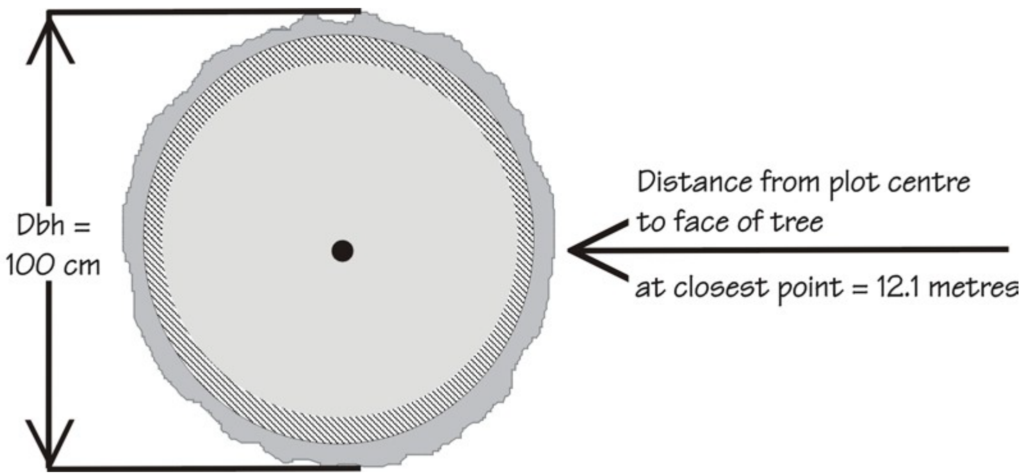


Figure 4-5 Borderline Tree Measurements - Variable Plot

Example:

Borderline tree of 100 cm DBH, measured with a BAF 16 Prism (see Figure 7.1 Illustration of Basal Area/Hectare.)

PRF = $\dfrac{1}{2\sqrt{BAF}} = \dfrac{1}{2\sqrt{16}} = 0.125$

Plot radius of 100 cm tree = 0.125 x 100 = 12.50 m.

Distance to centre of tree = 12.10 m + $\left(\dfrac{100\text{cm}}{2} = 0.5\text{m}\right) = 12.60\text{ m}$.

The measured distance exceeds the plot radius of the tree, therefore the tree is out and not tallied. Record the measured horizontal distance on the tally card and run a single pencil line through the tree details if the tree is out.

This method will be used for check cruising:

(PRF minus 0.005) times DBH = the plot radius distance for the tree from plot centre to the face of the tree.

The following table shows plot radius factors for a selection of prism basal area factors:

Basal Area Factor	Plot Radius Factor		Basal Area Factor	Plot Radius Factor	
	Tree Center	Tree Face		Tree Center	Tree Face
2	0.3536	0.3486	13	0.1387	0.1337
3	0.2887	0.2837	14	0.1336	0.1286
4	0.2500	0.2450	15	0.1291	0.1241
5	0.2236	0.2186	16	0.1250	0.1200
6	0.2041	0.1991	18	0.1179	0.1129
6.25	0.2000	0.1950	20	0.1118	0.1068
7	0.1890	0.1840	20.25	0.1111	0.1061
8	0.1768	0.1718	24	0.1021	0.0971
9	0.1667	0.1617	25	0.1000	0.0950
10	0.1581	0.1531	30.25	0.0909	0.0859
11	0.1508	0.1458	32	0.0884	0.0834
12	0.1443	0.1393	64	0.0625	0.0575

Leaning or "Down" Trees

Leaning and down trees must be measured from the centre of the tree at breast height to the plot centre in order to determine whether a tree is “in” or “out”. When a tree is laying on the ground, the measurement is made from the centre of the top side of the tree at breast height to the plot centre.

Hidden Trees

If a tree cannot be sighted easily it must be treated as a borderline tree, the tree’s plot radius calculated and the distance from the plot centre to the tree must be measured.

Walkthrough Method

The Walkthrough Method must be used for variable plot appraisal cruises. The walkthrough method is based on a description of the procedure from Dr. Iles book entitled “*A Sampler of Inventory Topics*”.

The following general procedures must be followed in the establishment of a walkthrough plot:

Do not tally trees that fall outside the cruise area.

Walkthrough plots must not be used near boundaries that are difficult to define in the field, such as unribboned timber type or harvest method boundaries. In those situations, it is appropriate to use a full sweep plot. Similarly, full sweep plots are appropriate where plots are located on a road centerline external to a cutblock and the boundary of the right of way is not riboned in the field.

All "in" or "out" tree distance measurements are recorded on a horizontal basis and are measured at 1.3 metres breast height.

Boundary ribbons must not be hung on any tree that is within the harvest area. Hang ribbons on trees and vegetation that will be retained after harvest is complete. Trees with boundary ribbons on the stem must not be included in the plot, regardless of whether stubbing is planned.

Regular Boundary – see Figure 4.6 Walkthrough Method - Regular Boundary.

Measure the bearing and distance from the plot centre to the centre of the "in" tree and then measure an equal distance beyond the centre of the tree on the same bearing from plot centre. Record the tree details twice if the measurement is outside the cruise area. Record separate tree numbers for each tree. Record the tree details once if the measurement is inside the cruise area.

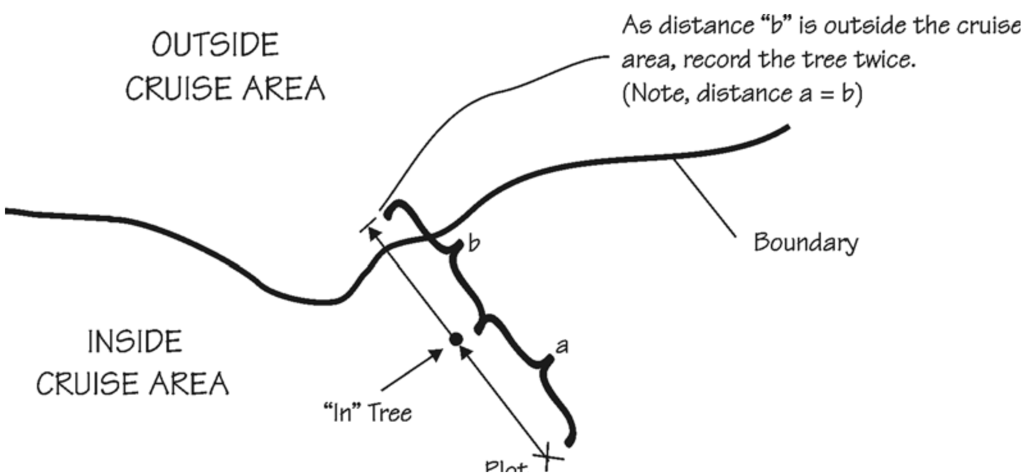


Figure 4-6 Walkthrough Method - Regular Boundary

Use the walkthrough method at all flagged and traversed harvest boundaries, non-forest type boundaries identified on the cruise plan and road right of way centrelines (as specified later in this section).

Irregular Boundary – see Figure 4.7 Walkthrough Method - Irregular Boundary.

If the point bearing and distance places the point back inside the cruise area then record the tree once.

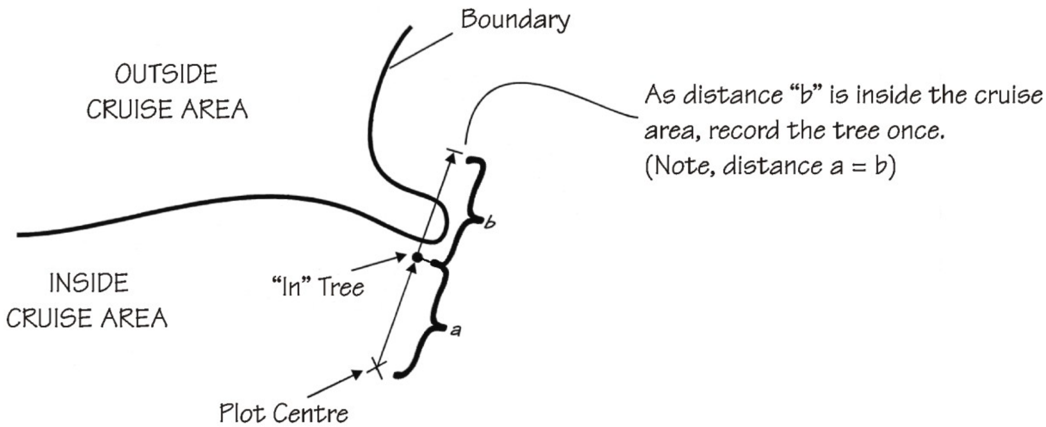


Figure 4-7 Walkthrough Method - Irregular Boundary

Unmarked Boundary – see Figure 4.8 Walkthrough Method - Unflagged and Harvested Rights of Way.

When an unmarked harvest boundary is encountered (e.g. a cleared road right of way, NP patch identified on cruise plan), the cutblock edge for walkthrough purposes is determined by projecting a line between the outer most face of the merchantable trees on the edge of the opening and parallel to the mapped boundary line. The orientation of the mapped boundary should be similar to the interpreted boundary on the ground.

If a non-harvested road right of way (ROW) forms the external cutblock boundary and the road ROW is to be harvested under road permit but is not marked in the field, the road centreline will be used as the cutblock boundary. Removal of road ROW area under the road permit will remove area from the cutting permit, but the sampled cruise plots will be included in the cruise compilation for the cutting permit.

If a road centreline is used as a boundary rather than the correct cutblock boundary, there will be a small bias involved with sampling area between the cutblock boundary and road centreline. This small bias is acceptable.

If the road ROW is to be harvested under cutting permit or the licensee is not sure under what tenure the timber will be removed, the cutblock harvest area and cruised area must include the full ROW boundaries (both sides of the centreline).

If the type of tenure for the road area is changed after cruising, it will be considered a change to the cruise plan and assessed accordingly.

Please refer to Figure 4.8 Walkthrough Method - Unflagged and Harvested Rights of Way. for examples of how to apply the walkthrough method to unflagged and harvested rights of ways.

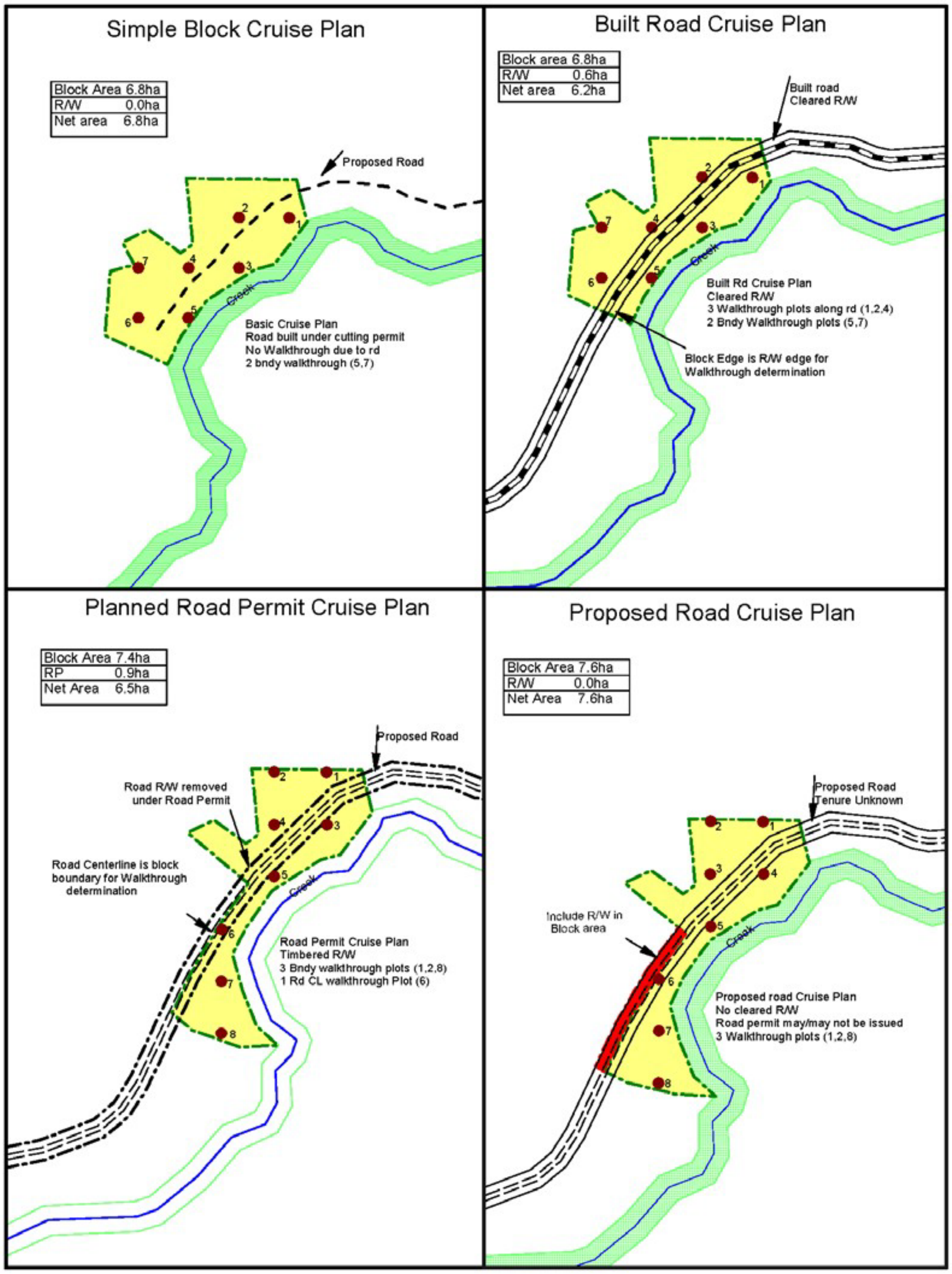


Figure 4-8 Walkthrough Method - Unflagged and Harvested Rights of Way

4.3.1.16. Positions 37 to 39 DBH Limit

The minimum DBH to which the trees on the main plot are measured to meet the timber merchantability specifications for appraisal purposes.

The timber merchantability specifications for coast cruises are dependent upon the maturity level of the cutblock. See Section 5.4.3.

Coast Cruises

Immature - code 12.0 cm (less than 121 years old for coniferous, less than 41 years old for deciduous).

Mature - code 17.5 cm (greater than 120 years old for coniferous, greater than 40 years old for deciduous).

Interior Cruises

PL - code 12.5 cm.

All other species - code 17.5 cm.

> The Map Area Statement (MAS) determines the compilation level of the cruise (see Section 5.4.3). Measured trees below this minimum can be tallied but, based on diameter, will be ignored in the compilation. For count plots the minimum DBH tallied must be the same as the DBH entered on the MAS (See Section 5.2.7). DBH must be recorded for count plot trees where timber merchantability specifications may indicate a different DBH limit level from the field tally level.

Marking Trees

A paint line or tag must be displayed on the tree at the point of DBH measurement, with the numbers facing the plot centre, to facilitate checking. Borderline "in" trees must be numbered; "out" trees will be labelled with an "X". Trees are to be marked the same in both count and measure plots. Live useless and dead useless stems are not tallied in count plots.

4.3.1.17. Positions 40 to 52 Sub-Plot Sizes

In stands with a high density of stems in the smaller diameter classes, a sub-plot may be established for the smaller diameter classes. The same sub-plot size should be maintained throughout the timber type. The sub-plot should always be smaller than the main plot. Sub- plots are not generally used for appraisal cruising.

4.3.1.18. Positions 40 to 43 Hectares (Fixed Plot)

If smaller plot areas are required, the following are acceptable:

Hectar	Radius (m)
0.005	3.99
0.008	5.05
0.010	5.64
0.020	7.98

4.3.1.19. Positions 44 to 48 Basal Area Factor (BAF) Variable Plots

See description as per the Main Plot entries in Positions 31 to 35 (see section 4.3.1.14).

4.3.1.20. Position 49 Prism Sweep

See description under the Main Plot entries in position 36 (see section 4.3.1.15).

4.3.1.21. Positions 50 to 52

The minimum DBH to which trees on the subplot are measured.

4.3.1.22. Positions 53 to 54 Harvesting Method (Optional)

The harvesting method that will be used:

SL	=	heli selection – land drop	Coast
SW	=	heli selection – water drop	Coast
FL	=	heli single standing stem – land drop	Coast
FW	=	heli single standing stem – water drop	Coast
HW	=	helicopter clearcut - water	Coast
HL	=	helicopter clear-cut - land	Coast
HC	=	helicopter clear-cut	Interior

HS	=	helicopter selective	Interior
CC	=	cable clear-cut	Both
CS	=	cable selective	Both
LC	=	sky line clear-cut	Both
LS	=	sky line selective	Both
HO	=	horse	Interior
SC	=	ground system-clear-cut	Both
SS	=	ground system - selective	Both
SP	=	specified operation	Interior

4.3.1.23. Positions 55 to 57 Slope Percent

Record the most severe slope measurement in any direction to a point 15 m slope distance from the plot centre and within the cutblock. Plot slope must be recorded in both measure and count plots. If the slope is not recorded, it will be compiled as zero slope.

The plot slope reading must be along a line that is entirely within the harvesting method area that contains the plot centre (if the harvesting method boundary is known when the field work is performed).

Plot slope data is required for all road rights-of-way areas contained within a cutting authority. Plot slope is not recorded on road cuts or fills.

It is recommended that a ribbon is hung at the point where the plot slope was taken to assist with check cruises.

4.3.1.24. Positions 58 to 61 Year/Month

Record the year and month that the fieldwork was performed. The date must be recorded by the cruiser and entered into the cruise compilation.

4.3.2. Card Type 2

4.3.2.1. Position 1 Tree Details

This card contains the individual tree details.

4.3.2.2. Positions 25 to 26 Tree Number

Number trees consecutively from number 1 (do not duplicate numbers on any plot). Plot trees selected as sample trees maintain the same number in Sample Tree Details (Card Type 3).

4.3.2.3. Positions 27 to 29 Total Height

All heights entered here will be used in the calculation of individual tree volume. Heights must be recorded to the nearest 0.1 m. Heights of intact trees must be measured to the highest point of the leader as presented when the tree is standing. It is wrong to increase the height to account for drooping leaders (i.e. in western hemlock).

The "One Hundred Percent Method" is the mandatory method of tree height determination. All tree heights must be either measured or estimated. The use of a clinometer or electronic measuring device is recommended for tree height measurements and estimates. A lower top reading generally indicates a more precise measurement, so readings should be kept below 100 percent.

The height curve method is restricted to use in stump cruises or where severe damage due to wind shear or freezing has occurred (see Chapter 6 Stump Cruising). Severely damaged stands must be identified on the cruise plan and submitted to the Area Director for sampling alternatives.

Project the original height of trees with broken tops (as per Figure 4.9 Example of Where to Measure the Height on Trees with a Broken Top or Fork/Crook. below).

4.3.2.3.1. Trees with Broken Tops

If a tree has a broken top, the height of the tree must be estimated. There are three methods used to estimate the height of a tree with a broken top:

1. If the broken top segments are available on the ground, add the length of these segments to the standing portion of the stem.
2. Project the original height of the tree with a broken top (see Figure 4.9 Example of Where to Measure the Height on Trees with a Broken Top or Fork/Crook.). Use adjacent trees and comparable tree heights to estimate heights of trees with broken tops. Trees that are acceptable for comparison are:
    a. Same/ similar species,
    b. same 10 cm diameter class (10-20, 21-30, 31-40, etc.),
    c. live top,
    d. if no live tops, then an intact dead top.
3. Where no suitable trees exist within the stand to base an estimate on, project the height of the tree based on the species' natural taper.

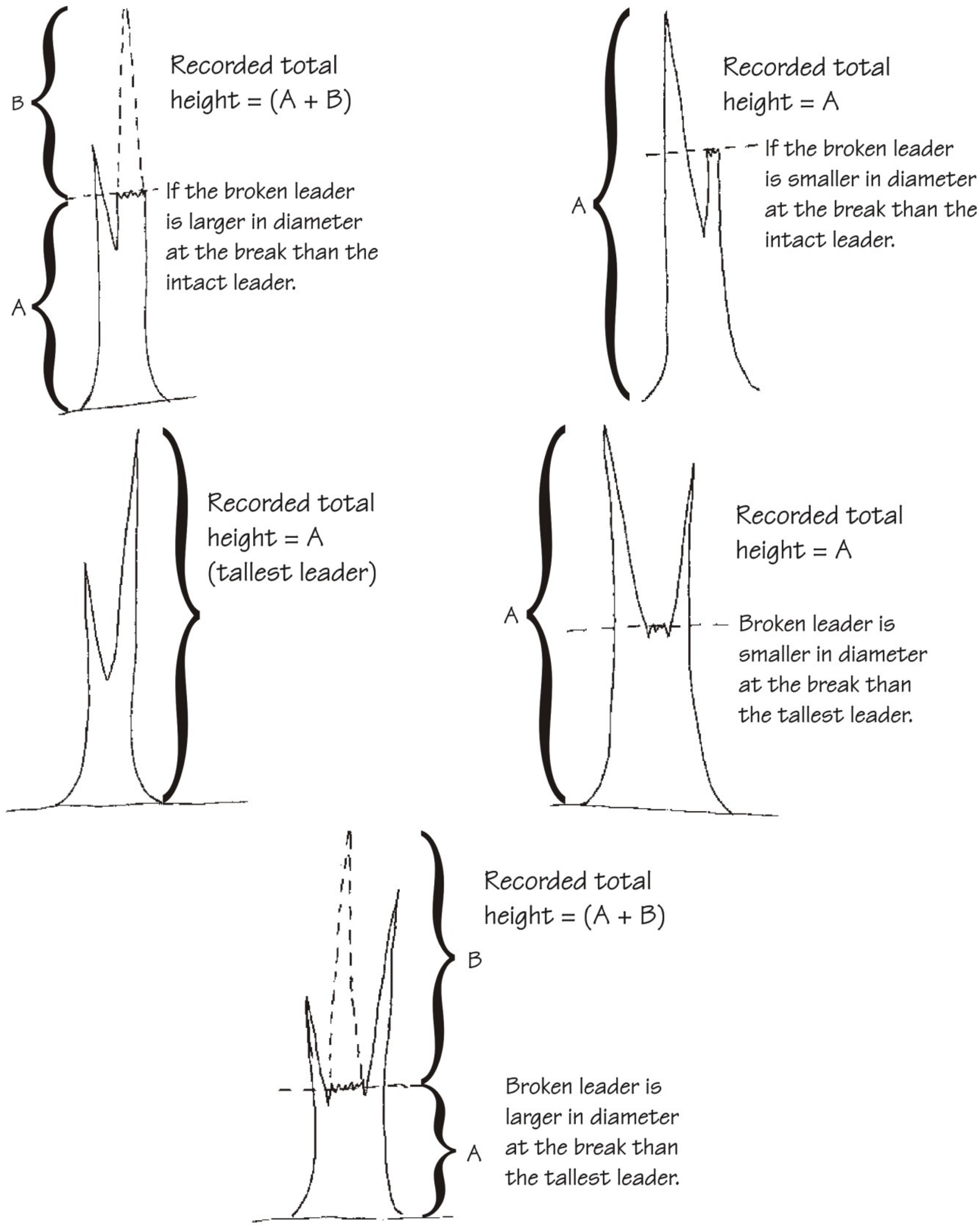


Figure 4-9 Example of Where to Measure the Height on Trees with a Broken Top or Fork/Crook

4.3.2.3.2. Leaning Trees

The following method should be used for measuring the tree length of trees leaning more than ten degrees (B) from the vertical (see Figure 4.10 Measuring Height of Leaning Trees.). The angle A must be 90 degrees.

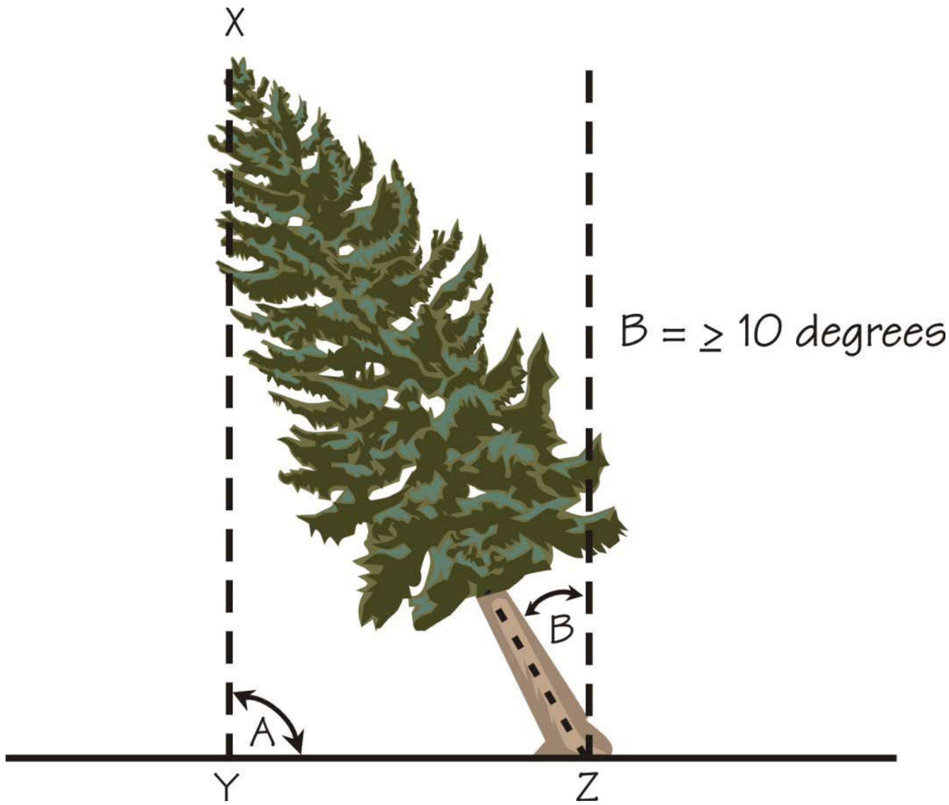


Figure 4-10 Measuring Height of Leaning Trees

1. Calculate the vertical distance from the ground (Y) to the top of the tree (X) using a clinometer or electronic measuring device from a point perpendicular to the lean of the tree (i.e., A = 90 degrees).
2. Measure the horizontal distance from the centre of the tree (Z) to a point directly under the top of the leaning tree (Y).
3. Calculate the tree length by using the Pythagorean formula for right triangles:

$$Tree\ Length(m) = \sqrt{\left(length\,XY_{(m)}\right)^2 + \left(length\,YZ_{(m)}\right)^2}$$

The degree of lean will not be a check cruising item, however, tree length will be considered the true tree height.

4.3.2.3.3. Deciduous Tree Heights

In order to obtain a reasonable height for deciduous trees, ensure the height is measured from an adequate distance from the tree when measuring the highest point. It is recommended that the angle of measurement is less than 100 percent. This will assist in distinguishing the highest point on the tree from lower branching or forks.

4.3.2.4. Positions 30 to 31 Species

All living and dead, standing and down trees which are listed in this section (except dead and down tree class 4 that do not meet the minimum CGNF standard on the Coast) and which meet or exceed the timber merchantability specifications must be recorded when present in a plot.

Enter the appropriate commercial species symbol. Genus symbol letters must be "Capitalized" or upper case. Species symbols should be upper case also (entry is left oriented).

Genus Symbols - These symbols must always be entered for the proper implementation of the volume equations and loss factors.

Species Symbols:

1. The specific symbol for broadleaf maple (Mb), the pines (Pl, Pw, Pa, Py), aspen (At) and cottonwood (Ac) must be entered for the proper implementation of the loss factors and volume equations.
2. The species symbols for other species such as the spruces, hemlock and balsams (Abies sp.) should only be used when positive identification can be made in the field and the appraisal requires it. Species specific symbols for Abies amabilis, grandis and lasciocarpa must be entered for Interior cruises. Coastal Call Grade Net Factor cruises must use species specific symbols for Tsuga mertensiana (Hm), if known. Tsuga heterophylla can use H or Hw.

4.3.2.4.1. Commercial Tree Species Names and Symbols

Common Name of Genus/Species	Scientific Name of Genus/Species	Genus Symbol*	Species Symbol*
Alder	*Alnus*	**D**	
Red Alder	*A. rubra*		Dr
Balsam (*Abies* sp.)	*Abies*	**B**	
Alpine fir	*A. lasiocarpa*		Bl
Amabilis fir	*A. amabilis*		Ba
Grand fir	*A. grandis*		Bg
Birch	*Betula*	**E**	

Common Name of Genus/Species	Scientific Name of Genus/Species	Genus Symbol*	Species Symbol*
Common paper birch	*B. papyrifera*		Ep
Alaska paper birch	*B. neoalaskana*		En
Cedar	*Thuja*	**C**	
Western red cedar	*T. plicata*		Cw
Cypress	*Chamaecyparis*	**Y**	
Yellow cedar	*C. nootkataensis*		Yc
Douglas-fir	*Pseudotsuga*	**F**	
Douglas-fir	*P. menziesii*		Fd
Hemlock	*Tsuga*	**H**	
Mountain hemlock	*T. mertensiana*	CGNF cruises	**Hm**
Western hemlock	*T. heterophylla*	CGNF cruises	**Hw or H**
Larch	*Larix*	**L**	
Alpine larch	*L. lyallii*		Li
Tamarack	*L. laricina*		Lt
Western larch	*L. occidentalis*		Lo
Maple	*Acer*	M	
Broadleaved maple	*A. macrophyllum*		**Mb**
Pine	*Pinus*	P	
Lodgepole pine	*P. contorta*		**Pl**
Western white pine	*P. monticola*		**Pw**
Whitebark pine	*P. albicaulis*		**Pa**
Yellow pine	*P. ponderosa*		**Py**
Poplar	*Populus*	A	
Aspen	*P. tremuloides*		**At**
Balsam poplar	*P. balsamifera*		**Ac**
	sub. sp. Balsamifera		
Black cottonwood	*P. balsamifera*		**Ac**
	sub. sp. trichocarpa		
Spruce	*Picea*	**S**	
Black spruce	*P. mariana*		Sb
Engelmann spruce	*P. engelmannii*		Se
Sitka spruce	*P. sitchensis*		Ss
White spruce	*P. glauca*		Sw
Yew	*Taxus*	**T**	Optional
Western Yew	*T. brevifolia*		

* The bolded symbols are required for operational cruises. *Species* symbols which are not bolded may also be used if required. The symbol(s) chosen must be used consistently in all plots. The genus symbols M (maple), P (pine) and A (poplar) cannot be used alone and require the species symbol as well. The genus and species symbol is required for Mountain hemlock in Call Grade Net Factor cruises. Yew is not required for appraisal cruising.

4.3.2.5. Positions 32 to 35 DBH

Enter the diameter at breast height to the nearest 0.1 centimetre for each tree equal to or above the timber merchantability specifications. Whole numbers are recorded as decimals (e.g., 12.0 not 12).

4.3.2.5.1. High Side

High side is defined as the highest point of the ground around the base of the tree. Kick aside any loose litter and debris. If obstacles obstruct the base of the tree at the high side, measure breast height (1.3 m) from the high side of the ground and *not* from the top of the obstacle.

Road fill material is considered an obstacle.

If high side is lower than the point of germination (POG), then measure breast height (1.3 m) starting from the POG.

If the lower portion of the stem has sweep, pistol grip or the tree is on the ground, then measure breast height (1.3 m) along the curve and parallel to the centre line of the tree.

4.3.2.5.2. Horizontal Distance from Plot Centre

This is the measured horizontal distance from the plot centre to the face of standing trees at breast height (1.3 m) plus half the DBH. Leaning and down trees must be measured from the centre of the tree at breast height to the plot centre (see Section 4.2.1.15). When a tree is laying on the ground, the measurement is made from the centre of the top side of the tree at breast height to the plot centre.

4.3.2.5.3. Diameter of trees forked at or near DBH

A tree that is forked below breast height will be measured as two trees. If the diameter tape cannot be wrapped around the circumference of the tree at breast height because the forks are too close together, then measure the diameter at the nearest opportunity above the fork and adjust for DBH accordingly. Note on the tally card that the diameter has been estimated. Refer to Figure 4.11 Two Trees or One.

A tree that is forked at or above DBH will be measured as one tree. If there is swelling at DBH due to the fork, measure the tree at the nearest available location and estimate the diameter at DBH. Note on the tally card that the diameter has been estimated. Refer to Figure 4.11 Two Trees or One.

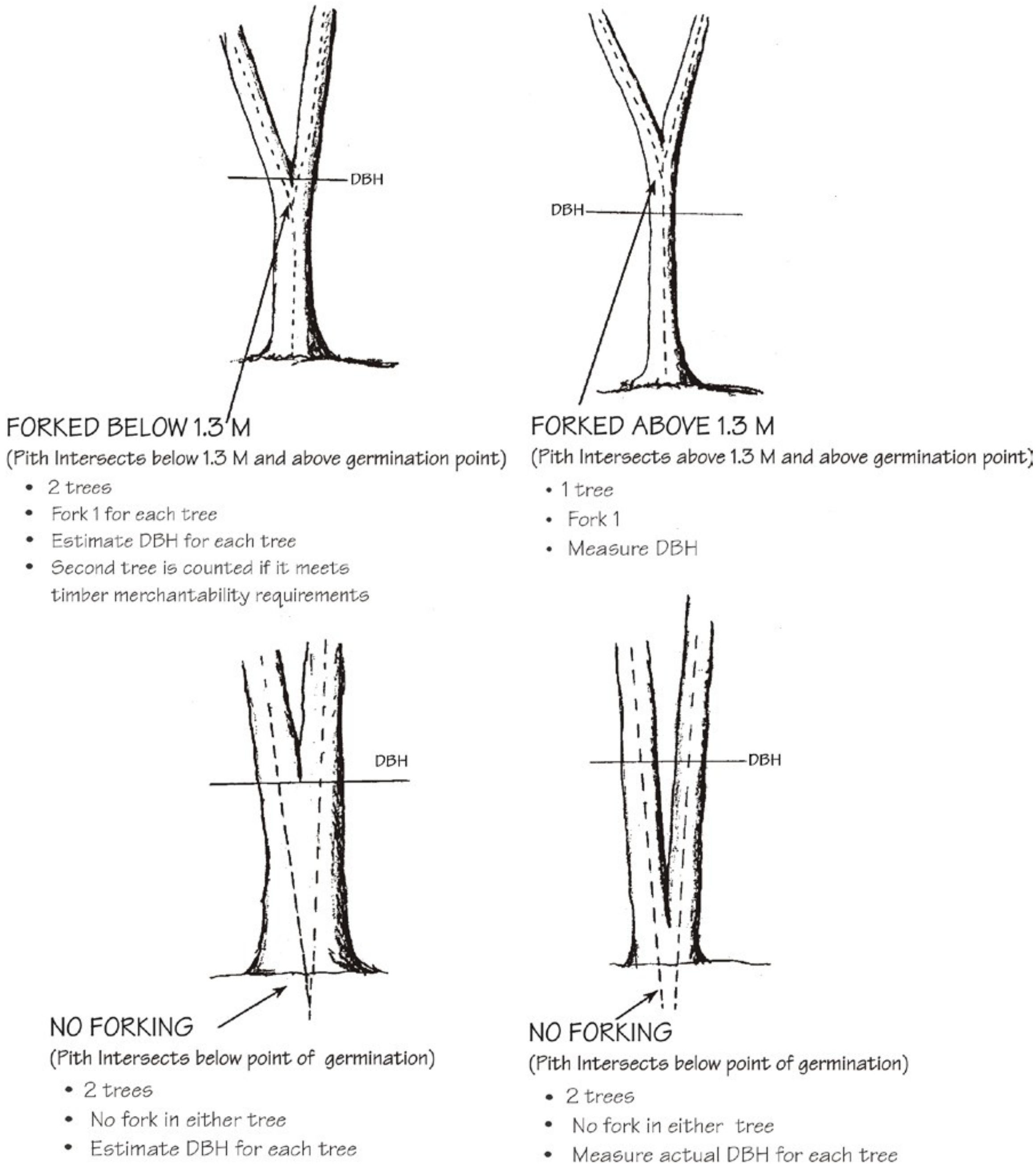


Figure 4-11 Two Trees or One

Also see Pathological Classification of Trees (Appendix 17) for details regarding forks and crooks.

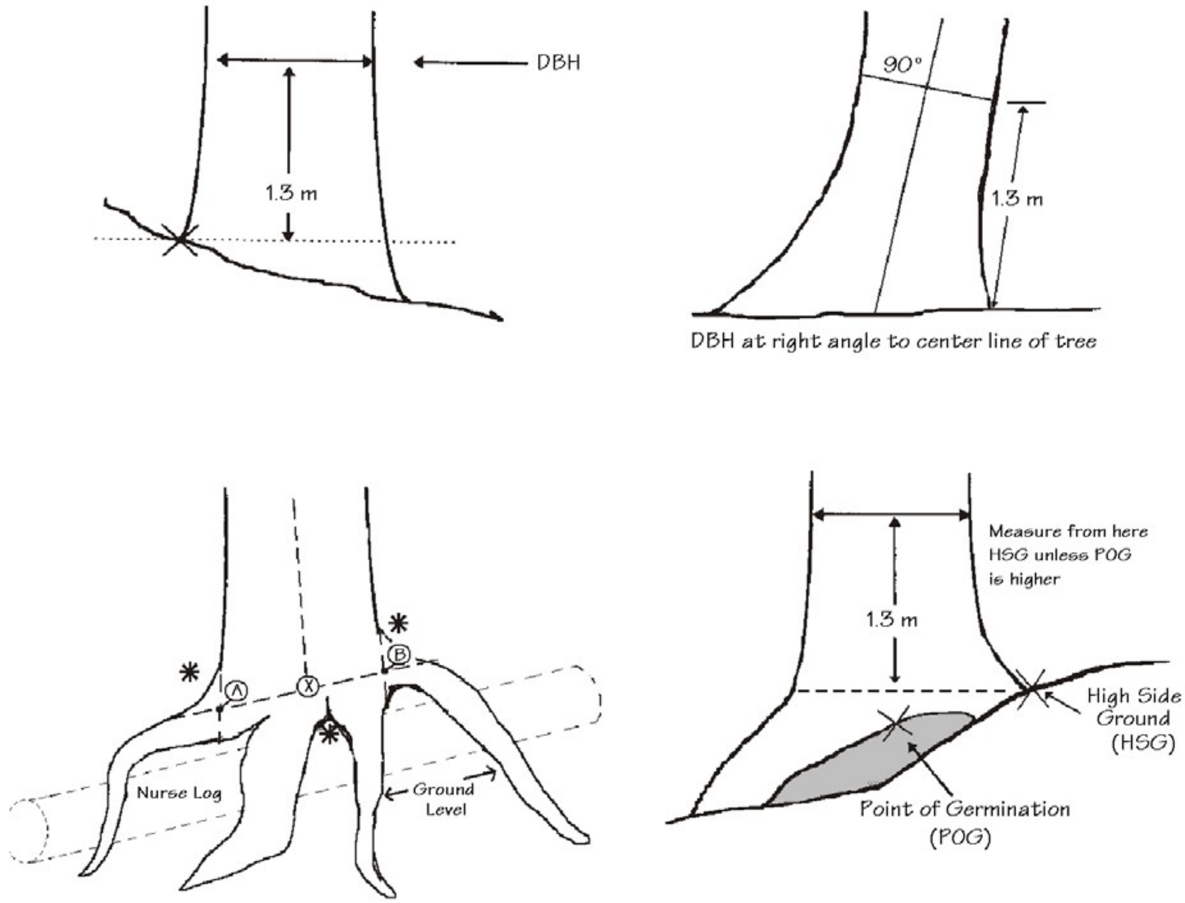
If there are burls, galls or swelling obstructing a normal taper measurement for a tree at breast height, then measure above and below the abnormalities and estimate the diameter from the two measurements. Note on the tally card that the diameter has been estimated.

Do not make allowances for missing bark at breast height.

Breast height must still be established at 1.3 m from the high side ground when there is snow on the ground.

Trees that have been cut into pieces or that have had pieces removed will be measured if 50 percent or more of the tree's gross volume is still on site (or the remaining piece meets the minimum standard for Coastal CGNF). Measure DBH 1.0 metre from the butt end of the log. The tree height will be measured or estimated from the butt end of the log to the top plus 0.3 metres to account for a stump height.

The plot radius for logs will be measured to their DBH using the same method as for uprooted trees (see Section 4.2.1.15).



High side location when POG clearly above ground level, nurse logs/stumps, hummucky/rocky ground, erosion and upturned stumps.

(X) POG defined by the midpoint of the low root centre and a transect line to the midpoint of the highroot centre.

(A) to (B) The POG is the point where this transect line intersects the pith.

✱ Indicates incorrect locations for highside and POG on this tree.

Figure 4-12 Breast height in Relation to High Side

4.3.2.6. Position 36 Tree Class

The tree class must be consistent with the age in 10's reported for the plot.

All living and dead trees must be given the appropriate tree class code numbered from 1 to 9. It is essential that every tree be viewed from all sides to assess the classification.

> Refer to Pathological Classification of Trees (Appendix 17) for diagrams and further information about pathological indicators.

Use the following age in 10s and tree class combinations:

Interior	Enter 11 for the Age in 10's on the cruise tally card type 9. The tree classes will be coded as follows: Older immature – tree class 1 Older immature -Suspect – tree class 2 Older Imm. Dead Potential – tree class 3 Dead useless – tree class 4 *Mature – tree class 5 Live Useless – tree class 6 *Mature-Dead Potential – tree class 7 Younger Immature – tree class 8 Younger Imm. Dead Potential – tree class 9 * except FIZ K and L Aspen and Cottonwood - see Forest Inventory Zone Series Numbers (Appendix 5: Table 7.5.6)
Coast	Use the same coding as above for younger and older immature stands if there are not any trees older than 120 years in a plot. Refer to Section 4.2.1.8 and Appendix 5 for details regarding the age in 10s and tree class reporting.

Tree Class 1

These are living trees with none of the eight external pathological indicators.

Tree Class 2

These are living trees containing one or more of the following eight external pathological indicators of decay:

Conks, blind conks, scars, fork and/or pronounced crook, frost crack, mistletoe (trunk swelling), rotten branches, dead or broken top.

All pathological indicators must be recorded for each tree in the tree third where they occur to properly assign the appropriate loss factor. Tree classification will be made on the basis of the above signs of decay only. See 'Metric Diameter Class Decay, Waste and Breakage Factors' for the specifications of Risk Groups and Risk Group Ratings by Pathological Indicators (Appendix 20: Table 7.20.1) for risk group assignments by pathological indicators.

Tree Class 3 (Dead Potential; Older Immature Dead Potential in Interior)

Tree Class 3 are dead standing or down timber which is estimated to contain at least 50 percent of its original gross volume in soundwood (firmwood) content. All dead potential standing and down trees must be tallied.

Trees with green and/or red needles are considered live trees and will be classified based on pathological indicators. Standing or windfall trees with grey or no needles will be considered dead trees; except for insect attacked trees where a tree with less than 5.0% red needles will be considered dead.

For net merchantable volume compilation, dead potential stems will have the highest Risk Group deduction for the species, except Lodgepole Pine which will use Risk Group 2 Loss Factors.

Refer to Sound Wood Factors for Saprot (Appendix 7: Table 7.7.1) and the Ten Metre Log Table (Appendix 7: Table 7.7.2) to assist in the determination of 50.0 percent soundwood content.

Decay should be determined at various intervals on the tree, preferably at the mid-point of each third of down trees.

1. Dead Standing

Decay percent is difficult to assess on standing trees. "Sounding" can be helpful, but must only be done in safe conditions.

2. Dead Down

Good judgement must be exercised in applying tree classes to down material. Since some species are more resistant to decay than others, decisions will be influenced by the tree species involved and local climatic conditions. C, Cy, F, S, P and L are the most decay resistant species and are less likely to exhibit extensive sloughing bark and conks. Other species exhibiting these characteristics are more likely to be "Dead Useless". However, it should be remembered that in drier areas, dead and down Pl and Py may be entirely bark-free yet still be relatively sound.

Pathology is required on all dead potential trees on the coast and dead potential hemlock, white pine and balsam (*Abies* sp.) in the interior for use in the log grade algorithms.

The only exception to the green and/or red needle rule is for *Abies lasciocarpa* in the Interior, where the following guidelines will apply:

Indications – One or More Must be Present

1. Sap-rot and/or,
2. Deep checking and/or,
3. Loose or shedding bark.

Contraindications – None can be Present for Tree Classes 3, 7 and 9 Trees

1. Live Cambium.
2. Green needles.
3. Pitching that is on the end of a log or on exposed wood and not under the bark.
4. Live bark beetles are present.

If there is any doubt after applying the indicators and contraindicators, then the tree will be classified as green.

Tree Class 4 (Dead Useless)

Dead standing trees that have less than 50.0 percent of their original gross volume in soundwood (firmwood) content or otherwise fail to meet the criteria of a dead potential tree as described above as Tree Class 3 will be classified as "dead useless" trees.

In the Interior, only standing Tree Class 4 trees greater than 3 metres in height are tallied. In the Interior, the actual observed height and the estimated DBH must be recorded.

On the Coast, only Tree Class 4 trees that contain a CGNF minimum 8 m standard U grade log are tallied. On the Coast, the original tree height and DBH are required for CGNF measurements and must be recorded.

Tree Class 4 trees that are not self-supporting are not to be tallied as they are considered down trees.

Tree Class 5 (Mature)

Tree Class 5 trees are living mature trees which are considered:

a. A coniferous tree greater than 120 years old in a stand with age in 10's of 12 or less.

b. A deciduous tree greater than 40 years old in a stand with age in 10's of 4 or less.

Two exceptions exist:

a. Aspen and Cottonwood in FIZ K and L where tree classes 5 or 7 will be used for trees 141 years and older,

b. Coastal cruises where there are trees between 121 and 140 years old, then tree classes 5 and 7 will be used for trees 141 years and older.

Tree Class 6 (Live Useless)

Live useless trees are trees that exhibit extreme decay and are generally described as broken stems with a hollow or rotten centre and have only one or two live limbs. They are combined with Tree Class 4 for the compilation of percent snags. This tree class must not be confused with a Tree Class 2 tree with a high proportion of rot due to conk.

Cedar and Cypress	The tree must be almost completely rotten or hollow with just a thin shell of sound wood remaining. The low proportion of sound wood must be obvious (i.e., rotten or hollow knots, and large open scar).
Hemlock, Balsam, Fir, Pine & Spruce	The tree must be broken off in the lower or middle thirds (i.e., at least the top third must be missing) with only a few live branches and almost completely rotten or hollow.

Tree Class 7 (Dead Potential; Mature Dead Potential in Interior)

Tree class 7 dead potential trees are mature and contain at least 50.0% of the tree's original volume. Tree Class 7 shares the characteristics of both the immature dead potential (Tree Class 3) and mature tree classes (Tree Class 5). Therefore, the guidelines for Tree Class 3 and Tree

Class 5 apply.

Dead potential Lodgepole pine will use Risk Group 2 loss factors unless the tree has conk or blind conk. If a dead potential Lodgepole pine has conk or blind conk, it will use the highest risk group.

Tree Class 8 (Younger Immature)

Tree Class 8 trees are younger immature living trees which are:

a. Coniferous trees, other than Lodgepole pine, equal to or less than 80 years of age,

b. Lodgepole pine trees equal to or less than 60 years of age, or

c. Deciduous trees equal to or less than 20 years of age.

Two exceptions exist:

a. Aspen and Cottonwood in FIZ K and L where tree classes 8 will be used for trees less than 81 years of age, or

b. Coastal cruises where the age in 10's is 13 or 14, tree class 8 will be used for trees equal to or less than 120 years of age.

Tree Class 9 (Dead Potential; Younger Immature Dead Potential in Interior)

Tree class 9 dead potential trees are immature and contain at least 50.0% of the tree's original volume. Tree Class 9 shares the characteristics of both the immature dead potential (Tree Class 3) and younger immature tree classes (Tree Class 8). Therefore, the guidelines for Tree Class 3 and Tree Class 8 apply.

Ages

In over mature stands, the establishment of age is not critical except for interior cedar over 141 years as it requires a different top diameter for compilation.

The age correction to breast height is found in the Site Index Tables for British Columbia – All Species in Appendix 21.

Tree class 3, 7 and 9 trees – To assign age to a dead tree, use the age of a similar species/size, and consider visual characteristics of the tree.

Age of living trees is determined by a ring count from an increment borer core, taken at diameter breast height (DBH). The pith must be included in the core to properly count the age of the tree. In cases where the pith is not contained in the core, and is missed by an estimated three years or more, the tree must be re-bored.

Sufficient trees must be bored for age to ensure the correct maturity classes. The number of trees that need to be drilled will be dependent upon the maturity profile in each plot.

Refer to the age class code from the table below to determine the corresponding age range.

Code Age	Age Class Limits	Allowable Tree Classes
1	1 to 20 years	8, 9
2	21 to 40 years	
3	41 to 60 years	
4	61 to 80 years	1, 2, 3
5	81 to 100 years	
6	101 to 120 years	
7	121 to 140 years	5, 7
8	141 to 160 years	
9	250 + years	

Note: Tree Classes 4 and 6 are allowed for all age classes.

4.3.2.7. Positions 37 to 44 Pathological Remarks

Pathological indicators are recorded when observed on the bole or a merchantable secondary leader (see Section 7.4.2) of the tree. The exceptions are:

- *Phaeolus Schweinitzii*, which will occur on the ground near the base of the tree.
- Scars on root collars.

There are qualifications to many of the pathological indicators, such as age of scars, position of fork or crook, size of rotten branches, etc. (please refer to Pathological Classification of Trees - Appendix 17, for a detailed description of pathology).

Pathological Indicators located above 10 cm top diameter (inside bark) are not to be recorded.

Refer to the box entitled "Path Code by Tree Third". This indicates the numerical coding to be used in this section. The tree is schematically divided into thirds, with the bottom (BOT) cells representing the bottom third, the middle (MID) cells the middle third, and the top (TOP) cells the top third. The shading indicates in which third or thirds the defects occur based on the codes 1 through 7. If the defects occur in the bottom third only, "1" is entered in the defect column. If a defect occurs in both the middle and top thirds, "5" is entered; etc.

Path Code by Tree Third

	1	2	3	4	5	6	7
TOP							
MID							
BOT							

The column heads under "PATH REMARKS" are self-explanatory except for the last two: "Rotten Br." means "Rotten Branch"; "D. or B. Top" means "Dead or Broken Top". All the pathological indicators listed must be recorded in the third(s) where they occur.

Refer to the Risk Group Ratings by Pathological Indicators in (Appendix 20: Table 7.20.1) for pathological occurrence by species and forest inventory zones.

Examples:

1. A tree has conks on the middle and top thirds of the trunk and an open basal scar on the lower third. Under "Conk" enter "5" and under "Scar" enter "1".
2. A tree has a fork on the middle third, blind conks on the top third and a broken top. Under "Fork" enter "2", under "Blind Conk" enter "3" and under "D. or B. Top" enter "3".
3. A tree has a fork on the middle third, with a frost crack extending from the ground to the fork; one of the leaders of the fork is broken and the leader is not of merchantable size. Under "Fork or Crook" enter "2", under "Frost Crack" enter "4".

4.3.2.8. Positions 45 to 51 Quality Remarks (Mandatory on Coast, Optional in Interior)

The quality information will be collected on all age classes and will apply to all commercial living trees plus dead potential standing or down trees found on the plot and on the largest leader on a forked stem. This is in addition to the eight pathological indicators of decay which can also be considered as affecting the quality of products obtained from a given tree.

Codes are indicated in the "Quality Code" box on the back of the plot sheet.

Stem quality information forms the basis for a computerized grading system. They are recorded when observed 30 cm or more above the high side of the tree. This data collection is currently optional in the interior.

The quality information will be collected on all commercial living and dead potential trees (refer to Positions 45-51).

4.3.2.9. Position 45 Spiral Grain

Spiral grain is also known as "twist". The direction of the grain can best be seen in exposed wood such as the open scars in living trees or dead trees with sloughing bark. Spiralling bark fissures and frost cracks also provide useful evidence of spiral grain.

Spiral grain shall be estimated at the halfway point between stump height and 10.3 m and expressed as a percentage.

> For Loss Factor Cruises Only - Estimate the most severe spiral grain on the 1 m section at 5.3 m above the high-side. The offset from the vertical line in centimetres is the percent spiral grain per metre. Use the spiral at breast height as a guide for estimation.

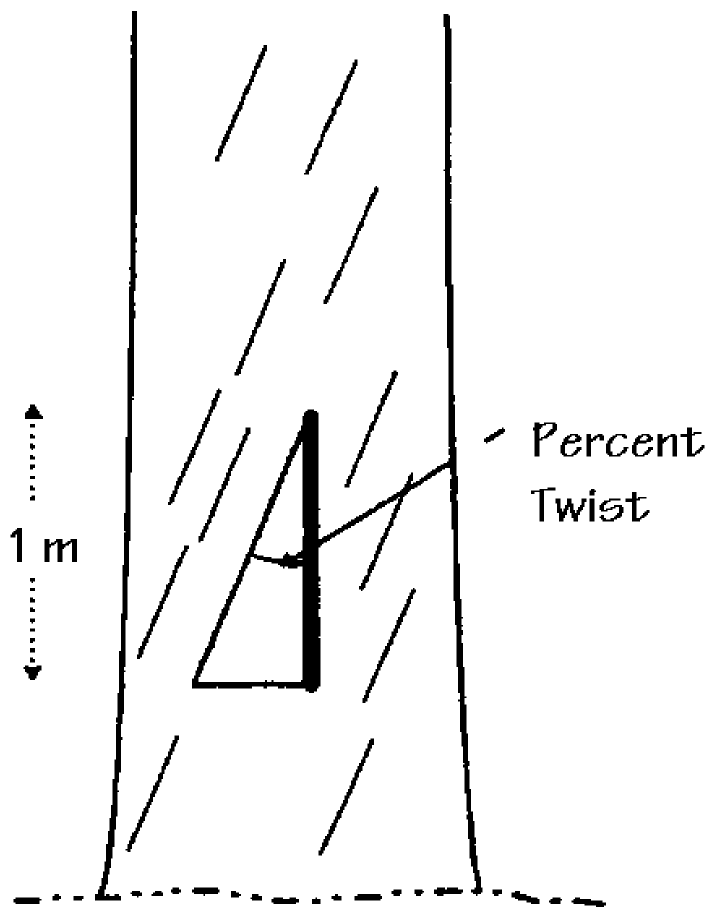


Figure 4-13 Determination of Percent Twist

Recording Code	% Displacement	Recording Code	% Displacement
0	0 - 5%	5	46 - 55%
1	6 - 15%	6	56 - 65%
2	16 - 25%	7	66 - 75%
3	26 - 35%	8	76 - 85%
4	36 - 45%	9	86 +

4.3.2.10. Position 46 Sweep

Currently not required.

4.3.2.11. Position 47 Lean Currently not required. Live Limb, Stub and Knots

These quality indicators are recorded in 5 m log lengths starting at the timber merchantability specification stump height (0.3 m). Live limb and stub are recorded as the log containing the required indicator. The knot indicators are recorded by dividing the log into quarters and recording the number of quarters containing knot indicators. Once the quarters have been determined, the quarters must remain the same in all 5 m logs of the tree.

4.3.2.12. Position 48 Live Limb (LL)

Enter the log number in which the log quality worsens, for example:

1. No knots to knots or knot indicators. However, if the bottom 5m is completely clear (no knots or knot indicators), LL must be at least 3.
2. Small knots to large knots.
3. Well spaced knots to excessive knots.

The knot changes above should align with established knot sizes and top diameters in the scaling manual. However, the live limb position is a quality observation in 5m log sections. It does not involve any grading rules or procedures (aside from observing log top diameter and the knot characteristics).

If knots have consistent size and frequency from the base to the top of the tree, live limb should be the 5m log where the diameter is 38cm inside bark. If that tree does not contain an 8m log with a 38cm top inside bark, live limb may be recorded as 1.

If frequent, large branches are present from the base of the tree (e.g. open grown, wolf tree, severe mistletoe), the live limb may be recorded as 1.

On deciduous trees, live limb is recorded as the 5 m log where natural forking starts.

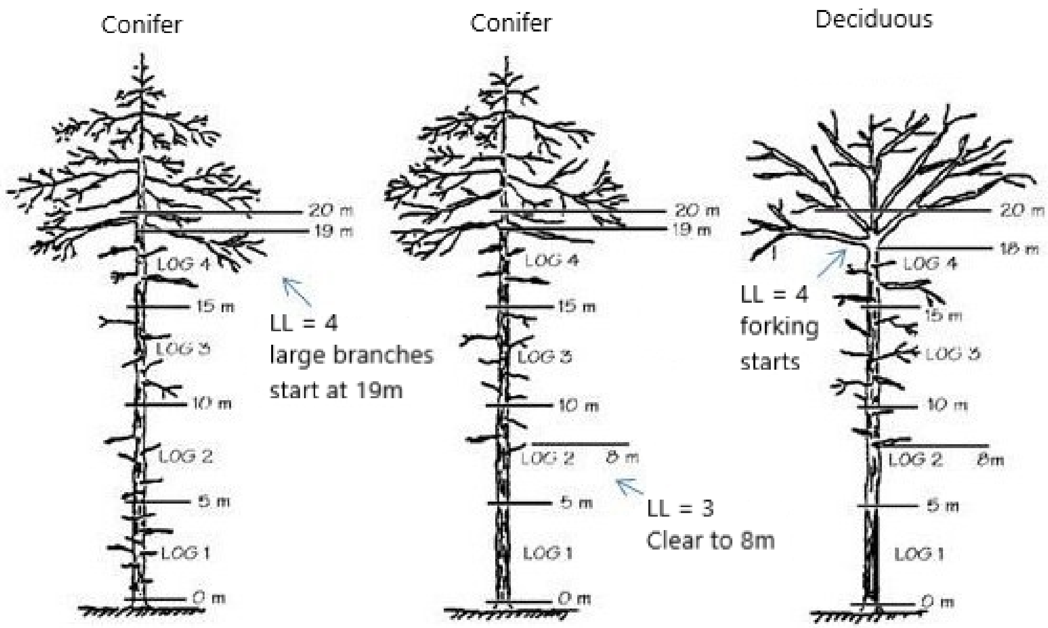


Figure 4-14 Example of Live Limb

4.3.2.13. Position 49 Log No. of 1st Stub

Enter the log number on which the first stub or first branch occurs, irrespective of diameter or length. This may occur on the same log as the base of the crown or at some point below.

Any stub and live or dead branch is considered when identifying the log number of the first stub (see the following section for discussion of epicormic branching). A stub is a protruding branch or remnant of a branch including wood fibre (bark alone is not a stub).

4.3.2.14. Positions 50 and 51 Knots, 1st 5 m and 2nd 5 m

The location of clear surface area in the first two 5 m logs indicates the potential grade of a log. The location of the four quarters on the second 5 m log must be the same as the location of the four quarters on the first 5 m log.

A clear quarter must be free of any open knot, knot indicator, branch stub, dead or living side branch, bunch knots or forks.

> Epicormic branches, suckers and candelabras are not classed as knots or stubs.

Forks are considered knots.

Record the number of clear quarters for the first log (0.3 - 5.3 m from the high side of ground) and for the second log (5.3 - 10.3 m) as follows:

Code	Remarks
0	No quarters with knots (four clear quarters)
1	Knots in one quarter (three clear quarters)
2	Knots in two quarters
3	Knots in three quarters
4	Knots in four quarters
5	One to three knots, branches or stubs estimated to be greater than 10 cm dib, irrespective of the number of clear quarters.
6	Four or more knots, branches or stubs greater than 10 cm dib, irrespective of the number of clear quarters.

Epicormic branches are small sprout-type limbs that originate from dormant or adventitious buds. According to current literature, this type of branching is not generally prevalent on conifers except on the true fir (Abies) species. Since these branches do not originate from the pith and if present, live for only a short period (4-6 years), they have no effect on the quality of the wood.

4.3.2.15. Positions 52 to 56

These columns are not in use.

4.3.2.16. Position 59 Selective Cutting

L	leave tree
Blank or C	cut tree

4.3.2.17. Position 60 Miscellaneous

Root Rot	Description
J = light	Tree within a disease centre or within 10 m of a tree or stump that is symptomatic or killed by root disease.
K = moderate	Tree with root disease crown symptoms.
L= heavy	Tree with root disease confirmed by stain, decay, fruiting bodies or basal resinous.

Interior Dead Potential White Pine Log Grade Algorithm

Sap rot and weather checks can be collected in the root rot column, column 60. The sap rot and weather check codes are as follows:

a. record by tree third as per pathological indicator location codes 1 to 7,

b. record codes 1 to 7 for tree thirds that will not be suitable to produce at least 50 percent lumber.

Refer to the Interior Dead Potential White Pine Log Grade Algorithm (Appendix 15) for a more detailed description of the algorithm.

The hemlock and dead white pine grade algorithms are used for interior appraisals. The hemlock algorithm is found in Appendix 15 (Interior Hemlock Algorithm Flow Chart) and the white pine algorithm is found in Appendix 15 (Dead Potential White Pine Log Grade Algorithm). Sap rot and suncheck codes are required for the dead potential white pine algorithm. The procedure is outlined in Appendix 15 (Interior Lumber Recovery Factor (LRF) Algorithms).

4.3.2.18. Positions 61 to 63 Damage Codes

Damage codes are to be recorded as they appear at the time of the cruise with no attempt to predict the future condition of the trees.

The codes are for appraisal reporting purposes and for net volume adjustment purposes in the compilation.

All damage types will be compiled for net volume. Where multiple damage is recorded for a single tree, the most severe damage type will be compiled for that tree.

All damage types will be reported in the cruise as a percentage of the cruise net volume. See the Damaged Stands (Appendix 6) for further information.

4.3.2.19. Positions 64 to 90 Used in Coastal CGNF Cruises.

Reverse Side of Cruise Tally Sheet (FS 205 HVA)

Date

Record the year, month and day that the field work was completed. .

Signatures

The data collected by timber cruisers is used to determine stumpage rates and in the case of cruise based billing, the volume for billing.

Refer to Section 3.8(5) for details on the signing of cruise cards.

Miscellaneous

Ecosystem	Record the Biogeoclimatic subzone and variant if known.
Snow Depth	Note average depth of snow in centimetres at the time of cruise for the cruise plot, along with the date on which the cruise plot was completed.
Cruised By	Signature, full name and professional designation (where applicable)
Checked By	Signature and full name If the check cruiser uses the original cruise tally sheets, they must be signed and dated by the check cruiser.

Growth rates, the number of rings in the last 10 cm, and 10 year growth can be noted in the Remarks section.

5. Ministry of Forests Map Area Statement (FS 121)

5.1. Cruise Identity (Card Type A)

The Map Area Statement consists of required and optional information to be entered into the compilation program for compilation purposes.

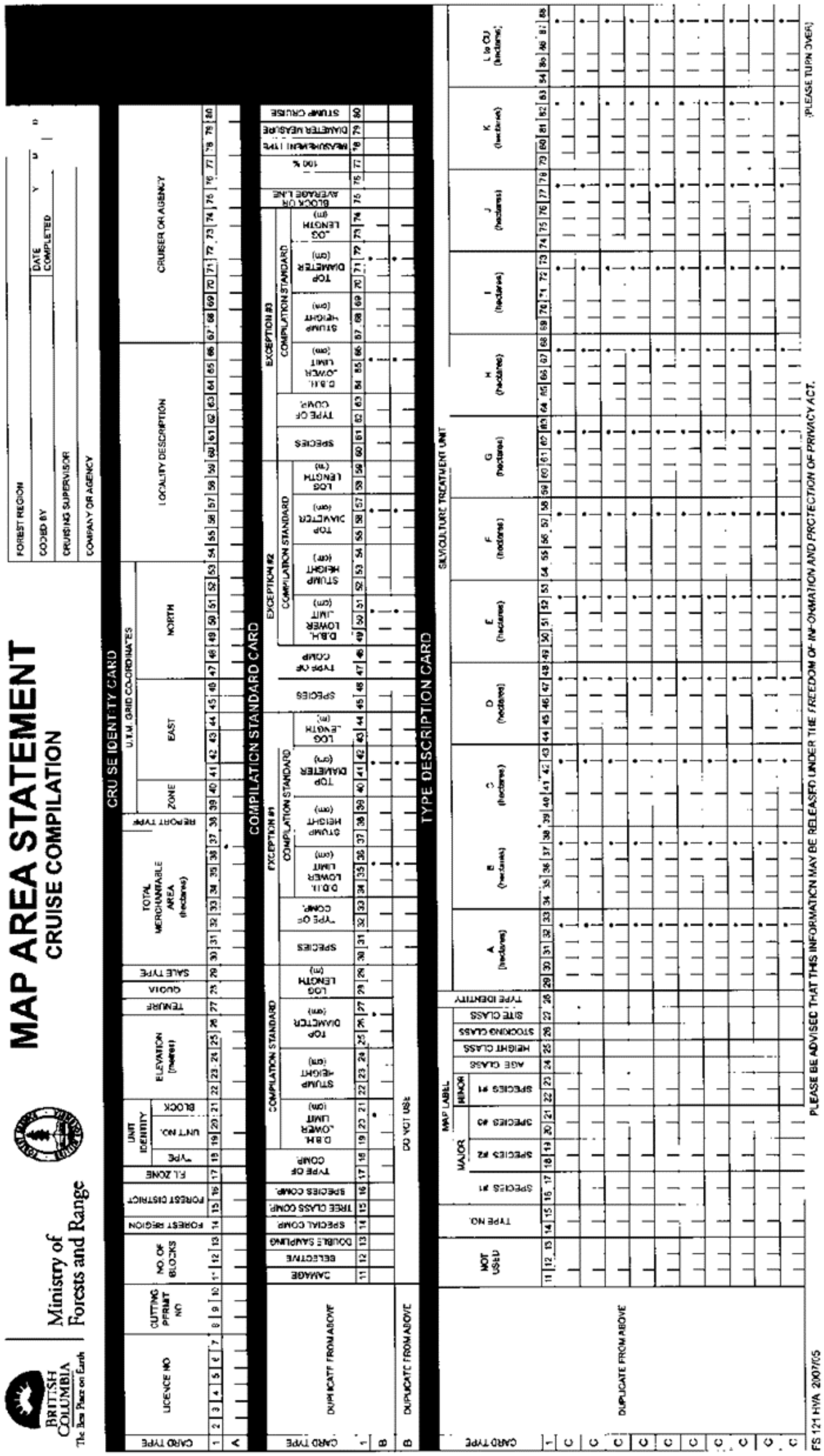


Figure 5-1 Front Side of Map Area Statement Form (FS 121)

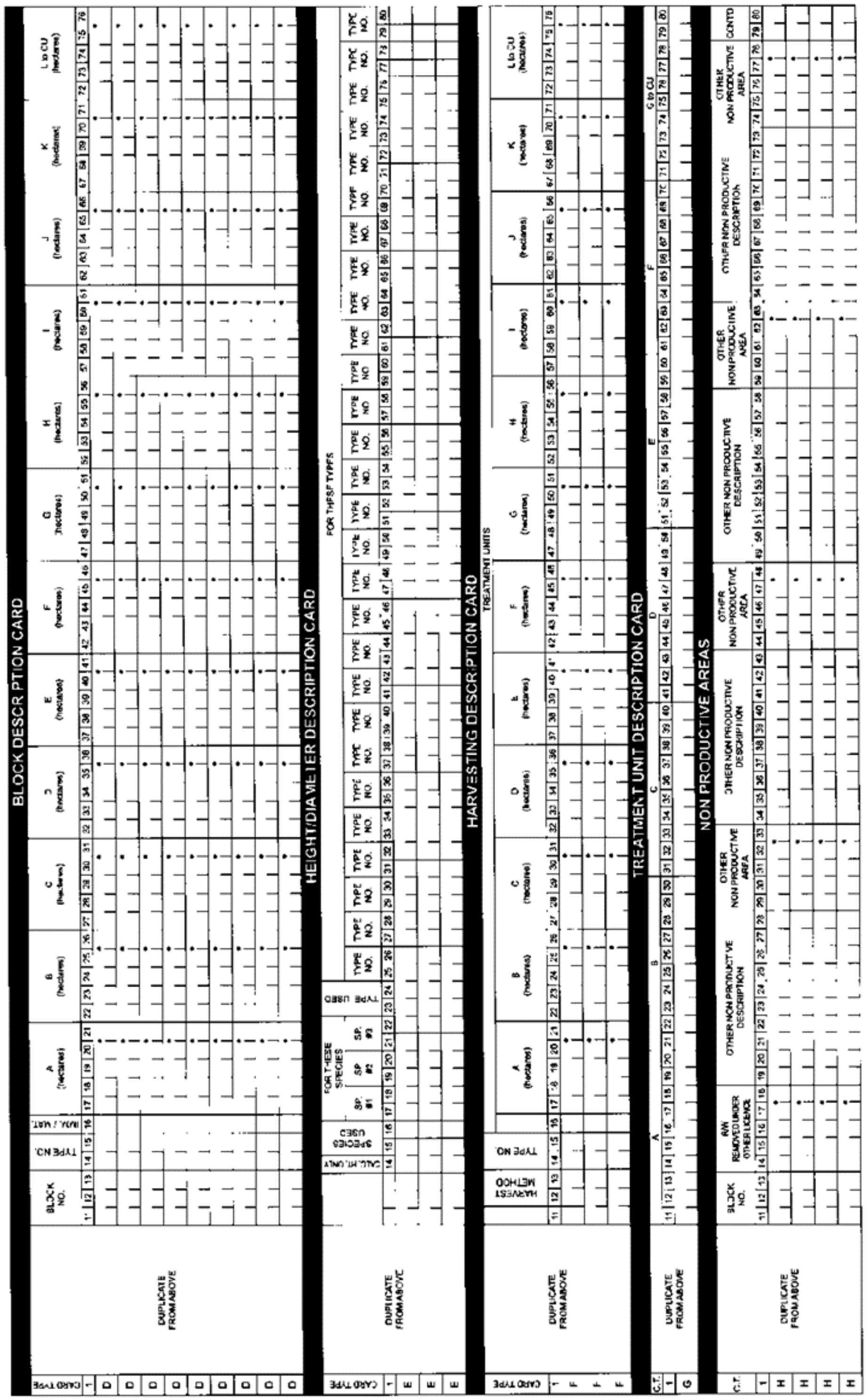


Figure 5-2 Reverse Side of Map Area Statement Form (FS 121). Cruise Identity (Card Type A)

This card establishes the location and describes the nature of the cutting authority.

5.1.1. Positions 2 to 7 Licence Number (required)

The license number can be Alpha-Numeric, and cannot exceed 6 spaces.

5.1.2. Positions 8 to 10 Cutting Permit (required)

The Cutting Permit can be Alpha-Numeric and cannot exceed 3 spaces.

5.1.3. Positions 11 to 13 Number of Cutblocks (required)

Must be between 1 and 999.

5.1.4. Positions 14 to 16 Forest Regions and Districts (required)

Refer to the Region and District Codes in Appendix 19 for detailed region and district information.

5.1.5. Position 17 Forest Inventory Zones (required)

The province is divided into 12 Forest Inventory Zones:

- A, B, C are all Coast zones,
- D has portions in both the Coast and Interior, and
- E to L are all Interior zones.

The correct zone is vital for the application of volume equations, loss factors and LRFs. If more than 1 FIZ exists in a cutting authority, use the FIZ with the greatest area.

Refer to the Mapview utility on the Internet for a detailed location of the FIZ and Special Cruise Number. https://arcmaps.gov.bc.ca/ess/sv/mapview/.

See the Cruise Compilation Loss Factor Table (Appendix 5) for details.

5.1.6. Positions 18 to 21 Unit and PSYU number (required).

Leave this position blank if none of the codes below apply.

Refer to the Mapview utility on the Internet to locate the PSYU Number (Special Cruise Number in Mapview). See Cruise Compilation Loss Factor Table (Appendix 5) for details.

If a cutting authority area occupies more than one Public Sustained Yield Unit (PSYU), then use the PSYU unit which has the greatest area within the cruise.

Enter 0 if the sale area is located within an established or proposed PSYU which is not part of a larger PHA (Pulp Harvesting Area).

1	if it is located within PHA 1
2	if it is located within PHA 2
3	if it is located within PHA 3
5	if it is located within PHA 5
7	if it is located within PHA 7
B	if located in Blue Mountain Forest Reserve
C	if sold under Beach Clearing Licence
E	if located in E & N Land Belt
G	if located in Gulf Islands
K	if located in Kitimat Valley but not in Skeena PSYU or TFL41
L	if sold as Pulp Timber Sale in Nootka PSYU
M	if located in a Municipality
P	if located in a Park
S	if located in a Special Sale Area
T	if located in a TFL
W	if located in a Watershed Reserve.

5.1.7. Positions 22 to 26 Elevation (required)

Record the elevation of the centre of the sale to the nearest 50 m. Must have at least a 1 entered.

5.1.8. Position 27 Tenure (required)

See the *Cruise Compilation Manual.*

Tenure Description	Code
Coast	
Forest Licences	A
Timber Licences	B
C.G. 1914 to date - stumpage & royalty	S
C.G. 1914 to date - stumpage including royalty	U
Road Permits	V
Timber Sales & Licences to Cut	X

Tenure Description	Code
T.F.L. Cutting Permits	Y
Woodlot Licences	1
Interior	
Forest Licences	W
C.G. 1914 to date - stumpage & royalty	T
C.G. 1914 to date - stumpage including royalty	2
Road Permits	3
Timber Sales & Licences to Cut	5
T.F.L. Cutting Permits	6
Woodlot Licences	7
All	
First Nations Woodland Licences	C
Community Forest Agreements	4
Timber Sale Licence Major	8

5.1.9. Position 28 Quota Type (optional)

Leave this column blank if the licensee quota is in a proposed or managed TSA, TFL or SSA.

Enter:

D	for Regional Executive Director Quota
H	for Handlogging Timber Sale
N	for Non-quota timber sold in a managed PSYU, TFL or SSA.
R	for Prince Rupert 20 percent contractor Northline timber
S	for Dead and Down Salvage Sale
T	for Third Band Sale
Q	for Quota Holder

5.1.10. Position 29 Sale Type (optional)

Leave blank if none of the following apply.

See the *Cruise Compilation Manual*.

Enter:

A	for Deciduous
B	for Salvage - Blowdown
C	for Salvage - Cleanup or Residuals
D	for Salvage - Dead or Down
E	for Salvage - Decadent
F	for Salvage - Flood Killed
G	for Salvage - Winter Killed
H	for Salvage - Pondage Clearing
I	for Salvage - Insect Killed
J	for Salvage - Disease Killed
K	for Salvage - Fire Killed
M	for Minor Products only
N	for Cash or Direct Sale
R	for Right of Way Clearing

5.1.11. Positions 30 to 37 Total Merchantable Area (Hectares) (required)

Enter the total net merchantable hectares to the nearest 0.1 hectare for the cutting authority.

5.1.12. Position 38 Ministry Appraisal Information (required)

All compilation reports must indicate whether they are for appraisal purposes. (Enter A for appraisal purposes).

5.1.13. Positions 39 to 53 UTM Co-ordinates (optional)

The following web site and instructions can be used to access UTM co-ordinates:

http://a100.gov.bc.ca/pub/mascotw/

5.1.14. Positions 54 to 66 Locality Description (optional)

Enter a brief description where the sale is located.

5.1.15. Positions 67 to 80 Cruised By (required)

Enter first and last name of the cruiser and professional designation, where applicable. Where there is more than one cruiser on the cutting authority, enter the name of the company that performed the cruise.

5.2. Compilation Standard (Card Type B)

This card defines the standard of compilation and the output required for the cutting authority.

5.2.1. Position 11 Damage Reporting (required)

Identify whether damage is to be reported in the compilation. Damage must be reported for appraisal purposes, but is optional for non-appraisal compilations. If the value is left as blank, all damage will be compiled and reported.

5.2.2. Position 12 Selective/ Leave Tree Indicator (required)

blank	compile all trees (default)
C	compile only "C" indicated (cut trees) and blank indicated trees.
L	compile only "L" indicated (leave trees) trees.

5.2.3. Position 13 Double Sampling Indicator (required)

Indicates whether the compilation uses measure plots or a combination of measure and count plots. If the value is left as blank, all plots will be compiled. A value of 1 indicates that count plots should not be compiled.

5.2.4. Position 14 Special Compilation (required for interior cruises)

If the cutting permit occupies both Wet and Dry Belt BEC zones, subzones or variants, compile using the zone with the highest Douglas fir total net volume based on the post reduction cruise data. Wet/Dry Belt code is not a compilation check item if the compilation does not include any Douglas fir volume.

WET AND DRY BELT DOUGLAS FIR ZONES		
	Biogeoclimatic Zone	**Biogeoclimatic Subzone and Variant**
Wet Belt **Code = 1**	ESSF (Engelmann Spruce - Subalpine Fir)	dc, dcw, dh dk, dkw, dv, dvw, mc, mcw, mh, mk, mkw, mm, mmw, un, vc, vcw, ~~vv~~, wc, wcw, wh, wk, wm, wmw, wv, wvw
	ICH (Interior Cedar Hemlock)	dk, dm, dw, mc, mk, mm, mw, vc, vk, wc, wk
	SBPS (Sub-Boreal Pine - Spruce)	dc, mc, mk
	SBS (Sub-Boreal Spruce)	undifferentiated, dh, dk, dw, mc, mh, mk, mm, mw, vk, wk

	SWB (Spruce Willow Birch)	mk, mks, un, uns, vk, vks
Dry Belt Code = 2	BG (Bunchgrass)	xh, xw
	ESSF (Engelmann Spruce - Subalpine Fir)	xc, xcw, xv, xvw
	ICH (Interior Cedar Hemlock)	xm, xw
	IDF (Interior Douglas Fir)	dc, dh, dm, dw, mw, ww, xc, xh, xk, xw, xx
	MS (Montane Spruce)	dc, dk, dm, dv, dw, xk, xv
	PP (Ponderosa Pine)	xh,
	SBPS (Sub-Boreal Pine - Spruce)	xc

If subzones are missing from the above listing, the general rule to apply is: very dry and dry subzones are Dry Belt; and moist, wet and very wet are Wet Belt.

5.2.5. Positions 15 to 16 Tree Class and Species Compilations (optional)

The default values for appraisal purpose compilations are zero. This will ensure that useless tree class volumes are excluded and all species are compiled in the same manner.

5.2.6. Positions 17 to 18 Type of Compilation (required)

Enter 3 for Interior Cruises and 32 for Coastal cruises. This represents the appropriate end product or combination of products.

5.2.7. Positions 19 to 27 Timber Merchantability Specifications (required for Interior compilations)

This section indicates the minimum timber merchantability specifications that will be assigned by the cruise compilation programs when the compilation program is used for appraisal purposes.

Coast		DBH	Stump	Top
	Mature	17.5	30	15.0
	Immature	12.0	30	10.0
Interior	All	17.5	30	10.0
	Lodgepole Pine	12.5	30	10.0

	Cedar > 140 years	17.5	30	15.0

Red cedar (Interior only):

- if greater than 50.0 percent of the red cedar net volume is in trees less than 141 years old, the top diameter inside bark is 10.0 cm, and
- if greater than or equal to 50.0 percent of the red cedar net volume is in trees greater than 140 years old, the top diameter inside bark is 15.0 cm.

The stump height, top dib, DBH limit or log length can be altered in Positions 30 to 74 for one or more species on the sale in compilations that are not used for appraisal purposes.

5.2.8. Positions 28 to 29 Log Lengths (to the nearest metre) (required)

Log Lengths for product analysis. If not equal to 5 m for Interior or 10 m for Coast, reports are titled "Not for Appraisal Purposes".

One exception is the portion of the Coast Mountains Resource District west of the Cascade Mountains administrative line in coastal FIZ A utilizes Interior appraisals. This area is permitted to use 5 m logs for interior appraisal purposes.

Log Lengths for other purposes can be 1 to 99 m.

(Zero) 0 = total tree length between stump height and top dib.

5.2.9. Positons 30 to 74 Exceptions (optional)

See Sections 5.2.6 to 5.2.8. See Section 4.3.2.4 for species codes.

5.2.10. Position 75 Cutblock or Average Line Method of Compilation (required)

Enter A for all cruises used for appraisal purposes as the average line method must be used.

5.2.11. Position 76 (required for CGNF cruises)

Enter C for CGNF cruises.

5.2.12. Position 77 100% (required for 100% cruises)

Enter A if this cruise or stump cruise is 100% measure.

5.2.13. Positions 78 to 80 Stump Cruise Information (required for stump cruises)

See Section 6.8.

5.3. Type Description (Card Type C)

This section contains the area information for the types, harvest methods and treatment units within the compilation.

5.3.1. Positions 14 to 15 Type Number (required)

The type number corresponds to the type number on the cruise map for the area to be compiled within that type polygon**.**

5.3.2. Positions 16 to 28 Map Label and Type Identity (optional)

Timber types were traditionally given labels that followed inventory naming conventions, but this is not mandatory. For further information, see the Timber Type Label Information in the appendices.

5.3.3. Positions 29 to 88 Timber Type Area (required)

Record the merchantable timbered hectares for each timber type (stratum) and treatment unit in the cutting authority to the nearest 0.1 ha.

5.4. Cutblock Description (Card Type D)

This card must have an entry for each type within a block. The number of cutblocks entered must equal the number of cutblocks entered on Card Type A (See Section 5.1.3)

5.4.1. Positions 11 to 13 Cutblock Number (required)

The cutblock number must correspond to the cutblock number on the cruise card. The cutblock number may be Alpha-Numeric, but cannot exceed 3 characters.

5.4.2. Positions 14 to 15 Type Number (required)

Enter the type number (see Section 5.3.1).

5.4.3. Position 16 Coast Cutblock Maturity Indicator (required)

I	Immature
M	Mature

Each cutblock must be compiled as mature or immature. All types within a cutblock must be cruised and compiled to the same timber merchantability specifications (immature or mature).

The cut block will be compiled using immature timber merchantability specifications if the immature volume is at least 50.1% of the total net volume (post reduction). Immature volume includes all coniferous and deciduous immature stems.

5.4.4. Positions 17 to 76 Hectares / Treatment Units (required)

Enter the total net merchantable hectares to the nearest 0.1 hectare of the cutblock which is part of each treatment unit in the cutblock and type.

Treatment Units are geographic units allowing the user to prescribe different prescriptions within a type, cutblock or harvest method area.

At least one treatment unit must be assigned in the compilation program. Up to ninety nine (99) treatment units are allowed within the current compilation programs.

5.5. Height/Diameter Description (Card Type E)

See Section 6.8.2.

5.6. Harvesting Description (Card Type F)

Multiple Harvesting Methods may exist within a cutting authority. The harvesting method and corresponding plots must be clearly identified on the final cruise map to ensure the correct plots are assigned to the harvest method. The volume for the harvest method is based on the type information within the harvest method, but the average slope is associated with only the plots within the harvest method area.

5.6.1. Positions 12 to 13 Harvesting Method (required)

Record the Harvesting Method (see Section 4.3.1.22)

5.6.2. Positions 14 to 15 Type No. (required)

Enter the timber type (see Section 5.3.1)

5.6.3. Positions 17 to 76 Treatment Units Area (required)

Each harvest method area must equal the sum of the timber type areas in the harvest method to the nearest 0.1 ha.

5.7. Treatment Unit Description (Card Type G) (optional)

Up to ninety-nine user coded descriptions may be entered so that individual treatment unit summaries can be identified.

5.8. Non-productive Area Descriptions (Card Type H) (optional)

These areas may be entered and will contribute to the gross area of the compilation only. No volume will be associated with these areas and the areas are reported for information purposes only.

5.9. FS 221 – Percent Reduction

This form below (Figure 5.3 Percent Reduction Worksheet) enables the reduction of stems and volumes by percentage points. The percent reduction must be consistent with the cutting specifications in the site plan and/or schedule B. Where dispersed faller selection or retention harvesting is to be used, a percent reduction must be applied. The reduction can be accomplished by a number of methods when the Forest Type Stand and Stock Table output has been analyzed.

When a range of stems per hectare is stated in the prescription (e.g. site plan, schedule B), the percent reduction input will be based on the average number of stems within that range.

Special consideration must be given to whether dead trees will actually be reserved from harvest when identifying percent reductions. If tree class or live/dead status is not specified in the percent reductions, both live and dead trees will be reserved from harvest and must remain undamaged and on site.

For more information on percent reductions, please refer to Chapter 5 of the *Cruise Compilation Manual.*

The approved methods of reduction for the dbh classes are:

1. By species, timber type, risk group/tree class and treatment unit.
2. By species, timber type and treatment unit.
3. By species, risk group/tree class, mature/second growth, live/dead and treatment unit.
4. By species and treatment unit:
    a. Positions 1-2 - Species

       These are the letter codes and all species letters must start in column 1. (Section 4.3.2.4)

    b. Position 3-4 - Timber Type

       These are the numeric codes of the timber type.

    c. Position 5 – Risk Group or Tree Class

       These codes are as follows:

CODE	RISK GROUP/ TREE CLASS
A	Risk Group 0 - Living Trees – not used at this time
B	Risk Group 1 - Living Trees
C	Risk Group 2 - Living Trees
D	Risk Group 3 - Living Trees
3	Tree class 3 - Dead Potential (Older Immature D.P. in the Interior)

CODE	RISK GROUP/ TREE CLASS
4	Tree Class 4 - Dead Useless
6	Tree Class 6 - Live Useless
7	Tree Class 7 - Mature Dead Potential
9	Tree Class 9 - Younger Immature Dead Potential

d. Position 6-7 - Silviculture Treatment Units (99 are available) - This is the unit.

e. Position 8-10 - Cutblock Number - This is the cutblock number, code blank if for appraisal.

f. Position 11 - Damage Code - This field corresponds to the damage types:

DAMAGE CODE	DAMAGE TYPE	INCLUDED CODES IN CRUISE DATA
B	Blowdown	E, G
F	Fire	A, B, C
I	Insect	1 to 8, X, Y
R	Root Rot	J, K and L

100 percent of the trees with the appropriate damage type code will be included in the appraisal data.

g. Position 13 - Code "L" for live trees and "D" for dead trees. These codes allow for live tree classes 1, 2, 5 and 8 or L (all) or dead tree classes 3, 7 and 9 or D (all) to be included in the appraisal compilation.

h. Position 14-82 - Percent Reduction for dbh classes (e.g. 10 cm class = 7.5 - 12.4 cm). Use whole numbers only.

100 percent reduction means all trees will be excluded from the appraisal compilation.

A blank entry represents all values in a field.

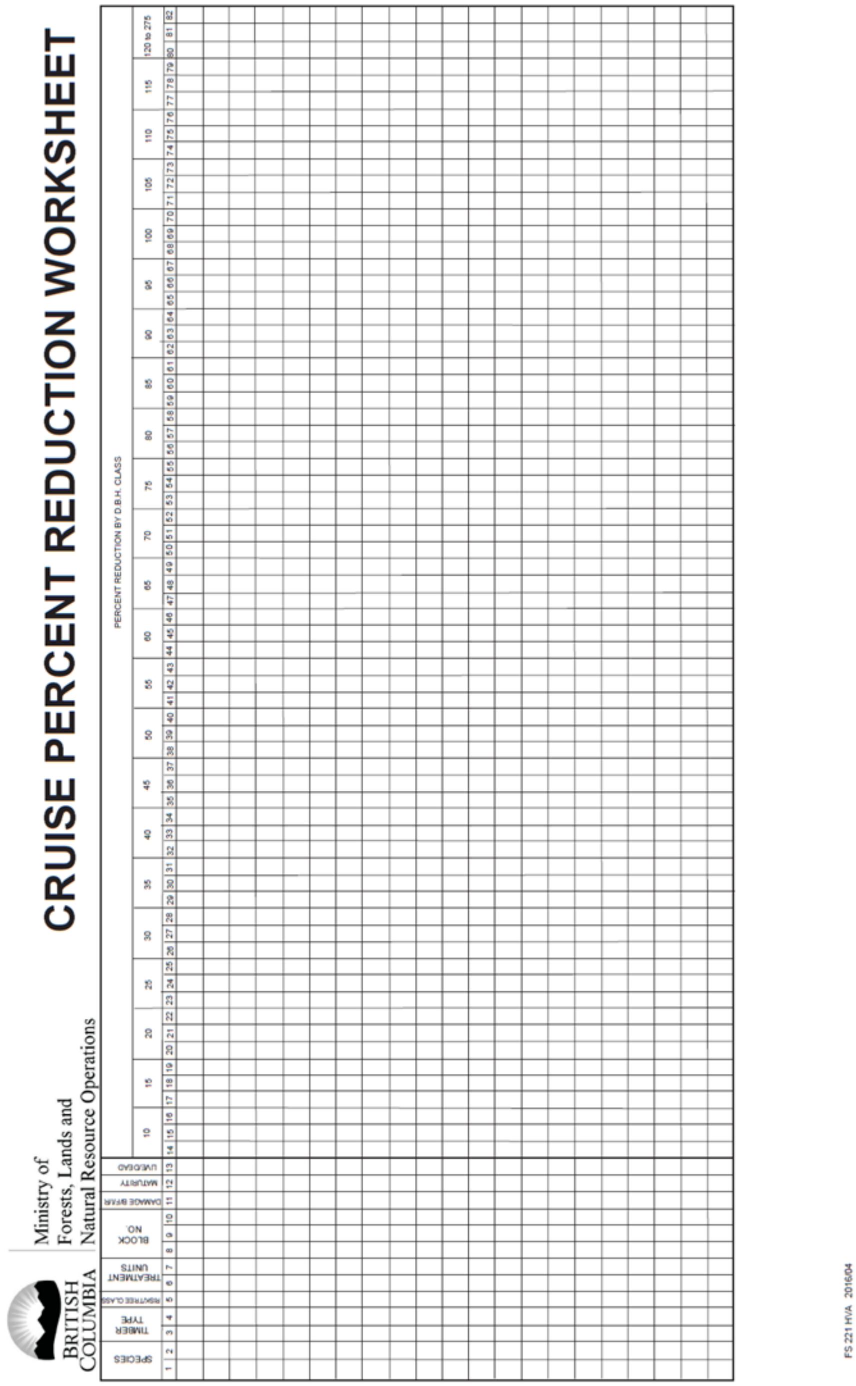


Figure 5-3 Percent Reduction Worksheet

5.10. Compilation Output

The cruise compilation shall accurately represent the area and net volume by species, grade, LRF, diameter class, timber type and risk group to be appraised and harvested and shall be compiled with the most recent version of the cruise compilation as of the date of the appraisal data submission to the Ministry.

The cruise compilation version must be approved by Timber Pricing Branch.

> Modifications to the cruise compilation reports utilizing a calculator are not acceptable for initial compilations used in new appraisals. Manual or hand compilations shall only be used in exceptional cases as approved by the Area Director.

5.10.1. Summary of Required/Optional Reports and digital files

The following reports must be submitted electronically as specified in the *Interior* and *Coast Appraisal Manuals*:

Required for all compilations

1. Cruise Statistics
2. CP, Type and Cutblock Volume Summaries
3. Detailed Plot Summary
4. Harvest and all Harvest Method Summaries
5. Appraisal Summary
6. Digital data in ASCII format (.dat, .pr, .red)
7. Digital data in csv file format (CP Summary, Cutblock Summaries and Harvest Method Summaries - full and reduced, where applicable)
8. Percent reduction input values (when used)
9. Double sampling ratios (when count plots are used)

Required if requested by Ministry

1. Edit Report (data listing) of cruise data
2. Extended Timber Type Stand and Stock Tables
3. Partial Cut Percent Reports

4. CP. Block and Type Damage Summary Reports
5. Stand, Stock and Leave Tree Tables
6. Volume and Lumber Recovery Information

Required for Stump Cruises

1. Scattergram of all heights and diameters
2. Scattergram of sample trees/regression coefficients
3. Original scattergram of sample trees/regression coefficients, if suggested curve is over-ridden. Actual keyed values and explanation is required.
4. Edit Report if height curves used

Optional

1. Plot Summary by Maturity
2. Harvest Method Treatment Unit Summaries

> If a percent reduction is being applied, the following reports will also be required:
>
> i. the **original** reports before percent reduction was applied,
>
> ii. the reports after percent reduction was applied, and
>
> iii. percent reduction table showing keyed input values for the percent reductions.
>
> The source documentation for percent reductions must be provided to the Ministry upon request.

5.10.2. Valid Compilation Programs

The valid compilation programs can be viewed at the following web link:

Valid Compilation Programs

6. Stump Cruising

6.1. Introduction

The methods described in this chapter are prioritized by safety considerations and the most accurate answer obtainable.

- all species, including deciduous, must be tallied,
- all stumps and/or felled trees, including non-merchantable (species and size) must be tallied,
- appropriate timber merchantability specifications will be used. Refer to Sections 4.3.1.16 and 5.2.7.
- if the volume can be isolated through the official scale, then utilize the scale volume plus a residue and waste volume for the area, and
- if there are situations that arise and the following methods do not apply, contact the Area Cruising Coordinator in the area.

6.1.1. General Procedures

The standards provide the basis for the sampling system to be used, and the rules for consistent and accurate measurement and compilation of the stumps and tree heights.

The application of a 100 percent stump cruise of an area is currently the most accurate method of volume determination available to the Ministry of Forests where unauthorized harvest (UTH) has occurred. The 100 percent stump cruise methodology eliminates the chance of statistical variation that may be attributed to plot sampling.

The regression coefficients and equations used in the conversion of stump diameter to diameter breast height (DBH) are listed in the February, 1989 FRDA publication "Stump and Breast Height Diameter Tables for British Columbia Tree Species", report #062.

www.for.gov.bc.ca/hfd/pubs/Docs/Frr/Frr062.htm

Refer to the following tables in the appendices:

Butt Taper – Mature – FIZ A, B and C – Coast (Appendix 22: Table 7.22.2).

Constants for Species and Zones (Appendix 22: Table 7.22.1).

Crown cutting authorities specify a 30 cm stump height.

The following information must be provided with the volume estimate:

- the source of the tree heights – the sample tree heights must originate from the same BEC subzone and the same timber type. Tree heights may be available for the stump cruise area if it was previously cruised. If the area was not previously cruised, tree heights are measured from an adjacent and similar timber type (within the same BEC subzone) for each major species in the stump cruise,
- data listing or plot summaries and evidence of data reconciliation,
- age in 10s reported on the tally card, to determine which loss factors were used in the compilation,
- traverse sheets and tally cards must be signed,
- record the type of instruments used,
- the notes recorded correctly and ground slope recorded which is required to calculate horizontal distance.(i.e., HD = Cos(1/Tan(slope%/100) See <u>Distance Slope Correction</u> in Appendix 14), and
- maximum closing error allowed is 1 percent. However, if the UTH is a 100 percent cruise an area measurement is not required to compile volume. An area is required if there will be a penalty rate set on a per hectare basis or if the stump cruise is a fixed area plot sample.

The reliability of the estimate is a function of the following:

- the degree of fit of the stump to DBH conversion equations, volume equations, loss factors and height curves to the harvest area,
- the non-sampling error (fieldwork), and
- the accurate transfer of data to the compilation program.

In order to review the degree of fit of the taper equations used in the stump cruise compilation program, the following process should be followed:

- Measure the height and DBH of trees in adjacent, similar timber types within the same biogeoclimatic subzone. The trees may be sample trees used for the height curves.
- Determine the volume estimate of these trees using the compilation program.
- Measure the diameter inside bark at stump height of these same trees by cutting bark windows at 30 cm above POG or a similar method.
- Determine the volume estimate of these same trees using the diameter inside bark and measured tree height in the stump cruise compilation program.
- Compare these 2 volume estimates to determine the degree of fit of the equations used for the stump cruise area.

6.1.2. Stump Cruising - Volume Calculations

The detailed compilation of stump cruise data is as follows:

- the species, age and Forest Inventory Zone (FIZ) that the stump cruise area is located in determines the regression coefficients used in the regression equation that is used to convert the stump diameter inside bark(dib) and stump height measured from the point of germination (POG) to an equivalent DBH outside bark (dob). Refer to Figure 4.12 for point of germination illustrations. The stump dib may be measured in centimetres (cm) or radius class units (1 rad = 2 cm) and the stump height is measured in cm. The POG is used for measuring stump height because the stump to DBH conversion equations are based on POG.

Tree heights are measured from an adjacent and similar timber type (within the same BEC subzone) for each major species (comprising 20 percent or more of the volume on the area) in the stump cruise and these are used to produce DBH curves by the compilation program. Minor species (comprising less than 20 percent of the volume on the area) can be grouped with a major species within the same forest type or have their own height curve produced provided that there are 20 or more height samples collected. The compilation program analyzes various mathematical descriptions of the curve and selects the curve with the lowest standard error of the estimate for volume.

- The tree data is now in standing tree format. The tree volume is calculated by the Kozak taper equation in the compilation program that has specific coefficients for the species and the FIZ group where the area is located. The equation produces a gross tree volume for the tree from the DBH outside bark (dob) and height that is assigned to the tree from the height DBH curve, and

- the net volume factors for decay, waste and breakage (DWB) by FIZ, species, diameter class, and risk group are then applied to reduce the gross volume to a net merchantable volume. Reference is the Ministry of Forests publication - “Metric Diameter class Decay, Waste and Breakage Factors, All Forest Inventory Zones - 1976”. This is the volume from the measured stump height (cm) to a minimum top dib (cm) specified in the cruise control card or Map Area Statement minus an allowance for DWB. The DWB deductions are based on Ministry Inventory decay and taper data collected for all commercial species and the data is partitioned into Forest Inventory Zones (FIZ’s) and Public Sustained Yield Units (PSYU’s). In some circumstances local factors apply to a portion of a FIZ. All volumes are reported in cubic metres by species.

6.1.3. Sampling Errors

Potential sources of sampling errors are:

- variation between the decay, waste and breakage for the FIZ and PSYU versus the actual site. The age in 10’s and tree classes recorded on the stump cruise tally cards determine the maturity class and risk group,

- variation between the equation to convert from stump diameter to DBH versus the actual DBH. For example, the standard error for spruce noted in FRDA report 062 is as follows:

> Spruce: 1.46 cm - coefficients are based on a sample of 3054 trees in FIZ's K and L.

- variation between the calculated tree volume based on the volume equation and the actual volume. The only way to measure this variation is to fall/buck and scale trees from the same timber type that was harvested and perform a taper study, and
- variation between the height DBH curve and the actual tree heights for the harvested trees. The important factors are that the timber type used for the source of the tree height data is similar to the harvested timber type and the full range of diameter classes measured in the stump cruise are represented in the height curves.

6.2. Boundaries

- Locate legal survey posts and confirm the boundary location. Re-establish cutblock boundaries from original traverse notes if necessary.
- Closed traverse the UTH area to the tolerances set out in Section 3.5 of the *Cruising Manual* under cruise based allowable errors.
- If the unauthorized harvest will result in an administrative penalty under Section 52 of the *Forest and Range Practices Act* and Section 13 of the *Administrative Orders and Remedies Regulation*, then a closed traverse of the area will be required since the penalty levied is in dollars per hectare.

6.3. Measurement Methods

The following methods are listed in order of preference. If stumps are lower than 30 cm height at the point of germination (POG), record the actual height as the additional volume removed will be included with the UTH volume in the compilation.

6.3.1. Method 1: Areas Less than 10.0 ha

Conduct a 100 percent cruise of the trees if the trees are still full length. If the trees have been bucked into log lengths, scale them as per scaling procedures outlined in the *Scaling Manual.*

If the UTH area is within a homogeneous pine or pine and spruce timber type of a density of 1 000 stems per hectare or more and greater than 3.0 ha, method 2 may be used.

6.3.2. Method 2: Areas Greater than or Equal to 10.0 ha

The sampling intensity must be sufficient that a sampling error of plus or minus 8 percent is achieved at the 95 percent confidence interval.

If the sampling error cannot be achieved, establish 400 m^2 (0.04 ha) plots at an intensity to cover at least 10.0 percent of the area. A grid spacing of 60 m should be sufficient to ensure plot coverage of 10.0 percent of the area.

Establish 400 m^2 (11.28 m radius) fixed area plots on a systematic grid. Record all of the necessary information for each stump in the plot (i.e., pith of stump is within 11.28 m of plot centre).

6.4. Timber Available For Measuring

This method can be used if the timber is safe to measure and the cruiser or scaler can match the tree to its stump.

The following points apply to all options under Section 6.4.

6.4.1. Tally Card - FS 205S

Use the Figure 6.4 FS 205S Ministry of Forests Stump Cruise Tally Sheet. unless the timber will be scaled. If the timber is scaled, use the FS 161 residue and waste tally sheet.

Record the Enforcement Action Administrative Review and Appeals (ERA) system case file number (i.e., DPA960001) in the licence and cutting permit header box.

Code column 26 of each stump cruise tally sheet with a unique letter (A to Z) or number (0 to 9). This code will simplify the field data reconciliation in the cruise compilation.

6.4.2. Field Measurements

If performing a cruise of the felled trees, complete the Figure 4.1 Cruise Tally Sheet – FS 205C (front side). as you would for a regular fixed area cruise and record all of the necessary information including pathological indicators and quality remarks. The cruiser must sign and date each tally card.

Record the total length of each tree in the height field and include the height of the stump in the total tree length.

Record the DBH of the felled trees and account for the stump height when determining DBH.

Use the Figure 6.4 FS 205S Ministry of Forests Stump Cruise Tally Sheet. if measuring the stump heights and diameters. Record the total tree lengths in the margin of the tally sheet beside each stump tally.

All stumps and corresponding trees must be numbered. Each stump and its corresponding tree must be numbered with the same unique number.

6.5. All Stumps Removed From the UTH Area (i.e., Land Cleared, Road is Built)

6.5.1. Option 1

Perform a variable plot cruise or fixed area cruise in the adjacent timber as per the *Cruising Manual* to determine the net volume per hectare.

Measure the length of the timber edge along the UTH area and space the plots equally along the timber edge.

6.5.2. Option 2

Use the net volume per hectare from the cruise information for an adjacent cutting authority if the timber types were the same on the forest cover map.

6.5.3. Option 3

Use aerial photographs (approximate scale 1:3000 is recommended) taken before and after the UTH occurred. Ensure that before and after aerial photos are enlarged to the same scales for photo interpretation. Use the following procedure to determine a volume estimate for the UTH:

1. A qualified photo interpreter can identify the tree count by species removed from the UTH cleared area based on the pre-harvest and post harvest aerial photographs. The UTH boundary must be transposed to the aerial photographs using legal map references and iron pin (legal references) wherever possible.

2. Field staff must attend the site and measure tree heights and diameters at breast height (DBH) of all species identified on the pre-harvest aerial photos that were cut from the UTH area. Selected measured trees of various heights must be stem mapped with bearing and distance recorded to points on the ground that are visible on the post-logging aerial photograph. This will assist the photo interpreter in determining the tree heights of the cut trees on the pre-harvest aerial photographs.

3. The tree height and DBH data estimated for the removed trees must be plotted onto a height DBH curve by species (x-axis DBH, y-axis height). The height/DBH relationship will be used to interpolate tree diameters for the tree heights that were estimated by the photo interpreter for the removed trees.

4. Using the tree heights estimated by the photo interpreter and the diameters interpolated from the height DBH curve, compute a merchantable volume for the UTH using the cruise compilation program.

6.6. Portions of Trees Removed (i.e., Shake Blocks or Special Forest Products Removed From a Segment of Tree(s))

Use the residue and waste tally sheet FS 161 to record the missing and remaining portions of the tree using scaling procedures in the *Scaling Manual*. Code the missing portion(s) as "A" for remaining and "U" for missing under the "Waste/Residue Class" column. These codes will permit segregation of the removed and remaining volumes in the Cutblock Type Summary Report of the residue and waste systems reports.

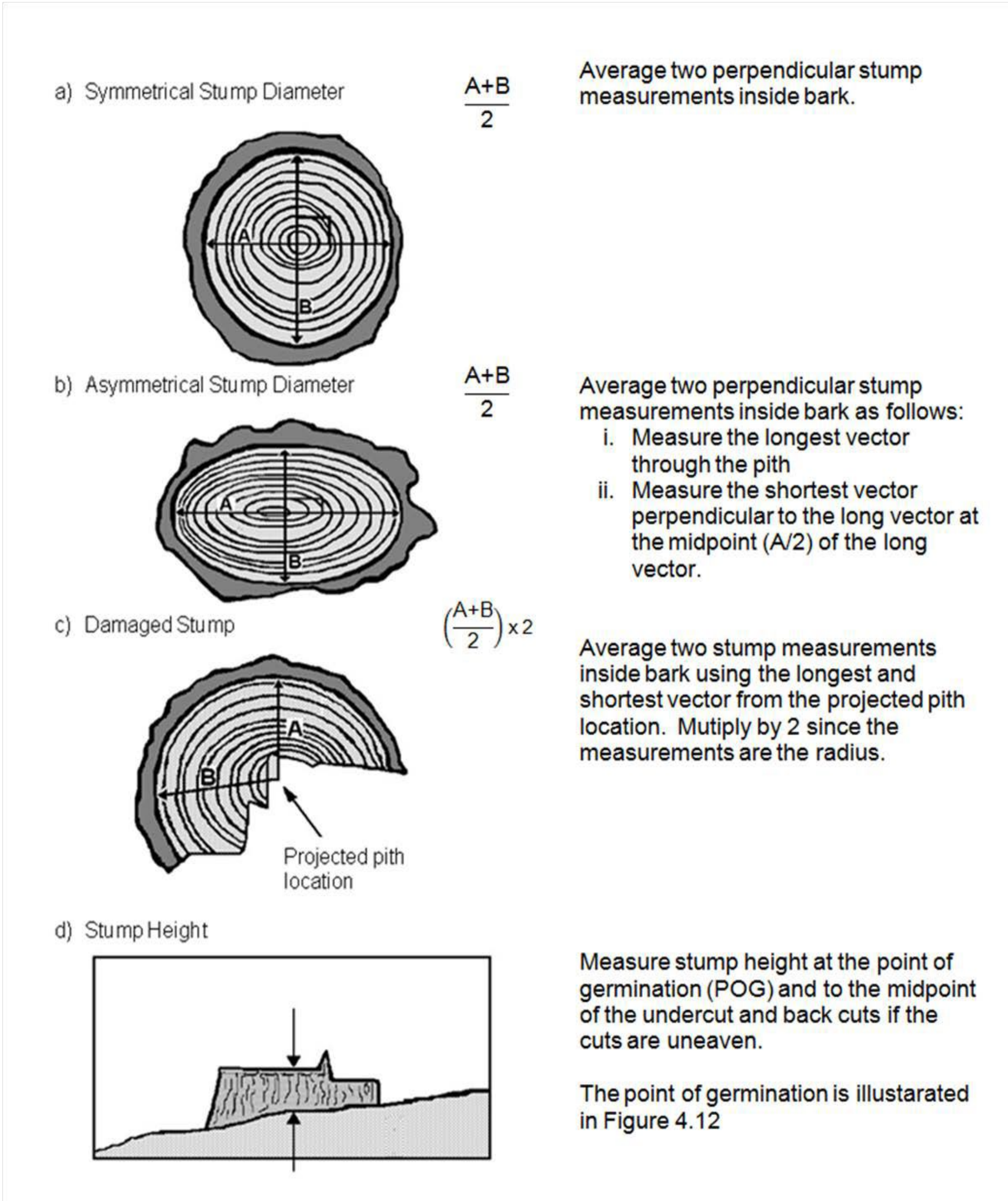
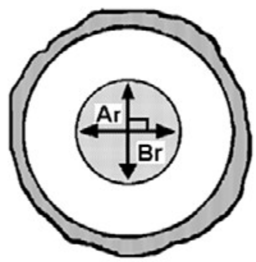


Figure 6-1 Examples of Recommended Stump Measurements

a) Stumps with Heartrot > 50% of Stump Diameter

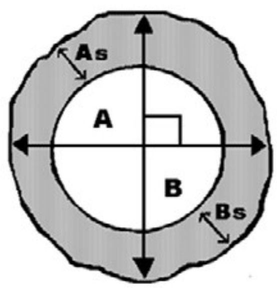


i. Determine stump diameter inside bark using long and short vectors - $\frac{A+B}{2}$

ii. Determine the rot diameter using long and short vectors - $\frac{A\ rot\ +\ B\ rot}{2}$

iii. If the rot diameter is greater than half the stump diameter, record scar or scar and frost crack to ensure that the stump is compiled as Risk Group 2.

b) Dead Stumps



i. Determine stump diameter inside bark using long and short vectors - $\frac{A+B}{2}$

ii. Determine average thickness of the sap rot - $\frac{As\ +\ Bs}{2}$

iii. If the average sap rot thickness is 1/6 or more of the average stump diameter, record the stump as a tree class 4 (dead useless). If not, record the stump as tree class 3 (will be compiled as highest risk group).

Figure 6-2 Examples of Risk Group Determinations for Stumps

6.7. Stump Cruise Tally Sheet (FS 205S)

6.7.1. Card Type 9

Record the Enforcement Action Administrative Review and Appeals (ERA) system case file number (i.e., DPA960001) in the licence and cutting permit header box. The first three characters identify the administrative organization unit, the next two characters identify the fiscal year, and the last four characters identify the number of the incident in the Administrative Organizational Unit (AOU) for the reporting year. The ERA file number must be recorded in the locality description boxes in Card Type A of the Map Area Statement.

Complete the Figure 6.4 FS 205S Ministry of Forests Stump Cruise Tally Sheet. and sign and date each one.

Code column 26 of each stump cruise tally sheet with a unique letter (A to Z) and/or number (0 to 9). This code will simplify the field data reconciliation of the cruise compilation.

If the stump cruise is 100 percent measure, do not enter a plot size in the fixed area plot size on card type 9. Enter an "A" in column 77 of the map area statement. The plot size field will be overridden by the type areas in the map area statement, card type D.

The stump cruise tally sheet, Card Type 3 height sample trees cannot use the same tree numbers that are used on the Card Type 2's on the same tally sheet. If necessary, the tree heights may be entered on a separate tally sheet, however the plot must be used in the determination of the plot size calculation and assigned a unique plot number.

6.7.2. Card Type 3

6.7.2.1. Positions 2 to 24

Common to Card Type 1 and 2.

6.7.2.2. Positions 25 and 26 Tree Number

Sample trees must be numbered 99, 98, 97, etc. to prevent confusion with stumps numbered on the plot.

6.7.2.3. Positions 27 to 29 Total Height

Enter the calculated height plus correction.

Tree heights must be selected from a similar timber type and nearest adjacent area wherever possible. Adjacent height curve equations or tree heights from existing data may be acceptable if the data is validated in the field.

Height Sample Size

For each major species, a minimum of 20 tree heights are required per timber type evenly distributed throughout the full range of diameters at breast height (DBH) represented on the

UTH area. These sample heights must be evenly distributed throughout each type or site-class (i.e., at least one sample height per plot for damaged stands). A species is considered major if it comprises 20 percent or more of the UTH area gross volume.

If it appears that a certain species exhibits a similar height/DBH relationship in two or more forest types in the same area, it is permissible to develop a common height - DBH curve; the tree heights for a given species must be similar throughout the DBH range common to the species. In this case only, a total of 20 sample trees need to be measured within the two or more forest types.

> A similar height/ DBH relationship means an average height variation that does not exceed 3 percent over the full range of DBH's between two sets of data.

There are 3 options for sampling the height of a minor species, or species that are less than 20 percent of the UTH area gross volume. These options are listed in order of preference:

1. Select a minimum of 10 tree heights per minor species per timber type and evenly distributed throughout the full range of stump diameters measured on the UTH area. This data will be used to produce a height/ DBH curve.

2. Combine the minor species with another species within the same timber type and with a similar height/ DBH relationship.

In situations where only a few trees of a high value species are present, consider the following method. Measure two or more standing trees of the same species and 5 cm diameter class outside bark at the equivalent stump height as the stump measurement. Calculate the average for the measured tree heights and apply the average to the minor species trees.

Height Sample Selection (Height/ DBH Curve)

All trees must be marked and numbered at the point of DBH (to facilitate checking) so that the number can be seen when standing at the plot centre.

Abnormal trees such as leaning trees, trees with heavy sweeps, broken tops or forks must not be used as height sample trees. Trees with minor forks or crooks may be used if these trees comprise a considerable portion of the stand.

Dead potential trees should not normally be selected as height sample trees. Assuming that these stems died as a result of low vigour and/or pathological depletion, their growth rate would be less than average, their heights could unduly bias that species' height/ DBH curve. However, if a significant proportion of the population of a certain species is classed as dead potential, a representative number of dead potential stems should be sampled for height.

Height Sample Distribution (Height/ DBH Curves)

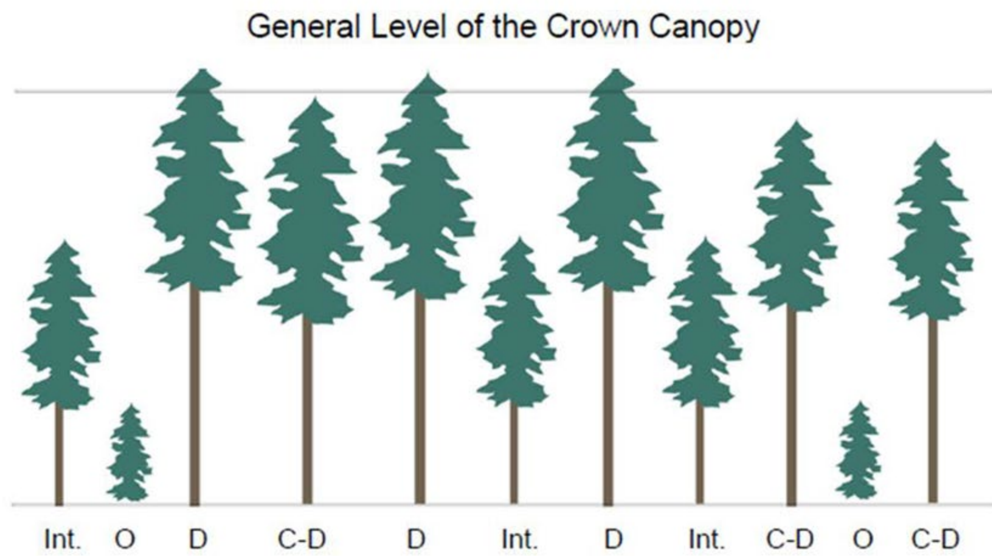
Measurements of height and DBH are required so that height/DBH relationships can be developed. Therefore, height sample trees must cover the range of heights and DBH’s in the stand. Each height curve must represent only one species and have at least 2 sample trees for each 10 cm DBH class unless 2 species exhibit similar height/DBH relationships. The reference point for DBH and height is the high side of the tree as shown in Figure 4.12 Breast height in Relation to High Side.

Height samples must be distributed as follows for each species:

Measure	1/4 in the dominant crown class
Measure	1/2 in the co-dominant crown class
Measure	1/4 in the intermediate and overtopped crown classes

Crown Classes

There are four crown classes as follows:



1.	= Dominant (D)	Trees with crowns extending above the general level of the crown canopy. They are somewhat larger than the average and have well developed crowns, which may be somewhat crowded on the sides.
2.	= Codominant (C-D)	Trees with crowns forming the general level of the crown canopy. The crown is generally smaller than that of the dominant trees and usually more crowded on the sides.
3.	= Intermediate (Int.)	Trees with crowns below, but still extending into the general level of the canopy. The crowns are usually small and quite crowded on the sides.
4.	= Overtopped (O)	Trees with crowns entirely below the level of the canopy.

Figure 6-3 Crown Classes

Height Sample Measurements

Tree heights will be measured from the ground on the high side of the tree. The total height is measured to the highest point of the crown. The most important aspect of measuring a tree height is seeing clearly to the top and DBH or bottom of the tree.

Consideration must be given to:

1. Slopes: trees standing adjacent to each other for comparison may not be on the same contour or elevation (i.e., uphill or downhill).

2. Understory trees and underbrush.

3. Tree length of leaning trees must be measured if they lean more than 10 (ten) degrees from vertical. (Section 4.3.2.3.2)

Paint an "S" on the sample tree facing the direction that the sample tree height was measured from. Measure the length at a 90 degree angle from the direction of the lean. Apply the Pythagorean formula to calculate the tree length.

6.7.2.4. Positions 30 and 31 Species

See Section 4.3.2.4

6.7.2.5. Positions 32 to 35 DBH

See Section 4.3.2.5

6.7.2.6. Position 36 C/C Crown Class

Enter the Crown class for the tree by number code as shown in Figure 6.3 Crown Classes.

6.7.2.7. Positions 37 to 39 Total Age (see Section 4.3.2.6)

The age of at least three co-dominant sample trees for each major species must be established for each forest type if the age of the forest type is as follows:

- coniferous – 90 to 150 years,
- deciduous – 20 to 60 years, or
- aspen/cottonwood (FIZ K and L) – 50 to 170 years.

If the age of the forest type is not within the above limits, the age of at least one co-dominant sample tree for each major species must be established for each forest type.

To determine the age in stump cruises, simply count the rings on the stumps.

Calculate the ages as follows:

1. Boring Height – always 1.3 m above high side (breast height).

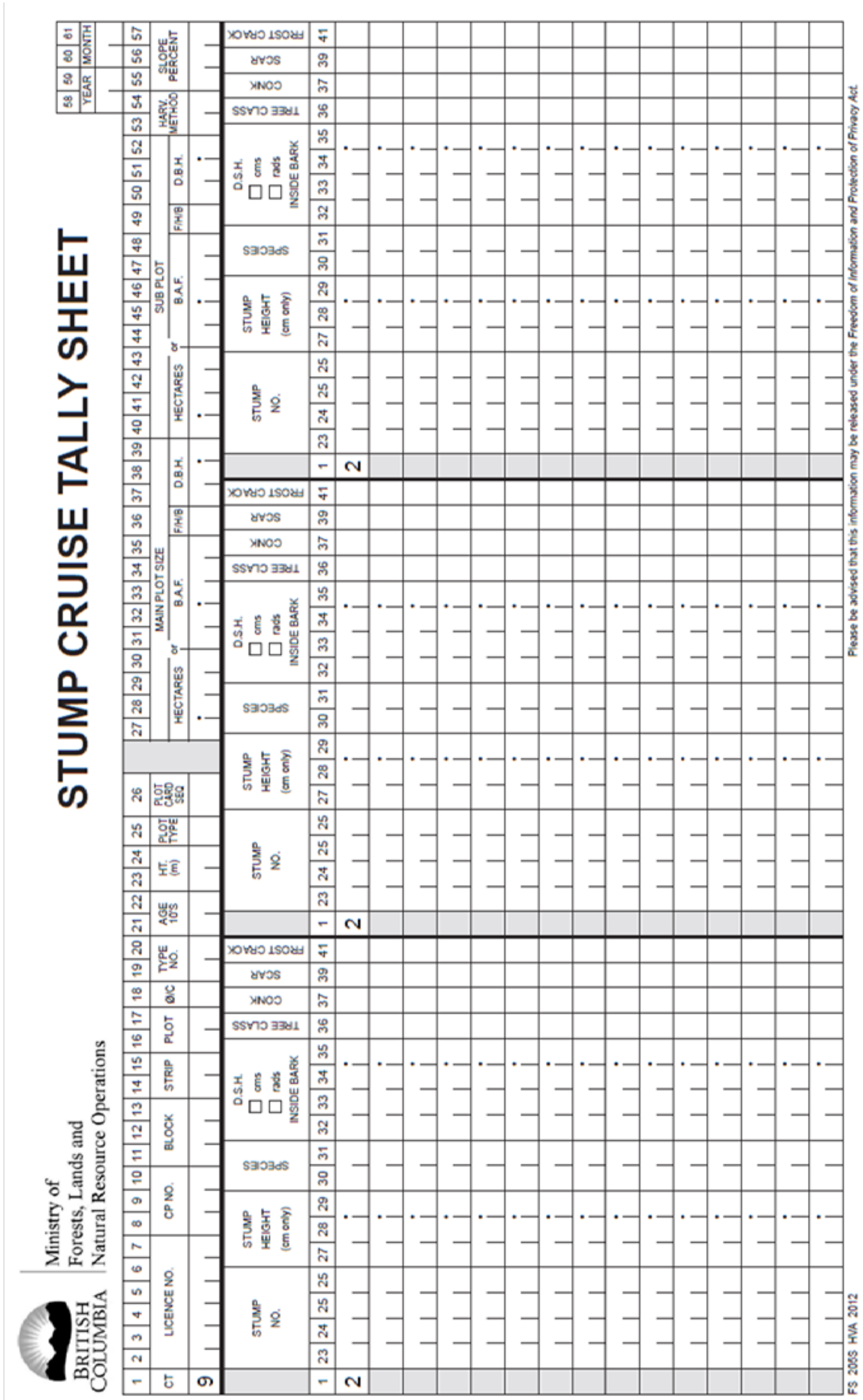
2. Breast Height Age – enter the age of the tree measured at the boring height according to the ring count (pith counts for one year).

3. Correction – use the Site Index Tables for British Columbia All Species (Appendix 21). Go to the bottom of the appropriate Site Index Table and note the “Years to bh” (years to boring height) correction value based on the top height and counted age at DBH for the tree.

4. Total Age – the sum of the Breast Height Age and the Correction.

6.7.2.8. Position 40 Partial Cutting

L	Leave tree.
Blank or C	Cut tree.


BRITISH COLUMBIA

Ministry of Forests, Lands and Natural Resource Operations

STUMP CRUISE TALLY SHEET

CT | LICENCE NO. | CP NO. | BLOCK | STRIP | PLOT | Ø/C | TYPE NO. | AGE 10'S | HT. (m) | PLOT TYPE | PLOT CARD SEQ | MAIN PLOT SIZE: HECTARES or B.A.F. | F/H/B | D.B.H. | SUB PLOT: HECTARES or B.A.F. | F/H/B | D.B.H. | HARV. METHOD | SLOPE PERCENT | YEAR | MONTH

STUMP NO. | STUMP HEIGHT (cm only) | SPECIES | D.S.H. ☐ cms ☐ rads INSIDE BARK | TREE CLASS | CONK | SCAR | FROST CRACK

Please be advised that this information may be released under the Freedom of Information and Protection of Privacy Act.

FS 205S HVA 2012

Figure 6-4 FS 205S Ministry Stump Cruise Tally Sheet

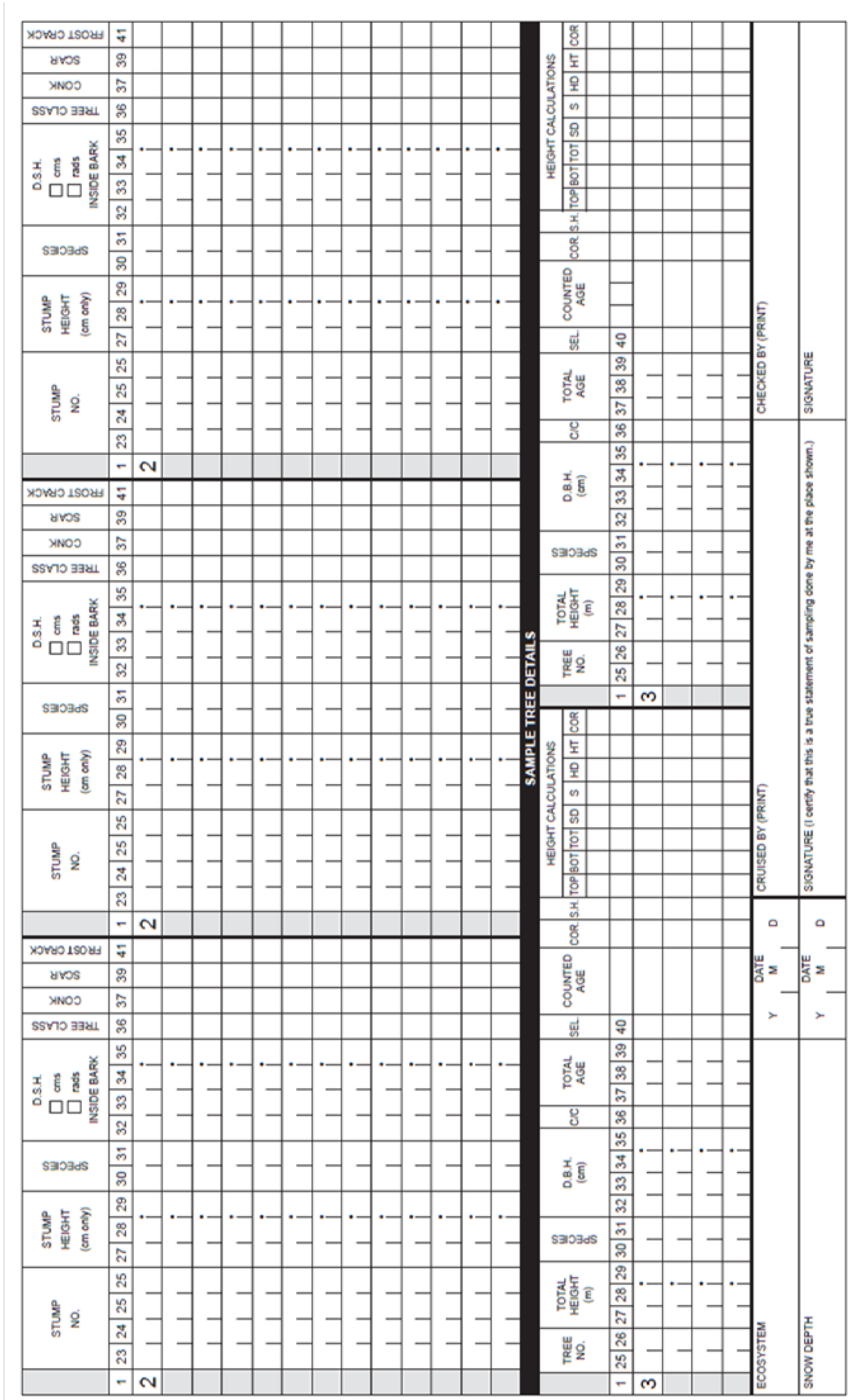

STUMP NO. | STUMP HEIGHT (cm only) | SPECIES | D.S.H. cms rads INSIDE BARK | TREE CLASS | CONK | SCAR | FROST CRACK
1 | 23 24 25 25 | 27 28 29 | 30 31 | 32 33 34 35 | 36 | 37 | 39 | 41
2
SAMPLE TREE DETAILS
TREE NO. | TOTAL HEIGHT (m) | SPECIES | D.B.H. (cm) | C/C | TOTAL AGE | SEL | COUNTED AGE | COR | HEIGHT CALCULATIONS: S.H. TOP BOT TOT SD S HD HT COR
1 | 25 26 | 27 28 29 | 30 31 | 32 33 34 35 | 36 | 37 38 39 | 40
3
ECOSYSTEM | DATE Y M D | CRUISED BY (PRINT) | CHECKED BY (PRINT)
SNOW DEPTH | DATE Y M D | SIGNATURE (I certify that this is a true statement of sampling done by me at the place shown.) | SIGNATURE

Figure 6-5 FS 205S Ministry Stump Cruise Tally Sheet (side 2 of 2)

6.8. Map Area Statement (FS 121)

A map area statement (Figure 5.1 Front Side of Map Area Statement Form (FS 121).) must be completed for stump cruises according to Chapter 5 Ministry of Forests Map Area Statement (FS 121).

6.8.1. Card Type B

The following positions in Card Type B are specific to stump cruises only:

6.8.1.1. Position 78 Stump Diameter Measurement Type

Code "C" if the stump diameters inside bark are measured in centimetres.

Code "R" if the stump diameters inside bark are measured in radius class units (rads).

Stump height must be in centimetres above point of germination.

6.8.1.2. Position 79 Diameter Measurements

Code "I" for inside bark.

6.8.1.3. Position 80

Code "S" for stump cruise.

6.8.2. Card Type E

6.8.2.1. Position 1

Height/DBH Description - Stump Cruises & Severely Damaged Stands

This card is used to calculate a height/DBH equation for a species within a stratum or forest type.

The sample trees for one major species occurring in two or more types can be combined into one equation, which will be applied against all trees of that species for the designated types.

The sample heights for two or more different minor species exhibiting similar growth characteristics can be combined with a major or minor species into one equation so that all trees of the combined species in the Card Type E will have their heights calculated by the same equation.

Examples:

HEIGHT/DIAMETER DESCRIPTION

CARD TYPE			CALC. HT. ONLY	SPECIES USED	FOR THESE SPECIES SP. #1	SP. #2	SP. #3	TYPE USED	TYPE NO.	TYPE NO.	TYPE NO.	TYPE NO.	TYPE NO.	TYPE NO.	TYPE NO.	TYPE NO.	TYPE NO.	TYPE NO.	TYPE NO.
1	*EXAMPLE*	11 12 13	14	15 16	17 18	19 20	21 22	23 24	25 26	27 28	29 30	31 32	33 34	35 36	37 38	39 40	41 42	43 44	45 46
E		1	0	F	B			0 1											
E	DUPLICATE FROM ABOVE	2	0	P A	P W	P Y		0 3	0 4										
E		3	1	P A	L			0 3											
E		4	0	F	C	H	B	0 1	0 2	0 3	0 4								
E			0	F	S	P L	C T	0 1	0 2	0 3	0 4								
E			0	F	B 1			0 1	0 2	0 3	0 4								
E																			
E																			
E																			

Figure 6-6 Card #1—Height / DBH Description Card

Example 1.	One height/ DBH equation will be produced from all the F and B sample trees (Card Type 3) submitted in Type 1. This equation will be labelled as an equation for F in Type 1. All F and B trees without heights (Card Type 2) in Type 1 will have their heights calculated by this equation.
Example 2.	One height/DBH equation will be produced from all the Pa, Pw and Py sample trees (Card Type 3) submitted in Type 3 and 4. This equation will be labelled as an equation for Pa in Type 3. All Pa, Pw and Py trees without heights in Type 3 and 4 will have their heights calculated by this equation.
Example 3.	The height/DBH equation for PA in Type 3 will be used to calculate the tree heights of all L and Pa trees without heights in Type 3.
Example 4.	If producing one curve for all the species and there are too many species for one line, the species can be continued on the next line(s). The first species and first type on each line must be repeated (otherwise they will each be treated as separate curves). The program will combine all these lines (in the example) and produce one curve. The column 14 can be either 0 or 1.

6.8.2.2. Positions 2 to 10

Common to all Card Types.

6.8.2.3. Positions 11 to 13

Not used.

6.8.2.4. Position 14 Calculated Height Only

Code	
0 or blank	The sample trees from all the species (columns 15 to 22) and all the types (columns 23...) will be grouped together to calculate one height/ DBH equation. The height from this curve will be used for all of the plot trees of the species and types entered on the line.
1	Sample trees from only the species used (columns 15 to 16), and only the type used (columns 23 to 24) will be used to make an equation. The heights from this equation will then be applied to all of the species (columns 15 to 22) and all the types (columns 23...) entered on the line.

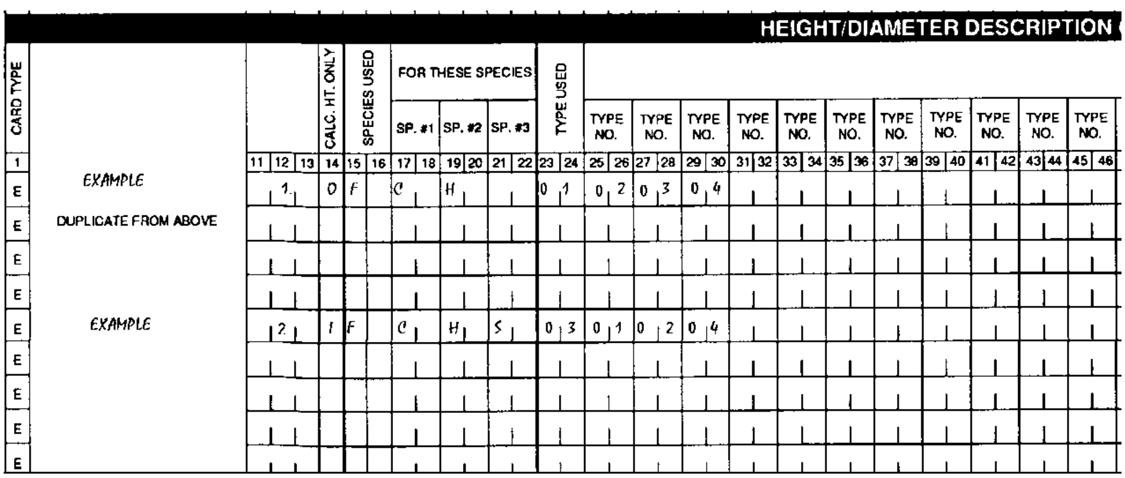


Figure 6-7 Card #2—Height / DBH Description Card

Column 14 determines how the equation will be formulated.

Example 1.	if column 14 is 0 it means; the sample trees from *all* the species listed (F, C, H) and *all* the types listed (1, 2, 3, 4) will be grouped together to produce a curve. The heights for all F, C, H in types 1, 2, 3, 4 on card type 2 will be assigned from this curve.
Example 2.	if column 14 is *1* it means: the sample trees from only the first species- F - (columns 15 and 16) in the first type -3- (columns 23 and 24) will be used to produce a curve. The heights from this curve will *then* be applied to *all* of the species in *all* of the types listed on the line.

6.8.2.5. Positions 15 to 16 Species Used

If only one species is used, enter that species. If more than one species is used, then enter the major species. All trees of the species in positions 17 to 22 and type number in positions 23 to 80 will use this equation.

6.8.2.6. Positions 17 to 22 For These Species

Enter the species which will be grouped with the species entered in the positions 15/16.

6.8.2.7. Positions 23 to 24 Type Used

If only one type is used, enter that type. If more than one type is used, enter the type that has the Site Code and Type Identity (Card Type C fields) values that describe the whole group.

6.8.2.8. Positions 25 to 80 For These Types

Enter the types whose species will be amalgamated.

Type numbers must be zero filled (e.g., 01, 02, etc.).

7. Appendices

7.1. Appendix 1: Additional Sampling Information

7.1.1. Fixed Area Sample Size

The fixed area plot size must be consistent by timber type and count plots are not permitted in fixed area plots. Border plots are permitted in fixed area plots.

The standard method is sampling in a finite population without replacement. Once a plot has been measured on 0.08 ha, this particular 0.08 ha is withdrawn from the population and it is not permitted to be sampled again. If the sampling intensity is greater than 5 percent of the total merchantable area the basic equation for determining the number of plots required is:

$$\left(\frac{\left(t^2\ x\ CV^2\right)}{\left(E^2\right)}\right)\left(\frac{N-n}{N}\right)\ where$$

t	=	probability factor
CV	=	coefficient of variation
E	=	error objective in percent
N	=	total possible number of plots in the sale
n	=	actual number of plots in the sale
N-n/N	=	the finite population multiplier

By algebraic manipulation the above equation for number of plots required can be transformed into the more familiar form of:

$$n = \frac{(t^2\ x\ CV^2\ x\ N)}{(N\ x\ E^2 + t^2\ x\ CV^2)}\ \text{where}$$

n = number of plots required and the other terms are as defined above.

This equation may also be used for plot sampling, but only if the sampling intensity is 5 percent or less.

When stratified sampling is used, an average weighted coefficient of variation must be determined. This value is used in the equation to calculate the total number of plots required. For example:

	Type Area		Area X	Proportional	Weighted CV	
Type	**Hectares**	**Av. Volume/ha**	**Av. Vol.**	**(Area x Vol)**	**CV**	**(P x CV)**
F P1	12	272	3 264	0.43	30	12.9
P1	12	134	1 608	0.21	50	10.5
P1 F	16	171	2 736	0.36	40	14.4
	40		7 608	1.00		37.8

If this 40 ha timber sale is to be sampled with 0.1 ha plots and a sampling accuracy of *plus or minus* 15.0% at 2 SE, the required number of samples is:

$$n = \frac{(t^2\ x\ CV^2\ x\ N)}{(N\ x\ E^2 + t^2\ x\ CV^2)} \qquad = \frac{((2)^2\ x\ (38)^2\ x\ 400)}{(400\ x\ (15)^2 + (2)^2\ x\ (38)^2)}$$

$$= \frac{(4\ x\ 1444\ x\ 400)}{(400\ x\ 225 + 4\ x\ 1444)} \qquad = \frac{(5776\ x\ 400)}{(90000 + 5776)} \qquad = \frac{(2310400)}{(95776)}$$

= 24

(Note N= 40 ha/ 0.1 ha = 400)

The probability factor (t=2.069) for n -1 (24-1=23) can be found in the Distribution of ‘t’ table in the appendices.

This new probability factor (t) replaces t=2 and is then used to calculate a new "n", which equals 26. These 26 samples are then distributed among the three types as follows:

$$n_1 = \frac{PCV_1}{PCV}\ x\ n\ etc. \qquad = F - Pl; n = \frac{12.9}{37.8}\ x\ 26 = 9$$

$$Pl; n = \frac{10.5}{37.8}\ x\ 26 = 7 \qquad Pl - F; n = \frac{14.4}{37.8}\ x\ 26 = 10$$

Exact estimates of type size, volume and coefficient of variation are not necessary in advance of cruising to predict sampling requirements. Reasonable approximations are sufficient (e.g. adjacent cruise information) to establish correct relative intensities of sampling for each type.

The sampling error objective (e.g., plus or minus 15 percent, 19 times out of 20) for scale based cruises is for the total net volume per hectare of the cutblocks, and the basis for estimating the number of samples required to meet this objective is the forest types within the area to be cut and their relative volumes.

7.1.2. Variable-Plot Sampling (Prism or Relaskop)

In Variable-Plot (prism) cruising, every tree has its own plot size because the radius of the plot varies directly with the DBH of the tree. The area of the plot is directly proportional to the basal area of the tree DBH it represents. Therefore, the relationship of the basal area of one tree to its plot area is the same as the relationship on a per hectare basis. Basal area per hectare, for a given prism, is the same for every tree in the plot regardless of its DBH or plot size.

Supporting mathematical calculations are as follows. For a 5.0 diopter prism:

Basal Area Factor (m^2/ha)	=	6.25
Plot Radius Factor	=	0.2
DBH	=	30 cm
DBH	=	90 cm
Basal Area of a 30 cm tree	=	0.07069 m^2
Basal Area of a 90 cm tree	=	0.63617 m^2

The plot radius for a 30 cm tree = 0.2 x 30 = 6.0 m. Therefore, a 30 cm tree is counted if it falls within 6.0 m of the sample point.

The area of 6 m radius plot is 113.098 m^2 or 0.01131 ha, hence there are 88.425 plots per hectare. Therefore, one counted tree represents 88.425 trees per hectare and a basal area per hectare of 88.425 x 0.07069 or 6.25 m^2.

Similarly, a 90 cm tree has a plot radius of 0.2 x 90 = 18.0 m and an area of 1017.878 m^2 or 0.10179 ha. Hence there are 9.824 plots per hectare and one counted tree represents 9.824 trees per hectare and a basal area per hectare of 9.824 x 0.63617 or 6.25 m^2.

In the foregoing example, it is shown that each tree regardless of DBH, contributed 6.25 m^2 of basal area per hectare. The Basal Area Factor of the prism used was 6.25 m^2/ha. Therefore, total basal area per hectare can be calculated directly by multiplying stem count per point x basal area factor. This value is all that can be calculated directly.

In order to obtain volume per hectare it is necessary to measure DBH on all or some of the samples. There are several possible methods of calculating volume per hectare, depending on the method of sampling used and the type of information required (e.g., total volume per hectare, volume per hectare by species).

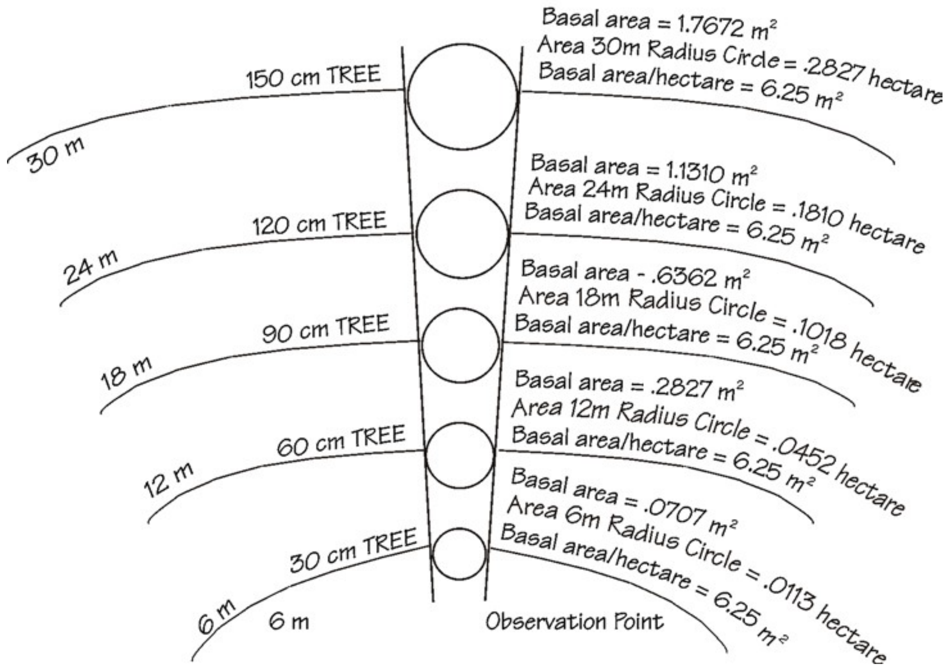


Figure 7-1 Illustration of Basal Area/Hectare

This figure shows why each tree tallied in a plot, regardless of its diameter, has an equal effect on the basal area per hectare. In this example, a 6.25 BAF (5.000 diopter) wedge prism was used, but any BAF or diopter size would still result in equal weighting for each tree.

7.1.3. Variable Plot Sample Size

The factors for selecting the prism basal area factor (BAF) are the size of the trees and the density of the stand.

Samples that include a small number of trees per point generally result in a higher variance than samples with larger numbers of trees. As the number of trees increase, a point is reached where a further decrease in basal area factor and a corresponding increase in tree count results in only a slight gain in precision. If a sample contains more than ten trees it is statistically inefficient because it only repeats the information that is obtained from a smaller sampling unit.

The choice of plot size (BAF) will influence the amount of sampling required to achieve the sampling error because sampling intensity depends on the coefficient of variation.

Prism sampling can be thought of as sampling in an infinite population, since there are an “infinite” number of prism points in the area to be cruised. Prism sampling can also be thought of as sampling in a finite population with replacement, since a given tree may be included in more than one sample. In either case the finite population multiplier is not required and the equation for determining the number of plots required becomes:

$$n = \frac{t^2 \times CV^2}{E^2}$$

t	=	probability factor
CV	=	coefficient of variation
E	=	error objective in percent
n	=	number of plots

A spreadsheet that can be used to calculate variable plot sample size can be accessed at the following website:

Cruising Calculations

7.1.4. Coefficient of Variation (CV)

The coefficient of variation is the standard deviation expressed as a percentage of the mean volume.

The coefficient of variation is unique for each timber type and may also vary with the timber merchantability specifications.

The coefficient of variation may be estimated from:

1. Plots previously measured in the same timber types.
2. A pre-cruise of the stand.
3. A general knowledge of the timber types to be harvested.

The CV is calculated as shown in the following example:

Plot #	Plot Volume/ha	Plot Vol/ha Squared	
1	119	14161	Standard deviation (SD)
2	130	16900	$= \sqrt{\frac{\left(\sum(x^2) - \frac{(\sum x)^2}{(n)}\right)}{(n-1)}}$
3	79	6241	
4	215	46225	
5	46	2116	
6	223	49729	
7	164	26896	
8	317	100489	$= \sqrt{\frac{\left(362145 - \frac{2123^2}{(16)}\right)}{(16-1)}} = 73$
9	160	25600	
10	42	1764	
11	77	5929	
12	105	11025	Coefficient of Variation (CV)
13	54	2916	
14	151	22801	$= \frac{(SD)}{mean}\ x\ 100$
15	108	11664	
16	133	17689	
Sum	**2123**	**362145**	$= \frac{(73)}{133}\ x\ 100 = 55$ percent
Mean (x)	**133**		

7.2. Appendix 2: Age and Height Class Limits

Age in Tens					
Age	**Limits**	**Age**	**Limits**	**Age**	**Limits**
1	1-10	10	91-100	19	181-190
2	11-20	11	101-110	20	191-200
3	21-30	12	111-120	21	201-210
4	31-40	13	121-130	22	211-220
5	41-50	14	131-140	23	221-230
6	51-60	15	141-150	24	231-240
7	61-70	16	151-160	25	241-250
8	71-80	17	161-170	26	251-260
9	81-90	18	171-180	27	261-270

Height Class Limits for Height in Threes					
Height	**Limits**	**Height**	**Limits**	**Height**	**Limits**
3	0.0-4.4	24	22.5-25.4	45	43.5-46.4
6	4.5-7.4	27	25.5-28.4	48	46.5-49.4
9	7.5-10.4	30	28.5-31.4	51	49.5-52.4
12	10.5-13.4	33	31.5-34.4	54	52.5-55.4
15	13.5-16.4	36	34.5-37.4	57	55.5-58.4
18	16.5-19.4	39	37.5-40.4	60	58.5-61.4
21	19.5-22.4	42	40.5-43.4	63	61.5-64.4

7.3. Appendix 3: Circular Error Probability (CEP) Method

This section has been provided for additional information. The standard to be used in audits is in section 3.5.

CEP, as it applies to cruise plots and GPS technology, is defined as the radius of a circle (n), centered around the mean, whose boundary is expected to include 50% of the cruise plot location attempts. The distance between the CEP (n) and two times this radius (2n) is where 43% of the plot location attempts would be expected. In addition, the distance between two times CEP (2n) and three times this radius (3n) is where the remaining 7% of the plot location attempts would be expected.

Figure 7.2 Circular Error Probability demonstrates the CEP concept. In this diagram, there are a total of 100 plot location attempts (represented by stars). These stars do not represent the GPS coordinates or hits, but rather represent established plot locations. Fifty (50%) of the stars fall within the smallest circle, which has a radius of “n”. An additional 43 (43%) of the stars fall in the space between the outer boundaries of the smallest and middle circle, or 93% fall within “2n”. The remaining 7 (7%) of the stars fall in the space between the outer boundaries of the middle and largest circle, which means 100% of the stars fall within “3n”.

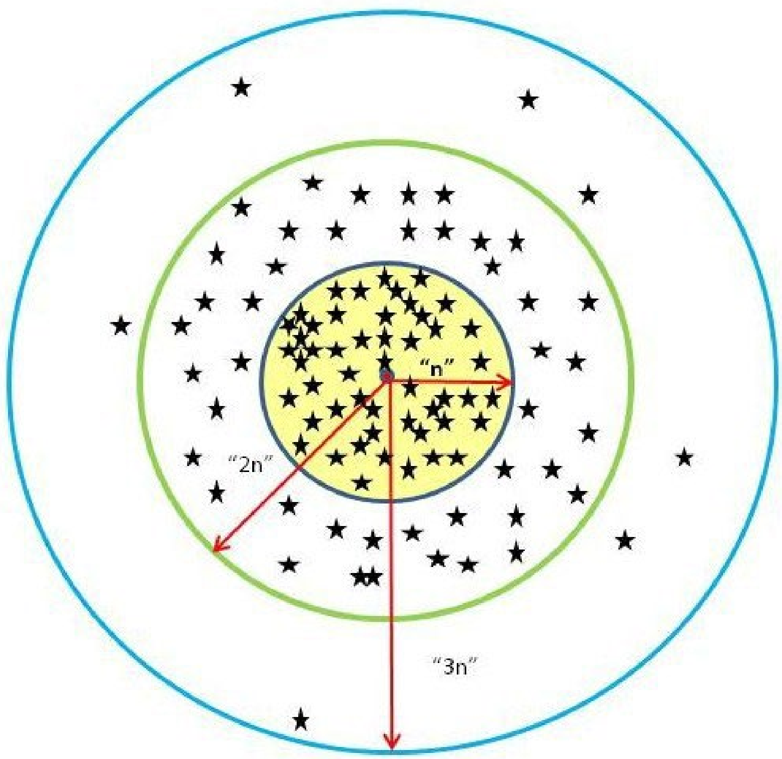


Figure 7-2 Circular Error Probability

The CEP tolerance or "n" for check cruising purposes will be 2.5m. The check cruise plot location will be considered to be the mean. The CEP standard means that:

a. 50% of all cruise plots checked should be within 2.5 m of the respective check cruise plot location. (This standard has been removed to streamline the standards).
b. 90% of all cruise plots checked must be within 5.0 m of the respective check cruise plot location

Although the CEP method states that 100% of the cruise plots checked should be within 7.5 m of their respective check cruise plot locations when the CEP is 2.5m, this standard is omitted to allow for anomalies.

<u>Figure 7.3 Example of Circular Error Probability Theory in Check Cruising</u> diagrams show the location of 5 cruise plot locations in relation to their respective check cruise plots. The distances from the cruise plot locations to the check cruise plots are: 0.7 m, 1.9 m, 2.3 m, 3.9 m and 4.6 m.

The variation of the cruise plot locations is 2.7 m ((0.7+1.9+2.3+3.9+4.6)/5). Sixty percent (60%) of the cruise plots (3/5) are within 2.5 m of their check cruise plot locations. In addition, 100% of the cruise plots are within 5.0 m of their check cruise plot locations. This cruise data would not be rejected based on plot location data using the CEP method.

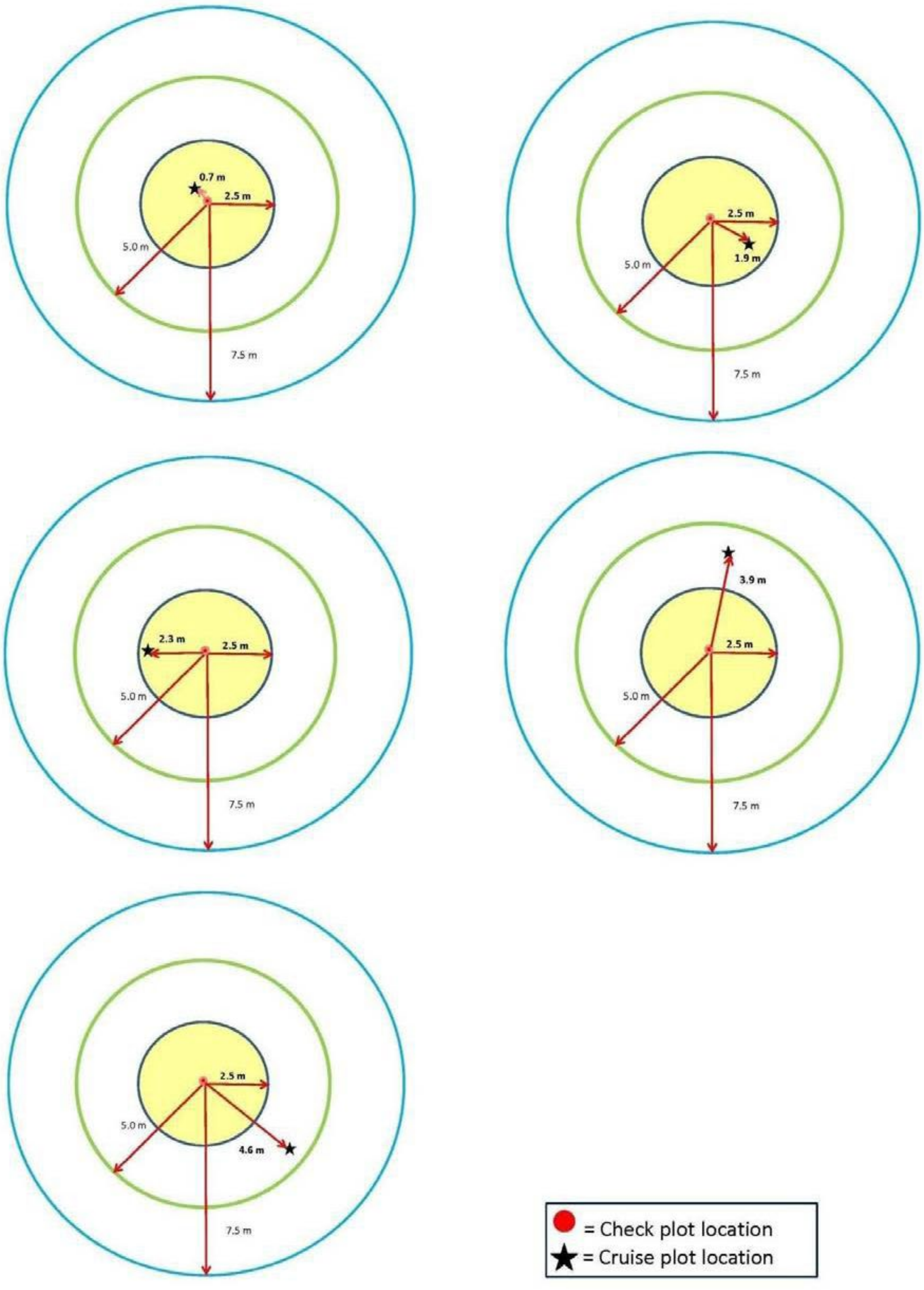


Figure 7-3 Example of Circular Error Probability Theory in Check Cruising

7.4. Appendix 4: Combined GPS and Conventional Traverse Procedure

To calculate the closing error for traverses which have a combination of conventional traversing (using a compass, clinometer and metric tape or electronic measuring device) and Global Positioning Systems (GPS) traversing:

1. Calculate the bearing and distance between the first GPS point (end of conventional traverse) and the last GPS point (beginning of conventional traverse).

   On the Internet go to:

   http://a100.gov.bc.ca/pub/mascotw/

   and:

   a. select Survey Utilities,
   b. select Computations on the Ellipsoid,
   c. select Compute Geodetic Observations using the Inverse Problem,
   d. input the latitude [Degrees (45-65), Minutes (00-59), Seconds (0.00000-59.99999)] of the first GPS point under OCCUPIED,
   e. input the longitude [Degrees (109-145), Minutes (00-59), Seconds (0.00000-59.99999) of the first GPS point under OCCUPIED,
   f. input the latitude [Degrees (45-65), Minutes (00-59), Seconds (0.00000-59.99999)] of the last GPS point under SIGHTED,
   g. input the longitude [Degrees (109-145), Minutes (00-59), Seconds (0.00000-59.99999) of the last GPS point under SIGHTED, and
   h. click on “Do Calculation” or hit the “Enter” key and the program will calculate the Azimuth bearing and the distance between the two GPS points.

2. Option to calculate the conventional azimuth bearings from UTM Northing and Easting GPS readings:

   a. select Survey Utilities,
   b. select Mapping Plane Computation,
   c. select Compute Grid Observations using the Inverse Problem,
   d. input the Northing of the first GPS point under OCCUPIED,
   e. input the Easting of the first GPS point under OCCUPIED,
   f. input the Northing of the last GPS point under SIGHTED,
   g. input the Easting of the last GPS point under SIGHTED, and
   h. click on “Do Calculation” or hit the Enter key, and the program will calculate the azimuth bearing and the distance between the two GPS points.

> There is a free MS-DOS executable file at this site that can be downloaded into your computer for future use.

3. Use the calculated bearing and distance between the first and last GPS points to close the conventional portion of the traverse and determine the closing error.
4. The closing error determined in Step 2 is used to determine if the traverse meets the closure error requirement in Section 3.5.

7.5. Appendix 5: Cruise Compilation Loss Factor Tables

The loss factor tables listed in this manual will be used for appraisal cruises. This list is the reference for Cruise Compilation and the auditing of Cruise Compilations. Refer to the following web utility to find the Forest Inventory Zone and Special Cruise Number to cross reference to Appendix 5: Table 7.5.6.

Map View can be accessed on the Internet at:

.http://webmaps.gov.bc.ca/imfs/imf.jsp?site=mapview

7.5.1. PSYU Cross Reference Procedure

1. Open MAPVIEW and follow one of the processes below:
    a. If the cutblock mapping information has been uploaded:
        i. Find the Feature Search option from the '*Forest Tenures*' tab (e.g. Tenure Cutblock, Tenure Harvest Authority, etc.). If you have access to FTA (Forest Tenures Administration) and the permit is in FTA, the cutblock screen has a link to MAPVIEW that will take you right to the cutblock.
        ii. Enter the search criteria and select search. Letters used in the licence and CP should be capitalized (i.e. A12345, not a12345).
    b. If the cutblock mapping information has not been uploaded, or if a search is being completed for information purposes:
        i. Under the '*Navigation*' tab, select one of the search functions or zoom to the desired location.
2. Once the cutblock or area of interest has been located, follow these steps:
    a. Under the '*Navigation*' tab, select '*Map Layers*'.
    b. Expand the '*Administrative Boundaries*' category.
    c. Select the boxes beside '*Public Sustained Yield Units - Outlined*' and '*Forest Inventory Region Compartment- Outlined*'.
    d. Select the '*Identify*' symbol at the top up the page (under navigation tab).
    e. Click on the map location that you want to define.
    f. The results are displayed on the left side of the map.
    g. Among the results highlighted in blue at the left hand side of the map, there should be one or more 5 digit numbers for PSYU (e.g.10706). Select each number until the pop up screen indicates the Special Cruise Number under the '*Attributes*' tab.
    h. Find the SCN in the Tabular Listing of Table Numbers in Appendix 5: Table 7.5.4. The corresponding administrative unit (e.g., *PSYU #*) and *FIZ* are listed on the same

row.

i. To check the FIZ, re-select '*Map Layers*' under the '*Navigation*' tab.

j. Expand the '*Land Cover*' category.

k. Select the box beside '*Vegetated Land Cover*'.

l. Select the '*Identify*' symbol at the top up the page (under navigation tab).

m. Click on the map location you want to define.

n. The results are displayed on the left side of the map.

o. Among the results highlighted in blue at the left hand side of the map, there should be one or more 7 digit numbers for PSYU (e.g.3391115). Select one of these numbers.

p. Scroll down the list under the attributes tab until you find FIZ Code.

7.5.2. Tree Farm Licences

The TFL loss factors are the same as those approved by the Chief Forester in the Management Plans (MP). This manual will be updated as new Management Plan's result in loss factors changes. All "local" factors noted below apply only to mature volumes (i.e., 121 years or greater). Timber Licences in the TFL's use the TFL loss factors and Timber Licences outside of the TFL will use the *Metric Diameter Class Decay, Waste And Breakage Factors 1976*.

All loss factors referenced in the following lists refer to the Ministry of Sustainable Resources Management publication entitled: *Metric Diameter Class Decay, Waste And Breakage Factors 1976*.

7.5.2.1. TFL Loss Factors for Coast Forest Region (Table 7.5.1)

TFL 6	Kingcome locals for Cedar and Hemlock. All others FIZ "B"
TFL 10	All FIZ "B"
TFL 19	Nootka local for mature Hemlock. All others FIZ "B"
TFL 25	Area #1 (Dean PSYU) - Kingcome locals for Cedar and Hemlock. All others FIZ "A" Area #2 (Quadra PSYU) - Kingcome locals for Cedar and Hemlock. All others FIZ "B" Area #3 (South Island) - All FIZ "B" Area #4 (Old TFL 24 – Queen Charlotte Is.) – use FIZ A for all species and maturity classes.
TFL 26	Vancouver locals for Hemlock and Balsam (*Abies* sp). All others FIZ "C".

TFL 37	Kingcome locals for mature cedar and hemlock for decay and waste. All other species use FIZ "B" decay and waste. Company breakage factors for all species and maturity classes.
TFL 38	Soo locals for Hemlock and Balsam (*Abies* sp). All others FIZ "B"
TFL 39 Blocks 1, 2, 4, 5	*Currently an exemption is in effect. Underlying PSYU loss factors are to be used in this TFL until further notice.
Blocks 3, 6 and 7	Company decay and waste factors and FIZ "A" breakage factors for mature. All other maturity classes are FIZ "A" (Queen Charlotte Islands).
TFL 43	Northern Blocks - Use FIZ "A" - Kingcome locals for Cedar and Hemlock. Homathko Block - Use FIZ “B”. Fraser Block - Dewdney (Chilliwack) locals for Hemlock and Balsam (*Abies* sp). All others FIZ "C"
TFL 44	*Currently an exemption is in effect. Underlying PSYU loss factors are to be used in this TFL until further notice.
TFL 45	Area #1 (old TFL 17) - Kingcome locals for Cedar and Hemlock. All others FIZ "A". Area #2 (old TFL 36) - All FIZ "B".
TFL 46	Nootka local for Hemlock. All others FIZ "B".
TFL 47	Area #1 (majority) - Kingcome locals for Cedar and Hemlock. All others FIZ "B". Area #2 (4 small islands) - Kingcome locals for Cedar and Hemlock. All others FIZ "A". Area #3 - Haida Gwaii (formerly Queen Charlottes) - All FIZ "A".
TFL 54	Nootka locals for hemlock. All others FIZ "B".
TFL 57	Nootka locals for hemlock. All others FIZ "B".
TFL 61	All FIZ "B"

7.5.2.2. TFL Loss Factors for Northern Interior Forest Region (Table 7.5.2)

TFL 1	Skeena (Terrace) - locals for Balsam (*Abies* sp). All others FIZ "A" or "J".
TFL 41	Skeena (Terrace) - locals for Hemlock and Balsam (*Abies* sp). All others FIZ "A".
Old TFL 51	(Now Cranberry TSA).
Skeena (Kitwanga)	locals for Hemlock and Balsam (*Abies* sp). All others FIZ "J".
TFL 30	Monkman locals for Cedar, Hemlock, Balsam (*Abies* sp), and Spruce. All others FIZ "I"
TFL 42	Stuart locals for Balsam (*Abies* sp) and Spruce. All others FIZ "I"
TFL 48	All FIZ "L"
TFL 53	Naver locals for Hemlock, Balsam (*Abies* sp) and Spruce. All others FIZ "H, I"

7.5.2.3. TFL Loss Factors for Southern Interior Forest Region (Table 7.5.3)

TFL 15	All FIZ "D".
TFL 18	Raft locals for Cedar and Hemlock. All others FIZ "G".
TFL 33	Eagle locals for Cedar and Hemlock. All others FIZ "G".
TFL 35	All FIZ "D" or "G".
TFL 49	Area #1 (old TFL's 9 and 32) - Okanagan locals for Fir (*Pseudotsuga*), Cedar and Hemlock. All others FIZ "D". Area #2 (old TFL 16) - Kamloops local for Fir (*Pseudotsuga*). All others FIZ "D".
TFL 3	Slocan locals for Cedar and Hemlock. All others FIZ "G".
TFL 8	Kettle locals for Spruce and Lodgepole Pine. All others FIZ "E".
TFL 13	All FIZ "F".
TFL 14	Lardeau locals for mature Cedar and Hemlock. All others FIZ "G".

TFL 23 - as located South of Highway 1	Nakusp locals for Cedar and Hemlock. All others FIZ "G".
TFL 55	Arrowhead locals for Cedar and Hemlock. All others FIZ "G".
TFL 56	Arrowhead locals for Cedar and Hemlock. All others FIZ "G".
TFL 5	All FIZ "H".
TFL 52	Cottonwood locals for Cedar, Hemlock, Balsam (*Abies* sp.) and Spruce. All others FIZ "I".

7.5.3. Other Tenures

1. For all tenures other than TFL's the appropriate loss factor tables are determined as per: *Metric Diameter Class Decay Waste And Breakage Factors 1976.* The SCN found in Mapview and the corresponding loss factors must be used. There is no option to choose one table over another. Where a non-TFL tenure is geographically within a TFL (was formerly TFL), the loss factors used in the TFL and non TFL tenures should be the same, ensuring the MPS works as intended. If there are any discrepancies, these should be brought to the attention of Timber Pricing Branch and spatial data will be corrected.

The only authorized exceptions are:

2. The deletion of Stum/Chilko locals for mature Lodgepole Pine. FIZ "H" factors now apply in the Stum and FIZ "B" or "H" in the Chilko PSYU.
3. The use of 10 percent decay, 0 percent waste and 5 percent breakage for all risk groups and diameter classes for cottonwood 41+ years in F.I.Z. A, B and C.
4. Special Cruise Number (SCN) #233 - is for Denman, Hornby, Gabriola, Valdes, Galiano, Thetis, Kuper, Mayne, Prevost, Saltspring, North Pender, South Pender, Saturna, Moresby, Portland, Sidney, James and the Saanich Peninsula. Use FIZ C and the Vancouver PSYU.

SCN #234 - is for the E&N Lands within the Quadra PSYU. Use FIZ B and the Quadra PSYU.

SCN #235 - is for the crown portion of the E&N Lands within the South Island Forest District and the Nootka PSYU with the exception of all the Gulf Islands. Use FIZ C and the Vancouver PSYU.

Note - The southern boundary between SCN#233 and SCN #235 runs from the head of Finlayson Arm west for a short distance and then approximately S30W by Empress

Mountain and Bluff Mountain to just east of Shirley. The northern boundary between SCN #235 and SCN #234 runs along the boundary between the Nootka and Quadra PSYUs.

5. The Greater Vancouver Water District uses the Vancouver PSYU locals for hemlock and balsam (*Abies* sp.).
6. Those portions of the old TFL 23 block located north of Highway 1 and not included in TFL's 55 and 56 will use the Arrowhead PSYU loss factors.
7. Any cruises that are in the areas that overlap between the Purden and Longworth PSYUs will use the PSYU with the greatest amount of area in the cruise. Contact the Northern Interior Forest Region Cruising Coordinator for the region and compartment numbers that occupy the overlap areas.

All references are to mature factors unless otherwise indicated.

7.5.4. Tabular Listing of Table Numbers (Table 7.5.4)

The following listing is provided for easy reference and compilation edit checks.

	Mature							OI.	MAT.	
PSYU/ SSA / TSA /TFL	**PSYU #**	**SCN #**	**F**	**C**	**H**	**B**	**S**	**PL**	**PL**	**FIZ**
Public Sustained Yield Units										
Adams	01	146		95	87					G
Alsek	02	266								K
Arrowhead	03	125		93	89					G
Ashnola	04	181	98							D
Babine	05	134				93	99			H, I
Barriere	06	113		95	87					G
Barton Hill	07	182	98							D
Bell Irving	08	190			91					J
Big Bar	09	142	99							D
Big Valley	10	152				92	98			I
Blueberry	11	178								L
Botanie	12	144	98							D
Boundary	13	199								A, K
Bowron	14	151		96	90	92	98			I
Burns Lake	15	154								H I

Canoe	16	184		92	86					G
Carp	17	116				91	97			I
Chilko	18	147						98		B, H
Cottonwood	19	122		98	90	92	98			I

Not all of the Tree Farm Licence "Identify Results" attributes are available at this time.

	Mature							Ol.	MAT.	
PSYU/ SSA / TSA /TFL	**PSYU #**	**SCN #**	**F**	**C**	**H**	**B**	**S**	**PL**	**PL**	**FIZ**
Public Sustained Yield Units										
Cranbrook	20	186								E, F
Creston	21	130								E
Crooked River	22	117				91	97			I
Dean	23	165								A
Dease - Proposed	25	262								K
Dewdney:	26	193								
Chilliwack Portion	- 1				99	99				C, D
Yale Portion	- 2				95	98				C
Harrison Portion	- 3				99	99				C
Eagle	27	150		94	85					G
Edgewood	28	126								E, G
Fernie	29	161								F
Finlay	30	189					96			I, K
Fontas - Proposed	31	198								L
Fort Nelson - Proposed	32	185								L
Granby	33	170								E
Hecate	34	173								A, J
Kamloops	35	261	98							D, G
Ketchika - Proposed	36	264								K
Kettle	37	124					95		97	E
Kinbasket	38	175		92	86					G

Not all of the Tree Farm Licence "Identify Results" attributes are available at this time.

	Mature							OI.	MAT.	
PSYU/ SSA / TSA /TFL	**PSYU#**	**SCN#**	**F**	**C**	**H**	**B**	**S**	**PL**	**PL**	**FIZ**
Public Sustained Yield Units										
Kingcome	39	195		99	98					A, B
Klappan - Proposed	40	127								K
Kluskus	41	289								H
Kotcho - Proposed	42	191								L
Lac La Hache	43	141	99	98						D, G, H
Lardeau	44	160		91	84					G
Liard - Proposed	45	145								L
Longworth	46	153		96	90	92	98			G
Moberly	47	177								L
Monkman	48	174		96	90	92	98			I
Morice	49	132		13	12	93	99			H, J
Nakusp	50	128		91	84					G
Narcosli - P.H.A. #5	51	137								H
Naver	52	121			90	92	98			H, I
Nechako - P.H.A #1	53	168								H, I
Nehalliston - P.H.A. #2	54	159								G
Nicola	55	111	98							D
Niskonlith - P.H.A. #2	56	114								D, G
Nootka	57	196			96					B
North Thompson	58	158		97	88					G
Okanagan	59	187	98	94	85					D, E

Not all of the Tree Farm Licence "Identify Results" attributes are available at this time.

	Mature							OI.	MAT	
PSYU/ SSA / TSA /TFL	**PSYU #**	**SCN #**	**F**	**C**	**H**	**B**	**S**	**PL**	**PL**	**FIZ**
Public Sustained Yield Units										
Ootsa	60	155								H
Parsnip	61	149				91	97			I
Peace - P.H.A. #7	62	162								L
Purden	63	119		96	90	92	98			I
Quadra (includes all of the islands in Howe Sound)	64	194								B
Haida Gwaii (formerly Queen Charlotte)	65	166								A
Quesnel Lake	66	109		98	90	92	98			D, G, H
Raft	67	183		97	88					G
Rivers Inlet	68	103								A
Robson	69	176		96	90	92	98			G
Salmo	70	180								E, G
Salmon Arm	71	115		94	85					D, G
Shuswap	72	171		95	87					G, D
Sikanni - Proposed	73	197								L
Similkameen	74	110	98							D
Skeena	75	169								
Terrace Portion	-1				94	96				A, J
Kitwanga Portion	-2				93	95				J
Hazelton Portion	-3				92	94				J
Slocan	76	129		91	84					G
Smithers	77	133		13	12	93	99			I, J

Not all of the Tree Farm Licence "Identify Results" attributes are available at this time.

	Mature							Ol.	MAT.	
PSYU/ SSA / TSA /TFL	**PSYU #**	**SCN #**	**F**	**C**	**H**	**B**	**S**	**PL**	**PL**	**FIZ**
Public Sustained Yield Units										
Soo	78	156			97	97				C
Spallumcheen	79	112		94	85					D, G
Stikine	80	172			91					K
Stuart Lake	81	135				91	97			I
Stum	82	140	99					98		H
Takla	83	188				91	97			I
Taku - Proposed	84	263								K
Upper Kootenay	85	131								F
Vancouver (includes Furry CK SSA)	86	179			99	99				C
Wapiti	87	192								L
Westlake	88	118				92	98			H, I
Williams Lake	89	123	99							D, H
Willow River	90	120			90	92	98			I
Windermere	91	136								F
Yalakom	92	143	99							D
Special Sale Area										
Dawson Creek	S05	265								L
Fort St James	S02	243				91	97			I
Prince George - Quesnel	S04	251	99			92	98			H, I, G
Tree Farm Licence										
TFL 1 - Terrace	01	301				96				A, J
TFL 3	03	303		91	84					G

Not all of the Tree Farm Licence "Identify Results" attributes are available at this time.

	Mature							Ol.	MAT.	
PSYU/ SSA / TSA /TFL	**PSYU #**	**SCN#**	**F**	**C**	**H**	**B**	**S**	**PL**	**PL**	**FIZ**
Public Sustained Yield Units										
TFL 5	05	305								H
TFL 6	06	306		99	98					B
TFL 8	08	308					95		97	E
TFL 10	10	310								B
TFL 13	13	313								F
TFL 14	14	314		91	84					G
TFL 15	15	315								D
TFL 18	18	318		97	88					G
TFL 19	19	319			96					B
TFL 23	23	323		91	84					G
TFL 25	25	343								
Dean PSYU	-1			99	98					A
Quadra PSYU	-2			99	98					B
South Island	-3									B
Haida Gwaii (formerly Queen Charlotte Is.) (Old TFL 24)	-4									A
TFL 26	26	342			99	99				C
TFL 30	30	325		96	90	92	98			I
TFL 33	33	339		94	85					G
TFL 35	35	332								D, G
TFL 37	37	347		99	98	Kingcome Locals and company breakage factors				B

Not all of the Tree Farm Licence "Identify Results" attributes are available at this time.

	Mature							OI.	MAT.	
PSYU/ SSA / TSA /TFL	PSYU #	SCN#	F	C	H	B	S	PL	PL	FIZ
Public Sustained Yield Units										
TFL 38	38				97	97				B
TFL 39 Blks 1,2,4,5	39	344	Company DW & FIZ "B" breakage factors for mature.							B
Blks 3,6 & 7	39	344	Company DW & FIZ "A" breakage factors for mature.							A
TFL 41	41	341			94	96				A
TFL 42	42	458				91	97			I
TFL 43	43	469								
Northern Blocks	-1	469		99	98					A
Fraser Block	-2	469			99	99				C
Homathko Block	-3	469								B
TFL44	44	471	Company DW & FIZ "B" breakage factors for mature.							B
TFL 45	45	456								
old TFL 17	-1	456		99	98					A
old TFL 36	-2	456								B
TFL 46	46	457			96					B
TFL 47	47	470								
majority	-1	470		99	98					B
4 small islands	-2	470		99	98					A
Haida Gwaii (formerly Queen Charlottes)	-3	470								A

Not all of the Tree Farm Licence "Identify Results" attributes are available at this time.

	Mature							Ol.	MAT.	
PSYU/ SSA / TSA /TFL	**PSYU #**	**SCN#**	**F**	**C**	**H**	**B**	**S**	**PL**	**PL**	**FIZ**
Public Sustained Yield Units										
TFL 48	48	474								L
TFL 49	49	472								
old TFL 9 & 32	-1		98	94	85					D
old TFL 16	-2		98							D
TFL 51 - Kitwanga (Cranberry TSA)	51	473	93	95						J
TFL 52	52	477		98	90	92	98			I
TFL 53	53	476			90	92	98			H, I
TFL 54	54	478			96					B
TFL 55	55	479		93	89					G
TFL 56	56	481		93	89					G
Watersheds										
G. Van. W. D.	01	354			99	99				C

Not all of the Tree Farm Licence "Identify Results" attributes are available at this time.

Parks	PSYU #	SCN #	FIZ	Parks	PSYU #	SCN#	FIZ
Apex Mountain	01	648	D	Manning	22	542	D
Birkenhead Lake	02	684	C	Monashee	23	666	G
Bowron Lake	03	650	G	Mount Assiniboine	24	548	F
Boya Lake	04	791	K	Mount Edziza	25	690	J
Cape Scott	05	1000	A	Mount Revelstoke	26	503	G
Cathedral	06	760	D	Mount Robson	27	549	G
Champion Lakes	07	511	E	Mount Seymour	28	550	C

Parks	PSYU #	SCN #	FIZ	Parks	PSYU #	SCN#	FIZ
Crooked River	08	774	I	Muncho Lake	29	595	L
Cultus Lake	09	515	C	Naikoon	30	1067	A
Darke Lake	10	516	D	Pacific Rim	31	676	B
Elk Falls	11	519	B	Sasquatch	32	619	C
Eneas Lakes	12	755	D	Silver Star	33	757	D
Garibaldi	13	525	C	Skagit River	34	688	C, D
Glacier	14	501	G	Stagleap	35	704	E
Golden Ears	15	674	C	Stone Mountain	37	596	L
Hamber	16	564	G	Strathcona	38	590	B
Kikomun Creek	17	698	F	Tweedsmuir	39	567	H
Kokanee Glacier	18	535	G	Wells Gray	40		G
Kootenay	19	502	G	White Pelican	41	568	H
Liard River Hot Springs	20	594	L	Yoho	42	504	G
Little Qualicum Falls	21	539	B	Other - not specified	99	675	

Not all of the Tree Farm Licence "Identify Results" attributes are available at this time.

7.5.5. Tree Class Modification of Loss Factor Tables (Table 7.5.5)

Coniferous All Forest Inventory Zones				Lodgepole Pine All Forest Inventory Zones			
Age in	Tree Classes			Age in	Tree Classes		
10's	1, 2, 3, 4, 6	5, 7	8, 9	10's	1, 2, 3, 4, 6	5, 7	8, 9
2	YI	M	YI	2	YI	M	YI

Coniferous All Forest Inventory Zones				Lodgepole Pine All Forest Inventory Zones			
Age in	**Tree Classes**			**Age in**	**Tree Classes**		
3	YI	M	YI	3	YI	M	YI
4	YI	M	YI	4	YI	M	YI
5	YI	M	YI	5	YI	M	YI
6	YI	M	YI	6	YI	M	YI
7	YI	M	YI	7	OI	M	YI
8	YI	M	YI	8	OI	M	YI
9	OI	M	YI	9	OI	M	YI
10	OI	M	YI	10	OI	M	YI
11	OI	M	YI	11	OI	M	YI
12	OI	M	YI	12	OI	M	YI
13	M	M	OI	13	M	M	OI
14	M	M	OI	14	M	M	OI
15	M	M	OI	15	M	M	OI
16	M	M	OI	16	M	M	OI
25	M	M	OI	25	M	M	OI

Deciduous F.I.Z. A - L Except Aspen and Cottonwood F.I.Z. K & L				**Aspen & Cottonwood F.I.Z. K & L**			
Age in	**Tree Classes**			**Age in**	**Tree Classes**		
10's	1, 2, 3, 4, 6	5, 7	8, 9	10's	1, 2, 3, 4, 6	5, 7	8, 9
2	YI	M	YI	2	YI	M	YI
3	OI	M	YI	3	YI	M	YI
4	OI	M	YI	4	YI	M	YI
5	M	M	OI	5	OI	M	YI
6	M	M	OI	6	OI	M	YI
7	M	M	OI	7	OI	M	YI
8	M	M	OI	8	OI	M	YI
9	M	M	OI	9	M	OM	OI
10	M	M	OI	10	M	OM	OI
11	M	M	OI	11	M	OM	OI
12	M	M	OI	12	M	OM	OI
13	M	M	OI	13	M	OM	OI
14	M	M	OI	14	M	OM	OI
15	M	M	OI	15	M	OM	OI
16	M	M	OI	16	M	OM	OI
26	M	M	OI	26	OM	OM	OI

YI = Young Immature OI = Older Immature M = Mature OM = Over Mature

7.5.6. Forest Inventory Zone Series Number (Table 7.5.6)

FOREST INVENTORY
ZONE SERIES NUMBERS
SPECIES

	Douglas Fir			Western Red Cedar			Hemlock			Balsam			Spruce			Yellow Cedar			White Pine			Lodgepole Pine		
F.I.Z.	YI	OI	M	YI	OI	M	YI	OI	M	YI	OI	M	YI	OI	M	YI	OI	M	YI	OI	M	YI	OI	M
A	01	02	10	01	02	10	01	02	10	01	02	10	01	02	10	01	02	10	01	02	10	01	02	10
B	01	02	10	01	02	11	01	02	14	01	02	11	01	02	10	01	02	10	01	02	10	01	02	10
C	01	02	11	01	02	12	01	02	11	01	02	11	01	02	10	01	02	10	01	02	10	01	02	10
D	03	04	12	03	04	14	03	04	13	05	06	14	03	04	12	01	02	10	03	04	11	01	04	13
E	03	04	13	03	04	14	03	04	13	05	06	14	03	04	12	01	02	10	03	04	11	01	04	13
F	03	04	13	03	04	14	03	04	13	05	06	14	03	04	12	-	-	-	03	04	11	01	04	13
G	03	04	13	03	04	14	03	04	13	05	06	14	03	04	12	01	02	10	03	04	11	01	03	12
H	03	04	12	03	04	14	03	04	13	05	06	13	03	04	11	-	-	-	03	04	11	01	03	12
I	03	04	14	03	04	14	03	04	13	05	06	13	03	04	11	-	-	-	-	-	-	01	03	12
J	-	-	-	03	04	13	03	04	12	03	04	12	03	04	13	01	02	10	-	-	-	01	03	11
K	-	-	-	-	-	-	03	04	12	05	06	13	03	04	11	-	-	-	-	-	-	01	03	12
L	-	-	-	-	-	-	-	-	-	05	06	13	03	04	11	-	-	-	-	-	-	01	03	12

	Yellow Pine			White Bark Pine			Larch			Cottonwood				Alder			Broadleaf Maple			Birch			Aspen			
F.I.Z.	YI	OI	M	YI	OI	M	YI	OI	M	YI	OI	M	OM	YI	OI	M	YI	OI	M	YI	OI	M	YI	OI	M	OM
A	-	-	-	01	02	10	-	-	-	01	02	10	-	01	02	10	01	02	10	01	02	10	01	02	10	-
B	-	-	-	01	02	10	-	-	-	01	02	10	-	01	02	10	01	02	10	01	02	10	01	02	10	-
C	01	02	10	01	02	10	-	-	-	01	02	10	-	01	02	10	01	02	10	01	02	10	01	02	10	-
D	01	02	10	03	04	11	01	02	10	01	02	11	-	-	-	-	-	-	-	01	02	11	01	02	10	-
E	01	02	10	03	04	11	01	02	10	01	02	11	-	-	-	-	-	-	-	01	02	11	01	02	10	-
F	01	02	10	03	04	11	01	02	10	01	02	11	-	-	-	-	-	-	-	01	02	11	01	02	10	-
G	01	02	10	03	04	11	01	02	10	01	02	11	-	-	-	-	-	-	-	01	02	11	01	02	10	-
H	-	-	-	03	04	11	01	02	10	01	02	11	-	-	-	-	-	-	-	01	02	11	01	02	10	-
I	-	-	-	03	04	11	01	02	10	01	02	11	-	-	-	-	-	-	-	01	02	11	01	02	10	-
J	-	-	-	03	04	11	-	-	-	01	02	11	-	01	02	10	-	-	-	01	02	11	01	02	10	-
K	-	-	-	-	-	-	01	02	10	03	04	12	13	01	02	10	-	-	-	01	02	11	04	03	11	12
L	-	-	-	-	-	-	01	02	10	03	04	12	13	-	-	-	-	-	-	01	02	11	04	03	11	12

Note: Species prefix codes are: Fir – 1/Cedar – 2/Hemlock – 3/Balsam – 4/Spruce – 5/Yellow Cedar – 6/White Pine – 7/Lodgepole Pine – 8/Yellow Pine – 9/Larch – 10/Cottonwood – 11/Alder – 12/Maple – 13/Birch – 14/Aspen – 15/Whitebark Pine – 16

Example – FIZ A, Mature Fir = Table 110
Aspen M (mature) and OM (over-mature)
See Tables 7.5.1 – 7.5.4 for Local Loss Factor Table Numbers for a specific PSYU/SSA/TSA/TFL.

7.6. Appendix 6: Damaged Stands

Trees are assigned damage codes for volume and value adjustments. Each tree is assessed and coded as it appears at the time of the cruise with no attempt to predict the future condition of the trees. Where damage is tallied, it will be compiled and reported.

Damaged tree volumes and LRF's are adjusted using the loss factors. In addition, the cruise compilation reports identify tree volume within the damage code categories to enable cost and value adjustments in appraisal.

Each code has a different effect in the compilation. Damage codes result in the modification of risk group and corresponding adjustments to net volume.

Depending on the patchiness of the damage, consider whether these patches should be treated as unique timber types when designing the sampling plan.

7.6.1. Pest Damage

The following insect damage codes apply to all appraisal cruises and will be entered in column 61 of the cruise tally sheet (Figure 4.1 Cruise Tally Sheet – FS 205C (front side)). Standard cruising methods as outlined in the *Cruising Manual* are to be followed with all beetle attack trees on the cutting authority coded with the appropriate Bark Beetle Code.

7.6.1.1. Bark Beetle Descriptions

The most common and destructive infestation the cruiser will encounter are caused by the following bark beetles:

Mountain pine beetle attacks Lodgepole, Ponderosa and White pine (however, Whitebark, Limber and exotic pines could also be infested).

Douglas fir beetle attacks Douglas fir and sometimes Western larch.

Spruce beetle attacks mainly White and Engelmann spruce in the Interior.

Western pine beetle attacks Ponderosa pine.

Western balsam bark beetle attacks mainly Subalpine fir (*Abies lasiocarpa*).

See the following website for photos and descriptions of common forest pests:

https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/forestry/forest-health/forest-health-docs/field_guide_to_forest_damage_in_bc_web.pdf

Beetle Attack Code Definition

Green Attack Codes 1, 5, 6	Trees attacked have green needles, but other colours may also be present. Green attack must contain greater than or equal to 5% green coloured needles.
Red Attack Codes 2, 8	Trees attacked have red, fading and possibly some grey needles. Red includes straw to rust colour. Red attack must contain less than 5% green needles and greater than or equal to 5% red needles.
Grey Attack Codes 3, 7	Trees attacked have grey or no needles. Grey attack must have less than 5% red needles, except *Abies lasiocarpa*, which can have grey or red needles.

7.6.1.2. Attack Codes for Balsam (*Abies* sp.), White Pine, Yellow Pine and Lodgepole Pine

Code	Description
1	Green Attack
2	Red Attack
3	Grey Attack

These attack codes are applicable to the following insects:

- The mountain pine beetle (*Dendroctonus ponderosae*) and the lodgepole pine beetle (*Dendroctonus murrayannae*) in lodgepole pine (*Pinus contorta*-PL), yellow pine (*Pinus ponderosa*- PY) and white pine (*Pinus monticola*-PW).
- The western pine beetle (*Dendroctonus brevicomis*) in yellow pine (*Pinus ponderosa*-PY).
- The western balsam bark beetle (*Dryocoetes cofusus*) in alpine fir (*Abies lasiocarpa*-BL).

Green Attack Code 1

Since the mountain pine beetle and the western pine beetle normally complete their life cycles in one year, the Green Attack code will represent trees that have been infested ten to twelve months or less. The crown is green but pitch tubes are evident on the lower bole and the inner bark will contain characteristic gallery patterns and immature stages of the beetles. Successfully attacked trees usually die within a few weeks following initial attack even though their crowns may stay green up to twelve months. How long the crown of an infested tree stays green depends on climate, soil, topography and tree species. White pine and yellow pine infested by mountain pine beetle often start discolouring by fall or mid-spring. The compilation program will downgrade these trees to Risk Group 2.

Red Attack Code 2

This code represents trees that, on average, had been attacked during the previous two seasons. The crowns first fade to straw colour, then to red and finally to rust colour before the needles fall off the tree. By the time the foliage is rust coloured, the beetles have usually left these trees to infest green trees. The boles of many trees in this category may be heavily worked by woodpeckers, making them susceptible to checking. The compilation program will downgrade these trees to Risk Group 2.

Grey Attack Code 3

This code will represent trees that are dead and have grey needles except *Abies lasiocarpa*, which can have grey or red needles. The bole of the older kills will have much checking and loose bark. However, pitch tubes on the bark of the lower bole and/or bark beetle galleries under the bark will be readily discernible.

The western pine beetle has a different gallery pattern than the mountain pine beetle, but infested trees go through the same sequence of foliage changes after attacks by either beetle. Therefore, the same attack code is applicable.

The western balsam bark beetle usually completes its life cycle in two years. Therefore, both green and red attacked trees will contain brood. Also quite often there is no evidence of pitch tubes on the trunk of infected trees. Therefore, the boles of balsam fir need to be examined at close range for signs of boring dust in the crevices of the bark and/or small round holes in the bark that signify entry or emergence by this beetle. Thus, in the green infected stage, attacked trees are quite difficult to find.

Grey attack trees that have been dead for many years often no longer show evidence of beetle attack. In beetle attacked stands, it is acceptable for check cruisers to extend the "benefit of the doubt" on Grey Attack Code 3 classifications if these trees show signs of significant bark loss and other signs of long-time mortality but no remaining bark beetle signs (beetles, pitch-tubes, frass, exit holes, blue stain, etc.). Cruisers are still expected to look for beetle sign and to rationalize their damage codes if they suspect these sign to be removed, obscured, or faded. The compilation program will downgrade these trees to Risk Group 2 unless tree class and/or pathological indicators downgrade the tree further.

7.6.1.3. Blister Rust Code 4 (Risk Group 2, White Pine)

This attack code is applicable to the fungus species White Pine Blister Rust (*Cronartium Ribicola*). It applies only on western white pine and whitebark pine trees. Rusts on any other tree species cannot have this code.

The trees in this code must have a stem infection.

All bark beetle attack codes take precedence over Blister Rust, Code 4.

7.6.1.4. Attack Codes for Spruce, Douglas Fir

Code	Description
5	Green Strip Attack – S and F
6	Green Full Attack – S and F
7	Grey Attack – S and F
8	Red Attack – Fir only

These attack codes are applicable to the following insects:

- The spruce bark beetle (*Dendroctonus rufipennis*) in spruce species (*Picea spp.*)
- The douglas fir bark beetle (*Dendroctonus pseudotsuga*) in Douglas-fir (*Pseudotsuga menziesii*-FD).

Spruce foliage turns yellowish for a brief period in the winter season following an attack before the needles drop off the tree. Therefore, spruce was not included in the red attack. Infested trees with faded crowns should be included in the green full attack.

Green Strip Attack Code 5 (Path/Tree Class = Risk Group, Fir and Spruce)

The trees in this code will be infested in a strip on the lower bole where broods either failed or succeeded in completing their development. In either case, the attacks did not kill the trees. These trees will live on, at least until subsequent attacks (which can happen quite often) completely girdle the bole. Green strip attacked Douglas fir in well established infestations are usually much less common than green fully attacked trees. The loss factors are unaffected by this code.

Green Fully Attacked Code 6 (Risk Group 2, Fir and Spruce)

The trees in this code still have green foliage, but the attack by the bark beetles has completely girdled the tree. Some of these trees will have a considerable amount of their bark removed by woodpeckers lowering the value because of checks and splits.

In the case of Douglas fir, the beetle usually has a one year life cycle. The attack is usually in May and June. The crowns of infested trees stay green from a few months to a year after attack. Do not code as Tree Class 3. The compilation program will downgrade these trees to Risk Group 2.

Grey Attack Code 7 (Highest Risk Group for Fir/Highest Mature Risk Group for Spruce).

This code represents trees which are dead and have gray needles. Little or no foliage is left, the boles of the older kills may have much checking and loose bark. The compilation program downgrades Fir trees to the highest risk group and Spruce trees to the highest mature risk group.

Red Attack Code 8 (Risk Group 2, Fir)

This code is reserved for Douglas fir where the red foliage remains on the tree for an average of two years. The compilation program downgrades these trees to Risk Group 2. If they have conk or blind conk they will be compiled as Risk Group 3.

7.6.1.5. Defoliators

This damage category is no longer in use for appraisal cruising. This field is optional and not auditable. Defoliator damage codes may be used when more than 50% of a tree's leaves or needles are damaged by defoliating insects such as Western Spruce Budworm, Douglas-fir Tussock Moth, or Western Hemlock Looper.

- Code X – live trees affected by these species. Tree classes 1, 2, 5, 8
- Code Y – dead trees killed by these species. Tree classes 3, 7, 9.
- All other insect attack codes take precedence over defoliator, codes X and Y.

7.6.2. Fire Damage

"Merchantable section" means the section of the stem between 30cm stump and the 10cm or 15cm top diameter inside bark as per the appropriate timber merchantability standards. Damage outside of these limits was not included in the loss factor data.

"Charring" means the actual destruction of wood by fire. There must be identifiable damage to wood fibre.

"Shallow charring" means charring with is greater than 100 cm2 in surface area and less than one-third of the radius of the tree (e.g. 10cm x 10cm).

"Extensive Shallow charring" means charring in the bottom third of the tree that has 3 or more area (each at least 100 cm2) of exposed and charred wood fibre or cumulative total of charred areas is greater than 300cm2 (e.g. 10cm x 30cm).

"Deep Charring" means where charring is deeper than one-third of the radius of tree.

"Multiple Deep Checks" means where more than 1 check is deeper than one-third of the radius of the tree.

The following fire damage codes apply to all appraisal cruises and will be entered in column 62 of the cruise tally sheet (Figure 4.1 Cruise Tally Sheet – FS 205C (front side).):

7.6.2.1. Light Damage - Code A

Damage consisting of scorched bark and/or foliage but little or no charring in the merchantable portion of the stem (less than $100cm^2$). Bark scorching greater than or equal to 5 years after the date that the fire was recorded by the Ministry of Forests does not qualify for the fire damage coding.

7.6.2.2. Moderate Damage - Code B

Damage of any age consisting of shallow charring of wood fibre in the merchantable portion of the stem.

7.6.2.3. Heavy Damage - Code C

Damage of any age consisting of extensive shallow charring or deep charring in the merchantable portion of the stem. Multiple deep checks in trees less than 30 cm DBH with fire damage also qualify for heavy damage.

The risk groups of all fire damaged trees will be determined by tree class and pathology.

> Surface checking may occur as the result of fire damage but this does not affect the tree classification.

7.6.3. Down Trees

The following Down Tree Codes apply to all appraisal cruises and will be entered in column 63 of the Tally Sheet (Figure 4.1 Cruise Tally Sheet – FS 205C (front side). If they are located between POG and the merchantable top diameter of living or dead potential trees and the tree is:

7.6.3.1. Damage Code E

- Uprooted
- Uprooted with one clean break.
- Standing and one clean break in the bottom or middle third.
- Standing and any shattered breaks in the middle third.

A clean break is shorter in length than the diameter of the stem at the break. The compilation program will assign the risk group by tree class and pathological indicators.

A tree with a clean or shattered break that does not extend above stump height will be considered uprooted.

A tree felled by a beaver will be considered equivalent to a chainsaw cut and does not cause a blowdown code.

No blowdown code will be applied if a broken top is less than 50% sound and a merchantable log has taken over as a new leader.

7.6.3.2. Damage Code G

- Uprooted with more than one clean break .
- Uprooted with any shattered breaks.
- Standing with any shattered break in the bottom third.
- Standing with one clean break in the bottom third and an additional break in the merchantable portion of the tree.

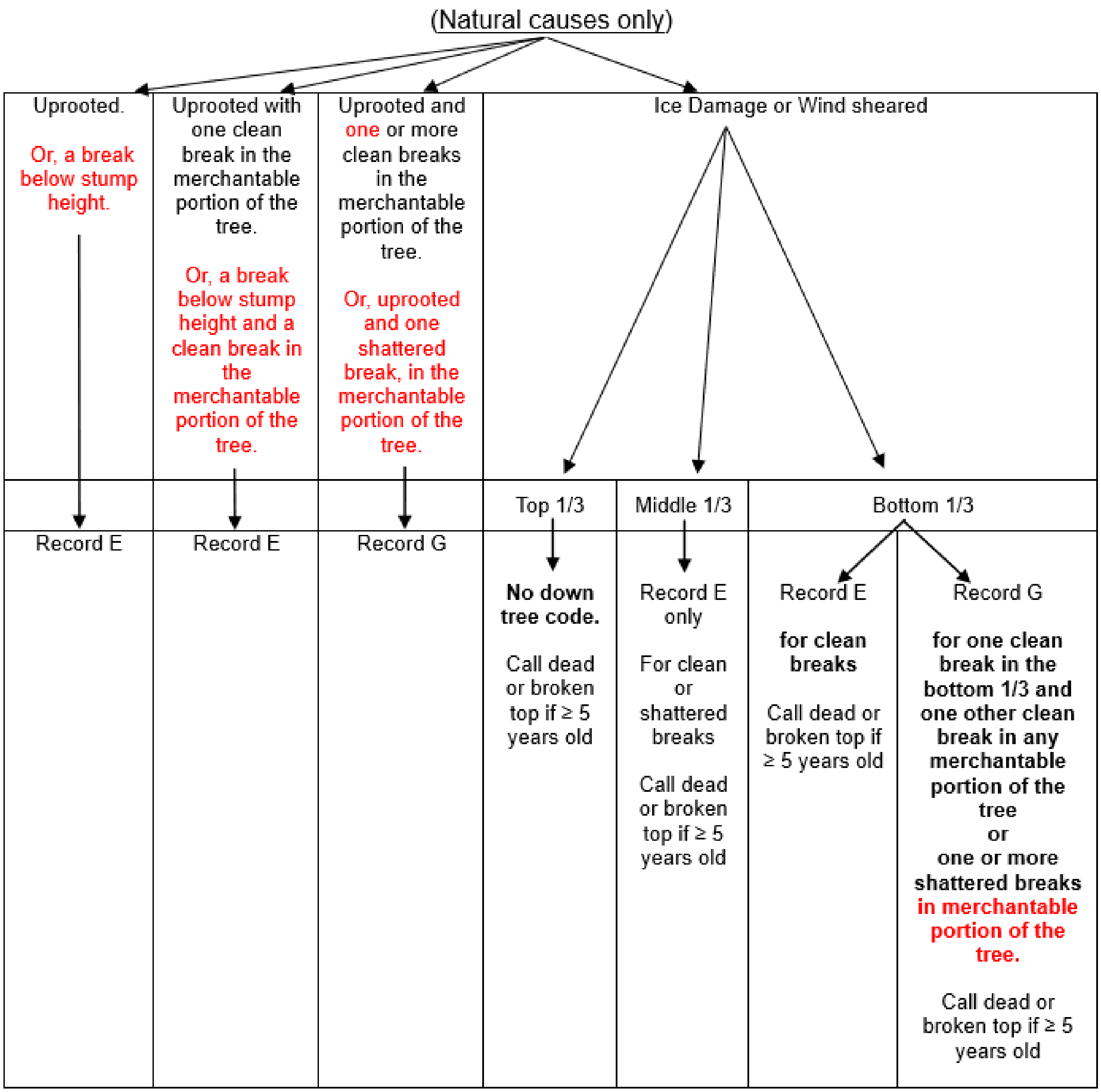
A shattered break is longer in length than the diameter of the stem at the break. A tree with a break below stump height and above POG will be considered uprooted. If the break extends into the merchantable portion of the stem[1] then the entire length of shatter above POG will be assessed to determine if it is a clean break or a shattered break.

The compilation program will down grade these trees to the highest risk group.

If the tree is partially uprooted or broken and supported by another standing tree, assign the appropriate down tree code (except Tree Classes 4 and 6). Blowdown codes are not asssigned to Tree Class 4 or 6 trees.

If a shatter extends through DBH and either the standing or down portion of the tree fall outside of the plot, use the portion of the tree with greater than 50% of the basal area at breast height to determine if the tree is "in" or "out" and assign applicable damage codes (See Section 4.3.1.15).

[1] *The merchantable portion of the stem is from 30cm stump height to a 10cm or 15cm top diameter inside bark as per the appropriate timber merchantability standards.*



Note: Record all trees in plot if DBH is in the plot (natural or man induced).
Damage codes can only be recorded for natural occurrences. No codes for hand felled, beaver felled or mechanical influences.
Do not record uprooted TC4 or TC6.

Figure 7-4 Damage Call Matrix for Uprooted, Ice Damaged and Wind Sheared Trees

Figure 7-5 Example of Mechanical Damage

7.7. Appendix 7: Dead Potential 50% Threshold Calculations

7.7.1. Sound Wood Factors for Saprot (Table 7.7.1)

$$\text{\% Sound Fibre} = \left(\frac{DIB - 2 \times Saprot\ Depth}{DIB}\right) \wedge 2$$

A spreadsheet to calculate sound wood using the above equation can be found at the following website:

Cruising Calculations

	**Saprot Depth - cm														
*Diameter	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
20	**0.81**	**0.64**	0.49	0.36	0.25	0.16	0.09	0.04	0.01						
25	**0.85**	**0.71**	**0.58**	0.46	0.36	0.27	0.19	0.13	0.08	0.04	0.01				
30	**0.87**	**0.75**	**0.64**	**0.54**	0.44	0.36	0.28	0.22	0.16	0.11	0.07	0.04	0.02		
35	**0.89**	**0.78**	**0.69**	**0.60**	**0.51**	0.43	0.36	0.29	0.24	0.18	0.14	0.10	0.07	0.04	0.02
40	**0.90**	**0.81**	**0.72**	**0.64**	**0.56**	0.49	0.42	0.36	0.30	0.25	0.20	0.16	0.12	0.09	0.06
45	**0.91**	**0.83**	**0.75**	**0.68**	**0.60**	**0.54**	0.47	0.42	0.36	0.31	0.26	0.22	0.18	0.14	0.11
50	**0.92**	**0.85**	**0.77**	**0.71**	**0.64**	**0.58**	**0.52**	0.46	0.41	0.36	0.31	0.27	0.23	0.19	0.16
55	**0.93**	**0.86**	**0.79**	**0.73**	**0.67**	**0.61**	**0.56**	**0.50**	0.45	0.40	0.36	0.32	0.28	0.24	0.21
60	**0.93**	**0.87**	**0.81**	**0.75**	**0.69**	**0.64**	**0.59**	**0.54**	0.49	0.44	0.40	0.36	0.32	0.28	0.25
65	**0.94**	**0.88**	**0.82**	**0.77**	**0.72**	**0.66**	**0.62**	**0.57**	**0.52**	0.48	0.44	0.40	0.36	0.32	0.29
70	**0.94**	**0.89**	**0.84**	**0.78**	**0.73**	**0.69**	**0.64**	**0.60**	**0.55**	**0.51**	0.47	0.43	0.40	0.36	0.33
75	**0.95**	**0.90**	**0.85**	**0.80**	**0.75**	**0.71**	**0.66**	**0.62**	**0.58**	**0.54**	**0.50**	0.46	0.43	0.39	0.36
80	**0.95**	**0.90**	**0.86**	**0.81**	**0.77**	**0.72**	**0.68**	**0.64**	**0.60**	**0.56**	**0.53**	0.49	0.46	0.42	0.39
85	**0.95**	**0.91**	**0.86**	**0.82**	**0.78**	**0.74**	**0.70**	**0.66**	**0.62**	**0.58**	**0.55**	**0.52**	0.48	0.45	0.42
90	**0.96**	**0.91**	**0.87**	**0.83**	**0.79**	**0.75**	**0.71**	**0.68**	**0.64**	**0.60**	**0.57**	**0.54**	**0.51**	0.47	0.44
95	**0.96**	**0.92**	**0.88**	**0.84**	**0.80**	**0.76**	**0.73**	**0.69**	**0.66**	**0.62**	**0.59**	**0.56**	**0.53**	**0.50**	0.47
100	**0.96**	**0.92**	**0.88**	**0.85**	**0.81**	**0.77**	**0.74**	**0.71**	**0.67**	**0.64**	**0.61**	**0.58**	**0.55**	**0.52**	0.49
105	**0.96**	**0.93**	**0.89**	**0.85**	**0.82**	**0.78**	**0.75**	**0.72**	**0.69**	**0.66**	**0.62**	**0.60**	**0.57**	**0.54**	**0.51**
110	**0.96**	**0.93**	**0.89**	**0.86**	**0.83**	**0.79**	**0.76**	**0.73**	**0.70**	**0.67**	**0.64**	**0.61**	**0.58**	**0.56**	**0.53**

*Use diameter of stem where saprot depth is measured

**Saprot depth is the average rot depth penetrating the stem radius

Useful Formulas

Volume of Tree = $1/3\ \pi R^2 L$, where R = tree dbh and L = tree length

Volume of Cylindrical Rot = $\pi R^2 L$, where R = the radius of the rot and L = rot length

Volume of Conical Rot = $1/3\ \pi R^2 L$, where R = the radius of the rot and L = rot length

% Sound = $100 - \dfrac{Volume\ of\ Rot}{Volume\ of\ Tree\ or\ Log}$

7.7.2. Ten Meter Log Tables (Table 7.7.2)

The purpose of these tables is to assist timber cruisers in calculating the 50% firmwood threshold for dead potential trees. Timber cruisers may choose to either use a general or species/maturity specific table to calculate the 50% firmwood threshold, but should document which tables they use.

The following gross 10m log volume table is a general table for all species and top size based on a weighted average volume for a range of 10cm DBH classes and 5m tree height classes.

Volume % by 10m Log						
Total Height (m)	**Log 1**	**Log 2**	**Log 3**	**Log 4**	**Log 5**	**Log 6**
15	**96**	**4**				
20	**84**	**16**				
25	**72**	**27**	**1**			
30	**65**	**30**	**5**			
35	**57**	**31**	**11**	**1**		
40	**52**	**31**	**15**	**2**		
45	**49**	**29**	**17**	**5**		
50	**46**	**28**	**18**	**7**	**1**	
55	**42**	**27**	**19**	**10**	**2**	
60	**40**	**25**	**19**	**11**	**4**	**1**

The following tables are specific to species, maturity and top size.

Douglas Fir/Larch/White Pine							
10m Log % - 10cm Top (Coast Immature)							
Total Height (m)	**Log 1**	**Log 2**	**Log 3**	**Log 4**	**Log 5**	**Log 6**	
15	97	3					100
20	81	19					100
25	69	31					100
30	60	34	6				100
35	53	33	14				100
40	47	32	18	3			100
45	43	30	20	7			100
50	40	28	20	10	2		100
55	38	27	20	12	3		100

60	35	25	20	13	6	1	100

Douglas fir used to generate the table.

Western & Mountain Hemlock							
10m Log % - 10cm Top (Coast Immature)							
Total Height (m)	**Log 1**	**Log 2**	**Log 3**	**Log 4**	**Log 5**	**Log 6**	
15	100						100
20	85	15					100
25	74	26					100
30	65	31	4				100
35	56	34	10				100
40	51	32	15	2			100
45	47	31	17	5			100
50	44	30	18	7	1		100
55	43	28	18	9	2		100
60	39	27	19	11	4		100

Western hemlock used to generate the table.

Spruce							
10m Log % - 10cm Top (Coast Immature)							
Total Height (m)	**Log 1**	**Log 2**	**Log 3**	**Log 4**	**Log 5**	**Log 6**	
15	100						100
20	85	15					100
25	74	26					100
30	65	30	5				100
35	58	31	11				100
40	52	31	15	2			100
45	47	30	17	6			100
50	43	28	19	9	1		100

55	45	27	17	9	2		100
60	42	25	18	10	4	1	100

Sitka spruce used to generate the table.

Cypress							
10m Log % - 10cm Top (Coast Immature)							
Total Height (m)	**Log 1**	**Log 2**	**Log 3**	**Log 4**	**Log 5**	**Log 6**	
15	100						100
20	83	17					100
25	72	28					100
30	64	31	5				100
35	59	30	11				100
40	53	30	15	2			100
45	49	28	18	5			100
50	46	27	18	8	1		100
55	43	26	18	10	3		100
60	42	25	18	10	4	1	100

Cypress used to generate the table.

Western Red Cedar							
10m Log % - 10cm Top (Coast Immature)							
Total Height (m)	**Log 1**	**Log 2**	**Log 3**	**Log 4**	**Log 5**	**Log 6**	
15	100						100
20	86	14					100
25	75	25					100
30	68	28	4				100
35	61	29	10				100
40	55	29	14	2			100
45	52	27	16	5			100

50	53	25	15	6	1		100
55	49	25	16	8	2		100
60	46	24	16	10	4		100

Western red cedar used to generate the table.

Balsam							
10m Log % - 10cm Top (Coast Immature)							
Total Height (m)	**Log 1**	**Log 2**	**Log 3**	**Log 4**	**Log 5**	**Log 6**	
15	100						100
20	84	16					100
25	71	29					100
30	62	32	6				100
35	55	33	12				100
40	48	33	16	3			100
45	45	31	18	6			100
50	42	30	19	8	1		100
55	40	28	19	10	3		100
60	37	27	19	11	5	1	100

Balsam genius used to generate the table.

Lodgepole, Ponderosa and Whitebark Pine							
10m Log % - 10cm Top (Coast Immature)							
Total Height (m)	**Log 1**	**Log 2**	**Log 3**	**Log 4**	**Log 5**	**Log 6**	
15	100						100
20	72	28					100
25	74	26					100
30	67	28	5				100
35	60	30	10				100
40	53	30	15	2			100

45	50	29	16	5			100
50	48	28	16	7	1		100
55	48	27	16	7	2		100
60	45	26	17	9	3	1	100

Lodgepole pine used to generate the table.

Deciduous							
10m Log % - 10cm Top (Coast Immature)							
Total Height (m)	**Log 1**	**Log 2**	**Log 3**	**Log 4**	**Log 5**	**Log 6**	
15	100						100
20	87	13					100
25	76	24					100
30	68	29	3				100
35	59	31	10				100
40	54	31	14	1			100
45	48	31	17	4			100
50	44	29	18	8	1		100
55	48	27	17	7	1		100
60	43	27	17	9	3	1	100

Alder/Aspen/Maple/Cottonwood used to generate the table.

Douglas Fir/Larch/White Pine							
10m Log % - 15cm Top (Coast Mature)							
Total Height (m)	**Log 1**	**Log 2**	**Log 3**	**Log 4**	**Log 5**	**Log 6**	
15	100						100
20	84	16					100
25	70	30					100
30	61	34	5				100
35	53	34	13				100

40	47	32	18	3			100
45	43	30	20	7			100
50	40	28	20	10	2		100
55	38	27	20	12	3		100
60	35	25	20	13	6	1	100

Douglas fir used to generate the table.

Western & Mountain Hemlock							
10m Log % - 15cm Top (Coast Mature)							
Total Height (m)	**Log 1**	**Log 2**	**Log 3**	**Log 4**	**Log 5**	**Log 6**	
15	100						100
20	85	15					100
25	74	26					100
30	65	31	4				100
35	56	34	10				100
40	51	32	15	2			100
45	47	31	17	5			100
50	44	30	18	7	1		100
55	43	28	18	9	2		100
60	39	27	19	11	4		100

Westerm hemlock used to generate the table.

Spruce							
10m Log % - 15cm Top (Coast Mature)							
Total Height (m)	**Log 1**	**Log 2**	**Log 3**	**Log 4**	**Log 5**	**Log 6**	
15	100						100
20	88	12					100
25	76	24					100
30	66	30	4				100

35	59	31	10				100
40	53	31	15	1			100
45	47	30	18	5			100
50	44	28	19	9			100
55	45	27	17	9	2		100
60	42	26	18	10	4		100

Sitka spruce used to generate the table.

Cypress							
10m Log % - 15cm Top (Coast Mature)							
Total Height (m)	**Log 1**	**Log 2**	**Log 3**	**Log 4**	**Log 5**	**Log 6**	
15	100						100
20	86	14					100
25	73	27					100
30	65	31	4				100
35	59	31	10				100
40	53	30	15	2			100
45	49	28	18	5			100
50	46	27	18	8	1		100
55	43	25	18	11	3		100
60	40	24	18	12	5	1	100

Cypress used to generate the table.

Western Red Cedar							
10m Log % - 15cm Top (Coast Mature)							
Total Height (m)	**Log 1**	**Log 2**	**Log 3**	**Log 4**	**Log 5**	**Log 6**	
15	100						100
20	90	10					100
25	77	23					100

30	68	29	3				100
35	61	30	9				100
40	55	29	15	1			100
45	52	28	16	4			100
50	53	26	15	6			100
55	49	25	16	8	2		100
60	46	24	16	10	4		100

Western red cedar used to generate the table.

Balsam							
10m Log % - 15cm Top (Coast Mature)							
Total Height (m)	**Log 1**	**Log 2**	**Log 3**	**Log 4**	**Log 5**	**Log 6**	
15	100						100
20	86	14					100
25	72	28					100
30	62	33	5				100
35	55	33	12				100
40	49	33	16	2			100
45	45	31	18	6			100
50	42	30	19	8	1		100
55	40	28	19	10	3		100
60	37	27	19	11	5	1	100

Balsam used to generate the table.

Lodgepole, Ponderosa and Whitebark Pine							
10m Log % - 15cm Top (Coast Mature)							
Total Height (m)	**Log 1**	**Log 2**	**Log 3**	**Log 4**	**Log 5**	**Log 6**	
15	100						100
20	89	11					100

25	76	24					100
30	69	28	3				100
35	60	30	10				100
40	53	30	15	2			100
45	50	29	16	5			100
50	43	28	19	9	1		100
55	48	27	16	7	2		100
60	45	26	17	9	3		100

Lodgepole pine used to generate the table.

Deciduous							
10m Log % - 15cm Top (Coast Mature)							
Total Height (m)	**Log 1**	**Log 2**	**Log 3**	**Log 4**	**Log 5**	**Log 6**	
15	100						100
20	91	9					100
25	77	23					100
30	67	29	4				100
35	59	32	9				100
40	53	32	14	1			100
45	48	31	17	4			100
50	44	29	19	8			100
55	46	26	16	11	1		100
60	44	27	17	9	3		100

Alder/Aspen/Maple/Cottonwood used to generate the table.

7.8. Appendix 8: Distribution of "t"

Degrees of Freedom	0.05 (95 % Confidence Interval)
1	12.706
2	4.303
3	3.182
4	2.776
5	2.571
6	2.447
7	2.365
8	2.306
9	2.262
10	2.228
11	2.201
12	2.179
13	2.160
14	2.145
15	2.131
16	2.120
17	2.110
18	2.101
19	2.093
20	2.086
21	2.080
22	2.074
23	2.069
24	2.064
25	2.060
26	2.056
27	2.052
28	2.048
29	2.045
30	2.042
31 – 67	2.000
68 – 112	1.980
113 +	1.960

7.9. Appendix 9: FS 693 Provincial Cruise Plan

BRITISH COLUMBIA | Ministry of Forests, Lands and Natural Resource Operations

PROVINCIAL CRUISE PLAN

Tenure:
C.P. (if known):

☐ ORIGINAL ☐ REVISED CRUISE PLAN

ATTENTION		
District Manager:	**Cruise Area (ha):**	
Licensee:	**Base Map #:**	
Location (name):	**Wet or Dry Belt Fir (interior only):**	
Contact:	**BEC Subzone/Variant:**	
TSA:	**PSYU:**	**FIZ:**

COMPILING AGENCY	
Name:	Address:

CRUISING AGENCY		
Agency Name:	Proposed Cruiser Name(s):	Prof. Designation(s):
Address:		

TENTATIVE CRUISE DATES	
Start:	Finish:
Access:	

TYPE OF SAMPLE GRID	
GIS Grid – UTM or BC Albers:	GPS Used ☐ Yes ☐ No
Local Grid ☐ Yes ☐ No	

BLOCK #	BEC Zone	Block Area (ha)	Plot Size (proposed BAF)	Timber Type number	# Measure Plots	# Count Plots	Grid Spacing (m)	Mature or Immature	Timber Type Description
Total									

SAMPLING ERROR OBJECTIVE			
Scale Based ☐	S.E. Achieved	%	S.E. Waived ☐ Yes ☐ No
MPB Cruise Based ☐			
Green Cruise Based ☐			

MINIMUM DBH LIMITS (cm):		COAST		INTERIOR	
		Mature Blocks	Immature Blocks	Standard (cm)	Lodgepole Pine (cm)
Field Tally	Non-Appraisal				
	Appraisal	17.5	12.0	17.5	12.5

Authorized Signature:	**Prof. Designation:**	**Registration No.:**
Name:	**Date:**	

FS 693 HVA 2018/11 *Please be advised that this information may be released under the Freedom of Information and Protection of Privacy Act*

Figure 7-6 FS 693 - Provincial Cruise Plan (Page 1 of 2)

MARKING	Ribbon Colour	Paint Colour	Axe Blaze	Other (tags)
Baseline				
Boundaries				
Harvest Methods				
Strips				
Plot Centre				
Tie Points				
Non Forest Types				
Riparian Areas				
Wildlife Tree Patches				
Other				
Comments				

Figure 7-7 FS 693 - Provincial Cruise Plan (Page 2 of 2)

Link: https://www.for.gov.bc.ca/isb/forms/lib/FS693.pdf

7.10. Appendix 10: FS 694 Provincial Cruise Plan and Map Check List

BRITISH COLUMBIA

Ministry of
Forests, Lands and
Natural Resource Operations

PROVINCIAL CRUISE PLAN AND MAP CHECK LIST

TENURE:	________
C.P.:	________
CRUISE AREA (ha):	________
BASE MAP #:	________

		YES	NO	N/A
A.	**TENURE and CRUISING AGENCY INFORMATION**			
1.	Licensee's name:			
2.	Tenure and Cutting Permit & Block numbers:			
3.	Forest Region & District:			
4.	Name(s) of persons who completed the cruise fieldwork:			
5.	Name(s) of persons who completed the cruise plan and map:			
B.	**AREA INFORMATION**			
6.	Cutting Boundaries and Block Net Areas:			
7.	Timber Type Net Areas:			
8.	Harvesting Method & Net Areas for Heli-Logging:			
9.	Non-Forest Type & Forest Reserve Areas:			
C.	**CRUISE PLAN MAP**			
10.	Tenure information adequate:			
11.	Acceptable map scale (1:5 000; 1:10 000):			
12.	Cruise based/Scale based indicator (Coast Only)			
13.	Timber type lines and identifier. A forest cover map included for the cruise and surrounding area if PI is present:			
14.	Minimum number of plots per timber type polygon:			
15.	Sufficient number of plots per type or 1.0 plots per hectare and SE waived:			
16.	Maximum grid - 200m if cruise < 250 ha or 250m if cruise ≥ 250 ha:			
17.	Prism and/or fixed area plot size consistent in each type?			
18.	Cut block boundaries and forest types clearly delineated on map?			
19.	Point of Commencement established:			
20.	Strips tied to cutblock boundaries (unless GPS is used):			
21.	Measure & Count Plots identified and numbered:			
22.	Legal Survey Features (if they affect sampling):			
23.	Portions of Cutting Boundaries that will be Stubbed (if applicable):			
24.	Existing & Proposed Roads identified:			

Note: The cruise plan map may contain all of the information in lieu of using the form too.

Remarks:

Action:	
Signature:	**Professional Designation:**

FS 694 HVA 2016/12 *Please be advised that this information may be released under the Freedom of Information and Protection of Privacy Act*

Figure 7-8 FS 694 - Provincial Cruise Plan and Map Check List

Link: https://www.for.gov.bc.ca/isb/forms/lib/FS694.pdf

7.11. Appendix 11: FS 695 Provincial Office Check of Field Cruise Data

BRITISH COLUMBIA
Ministry of
Forests, Lands and
Natural Resource Operations

PROVINCIAL OFFICE
CHECK OF FIELD CRUISE DATA

TENURE:	C.P.:

A. CRUISE PLAN and FINAL CRUISE MAP	YES	NO
1. Cruise Plan acceptable:		
2. Cruise Plan followed:		
3. Final Cruise Map acceptable:		

B. PLOT CARDS	YES	NO
4. All of the plot cards submitted:		
5 Each plot card completed properly and mandatory data elements completed:		
6. Each plot card signed and dated:		
7. Prism or fixed area plot size consistent within each timber type (if not, documentation):		
8. Plot locations by type, strip and cutblock match the final cruise map:		
9. Count/measure ratio:	COUNT	MEASURE

C. MATURITY CLASSES	YES	NO
10. Total age of age samples correct:		
11. Lodgepole pine age inventory age classes correct:		
12. Age in 10s & classes correct:		
13. Are 95% of all trees in the correct maturity class for loss factor deductions:		

Remarks:

Accepted:	Rejected:	Date:
Action:		
Signature:	Professional Designation:	
Approval/rejection letter sent by:		Date:

FS 695 HVA 2014/02 *Please be advised that this information may be released under the Freedom of Information and Protection of Privacy Act*

Figure 7-9 FS 695 - Provincial Office Check of Field Cruise Data

Link: https://www.for.gov.bc.ca/isb/forms/lib/FS695.pdf

7.12. Appendix 12: FS 696 Provincial Field Check Cruise Summary

BRITISH COLUMBIA

Ministry of
Forests, Lands and
Natural Resource Operations

PROVINCIAL
FIELD CHECK CRUISE SUMMARY

TENURE: ______ **C.P.:** ______

Risk Assessment Category: ______

Cruised by:		**Cruise Date:**		**# plots:**	
Checked by:		**Check Date:**		**# plots:**	

A. PLOT ESTABLISHMENT & DISTANCE MEASUREMENT:	**NUMBER (IF REQUIRED)**	**ACCEPTABLE (Y/N)**	**NOT CHECKED**
1. Plot interval spacing:			
2. Distance & bearings from reference trees to plot centre:			
3. Sample point integrity plots established:			
4. Cutting boundaries & non-forest types - marking & traverse accuracy:			
B. SPECIES IDENTIFICATION:			
5. % of stems incorrectly identified (max. - 1 stem in 50, tree class 1,2,3,5,7,8,9):			
C. NUMBER OF STEMS:			
6. Stem count difference for tree class 1,2,3,5,7,8,9 (max. - 1 stem in 50):			
7. Live and dead useless stem count difference (max. - 1 stem in 50):			
8. Multiple BAFs in a timber type polygon (if yes; reason verified):			
D. HEIGHT SAMPLES:			
9. Number of heights checked:			
10. % average absolute variation of all of heights checked (max. 5%):			
E. DBH:			
11. Number of diameters checked:			
12. % of diameters that vary > ± 2% (at least 90% within 2%):			
13. Average absolute variation of all diameters checked: (max. 2%):			
F. PATHOLOGICAL INDICATORS/DAMAGE CODES:			
14. Path - % trees with > 1 risk group change (max 10%, including damage code):			
15. Damage - % trees checked with incorrect codes (max. 5%):			
16. Damage - % trees checked with incorrect risk group (add to 12):			
G. AGES & PI INVENTORY AGE CLASS:			
17. 95% of all trees in correct maturity class for loss factor deductions:			
H. QUALITY (Coast Only):			
18. i. Path - % trees with path incorrectly coded in 1st and 2nd third (max 10%):			
19. ii. Quality - % of quality indicators ± 1 code change (max 10%):			
Note - Codes 5 and 6 must be correct.			
I. PLOT SLOPE:			
20. i. At least 90% plots within +/- 5 plot slope % (Y/N)			
ii. Average Variation of all check plots within +/- 5 slope % (Y/N)			
J. CALL GRADE NET FACTOR (Coast Only):			
21. Net Volume Variation:			
22. Net Value Variation:			
K. REMARKS:			

Accepted:	**Rejected:**	**Date:**
Action:		
Signature:	**Professional Designation:**	
Approval/rejection letter sent by:		**Date:**

FS 696 HVA 2014/02 *Please be advised that this information may be released under the Freedom of Information and Protection of Privacy Act*

Figure 7-10 FS 696 - Provincial Field Check Cruise Summary

Link: https://www.for.gov.bc.ca/isb/forms/lib/FS696.pdf

7.13. Appendix 13: FS 697 Provincial Compilation Check Form

BRITISH COLUMBIA
Ministry of Forests, Lands and Natural Resource Operations

PROVINCIAL COMPILATION CHECK FORM

TENURE: ________ C.P.: ________

A. CRUISE/TENURE INFORMATION	YES	NO
1. Field checked:		
2. Licensee:		
3. Forest District:		
4. a) Forest Inventory Zone (FIZ) correct:		
5. b) Forest Sustained Yield Unit (PSYU) correct:		
B. MAP AREA STATEMENT	**YES**	**NO**
6. Net merchantable area match appraisal:		
7. Do the final cruise map merchantable areas agree with the compilation and appraisal:		
8. Do the number and area of the cutblocks on the final cruise map agree with the compilation and appraisal:		
9. Do the number and area of the timber types on the final cruise map agree with compilation:		
10. Type of compilation correct (Wet or dry belt fir = BEC Subzone with most fir):		
C. COMPILATION VERSION	**YES**	**NO**
11. Is the compilation version correct:		
D. SAMPLE ERROR (Pre-reduction Compilation)	**YES**	**NO**
12. Sampling error % (SE) achieved:		
13. If SE % not achieved, minimum average # trees/plot and plots/ha been achieved:		
F. PLOT SUMMARIES AND LOSS FACTORS	**YES**	**NO**
14. Have the correct loss factors been used for each species:		
15. Are the plots in the compilation and appraisal only from the harvest area:		
G. REDUCTION COMPILATIONS (Factored, Partial Cut, etc)	**YES**	**NO**
16. Pre-reduction compilation submitted:		
17. Percent reduction input consistent with the selection harvest source documentation and surveys:		
H. APPRAISAL	**YES**	**NO**
18. All pages of the compilation reporting '*For Appraisal Purposes*':		
19. Cruise data entered in ECAS the same as the compilation:		
20. ASCII cruise data file and CSV file attached in ECAS:		

REMARKS :

Accepted:	Rejected:	Date:
Action:		
Signature:	Professional Designation:	
Approval/rejection letter sent by:		Date:

FS 697 HVA 2014/02 *Please be advised that this information may be released under the Freedom of Information and Protection of Privacy Act*

Figure 7-11 FS 697 - Provincial Compilation Check Form

Link: https://www.for.gov.bc.ca/isb/forms/lib/FS697.pdf

7.14. Appendix 14: Horizontal Distance Correction

7.14.1. Slope Correction Formula

All distances (strip and base lines, plot radii and closed traverses) must be corrected for slope to obtain horizontal distance and measured to the standards listed in Section 3.5.

The formula used to correct for slope is:

$$COS\left(TAN^{-1}\ \frac{(Slope\ \%)}{100}\right) = slope\ correction\ factor\ \leq 1.000$$

The resulting number is multiplied by a measured slope distance to obtain the equivalent horizontal distance. For example:

- slope of 59 percent and measured slope distance of 8.62 m to tie point,

$$COS\left(TAN^{-1}\ \frac{(59)}{100}\right) = 0.8613\ and$$

- 8.62 m x 0.8613 = 7.42 m horizontal distance to the tie point.

To obtain a slope distance, the specified horizontal distance is multiplied by the inverse of the slope correction factor. For example:

- slope of 74 percent and specified horizontal distance of 50 m,

$$1\ /COS\left(TAN^{-1}\ \frac{(74)}{100}\right) = 1/0.8038 = 1.2441 \text{ and}$$

- 50 m x 1.2441 = 62.205 m slope distance will equal 50 m horizontal distance. Refer to the Correction Table for Chaining.

A spreadsheet to calculate horizontal distance can be found at the following website:

Cruising Calculations

7.14.2. Correction Table for Chaining (Table 7.14.1)

% Slope	Horizontal Distance in Metres (5m intervals) – Chainage Plus Slope Allowance									
	5	10	15	20	25	30	35	40	45	50
10	5.02	10.05	15.07	20.10	25.12	30.15	35.17	40.20	45.22	50.25
12	5.04	10.07	15.11	20.14	25.18	30.22	35.25	40.29	45.32	50.36
14	5.05	10.10	15.15	20.20	25.24	30.29	35.34	40.39	45.44	50.49
16	5.06	10.13	15.19	20.25	25.32	30.38	35.45	40.51	45.57	50.64
18	5.08	10.16	15.24	20.32	25.40	30.48	35.56	40.64	45.72	50.80
20	5.10	10.20	15.30	20.40	25.50	30.59	35.69	40.79	45.89	50.99
22	5.12	10.24	15.36	20.48	25.60	30.72	35.84	40.96	46.08	51.20
24	5.14	10.28	15.43	20.57	25.71	30.85	35.99	41.14	46.28	51.42
26	5.17	10.33	15.50	20.66	25.83	31.00	36.16	41.33	46.50	51.66
28	5.19	10.38	15.58	20.77	25.96	31.15	36.35	41.54	46.73	51.92
30	5.22	10.44	15.66	20.88	26.10	31.32	36.54	41.76	46.98	52.20
32	5.25	10.50	15.75	21.00	26.25	31.50	36.75	42.00	47.25	52.50
34	5.28	10.56	15.84	21.12	26.41	31.69	36.97	42.25	47.53	52.81
36	5.31	10.63	15.94	21.26	26.57	31.88	37.20	42.51	47.83	53.14
38	5.35	10.70	16.05	21.40	26.74	32.09	37.44	42.79	48.14	53.49
40	5.39	10.77	16.16	21.54	26.93	32.31	37.70	43.08	48.47	53.85
42	5.42	10.85	16.27	21.69	27.12	32.54	37.96	43.38	48.81	54.23
44	5.46	10.93	16.39	21.85	27.31	32.78	38.24	43.70	49.16	54.63
46	5.50	11.01	16.51	22.01	27.52	33.02	38.53	44.03	49.53	55.04
48	5.55	11.09	16.64	22.18	27.73	33.28	38.82	44.37	49.92	55.46
50	5.59	11.18	16.77	22.36	27.95	33.54	39.13	44.72	50.31	55.90
52	5.64	11.27	16.91	22.54	28.18	33.81	39.45	45.08	50.72	56.36
54	5.68	11.36	17.05	22.73	28.41	34.09	39.78	45.46	51.14	56.82
56	5.73	11.46	17.19	22.92	28.65	34.38	40.11	45.84	51.58	57.31
58	5.78	11.56	17.34	23.12	28.90	34.68	40.46	46.24	52.02	57.80
60	5.83	11.66	17.49	23.32	29.15	34.99	40.82	46.65	52.48	58.31
62	5.88	11.77	17.65	23.53	29.42	35.30	41.18	47.06	52.95	58.83
64	5.94	11.87	17.81	23.75	29.68	35.62	41.55	47.49	53.43	59.36
66	5.99	11.98	17.97	23.96	29.95	35.94	41.94	47.93	53.92	59.91
68	6.05	12.09	18.14	24.19	30.23	36.28	42.33	48.37	54.42	60.46
70	6.10	12.21	18.31	24.41	30.52	36.62	42.72	48.83	54.93	61.03
72	6.16	12.32	18.48	24.64	30.81	36.97	43.13	49.29	55.45	61.61
74	6.22	12.44	18.66	24.88	31.10	37.32	43.54	49.76	55.98	62.20
76	6.28	12.56	18.84	25.12	31.40	37.68	43.96	50.24	56.52	62.80
78	6.34	12.68	19.02	25.36	31.71	38.05	44.39	50.73	57.07	63.41
80	6.40	12.81	19.21	25.61	32.02	38.42	44.82	51.22	57.63	64.03
82	6.47	12.93	19.40	25.86	32.33	38.80	45.26	51.73	58.19	64.66
84	6.53	13.06	19.59	26.12	32.65	39.18	45.71	52.24	58.77	65.30

% Slope	Horizontal Distance in Metres (5m intervals) – Chainage Plus Slope Allowance									
86	6.59	13.19	19.78	26.38	32.97	39.57	46.16	52.76	59.35	65.95
88	6.66	13.32	19.98	26.64	33.30	39.96	46.62	53.28	59.94	66.60
90	6.73	13.45	20.18	26.91	33.63	40.36	47.09	53.81	60.54	67.27
92	6.79	13.59	20.38	27.18	33.97	40.76	47.56	54.35	61.15	67.94
94	6.86	13.72	20.59	27.45	34.31	41.17	48.04	54.90	61.76	68.62
96	6.93	13.86	20.79	27.72	34.66	41.59	48.52	55.45	62.38	69.31
98	7.00	14.00	21.00	28.00	35.00	42.00	49.00	56.01	63.01	70.01
100	7.07	14.14	21.21	28.28	35.36	42.43	49.50	56.57	63.64	70.71
102	7.14	14.28	21.43	28.57	35.71	42.85	49.99	57.14	64.28	71.42
104	7.21	14.43	21.64	28.86	36.07	43.28	50.50	57.71	64.92	72.14
106	7.29	14.57	21.86	29.15	36.43	43.72	51.00	58.29	65.58	72.86
108	7.36	14.72	22.08	29.44	36.80	44.16	51.52	58.87	66.23	73.59
110	7.43	14.87	22.30	29.73	37.17	44.60	52.03	59.46	66.90	74.33

7.14.3. Correction Table for Plot Radii

7.14.3.1. Plot Radius – Page T-3 (Table 7.14.2)

% Slope	Plot Radii Plus Slope Allowance								
	0.005 ha	0.008 ha	.010 ha	0.02 ha	0.04 ha	0.06 ha	0.08 ha	0.1 ha	0.2 ha
	3.99	5.05	5.64	7.98	11.28	13.82	15.96	17.84	25.23
10	4.01	5.08	5.67	8.02	11.34	13.89	16.04	17.93	25.36
12	4.02	5.09	5.68	8.04	11.36	13.92	16.07	17.97	25.41
14	4.03	5.10	5.70	8.06	11.39	13.95	16.12	18.01	25.48
16	4.04	5.11	5.71	8.08	11.42	14.00	16.16	18.07	25.55
18	4.05	5.13	5.73	8.11	11.46	14.04	16.22	18.13	25.64
20	4.07	5.15	5.75	8.14	11.50	14.09	16.28	18.19	25.73
22	4.09	5.17	5.77	8.17	11.55	14.15	16.34	18.27	25.83
24	4.10	5.19	5.80	8.21	11.60	14.21	16.41	18.35	25.95
26	4.12	5.22	5.83	8.25	11.66	14.28	16.49	18.43	26.07
28	4.14	5.24	5.86	8.29	11.71	14.35	16.57	18.53	26.20
30	4.17	5.27	5.89	8.33	11.78	14.43	16.66	18.63	26.34
32	4.19	5.30	5.92	8.38	11.84	14.51	16.76	18.73	26.49
34	4.21	5.33	5.96	8.43	11.91	14.60	16.86	18.84	26.65
36	4.24	5.37	5.99	8.48	11.99	14.69	16.96	18.96	26.82
38	4.27	5.40	6.03	8.54	12.07	14.78	17.07	19.08	26.99
40	4.30	5.44	6.07	8.59	12.15	14.88	17.19	19.21	27.17
42	4.33	5.48	6.12	8.66	12.23	14.99	17.31	19.35	27.36
44	4.36	5.52	6.16	8.72	12.32	15.10	17.44	19.49	27.56
46	4.39	5.56	6.21	8.78	12.42	15.21	17.57	19.64	27.77
48	4.43	5.60	6.26	8.85	12.51	15.33	17.70	19.79	27.99

% Slope	Plot Radii Plus Slope Allowance							
50	4.46	5.65	6.31	8.92	12.61	15.45	17.84	19.95	28.21
52	4.50	5.69	6.36	8.99	12.71	15.58	17.99	20.11	28.44
54	4.53	5.74	6.41	9.07	12.82	15.71	18.14	20.27	28.67
56	4.57	5.79	6.46	9.15	12.93	15.84	18.29	20.45	28.92
58	4.61	5.84	6.52	9.23	13.04	15.98	18.45	20.62	29.17
60	4.65	5.89	6.58	9.31	13.15	16.12	18.61	20.80	29.42
62	4.69	5.94	6.64	9.39	13.27	16.26	18.78	20.99	29.69
64	4.74	6.00	6.70	9.47	13.39	16.41	18.95	21.18	29.95
66	4.78	6.05	6.76	9.56	13.52	16.56	19.12	21.38	30.23
68	4.83	6.11	6.82	9.65	13.64	16.71	19.30	21.57	30.51
70	4.87	6.16	6.88	9.74	13.77	16.87	19.48	21.78	30.80
72	4.92	6.22	6.95	9.83	13.90	17.03	19.67	21.98	31.09
74	4.96	6.28	7.02	9.93	14.03	17.19	19.85	22.19	31.39
76	5.01	6.34	7.08	10.02	14.17	17.36	20.05	22.41	31.69
78	5.06	6.40	7.15	10.12	14.31	17.53	20.24	22.63	32.00
80	5.11	6.47	7.22	10.22	14.45	17.70	20.44	22.85	32.31
82	5.16	6.53	7.29	10.32	14.59	17.87	20.64	23.07	32.63
84	5.21	6.60	7.37	10.42	14.73	18.05	20.84	23.30	32.95
86	5.26	6.66	7.44	10.53	14.88	18.23	21.05	23.53	33.28
88	5.31	6.73	7.51	10.63	15.03	18.41	21.26	23.76	33.61
90	5.37	6.79	7.59	10.74	15.18	18.59	21.47	24.00	33.94
92	5.42	6.86	7.66	10.84	15.33	18.78	21.69	24.24	34.28
94	5.48	6.93	7.74	10.95	15.48	18.97	21.90	24.48	34.63
96	5.53	7.00	7.82	11.06	15.64	19.16	22.12	24.73	34.97
98	5.59	7.07	7.90	11.17	15.79	19.35	22.35	24.98	35.33
100	5.64	7.14	7.98	11.29	15.95	19.54	22.57	25.23	35.68
102	5.70	7.21	8.06	11.40	16.11	19.74	22.80	25.48	36.04
104	5.76	7.29	8.14	11.51	16.27	19.94	23.03	25.74	36.40
106	5.81	7.36	8.22	11.63	16.44	20.14	23.26	26.00	36.77
108	5.87	7.43	8.30	11.75	16.60	20.34	23.49	26.26	37.14
110	5.93	7.51	8.38	11.86	16.77	20.54	23.73	26.52	37.51
112	5.99	7.58	8.47	11.98	16.94	20.75	23.96	26.79	37.88
114	6.05	7.66	8.55	12.10	17.11	20.96	24.20	27.05	38.26
116	6.11	7.73	8.64	12.22	17.28	21.17	24.44	27.32	38.64
118	6.17	7.81	8.72	12.34	17.45	21.38	24.69	27.59	39.02
120	6.23	7.89	8.81	12.47	17.62	21.59	24.93	27.87	39.41
122	6.29	7.97	8.90	12.59	17.79	21.80	25.18	28.14	39.80
124	6.36	8.04	8.98	12.71	17.97	22.02	25.42	28.42	40.19
126	6.42	8.12	9.07	12.84	18.15	22.23	25.67	28.70	40.59
128	6.48	8.20	9.16	12.96	18.32	22.45	25.92	28.98	40.98
130	6.54	8.28	9.25	13.09	18.50	22.67	26.18	29.26	41.38
132	6.61	8.36	9.34	13.22	18.68	22.89	26.43	29.54	41.78
134	6.67	8.44	9.43	13.34	18.86	23.11	26.69	29.83	42.18
136	6.74	8.52	9.52	13.47	19.04	23.33	26.94	30.12	42.59
138	6.80	8.61	9.61	13.60	19.22	23.55	27.20	30.40	43.00
140	6.86	8.69	9.70	13.73	19.41	23.78	27.46	30.69	43.41

A spreadsheet to calculate Plot Radii Slope Allowance can be found at the following website:

Cruising Calculations

7.15. Appendix 15: Interior Lumber Recovery Factor (LRF) Algorithms

For additional information on these algorithms, please refer to the Cruise Compilation Manual.

7.15.1. Dead Potential White Pine Log Grade Algorithm

7.15.1.1. Assumption

Pathology and surface characteristics on the tree can predict grade (see figure below).

7.15.1.2. Procedures

1. The compilation program utilizes a matrix for allocation of path in thirds to the 5 metre logs (see Appendix A.10.2 of the *Cruise Compilation Manual*).
2. Pathological indicators are collected as per the manual.
3. Saprot/checks are recorded in the root rot column. At least 50 percent of the log must be suitable for lumber. Sound cores must be at least 10 cm top diameter, and logs less than 15 cm top diameter are allowed only one check 4 cm deep or more to be classified as sawlog. Code the pathological indicator tree third positions 1 to 7 for each third that *does not* qualify as lumber.

7.15.1.3. Flowchart

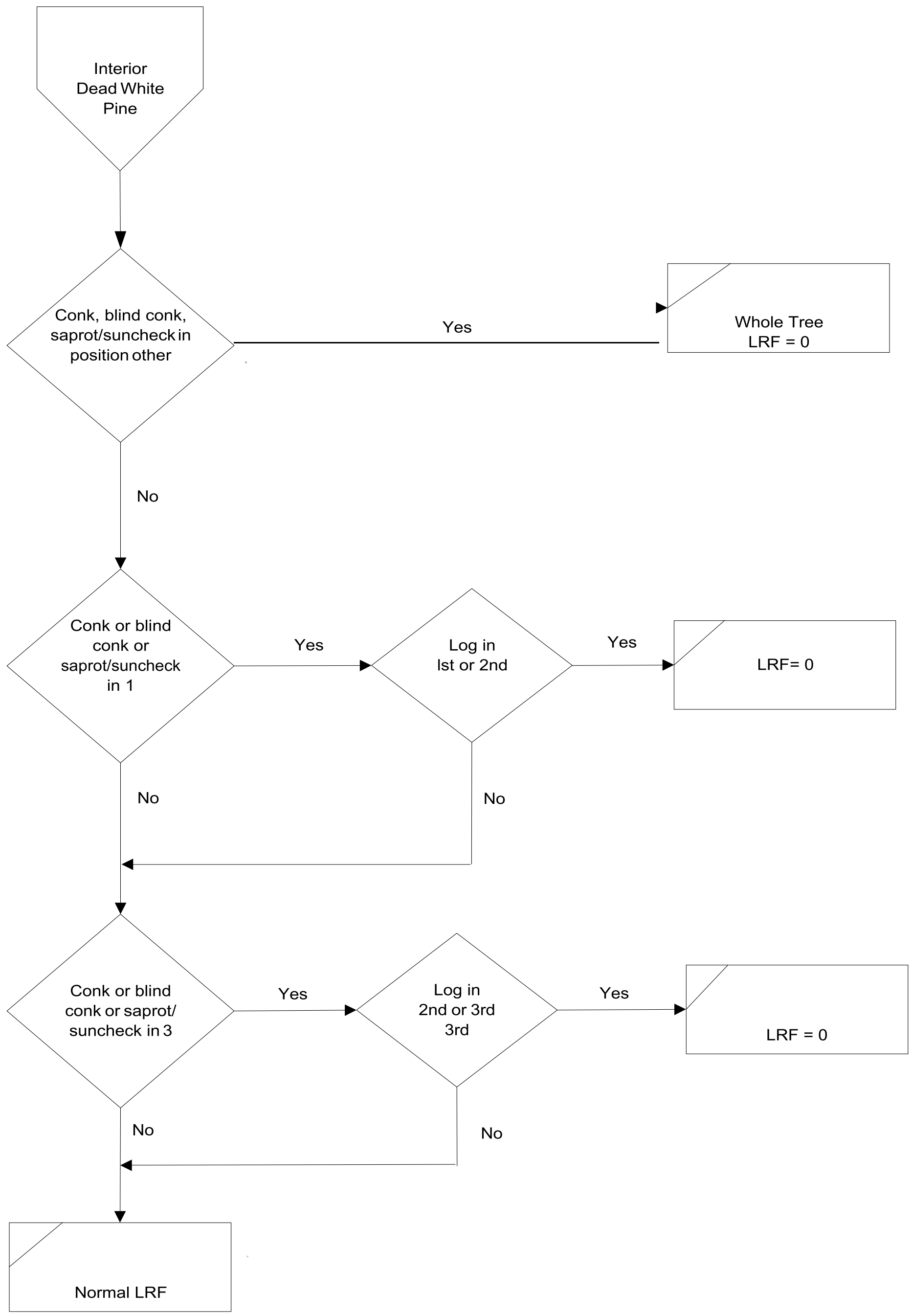


Figure 7-12 Dead Potential White Pine Log Grade Algorithm

7.15.2. Interior Hemlock Algorithm Flowchart

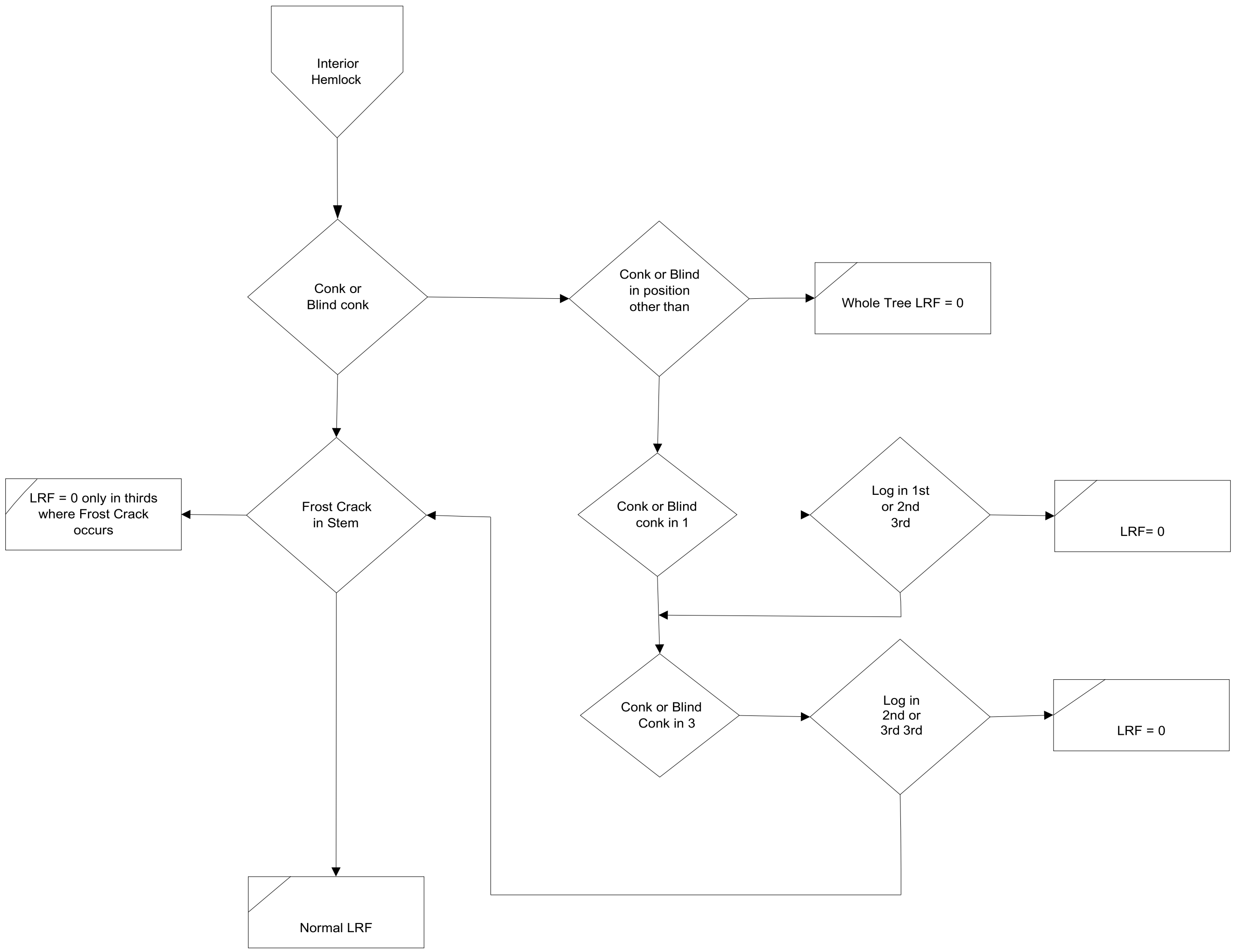


Figure 7-13 Interior Hemlock Algorithm

7.15.3. Interior Balsam (*Abies* sp.) Process

The LRF compiled for balsam is based on the sawlog component only. The compilation will assess each balsam tree and segregate those with decay, waste and breakage (DWB) of less than 48% as all sawlogs. Those balsam trees with greater than or equal to 48% DWB will have zero LRF assigned to the complete volume of the tree. The average LRF's will be lowered due to the reduction of the sawlog net volume over the total net volume.

7.16. Appendix 16: Magnetic Declination

Magnetic variation or declination changes from year to year and from place to place. It is important that mappers check and update their declination for each project as needed. The link below provides the correct declination, which must be shown on the cruise plan map. Coordinates of various locations in BC are provided below.

Link: https://www.ngdc.noaa.gov/geomag/calculators/magcalc.shtml

Region	Location	Latitude (in degrees, minutes)	Longitude (in degrees, minutes)
Coastal	Chilliwack	49 ° 10'	121 ° 57'
Coastal	Haney	49 ° 13'	122 ° 36'
Coastal	Abbotsford	49 ° 03'	122 ° 17'
Coastal	Vancouver	49 ° 15'	123 ° 07'
Coastal	Squamish	49 ° 45'	123 ° 07'
Coastal	Powell River	49 ° 51'	124 ° 32'
Coastal	Campbell River	50 ° 01'	125 ° 20'
Coastal	Port McNeill	50 ° 35'	127 ° 06'
Coastal	Gold River	49 ° 41'	126 ° 07'
Coastal	Nanaimo	49 ° 10'	123 ° 56'
Coastal	Tofino	49 ° 07'	125 ° 53'
Coastal	Duncan	48 ° 47'	123 ° 42'
Coastal	Port Alberni	49 ° 14'	124 ° 48'
Coastal	Sayward	50 ° 23'	125 ° 58'
Coastal	Holberg	50 ° 39'	128 ° 01'
Coastal	Port Renfrew	48 ° 33'	124 ° 25'
Coastal	Massett	54 ° 01'	132 ° 06'
Coastal	The Village of Queen Charlotte	53 ° 15'	132 ° 07'

Region	Location	Latitude (in degrees, minutes)	Longitude (in degrees, minutes)
Coastal	Klemtu	52 ° 35'	128 ° 31'
Coastal	Hagensborg	52 ° 23'	126 ° 33'
Coastal	Security Bay	51 ° 22'	127 ° 28'
Coastal	Alison Sound	51 ° 15'	127 ° 00'
Coastal	Pemberton	50 ° 19'	122 ° 48'
Coastal	Boston Bar	49 ° 52'	121 ° 26'
Coastal	Stuart Island	50 ° 22'	125 ° 08'
Coastal	Sewell Inlet	52 ° 53'	131 ° 59'
Coastal	Franklin River	49 ° 00'	124 ° 45'
Coastal	Rivers Inlet	51 ° 41'	127 ° 15'
Coastal	Prince Rupert	54 ° 18'	130 ° 20'
Northern	Burns Lake	54 ° 14'	125 ° 46'
Northern	Houston	54 ° 27'	126 ° 37'
Northern	Smithers	54 ° 47'	127 ° 11'
Northern	Hazelton	55 ° 14'	127 ° 35'
Northern	Terrace	54 ° 31'	128 ° 36'
Northern	Stewart	55 ° 57'	130 ° 00'
Northern	Lower Post	59 ° 55'	128 ° 30'
Northern	Bob Quinn Lake	56 ° 58'	130 ° 15'
Northern	Dease Lake	58 ° 26'	130 ° 00'
Northern	Atlin	59 ° 35'	133 ° 41'
Northern	Hixon	53 ° 25'	122 ° 35'
Northern	Prince George	53 ° 55'	122 ° 45'
Northern	Bear Lake (Hart Hwy)	54 ° 30'	122 ° 41'
Northern	Vanderhoof	54 ° 01'	124 ° 01'
Northern	Kenny Dam	53 ° 35'	124 ° 57'
Northern	Ft. St. James	54 ° 26'	124 ° 15'
Northern	Takla Landing	55 ° 29'	125 ° 58'
Northern	Manson Creek	55 ° 40'	124 ° 29'

Region	Location	Latitude (in degrees, minutes)	Longitude (in degrees, minutes)
Northern	Aiken Lake	56 ° 26'	125 ° 45'
Northern	Bear Lake (Driftwood)	56 ° 12'	126 ° 51'
Northern	Mackenzie	55 ° 18'	123 ° 10'
Northern	Fort Ware	57 ° 26'	125 ° 38'
Northern	Ingenika Point	56 ° 47'	124 ° 54'
Northern	Ingenika Mine	56 ° 42'	125 ° 11'
Northern	Dawson Creek	55 ° 46'	120 ° 14'
Northern	Chetwynd	55 ° 42'	121 ° 38'
Northern	Tumbler Ridge	55 ° 07'	121 ° 00'
Northern	Fort St. John	56 ° 15'	120 ° 51'
Northern	Beaton River (settl.)	57 ° 23'	121 ° 25'
Northern	Pink Mountain	57 ° 02'	122 ° 31'
Northern	Fort Nelson	58 ° 48'	122 ° 43'
Northern	Muncho Lake	58 ° 56'	125 ° 46'
Northern	Nelson Forks	59 ° 30'	124 ° 01'
Southern	Chase	50 ° 49'	119 ° 41'
Southern	Lillooet	50 ° 40'	121 ° 56'
Southern	Merritt	50 ° 07'	120 ° 47'
Southern	Princeton	49 ° 28'	120 ° 30'
Southern	Penticton	49 ° 30'	119 ° 35'
Southern	Vernon	50 ° 16'	119 ° 16'
Southern	Salmon Arm	50 ° 42'	119 ° 16'
Southern	Kamloops	50 ° 40'	120 ° 19'
Southern	Clearwater	51 ° 39'	120 ° 02'
Southern	Beaverdell	49 ° 26'	119 ° 05'
Southern	Valemount	52 ° 50'	119 ° 15'
Southern	McBride	53 ° 18'	120 ° 10'
Southern	Castlegar	49 ° 19'	117 ° 39'
Southern	Cranbrook	49 ° 30'	115 ° 46'
Southern	Creston	49 ° 06'	116 ° 31'
Southern	Flathead	49 ° 22'	114 ° 37'

Region	Location	Latitude (in degrees, minutes)	Longitude (in degrees, minutes)
Southern	Golden	51 ° 18'	116 ° 58'
Southern	Grand Forks	49 ° 02'	118 ° 27'
Southern	Invermere	50 ° 31'	116 ° 02'
Southern	Kaslo	49 ° 55'	116 ° 54'
Southern	Mica Creek	52 ° 00'	118 ° 34'
Southern	Nakusp	50 ° 14'	117 ° 48'
Southern	Nelson	49 ° 29'	117 ° 17'
Southern	Revelstoke	50 ° 59'	118 ° 12'
Southern	Sparwood	49 ° 43'	114 ° 53'
Southern	Quesnel Townsite	52 ° 59'	122 ° 30'
Southern	Farwell Canyon	51 ° 49'	122 ° 34'
Southern	Mid - Horsefly Lake	52 ° 24'	121 ° 02'
Southern	100 Mile House Townsite	51 ° 39'	121 ° 17'
Southern	Chilanko Forks Settlement	52 ° 07'	124 ° 04'

7.17. Appendix 17: Pathological Classification of Trees

Within mature stands, or stands approaching maturity, (i.e., older immature stands) individual trees contain varying amounts of decay. In stands of this type the estimation of cull is subject to considerable error. Therefore, it would be advantageous to know which trees are likely to contain decay, particularly those which are likely to contain excessive amounts of decay. Pathological studies have shown that two broad classes of living trees are clearly recognizable in stands of this character. The classification of trees is made on the basis of the presence or absence of external signs of decay, and each class of tree will represent a different potential loss factor within the stand.

7.17.1. Class of Trees

All living trees measured on each sample plot will be classed as:

- Residual, or
- Suspect.

7.17.1.1. Residual Trees

Residual trees are living trees which bear none of the external indicators of decay listed in 7.17.2.

Examples of signs and defects on residual trees are listed in Section 7.17.2 and Figure 7.40 Illustrates Forks and Crooks Which are Not Suspect.

7.17.1.2. Suspect Trees

Suspect trees are living trees which bear one or more of the following external indications of decay, on or immediately adjacent to the trunk of the tree within the limits specified in this Appendix:

1. Conks.
2. Blind conks (swollen knots).
3. Scars.
4. Fork or pronounced crook.
5. Frost crack.
6. Mistletoe trunk infections.
7. Rotten branches.
8. Dead or broken top.

The amount of decay indicated by signs will be subject to considerable variation within species and individual trees. For example, frost cracks may be highly significant as indicators of decay on a particular species in the stand as a whole, but not as significant on individual trees.

"Suspect" classifications will be made on the basis of the above listed signs of decay only; no other abnormalities are to be used.

See Risk Group Ratings by Pathological Indicators (Appendix 20: Table 7.20.1) for Pathological Occurrence by Species and Forest Inventory Zones.

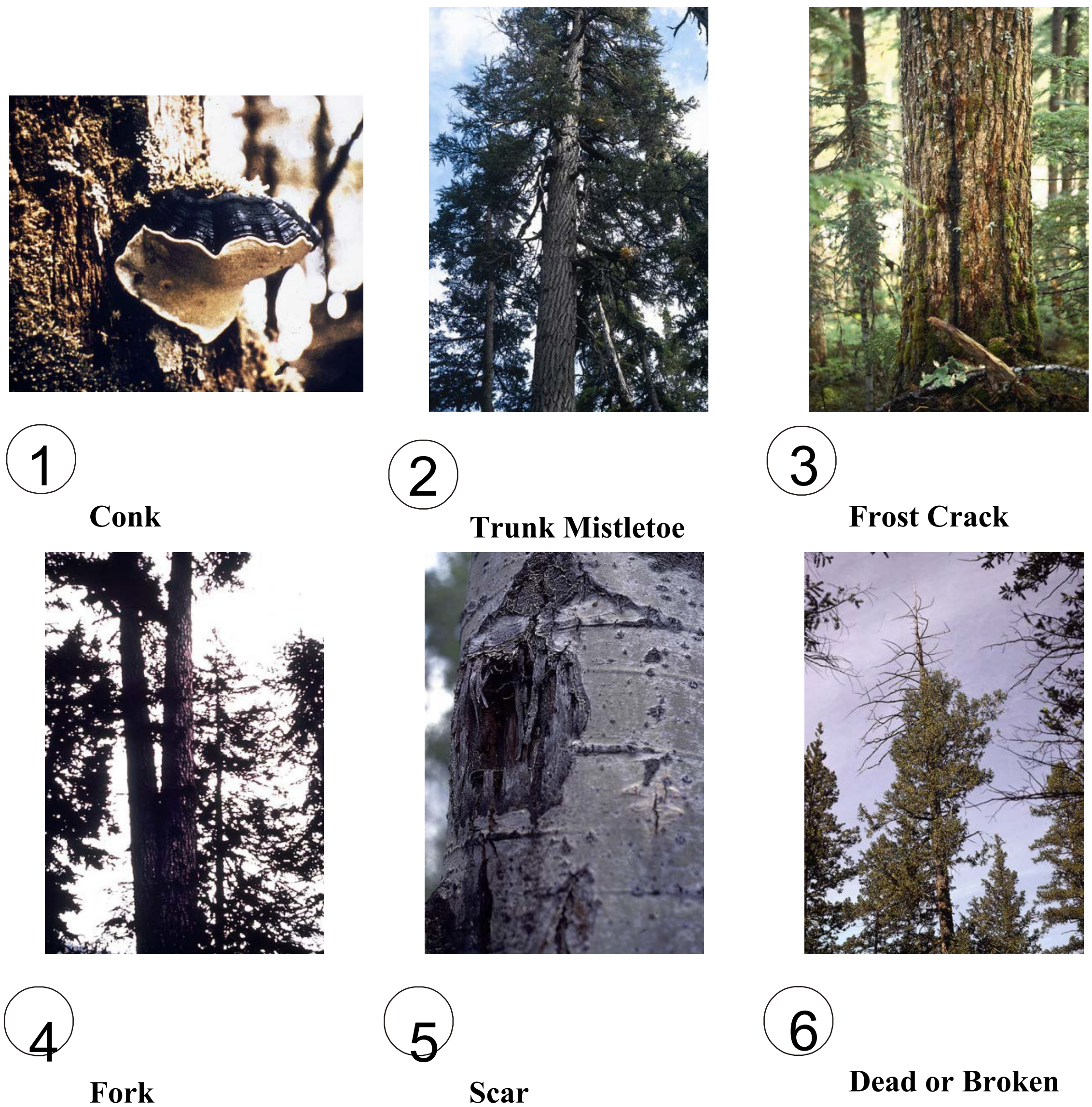


Figure 7-14 Suspect Trees

7.17.2. Signs and Defects Indicative of Decay in Standing Trees

The following is a brief description and explanation of the external indications of decay listed in this Appendix.

Coast – Pathological indicators must be recorded on all live and dead potential trees. Interior – Pathological indicators must be recorded on:

i. All live trees,

ii. dead potential white pine, balsam (Abies sp.) and hemlock trees, and

iii. dead potential lodgepole pine trees with conk and blind conk.

Do not record pathological indicators occurring above the top diameter timber merchantability specification[1].

7.17.2.1. Secondary Leaders

Record all pathological indicators on secondary leaders if the leader is alive and of merchantable size. Conks of an identifiable heart rot fungi may be called on non-merchantable live secondary leaders. Do not record any pathological indicators on non-merchantable dead secondary leaders.

Record pathological indicators on dead, merchantable secondary leaders for cedar and cypress only.

Record all pathological indicators on dead potential trees for the coastal log grade algorithm, however do not record saprophytic fungi as conk.

7.17.2.2. Conks

Conks are the fruiting bodies (sporophores) of decay fungi, and are definite and reliable indicators of decay. Conks can occur anywhere on the main stem, branches, and exposed roots of the tree, but appear most frequently around knots and on the underside of both dead branch stubs and live branches. Fruiting bodies from a variety of saprophytic fungi can also occur on slash, however saprophytic conks are not suspect indicators. It is important to be able to differentiate between the fruiting bodies of saprophytic fungi that occur on live and dead branches, wounds and roots of living trees and those of suspect indicators found on living conifers and hardwoods. For cruising purposes, only specific root, butt and heart rot conks are suspect indicators (see Figure 7.19 Residual and Suspect Indicators and Their Host Species for a list of Residual and Suspect indicators, as well as their host species native to British Columbia).

On conifers, the suspect indicators which must be recognized are *Echinodontium tinctorium, Phellinus (Fomes) pini, Phaeolus (Polyporous) schweinitzii* and *Fomitopsis pinicola*. On hardwoods, the suspect indicators to recognize are *Phellinus igniarius* and *Phellinus tremulae*.

The major heart rot conks are hard, thick, woody-like perennial structures, and form singly at branch stubs or in small clusters on the underside of living branches. An exception to this is the mushroom-shaped to bracket-like sporophore of *P. schweinitzii* which is annual, but may persist for more than two years. Conks vary in size and shape and therefore are hard to spot, particularly when they are just developing, or when they occur on the upper trunk.

Before recording suspect conks on living branches in the upper crown, there must be conks of the suspect indicator heart rot fungi evident in the stand.

[1] *The merchantable portion of the tree is from 30cm stump height to a 10cm or 15cm top diameter inside bark as per the appropriate timber merchantability standards. Pathological factors outside of these limits were not included in the loss factor data.*

Conks of *E. tinctorium* and *P. pini* frequently appear as small hoof-like or shelf-like structures on the underside of dead branch stubs and/or lower trunk of an infected tree. Moss-covered branch stubs and burls often resemble conks, particularly when viewed from directly below; it is important, therefore, to view the tree from the side before making a decision.

A variety of saprophytic conk species that occur on dead wood of living trees can be both annual (small, thin, leathery) and perennial, and are often more numerous, and occur anywhere on the tree. Saprophytic conks are not acceptable as suspect indicators, with the exception of *F. pinicola*, which is considered a suspect indicator only when occurring on live trees, as studies have found that its presence indicates significant decay. When *F. pinicola* occurs on dead trees, or dead branches on live trees, it is not considered a suspect indicator.

Conks of Phaeolus schweinitzii

P. schweinitzii is the cause of brown cubical rot and butt rot of most conifers, however Douglas-fir and spruce are the most susceptible. The fruiting bodies may occur:

- on the base of a tree,
- on the ground up to 2 m from the tree where no exposed roots are evident, or
- on the exposed roots.

If a *P. schweinitzii* conk is located mid-way between:

1. Two living susceptible trees, only one tree is considered to be infected. If one tree is a highly susceptible species (e.g. Douglas-fir) and the other is a less susceptible tree (e.g. western red cedar), the most susceptible species is considered to be infected.
2. A living tree and a stump showing brown cubical rot, and it is not on a root of the live tree, it is assumed to be associated with the stump.

Conks of Phaeolus schweinitzii Vs. conks of Inonotus tomentosus

It may be easy to confuse conks of *P. schweinitzii* (shown in Figure 7.19 Residual and Suspect Indicators and Their Host Species and Figure 7.41 Suspect Indicators) with those of *I. tomentosus* (Figure 7.42: Residual Indicators), as the fruiting bodies can be somewhat similar in appearance. Particular care should be taken in identification of these pathogens.

Young conks of *P. schweinitzii* may often look the same as young conks of *I. tomentosus*, however conks of *I. tomentosus* are usually smaller (usually < 10 cm in diameter than those of *P. schweinitzii*, which can be up to 25 cm in diameter. In addition, conks of *P. schweinitzii* are often darker than those of *I. tomentosus*.

P. schweinitzii usually appears shelf-like when growing on a stem, stalked and stipate when growing on the ground. Its upper surface has concentric rings, and is red-brown and velvety in appearance. The lower surface of the fruiting body can appear a tan yellow-green in colour, and can turn a brown colour when bruised. In contrast, the fruiting bodies of *I.*

tomentosus are stalked and found on the ground and around infected trees. The upper surface usually appears yellow-brown to rust-brown in colour, and becomes a darker brown with age and when wet.

Figure 7-15 Example of P. schweinitzii

7.17.2.3. Blind Conks

Blind conks are pronounced swellings or depressions around knots caused mainly by *P. pini* on conifers and *P. tremulae* on aspen (see Figure 7.16 Example of Blind Conk in a Knot. to Figure 7.18 Blind Conk and Sound Knot.). If identified correctly, blind conks are definite indicators of decay. The swelling or depression results from the tree attempting to heal over an abortive conk, a newly developing conk, or a point from which an old conk has dropped. Non-typical forms may appear as small branch holes or branch stubs at the base of trees. This form is often found in over-mature Douglas-fir and balsam (*Abies*) species in the coast-interior transition zone (e.g. Boston Bar). Consequently, over-mature trees with basal branch stubs should be examined for blind conk.

Calling Blind Conks

Accessible indicators:

- Must be verified by cutting with an axe or equivalent implement. This will reveal a bright yellow or buff-colour of the conk.

Inaccessible indicators:

- Record only those indicators which have a high chance of being blind conk, such as large swollen knots and large caved-in knots. They must be similar to the ones that have been identified in the stand.
- Do not call small knots and knot indicators on any species.

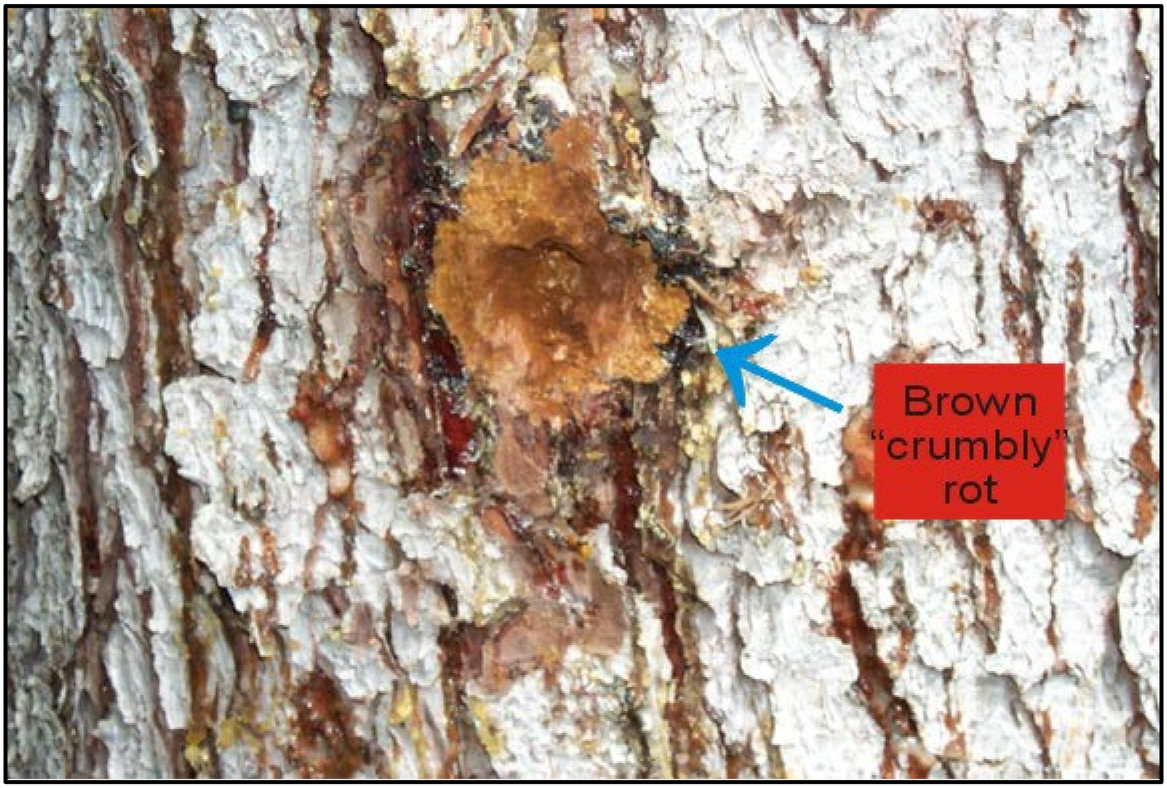


Figure 7-16 Example of Blind Conk in a Knot

Figure 7-17 Non-blind Conk in a Knot

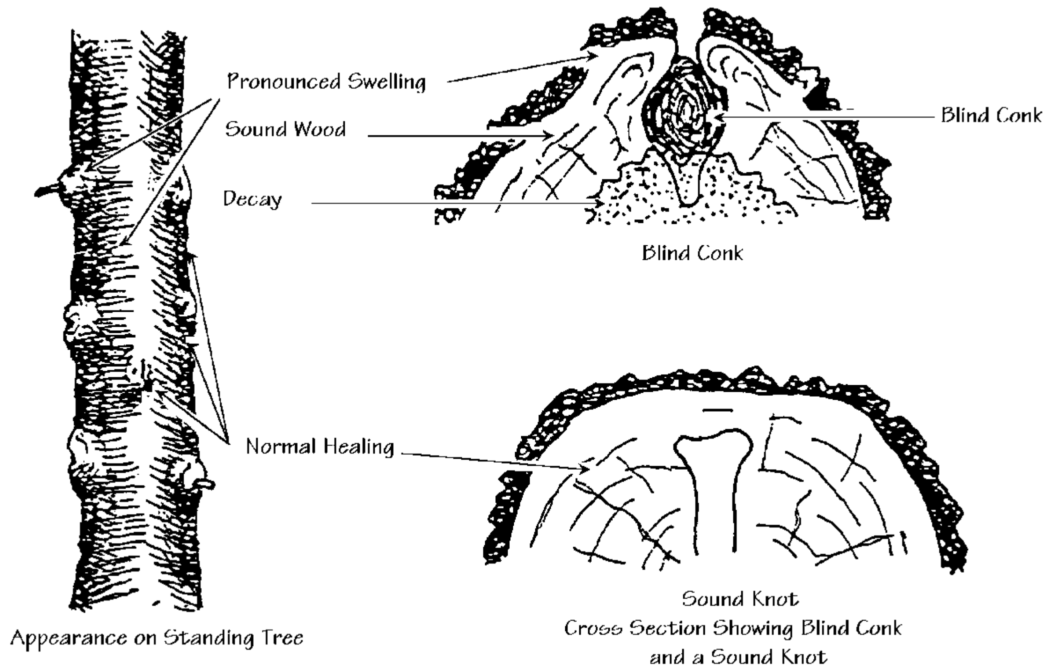


Figure 7-18 Blind Conk and Sound Knot

Residual Trees (Do not record these indicators – See Figure 7.42 Residual Indicators)		**Suspect Trees (Record these indicators – See Figure 7.41 Suspect Indicators)**	
Roots and Butt Rots			
Species	**Common BC Native Host Species**	**Species**	**Common BC Native Host Species**
Armillaria spp.	Ba, Bg, Bl, Lw, Se, Sw, Ss, Pl, Pw, Py, Fd, Tw, Cw, Hw, Ep, At, Act, Qg, W spp.	***Phaeolus schweinitzii***	Ba, Bl, Cw, Fd, Hw, Lt, Lw, Pl, Pw, Py, Ss, Sw, Qg
Heterobasidion annaosum	Ba, Bg, Sw, Ss, Fd, Cw, Hw, Mb, Dr		
Inonotus tomentosus	Ba, Bl, Fd, Hw, Lw, Pa, Pl, Py, Se, Sw, Ss		
Phellinus weirii	Fd, Bg, Hm, Se, Ss, Bl, Hw, Lw, Pl, Pw, Py		
Rhizina undulata	Cw, Fd, Hw, Lw, Pl, Se, Ss, Sw		
Heart Rots			
Ceriporiopsis rivulosa	Ba, Cw, Fd, Hw, Sw, Ss	*Echinodontium tinctorium*	Ba, Bg, Bl, Cw, Fd, Hw, Hm, Ss, Sw
*Fomes fomentarius**	D spp., Act, Acb, E spp.	*Fomitopsis pinicola* - Only if found on bole of live tree.	Ba, Bg, Bl, Cw, Fd, Hm, Hw, He, Lw, Pl, Pw, Py, Se,

Residual Trees (Do not record these indicators – See Figure 7.42 Residual Indicators)		**Suspect Trees (Record these indicators – See Figure 7.41 Suspect Indicators)**	
			Ss, Sw, Dr, Ep, A spp., Act
Fomitopsis officinalis	Ba, Bg, Fd, Hw, Lw, Pl, Pw, Py, Se, Ss	*Phellinus igniarius**	D spp., R spp., Act, E spp., G spp., M spp., W spp.
Fomitopsis pinicola - Found anywhere other than on large, old scar	Ba, Bg, Bl, Cw, Fd, Hm, Hw, He, Lw, Pl, Pw, Py, Se, Ss, Sw, Dr, Ep, A spp., Act	*Phellinus tremulae**	At
Ganoderma applanatum	Ba, Bg, Cw, Fd, Hm, Hw, Se, Sw, D spp., A spp., E spp., M spp., Q spp., W spp.	*Phellinus pini*	Ba, Bg, Bl, Cw, Yc, Fd, Hm, Hw, Lw, Pj, Pl, Pw, Py, Sb, Se, Ss, Sw
Hericium abietis	Ba, Bg, Bl, Hm, Hw, Ss		
Laetiporus sulphureus	Ba, Bg, Bl, Bp, Cw, Fd, Hw, L spp., Py, Pw, S spp., Qg		
Neolentinus kauffmanii	Ss		
Perenniporia subacida	Ba, Bg, Bl, Cw, Fd, Hw, Lt, Pl, Pw, Se, Ss, Sw, D spp., R spp., Act, E spp., M spp., W spp.		
Phellinus hartigii	Ba, Bl, Fd, Hw		
*Pholiota populnea**	Act		
*Piptoporus betulinus**	Ep		
Postia sericeomollis	Ba, Cw, Yc, Fd, Hw, Lw, Pl, Py, Se, Ss, Sw		
*Spongipellis delectans**	Act		
Sterium sanguinolentum	Ba, Bg, Bl, Cw, Fd, Hm, Hw, Lt, Lw, Pl, Pw, Py, Se, Sw		
Veluticeps fimbriata	Ba, Bg, Bl, Fd, Hm, Hw, Se, Ss		

** deciduous hosts only*

*** Root rots can be recorded (codes J, K and L), but they do not affect the appraisal compilation.*

Figure 7-19 Residual and Suspect Indicators and Their Host Species

7.17.2.4. Scars

On live and dead trees, a scar is an injury caused by external forces which has damaged the cambial layers of the tree. Furthermore, trees with sloughing (missing) bark exposing the cambial layers of the tree also constitutes a scar if greater than five (5) years old. This exposes either the sap wood or heartwood (or both) to potential attack by wood rotting fungi. These wood rotting fungi are ever present in forest stands and are carried widely by air currents.

Forms of scars - both open and closed scars will be recorded. Open scars:

- open scars appear as areas of exposed wood of varying sizes and shapes (see Figure 7.20 Open Scars), and
- scars are slow to heal over and the wood tissues of the tree may remain exposed for a considerable time allowing entrance of wood rotting fungi.

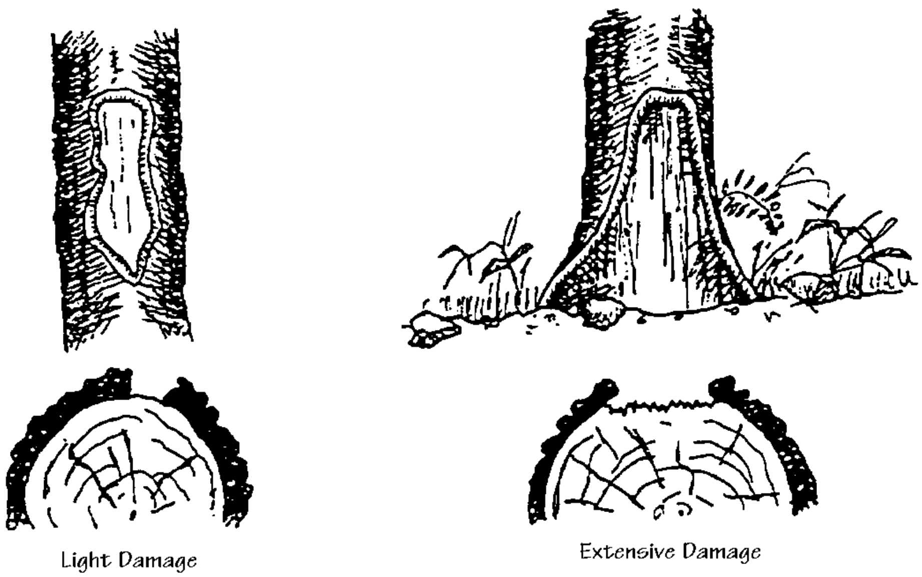


Figure 7-20 Open Scars

For root scars to be eligible calls, the scar must be on the portion of the root that is exposed before it enters the ground (see Figure 7.21 Root Scars.).

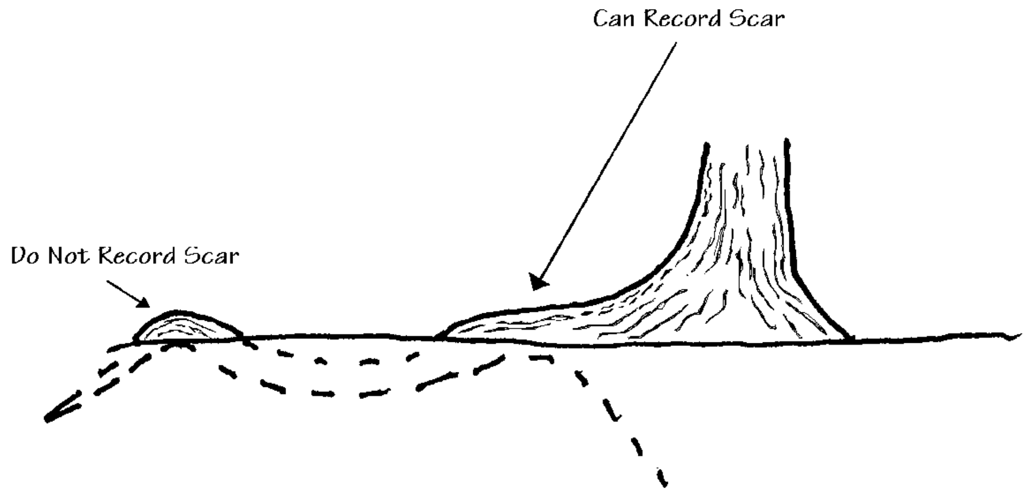


Figure 7-21 Root Scars

Closed scars:

- closed scars appear as slight to pronounced indentations of the bark in the case of early scarring which has healed over, or as pronounced scar tissue or callous growth in the case of later scarring. The latter type of scars frequently show considerable resin flow (see Figure 7.22 Closed Scars.).

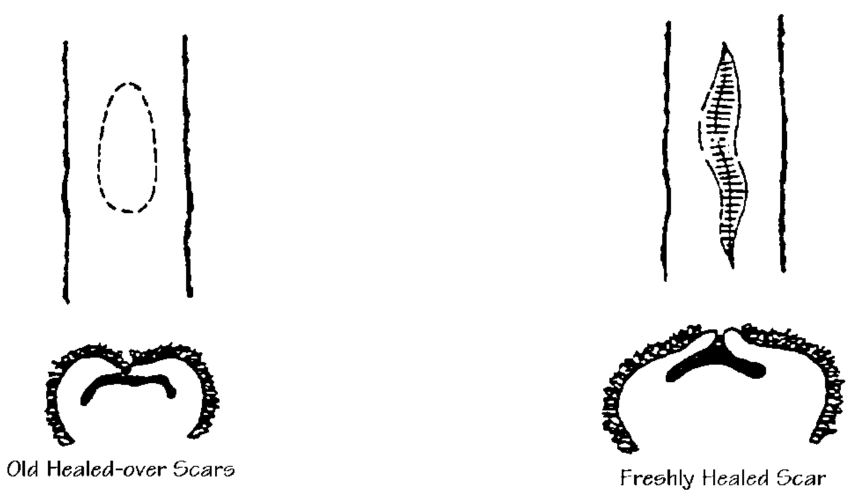


Figure 7-22 Closed Scars

The volume and decay studies of the past thirty years identified only scars visible to the naked eye without the use of binoculars or other lens. The scars were assessed without chopping into the indicator.

To be compatible with these initial assessments, the same methodology must therefore be followed today. This also is the most practical method of observation at present.

A scar may or may not have visible decay associated with it.

The decay studies have scars with both decay and no decay in the data base. Age of scar:

- a scar shall not be recent in origin. This is interpreted as the injury having not occurred within approximately the past five years[1],
- the scar or catface should show greyed or weathered wood. Weathered wood shall be described as:
    - dried and some "sun checking" evident,
    - usually associated with change of wood colour to a greyish tone,
    - callous growth should also be evident where the tree is attempting to grow over the scar, and
    - decay does not have to be evident.

Location of scar:

- a scar should be recorded if the damage occurs on any portion of the trunk of the main stem or on the secondary leader (only if the secondary leader contains a merch log),
- a scar which extends from the first third of the tree into the upper 1/3 of the tree on which the top is dead will be recorded as a scar "4" by convention. The objective is not to double call the pathological indicators in the upper 1/3 of the tree,
- scars occurring completely below the point of germination, either on the trunk or an exposed root adjacent to the trunk, will be recorded as a scar, and
- do not record scars above 10 cm top diameter[2].

Causes of scars:

Scars may be caused by many external forces, such as:

1. Fire:
    a. old fire scars that have healed over appear typically as slight ridging of the bark and may have very old callous tissue on the bark, whereas more recent fire scars or ones resulting from severe damage appear as open catfaces or hollowing of the stem,

[1] *Recent pathological damage was not included in the loss factor data.*

[2] P*athological factors above 10 cm top diameter were not included in the loss factor data.*

b. fire scars are usually confined to the base of the tree, and

c. fire scars may be important indicators of decay. Trees growing in forest stands (i.e., south or west facing slopes with pioneer species such as Douglas fir or Lodgepole Pine) having a history of fire should be examined carefully for evidence of charred wood in root crotches or on exposed roots.

See Section 7.6.2 in Appendix 6: Damaged Stands.

2. Lightning:

   a. lightning can cause extensive damage to the top and stem of the tree. It typically appears as narrow to wide strips of torn wood, often extending down the entire length of the tree and often in the form of a spiral around the stem.

3. Damage by a fall tree:

   a. trees are frequently scarred by other trees falling against them. Scars of this type are common in selectively logged stands or decadent stands where windfall trees are more common. Look for evidence that a fallen tree might have rubbed off the branches along the side of the tree.

4. Machinery damage:

   a. machinery can cause extensive damage, especially where selective logging has occurred, and

   b. these scars are usually confined to the lower trunk, but they may also occur on the upper trunk when damage is caused by rigging lines.

5. Blazes:

   a. blazes are entry points for decay fungi if they penetrate into the cambium layer.

6. Breakage of branches, secondary leaders or suckers from the bole of the tree:

   a. high winds or heavy snow may cause the branches to break from the main stem creating exposed wood on the bole of the tree.

7. Falling rocks (see Figure 7.23 Scars Caused by Rock Slides and Falling Rocks)

   a. rock slides or individual rock movement can cause extensive damage to trees in their path,

   b. scars caused by rocks are usually confined to the basal portion of the trunk on the uphill side, and

c. falling rocks may scar trees a considerable height above the ground, either due to snow levels at the time of injury or bouncing rocks on steeper slopes. Rock damage is often evident on trees adjacent to road construction where blasting has occurred.

Figure 7-23 Scars Caused by Rock Slides and Falling Rocks

8. Animal/bird damage:
   a. wood must be exposed,
   b. bear, moose, deer etc. can cause damage by removing areas of bark and cambium from the trunks of many trees,
   c. rodents and beavers also cause damage to trees by gnawing on areas of the trunk,
   d. woodpecker holes of considerable size provide entrance for wood rotting fungi, however, sap sucker holes are not scars, and
   e. care must be taken to exclude superficial damage caused by these agents.

9. Cankers caused by fungi (see Figure 7.24 Cankers Caused by Fungi.):
   a. only cankers with exposed weathered wood are called, and
   b. cankers caused by fungi result in the death of localized areas of bark and cambium on the trunks of trees. Eventually the dead bark is sloughed off exposing the underlying wood. There is usually evidence of repeated callous growth, and for this reason cankers are frequently mistaken for mechanical scars. Cankers are usually flattened and elongated, and may be indefinite in contour. The exposed wood is often stained and impregnated with resin. Fruiting bodies of the fungus may also be in evidence.

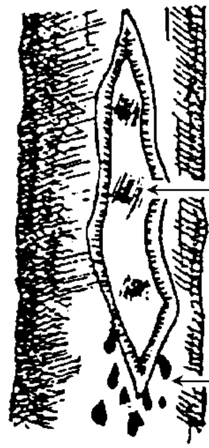


Figure 7-24 Cankers Caused by Fungi

Abnormalities similar to scars but not classified as scars:

Black knots:

- black knots frequently develop around unhealed knots and wounds. A superficial saprophytic fungus, which feeds on the exuded sap, causes the blackness. Black knots are quite sound and when cut into with an axe do not signify decay.

Burls and galls:

- burls and galls develop from abnormal cell growth in trees and are not associated with scarring, however scars occurring on burls and galls will be recorded.

Dry side:

- dry side results from the death of the cambium through bruising by other trees or by other physiological causes. Dry side may appear as a narrow to wide strip or as a localized area on the side of a tree. The bark remains over the affected area and provides protection against wood rotting fungi. Dry side is not a scar unless the bark has sloughed (is missing).

Sap sucker holes:

- sap sucker holes are superficial in extent and have no established significance for causing decay.

Insect borings:

- borings by bark beetles or other insects are generally recent in origin and they are not pathological indicators.

7.17.2.5. Fork or Pronounced Crook

A fork or crook is the result of damage to the main leader of the tree where one or more lateral limbs take over as the main stem. Fork or crook is called if severe enough to indicate that the original injury exposed the wood and provided an entrance point for decay fungi. Fork or crook is to be recorded between the root collar and the minimum top diameter specified in the cutting authority document.

Forks are recorded for any of the following conditions:

1. The main stem is markedly forked to indicate that 2 or more leaders have resulted from serious damage to the original leader (see Figure 7.25 Types of Forks and Crooks Which are Recorded, Example A and B).
2. The diameter of the main stem changes excessively from its normal taper to indicate that a serious injury has occurred. For cruising purposes, the diameter change must be at least 10 percent (Figure 7.25 Types of Forks and Crooks Which are Recorded, Example C and D).
3. Where there is no evidence of a broken top in the stem at the fork/crook position and neither of the leaders are merchantable, record fork/crook.

Crooks are recorded if:

1. There is at least a 10 percent diameter change in the bole above and below the crook (see Figure 7.25 Types of Forks and Crooks Which are Recorded, Example F).
2. The offset is severe enough to indicate that damage occurred to the main stem. For cruising purposes, the offset must be at least 50 percent of the diameter of the tree at the crook (see Figure 7.25 Types of Forks and Crooks Which are Recorded, Example E).

Some forks and crooks are not recorded (see Figure 7.40 Illustrates Forks and Crooks Which are Not Suspect). Forks and Crooks may be a growth characteristic of the tree species (for example deciduous species) or may have developed from malformation of the terminal leader due to insect or mistletoe attack. In addition, a fork may be confused with a branch. Forks or crooks which are not recorded are as follows:

1. Crooks with a minor offset (for cruising purposes, an offset less than 50 percent of the diameter of the tree at the crook).
2. Small sharply angled branches or spikes (for cruising purposes, less than a 10 percent change in the diameter of the main stem).
3. Natural forking in deciduous tree species.
4. If the damage is less than 5 years old and/or occurs above the minimum timber merchantability specifications specified in the Timber Utilization Policy (Coast or

Interior)[1].

5. Flattening of the top of the tree caused by wind or natural outgrowth.

6. Candelabra branches in coniferous species.

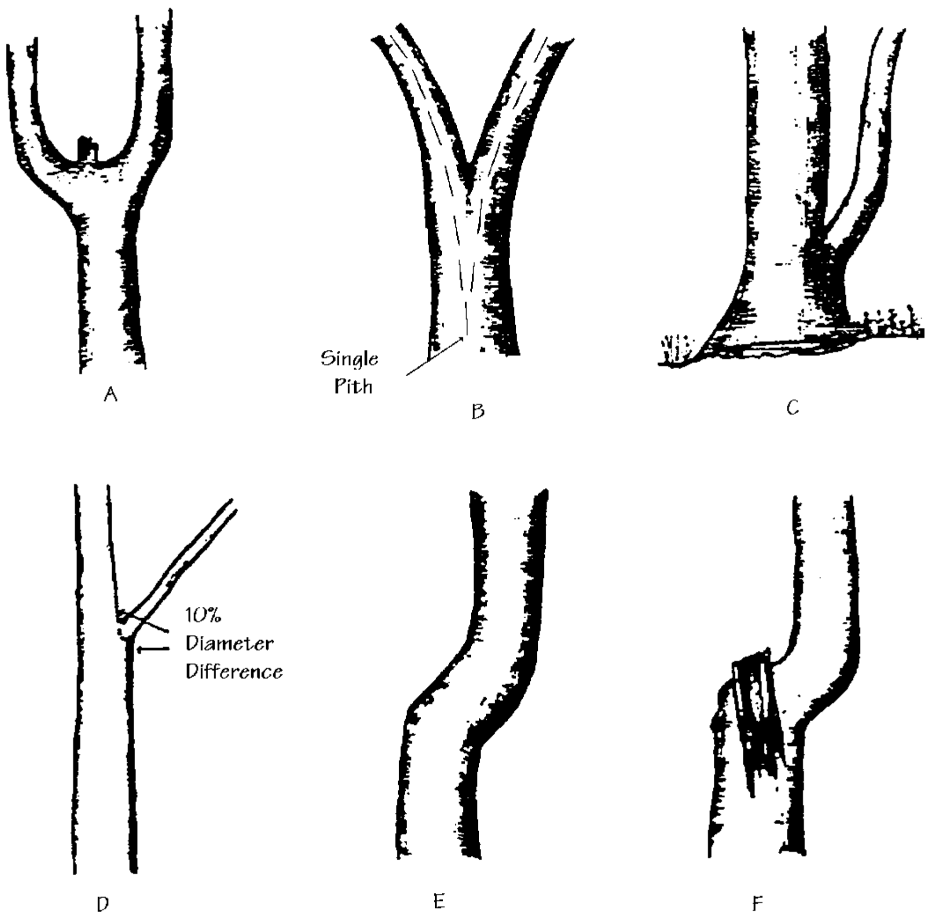


Figure 7-25 Types of Forks and Crooks Which are Recorded

Examples A and B illustrate forks which occur in the merchantable portion of the trunk. Example C illustrates forks which occur on the basal portion of trees. Examples E and F illustrate pronounced crook.

[1] *Recent pathological damage and pathological factors above 10 cm top diameter were not included in the loss factor data.*

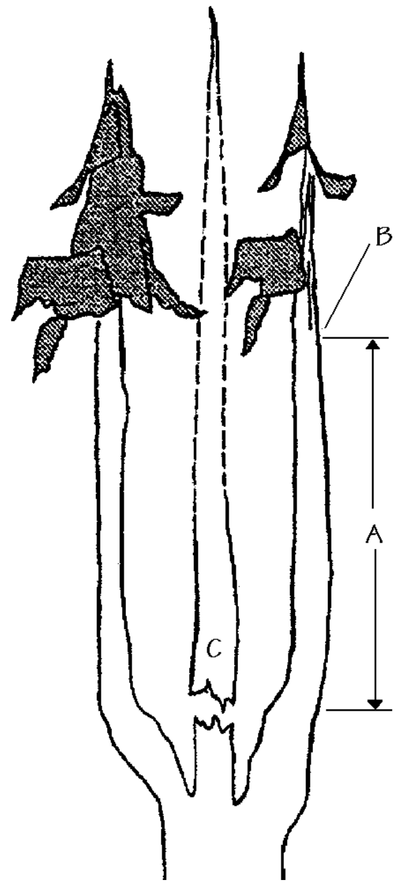


Figure 7-26 Fork or Crook and/or Dead or Broken Top

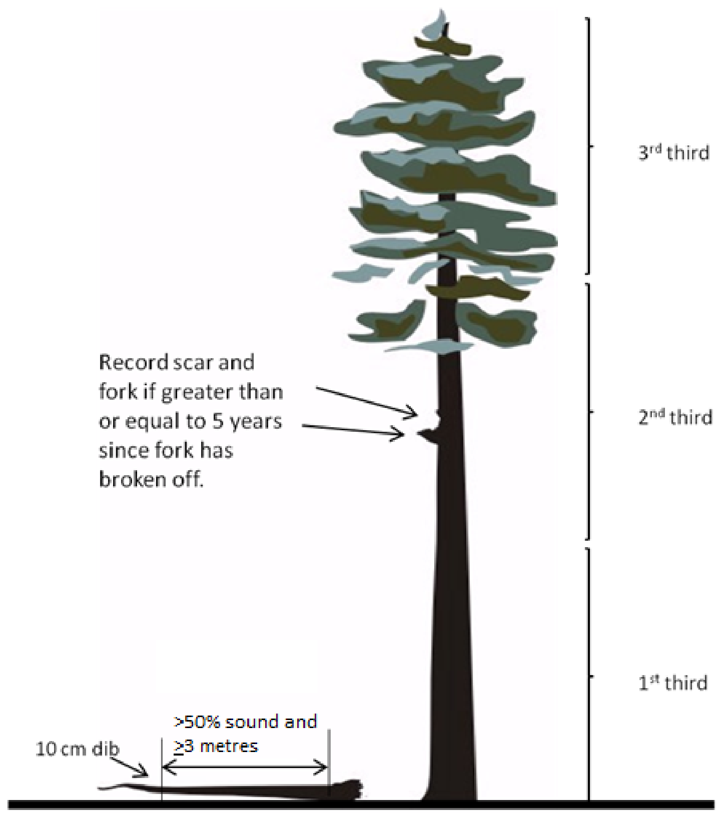
1. If the ‘forked’ leaders exceed the dimensions of a log as defined by the merchantability specifications (i.e., “A” is estimated to be greater than 3 m, and “B” is greater than 10 cm dib) record the pathological defect as a ‘fork’.
2. If the leader material is relatively small in size (i.e., less than 3 m in length) record the defect as a “dead or broken top”.
3. In no instance should you “double call” any pathological indicators (i.e., either call a fork or a dead top, not both!).

   ‘A’ is estimated length of log that could be obtained from the ‘forked’ leader.

   ‘B’ is estimated to 10 cm top.

   ‘C’ is dead top or broken top.

If a merchantable fork has broken off and has been on the ground for greater than or equal to 5 years, the fork and scar may be recorded.



Record down tree code if fork broke from first or second third of tree.

Segment of Cruise Tally Card (FST 205)

Tree Number	Height	Species	DBH	Tree Class	Conk	Blind Conk	Scar	Fork/Crook	Frost Crack	Mistletoe	Rotten Branch	Dead/Broken Top	Down Tree
01	40.0	F	60.0	2			2	2					E

Figure 7-27 Fork/crook

Record a down tree code (clean break) since the broken fork is long enough to produce a merchantable log and is greater than 50% sound. Record fork and scar if the injury is at least 5 years old. See Section 7.6.2 Appendix 6: Fire Damage for the down tree codes. See Section 7.17.2.4 details regarding the coding of scars and see Section 7.17.2.1 for details regarding the coding of pathology on secondary leaders.

7.17.2.6. Frost Cracks

- frost cracks result from deep radial splitting of the trunk caused by uneven expansion of the wood after sudden and pronounced drops in temperature,
- the cracks usually originate at the base of the trunk and extend up the tree following the longitudinal grain of the tree (see Figure 7.28 Appearance of Frost Crack on Standing Trees),
- frost cracks are often repeatedly opened by wind stresses or by low temperatures which freeze the moisture within the cracks and expands and splits the tree further,
- repeated healing of the wood produces considerable callous tissue giving the wood a pronounced ribbed appearance, and
- frost cracks must have occurred at least 5 years previously before they can be recorded[1].

Frost cracks are often associated with severe basal decay.

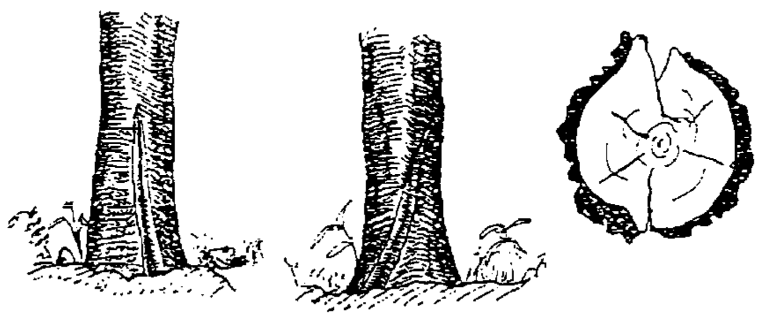


Figure 7-28 Appearance of Frost Crack on Standing Trees

7.17.2.7. Mistletoe Trunk Infections

Trunk infections of mistletoe are indicated either by abnormal swelling or malformations of the trunk at the point of infection, or by clusters of dead and broken branches on the trunk or on hypertrophied branches immediately adjacent to the trunk (see Figure 7.29 Trunk Infections of Mistletoe).

[1] *Recent pathological damage and pathological factors above 10 cm top diameter were not included in the loss factor data.*

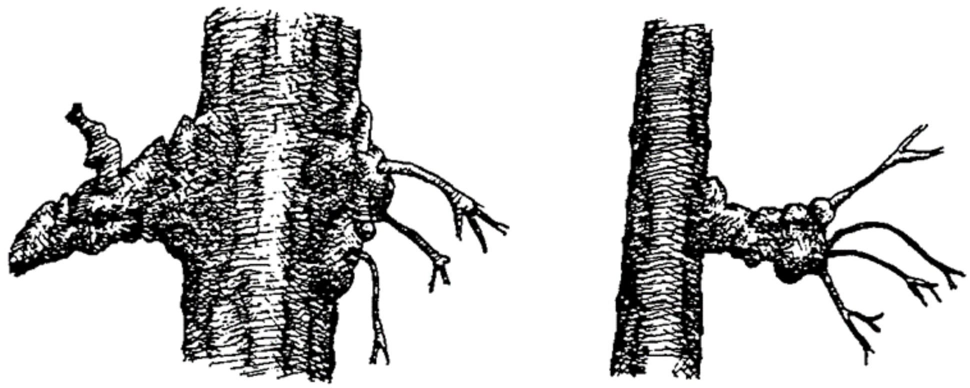


Figure 7-29 Trunk Infections of Mistletoe

Wood-rotting fungi gain entrance to the trunk through the dead hypertrophied branches or branch stubs where the swelling is on, or adjacent to the trunk.

Do not record mistletoe on living limbs or limbs that are swollen only at some distance from the trunk. Record only those branch infections in which the swelling has clearly extended to trunk (see Figure 7.30 Branch Infections of Mistletoe).

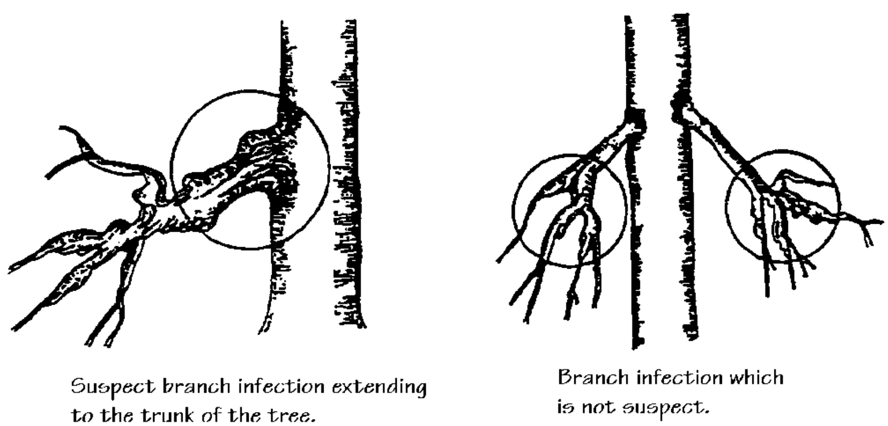


Figure 7-30 Branch Infections of Mistletoe

7.17.2.8. Large Rotten Branches

Large rotten branches are dead branches that are large (over 10 cm DIB) and are clearly decayed. These branches are usually broken off within a couple of metres of the trunk. Decayed heartwood close to or at the branch base should be obvious. The branches may be found at any position on the tree, but are generally confined to a position below the base of the live crown. This indicator is typically found on over- mature trees (see Figure 7.31 Rotten Branches.).

Large rotten branches should not be confused with the normal decay of dead branches. It should be associated with large branches that have broken off, exposing a large heartwood surface to decay producing fungi, thereby potentially infecting the adjacent trunk.

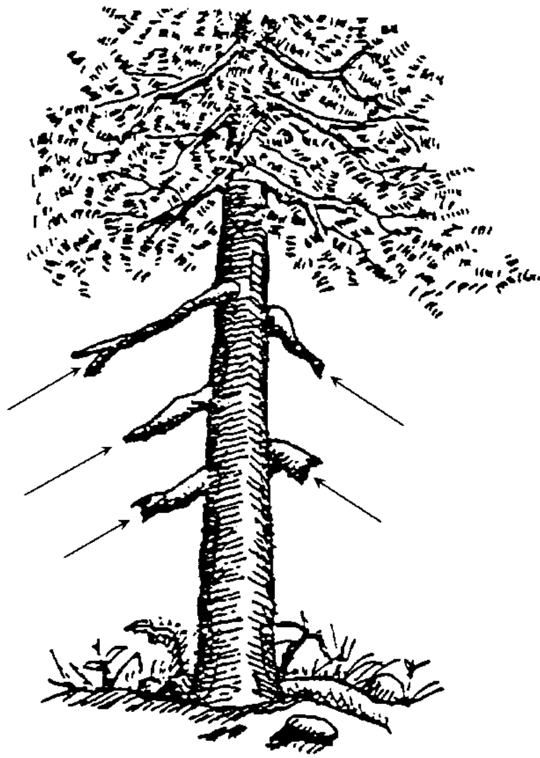


Figure 7-31 Rotten Branches

7.17.2.9. Dead or Broken Top

Definition:

> Where the tree top or complete stem has died due to various physiological causes. By convention if the complete and intact stem has died, under "D. or B. Top" enter "3".

Examples:

1. A dead potential tree with exposed wood (loose or shedding bark) running continuously from the base to the top is assigned the following path: Under "Scar" enter "4" and under "D. or B. Top" enter "3". The intent of this convention is to avoid double calling pathology indicators in the top.
2. An intact live tree with live branches only in the lower third and an injury with exposed wood in the middle third is assigned the following path: Under "Scar" enter "2" and under "D. or B. Top" enter "3".

Causes of dead tops

Dead tops may be caused by several factors such as:

- insect attack,
- drought conditions,
- sun scald, and
- physiological death.

The recording of dead tops:

- a dead top must be obviously weathered, indicating that death occurred at least five (5) years ago and below the 10 cm top before it will be recorded as a pathological indicator[1].

Causes of broken tops

- wind breakage,
- snow damage, and
- damage from falling trees, etc.

Standing trees that are broken in the bottom third will have a windthrow damage code assigned. In this instance, do not record a dead or broken top in the first third unless the broken top occurred at least 5 years previously.

If a fork is present at a broken top position, record the fork if a merchantable log (3 m long and 10 cm top) can be recovered from the fork. If the fork is not of merchantable size, record the d or b top. Do not call both indicators (see Figure 7.26 Fork or Crook and/or Dead or Broken Top).

If a candelabra is present at a broken top position, record d or b top.

Flat topped trees

When trees attain their potential height for a specific site, the tendency for the top of the crown to flatten out is prevalent especially in certain species such as Douglas fir. This flattening of the crown is not indicative of damage to the tree and will not be recorded as a pathological indicator.

[1] *Recent pathological damage and pathological factors above 10 cm top diameter were not included in the loss factor data.*

7.17.3. Abnormalities which are not Recorded

The following abnormalities are not indicative of decay and are, therefore, not recorded.

7.17.3.1. External Evidence of Butt Rot not Associated with Suspect Abnormalities

Butt rot may be evident in exposed roots or within root crotches. However, unless one or more of the suspect abnormalities appears on the tree, such trees will not be classed as suspect. It is defect of this nature which contributes to the decay loss factor associated with the residual tree class.

7.17.3.2. Flutes

Pronounced flutes on the trunk are a common growth characteristic of many species. They have no decay significance except in the case of interior cedar where the fold may hide an open scar leading to a hollow or decayed tree centre (see Figure 7.32 Flutes).

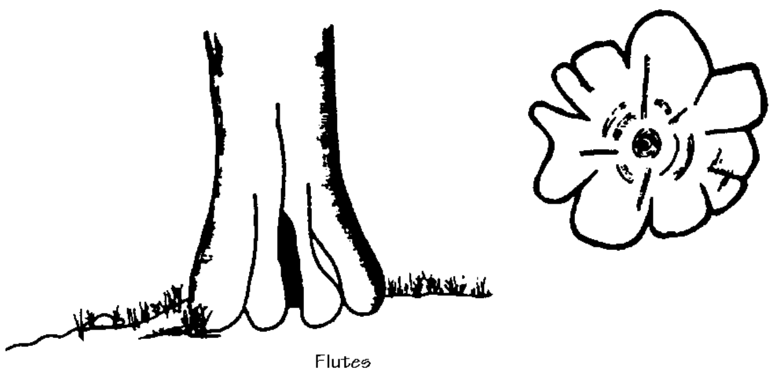


Figure 7-32 Flutes

7.17.3.3. Candelabra Branches

"Candelabra" branches develop as a result of abnormal branch growth and as such are confused with suspect forking. Branching of this type has no decay significance. It is important to note that candelabra branches do not originate as a fork in the trunk of a tree (see Figure 7.33 Candelabra Branches). Do not record defect on candelabras.

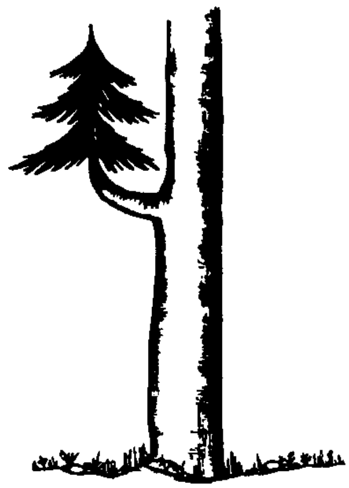


Figure 7-33 Candelabra Branches

7.17.3.4. Branch Fans

Branch fans which appear most commonly as 'fans' of branches originating from burl-like swellings on the trunks (see Figure 7.34 Branch Fans) are not suspect.

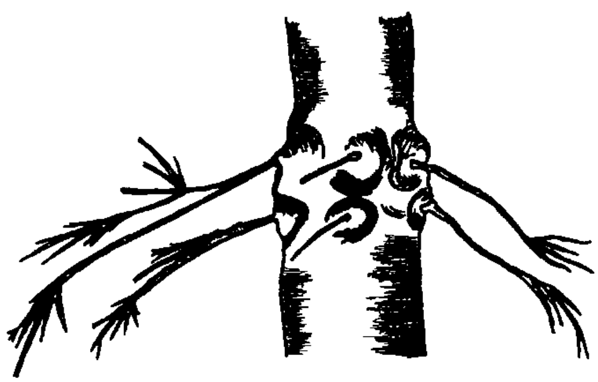


Figure 7-34 Branch Fans

7.17.3.5. Black Knots

Black knots frequently develop around unhealed knots and wounds. The blackened appearance develops from a superficial saprophytic fungus which feeds on the exuded sap. Black knots are quite sound when cut into with an axe and have no decay significance (see Figure 7.35 Black Knots).

Figure 7-35 Black Knots

7.17.3.6. Burls and Galls

Burls and galls develop from abnormal cell growth in trees and although formidable in appearance, have no decay significance (see Figure 7.36 Burls and Galls).

Scars on burls will be recorded.

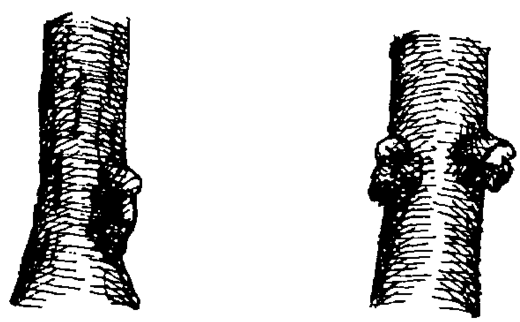


Figure 7-36 Burls and Galls

7.17.3.7. Sweep

Sweep which is a slight curvature or distortion of the trunk has no decay significance (see Figure 7.37 Sweep.).

Figure 7-37 Sweep

7.17.3.8. Exposed Roots

Exposed roots and buttress roots have no established decay significance unless scarring is present above ground level (see Figure 7.38 Exposed Roots.).

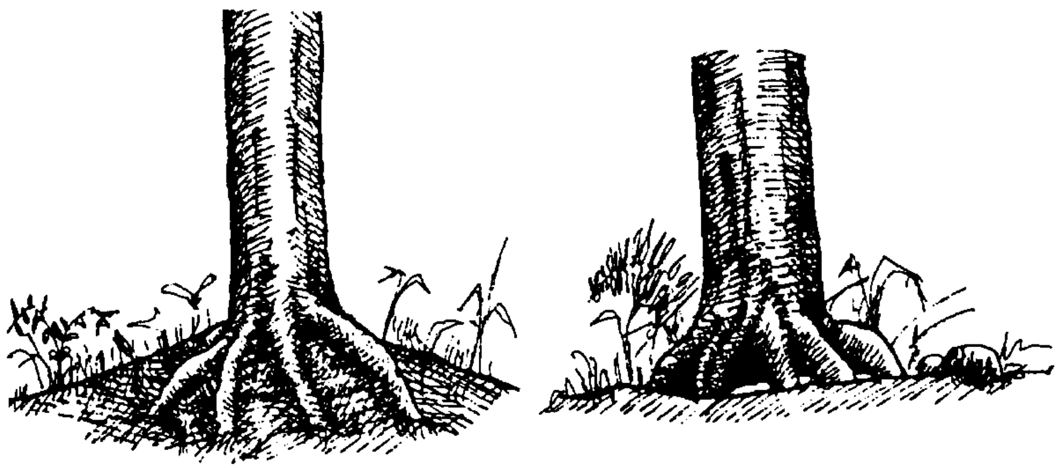


Figure 7-38 Exposed Roots

7.17.3.9. Other

Spiral Grain

Spiral grain is a growth characteristic of trees and has no decay significance.

Dry Side

Dry side results from the death of the cambium resulting from bruising by other trees or from other physiological causes. Dry side appears as a narrow to wide strip down the side of the tree or as small localized areas. The bark often remains intact over the dead areas. Although dry side may be responsible for the complete rejection, or degrade of a pole tree, it has no established decay significance. Dry side is not a scar unless the bark has sloughed (is missing).

Sap Sucker Holes

Sap sucker holes are superficial in extent and have no established decay significance. They are in marked contrast to suspect scarring caused by woodpeckers (see Figure 7.39 Bird Damage.).

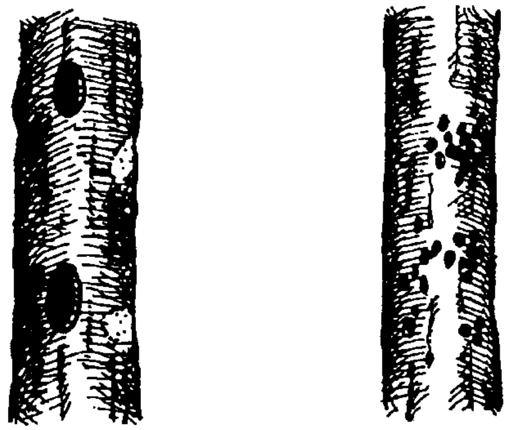


Figure 7-39 Bird Damage

Insect Borings

Borings by bark beetles or other insects have no established decay significance and will not be classed as suspect.

Non- suspect Forking

Figure 7.40 Illustrates Forks and Crooks Which are Not Suspect shows two types of non-suspect forking most commonly occurring in deciduous trees. Deciduous trees with "U" shaped forks containing a dead branch are definitely suspect. Non- suspect forking is more "V" shaped.

Trees growing in clumps, such as birch, should not be classed as suspect on this characteristic alone.

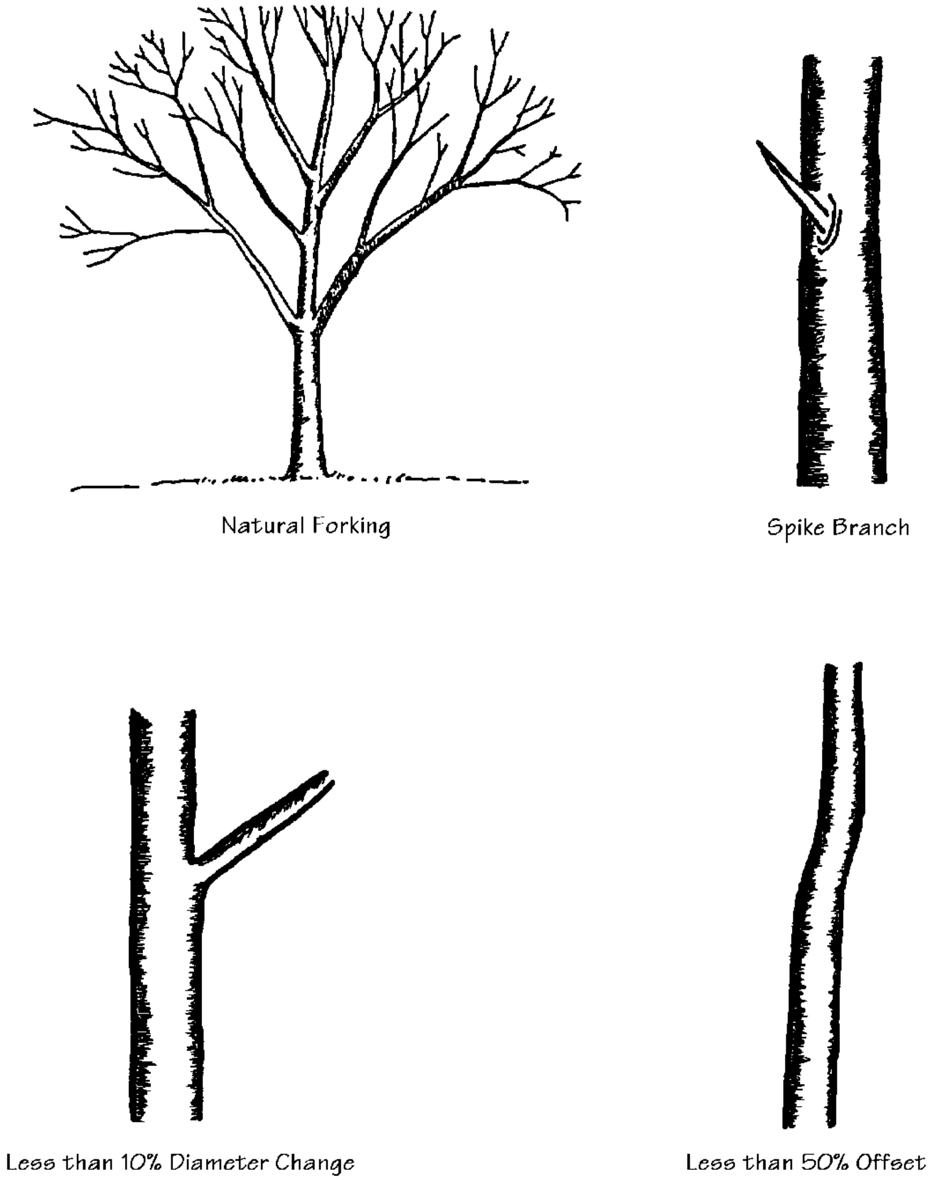


Figure 7-40 Illustrates Forks and Crooks Which are Not Suspect

7.17.4. Some Common Decays of Forest Tree Species in British Columbia

Brief descriptions of the major root diseases, heart rots, sap rots and canker diseases of coniferous and deciduous tree species in British Columbia have been included in Figure 7.41 Suspect Indicators and Figure 7.42 Residual Indicators as an aid to their identification in the field. Pathological studies have shown that although most tree species are subject to attack by a large number of wood-rotting fungi, only a few are treated as suspect indicators. Suspect as well as residual pathogens are described in this comprehensive table.

Refer to Section 7.17.2 for additional information.

7.17.5. Suspect Indicators (Figure 7.41)—record these indicators

Root and Butt Rots

Current (left) and previous year's (right) sporophores of *P. schweinitzii* (Photo credit R. Reich).

Shelf-like conk of *P. schweinitzii* and brown cubical decay (Photo credit R. Reich).

Phaeolus schweinitzii **(Fr.:Fr.) Pat.**

Schweinitzii Butt Rot, Brown Cubical Butt Rot

Hosts: Ba, Bl, Cw, Fd, Hw, Lt, Lw, Pl, Pw, Py, Ss, Sw, Qg

On conifers, common in Douglas-fir, spruce and pine. Occasionally found on hardwoods in all regions of BC.

Sporophores: Annual, spongy to leathery, stipate. Upper surface reddish-brown, velvety with concentric rings and light yellowish margin. Context yellow-green to light brown, lower surface yellow-green, turning brown when bruised. Pores regular to daedaloid.

Decay: The incipient stage may be difficult to detect, often appearing as a light yellow stain. At a late stage the wood becomes brittle and breaks into large cubes which are reddish-brown in colour. An odour of anise is often associated with advanced decay.

Entrance: Roots.

Activity: A cellulose-destroying heart rot, generally confined to the roots and basal log.

Remarks: Very general distribution throughout North America. Occurs in trees of all ages. Young trees may be killed outright, older trees become subject to windfall.

Sporophores develop on roots and freshly felled trees, and provide a valuable index of infection.

Heart Rots

Sporophore of *E. tinctorium* (Photo credit R. Reich).

Sporophore of *E. tinctorium* *in lower light conditions*.

Brown stringy rot cause by *E. tinctorium* on Mountain hemlock (Photo credit R. Reich).

***Echinodontium tinctorium* (Ell. & Ever).**

Brown Stringy Trunk Rot

Hosts: Ba, Bg, Bl, Cw, Fd, Hw, Hm, Ss, Sw

Reported on a large number of coniferous hosts. Of major importance in British Columbia on western hemlock, alpine fir and amabilis fir. Reported on the coast only at higher elevations and in the north.

Sporophores: Perennial, hard, woody, sessile, ungulate. Upper surface black and furrowed. Context brick-red.

Lower surface grey.

Decay: The incipient stage may appear as light yellow to brown or water-soaked stain. Later, the wood darkens to a reddish-brown to brownish-yellow colour. Small rust coloured spots, and occasionally red streaks may develop. Finally, the wood is reduced to a brown, fibrous, string mass.

Entrance: Infections occur on living branches after 35 to 45 years, but normally do not become established in the trunk for another 100 years. Conditions affecting entry into the trunk are unknown.

Sporophores of *F. pinicola on interior spruce* (Photo credit R. Reich).

Fruiting bodies of *F. pinicola on subalpine fir* (Photo credit R. Reich).

Brown crumbly rot decay with white mycelium.

Fomitopsis pinicola (Sw.:Fr.) P. Karst.

(*Fomes pinicola* (Sw.:Fr.) Cooke)

Brown Crumbly Rot, Red Belt Fungus

Note: This is only a suspect indicator if found on the bole of a living tree.

Hosts: Ba, Bg, Bl, Cw, Fd, Hm, Hw, Lw, Pl, Pw, Py, Se, Ss, Sw, Dr, Ep, Ac, At

Common on most conifers and hardwood species in BC.

Sporophores: Perennial, woody to leathery, sessile, variable, ungulate, bracket-like, occasionally effused-reflexed. Upper surface dark brown to black. Outer margin often reddish or otherwise lighter in colour. Context cream to light brown. Lower surface white, often tinged with yellow. Poroid, pores small and regular.

Decay: The incipient stage may appear as a light brown discolouration. Later the wood breaks into small brown cubes which are soft and crumbly. White felts of mycelium may be formed in the shrinkage cracks.

Entrance: Scars, dead tops, insect injuries, etc.

Activity: A cellulose-destroying trunk rot, occurring in the heartwood or sapwood.

Remarks: Very common in dead trees, slash, and other forest litter, thus occasionally known as the scavenger fungus. May be associated with decay in living trees, frequently gaining entrance through scars. Also an important rot contributing to the deterioration of killed stands, especially by fire and insects. Sporophores develop infrequently on living trees.

Sporophore of *P. igniarius* (Photo credit R. Reich).

Hardwood trunk decay of *P. igniarius.*

Phellinus igniarius (L.:Fr.) Quél.

(_Fomes igniarius_ (L.) Gill.)

White Trunk Rot, White Heart Rot, Hardwood Trunk Rot

Hosts: D spp., R spp., Act, E spp., G spp., M spp., W spp.

Occurs mainly in hardwoods. Common in aspen and birch.

Sporophores: Perennial conks are usually hoof-shaped, but sometimes shelf-like and may obtain a width of 20 cm or more. The upper surface is greyish-black to black, dull or shiny, smooth when younger, becoming rough and cracked with age. The under surface is brown with mouths of tubes small and circular in outline. Context is rusty-brown, often interspersed with grey or white mycelium flecks.

Decay: Incipient stage has yellowish-white spots, streaks, or larger areas in the heartwood, the whole usually surrounded by a yellowish-green to brownish-black zone. In the advanced stage the wood is light in weight, soft, whitish and rather uniform in texture, with fine black lines running throughout. In aspen, the incipient wood is faintly coloured from light pink to straw-brown, in the intermediate stage of decay, the wood is straw to chocolate-brown, but is still hard and firm. In the advanced stage, all soft, punky wood irrespective of colour is included.

Entrance: Unknown – probably on branches and wounds.

Activity: Sporophores form on standing trees and on slash. The presence of a single sporophore generally indicates a considerable volume of decay.

Sporophore of ***Phellinus tremulae***
(Photo credit R. Reich).

Section of decay caused by *P. tremulae*
(Photo credit R. Reich).

Phellinus tremulae (Bondarzev) Bondarzev & Borisov in Bondarzev

(_Fomes igniarius_ (L.:Fr.) J. Kickx fil. f. _tremulae_ Bondarzev)

(_Fomes igniarius_ var. _populinus_ (Neuman) Camp.)

Aspen Trunk Rot

Hosts: At

Found only in trembling aspen.

Sporophores: Perennial, hard, woody, growing up to 20 cm wide and 10 cm thick. Generally triangular shaped in longitudinal section with upper and lower surfaces at angles of about 45º from horizontal. Upper surface is grey-black to black, deeply zoned, and appears roughened when old. Lower surface has small, regular pores. Context is rust-brown, often interspersed with white mycelium flecks.

Decay: Incipient stage appears as yellow-white zone in heartwood, usually surrounded by yellowish-green zone. In the advanced stage, the soft yellow-white zone usually contains black zone lines running throughout. Zone lines often surround the decay column as well.

Entrance: Unknown – probably on branches.

Activity: Sporophores form on branch scars, on living and dead standing trees, as well as on slash.

Sporophore of ***P. pini***.

Longitudinal section of decay caused by *P. pini* (Photo credit R. Reich).

Cross section of decay caused by *P. pini* (Photo credit R. Reich).

Phellinus pini **(Thore:Fr.) Ames**

Fomes pini **(Thore:Fr.) Fr.**

Red Ring Rot, Conk Rot, White-pitted rot, Pecky Rot, Honeycomb Rot

Hosts: Ba, Bg, Bl, Cw, Yc, Fd, Hm, Hw, Lw, Pj, Pl, Pw, Py, Sb, Se, Ss, Sw

Occurs essentially on all conifers in British Columbia, very common in hemlock, spruce and Douglas-fir. Also known to occur on hardwoods.

Sporophores: Perennial, woody to punky, sessile, ungulate, occasionally effused-reflexed if on branches. Upper surface dark brown and furrowed. Context cinnamon brown. Lower surface light brown. Poroid, pores regular to daedaloid.

Decay: The incipient stage may appear as a reddish stain. Later small white, spindle-shaped pits develop parallel to the grain.

Entrance: Unknown – probably branches and wounds.

Activity: A lignin destroying heart rot, mostly occurring in the trunk.

Remarks: One of the most important decay fungi in British Columbia. Of greater importance on good sites. Conks develop on living trees and provide a valuable index to hidden defect. Also recognized through the occurrence of blind conks (punk knots) which constitute early or abortive stages in the development of sporophores.

Figure 7-41 Suspect Indicators

7.17.6. Residual Indicators <u>(Figure 7.42)</u> – Do not record as conk

Do not record these as conk, but may be recorded in root rot column 60 of the cruise tally sheet)

Root and Butt Rots

Clusters of *Armillaria* mushrooms.

Roots and base of tree affected by armillaria root rot.

Armillaria spp.

Armillaria ostoyae (Romagnesi) Herink

Armillaria sinapina (Bérubé & Dessureault)

Armillaria gallica Marxmüller & Romagnesi

Armillaria cepistipes Velanovsky

Armillaria nabsnona Volk & Burdsall

Armillaria Root Disease

Hosts: *Armillaria ostoyae* **-** Ba, Bg, Bl, Lw, Se, Sw, Ss, Pl, Pw, Py, Fd, Tw, Cw, Hw, Ep, At, Act, Qg, W spp.

Armillaria species are found on a broad range of conifers and deciduous trees in British Columbia.

Armillaria ostoyae has the greatest impact on conifer management. Other *Armillaria* species are considered weakly pathogenic on live broadleaved trees, and do not kill healthy conifers.

Sporophores: Mushrooms occur at the base of infected live and dead trees, as well as colonized stumps. Also commonly found on scar-associated dead wood on living trees. Mushrooms appear cream to brown coloured with a distinct ring on the stem. Caps grow 5-10 cm wide.

Most obvious on resinous tress, where fungus is present at the root collar, resin exudes through the bark of the lower bole, and under bark showing resin sis, and white mycelial fans occur in the bark and cambial zone.

Another aid in the identification of *Armillaria* is the presence of rhizomorphs. The rhizomorphs of parasitic

A. ostoyae are observed as being Y-shaped, and the rhizomorphs of saprophytic *A. sinapina* are T-shaped in appearance.

	Decay: Incipient decay is yellow to brown in colour, roots often appear water-soaked. Decayed wood later becomes stringy, gelatinous and very wet. **Remarks:** Dead and diseased trees can occur scattered throughout stands, however they most commonly occur in disease centres. These centres appear as openings in the canopy, and can range in size, potentially reaching approximately 0.1 ha in mature stands.

Sporophores of *H. annosum* at base of tree.

Incipient decay caused by *H. annosum*.

Stringy root decay caused by *H. annosum*.

***Heterobasidion annosum* (Fr.:Fr.) Bref.**

***Fomes annosus* (Fr.:Fr.) Cooke**

Annosus Root and Butt Rot, Pine Root Fungus

Hosts: Ba, Bg, Sw, Ss, Fd, Cw, Hw, Mb, Dr

Occurs on most hardwoods and conifers. Common in western hemlock. Range is generally west of the coast mountains and in the ICH biogeoclimatic zones.

Sporophores: Perennial, woody to leathery, sessile, ungulate or bracket-like to resupinate. The upper surface is dark-coloured to black, zonal with acute margins. The context is white to cream coloured. Poroid, pores small and regular.

Decay: The incipient stage may appear as a reddish-brown stain. In the advanced stage the wood is reduced to a white stringy or spongy mass containing numerous black flecks running parallel to the grain. In the final stage the wood may be completely destroyed.

Entrance: Roots and scars.

Activity: Heartwood and occasionally sapwood decomposition of lignin, and to a lesser and slower extent, cellulose. Generally confined to root and butt sections.

Remarks: Sporophores are generally produced on dead material or on the under-surface of roots exposed to the atmosphere. Capable of causing extensive root rot in young stands. Also occurs as a common decay of mature timber.

O. tomentosa **fruiting bodies (Photo credit R. Reich).**

Wet *O. tomentosa* fruiting body on forest floor (Photo credit R. Reich).

Tangential view of advanced honeycomb decay caused by *O. tomentosa* (Photo credit R. Reich).

End view of decay caused by *O. Tomentosa* (Photo credit R. Reich).

Onnia tomentosa (Fr.) P. Karst
Inonotus tomentosus (Fr.:Fr.) S. Teng.
Polyporus tomentosus (Fr.:Fr.) (Fr.) P. Karst.
Tomentosus Root Rot

Hosts: Ba, Bl, Fd, Hw, Lw, Pa, Pl, Py, Se, Sw, Ss

Occurs on a broad range of conifers in British Columbia, found most frequently in northern and central spruce- pine forests, and at higher elevations in southern British Columbia.

Sporophores: Found on ground around infected trees. Annual, leathery, stalked. Small fruiting bodies (usually < 10 cm diameter). Shelf-like fruiting bodies sometimes found on dead roots and base of infected trees. Upper yellow-brown to rust-brown, velvety, becomes dark brown with age and when wet.

Decay: Incipient stage can appear as reddish-brown stain in heartwood. In the advanced stage, the elongated or rectangular-shaped pits appear in the heartwood which are separated by reddish-brown firm wood. Stem cross- sections display honeycombed appearance which can also often be observed on stump surfaces.

Entrance: From tree to tree at points of root contact, and by airborne basidiospores through fine roots.

Activity: Extensive butt call, reduced increment growth, windthrow. Disease and mortality often appears in groups and results in stand openings.

P. weirii **fruiting body on Douglas-fir.**

Black stain on base of Douglas-fir caused by *P. weirii*.

Incipient decay caused by *P. weirii* in Douglas-fir.

Phellinus weirii (Murrill) R.L. Gilbertson

Poira weirii (Murrill) Murrill

Inonotus weirii (Murrill) Kotl. & Pozar

Laminated Root Rot

Hosts: *Highly susceptible* – Fd, Bg, Hm. *Susceptible* – Se, Ss, Bl, Hw, Lw. *Tolerant* – Pl, Pw, Py. *Resistant* – Cw

Two forms of the disease have been identified – the Douglas-fir and cedar forms. They can be distinguished by symptoms and host preference. Described above are hosts of the Douglas-fir form of the disease.

Fruiting Bodies: White or tawny to mauve mycelium often found at root collar on or in bark. Crust-like brown mycelium growth often occurs over ectotrophic mycelium at root collar with appearance of blistering paint. Fruiting bodies annual, nut rare. Appear as brown crust-like layers. Light buff with narrow white margins when fresh. Uniformly dark brown when aged, and may remain for up to 2 or 3 years. Exposed surface poroid, pores small and irregular.

Decay: Incipient stage may appear as red-brown stain on fresh stump tops, or cross sections of major roots. In living trees infection rarely extends past 1 m up the stem. In advanced stage stained wood softens and annual rings separate to form laminated sheets of decay with accumulations of reddish-brown mycelium forming between the layers. Decayed wood becomes pitted.

Entrance: Root contact. Fungus has potential to remain viable in dead stumps and roots for decades.

Heart Rots

Decay caused by *C. rivulosa* in western red cedar.

***Ceriporiopsis rivulosa* (Berk. & Curtis) Gilb. & Ryvarden**

***Poria rivulosa* (Burk. & Curtis) Cooke**

***Poria albipellucida* D. Baxter**

White Butt Rot, White Laminated Rot

Hosts: Ba, Cw, Fd, Hw, Sw, Ss

Widely distributed throughout the range of these conifer hosts in British Columbia.

Sporophores: White, annual, thin, resupinate and poroid. Fruiting bodies are rare, not especially useful for identification of presence of decay. Occur mostly on slash.

Decay: Incipient stage appears as yellow discoloration in heartwood. This discolouration is sometimes surrounded by a blue to red stain. As the wood dries radial cracks may form. Annual rings separate in late stage of decay to form a crumbly mass or coarse laminations. Decay symptoms are sometimes not evident in freshly cut wood, but become more conspicuous as wood dries.

Remarks: Considered the most important butt rot of western red cedar in coastal regions of BC. Decay symptoms are most useful for identification of this disease. If decay is present butt logs of mature trees are often significantly damaged since decay develops readily in early life of the tree.

Sporophores of *F. Fomentarius*
(Photo credit R. Reich).

Cross section of *F. fomentarius* sporophore and advanced stage of trunk decay.

Fomes fomentarius **(L.:Fr.) J. Kicks fil.**

White Spongy Trunk

Rot Hosts: D spp., Acb, Act, E spp.

Occurs on and is widely distributed throughout its deciduous hosts in British Columbia.

Sporophores: Perennial, can be woody or leathery, usually hoof-shaped. Upper surface smooth with a thick crust, zoned, and is grey to brown or black in colour.

Context is a thin brown layer located between the upper crust and the old tube layers. The lower surface is pale brown, concave and poroid. Pores are small and regular. Conk age can be estimated relatively accurately by counting the distinct layers of tubes which are laid down annually.

Decay: In the incipient stage the wood remains firm and signs of decay appear as light brown discoloration. In the advanced stage of decay the wood is yellow-white in colour, often containing brown or black zone lines. Wood in the advanced stage is softy and spongy. Decayed wood may have a mottled appearance as small radial cracks are filled with a yellow mycelium.

Entrance: Infection occurs through exposed dead wood tissue by spread of airborne spores.

Activity: Rot can be present in sapwood and heartwood in living and dead timber. Fruiting bodies can be found on living trees, dead trees, and on slash. Presence of fruiting bodies often indicates heartwood is not merchantable.

Sporophore of *F. officinalis*
(Photo credit R. Reich).

Sporophore of *F. officinalis*.

Advanced decay caused by *F. officinalis* in western larch.

Fomitopsis officinalis (Villars.:Fr.) Bondartsev & Singer

Fomes officinalis (Villars.:Fr.) Faull.

Fomes laricis (Jacq.) Murrill

Brown Trunk Rot, Quinine

Fungus

Hosts: Ba, Bg, Fd, Hw, Lw, Pl, Pw, Py, Se, Ss

Distributed widely throughout host range in British Columbia.

Sporophores: Hoof-shaped to long and pendulous. Variable in size, can be up to 40 cm in diameter. Upper surface is zoned and white when fresh, turning dark grey or light brown when dried. A white powdery or chalky coating can be present. The context is white or grey, and toughens with age. The lower surface is poroid, and is also white when fresh, and dries to a light brown color. Pores are small and uniform.

Decay: During the incipient stage of decay a light yellow to red-brown stain appears, and in Douglas-fir can be seen as a purple discolouration. The stain may extend considerably beyond the advanced decay. In advanced stages of decay the wood will break into thick cubes with mycelia felts which are white in colour often forming in the shrinkage cracks.

Activity: Fungus is capable of destroying most of the wood volume of a tree, and fruiting bodies present are indicative of this. Fruiting bodies appear frequently on larch, but are less common on other species. The sporophore context has a characteristic bitter taste, which is what gives the fungus one of its common names ‘quinine fungus’.

Typical sporophores of *G. apllanatum*.

Section of white mottled rot caused by *G. applanatum*.

***Ganoderma applanatum* (Pers.) Pat.**

***Fomes applanatus* (Pers.) Gill.**

***Polyporus applanatus* (pers.) Wallr.**

White Mottled Rot, Applanatus Rot, Picture Conk

Hosts: Ba, Bg, Cw, Fd, Hm, Hw, Se, Sw, D spp., A spp., E spp., M spp., Q spp., W spp.

Occurs commonly on deciduous trees, but also on a broad range of conifers in British Columbia, affecting trees in all regions of BC.

Sporophores: Perennial, leathery to woody, sessile, applanate. Upper surface is light brown to grey and often shiny. Context is dark brown. The lower surface is white, turning dark brown when bruised. Poroid, with regular pores.

Decay: The incipient stage may appear as a light stain or infected wood may have a bleached appearance and be difficult to detect. In the advanced stage the decay is characterized by a mottled appearance. The wood is white or light coloured, soft and spongy, and often contains zone lines and accumulations of mycelium.

Entrance: Scars.

Activity: Heartwood and sapwood decomposition of lignin and to a lesser and slower extent cellulose. May occur in the butt or trunk.

Remarks: Sporophores develop infrequently on living trees. The lower surface of fresh sporophores may be permanently marked on contact. Brownish spores may be carried to the upper surface giving a dusty brown appearance to the sporophore.

Coral-like fruiting body of *Hericium abietis*.

Advanced stage of decay caused by *H. abietis*.

Hericium abietis (Weir ex Hubert) K. A. Harrison

Hydnum abietis Weir ex

Hubert Yellow Pitted Rot

Hosts: Ba, Bg, Bl, Hm, Hw, Ss

Host range restricted to west of the rocky mountains in British Columbia.

Sporophores: Annual, soft, fleshy. White with many downward-directed coral-like spines which are 1-2 cm long when developed fully.

Decay: Incipient stage appears as yellow to brown stain in heartwood. Elongated pits appear in advanced stage of decay which may contain yellow to white mycelium. In cross section, the decay pits appear irregular to honeycomb.

Entrance: Wounds.

Activity: Fruiting bodies are generally found on slash and on ends of cut logs. May for on wounds of living trees.

Presence of fruiting bodies indicates extensive stem decay.

Sporophores of *L. sulphureus*.

Decay caused by *L. sulphureus*.

***Laetiporus sulphureus* (Bull.:Fr.) Murrill**

Polyporus sulphurous

(Bull.:Fr.) Fr.

Brown Cubical Rot, Sulphur

Fungus

Hosts: Ba, Bg, Bl, Bp, Cw, Fd, Hw, L spp., Py, Pw, S spp., Qg

Common on most hardwoods and conifers, including oak, true fir and spruce in all regions of British Columbia.

Sporophores: Annual, spongy to leathery, sessile or stalked (stem eccentric), applanate to bracket-like. The upper surface is orange-yellow. The context is white to yellow. The lower surface is a sulphur-yellow colour and poroid with regular pores. Old sporophores appear white and brittle.

Decay: The incipient stage may appear as a light brown stain. Later the wood breaks into small brown cubes.

The decay may have a ‘rippled’ appearance in longitudinal section and white mycelia felts may develop in the shrinkage cracks.

Entrance: Scars, dead branch stubs.

Activity: A cellulose decomposing heart rot and occasionally sap rot. May occur in the butt or trunk, but generally in the trunk.

Remarks: Sporophores develop infrequently on living trees but are easily recognized by their shape, size and colour. They decompose quickly following insect attack and weathering and seldom remain on the host past one season.

Sporophores of *N. kauffmanii*.

Pocket rot decay caused by *N. kauffmanii*.

***Neolentinus kauffmanii* (A. H. Smith) Redhead & Ginns**

***Lentinus kauffmanii* A. H. Sm. in Bier and Nobles.**

Brown Pocket Rot of Sitka Spruce

Hosts: Ss

Restricted to the range of Sitka spruce in British Columbia.

Sporophores: Pinkish-tan mushrooms, small in size. Usually occurring on areas of exposed, advanced decay of fallen or split dead trees.

Decay: Boundaries of advanced decay are often delimited by wood that appears sound, however adjacent pockets may occasionally merge to form a continuous decay column. Wood breaks down within the pockets to form small, soft brown cubes. In advanced stages of decay wood crumbles away completely leaving hollow pockets which are well-defined.

Remarks: Decay cannot be detected in standing timber since fruiting bodies form only on infected wood which is exposed to air.

Sporophores of *P. subacida*.

The Spongy Butt Rot Complex:

***Perenniporia subacida* (Peck) Donk, *Corticum galactinum* (Fries) Bur, *Odontia bicolor* (Alb. & Schw. Ex. Fr.) Bres.**

Stringy Butt Rot, Spongy Butt Rot, Feather Rot

Hosts: Ba, Bg, Bl, Cw, Fd, Hw, Lt, Pl, Pw, Se, Ss, Sw, D spp., R spp., Act, E spp., M spp., W spp.

Widely distributed through its range of deciduous and coniferous species found in all ranges of British Columbia.

Sporophores: Superficially similar in the three species: Annual to perennial and resupinate. White, yellow or buff in colour. The surface of *C. galactinum* is smooth and waxy. *O. bicolor* becomes cracked with age and covered with short fragile evenly-distributed teeth. *P. subacida* has small circular pores and is leathery to crust- like.

Decay: The incipient stage may appear as a light stain. Later, small white pits develop and coalesce to form masses of spongy white fibres containing small black flecks. The annual rings may separate to form a laminate decay. Finally, the wood is reduced to a spongy mass.

Entrance: Roots.

Activity: A lignin and to a slower and lesser extent, cellulose, decomposing heart rot and sap rot which is generally confined to the roots and butt.

Remarks: *P. subacida* which was formerly considered the sole causal fungus in some hosts is now believed to be the least important of the fungi commonly associated with the disease. White spongy butt rot is widely distributed throughout North America, and is common in mature age classes. Sporophores of the three fungi associated with this rot are generally found on the under- surfaces of old logs.

Sporophores of *P. hartigii.*

Advanced decay caused by *P. hartigii*.

***Phellinus hartigii* (Allesch. & Schnabl.) Bondartsev**

***Fomes hartigii* Allesch. & Schnabl.**

***Fomes robustus* P. Karst**

***Phellinus robustus* (P. Karst.) Bourd. &**

Galzin White Trunk Rot of Conifers

Hosts: Ba, Bl, Fd, Hw

Widely distributed throughout host range in British Columbia.

Sporophores: Perennial. Hoof-shaped, usually 5-15 cm wide when formed on stem and generally resupinate when formed on lowers surfaces of branches. The upper surface is dark brown to black. The lower surface is brown and poroid, with small circular pores.

Decay: Incipient stages of decay often appear as a straw- coloured to purple stain which may be irregular in shape. In the advanced stages, wood often appears bleached with occasional light brown areas or streaks, usually numerous zone lines are present. Decay sometimes occurs in a section of wood which extends in from the sapwood, and is often associated with wounds, dead branches, or with dwarf mistletoe infections which have killed part of the cambium.

Entrance: Wounds, dead branches, mistletoe infections.

Activity: Usually kills tissues localized near the point of infection, but can spread upwards and downwards 1-2m from each fruiting body. Decayed trees are prone to wind damage, and often breakage occurs up to 6m from the ground.

Mushrooms of *P. populnea* on a cut log.

P. populnea mushrooms

Pholiota populnea (Pers.:Fr.) Kuyper & Tjall.-Buekers

Pholiota destruens (Brond)

Yellow Laminated Butt Rot of Poplars

Hosts: Act

Widely distributed throughout its host's range in British Columbia.

Sporophores: Large gilled mushrooms which often occur in clusters. Mushroom cap is light brown and covered with white scales when fresh. Gills white when immature, turning to dark brown as spores mature. The stem is white or light brown, also covered with scales, and a white annulus (small ring) is present.

Decay: In the incipient stage the decay appears as buff to dark brown streaks in the heartwood. In the advanced stages of decay white patches for which give the wood a slight mottled appearance. Wood becomes uniformly yellow to tan and laminated in the final stage of decay.

Remarks: Thought to be the most damaging decay fungus found in cottonwood. It is found on living trees as well as on slash, however it tends to persist for longer on living trees, and will only remain active in stumps and logs for a few years.

Sporophores of *P. betulinus*. Young sporophore (above), older sporophore (below).

Cubical decay caused by *P. betulinus*.

***Piptoporus betulinus* (Bull.:Fr.) P. Karst.**

***Polyporus betulinus* (Bull.:Fr.) Fr.**

Brown Cubical Rot of Birch

Hosts: Ep

Found throughout the range of birch in British Columbia.

Sporophores: Annual, leathery, stout stipe. Can have a fairly large cap, up to 15 cm deep, 25 cm wide, and 6 cm high. The upper surface is light brown and becomes darker brown and scaly with a margin extending below the pore surface. The pore surface is white when fresh, and becomes light brown and tooth-like with age. Pores are circular. The context is white and easily separates from the tube layer when fresh.

Decay: The decayed wood is yellowish-brown in colour, and will crack into cubes. In the cracks thin, white mats of mycelium will form. In the advanced stages of decay, the wood is light weight and will easily crumble into powder.

Entrance: Dead branches.

Activity: A bark, sapwood and heartwood rot, only attacking hardwoods. Often present in dead branches of dying trees.

Advanced decay in western red cedar caused by *P. sericeomollis*.

Longitudinal section of brown cubical decay.

***Postia sericeomollis* (Romell) Jülich**

***Oligoporus sericeomollis* (Romell) Pouz.**

Polyporus sericeomollis

Romell *Poria sericeomollis*

(Romell) Egeland *Poria asiatica*

(Pilát) Overh.

Brown Cubical Butt and Pocket Rot of Cedar, Pecky Rot

Hosts: Ba, Cw, Yc, Fd, Hw, Lw, Pl, Py, Se, Ss, Sw

Reported on most conifers and is widely distributed throughout the range of its hosts in British Columbia.

Sporophores: Annual, resupinate, white in colour, growing up to 15 cm wide. Sporophores appear as thin crusts on the outer surfaces of dead wood or slash.

Fruiting bodies rarely occur on living trees, but are more commonly found on the ends of logs or on slash.

Decay: The incipient stage of decay is characterized by straw coloured to pale yellow-brown wood. In the advanced stage of decay, the wood turns light brown in colour and brittle. It breaks down into cubes and usually forms a cylinder or rot when in the butt. It can also form a series of isolated pockets which can run together to form arcs or concentric rings. Sometimes a thin, white mycelium weft will form between the cubes of decayed wood.

Entrance: Unknown.

Remarks: This decay is common in the butt logs of western red cedar, and though it has a broad host range, it seldom infects live trees other than western red cedar. The fungus is most common in the butt, but can develop at all levels in the stem.

Sporophores of *S. delectans*.

Spongipellis delectans (Peck) Murrill

Polyporus delectans Peck

Brown Stringy Trunk Rot of Hardwoods

Hosts: Act

Has only been found on black cottonwood in British Columbia, but has been reported on maple, alder and oak in other parts of North America.

Sporophores: Annual, fleshy to leathery. Grow in various shapes, but are usually shelved. The upper surface, context and lower surface is white when fresh, and dries to a light brown colour. Poroid with small regular pores.

Decay: During the incipient stage buff to light brown streaks appear in the heartwood. During the advanced stage of decay the wood becomes dark brown and light- weight. It is usually stringy, but can be laminate. The decay will at first form pockets of various size, and will usually merge to form a column in time.

Entrance: Branch stubs and/or branch scars.

Activity: In living and dead trees, the fungus occurs mainly as a trunk rot, and rarely as a butt rot. Decay is usually confined to the heartwood in living trees.

Sporophores of ***S. sanguinolentum***.

Red heart rot caused by *S. sanguinolentum*.

***Stereum sanguinolentum* (Albertini & Schwein.:Fr.) Fr.**

***Haematostereum sanguinolentum* (Albertini & Scwein.:Fr.) Pouzar**

Stereum balsameum

Peck Red Heart Rot,

Bleeding Conk

Hosts: Ba, Bg, Bl, Cw, Fd, Hm, Hw, Lt, Lw, Pl, Pw, Py, Se, Sw

Occurs on conifers, and is very common in true fir, pine and white spruce. It is widely distributed throughout its range of hosts in British Columbia.

Sporophores: Annual, leathery, resupinate to effused- reflexed, forms in this crust-like layers. The upper surface is zoned, and grey to light brown in the effused- reflexed form. The lower surface is roughened or wrinkled, and is also grey to light brown, but turns blood- red when bruised (only when fresh).

Decay: The incipient stage is firm and appears as a reddish-brown stain. In the advanced stage the wood becomes light brown to reddish-brown, dry and friable, the wood becoming a fibrous, stringy mass. Mycelial sheets, white to buff in colour, may develop during advanced decay.

Entrance: Broken tops and scars of living trees.

Activity: A lignin and generally, to a slower or lesser extent, cellulose, destroying heart rot.

Remarks: A very important decay-producing fungus, also occurs commonly as a slash destroyer. Sporophores develop occasionally on living trees, but are of limited value as indicators of defect, owing to their infrequent occurrence, small size, and colour.

	***Veluticeps fimbriata* (Ellis & Everh.) Nakas.** ***Hymenochaete fimbriata* Ellis & Everh.** ***Stereum rugisporum* (Ellis & Everh.)** **Burt Brown Cubical Pocket Rot** **Hosts:** Ba, Bg, Bl, Fd, Hm, Hw, Se, Ss Distributed widely throughout its host ranges in British Columbia. **Sporophores:** Perennial, small, resupinate or shelf-like. Upper surfaces are dark brown to black. Context is brown. Lower surfaces are grey to light brown and roughened. The hymenial (spore producing) surface can be smooth to warted and usually cracked. **Decay:** The incipient stage of decay produces a wet dark brown to black stain which occurs in streaks or patches. The advanced stage of decay develops in pockets which are enclosed by apparently sound wood. In the final stages, the pockets merge to form an almost continuous column of decay. The decayed wood is friable and often associated with dark stain and cobweb-like mycelium, often with an odour which resembles stored apples. **Activity:** A commonly occurring trunk rot in conifers. Once thought of as only a destroyer of slash. Fruiting bodies may form on old logs and dead material on the ground, as well as on the scarred faces of living trees. If present, it can also continue to develop in seasoned timber.

Sap Rots

Sporophores of *C. purpureum*.

Stain associated with decay caused by *C. purpureum*.

***Chondrostereum purpureum* (Pers.:Fr.) Pouzar**

***Stereum purpureum* Pers.:Fr.**

Silver Leaf Disease

Hosts: Bl, Cw, Fd, Hw, Dr, At, Act, Acb. Ep, M spp., W spp.

Found on conifers, hardwoods and common on angiosperms. Widely distributed throughout its host range in British Columbia.

Sporophores: Annual, resupinate to semi-pileate, often occurring in groups. Extend out from surface 2-4cm.

Upper surface is greyish white to purple and tomentose with indistinct, light coloured marginal zones. The spore producing surface is smooth to wrinkled, is bright purple when fresh and a brown-violet colour when it is old.

Fruiting bodies are thin (1-2.5 mm) and contain a black line in cross section.

Foliar Identification: Silver/leaden lustre occurring on leaves of some hosts. Midribs and margins of affected leaves will become brown.

Damage: A weak parasite on some hardwoods, killing some branches or trees of some hosts, however *C. purpureum* is largely a saprophyte, and is not considered an economically important pathogen to conifer species in BC.

Sporophores of *C. volvatus*.

Cross section of *C. volvatus* sporophore.

Sap rot decay caused by *C. volvatus* in an MPB affected tree.

Cryptoporus volvatus (Peck) Shear

Polyporus volvatus Peck

Grey-Brown Sap Rot

Hosts: Ba, Bg, Bl, Fd, Hw, Pl, Pw, Py, Ss, Sw

Widely distributed throughout its host range in British Columbia, but most commonly found on beetle-killed and fire-killed Douglas-fir.

Sporophores: Annual, leathery, pouch-like. The upper surface is smooth, yellow to light brown, and turns white with age. The lower surface, is brown, poroid, but is covered with a membrane that continues from the upper surface (forming a pouch), until later, when an opening forms at the base and spores are released.

Decay: Causes narrow bands of cream to light grey discolorations in the outer sapwood. In the advanced stages the decayed wood becomes light brown, cubical and crumbly.

Activity: Causes damage to the outer 1-2 cm of sapwood, therefore volume losses are not large, or are nonexistent. The fungus develops rapidly in dead standing trees, usually the year after death. The fungus can also be used as an indicator of beetle-kill in Douglas-fir.

Sporophore of *G. sepiarium*.

Sporophores of *G. sepiarium*.

Gleophyllum sepiarium **(Wulfen:Fr.) P. Karst.**

Lenzites saepiaria **(Wulfen:Fr.) Fr.**

Brown Cubical Sap Rot

Hosts: Ba, Bg, Bl, Cw, Fd, Hw, Pl, Pw, Py, Sb, Se, Ss, Sw, A spp., Ep

Widely distributed throughout its host range in British Columbia.

Sporophores: Annual, leathery, small, shelf-like, occasionally stalked. Form in cracks and checks on fallen logs and slash. The upper surface is light to dark cinnamon-brown and zoned. At first it appears velvety, but becomes roughened as it matures. The context is brown. The lower surface is brown and contains gill-like structures (lamellae).

Decay: In the incipient stage decay appears as yellow to yellow-brown pockets of discolouration located in the sapwood or outer heartwood. In the advanced stage of decay, a typical brown cubical rot is present with yellow to yellow-brown mycelia located in the shrinkage cracks.

Activity: Presence of fruiting bodies usually indicates extensive decay, affecting the entire sapwood and some heartwood. Most commonly found on slash and fire- killed trees. Sometimes found on living trees, and dead sapwood under scars. Also found occasionally on fence posts or other wooden structures.

Sporophores of *T. abietinum*
(Photo credit R. Reich).

Sporophores of *T. abietinum*
(Photo credit R. Reich).

Trichaptum abietinum (Dickson:Fr.)

Ryvarden

Hirschioporus abietinus (Dickson:Fr.)

Donk

Polyporus abietinus (Dickson:Fr.) Donk

Pitted Sap Rot

Hosts: Ba, Bg, Bl, Cw, Fd, Hw, Lw, Pa, Pl, Pw, Py, Sb, Ss, Sw, Ra

Found on a wide range of coniferous hosts in British Columbia, and affects trees in all ranges of BC.

Sporophores: Annual, small and thin, effused-reflexed or shelf-like. Form in abundance in crevices of bark. The upper surface is somewhat hairy, zoned and light grey when fresh. Upper surfaces may appear green or black in older specimens due to algal growth. When fresh the lower surface is purple, and turns light brown with age.

Pores are angular, and tissue between them becomes elongated and splits into irregular spines or ridges.

Decay: In the incipient stage the wood becomes soft and light yellow to tan coloured. Small pits develop in the advanced stage of decay which are elongated in the direction of the grain. They may be filled with fibrous material but will later become void. Cross section of decay appears as honeycombed.

Activity: Causes sapwood decay, fruiting bodies found abundantly on dead trees and forest litter. Primarily a saprophytic deteriorating agent, but also capable of casing sap rot and heart rot in living trees.

Canker Diseases

Black fungal mass of *I. obliquus*
(Photo credit R. Reich).

Trunk rot caused by *I. obliquus*.

***Inonotus obliquus* (Pers.:Fr.) Pilát**

***Polyporus obliquus* (Pers. :Fr.) Fr.**

***Poria obliqua* (Pers. :Fr.) P. Karst**

Sterile Conk Trunk Rot of Birch

Hosts: Ep, rarely on Act.

Widely distributed throughout host range in British Columbia, but also occurs on other hardwood species elsewhere in North America.

Conks: Sterile. Conspicuous perennial black fungal masses erupting from bark cankers, commonly 20-30 cm diameter. The surface of the conk is rough and cracked, and internal tissue is yellow-brown to rust-brown, having a punky texture.

Sporophores: Small, annual. Form under bark or outer layers of wood surrounding sterile conks on dead standing or fallen trees. Quickly degraded through insect and weather damage, making them less conspicuous.

Decay: A heart rot in living birches similar to that caused by *Phellinus (Fomes) igniarius*. Incipient decay is whitish- yellow and in irregular zones. Advanced heartwood decay produces alternating zones of white and light reddish-brown wood, and moves to the sapwood after the tree dies. White mycelium veins can often be found near cankers, and dark zone lines are a feature of decayed wood.

Entrance: Dead branch stubs, trunk wounds and pre-existing cankers.

Activity: Extensive sapwood and heartwood decay. Infected trees often severely damaged.

Subtle, resinous *E. deformans* stem infection (left), and subtle, non-resinous stem infection (right) (Photo credits R. Reich).

Cross section of *Elytroderma* infected trunk (Photo credit R. Reich).

Advanced *Elytroderma* stem infection (left), and spinning stem infection with associated live lower limb (right) (Photo credit R. Reich).

Elytroderma deformans (Weir) Darker

Hypoderma deformans Weir

Elytroderma Stem Canker, Elytroderma Needle and Shoot Disease

Hosts: Pl, Py

Restricted to hard, 2 and 3 needle pines. Found throughout the interior of British Columbia on lodgepole pine.

Remarks: Although typically noted as a disease affecting the needles and shoots of hard pines, *E. deformans* also causes stem infections, which have not been described in the literature to date. This section will describe the stem infections of *E. deformans* for identification in the field.

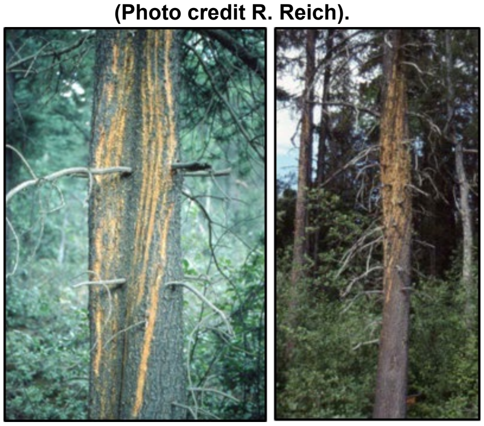
Stem Infections: Typically sunken, somewhat diamond- shaped cankered portions of the stem, which may be somewhat spiralled or straight depending on the grain of the tree. Outer bark is usually rough and cracked, and sometimes slightly resinous. Cankers may persist to rotation or may result in the premature mortality of the tree through chronic growth loss in completely girdled stems. Older cankers may develop ridges and become flared at the sides.

Damage: Infected trees can be girdled completely, though the inner bark typically remains live. Stem infections appear to have little impact on survival of young trees, but over time cankers appear to increase in severity. Most stem infections appear to occur before age 10, and spread at a fairly even rate both horizontally and vertically. Cankers on mature trees can be several meters in length and may resemble stalactiform blister rust infections.

Entrance: Infection is by windborne ascospores, which mature and are discharged in late summer and early fall under favourable (wet) conditions. Infection typically occurs on the current year’s foliage, with symptoms of flagging foliage by the following spring. Infection can spread to the bark and cambium becoming a perennial canker infection of the stem and/or branches.

Rusts

Sporulating diamond-shaped *C. coleosporioides* stem infections on young lodgepole pine (Photo credit R. Reich).



Long diamond shaped cankers of C. coleosporioides with concentric strips of squirrel feeding damage to bark (Photo credits R. Reich).

Cronartium coleosporioides **Arthur**

Cronartium stalactiforme **Arth. & Kern**

Stalactiform Blister Rust

Hosts: Pl, Py, Pj in natural forests.

Restricted to 2 and 3 needle hard pines in British Columbia. Also found on introduced hard pine varieties in BC.

Alternate (telial) Hosts: Paintbrush (*Castilleja miniata*), cow-wheat (*Melampyrum lineare*), and yellow rattle (*Rhinanthus minor*). Yellow owl's clover (*Orthocarpus luteus*) and bracted lousewort (*Pedicularis bracteosa*) have been found to be alternate hosts through artificial inoculation.

Identification: Perennial cankers can be found on the branches or stems of living hosts. Cankers are elongate, often diamond-shaped, and may display thickened bark due to swelling. Squirrel feeding damage on cankered areas of mature trees is common leaving areas of exposed wood. During late spring and summer, swollen areas produce white to orange aecial blisters which rupture and orange aeciospores are released to be disseminated by wind, rain and animals. During the fall and winter the presence of *C. coleosporioides* can be recognized due to size and shape of cankers, as well as their sunkeness, dead bark, and associated resinosis.

Entrance: Basidiospores which are produced on the telial horns of alternate hosts germinate in appropriate climatic conditions, infecting the tree through the stomatal openings of needles. Infection travels down the branch, and eventually into the stem.

Damage: Stem defects in older trees may result in decreased wood quality and increased susceptibility to abiotic damage such as caused by wind and heavy snow, as well as other pathogens such as stem decays.

Comandra blister rust stem infection (Photo credit R. Reich).

Stem canker caused by *C. Comandrae* with associated squirrel feeding on infected bark (Photo credit R. Reich).

Cronartium comandrae **Peck**

Comandra Blister Rust

Hosts: Pl, Py

Found in British Columbia where alternate host and host ranges overlap.

Alternate (telial) Hosts: False/bastard/northern toadflax (*Geocaulon lividum or Comandra livida*), Pale comandra (*Comandra umbellata*).

Identification: Perennial cankers can be found on the branches or stems of living hosts. Cankers grow radially as well as vertically, often girdling small branches and stems. Cankers of *C. comandrae*, similar to those of *C. coleosporioides*, are also prone to chewing by rodents and lagomorphs. During late spring and summer, swollen areas produce orange aecial blisters which rupture releasing orange aeciospores to be disseminated by wind, rain and animals.

Entrance: Basidiospores infect the tree through the stomatal openings of needles, travelling down the branch, and eventually into the stem.

Damage: Mortality usually occurs at an early age resulting in few mature trees with cankers.

Remarks: Cankers of *C. comandrae* and *C. coleosporioides* may appear similar to the untrained eye, however they can be distinguished by canker shape and size, as well as by microscopic examination of aecia.

Cankers of *C. comandrae* usually tend to grow faster radially than they do vertically, therefore *C. coleosporioides* cankers are more elongate, and tend to be larger, as well as have a characteristic diamond shape to them.

Stem swelling and hypertrophied ridges of sweetfern blister rust on young lodgepole pine (Photo credit R. Reich).

Hypertrophied ridges caused by sweetfern blister rust on lodgepole pine (Photo credit R. Reich).

Cronartium comptoniae **Arthur**

Sweetfern Blister Rust

Hosts: Pl, Pj, Py in natural forests.

Restricted to 2 and 3 needle hard pines in British Columbia. Restricted to areas where host and alternate host ranges overlap.

Alternate Host: Sweet gale (*Myrica gale*).

Identification: Appears as an elongate, diamond-shaped swelling on stems and branches, often girdling small branches and stems. During late spring and summer, swollen areas produce white to orange aecial blisters which rupture and orange aeciospores are released to be disseminated by wind, rain and animals. At other times of the year non-sporulating cankers can be identified by their size and shape, sunken dead bark and resin sis.

Cankers of *C. comptoniae*, similar to those of *C. coleosporioides* and *C. comandrae*, are not as prone to chewing by rodents and lagomorphs.

Entrance: Basidiospores which are produced on the telial horns of alternate hosts germinate in appropriate climatic conditions, infecting the tree through the stomatal openings of needles, travelling down the branch, and eventually into the stem.

Damage: Severe losses in plantations of pine located near swampy sweet gale habitats can occur, however these habitats are rare in BC.

Remarks: Distinguishing between *C. comptoniae* and *C. coleosporioides* can be difficult, as cankers and scars may appear similar to the untrained eye. The distinguishing feature is the hypertrophied ridges of *C. comptoniae*.

Stem and branch gall caused by *E. harknessii* (Photo credit R. Reich).

Cobra-shaped tree resulting from an *E. harknessii* hip gall (Photo credit R. Reich).

Western gall rust affected tree (Photo credit R. Reich).

Endocronartium harknessii (J. P. Moore) Y. Hiratsuka

Peridermium harknessii J. P. Moore

Western Gall Rust

Hosts: Pl, Py, Pj in natural forests.

Restricted to hard 2 needle pines in British Columbia. Also found on introduced 2 needle hard pine species in BC. The disease is widespread throughout BC, affecting hosts throughout their ranges.

Identification: Woody swellings (galls) are formed on branches and stems of infected trees. Galls are generally globose, but may be deeply fissured and irregularly shaped. In late spring blisters form beneath the bark of galls which contain orange coloured spores. Spores are exposed when bark sloughs off of the calls.

Entrance: Trees are infected by the spores of the fungus through the epidermis on elongating shoots, therefore all galls are formed initially on one-year-old growth.

Damage: Damage is not usually significant when occurring on branches, however stem galls can lead to serious growth losses and malformations as well as mortality. Malformations due to galls present on the main stem, especially in younger trees can predispose the tree to damage by abiotic factors such as wind or heavy snow.

Remarks: *E. harknessii*, unlike other stem rusts, does not require an alternate host to complete its life cycle.

Optimal climatic conditions for infection often occur every several years, as with other rust pathogens. This is known as the “wave year” phenomenon.

Figure 7-42 Residual Indicators

7.18. Appendix 18: References:

Allen et al. – Common tree Diseases of BC

P. sericeomollis – US Forest Service - https://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5187351.pdf

Photos taken from websites

1. *Fomitopsis pinicola*

Decay

NRC http://tidcf.nrcan.gc.ca/en/diseases/factsheet/18

2. *Phellinus igniarius*

Decay (2 photos)

NRC http://tidcf.nrcan.gc.ca/en/diseases/factsheet/332

3. *Armillaria*

Tree roots and base rot

NRC http://tidcf.rncan.gc.ca/en/diseases/factsheet/16

4. *Heterobasidion annosum*

Sporphores at base of tree

NRC http://tidcf.nrcan.gc.ca/en/diseases/factsheet/19

Incipient trunk decay

Bugwood USDA forest service archive
http://www.forestryimages.org/browse/detail.cfm?imgnum=2250054

Stringy root decay

Bugwood USDA forest service archive
http://www.forestryimages.org/browse/detail.cfm?imgnum=2250051

5. *Phellinus weirii*

Fruiting bodies

Black stain

Incipient decay

NRC http://aimfc.rncan.gc.ca/en/diseases/factsheet/1000027

6. Rhizina undualta

Seedling with black sporophore

Young brown fruiting bodies

NRC http://tidcf.nrcan.gc.ca/en/diseases/factsheet/1000042

7. Ceriporiopsis rivulosa

Decay

NRC http://tidcf.nrcan.gc.ca/en/diseases/factsheet/1000006

8. Fomes fomentarius

Decay

NRC http://aimfc.rncan.gc.ca/en/diseases/factsheet/183

9. Fomtipsis officinalis

Sporophore

Decay

NRC http://tidcf.nrcan.gc.ca/en/diseases/factsheet/1000019

10. Ganoderma applanatum

Sporophores

Decay

NRC http:/tidcf.nrcan.gc.ca/en/diseases/factsheet/191

11. Hericium abietis

Fruting body

Decay

NRC http://tidcf.nrcan.gc.ca/en/diseases/factsheet/1000025

12. Laettiporus sulphurous

Sporophores

NRC http://tidcf.nrcan.gc.ca/en/diseases/factsheet/1000014

Decay

Bugwood Daniel H. Brown USDA Forest Service
http://www.forestryimages.org/browse/detail.cfm?imgnum=1503080

13. Neolentinus kauffmanii

Sporophores

Decay

NRC http://tidcf.nrcan.gc.ca/en/diseases/factsheet/1000012

14. Phellinus hartigii

Sporophores

Bugwood Andrej Kunca National Forest Centre – Slovakia USDA
http://www.forestryimages.org/browse/detail.cfm?imgnum=1415109

Decay

NRC http://tidcf.nrcan.gc.ca/en/diseases/factsheet/1000007

15. Pholiota populnea

Mushrooms on cut log

NRC http://tidcf.nrcan.gc.ca/en/diseases/factsheet/1000029

Close up mushrooms

Bugwood Andrej Kunca National Forest Centre- Slovakia USDA
http://www.forestryimages.org/browse/detail.cfm?imgnum=1415248

16. Piptoporus betulinus

Sporophores (2photos)

NRC http://tidcf.nrcan.gc.ca/en/diseases/factsheet/354

Decay

Bugwood Frantisek Soukup
http://www.forestryimages.org/browse/detail.cfm?imgnum=0534044

17. Postia sericeomollis

Decay (2 photos)

NRC http://tidcf.nrcan.gc.ca/en/diseases/factsheet/1000018

18. Spongipellis delectans

Sporophores

NRC http://tidcf.nrcan.gc.ca/en/diseases/factsheet/1000021

19. Stereum sanguinolentum

Sporophores

NRC http://tidcf.nrcan.gc.ca/en/diseases/factsheet/418

Decay

Bugwood Andrej Kunca National Forest Centre –Slovakia
http://www.forestryimages.org/browse/detail.cfm?imgnum=5382917

20. Chondrostereum purpureum

Sprophores

Decay

NRC http://tidcf.nrcan.gc.ca/en/diseases/factsheet/1000040

21. Cryptoporus volvatus

Sprophores (2 photos)

NRC http://tidcf.nrcan.gc.ca/en/diseases/factsheet/1000024

Decay

Bugwood Russ Hogan
http://www.forestryimages.org/browse/detail.cfm?imgnum=1241533

22. Gleophyllum sepiarium

Sporophores (2 photos)

Bugwood Joseph O'Brien USDA Forest Service
http://www.forestryimages.org/browse/detail.cfm?imgnum=5299042

7.19. Appendix 19: Region and District Codes

Area	Natural Resource Region	Natural Resource District
Coast	South Coast (RSC)	Chilliwack Sea to Sky (previously Squamish) Sunshine Coast
	West Coast (RWC)	Campbell River North Island – Central Coast Haida Gwaii South Island
South	Thompson-Okanagan (RTO)	Thompson Rivers (includes previous Kamloops and part of previous Headwaters district) Cascades Okanagan Shuswap
	Cariboo (RCB)	100 Mile House Cariboo Chilcotin (previously Central Cariboo and Chilcotin) Quesnel
	Kootenay-Boundary (RKB)	Selkirk (previously Arrow Boundary, Columbia and Kootenay Districts) Rocky Mountain
North	Skeena (RSK)	Coast Mountain (previously North Coast and Kalum) Nadina Skeena Stikine
	Northeast (RNO)	Fort Nelson Peace
	Omenica (ROM)	Fort St. James Mackenzie Prince George (includes part of previous Headwaters district) Vanderhoof

British Columbia Timber Sales Offices

Burns Lake	Chilliwack	Campbell River	Dawson Creek
Kamloops	Nelson	Prince George	Port McNeill
Terrace	Vanderhoof	Vernon	Williams Lake

Access the BCTS map at: https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/forestry/bc-timber-sales/maps/ba_maps_overview_letter_locations.pdf

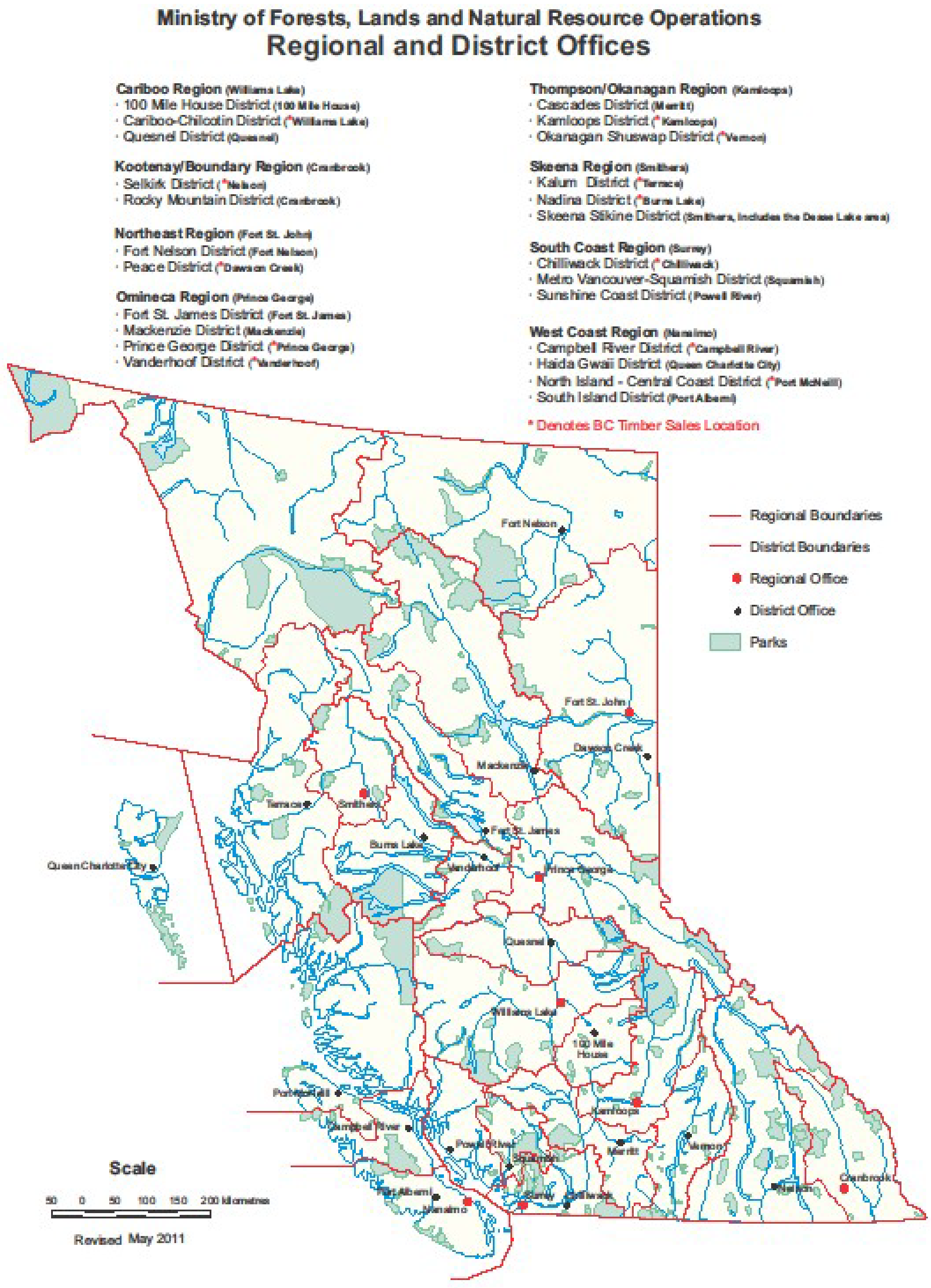


Figure 7-43 Forest Region and District Boundaries

7.20. Appendix 20: Risk Group Ratings by Pathological Indicators

7.20.1. Risk Group Ratings by Pathological Indicators (Table 7.20.1)

Species	Location	Age Group	Age Range	Risk Group 1	Risk Group 2	Risk Group 3
Cw	All FIZ	Immature	1-80	Any indicator		
		Old Immature	81-120	No indicators	Any indicator	
	FIZ D to I	Mature	121+	No indicators or large rotten branch	Any other indicators	
	FIZ A, B, C, J	Mature	121+	No indicators or either frost crack or fork/crook	Any other indicator(s)	
	*Exceptions	Mature	121+	Height ≥ 40.5 m.	Height < 40.5 m.	
CY	All FIZ	Immature	1-80	Any indicator		
	All FIZ	Old Immature	81-120	No indicators	Any indicator	
	All FIZ	Mature	121+	No indicators	Any indicator	

*Applies to the following PSYUs and TFL 30:
Bowron
Longworth
Monkman
Purden
Robson

Species	Location	Age Group	Age Range	Risk Group 1	Risk Group 2	Risk Group 3
Fd	All FIZ	Immature	1-80	Any indicator		

Species	Location	Age Group	Age Range	Risk Group 1	Risk Group 2	Risk Group 3
	FIZ A, B, C	Old Immature	81-120	Any indicator		
	FIZ D to I	Old Immature	81-120	No indicators	Any indicator	
	FIZ A, B, C	Mature	121+	No Indicators or 1 of dead/broken top or large rotten branch or frost crack	Any other indicator other than conk or blind conk	Conk or blind conk
	FIZ D, H	Mature	121+	No Indicators or 1 of mistletoe or large rotten branch or frost crack	Any other category or combination	
	FIZ E, F, G	Mature	121+	No Indicators or 1 of large rotten branch or mistletoe.	Any other category or combination	
	FIZ I	Mature	121+	No Indicators or 1 of dead/broken top, mistletoe, large rotten branch, or frost crack	Any other category or combination(s) other than conk or blind conk	Conk or blind conk
B	All FIZ	Immature	1-80	Any indicator		

Species	Location	Age Group	Age Range	Risk Group 1	Risk Group 2	Risk Group 3
		Old Immature	81-120	No indicators	Any indicator	
		Mature	121+	No indicator or forks/crooks	3 or less indicators	Conk or blind conk or 4 or more other indicators
H	All FIZ	Immature	1-80	Any Indicator		
	All FIZ	Old Immature	81-120	No indicators	Any indicator	
	FIZ A	Mature	121 +	D or B Top, large rotten branch, mistletoe, frost crack, fork/crook or scar	2 or 3 indicators	4 or more categories or conk or blind conk
	FIZ B, C	Mature	121 +	D or B Top and/or mistletoe	frost crack or fork/crook or scar or indicators in 2 or 3 categories	4 or more categories or rotten branch, conk, or blind conk
	Kingcome Local & TFLs 6, 25, 37, 43, 45, and 47	Mature	121 +	No indicators or one or both of D or B top or mistletoe	frost crack, fork/crook, scar or rotten branch or 2 or more categories	4 or more categories or conk or blind conk

Species	Location	Age Group	Age Range	Risk Group 1	Risk Group 2	Risk Group 3
	FIZ D to K	Mature	121 +	No indicators	No more than 3 of any indicator other than conk/blind conk	Conk/blind conk or 4 or more of any other indicators
S	All FIZ	Immatu re	1 - 80	Any indicator		
	FIZ A, B, C	Old Immatu re	81 - 120	Any indicator		
	FIZ D to L	Old Immatu re	81 - 120	No indicators	Any indicator	
	FIZ A, B, C	Mature	121 +	D or B Top, rotten branch, mistletoe, frost crack, fork/crook, scar	More than 1 indicator or Conk or Blind conk	
	FIZ D to L	Mature	121 +	No indicators	Any other than conk/blind conk	Conk/blind conk
L	All FIZ	Immature	1 - 80	Any indicator		
		Old Immature	81 - 120	No indicators	Any indicator	

Species	Location	Age Group	Age Range	Risk Group 1	Risk Group 2	Risk Group 3
		Mature	121 +	No indicators	Any other than conk or blind conk	Conk or blind conk
PL	All FIZ	Immature	1 - 60	Any indicator		
	All FIZ	Old Immature	61 - 120	No indicators	Any indicator	
	FIZ A, B, C	Mature	121 +	No indicators	Any indicator	
	FIZ D to L	Mature	121 +	No indicators	Any other than conk/blind conk	Conk/blind conk
Pw	All FIZ	Immature	1 - 80	Any indicator		
and		Old Immature	81 - 120	No indicators	Any indicator	
Pa		Mature	121 +	No indicators	Any indicator	
Py	All FIZ	Immature	1 - 80	Any indicator		
		Old Immature	81 - 120	No indicators	Any indicator	
		Mature	121 +	Fork/crook	Any indicator other than fork/crook	
Ac	FIZ A to J	Immature	1-20	Any indicator		

Species	Location	Age Group	Age Range	Risk Group 1	Risk Group 2	Risk Group 3
	FIZ K, L	Immature	1-40	Any indicator		
	FIZ A to J	Old Immature	21 - 40	Any indicator		
	FIZ K, L	Old Immature	41 - 80	Fork/crook	Any other than fork/crook	
	FIZ A to J	Mature	41 +	Any indicator		
	FIZ K, L	Mature	81 - 140	Fork/crook	Any other than fork/crook	
	FIZ K, L	Over Mature	141 +	Any indicator		
At	FIZ A to J	Immature	1-20	Any indicator		
	FIZ K, L	Immature	1-40	Any indicator		
	FIZ A to J	Old Immature	21 - 40	Any indicator		
	FIZ K, L	Old Immature	41 - 80	Any indicators other than conk or blind conk	Conk or blind conk	
	FIZ A to J	Mature	41 +	No indicators	Any	

Species	Location	Age Group	Age Range	Risk Group 1	Risk Group 2	Risk Group 3
	FIZ K, L	Mature	81 - 140	Fork/crook	Any other than fork/crook or conk or blind conk	Conk or Blind Conk
	FIZ K, L	Over Mature	141 +	Any indicator		
E	All FIZ	Immature	1 - 20	Any indicator		
		Old Immature	21 - 40	Any indicator		
		Mature	41 +	No indicators	Any Indicator	
D	All FIZ	Immature	1 - 20	Any indicator		
		Old Immature	21 - 40	Any indicator		
		Mature	41 +	Any indicator		
Mb	All FIZ	Immature	1 - 20	Any indicator		
		Old Immature	21 - 40	Any indicator		
		Mature	41 +	No indicators	Any indicator	

7.21. Appendix 21: Site Index Tables for British Columbia – All Species

The site index tables must be used for appraisal cruising.

The tables may be purchased on a waterproof paper from: Crown Publications
563 Superior St
Victoria, BC V8V
1T7 Phone: (250)
387-6409

Toll Free: 1-800-663-6105

Website: https://www.crownpub.bc.ca/

7.21.1. Use of Site Index Tables for BC to Determine the Age Corrections at Breast Height

1. Refer to the most recent Coast and Interior site index tables for the target tree species.
2. Bore the tree at breast-height (1.3 m) above the high-side.
3. Count the growth rings between the cambium and the pith (count the pith as one ring). Enter under "Counted Age" on Card Type 3 (Figure 4.1 Cruise Tally Sheet – FS 205C (front side).).
4. From top height and boring height age, determine the site index. Then go to the bottom of the Site Index Table to obtain the "Years to bh" (boring height) age correction.
5. Add this age correction to "Counted Age" to get the total age.

7.21.2. Coast

Table of Site Index by Breast Height Age and Height

Species: Fdc – Coastal Douglas-fir

Age @ bh	Top Height (m) 5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
	Site Index (m)																
5	35	45	53	59	62	65	67	69									
10	15	20	24	29	33	38	42	47	51	54	57	59	61	63			
15	10	13	16	19	22	24	27	30	33	36	39	42	45	47	50	52	55
20	8	10	12	15	17	19	21	23	25	27	29	31	34	36	38	40	42
25	7	9	10	12	14	16	17	19	21	22	24	26	27	29	31	33	34
30	6	8	9	11	12	14	15	17	18	19	21	22	24	25	27	28	30
35	6	7	8	10	11	12	14	15	16	17	19	20	21	23	24	25	26
40	5	7	8	9	10	11	12	14	15	16	17	18	19	21	22	23	24
45	5	6	7	8	9	11	12	13	14	15	16	17	18	19	20	21	22
50	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
55	5	6	7	8	9	10	10	11	12	13	14	15	16	17	18	19	20
60	5	6	6	7	8	9	10	11	12	13	14	15	15	16	17	18	19
65	5	5	6	7	8	9	10	11	11	12	13	14	15	16	17	17	18
70		5	6	7	8	9	9	10	11	12	13	13	14	15	16	17	18
75		5	6	7	8	8	9	10	11	11	12	13	14	15	15	16	17
80		5	6	7	7	8	9	10	10	11	12	13	13	14	15	16	17
85		5	6	6	7	8	9	9	10	11	12	12	13	14	15	15	16
90		5	6	6	7	8	9	9	10	11	11	12	13	14	14	15	16
95		5	6	6	7	8	8	9	10	10	11	12	13	13	14	15	15
100		5	5	6	7	8	8	9	10	10	11	12	12	13	14	14	15
105		5	5	6	7	7	8	9	9	10	11	11	12	13	13	14	15
110		5	5	6	7	7	8	9	9	10	11	11	12	13	13	14	15
115		5	5	6	7	7	8	9	9	10	10	11	12	12	13	14	14
120		5	5	6	7	7	8	8	9	10	10	11	12	12	13	14	14
125		5	5	6	6	7	8	8	9	10	10	11	11	12	13	13	14
130		5	5	6	6	7	8	8	9	9	10	11	11	12	13	13	14
135			5	6	6	7	8	8	9	9	10	11	11	12	12	13	14
140			5	6	6	7	7	8	9	9	10	10	11	12	12	13	13
145			5	6	6	7	7	8	9	9	10	10	11	12	12	13	13
150			5	6	6	7	7	8	8	9	10	10	11	11	12	13	13
155			5	6	6	7	7	8	8	9	10	10	11	11	12	12	13
160			5	5	6	7	7	8	8	9	9	10	11	11	12	12	13
165			5	5	6	7	7	8	8	9	9	10	11	11	12	12	13
170			5	5	6	7	7	8	8	9	9	10	10	11	12	12	13
175			5	5	6	6	7	8	8	9	9	10	10	11	12	12	13
180			5	5	6	6	7	8	8	9	9	10	10	11	11	12	13
185			5	5	6	6	7	8	8	9	9	10	10	11	11	12	12
190			5	5	6	6	7	7	8	9	9	10	10	11	11	12	12
195			5	5	6	6	7	7	8	8	9	10	10	11	11	12	12
200			5	5	6	6	7	7	8	8	9	10	10	11	11	12	12

Years to Boring Height

Site Index	Up to 10	11-16	17-22	23-28	29-35	36-41	42-47	48+
Correct yrs	12	11	10	9	8	7	6	5

SiteTools Version 3.2m – Research Branch, British Columbia Ministry of Forests
Date: February 28, 2002
Site Index Equation: Bruce (1981)

Page 1

Table of Site Index by Breast Height Age and Height

Species: Fdc – Coastal Douglas-fir

Top Height (m) 22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	Age @ bh
Site Index (m)																
																5
																10
57	59		62													15
44	46	49	50	52	54	56										20
36	38	40	41	43	45	47	48	50	52	53	55					25
31	33	34	36	37	39	40	42	43	45	46	47	49	50	52	53	30
28	29	30	32	33	34	35	37	38	39	41	42	43	45	46	47	35
25	26	28	29	30	31	32	33	35	36	37	38	39	41	42	43	40
23	25	26	27	28	29	30	31	32	33	34	35	36	37	39	40	45
22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	50
21	22	23	24	25	26	27	27	28	29	30	31	32	33	34	35	55
20	21	22	23	23	24	25	26	27	28	29	30	31	32	32	33	60
19	20	21	22	23	23	24	25	26	27	28	29	29	30	31	32	65
18	19	20	21	22	23	23	24	25	26	27	27	28	29	30	31	70
18	19	19	20	21	22	23	23	24	25	26	27	27	28	29	30	75
17	18	19	20	20	21	22	23	24	24	25	26	27	27	28	29	80
17	18	18	19	20	21	21	22	23	24	24	25	26	27	27	28	85
17	17	18	19	19	20	21	22	22	23	24	25	25	26	27	27	90
16	17	18	18	19	20	20	21	22	23	23	24	25	25	26	27	95
16	17	17	18	19	19	20	21	21	22	23	24	24	25	26	26	100
16	16	17	18	18	19	20	20	21	22	22	23	24	24	25	26	105
15	16	17	17	18	19	19	20	21	21	22	23	23	24	25	25	110
15	16	16	17	18	18	19	20	20	21	22	22	23	24	24	25	115
15	15	16	17	17	18	19	19	20	21	21	22	23	23	24	25	120
15	15	16	17	17	18	18	19	20	20	21	22	22	23	24	24	125
14	15	16	16	17	18	18	19	20	20	21	21	22	23	23	24	130
14	15	16	16	17	17	18	19	19	20	21	21	22	22	23	24	135
14	15	15	16	17	17	18	18	19	20	20	21	22	22	23	23	140
14	15	15	16	16	17	18	18	19	19	20	21	21	22	23	23	145
14	14	15	16	16	17	17	18	19	19	20	21	21	22	22	23	150
14	14	15	15	16	17	17	18	18	19	20	20	21	22	22	23	155
14	14	15	15	16	17	17	18	18	19	20	20	21	21	22	23	160
13	14	15	15	16	16	17	18	18	19	19	20	21	21	22	22	165
13	14	15	15	16	16	17	17	18	19	19	20	20	21	22	22	170
13	14	14	15	16	16	17	17	18	18	19	20	20	21	21	22	175
13	14	14	15	15	16	17	17	18	18	19	19	20	21	21	22	180
13	14	14	15	15	16	16	17	18	18	19	19	20	20	21	22	185
13	14	14	15	15	16	16	17	17	18	19	19	20	20	21	21	190
13	13	14	15	15	16	16	17	17	18	19	19	20	20	21	21	195
13	13	14	14	15	16	16	17	17	18	18	19	20	20	21	21	200

Years to Boring Height

Site Index	Up to 10	11-16	17-22	23-28	29-35	36-41	42-47	48+
Correct yrs	12	11	10	9	8	7	6	5

Page 2

Table of Site Index by Breast Height Age and Height
Species: Fdc – Coastal Douglas-fir

Age @ bh	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53
	Top Height (m) / Site Index (m)															
5																
10																
15																
20																
25																
30																
35	49	50	51													
40	44	45	46	48	49	50	51									
45	41	42	43	44	45	46	47	48	49	50						
50	38	39	40	41	42	43	44	45	46	47	48	49	50			
55	36	37	38	39	40	41	42	42	43	44	45	46	47	48	49	50
60	34	35	36	37	38	39	39	40	41	42	43	44	45	46	47	47
65	33	34	34	35	36	37	38	39	39	40	41	42	43	44	44	45
70	32	32	33	34	35	36	36	37	38	39	40	40	41	42	43	44
75	31	31	32	33	34	34	35	36	37	38	38	39	40	41	41	42
80	30	30	31	32	33	33	34	35	36	36	37	38	39	39	40	41
85	29	30	30	31	32	33	33	34	35	35	36	37	38	38	39	40
90	28	29	30	30	31	32	32	33	34	35	35	36	37	37	38	39
95	28	28	29	30	30	31	32	32	33	34	34	35	36	36	37	38
100	27	28	28	29	30	30	31	32	32	33	34	34	35	36	36	37
105	27	27	28	29	29	30	31	31	32	33	33	34	34	35	36	36
110	26	27	27	28	29	29	30	31	31	32	33	33	34	34	35	36
115	26	26	27	28	28	29	30	30	31	31	32	33	33	34	35	35
120	25	26	27	27	28	28	29	30	30	31	32	32	33	33	34	35
125	25	26	26	27	27	28	29	29	30	31	31	32	32	33	34	34
130	25	25	26	26	27	28	28	29	30	30	31	31	32	33	33	34
135	24	25	26	26	27	27	28	29	29	30	30	31	32	32	33	33
140	24	25	25	26	26	27	28	28	29	29	30	31	31	32	32	33
145	24	24	25	26	26	27	27	28	29	29	30	30	31	31	32	33
150	24	24	25	25	26	27	27	28	28	29	29	30	31	31	32	32
155	23	24	25	25	26	26	27	27	28	29	29	30	30	31	31	32
160	23	24	24	25	25	26	27	27	28	28	29	29	30	31	31	32
165	23	23	24	25	25	26	26	27	28	28	29	29	30	30	31	31
170	23	23	24	24	25	26	26	27	27	28	28	29	30	30	31	31
175	23	23	24	24	25	25	26	27	27	28	28	29	29	30	30	31
180	22	23	24	24	25	25	26	26	27	27	28	29	29	30	30	31
185	22	23	23	24	24	25	26	26	27	27	28	28	29	29	30	31
190	22	23	23	24	24	25	25	26	27	27	28	28	29	29	30	30
195	22	22	23	24	24	25	25	26	26	27	27	28	29	29	30	30
200	22	22	23	23	24	25	25	26	26	27	27	28	28	29	29	30

Years to Boring Height

Site Index	Up to 10	11-16	17-22	23-28	29-35	36-41	42-47	48+
Correct yrs	12	11	10	9	8	7	6	5

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Table of Site Index by Breast Height Age and Height
Species: Fdc – Coastal Douglas-fir

54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	Age @ bh
Top Height (m) / Site Index (m)																
																5
																10
																15
																20
																25
																30
																35
																40
																45
																50
																55
48	49															60
46	47	48	49	49												65
44	45	46	47	47	48	49										70
43	44	44	45	46	47	47	48	49								75
42	42	43	44	44	45	46	47	47	48	49						80
40	41	42	42	43	44	45	45	46	47	47	48	49				85
39	40	41	41	42	43	43	44	45	45	46	47	47	48			90
39	39	40	40	41	42	42	43	44	44	45	46	46	47	48	48	95
38	38	39	40	40	41	42	42	43	43	44	45	45	46	47	47	100
37	38	38	39	40	40	41	41	42	43	43	44	44	45	46	46	105
36	37	38	38	39	39	40	41	41	42	42	43	44	44	45	45	110
36	36	37	38	38	39	39	40	41	41	42	42	43	44	44	45	115
35	36	36	37	38	38	39	39	40	41	41	42	42	43	43	44	120
35	35	36	37	37	38	38	39	39	40	41	41	42	42	43	43	125
34	35	36	36	37	37	38	38	39	39	40	41	41	42	42	43	130
34	35	35	36	36	37	37	38	38	39	40	40	41	41	42	42	135
34	34	35	35	36	36	37	37	38	39	39	40	40	41	41	42	140
33	34	34	35	35	36	37	37	38	38	39	39	40	40	41	41	145
33	33	34	35	35	36	36	37	37	38	38	39	39	40	40	41	150
33	33	34	34	35	35	36	36	37	37	38	38	39	39	40	40	155
32	33	33	34	34	35	35	36	37	37	38	38	39	39	40	40	160
32	33	33	34	34	35	35	36	36	37	37	38	38	39	39	40	165
32	32	33	33	34	34	35	35	36	36	37	37	38	38	39	39	170
32	32	33	33	34	34	35	35	36	36	37	37	38	38	39	39	175
31	32	32	33	33	34	34	35	35	36	36	37	37	38	38	39	180
31	32	32	33	33	34	34	35	35	36	36	37	37	38	38	39	185
31	31	32	32	33	33	34	34	35	35	36	36	37	37	38	38	190
31	31	32	32	33	33	34	34	35	35	36	36	37	37	38	38	195
30	31	31	32	33	33	34	34	35	35	35	36	36	37	37	38	200

Years to Boring Height

Site Index	Up to 10	11-16	17-22	23-28	29-35	36-41	42-47	48+
Correct yrs	12	11	10	9	8	7	6	5

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Figure 7-44 Fdc – Coastal Douglas-Fir

Table of Site Index by Breast Height Age and Height
Species: Hwc – Western Hemlock - Coast

Age @ bh	Top Height (m) 6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
	Site Index (m)																
10	26	30	33	36	39	42	44	47	49	51	52	54	56	57	58	60	
15	18	20	23	26	28	31	33	35	37	39	41	43	45	46	48	49	51
20	13	15	18	20	22	24	26	28	30	32	33	35	37	38	40	41	43
25	11	13	14	16	18	20	21	23	25	26	28	29	31	32	34	35	37
30	9	11	12	14	15	17	18	20	21	23	24	25	27	28	30	31	32
35	8	9	11	12	13	15	16	17	19	20	21	23	24	25	26	28	29
40	7	8	10	11	12	13	14	16	17	18	19	20	21	23	24	25	26
45	6	8	9	10	11	12	13	14	15	16	17	18	20	21	22	23	24
50	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
55	6	7	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
60	5	6	7	8	9	10	10	11	12	13	14	15	16	17	17	18	19
65	5	6	7	7	8	9	10	11	12	12	13	14	15	16	17	17	18
70	5	6	6	7	8	9	9	10	11	12	13	13	14	15	16	16	17
75	5	5	6	7	8	8	9	10	10	11	12	13	13	14	15	16	17
80		5	6	7	7	8	9	9	10	11	11	12	13	14	14	15	16
85		5	6	6	7	8	8	9	10	10	11	12	12	13	14	14	15
90		5	5	6	7	7	8	9	9	10	11	11	12	13	13	14	15
95		5	5	6	6	7	8	8	9	10	10	11	12	12	13	13	14
100		5	5	6	6	7	7	8	9	9	10	11	11	12	12	13	14
105			5	6	6	7	7	8	8	9	10	10	11	11	12	13	13
110			5	5	6	7	7	8	8	9	9	10	11	11	12	12	13
115			5	5	6	6	7	7	8	9	9	10	10	11	11	12	13
120			5	5	6	6	7	7	8	8	9	10	10	11	11	12	12
125			5	5	6	6	7	7	8	8	9	9	10	10	11	11	12
130			5	5	6	6	7	7	8	8	9	9	10	10	11	11	12
135				5	5	6	6	7	7	8	8	9	9	10	10	11	12
140				5	5	6	6	7	7	8	8	9	9	10	10	11	11
145				5	5	6	6	7	7	8	8	9	9	10	10	11	11
150				5	5	6	6	7	7	7	8	8	9	9	10	10	11
155				5	5	6	6	6	7	7	8	8	9	9	10	10	11
160				5	5	5	6	6	7	7	8	8	9	9	10	10	11
165				5	5	5	6	6	7	7	8	8	9	9	9	10	10
170					5	5	6	6	7	7	8	8	8	9	9	10	10
175					5	5	6	6	7	7	7	8	8	9	9	10	10
180					5	5	6	6	6	7	7	8	8	9	9	10	10
185					5	5	6	6	6	7	7	8	8	9	9	9	10
190					5	5	5	6	6	7	7	8	8	8	9	9	10
195					5	5	5	6	6	7	7	8	8	8	9	9	10
200					5	5	5	6	6	7	7	7	8	8	9	9	10

Years to Boring Height

Site Index	10-13	14-20	21-27	28-34	35-42	43-49	50+
Correct yrs	8	7	6	5	4	3	2

SiteTools Version 3.2m – Research Branch, British Columbia Ministry of Forests
Date: February 27, 2002
Site Index Equation: Wiley (1978)

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Table of Site Index by Breast Height Age and Height
Species: Hwc – Western Hemlock - Coast

Top Height (m) 23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	Age @ bh
Site Index (m)																
																10
52	54	55	56													15
44	46	47	48	50	51	52	54	55								20
38	40	41	42	44	45	46	47	49	50	51	52	53	54			25
34	35	36	37	39	40	41	42	43	45	46	47	48	49	50	51	30
30	31	32	34	35	36	37	38	39	41	42	43	44	45	46	47	35
27	28	29	31	32	33	34	35	36	37	38	39	40	41	43	44	40
25	26	27	28	29	30	31	32	33	34	35	36	37	39	40	41	45
23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	50
21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	55
20	21	22	23	24	25	26	27	27	28	29	30	31	32	33	34	60
19	20	21	22	22	23	24	25	26	27	28	29	30	30	31	32	65
18	19	20	21	21	22	23	24	25	26	26	27	28	29	30	31	70
17	18	19	20	20	21	22	23	24	24	25	26	27	28	29	29	75
17	17	18	19	20	20	21	22	23	24	24	25	26	27	28	28	80
16	17	17	18	19	20	20	21	22	23	23	24	25	26	27	27	85
15	16	17	17	18	19	20	20	21	22	23	23	24	25	26	26	90
15	16	16	17	18	18	19	20	20	21	22	23	23	24	25	26	95
14	15	16	16	17	18	18	19	20	20	21	22	23	23	24	25	100
14	15	15	16	17	17	18	19	19	20	21	21	22	23	23	24	105
14	14	15	15	16	17	17	18	19	19	20	21	21	22	23	24	110
13	14	14	15	16	16	17	18	18	19	20	20	21	22	22	23	115
13	14	14	15	15	16	17	17	18	18	19	20	20	21	22	22	120
13	13	14	14	15	16	16	17	17	18	19	19	20	21	21	22	125
12	13	14	14	15	15	16	16	17	18	18	19	20	20	21	21	130
12	13	13	14	14	15	16	16	17	17	18	19	19	20	20	21	135
12	12	13	14	14	15	15	16	16	17	18	18	19	19	20	21	140
12	12	13	13	14	14	15	16	16	17	17	18	18	19	20	20	145
11	12	13	13	14	14	15	15	16	16	17	18	18	19	19	20	150
11	12	12	13	13	14	14	15	16	16	17	17	18	18	19	20	155
11	12	12	13	13	14	14	15	15	16	16	17	18	18	19	19	160
11	11	12	12	13	13	14	15	15	16	16	17	17	18	18	19	165
11	11	12	12	13	13	14	14	15	15	16	17	17	18	18	19	170
11	11	12	12	13	13	14	14	15	15	16	16	17	17	18	19	175
11	11	11	12	12	13	13	14	14	15	16	16	17	17	18	18	180
10	11	11	12	12	13	13	14	14	15	15	16	16	17	17	18	185
10	11	11	12	12	13	13	14	14	15	15	16	16	17	17	18	190
10	11	11	12	12	12	13	13	14	14	15	15	16	17	17	18	195
10	10	11	11	12	12	13	13	14	14	15	15	16	16	17	17	200

Years to Boring Height

Site Index	10-13	14-20	21-27	28-34	35-42	43-49	50+
Correct yrs	8	7	6	5	4	3	2

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Table of Site Index by Breast Height Age and Height
Species: Hwc – Western Hemlock - Coast

Top Height (m) / Site Index (m)

Age @ bh	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54
10																
15																
20																
25																
30	53	54														
35	48	49	50	51	53											
40	45	46	47	48	49	50	51	52								
45	42	43	44	45	46	47	48	49	50	51	52					
50	39	40	41	42	43	44	45	46	47	48	49	50	51	52		
55	37	38	39	40	41	42	43	44	45	46	47	48	48	49	50	51
60	35	36	37	38	39	40	41	41	42	43	44	45	46	47	48	49
65	33	34	35	36	37	38	39	40	41	41	42	43	44	45	46	47
70	32	33	33	34	35	36	37	38	39	40	41	42	43	43	44	45
75	30	31	32	33	34	35	36	36	37	38	39	40	41	42	43	44
80	29	30	31	32	33	33	34	35	36	37	38	39	40	40	41	42
85	28	29	30	31	31	32	33	34	35	36	36	37	38	39	40	41
90	27	28	29	30	30	31	32	33	34	35	35	36	37	38	39	40
95	26	27	28	29	29	30	31	32	33	33	34	35	36	37	38	39
100	26	26	27	28	29	29	30	31	32	33	33	34	35	36	37	38
105	25	26	26	27	28	29	29	30	31	32	33	33	34	35	36	37
110	24	25	26	26	27	28	29	29	30	31	32	33	33	34	35	36
115	24	24	25	26	27	27	28	29	29	30	31	32	33	33	34	35
120	23	24	24	25	26	27	27	28	29	30	30	31	32	33	33	34
125	23	23	24	25	25	26	27	27	28	29	30	30	31	32	33	34
130	22	23	23	24	25	26	26	27	28	28	29	30	31	31	32	33
135	22	22	23	24	24	25	26	26	27	28	29	29	30	31	32	32
140	21	22	23	23	24	25	25	26	27	27	28	29	30	30	31	32
145	21	22	22	23	23	24	25	25	26	27	28	28	29	30	30	31
150	21	21	22	22	23	24	24	25	26	26	27	28	29	29	30	31
155	20	21	21	22	23	23	24	25	25	26	27	27	28	29	30	30
160	20	21	21	22	22	23	24	24	25	26	26	27	28	28	29	30
165	20	20	21	21	22	23	23	24	25	25	26	27	27	28	29	29
170	19	20	21	21	22	22	23	24	24	25	26	26	27	28	28	29
175	19	20	20	21	21	22	23	23	24	25	25	26	27	27	28	29
180	19	19	20	21	21	22	22	23	24	24	25	26	26	27	28	28
185	19	19	20	20	21	22	22	23	23	24	25	25	26	27	27	28
190	18	19	20	20	21	21	22	22	23	24	24	25	26	26	27	28
195	18	19	19	20	20	21	22	22	23	23	24	25	25	26	27	27
200	18	19	19	20	20	21	21	22	23	23	24	24	25	26	26	27

Years to Boring Height

Site Index	10-13	14-20	21-27	28-34	35-42	43-49	50+
Correct yrs	8	7	6	5	4	3	2

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Table of Site Index by Breast Height Age and Height
Species: Hwc – Western Hemlock - Coast

Top Height (m) / Site Index (m)

55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	Age @ bh
																10
																15
																20
																25
																30
																35
																40
																45
																50
																55
50	51															60
48	49	50	51													65
46	47	48	49	50	51											70
45	46	47	47	48	49	50										75
43	44	45	46	47	48	49	50	51								80
42	43	44	45	46	46	47	48	49	50							85
41	41	42	43	44	45	46	47	48	49	50						90
39	40	41	42	43	44	45	46	47	48	49	50	51				95
38	39	40	41	42	43	44	45	46	47	47	48	49	50			100
37	38	39	40	41	42	43	44	45	45	46	47	48	49	50		105
37	37	38	39	40	41	42	43	44	45	45	46	47	48	49	50	110
36	37	37	38	39	40	41	42	43	44	45	45	46	47	48	49	115
35	36	37	38	38	39	40	41	42	43	44	45	45	46	47	48	120
34	35	36	37	38	38	39	40	41	42	43	44	45	46	47	47	125
34	34	35	36	37	38	39	39	40	41	42	43	44	45	46	47	130
33	34	35	35	36	37	38	39	40	41	41	42	43	44	45	46	135
33	33	34	35	36	36	37	38	39	40	41	42	42	43	44	45	140
32	33	34	34	35	36	37	38	38	39	40	41	42	43	44	45	145
31	32	33	34	35	35	36	37	38	39	40	40	41	42	43	44	150
31	32	33	33	34	35	36	36	37	38	39	40	41	42	42	43	155
31	31	32	33	34	34	35	36	37	38	38	39	40	41	42	43	160
30	31	32	32	33	34	35	35	36	37	38	39	40	40	41	42	165
30	30	31	32	33	33	34	35	36	37	37	38	39	40	41	42	170
29	30	31	32	32	33	34	35	35	36	37	38	39	40	40	41	175
29	30	30	31	32	33	33	34	35	36	37	37	38	39	40	41	180
29	29	30	31	32	32	33	34	35	35	36	37	38	39	39	40	185
28	29	30	30	31	32	33	33	34	35	36	37	37	38	39	40	190
28	29	29	30	31	32	32	33	34	35	35	36	37	38	39	40	195
28	28	29	30	31	31	32	33	34	34	35	36	37	37	38	39	200

Years to Boring Height

Site Index	10-13	14-20	21-27	28-34	35-42	43-49	50+
Correct yrs	8	7	6	5	4	3	2

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Figure 7-45 Hwc – Western Hemlock – Coast

7.21.3. Interior

Table of Site Index by Breast Height Age and Height
Species: Fdi – Interior Douglas-fir

Top Height (m) — Site Index (m)

Age @ bh	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
10	18	22	26	30	34	38	42	46	50														
15	12	15	18	21	24	26	29	32	34	37	40	42	45	48	50								
20	10	12	14	16	18	20	23	25	27	29	31	33	35	37	39	41	43	45	47	49			
25	8	10	12	13	15	17	19	20	22	24	25	27	29	31	32	34	36	37	39	41	42	44	46
30	7	9	10	12	13	15	16	18	19	21	22	23	25	26	28	29	31	32	34	35	36	38	39
35	6	8	9	10	12	13	14	16	17	18	19	21	22	23	25	26	27	29	30	31	32	34	35
40	6	7	8	9	11	12	13	14	15	16	18	19	20	21	22	23	25	26	27	28	29	30	32
45	5	6	8	9	10	11	12	13	14	15	16	17	18	19	20	22	23	24	25	26	27	28	29
50	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
55	5	6	7	8	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	23	24	25
60		5	6	7	8	9	10	11	12	12	13	14	15	16	17	18	19	19	20	21	22	23	24
65		5	6	7	8	8	9	10	11	12	13	13	14	15	16	17	18	19	19	20	21	22	23
70		5	6	6	7	8	9	10	10	11	12	13	14	14	15	16	17	18	18	19	20	21	22
75		5	5	6	7	8	8	9	10	11	12	12	13	14	15	15	16	17	18	19	19	20	21
80		5	5	6	7	7	8	9	10	10	11	12	13	13	14	15	16	16	17	18	19	19	20
85			5	6	7	7	8	9	9	10	11	11	12	13	14	14	15	16	17	17	18	19	19
90			5	6	6	7	8	8	9	10	10	11	12	13	13	14	15	15	16	17	17	18	19
95			5	5	6	7	7	8	9	9	10	11	11	12	13	14	14	15	16	16	17	18	18
100			5	5	6	7	7	8	9	9	10	11	11	12	12	13	14	14	15	16	16	17	18
105			5	5	6	6	7	8	8	9	10	10	11	12	12	13	13	14	15	15	16	17	17
110			5	5	6	6	7	8	8	9	9	10	11	11	12	13	13	14	14	15	16	16	17
115				5	6	6	7	7	8	9	9	10	10	11	12	12	13	14	14	15	15	16	17
120				5	5	6	7	7	8	8	9	10	10	11	11	12	13	13	14	14	15	16	16
125				5	5	6	7	7	8	8	9	9	10	11	11	12	12	13	14	14	15	15	16
130				5	5	6	6	7	8	8	9	9	10	10	11	12	12	13	13	14	15	15	16
135				5	5	6	6	7	7	8	9	9	10	10	11	11	12	13	13	14	14	15	16
140				5	5	6	6	7	7	8	8	9	10	10	11	11	12	12	13	14	14	15	15
145				5	5	6	6	7	7	8	8	9	9	10	11	11	12	12	13	13	14	14	15
150					5	6	6	7	7	8	8	9	9	10	10	11	11	12	13	13	14	14	15
155					5	5	6	6	7	8	8	9	9	10	10	11	11	12	12	13	14	14	15
160					5	5	6	6	7	7	8	8	9	10	10	11	11	12	12	13	13	14	14
165					5	5	6	6	7	7	8	8	9	9	10	11	11	12	12	13	13	14	14
170					5	5	6	6	7	7	8	8	9	9	10	10	11	11	12	13	13	14	14
175					5	5	6	6	7	7	8	8	9	9	10	10	11	11	12	12	13	13	14
180					5	5	6	6	7	7	8	8	9	9	10	10	11	11	12	12	13	13	14
185					5	5	6	6	7	7	8	8	9	9	10	10	11	11	12	12	13	13	14
190					5	5	6	6	6	7	7	8	8	9	9	10	10	11	12	12	13	13	14
195					5	5	5	6	6	7	7	8	8	9	9	10	10	11	11	12	12	13	13
200					5	5	5	6	6	7	7	8	8	9	9	10	10	11	11	12	12	13	13

Years to Boring Height

Site Index	5	6	7	8	9	10	11	12-13	14-15	16-18	19-22	23-28	29-39	40+
Correct yrs	24	21	18	16	15	14	13	12	11	10	9	8	7	6

SiteTools Version 3.2m – Research Branch, British Columbia Ministry of Forests
Date: February 27, 2002
Site Index Equation: Thrower and Goudie (1992)

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Table of Site Index by Breast Height Age and Height
Species: Fdi – Interior Douglas-fir

Top Height (m) — Site Index (m)

28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	Age @ bh
																							10
																							15
																							20
47	49																						25
41	42	44	45	47	48	49																	30
36	37	39	40	41	43	44	45	46	48	49	50												35
33	34	35	36	37	39	40	41	42	43	44	46	47	48	49	50								40
30	31	32	33	34	35	37	38	39	40	41	42	43	44	45	46	47	48	49	50				45
28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	50
26	27	28	29	30	31	32	33	34	35	36	37	38	39	39	40	41	42	43	44	45	46	47	55
25	26	27	27	28	29	30	31	32	33	34	35	36	36	37	38	39	40	41	42	43	44	45	60
24	24	25	26	27	28	29	30	30	31	32	33	34	35	36	36	37	38	39	40	41	42	42	65
23	23	24	25	26	27	27	28	29	30	31	32	32	33	34	35	36	36	37	38	39	40	41	70
22	22	23	24	25	26	26	27	28	29	30	30	31	32	33	33	34	35	36	37	37	38	39	75
21	22	22	23	24	25	25	26	27	28	28	29	30	31	32	32	33	34	35	35	36	37	38	80
20	21	22	22	23	24	25	25	26	27	28	28	29	30	31	31	32	33	34	34	35	36	36	85
20	20	21	22	22	23	24	25	25	26	27	27	28	29	30	30	31	32	33	33	34	35	35	90
19	20	20	21	22	22	23	24	25	25	26	27	27	28	29	30	30	31	32	32	33	34	34	95
19	19	20	21	21	22	23	23	24	25	25	26	27	27	28	29	29	30	31	32	32	33	34	100
18	19	19	20	21	21	22	23	23	24	25	25	26	27	27	28	29	29	30	31	32	32	33	105
18	18	19	20	20	21	22	22	23	24	24	25	26	26	27	27	28	29	29	30	31	31	32	110
17	18	19	19	20	20	21	22	22	23	24	24	25	26	26	27	28	28	29	30	30	31	32	115
17	18	18	19	19	20	21	21	22	23	23	24	25	25	26	26	27	28	28	29	30	30	31	120
17	17	18	18	19	20	20	21	22	22	23	23	24	25	25	26	27	27	28	29	29	30	30	125
16	17	18	18	19	19	20	21	21	22	22	23	24	24	25	26	26	27	27	28	29	29	30	130
16	17	17	18	18	19	20	20	21	21	22	23	23	24	25	25	26	26	27	28	28	29	29	135
16	16	17	18	18	19	19	20	21	21	22	22	23	24	24	25	25	26	27	27	28	28	29	140
16	16	17	17	18	19	19	20	20	21	21	22	23	23	24	24	25	26	26	27	27	28	29	145
15	16	17	17	18	18	19	19	20	21	21	22	22	23	24	24	25	25	26	26	27	28	28	150
15	16	16	17	17	18	19	19	20	20	21	21	22	23	23	24	24	25	26	26	27	27	28	155
15	16	16	17	17	18	18	19	20	20	21	21	22	22	23	24	24	25	25	26	26	27	28	160
15	15	16	17	17	18	18	19	19	20	20	21	22	22	23	23	24	24	25	26	26	27	27	165
15	15	16	16	17	17	18	19	19	20	20	21	21	22	22	23	24	24	25	25	26	26	27	170
15	15	16	16	17	17	18	18	19	19	20	21	21	22	22	23	23	24	24	25	26	26	27	175
14	15	15	16	17	17	18	18	19	19	20	20	21	21	22	23	23	24	24	25	25	26	27	180
14	15	15	16	16	17	17	18	19	19	20	20	21	21	22	22	23	23	24	25	25	26	26	185
14	15	15	16	16	17	17	18	18	19	19	20	21	21	22	22	23	23	24	24	25	25	26	190
14	15	15	16	16	17	17	18	18	19	19	20	20	21	21	22	23	23	24	24	25	25	26	195
14	14	15	15	16	16	17	18	18	19	19	20	20	21	21	22	22	23	23	24	25	25	26	200

Years to Boring Height

Site Index	5	6	7	8	9	10	11	12-13	14-15	16-18	19-22	23-28	29-39	40+
Correct yrs	24	21	18	16	15	14	13	12	11	10	9	8	7	6

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Figure 7-46 Fdi – Interior Douglas-Fir

Table of Site Index by Breast Height Age and Height
Species: Hwi – Interior Western Hemlock

Age @ bh	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
	Site Index (m)																						
10	24	28	32	35	39	42	45	48															
15	16	19	22	25	27	30	32	34	36	39	41	43	45	46	48	50							
20	12	15	17	19	21	23	25	27	29	31	32	34	36	37	39	40	42	43	45	47	48	49	
25	10	12	14	16	17	19	21	22	24	25	27	28	30	31	33	34	36	37	38	40	41	42	44
30	8	10	12	13	15	16	18	19	20	22	23	25	26	27	28	30	31	32	33	35	36	37	38
35	7	9	10	11	13	14	15	17	18	19	20	22	23	24	25	26	28	29	30	31	32	33	35
40	6	7	9	10	11	12	14	15	16	17	18	19	20	22	23	24	25	26	27	28	29	30	31
45	6	7	8	9	10	11	12	13	14	15	16	18	19	20	21	22	23	24	25	26	27	28	29
50	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
55	5	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	20	21	22	23	24	25
60		5	6	7	8	8	9	10	11	12	13	14	15	15	16	17	18	19	20	21	22	23	24
65		5	5	6	7	8	9	9	10	11	12	13	14	14	15	16	17	18	19	20	21	22	23
70			5	6	7	7	8	9	10	10	11	12	13	14	14	15	16	17	18	19	20	21	21
75			5	5	6	7	7	8	9	10	10	11	12	13	14	14	15	16	17	18	19	20	20
80				5	6	6	7	8	8	9	10	11	11	12	13	14	15	15	16	17	18	19	20
85				5	5	6	7	7	8	9	9	10	11	12	12	13	14	15	15	16	17	18	19
90				5	5	6	6	7	8	8	9	10	10	11	12	12	13	14	15	16	16	17	18
95					5	5	6	7	7	8	8	9	10	10	11	12	13	13	14	15	16	17	17
100					5	5	6	6	7	7	8	9	9	10	11	11	12	13	14	14	15	16	17
105						5	5	6	7	7	8	8	9	10	10	11	12	12	13	14	15	15	16
110						5	5	6	6	7	7	8	9	9	10	11	11	12	13	13	14	15	16
115						5	5	5	6	7	7	8	8	9	10	10	11	12	12	13	14	14	15
120							5	5	6	6	7	7	8	9	9	10	10	11	12	13	13	14	15
125							5	5	6	6	7	7	8	8	9	9	10	11	11	12	13	14	14
130								5	5	6	6	7	7	8	9	9	10	10	11	12	13	13	14
135								5	5	6	6	7	7	8	8	9	9	10	11	11	12	13	14
140								5	5	5	6	6	7	7	8	9	9	10	11	11	12	13	13
145									5	5	6	6	7	7	8	8	9	10	10	11	12	12	13
150									5	5	6	6	6	7	8	8	9	9	10	11	11	12	13
155									5	5	5	6	6	7	7	8	8	9	10	10	11	12	12
160										5	5	6	6	7	7	8	8	9	9	10	11	11	12
165										5	5	6	6	6	7	7	8	9	9	10	11	11	12
170										5	5	5	6	6	7	7	8	8	9	10	10	11	12
175											5	5	6	6	7	7	8	8	9	9	10	11	11
180											5	5	6	6	6	7	7	8	9	9	10	11	11
185											5	5	5	6	6	7	7	8	8	9	10	10	11
190												5	5	6	6	7	7	8	8	9	9	10	11
195												5	5	6	6	6	7	7	8	9	9	10	11
200												5	5	5	6	6	7	7	8	8	9	10	10

Years to Boring Height

Site Index	5	6	7	8	9	10	11	12	13	14	15	16-17	18-19	20-21	22-24	25-29	30-37	38+
Correct yrs	45	34	28	23	19	17	14	13	11	10	9	8	7	6	5	4	3	2

SiteTools Version 3.2m – Research Branch, British Columbia Ministry of Forests
Date: March 11, 2002
Site Index Equation: Nigh (1998)

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Table of Site Index by Breast Height Age and Height
Species: Hwi – Interior Western Hemlock

28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	Age @ bh
Site Index (m)																							
																							10
																							15
																							20
45	46	47	49	50																			25
40	41	42	43	44	46	47	48	49	50														30
36	37	38	39	40	41	42	43	45	46	47	48	49	50										35
33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	50							40
30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	48	49	50				45
28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	50
26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	55
25	26	27	28	29	30	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	60
23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	41	42	43	44	65
22	23	24	25	26	27	28	29	30	31	32	33	33	34	35	36	37	38	39	40	41	42	43	70
21	22	23	24	25	26	27	28	29	30	30	31	32	33	34	35	36	37	38	39	40	41	42	75
20	21	22	23	24	25	26	27	28	29	29	30	31	32	33	34	35	36	37	38	39	40	41	80
20	20	21	22	23	24	25	26	27	28	29	29	30	31	32	33	34	35	36	37	38	39	40	85
19	20	21	21	22	23	24	25	26	27	28	29	30	30	31	32	33	34	35	36	37	38	39	90
18	19	20	21	22	22	23	24	25	26	27	28	29	30	31	32	32	33	34	35	36	37	38	95
18	18	19	20	21	22	23	24	24	25	26	27	28	29	30	31	32	33	34	35	36	36	37	100
17	18	19	20	20	21	22	23	24	25	26	27	27	28	29	30	31	32	33	34	35	36	37	105
17	17	18	19	20	21	22	22	23	24	25	26	27	28	29	30	31	31	32	33	34	35	36	110
16	17	18	18	19	20	21	22	23	24	25	25	26	27	28	29	30	31	32	33	34	35	36	115
16	16	17	18	19	20	21	21	22	23	24	25	26	27	28	29	29	30	31	32	33	34	35	120
15	16	17	18	18	19	20	21	22	23	24	24	25	26	27	28	29	30	31	32	33	34	35	125
15	16	16	17	18	19	20	21	21	22	23	24	25	26	27	28	29	30	30	31	32	33	34	130
14	15	16	17	18	18	19	20	21	22	23	24	25	25	26	27	28	29	30	31	32	33	34	135
14	15	16	16	17	18	19	20	21	22	22	23	24	25	26	27	28	29	30	31	32	33	33	140
14	15	15	16	17	18	19	19	20	21	22	23	24	25	26	27	27	28	29	30	31	32	33	145
13	14	15	16	17	17	18	19	20	21	22	23	24	24	25	26	27	28	29	30	31	32	33	150
13	14	15	16	16	17	18	19	20	21	21	22	23	24	25	26	27	28	29	30	31	32	32	155
13	14	14	15	16	17	18	19	19	20	21	22	23	24	25	26	27	27	28	29	30	31	32	160
13	13	14	15	16	17	17	18	19	20	21	22	23	24	24	25	26	27	28	29	30	31	32	165
12	13	14	15	15	16	17	18	19	20	21	21	22	23	24	25	26	27	28	29	30	31	32	170
12	13	14	14	15	16	17	18	19	19	20	21	22	23	24	25	26	27	28	29	30	30	31	175
12	13	13	14	15	16	17	17	18	19	20	21	22	23	24	25	26	26	27	28	29	30	31	180
12	12	13	14	15	16	16	17	18	19	20	21	22	23	23	24	25	26	27	28	29	30	31	185
11	12	13	14	15	15	16	17	18	19	20	21	21	22	23	24	25	26	27	28	29	30	31	190
11	12	13	14	14	15	16	17	18	19	19	20	21	22	23	24	25	26	27	28	29	30	31	195
11	12	13	13	14	15	16	17	18	18	19	20	21	22	23	24	25	26	27	28	29	29	30	200

Years to Boring Height

Site Index	5	6	7	8	9	10	11	12	13	14	15	16-17	18-19	20-21	22-24	25-29	30-37	38+
Correct yrs	45	34	28	23	19	17	14	13	11	10	9	8	7	6	5	4	3	2

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Figure 7-47 Hwi – Interior Western Hemlock

7.21.4. Provincial – Coast and Interior

Table of Site Index by Breast Height Age and Height
Species: Act – Black Cottonwood - Provincial

Age @ bh	Top Height (m) 6	7	8	9	10	11	12	13	14	15	16	17
	Site Index (m)											
10	24	27	29	31	33	35	37	39	41	43	44	46
15	18	20	22	24	26	28	29	31	33	34	35	37
20	14	16	18	20	21	23	24	26	27	29	30	31
25	12	13	15	17	18	20	21	22	24	25	26	27
30	10	11	13	14	16	17	18	20	21	22	23	24
35	9	10	11	13	14	15	16	17	19	20	21	22
40	7	9	10	11	12	13	15	16	17	18	19	20
45	7	8	9	10	11	12	13	14	15	16	17	18
50	6	7	8	9	10	11	12	13	14	15	16	17
55	5	6	7	8	9	10	11	12	13	14	15	16
60	5	6	7	8	8	9	10	11	12	13	14	15
65	5	5	6	7	8	9	9	10	11	12	13	14
70		5	6	6	7	8	9	9	10	11	12	13
75		5	5	6	7	7	8	9	10	10	11	12
80			5	6	6	7	8	8	9	10	10	11
85			5	5	6	6	7	8	8	9	10	11
90				5	6	6	7	7	8	9	9	10
95				5	5	6	6	7	7	8	9	9
100				5	5	5	6	7	7	8	8	9
105					5	5	6	6	7	7	8	8
110					5	5	5	6	6	7	7	8
115						5	5	6	6	7	7	8
120						5	5	5	6	6	7	7
125							5	5	6	6	6	7
130							5	5	5	6	6	7
135								5	5	6	6	6
140								5	5	5	6	6
145									5	5	5	6
150									5	5	5	6
155										5	5	5
160										5	5	5
165											5	5
170											5	5
175												5
180												5
185												5
190												
195												
200												

Years to Boring Height

Site Index (m)	All S.I.'s
Correct yrs	2

SiteTools Version 3.2m – Research Branch, British Columbia Ministry of Forests
Date: February 27, 2002
Site Index Equation: Thrower (1992)

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Table of Site Index by Breast Height Age and Height
Species: Act – Black Cottonwood - Provincial

Top Height (m) 18	19	20	21	22	23	24	25	26	27	28	Age @ bh
Site Index (m)											
47	49	50	52	53	55	56	57	59	60	61	10
38	40	41	42	43	45	46	47	48	49	51	15
33	34	35	36	37	39	40	41	42	43	44	20
29	30	31	32	33	34	35	37	38	39	40	25
26	27	28	29	30	31	32	33	34	35	36	30
23	24	25	26	27	29	30	31	32	33	34	35
21	22	23	24	25	26	27	28	29	30	31	40
19	21	22	23	24	25	26	27	28	29	30	45
18	19	20	21	22	23	24	25	26	27	28	50
17	18	19	20	21	22	23	24	25	26	27	55
16	17	17	18	19	20	21	22	23	24	25	60
15	15	16	17	18	19	20	21	22	23	24	65
14	14	15	16	17	18	19	20	21	22	23	70
13	14	14	15	16	17	18	19	20	21	22	75
12	13	14	15	15	16	17	18	19	20	21	80
11	12	13	14	15	16	16	17	18	19	20	85
11	11	12	13	14	15	16	17	18	19	20	90
10	11	12	12	13	14	15	16	17	18	19	95
10	10	11	12	13	13	14	15	16	17	18	100
9	10	10	11	12	13	14	15	15	16	17	105
9	9	10	11	11	12	13	14	15	16	17	110
8	9	9	10	11	12	12	13	14	15	16	115
8	8	9	10	10	11	12	13	14	15	16	120
7	8	9	9	10	11	11	12	13	14	15	125
7	8	8	9	9	10	11	12	13	14	14	130
7	7	8	8	9	10	10	11	12	13	14	135
7	7	8	8	9	9	10	11	12	12	13	140
6	7	7	8	8	9	10	10	11	12	13	145
6	6	7	7	8	9	9	10	11	12	12	150
6	6	7	7	8	8	9	10	10	11	12	155
6	6	6	7	7	8	8	9	10	11	12	160
5	6	6	7	7	8	8	9	9	10	11	165
5	6	6	6	7	7	8	8	9	10	11	170
5	5	6	6	7	7	8	8	9	9	10	175
5	5	6	6	6	7	7	8	8	9	10	180
5	5	5	6	6	7	7	8	8	9	10	185
5	5	5	6	6	6	7	7	8	8	9	190
5	5	5	5	6	6	7	7	8	8	9	195
	5	5	5	6	6	6	7	7	8	9	200

Years to Boring Height

Site Index (m)	All S.I.'s
Correct yrs	2

Page 2

Table of Site Index by Breast Height Age and Height
Species: Act – Black Cottonwood - Provincial

Age @ bh	29	30	31	32	33	34	35	36	37	38	39
						Site Index (m)					
10	62	64	65	66	67	68	70	71	72	73	74
15	52	53	54	55	56	57	58	59	61	62	63
20	45	46	47	48	50	51	52	53	54	55	56
25	41	42	43	44	45	46	47	48	49	50	51
30	37	38	39	40	41	42	43	44	45	46	47
35	35	36	37	38	39	40	41	42	43	44	45
40	32	33	35	36	37	37	38	39	40	41	42
45	31	32	33	34	35	36	37	38	39	40	41
50	29	30	31	32	33	34	35	36	37	38	39
55	28	29	30	31	32	33	34	35	36	37	38
60	26	27	28	29	30	31	32	33	34	35	36
65	25	26	27	28	29	30	31	32	33	34	35
70	24	25	26	27	28	29	30	31	32	33	34
75	23	24	25	26	27	28	29	30	31	32	34
80	22	23	24	25	26	27	28	30	31	32	33
85	21	22	23	25	26	27	28	29	30	31	32
90	21	22	23	24	25	26	27	28	29	30	31
95	20	21	22	23	24	25	26	27	28	30	31
100	19	20	21	22	23	25	26	27	28	29	30
105	19	20	21	22	23	24	25	26	27	28	30
110	18	19	20	21	22	23	24	26	27	28	29
115	17	18	19	21	22	23	24	25	26	27	29
120	17	18	19	20	21	22	23	25	26	27	28
125	16	17	18	19	21	22	23	24	25	26	28
130	16	17	18	19	20	21	22	24	25	26	27
135	15	16	17	18	20	21	22	23	24	26	27
140	14	16	17	18	19	20	22	23	24	25	26
145	14	15	16	17	19	20	21	22	24	25	26
150	13	15	16	17	18	19	21	22	23	24	26
155	13	14	15	16	18	19	20	22	23	24	25
160	12	14	15	16	17	18	20	21	22	24	25
165	12	13	14	15	17	18	19	21	22	23	25
170	12	13	14	15	16	18	19	20	22	23	24
175	11	12	13	15	16	17	19	20	21	23	24
180	11	12	13	14	15	17	18	20	21	22	24
185	10	11	12	14	15	16	18	19	21	22	24
190	10	11	12	13	15	16	17	19	20	22	23
195	10	11	12	13	14	16	17	19	20	22	23
200	9	10	11	12	14	15	17	18	20	21	23

Years to Boring Height

Site Index (m)	All S.I.'s
Correct yrs	2

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Table of Site Index by Breast Height Age and Height
Species: Act – Black Cottonwood - Provincial

40	41	42	43	44	45	46	47	48	49	50	Age @ bh
					Site Index (m)						
75	76	78	79	80	81	82	83	84	85	86	10
64	65	66	67	68	69	70	71	72	73	74	15
57	58	59	60	61	62	63	64	65	66	67	20
52	53	54	55	56	57	58	59	60	61	62	25
48	49	50	51	52	53	54	55	56	57	58	30
46	47	48	49	50	51	52	53	54	55	55	35
43	44	45	46	47	48	49	50	51	52	53	40
42	43	44	45	46	47	48	49	50	51	52	45
40	41	42	43	44	45	46	47	48	49	50	50
39	40	41	42	43	44	45	46	47	48	49	55
37	38	39	40	42	43	44	45	46	47	48	60
36	37	38	39	40	42	43	44	45	46	47	65
35	36	37	39	40	41	42	43	44	45	46	70
35	36	37	38	39	40	41	42	43	44	45	75
34	35	36	37	38	39	40	41	42	43	44	80
33	34	35	36	37	38	39	41	42	43	44	85
32	33	35	36	37	38	39	40	41	42	43	90
32	33	34	35	36	37	38	39	41	42	43	95
31	32	33	35	36	37	38	39	40	41	42	100
31	32	33	34	35	36	37	38	40	41	42	105
30	31	32	34	35	36	37	38	39	40	41	110
30	31	32	33	34	35	37	38	39	40	41	115
29	30	32	33	34	35	36	37	38	40	41	120
29	30	31	32	34	35	36	37	38	39	40	125
28	30	31	32	33	34	36	37	38	39	40	130
28	29	30	32	33	34	35	36	38	39	40	135
28	29	30	31	33	34	35	36	37	38	40	140
27	29	30	31	32	33	35	36	37	38	39	145
27	28	29	31	32	33	34	36	37	38	39	150
27	28	29	30	32	33	34	35	37	38	39	155
26	28	29	30	31	33	34	35	36	38	39	160
26	27	29	30	31	32	34	35	36	37	39	165
26	27	28	30	31	32	33	35	36	37	38	170
26	27	28	29	31	32	33	35	36	37	38	175
25	27	28	29	31	32	33	34	36	37	38	180
25	26	28	29	30	32	33	34	35	37	38	185
25	26	27	29	30	31	33	34	35	37	38	190
24	26	27	29	30	31	33	34	35	36	38	195
24	26	27	28	30	31	32	34	35	36	37	200

Years to Boring Height

Site Index (m)	All S.I.'s
Correct yrs	2

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Figure 7-48 Act – Black Cottonwood – Provincial

Table of Site Index by Breast Height Age and Height
Species: At & E – Trembling Aspen and Birch – Provincial

Age @ bh	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
	Site Index (m)																						
10	18	22	25	29	32	35	38	41	44	46	49												
15	13	16	18	20	23	25	27	29	31	34	36	38	40	42	43	45	47	49					
20	10	12	14	16	18	20	22	23	25	27	29	30	32	33	35	37	38	40	41	43	45	46	48
25	8	10	12	13	15	17	18	20	21	23	24	26	27	28	30	31	33	34	36	37	38	40	41
30	7	9	10	12	13	14	16	17	19	20	21	22	24	25	26	28	29	30	31	33	34	35	36
35	6	8	9	10	12	13	14	15	17	18	19	20	21	23	24	25	26	27	28	30	31	32	33
40	6	7	8	9	11	12	13	14	15	16	17	18	20	21	22	23	24	25	26	27	28	30	31
45	5	6	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	27	28	29
50	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
55	5	6	7	8	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
60		5	6	7	8	9	10	11	12	12	13	14	15	16	17	18	19	20	21	22	23	24	25
65		5	6	7	8	8	9	10	11	12	13	14	15	15	16	17	18	19	20	21	22	23	24
70		5	6	6	7	8	9	10	11	11	12	13	14	15	16	17	17	18	19	20	21	22	23
75		5	5	6	7	8	9	9	10	11	12	13	13	14	15	16	17	18	19	19	20	21	22
80			5	6	7	7	8	9	10	11	11	12	13	14	15	16	16	17	18	19	20	21	21
85			5	6	6	7	8	9	9	10	11	12	13	13	14	15	16	17	18	18	19	20	21
90			5	5	6	7	8	8	9	10	11	11	12	13	14	15	15	16	17	18	19	20	20
95			5	5	6	7	7	8	9	10	10	11	12	13	14	14	15	16	17	18	18	19	20
100			5	5	6	7	7	8	9	9	10	11	12	12	13	14	15	16	16	17	18	19	20
105				5	6	6	7	8	8	9	10	11	11	12	13	14	14	15	16	17	18	18	19
110				5	6	6	7	8	8	9	10	10	11	12	13	13	14	15	16	17	17	18	19
115				5	5	6	7	7	8	9	9	10	11	12	12	13	14	15	15	16	17	18	19
120				5	5	6	7	7	8	9	9	10	11	11	12	13	14	14	15	16	17	18	18
125				5	5	6	6	7	8	8	9	10	11	11	12	13	14	14	15	16	17	17	18
130					5	6	6	7	8	8	9	10	10	11	12	13	13	14	15	16	16	17	18
135					5	6	6	7	8	8	9	10	10	11	12	12	13	14	15	15	16	17	18
140					5	5	6	7	7	8	9	9	10	11	12	12	13	14	14	15	16	17	17
145					5	5	6	7	7	8	9	9	10	11	11	12	13	14	14	15	16	17	17
150					5	5	6	7	7	8	8	9	10	11	11	12	13	13	14	15	16	16	17
155					5	5	6	6	7	8	8	9	10	10	11	12	13	13	14	15	15	16	17
160					5	5	6	6	7	8	8	9	10	10	11	12	12	13	14	15	15	16	17
165					5	5	6	6	7	8	8	9	9	10	11	12	12	13	14	14	15	16	17
170						5	6	6	7	7	8	9	9	10	11	11	12	13	14	14	15	16	17
175						5	6	6	7	7	8	9	9	10	11	11	12	13	13	14	15	16	16
180						5	5	6	7	7	8	9	9	10	11	11	12	13	13	14	15	16	16
185						5	5	6	7	7	8	8	9	10	10	11	12	13	13	14	15	15	16
190						5	5	6	7	7	8	8	9	10	10	11	12	12	13	14	15	15	16
195						5	5	6	6	7	8	8	9	10	10	11	12	12	13	14	15	15	16
200						5	5	6	6	7	8	8	9	10	10	11	12	12	13	14	14	15	16

Top Height (m)

Years to Boring Height

Site Index	5	6	7	8-9	10-12	13-17	18-32	33+
Correct yrs	9	8	7	6	5	4	3	2

SiteTools Version 3.2m – Research Branch, British Columbia Ministry of Forests
Date: March 11, 2002
Site Index Equation: Alberta Forest Service (1985)

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Table of Site Index by Breast Height Age and Height
Species: At & E – Trembling Aspen & Birch – Provincial

28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	Age @ bh
Site Index (m)																							
																							10
																							15
49																							20
42	44	45	46	48	49	50																	25
38	39	40	41	43	44	45	46	47	49	50													30
34	35	37	38	39	40	41	42	43	45	46	47	48	49	50									35
32	33	34	35	36	37	38	39	40	41	43	44	45	46	47	48	49	50						40
30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50			45
28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	50
27	28	29	30	31	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	55
26	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	44	45	46	60
25	25	26	27	28	29	30	31	32	33	34	35	36	37	38	38	39	40	41	42	43	44	45	65
24	25	26	26	27	28	29	30	31	32	33	34	35	36	36	37	38	39	40	41	42	43	44	70
23	24	25	26	27	27	28	29	30	31	32	33	34	35	35	36	37	38	39	40	41	42	43	75
22	23	24	25	26	27	28	28	29	30	31	32	33	34	35	36	36	37	38	39	40	41	42	80
22	23	23	24	25	26	27	28	29	30	30	31	32	33	34	35	36	37	38	38	39	40	41	85
21	22	23	24	25	26	26	27	28	29	30	31	32	32	33	34	35	36	37	38	39	40	40	90
21	22	23	23	24	25	26	27	28	28	29	30	31	32	33	34	35	35	36	37	38	39	40	95
20	21	22	23	24	25	25	26	27	28	29	30	31	31	32	33	34	35	36	37	37	38	39	100
20	21	22	23	23	24	25	26	27	28	28	29	30	31	32	33	33	34	35	36	37	38	39	105
20	21	21	22	23	24	25	25	26	27	28	29	30	31	31	32	33	34	35	36	36	37	38	110
19	20	21	22	23	23	24	25	26	27	28	28	29	30	31	32	33	34	34	35	36	37	38	115
19	20	21	22	22	23	24	25	26	26	27	28	29	30	31	31	32	33	34	35	36	37	37	120
19	20	20	21	22	23	24	25	25	26	27	28	29	29	30	31	32	33	34	35	35	36	37	125
19	19	20	21	22	23	23	24	25	26	27	28	28	29	30	31	32	33	33	34	35	36	37	130
18	19	20	21	22	22	23	24	25	26	26	27	28	29	30	31	31	32	33	34	35	36	36	135
18	19	20	21	21	22	23	24	25	25	26	27	28	29	29	30	31	32	33	34	34	35	36	140
18	19	20	20	21	22	23	24	24	25	26	27	28	28	29	30	31	32	33	33	34	35	36	145
18	19	19	20	21	22	23	23	24	25	26	27	27	28	29	30	31	32	32	33	34	35	36	150
18	18	19	20	21	22	22	23	24	25	26	26	27	28	29	30	30	31	32	33	34	35	35	155
18	18	19	20	21	21	22	23	24	25	25	26	27	28	29	29	30	31	32	33	34	34	35	160
17	18	19	20	21	21	22	23	24	24	25	26	27	28	28	29	30	31	32	33	33	34	35	165
17	18	19	20	20	21	22	23	23	24	25	26	27	27	28	29	30	31	32	32	33	34	35	170
17	18	19	19	20	21	22	23	23	24	25	26	27	27	28	29	30	31	31	32	33	34	35	175
17	18	19	19	20	21	22	22	23	24	25	26	26	27	28	29	30	30	31	32	33	34	35	180
17	18	18	19	20	21	22	22	23	24	25	25	26	27	28	29	29	30	31	32	33	34	34	185
17	18	18	19	20	21	21	22	23	24	25	25	26	27	28	29	29	30	31	32	33	33	34	190
17	17	18	19	20	21	21	22	23	24	24	25	26	27	28	28	29	30	31	32	32	33	34	195
17	17	18	19	20	20	21	22	23	24	24	25	26	27	27	28	29	30	31	32	32	33	34	200

Top Height (m)

Years to Boring Height

Site Index	5	6	7	8-9	10-12	13-17	18-32	33+
Correct yrs	9	8	7	6	5	4	3	2

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Figure 7-49 At - Trembling Aspen – Provincial

Table of Site Index by Breast Height Age and Height
Species: Ba – Amabilis fir – All Balsam Species - Provincial

Age @ bh	5	6	7	8	9	10	11	12	13	14	15	16	17	18
	Top Height (m) / Site Index (m)													
10	21	24	27	31	33	36	38	41						
15	14	17	20	22	25	27	29	31	33	35	37			
20	11	13	15	18	19	21	23	25	27	29	30	32	33	35
25	9	11	13	15	16	18	20	21	23	24	26	27	29	30
30	8	9	11	13	14	15	17	18	20	21	22	24	25	26
35	7	8	10	11	12	14	15	16	17	19	20	21	22	24
40	6	8	9	10	11	12	13	15	16	17	18	19	20	21
45	6	7	8	9	10	11	12	13	14	15	17	18	19	20
50	5	6	7	8	9	10	11	12	13	14	15	16	17	18
55	5	6	7	7	8	9	10	11	12	13	14	15	16	17
60		5	6	7	8	9	10	10	11	12	13	14	15	16
65		5	6	7	7	8	9	10	11	12	12	13	14	15
70		5	6	6	7	8	9	9	10	11	12	13	13	14
75		5	5	6	7	7	8	9	10	10	11	12	13	13
80			5	6	6	7	8	9	9	10	11	11	12	13
85			5	6	6	7	8	8	9	10	10	11	12	12
90			5	5	6	7	7	8	9	9	10	11	11	12
95			5	5	6	6	7	8	8	9	9	10	11	11
100				5	6	6	7	7	8	9	9	10	10	11
105				5	5	6	7	7	8	8	9	9	10	11
110				5	5	6	6	7	7	8	9	9	10	10
115				5	5	6	6	7	7	8	8	9	10	10
120				5	5	6	6	7	7	8	8	9	9	10
125					5	5	6	6	7	7	8	8	9	10
130					5	5	6	6	7	7	8	8	9	9
135					5	5	6	6	7	7	8	8	9	9
140					5	5	6	6	6	7	7	8	8	9
145					5	5	5	6	6	7	7	8	8	9
150						5	5	6	6	7	7	8	8	9
155						5	5	6	6	7	7	7	8	8
160						5	5	6	6	6	7	7	8	8
165						5	5	5	6	6	7	7	8	8
170						5	5	5	6	6	7	7	8	8
175						5	5	5	6	6	7	7	7	8
180							5	5	6	6	6	7	7	8
185							5	5	6	6	6	7	7	8
190							5	5	5	6	6	7	7	7
195							5	5	5	6	6	7	7	7
200							5	5	5	6	6	6	7	7

Years to Boring Height

Site Index	5-7	8-9	10-12	13-14	15-17	18-19	20-21	22-24	25-26	27-29	30-31	32+
Correct yrs	16	15	14	13	12	11	10	9	8	7	6	5

SiteTools Version 3.2m – Research Branch, British Columbia Ministry of Forests
Date: February 27, 2002
Site Index Equation: Kurucz (1992)

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Table of Site Index by Breast Height Age and Height
Species: Ba – Amabilis fir – All Balsam Species - Provincial

19	20	21	22	23	24	25	26	27	28	29	30	31	32	Age @ bh
Top Height (m) / Site Index (m)														
														10
														15
36														20
31	33	34												25
28	29	30	32	33	34									30
25	26	27	28	30	31	32	33	34						35
23	24	25	26	27	28	29	30	31	32	34				40
21	22	23	24	25	26	27	28	29	30	31	32	33		45
19	20	21	22	23	24	25	26	27	28	29	30	31	32	50
18	19	20	21	22	22	23	24	25	26	27	28	29	30	55
17	18	18	19	20	21	22	23	24	25	26	27	28	29	60
16	17	17	18	19	20	21	22	23	24	24	25	26	27	65
15	16	17	17	18	19	20	21	22	22	23	24	25	26	70
14	15	16	17	17	18	19	20	21	21	22	23	24	25	75
14	14	15	16	17	17	18	19	20	21	21	22	23	24	80
13	14	14	15	16	17	17	18	19	20	21	21	22	23	85
13	13	14	15	15	16	17	18	18	19	20	21	21	22	90
12	13	13	14	15	16	16	17	18	18	19	20	21	21	95
12	12	13	14	14	15	16	16	17	18	18	19	20	21	100
11	12	13	13	14	15	15	16	17	17	18	19	19	20	105
11	12	12	13	13	14	15	15	16	17	17	18	19	19	110
11	11	12	12	13	14	14	15	16	16	17	18	18	19	115
10	11	12	12	13	13	14	15	15	16	16	17	18	18	120
10	11	11	12	12	13	14	14	15	15	16	17	17	18	125
10	10	11	12	12	13	13	14	14	15	16	16	17	18	130
10	10	11	11	12	12	13	14	14	15	15	16	17	17	135
9	10	10	11	12	12	13	13	14	14	15	16	16	17	140
9	10	10	11	11	12	12	13	14	14	15	15	16	16	145
9	10	10	11	11	12	12	13	13	14	14	15	16	16	150
9	9	10	10	11	11	12	12	13	14	14	15	15	16	155
9	9	10	10	11	11	12	12	13	13	14	14	15	16	160
9	9	9	10	10	11	11	12	13	13	14	14	15	15	165
8	9	9	10	10	11	11	12	12	13	13	14	14	15	170
8	9	9	10	10	11	11	12	12	13	13	14	14	15	175
8	9	9	9	10	10	11	11	12	12	13	13	14	15	180
8	8	9	9	10	10	11	11	12	12	13	13	14	14	185
8	8	9	9	10	10	11	11	12	12	13	13	14	14	190
8	8	9	9	10	10	10	11	11	12	12	13	13	14	195
8	8	9	9	9	10	10	11	11	12	12	13	13	14	200

Years to Boring Height

Site Index	5-7	8-9	10-12	13-14	15-17	18-19	20-21	22-24	25-26	27-29	30-31	32+
Correct yrs	16	15	14	13	12	11	10	9	8	7	6	5

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Table of Site Index by Breast Height Age and Height
Species: Ba – Amabilis fir – All Balsam Species - Provincial

Age @ bh	Top Height (m) 33	34	35	36	37	38	39	40	41	42	43	44	45	46
	Site Index (m)													
10														
15														
20														
25														
30														
35														
40														
45														
50	33													
55	31	32	33											
60	30	30	31	32										
65	28	29	30	31	32	33								
70	27	28	29	29	30	31	32							
75	26	27	27	28	29	30	31	32						
80	25	25	26	27	28	29	30	31	32	32				
85	24	25	25	26	27	28	29	30	30	31	32			
90	23	24	24	25	26	27	28	29	29	30	31	32		
95	22	23	24	24	25	26	27	28	29	29	30	31	32	
100	21	22	23	24	25	25	26	27	28	29	29	30	31	32
105	21	22	22	23	24	25	25	26	27	28	29	29	30	31
110	20	21	22	22	23	24	25	25	26	27	28	29	30	30
115	20	20	21	22	23	23	24	25	26	26	27	28	29	30
120	19	20	21	21	22	23	23	24	25	26	27	27	28	29
125	19	19	20	21	21	22	23	24	24	25	26	27	27	28
130	18	19	20	20	21	22	22	23	24	25	25	26	27	28
135	18	18	19	20	20	21	22	23	23	24	25	26	26	27
140	17	18	19	19	20	21	21	22	23	24	24	25	26	27
145	17	18	18	19	20	20	21	22	22	23	24	25	25	26
150	17	17	18	19	19	20	21	21	22	23	23	24	25	26
155	16	17	18	18	19	20	20	21	22	22	23	24	24	25
160	16	17	17	18	19	19	20	21	21	22	23	23	24	25
165	16	16	17	18	18	19	20	20	21	21	22	23	24	24
170	16	16	17	17	18	19	19	20	20	21	22	23	23	24
175	15	16	16	17	18	18	19	20	20	21	21	22	23	24
180	15	16	16	17	17	18	19	19	20	21	21	22	23	23
185	15	15	16	17	17	18	18	19	20	20	21	22	22	23
190	15	15	16	16	17	17	18	19	19	20	21	21	22	23
195	14	15	15	16	17	17	18	18	19	20	20	21	22	22
200	14	15	15	16	16	17	18	18	19	19	20	21	21	22

Years to Boring Height

Site Index	5-7	8-9	10-12	13-14	15-17	18-19	20-21	22-24	25-26	27-29	30-31	32+
Correct yrs	16	15	14	13	12	11	10	9	8	7	6	5

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Table of Site Index by Breast Height Age and Height
Species: Ba – Amabilis fir – All Balsam Species - Provincial

Top Height (m) 47	48	49	50	51	52	53	54	55	56	57	58	59	60	Age @ bh
Site Index (m)														
														10
														15
														20
														25
														30
														35
														40
														45
														50
														55
														60
														65
														70
														75
														80
														85
														90
														95
														100
32														105
31	32													110
30	31	32												115
30	31	31	32											120
29	30	31	32											125
29	29	30	31	32										130
28	29	30	30	31										135
27	28	29	30	31	32									140
27	28	28	29	30	31	32								145
26	27	28	29	30	30	31								150
26	27	27	28	29	30	31	32							155
26	26	27	28	29	29	30	31							160
25	26	27	27	28	29	30	31	32						165
25	25	26	27	28	29	29	30	31						170
24	25	26	27	27	28	29	30	31	32					175
24	25	25	26	27	28	29	29	30	31					180
24	24	25	26	27	27	28	29	30	31	32				185
23	24	25	25	26	27	28	29	30	30	31				190
23	24	24	25	26	27	27	28	29	30	31	32			195
23	23	24	25	26	26	27	28	29	30	30	31	32	33	200

Years to Boring Height

Site Index	5-7	8-9	10-12	13-14	15-17	18-19	20-21	22-24	25-26	27-29	30-31	32+
Correct yrs	16	15	14	13	12	11	10	9	8	7	6	5

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Figure 7-50 Ba – Amabilis Fir – All Balsam Species – Provincial

Table of Site Index by Breast Height Age and Height
Species: Cw – Western Redcedar - Provincial

Age @ bh	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
	Top Height (m) / Site Index (m)																
10	22	26	29	32	36	39	41	44	47	49	52	54	56	58			
15	15	18	21	23	26	28	31	33	35	38	40	42	44	46	48	50	52
20	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40	41	43
25	10	12	13	15	17	19	20	22	24	25	27	29	30	32	33	35	37
30	9	10	12	13	15	16	18	19	20	22	23	25	26	28	29	31	32
35	8	9	10	12	13	14	16	17	18	19	21	22	23	25	26	27	28
40	7	8	9	11	12	13	14	15	16	18	19	20	21	22	23	25	26
45	6	7	9	10	11	12	13	14	15	16	17	18	19	20	22	23	24
50	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
55	6	7	8	8	9	10	11	12	13	14	15	16	17	18	19	20	21
60	5	6	7	8	9	10	11	12	12	13	14	15	16	17	18	19	20
65	5	6	7	8	9	9	10	11	12	13	14	14	15	16	17	18	19
70	5	6	7	7	8	9	10	11	11	12	13	14	15	15	16	17	18
75	5	6	6	7	8	9	9	10	11	12	12	13	14	15	15	16	17
80	5	5	6	7	8	8	9	10	11	11	12	13	13	14	15	16	16
85	5	5	6	7	7	8	9	9	10	11	12	12	13	14	14	15	16
90		5	6	6	7	8	9	9	10	11	11	12	13	13	14	15	15
95		5	6	6	7	8	8	9	10	10	11	12	12	13	14	14	15
100		5	6	6	7	7	8	9	9	10	11	11	12	13	13	14	15
105		5	5	6	7	7	8	9	9	10	10	11	12	12	13	14	14
110		5	5	6	7	7	8	8	9	10	10	11	11	12	13	13	14
115		5	5	6	6	7	8	8	9	9	10	11	11	12	12	13	14
120		5	5	6	6	7	7	8	9	9	10	10	11	12	12	13	13
125		5	5	6	6	7	7	8	8	9	10	10	11	11	12	13	13
130			5	6	6	7	7	8	8	9	9	10	11	11	12	12	13
135			5	5	6	7	7	8	8	9	9	10	10	11	12	12	13
140			5	5	6	7	7	8	8	9	9	10	10	11	11	12	13
145			5	5	6	6	7	7	8	9	9	10	10	11	11	12	12
150			5	5	6	6	7	7	8	8	9	10	10	11	11	12	12
155			5	5	6	6	7	7	8	8	9	9	10	10	11	12	12
160			5	5	6	6	7	7	8	8	9	9	10	10	11	11	12
165			5	5	6	6	7	7	8	8	9	9	10	10	11	11	12
170			5	5	6	6	7	7	8	8	9	9	10	10	11	11	12
175			5	5	6	6	7	7	8	8	9	9	10	10	11	11	12
180			5	5	6	6	6	7	7	8	8	9	9	10	10	11	11
185			5	5	5	6	6	7	7	8	8	9	9	10	10	11	11
190				5	5	6	6	7	7	8	8	9	9	10	10	11	11
195				5	5	6	6	7	7	8	8	9	9	10	10	11	11
200				5	5	6	6	7	7	8	8	9	9	10	10	11	11

Years to Boring Height

Site Index	5-10	11-16	17-22	23-28	29-35	36-41	42-47	48+
Correct yrs	12	11	10	9	8	7	6	5

SiteTools Version 3.2m – Research Branch, British Columbia Ministry of Forests
Date: February 27, 2002
Site Index Equation: Kurucz (1985)

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Table of Site Index by Breast Height Age and Height
Species: Cw – Western Redcedar - Provincial

23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	Age @ bh
Top Height (m) / Site Index (m)																
																10
54	56															15
45	47	48	50	52	53	55										20
38	40	41	43	44	46	47	49	50	52	53						25
33	35	36	38	39	40	42	43	44	46	47	48	50	51	52		30
30	31	32	34	35	36	37	39	40	41	42	44	45	46	47	48	35
27	28	29	30	32	33	34	35	36	37	39	40	41	42	43	44	40
25	26	27	28	29	30	31	32	33	34	35	37	38	39	40	41	45
23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	50
22	23	23	24	25	26	27	28	29	30	31	32	33	34	35	36	55
20	21	22	23	24	25	26	27	28	28	29	30	31	32	33	34	60
19	20	21	22	23	24	25	25	26	27	28	29	30	30	31	32	65
19	19	20	21	22	23	23	24	25	26	27	28	28	29	30	31	70
18	19	19	20	21	22	22	23	24	25	26	26	27	28	29	30	75
17	18	19	19	20	21	22	22	23	24	25	25	26	27	28	29	80
17	17	18	19	19	20	21	22	22	23	24	25	25	26	27	28	85
16	17	17	18	19	20	20	21	22	22	23	24	25	25	26	27	90
16	16	17	18	18	19	20	20	21	22	22	23	24	25	25	26	95
15	16	17	17	18	19	19	20	21	21	22	23	23	24	25	25	100
15	16	16	17	17	18	19	19	20	21	21	22	23	23	24	25	105
15	15	16	16	17	18	18	19	20	20	21	22	22	23	23	24	110
14	15	15	16	17	17	18	19	19	20	20	21	22	22	23	24	115
14	15	15	16	16	17	18	18	19	19	20	21	21	22	23	23	120
14	14	15	16	16	17	17	18	19	19	20	20	21	22	22	23	125
14	14	15	15	16	16	17	18	18	19	19	20	21	21	22	22	130
13	14	14	15	16	16	17	17	18	18	19	20	20	21	21	22	135
13	14	14	15	15	16	17	17	18	18	19	19	20	21	21	22	140
13	13	14	15	15	16	16	17	17	18	19	19	20	20	21	21	145
13	13	14	14	15	16	16	17	17	18	18	19	19	20	21	21	150
13	13	14	14	15	15	16	16	17	18	18	19	19	20	20	21	155
12	13	14	14	15	15	16	16	17	17	18	18	19	20	20	21	160
12	13	13	14	14	15	16	16	17	17	18	18	19	19	20	20	165
12	13	13	14	14	15	15	16	16	17	17	18	19	19	20	20	170
12	13	13	14	14	15	15	16	16	17	17	18	18	19	19	20	175
12	12	13	14	14	15	15	16	16	17	17	18	18	19	19	20	180
12	12	13	13	14	14	15	15	16	16	17	18	18	19	19	20	185
12	12	13	13	14	14	15	15	16	16	17	17	18	18	19	19	190
12	12	13	13	14	14	15	15	16	16	17	17	18	18	19	19	195
12	12	13	13	14	14	15	15	16	16	17	17	18	18	19	19	200

Years to Boring Height

Site Index	5-10	11-16	17-22	23-28	29-35	36-41	42-47	48+
Correct yrs	12	11	10	9	8	7	6	5

Page 2

Table of Site Index by Breast Height Age and Height
Species: Cw – Western Redcedar - Provincial

Age @ bh	Top Height (m) 39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54
	Site Index (m)															
10																
15																
20																
25																
30																
35	50	51														
40	45	46	48	49	50	51										
45	42	43	44	45	46	47	48	49	50							
50	39	40	41	42	43	44	45	46	47	48	49	50				
55	37	38	39	40	40	41	42	43	44	45	46	47	48	49	50	
60	35	36	37	37	38	39	40	41	42	43	44	45	46	47	47	48
65	33	34	35	36	37	37	38	39	40	41	42	43	44	44	45	46
70	32	32	33	34	35	36	37	37	38	39	40	41	42	43	43	44
75	30	31	32	33	34	34	35	36	37	38	38	39	40	41	42	42
80	29	30	31	32	32	33	34	35	35	36	37	38	39	39	40	41
85	28	29	30	31	31	32	33	34	34	35	36	37	37	38	39	40
90	27	28	29	30	30	31	32	33	33	34	35	36	36	37	38	38
95	27	27	28	29	30	30	31	32	32	33	34	35	35	36	37	37
100	26	27	27	28	29	29	30	31	32	32	33	34	34	35	36	36
105	25	26	27	27	28	29	29	30	31	31	32	33	34	34	35	36
110	25	25	26	27	27	28	29	29	30	31	31	32	33	33	34	35
115	24	25	26	26	27	28	28	29	29	30	31	31	32	33	33	34
120	24	24	25	26	26	27	28	28	29	30	30	31	31	32	33	33
125	23	24	25	25	26	26	27	28	28	29	30	30	31	32	32	33
130	23	24	24	25	25	26	27	27	28	29	29	30	30	31	32	32
135	23	23	24	24	25	26	26	27	27	28	29	29	30	31	31	32
140	22	23	23	24	25	25	26	26	27	28	28	29	29	30	31	31
145	22	23	23	24	24	25	25	26	27	27	28	28	29	30	30	31
150	22	22	23	23	24	25	25	26	26	27	28	28	29	29	30	30
155	21	22	23	23	24	24	25	25	26	27	27	28	28	29	30	30
160	21	22	22	23	23	24	25	25	26	26	27	27	28	29	29	30
165	21	21	22	23	23	24	24	25	25	26	27	27	28	28	29	29
170	21	21	22	22	23	23	24	25	25	26	26	27	27	28	29	29
175	21	21	22	22	23	23	24	24	25	25	26	27	27	28	28	29
180	20	21	21	22	23	23	24	24	25	25	26	26	27	27	28	29
185	20	21	21	22	22	23	23	24	24	25	26	26	27	27	28	28
190	20	21	21	22	22	23	23	24	24	25	25	26	26	27	28	28
195	20	20	21	21	22	22	23	24	24	25	25	26	26	27	27	28
200	20	20	21	21	22	22	23	23	24	24	25	26	26	27	27	28

Years to Boring Height

Site Index	5-10	11-16	17-22	23-28	29-35	36-41	42-47	48+
Correct yrs	12	11	10	9	8	7	6	5

Table of Site Index by Breast Height Age and Height
Species: Cw – Western Redcedar - Provincial

Top Height (m) 55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	Age @ bh
Site Index (m)																
																10
																15
																20
																25
																30
																35
																40
																45
																50
																55
49																60
47	48	49														65
45	46	47	48	48	49											70
43	44	45	46	47	47	48	49									75
42	43	43	44	45	46	47	47	48	49							80
40	41	42	43	44	44	45	46	47	47	48						85
39	40	41	41	42	43	44	45	45	46	47	48	48				90
38	39	40	40	41	42	43	43	44	45	46	46	47	48	49		95
37	38	39	39	40	41	42	42	43	44	44	45	46	47	47	48	100
36	37	38	38	39	40	41	41	42	43	43	44	45	46	46	47	105
36	36	37	38	38	39	40	40	41	42	42	43	44	45	45	46	110
35	35	36	37	37	38	39	40	40	41	42	42	43	44	44	45	115
34	35	35	36	37	37	38	39	39	40	41	41	42	43	44	44	120
34	34	35	35	36	37	37	38	39	39	40	41	41	42	43	43	125
33	34	34	35	36	36	37	37	38	39	39	40	41	41	42	43	130
32	33	34	34	35	36	36	37	38	38	39	39	40	41	41	42	135
32	33	33	34	34	35	36	36	37	38	38	39	40	40	41	41	140
32	32	33	33	34	35	35	36	36	37	38	38	39	40	40	41	145
31	32	32	33	34	34	35	35	36	37	37	38	38	39	40	40	150
31	31	32	33	33	34	34	35	36	36	37	37	38	39	39	40	155
30	31	32	32	33	33	34	35	35	36	36	37	38	38	39	39	160
30	31	31	32	32	33	34	34	35	35	36	37	37	38	38	39	165
30	30	31	31	32	33	33	34	34	35	36	36	37	37	38	39	170
29	30	31	31	32	32	33	33	34	35	35	36	36	37	38	38	175
29	30	30	31	31	32	33	33	34	34	35	36	36	37	37	38	180
29	29	30	31	31	32	32	33	33	34	35	35	36	36	37	38	185
29	29	30	30	31	31	32	33	33	34	34	35	36	36	37	37	190
28	29	30	30	31	31	32	32	33	34	34	35	35	36	36	37	195
28	29	29	30	30	31	32	32	33	33	34	34	35	36	36	37	200

Years to Boring Height

Site Index	5-10	11-16	17-22	23-28	29-35	36-41	42-47	48+
Correct yrs	12	11	10	9	8	7	6	5

Figure 7-51 Cw – Western Redcedar - Provincial

Table of Site Index by Breast Height Age and Height
Species: Dr – Red Alder - Provincial

Age @ bh	6	7	8	9	10	11	12	13	14	15	16	17	18	19
	Top Height (m)													
	Site Index (m)													
10	13	16	18	21	23	26	28	31	33	36	38			
15	10	12	13	15	17	19	21	22	24	26	28	30	31	33
20	8	10	11	13	14	16	17	19	20	22	23	25	26	28
25	7	9	10	11	13	14	15	17	18	19	21	22	23	25
30	7	8	9	11	12	13	14	15	17	18	19	20	21	23
35	7	8	9	10	11	12	13	15	16	17	18	19	20	21
40	6	7	9	10	11	12	13	14	15	16	17	18	19	20
45	6	7	8	9	10	11	12	13	14	15	16	18	19	20
50	6	7	8	9	10	11	12	13	14	15	16	17	18	19
55	6	7	8	9	10	11	12	13	14	15	16	17	18	19
60	6	7	8	9	10	11	12	12	13	14	15	16	17	18
65	6	7	8	9	9	10	11	12	13	14	15	16	17	18
70	6	7	7	8	9	10	11	12	13	14	15	16	17	18
75	6	6	7	8	9	10	11	12	13	14	15	16	17	17
80	6	6	7	8	9	10	11	12	13	14	15	15	16	17
85	5	6	7	8	9	10	11	12	13	14	14	15	16	17
90	5	6	7	8	9	10	11	12	13	13	14	15	16	17
95	5	6	7	8	9	10	11	12	12	13	14	15	16	17
100	5	6	7	8	9	10	11	11	12	13	14	15	16	17

Years to Boring Height

Site Index	≤ 6	7-14	15-21	22-28	29+
Correct yrs	5	4	3	2	1

SiteTools Version 3.2m – Research Branch, British Columbia Ministry of Forests
Date: February 27, 2002
Site Index Equation: Nigh and Courtin (1998)

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Table of Site Index by Breast Height Age and Height
Species: Dr – Red Alder - Provincial

20	21	22	23	24	25	26	27	28	29	30	31	32	33	Age @ bh
Top Height (m)														
Site Index (m)														
														10
														15
29	31	32												20
26	27	28	30											25
24	25	26	27	29	30									30
22	24	25	26	27	28	29								35
21	22	24	25	26	27	28	29							40
21	22	23	24	25	26	27	28	29						45
20	21	22	23	24	25	26	27	28	29					50
20	21	21	22	23	24	25	26	27	28					55
19	20	21	22	23	24	25	26	27	28	29				60
19	20	21	22	23	24	24	25	26	27	28				65
19	19	20	21	22	23	24	25	26	27	28	29			70
18	19	20	21	22	23	24	25	26	27	27	28			75
18	19	20	21	22	23	24	24	25	26	27	28			80
18	19	20	21	22	22	23	24	25	26	27	28	29		85
18	19	20	20	21	22	23	24	25	26	27	28	28		90
18	19	19	20	21	22	23	24	25	26	26	27	28		95
18	18	19	20	21	22	23	24	25	25	26	27	28	29	100

Years to Boring Height

Site Index	≤ 6	7-14	15-21	22-28	29+
Correct yrs	5	4	3	2	1

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Figure 7-52 Dr - Red Alder – Provincial

Table of Site Index by Breast Height Age and Height
Species: Lw – Western Larch - Provincial

Age @ bh	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
	Site Index (m)																						
10	20	23	26	29	32	35	38	41	44	47	50												
15	15	17	19	22	24	26	28	30	32	34	36	39	41	43	45	47	49						
20	13	14	16	18	19	21	23	25	26	28	30	31	33	35	36	38	40	41	43	45	47	48	50
25	11	12	14	15	17	18	20	21	22	24	25	27	28	30	31	33	34	35	37	38	40	41	43
30	9	11	12	13	15	16	17	18	20	21	22	24	25	26	27	29	30	31	33	34	35	36	38
35	8	9	11	12	13	14	15	16	18	19	20	21	22	23	25	26	27	28	29	30	32	33	34
40	7	8	9	10	12	13	14	15	16	17	18	19	20	21	22	23	25	26	27	28	29	30	31
45	6	7	8	9	10	11	12	13	14	15	17	18	19	20	21	22	23	24	25	26	27	28	29
50	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
55	5	6	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	23	24	25
60		5	6	7	8	8	9	10	11	12	13	14	15	16	17	18	18	19	20	21	22	23	24
65			5	6	7	8	9	9	10	11	12	13	14	15	16	17	17	18	19	20	21	22	23
70				5	6	7	8	9	10	10	11	12	13	14	15	16	17	17	18	19	20	21	22
75				5	5	6	7	8	9	10	11	11	12	13	14	15	16	17	17	18	19	20	21
80					5	6	6	7	8	9	10	11	12	12	13	14	15	16	17	17	18	19	20
85						5	6	7	8	8	9	10	11	12	13	13	14	15	16	17	18	18	19
90						5	5	6	7	8	9	9	10	11	12	13	14	14	15	16	17	18	19
95							5	6	6	7	8	9	10	11	11	12	13	14	15	15	16	17	18
100								5	6	7	8	8	9	10	11	12	12	13	14	15	16	17	17
105								5	6	6	7	8	9	10	10	11	12	13	14	14	15	16	17
110									5	6	7	8	8	9	10	11	12	12	13	14	15	16	16
115									5	6	6	7	8	9	10	10	11	12	13	13	14	15	16
120										5	6	7	8	8	9	10	11	11	12	13	14	15	15
125										5	6	6	7	8	9	10	10	11	12	13	14	14	15
130											5	6	7	8	8	9	10	11	12	12	13	14	15
135											5	6	7	7	8	9	10	11	11	12	13	14	14
140											5	6	6	7	8	9	9	10	11	12	13	13	14
145												5	6	7	8	8	9	10	11	12	12	13	14
150												5	6	7	7	8	9	10	10	11	12	13	14
155												5	6	6	7	8	9	9	10	11	12	13	13
160												5	5	6	7	8	9	9	10	11	12	12	13
165													5	6	7	8	8	9	10	11	11	12	13
170													5	6	7	7	8	9	10	10	11	12	13
175													5	6	6	7	8	9	10	10	11	12	13
180													5	5	6	7	8	9	9	10	11	12	12
185													5	5	6	7	8	8	9	10	11	12	12
190														5	6	7	8	8	9	10	11	11	12
195														5	6	7	7	8	9	10	11	11	12
200														5	6	7	7	8	9	10	10	11	12

Years to Boring Height

Site Index	5	6	7	8	9	10	11-12	13-14	15-16	17-21	22-27	28-40	41+
Correct yrs	21	18	16	14	13	12	11	10	9	8	7	6	5

SiteTools Version 3.2m -- Research Branch, British Columbia Ministry of Forests
Date: March 11, 2002
Site Index Equation: Milner (1992)

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Table of Site Index by Breast Height Age and Height
Species: Lw – Western Larch - Provincial

28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	Age @ bh
Site Index (m)																							
																							10
																							15
																							20
44	46	47	48	50																			25
39	40	41	43	44	45	47	48	49	50														30
35	36	37	39	40	41	42	43	45	46	47	48	49	50										35
32	33	34	35	37	38	39	40	41	42	43	44	45	46	47	49	50							40
30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50			45
28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	50
26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	40	41	42	43	44	45	46	47	55
25	26	27	28	29	29	30	31	32	33	34	35	36	37	38	39	40	40	41	42	43	44	45	60
24	25	25	26	27	28	29	30	31	32	33	33	34	35	36	37	38	39	40	41	42	42	43	65
23	23	24	25	26	27	28	29	30	30	31	32	33	34	35	36	37	37	38	39	40	41	42	70
22	23	23	24	25	26	27	28	28	29	30	31	32	33	34	34	35	36	37	38	39	40	40	75
21	22	22	23	24	25	26	27	28	28	29	30	31	32	33	33	34	35	36	37	38	39	39	80
20	21	22	23	23	24	25	26	27	28	28	29	30	31	32	33	33	34	35	36	37	38	38	85
19	20	21	22	23	23	24	25	26	27	28	28	29	30	31	32	33	33	34	35	36	37	37	90
19	20	20	21	22	23	24	24	25	26	27	28	28	29	30	31	32	33	33	34	35	36	37	95
18	19	20	21	21	22	23	24	25	25	26	27	28	29	29	30	31	32	33	34	34	35	36	100
18	18	19	20	21	22	22	23	24	25	26	26	27	28	29	30	30	31	32	33	34	34	35	105
17	18	19	20	20	21	22	23	24	24	25	26	27	28	28	29	30	31	32	32	33	34	35	110
17	17	18	19	20	21	21	22	23	24	25	25	26	27	28	29	29	30	31	32	33	33	34	115
16	17	18	19	19	20	21	22	23	23	24	25	26	27	27	28	29	30	31	31	32	33	34	120
16	17	17	18	19	20	21	21	22	23	24	25	25	26	27	28	29	29	30	31	32	32	33	125
16	16	17	18	19	19	20	21	22	23	23	24	25	26	27	27	28	29	30	31	31	32	33	130
15	16	17	18	18	19	20	21	22	22	23	24	25	25	26	27	28	29	29	30	31	32	33	135
15	16	16	17	18	19	20	20	21	22	23	24	24	25	26	27	27	28	29	30	31	31	32	140
15	15	16	17	18	19	19	20	21	22	22	23	24	25	26	26	27	28	29	30	30	31	32	145
14	15	16	17	18	18	19	20	21	21	22	23	24	25	25	26	27	28	28	29	30	31	32	150
14	15	16	17	17	18	19	20	20	21	22	23	24	24	25	26	27	27	28	29	30	31	31	155
14	15	16	16	17	18	19	19	20	21	22	23	23	24	25	26	26	27	28	29	30	30	31	160
14	15	15	16	17	18	18	19	20	21	22	22	23	24	25	25	26	27	28	29	29	30	31	165
14	14	15	16	17	17	18	19	20	21	21	22	23	24	25	25	26	27	28	28	29	30	31	170
13	14	15	16	17	17	18	19	20	20	21	22	23	24	24	25	26	27	27	28	29	30	31	175
13	14	15	16	16	17	18	19	19	20	21	22	23	23	24	25	26	26	27	28	29	30	30	180
13	14	15	15	16	17	18	19	19	20	21	22	22	23	24	25	26	26	27	28	29	29	30	185
13	14	15	15	16	17	18	18	19	20	21	22	22	23	24	25	25	26	27	28	29	29	30	190
13	14	14	15	16	17	18	18	19	20	21	21	22	23	24	25	25	26	27	28	28	29	30	195
13	14	14	15	16	17	17	18	19	20	21	21	22	23	24	24	25	26	27	28	28	29	30	200

Years to Boring Height

Site Index	5	6	7	8	9	10	11-12	13-14	15-16	17-21	22-27	28-40	41+
Correct yrs	21	18	16	14	13	12	11	10	9	8	7	6	5

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Figure 7-53 Lw – Western Larch – Provincial

Table of Site Index by Breast Height Age and Height
Species: Pli – Lodgepole Pine - Provincial

Age @ bh	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
	Site Index (m)																						
10	19	22	25	28	31	33	36	38	41	43	45	47	49										
15	13	16	18	20	22	24	26	28	30	32	34	35	37	39	40	42	44	45	47	48	50		
20	11	12	14	16	18	20	21	23	24	26	27	29	30	32	33	35	36	38	39	40	42	43	44
25	9	10	12	14	15	17	18	19	21	22	24	25	26	28	29	30	31	33	34	35	36	38	39
30	8	9	10	12	13	14	16	17	18	20	21	22	23	25	26	27	28	29	30	32	33	34	35
35	7	8	9	11	12	13	14	15	17	18	19	20	21	22	23	25	26	27	28	29	30	31	32
40	6	7	8	9	11	12	13	14	15	16	17	18	19	21	22	23	24	25	26	27	28	29	30
45	5	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
50	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
55	5	6	7	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
60		5	6	7	8	9	10	11	12	12	13	14	15	16	17	18	19	20	21	22	23	24	25
65		5	6	7	7	8	9	10	11	12	13	14	15	16	16	17	18	19	20	21	22	23	24
70		5	5	6	7	8	9	10	10	11	12	13	14	15	16	17	18	19	20	20	21	22	23
75			5	6	7	8	8	9	10	11	12	13	13	14	15	16	17	18	19	20	21	22	23
80			5	6	6	7	8	9	10	10	11	12	13	14	15	16	17	17	18	19	20	21	22
85			5	5	6	7	8	8	9	10	11	12	13	13	14	15	16	17	18	19	20	21	22
90			5	5	6	7	7	8	9	10	11	11	12	13	14	15	16	17	17	18	19	20	21
95				5	6	6	7	8	9	9	10	11	12	13	14	14	15	16	17	18	19	20	21
100				5	6	6	7	8	8	9	10	11	12	12	13	14	15	16	17	18	18	19	20
105				5	5	6	7	7	8	9	10	11	11	12	13	14	15	16	16	17	18	19	20
110				5	5	6	6	7	8	9	9	10	11	12	13	14	14	15	16	17	18	19	20
115					5	6	6	7	8	8	9	10	11	12	12	13	14	15	16	17	18	18	19
120					5	5	6	7	8	8	9	10	11	11	12	13	14	15	16	16	17	18	19
125					5	5	6	7	7	8	9	10	10	11	12	13	14	15	15	16	17	18	19
130					5	5	6	7	7	8	9	9	10	11	12	13	13	14	15	16	17	18	19
135					5	5	6	6	7	8	8	9	10	11	12	12	13	14	15	16	17	18	18
140						5	6	6	7	8	8	9	10	11	11	12	13	14	15	16	16	17	18
145						5	5	6	7	7	8	9	10	10	11	12	13	14	15	15	16	17	18
150						5	5	6	7	7	8	9	10	10	11	12	13	14	14	15	16	17	18
155						5	5	6	7	7	8	9	9	10	11	12	13	13	14	15	16	17	18
160						5	5	6	6	7	8	9	9	10	11	12	12	13	14	15	16	17	18
165						5	5	6	6	7	8	8	9	10	11	12	12	13	14	15	16	17	17
170							5	6	6	7	8	8	9	10	11	11	12	13	14	15	16	16	17
175							5	6	6	7	7	8	9	10	10	11	12	13	14	15	15	16	17
180							5	5	6	7	7	8	9	10	10	11	12	13	14	14	15	16	17
185							5	5	6	7	7	8	9	9	10	11	12	13	14	14	15	16	17
190							5	5	6	7	7	8	9	9	10	11	12	13	13	14	15	16	17
195							5	5	6	6	7	8	9	9	10	11	12	12	13	14	15	16	17
200							5	5	6	6	7	8	8	9	10	11	12	12	13	14	15	16	17

Years to Boring Height

Site Index	5	6	7	8	9	10-11	12-14	15-17	18-21	22-26	27-36	37+
Correct yrs	16	14	12	11	10	9	8	7	6	5	4	3

SiteTools Version 3.2m – Research Branch, British Columbia Ministry of Forests
Date: March 11, 2002
Site Index Equation: Nigh (1999)

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Table of Site Index by Breast Height Age and Height
Species: Pli – Lodgepole Pine - Provincial

28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	Age @ bh
Site Index (m)																							
																							10
																							15
46	47	48	49																				20
40	41	42	44	45	46	47	48	50															25
36	37	38	40	41	42	43	44	45	46	47	49	50											30
33	34	36	37	38	39	40	41	42	43	44	45	46	47	48	49								35
31	32	33	34	35	36	37	39	40	41	42	43	44	45	46	47	48	49	50					40
29	30	31	32	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50			45
28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	50
27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	55
26	27	28	29	30	31	32	33	34	35	36	37	37	38	39	40	41	42	43	44	45	46	47	60
25	26	27	28	29	30	31	32	33	34	35	36	37	37	38	39	40	41	42	43	44	45	46	65
24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	40	41	42	43	44	45	70
24	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	75
23	24	25	26	27	28	29	30	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	80
22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	38	39	40	41	42	43	85
22	23	24	25	26	27	28	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	90
22	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	37	38	39	40	41	42	95
21	22	23	24	25	26	27	28	29	29	30	31	32	33	34	35	36	37	38	39	40	41	42	100
21	22	23	24	25	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	40	41	105
21	21	22	23	24	25	26	27	28	29	30	31	32	33	33	34	35	36	37	38	39	40	41	110
20	21	22	23	24	25	26	27	28	28	29	30	31	32	33	34	35	36	37	38	39	40	41	115
20	21	22	23	24	25	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	40	120
20	21	22	22	23	24	25	26	27	28	29	30	31	32	33	34	35	35	36	37	38	39	40	125
20	20	21	22	23	24	25	26	27	28	29	30	31	31	32	33	34	35	36	37	38	39	40	130
19	20	21	22	23	24	25	26	27	27	28	29	30	31	32	33	34	35	36	37	38	39	40	135
19	20	21	22	23	24	25	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	140
19	20	21	22	23	23	24	25	26	27	28	29	30	31	32	33	34	35	36	36	37	38	39	145
19	20	21	21	22	23	24	25	26	27	28	29	30	31	32	33	33	34	35	36	37	38	39	150
19	19	20	21	22	23	24	25	26	27	28	29	30	30	31	32	33	34	35	36	37	38	39	155
18	19	20	21	22	23	24	25	26	27	28	28	29	30	31	32	33	34	35	36	37	38	39	160
18	19	20	21	22	23	24	25	26	26	27	28	29	30	31	32	33	34	35	36	37	38	39	165
18	19	20	21	22	23	24	25	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	170
18	19	20	21	22	23	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	37	38	175
18	19	20	21	22	22	23	24	25	26	27	28	29	30	31	32	33	34	35	35	36	37	38	180
18	19	20	21	21	22	23	24	25	26	27	28	29	30	31	32	33	33	34	35	36	37	38	185
18	19	20	20	21	22	23	24	25	26	27	28	29	30	31	31	32	33	34	35	36	37	38	190
18	19	19	20	21	22	23	24	25	26	27	28	29	29	30	31	32	33	34	35	36	37	38	195
18	18	19	20	21	22	23	24	25	26	27	28	28	29	30	31	32	33	34	35	36	37	38	200

Years to Boring Height

Site Index	5	6	7	8	9	10-11	12-14	15-17	18-21	22-26	27-36	37+
Correct yrs	16	14	12	11	10	9	8	7	6	5	4	3

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Figure 7-54 Pli – Lodgepole Pine – Provincial

Table of Site Index by Breast Height Age and Height
Species: Pw – Western White Pine - Provincial

Age @ bh	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
	Site Index (m)																						
10	25	29	32	35	37	40	42	44	46	48	50												
15	18	21	24	26	28	30	32	34	36	38	39	41	42	44	45	47	48	49					
20	14	17	19	21	23	25	26	28	30	31	33	34	35	37	38	39	41	42	43	44	45	46	48
25	11	13	15	17	19	20	22	24	25	26	28	29	30	32	33	34	35	36	38	39	40	41	42
30	9	11	13	14	16	17	19	20	22	23	24	25	27	28	29	30	31	32	34	35	36	37	38
35	8	9	11	12	14	15	16	17	19	20	21	22	24	25	26	27	28	29	30	31	32	33	34
40	6	8	9	10	12	13	14	15	16	18	19	20	21	22	23	24	25	26	27	28	30	31	32
45	6	7	8	9	10	11	12	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29
50	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
55		5	6	7	8	9	10	11	12	13	14	14	15	16	17	18	19	20	21	22	23	24	25
60		5	6	6	7	8	9	10	11	11	12	13	14	15	16	17	18	19	20	20	21	22	23
65			5	6	7	7	8	9	10	10	11	12	13	14	14	15	16	17	18	19	20	21	22
70			5	5	6	7	7	8	9	9	10	11	12	13	13	14	15	16	17	18	19	20	20
75				5	6	6	7	7	8	9	9	10	11	12	12	13	14	15	16	16	17	18	19
80				5	5	6	6	7	7	8	9	9	10	11	11	12	13	14	14	15	16	17	18
85					5	5	6	6	7	7	8	9	9	10	11	11	12	13	14	14	15	16	17
90						5	5	6	6	7	7	8	9	9	10	11	11	12	13	13	14	15	16
95						5	5	6	6	6	7	8	8	9	9	10	10	11	12	13	13	14	15
100							5	5	6	6	7	7	8	8	9	9	10	10	11	12	13	13	14
105							5	5	5	6	6	7	7	8	8	9	9	10	10	11	12	13	13
110								5	5	5	6	6	7	7	8	8	9	9	10	10	11	12	13
115									5	5	6	6	6	7	7	8	8	9	9	10	11	11	12
120									5	5	5	6	6	6	7	7	8	8	9	9	10	11	11
125										5	5	5	6	6	7	7	7	8	8	9	9	10	11
130											5	5	5	6	6	7	7	7	8	8	9	10	10
135											5	5	5	6	6	6	7	7	8	8	9	9	10
140												5	5	5	6	6	6	7	7	8	8	9	9
145												5	5	5	5	6	6	6	7	7	8	8	9
150													5	5	5	6	6	6	7	7	7	8	8
155														5	5	5	6	6	6	7	7	8	8
160														5	5	5	5	6	6	6	7	7	8
165															5	5	5	6	6	6	7	7	7
170															5	5	5	5	6	6	6	7	7
175																5	5	5	5	6	6	6	7
180																	5	5	5	6	6	6	7
185																	5	5	5	5	6	6	6
190																		5	5	5	5	6	6
195																		5	5	5	5	6	6
200																			5	5	5	5	6

Years to Boring Height

Site Index	5	6	7	8	9	10	11	12-13	14-15	16-17	18-20	21-25	26-33	34-47	48+
Correct yrs	26	23	20	18	16	15	14	13	12	11	10	9	8	7	6

SiteTools Version 3.2m – Research Branch, British Columbia Ministry of Forests
Date: March 11, 2002
Site Index Equation: Curtis, Diaz, and Clendenen (1990)

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Table of Site Index by Breast Height Age and Height
Species: Pw – Western White Pine - Provincial

28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	Age @ bh
Site Index (m)																							
																							10
																							15
49	50																						20
43	44	45	46	47	48	49	50																25
39	40	41	42	43	44	45	46	47	48	48	49	50											30
35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50								35
33	34	35	36	37	37	38	39	40	41	42	43	44	45	46	47	48	49	50					40
30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50			45
28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	50
26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	44	45	46	47	48	49	55
24	25	26	27	28	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	47	48	60
23	24	25	26	27	28	29	30	31	32	33	34	36	37	38	39	40	41	42	43	44	46	47	65
21	22	23	24	26	27	28	29	30	31	32	33	34	35	37	38	39	40	41	42	44	45	46	70
20	21	22	23	24	25	26	28	29	30	31	32	33	34	36	37	38	39	40	42	43	44	45	75
19	20	21	22	23	24	25	26	27	29	30	31	32	33	35	36	37	38	40	41	42	43	44	80
18	19	20	21	22	23	24	25	26	28	29	30	31	33	34	35	36	38	39	40	41	43	44	85
17	18	19	20	21	22	23	24	25	27	28	29	30	32	33	34	36	37	38	39	41	42	43	90
16	17	18	19	20	21	22	23	24	26	27	28	30	31	32	34	35	36	38	39	40	42	43	95
15	16	17	18	19	20	21	22	24	25	26	27	29	30	31	33	34	36	37	38	40	41	42	100
14	15	16	17	18	19	20	21	23	24	25	27	28	29	31	32	34	35	36	38	39	40	42	105
13	14	15	16	17	18	19	21	22	23	24	26	27	29	30	32	33	34	36	37	39	40	41	110
13	13	14	15	16	17	18	20	21	22	24	25	26	28	29	31	32	34	35	37	38	40	41	115
12	13	14	15	16	17	18	19	20	21	23	24	26	27	29	30	32	33	35	36	38	39	40	120
11	12	13	14	15	16	17	18	19	21	22	24	25	27	28	30	31	33	34	36	37	39	40	125
11	12	12	13	14	15	16	17	19	20	21	23	24	26	28	29	31	32	34	35	37	38	40	130
10	11	12	13	13	14	16	17	18	19	21	22	24	25	27	28	30	32	33	35	36	38	39	135
10	10	11	12	13	14	15	16	17	19	20	22	23	25	26	28	29	31	33	34	36	37	39	140
9	10	11	11	12	13	14	15	17	18	19	21	22	24	26	27	29	31	32	34	35	37	38	145
9	10	10	11	12	13	14	15	16	17	19	20	22	23	25	27	28	30	32	33	35	36	38	150
9	9	10	10	11	12	13	14	15	17	18	20	21	23	25	26	28	29	31	33	34	36	37	155
8	9	9	10	11	12	12	14	15	16	17	19	21	22	24	26	27	29	31	32	34	35	37	160
8	8	9	10	10	11	12	13	14	15	17	18	20	22	23	25	27	28	30	32	33	35	36	165
8	8	9	9	10	11	11	12	14	15	16	18	19	21	23	25	26	28	30	31	33	35	36	170
7	8	8	9	9	10	11	12	13	14	16	17	19	21	22	24	26	27	29	31	32	34	36	175
7	7	8	8	9	10	11	11	12	14	15	17	18	20	22	23	25	27	29	30	32	34	35	180
7	7	8	8	9	9	10	11	12	13	14	16	18	19	21	23	25	26	28	30	32	33	35	185
7	7	7	8	8	9	10	11	12	13	14	15	17	19	21	22	24	26	28	29	31	33	34	190
6	7	7	8	8	9	9	10	11	12	13	15	16	18	20	22	24	25	27	29	31	32	34	195
6	6	7	7	8	8	9	10	11	12	13	14	16	18	19	21	23	25	27	28	30	32	33	200

Years to Boring Height

Site Index	5	6	7	8	9	10	11	12-13	14-15	16-17	18-20	21-25	26-33	34-47	48+
Correct yrs	26	23	20	18	16	15	14	13	12	11	10	9	8	7	6

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Figure 7-55 Pw – Western White Pine – Provincial

Table of Site Index by Breast Height Age and Height
Species: Py – Ponderosa Pine - Provincial

Age @ bh	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
	Top Height (m) – Site Index (m)																						
10	22	27	32	37	42	47																	
15	14	18	21	25	28	31	34	38	41	44	47	50											
20	11	13	16	18	21	23	26	28	31	33	35	38	40	42	45	47	49						
25	9	11	13	15	17	19	21	23	25	26	28	30	32	34	36	38	40	41	43	45	47	49	
30	8	9	11	13	14	16	17	19	21	22	24	25	27	29	30	32	33	35	36	38	40	41	43
35	7	8	9	11	12	14	15	16	18	19	21	22	23	25	26	27	29	30	32	33	34	36	37
40	6	7	8	10	11	12	13	15	16	17	18	19	21	22	23	24	26	27	28	29	30	32	33
45	5	7	8	9	10	11	12	13	14	15	16	18	19	20	21	22	23	24	25	26	27	28	30
50	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
55	5	6	6	7	8	9	10	11	12	13	14	15	16	17	18	18	19	20	21	22	23	24	25
60		5	6	7	8	9	9	10	11	12	13	14	15	15	16	17	18	19	20	21	22	22	23
65		5	6	7	7	8	9	10	10	11	12	13	14	15	15	16	17	18	19	19	20	21	22
70		5	5	6	7	8	8	9	10	11	11	12	13	14	14	15	16	17	18	18	19	20	21
75			5	6	7	7	8	9	9	10	11	12	12	13	14	14	15	16	17	17	18	19	20
80			5	6	6	7	8	8	9	10	10	11	12	12	13	14	14	15	16	17	17	18	19
85			5	5	6	7	7	8	9	9	10	11	11	12	13	13	14	15	15	16	17	17	18
90			5	5	6	6	7	8	8	9	10	10	11	11	12	13	13	14	15	15	16	17	17
95				5	6	6	7	7	8	9	9	10	10	11	12	12	13	13	14	15	15	16	17
100				5	5	6	7	7	8	8	9	9	10	11	11	12	12	13	14	14	15	15	16
105				5	5	6	6	7	7	8	9	9	10	10	11	11	12	13	13	14	14	15	16
110				5	5	6	6	7	7	8	8	9	9	10	11	11	12	12	13	13	14	15	15
115					5	5	6	7	7	8	8	9	9	10	10	11	11	12	13	13	14	14	15
120					5	5	6	6	7	7	8	8	9	10	10	11	11	12	12	13	13	14	14
125					5	5	6	6	7	7	8	8	9	9	10	10	11	11	12	12	13	14	14
130					5	5	6	6	7	7	8	8	9	9	10	10	11	11	12	12	13	13	14
135					5	5	6	6	6	7	7	8	8	9	9	10	10	11	11	12	13	13	14
140						5	5	6	6	7	7	8	8	9	9	10	10	11	11	12	12	13	13
145						5	5	6	6	7	7	8	8	9	9	10	10	11	11	12	12	13	13
150						5	5	6	6	7	7	8	8	8	9	9	10	10	11	11	12	12	13
155						5	5	6	6	6	7	7	8	8	9	9	10	10	11	11	12	12	13
160						5	5	5	6	6	7	7	8	8	9	9	10	10	11	11	12	12	13
165						5	5	5	6	6	7	7	8	8	9	9	9	10	10	11	11	12	12
170						5	5	5	6	6	7	7	8	8	8	9	9	10	10	11	11	12	12
175							5	5	6	6	7	7	7	8	8	9	9	10	10	11	11	12	12
180							5	5	6	6	6	7	7	8	8	9	9	10	10	11	11	12	12
185							5	5	6	6	6	7	7	8	8	9	9	10	10	10	11	11	12
190							5	5	6	6	6	7	7	8	8	9	9	9	10	10	11	11	12
195							5	5	5	6	6	7	7	8	8	8	9	9	10	10	11	11	12
200							5	5	5	6	6	7	7	8	8	8	9	9	10	10	11	11	12

Years to Boring Height

Site Index	5	6	7	8	9-10	11-14	15-22	23-47	48+
Correct yrs	14	13	12	11	10	9	8	7	6

SiteTools Version 3.2m – Research Branch, British Columbia Ministry of Forests
Date: March 11, 2002
Site Index Equation: Hann and Scrivani (1986)

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Table of Site Index by Breast Height Age and Height
Species: Py – Ponderosa Pine - Provincial

28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	Age @ bh
Top Height (m) – Site Index (m)																							
																							10
																							15
																							20
																							25
44	46	47	49	50																			30
38	40	41	42	44	45	46	48	49	50														35
34	35	36	38	39	40	41	42	44	45	46	47	48	50										40
31	32	33	34	35	36	37	38	39	40	42	43	44	45	46	47	48	49	50					45
28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	50
26	27	28	29	30	31	31	32	33	34	35	36	37	38	39	40	41	42	43	44	44	45	46	55
24	25	26	27	28	28	29	30	31	32	33	34	35	35	36	37	38	39	40	41	42	42	43	60
23	23	24	25	26	27	28	28	29	30	31	32	33	33	34	35	36	37	37	38	39	40	41	65
21	22	23	24	25	25	26	27	28	28	29	30	31	32	32	33	34	35	36	36	37	38	39	70
20	21	22	23	23	24	25	26	26	27	28	29	29	30	31	32	32	33	34	35	35	36	37	75
19	20	21	22	22	23	24	24	25	26	27	27	28	29	29	30	31	32	32	33	34	35	35	80
19	19	20	21	21	22	23	23	24	25	25	26	27	28	28	29	30	30	31	32	33	33	34	85
18	19	19	20	21	21	22	23	23	24	25	25	26	27	27	28	29	29	30	31	31	32	33	90
17	18	19	19	20	20	21	22	22	23	24	24	25	26	26	27	28	28	29	30	30	31	32	95
17	17	18	19	19	20	20	21	22	22	23	24	24	25	26	26	27	28	28	29	29	30	31	100
16	17	17	18	19	19	20	20	21	22	22	23	24	24	25	25	26	27	27	28	29	29	30	105
16	16	17	18	18	19	19	20	21	21	22	22	23	24	24	25	25	26	27	27	28	29	29	110
15	16	17	17	18	18	19	19	20	21	21	22	22	23	24	24	25	25	26	27	27	28	29	115
15	16	16	17	17	18	18	19	20	20	21	21	22	23	23	24	24	25	26	26	27	27	28	120
15	15	16	16	17	17	18	19	19	20	20	21	22	22	23	23	24	24	25	26	26	27	27	125
14	15	15	16	17	17	18	18	19	19	20	21	21	22	22	23	23	24	25	25	26	26	27	130
14	15	15	16	16	17	17	18	19	19	20	20	21	21	22	22	23	24	24	25	25	26	27	135
14	14	15	15	16	17	17	18	18	19	19	20	20	21	22	22	23	23	24	24	25	26	26	140
14	14	15	15	16	16	17	17	18	18	19	20	20	21	21	22	22	23	24	24	25	25	26	145
13	14	14	15	16	16	17	17	18	18	19	19	20	20	21	22	22	23	23	24	24	25	25	150
13	14	14	15	15	16	16	17	17	18	19	19	20	20	21	21	22	22	23	23	24	25	25	155
13	14	14	15	15	16	16	17	17	18	18	19	19	20	20	21	22	22	23	23	24	24	25	160
13	13	14	14	15	15	16	17	17	18	18	19	19	20	20	21	21	22	22	23	24	24	25	165
13	13	14	14	15	15	16	16	17	17	18	18	19	20	20	21	21	22	22	23	23	24	24	170
13	13	14	14	15	15	16	16	17	17	18	18	19	19	20	20	21	21	22	23	23	24	24	175
13	13	14	14	15	15	16	16	17	17	18	18	19	19	20	20	21	21	22	22	23	24	24	180
12	13	13	14	14	15	15	16	16	17	17	18	18	19	20	20	21	21	22	22	23	23	24	185
12	13	13	14	14	15	15	16	16	17	17	18	18	19	19	20	20	21	22	22	23	23	24	190
12	13	13	14	14	15	15	16	16	17	17	18	18	19	19	20	20	21	21	22	23	23	24	195
12	13	13	14	14	15	15	16	16	17	17	18	18	19	19	20	20	21	21	22	22	23	23	200

Years to Boring Height

Site Index	5	6	7	8	9-10	11-14	15-22	23-47	48+
Correct yrs	14	13	12	11	10	9	8	7	6

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Figure 7-56 Py – Ponderosa Pine – Provincial

Table of Site Index by Breast Height Age and Height
Species: Sb – Black Spruce – Provincial

Age	Top Height (m)																						
@ bh	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
	Site Index (m)																						
10	17	20	23	25	27	29	32	34	35	37	39	41	43	44	46	47	49						
15	13	15	17	19	21	23	25	27	28	30	31	33	34	36	37	39	40	41	43	44	45	47	48
20	10	12	14	16	18	19	21	22	24	25	27	28	29	31	32	33	35	36	37	38	39	41	42
25	9	10	12	14	15	17	18	19	21	22	23	25	26	27	28	30	31	32	33	34	35	37	38
30	8	9	10	12	13	15	16	17	18	20	21	22	23	24	26	27	28	29	30	31	32	33	35
35	7	8	9	11	12	13	14	15	17	18	19	20	21	22	23	25	26	27	28	29	30	31	32
40	6	7	8	10	11	12	13	14	15	16	17	19	20	21	22	23	24	25	26	27	28	29	30
45	5	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
50	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
55	5	6	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
60		5	6	7	8	9	10	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
65		5	6	6	7	8	9	10	11	12	12	13	14	15	16	17	18	19	20	21	22	23	24
70		5	5	6	7	8	8	9	10	11	12	13	14	14	15	16	17	18	19	20	21	22	23
75			5	6	7	7	8	9	10	10	11	12	13	14	15	16	16	17	18	19	20	21	22
80			5	5	6	7	8	8	9	10	11	12	12	13	14	15	16	17	18	19	19	20	21
85			5	5	6	7	7	8	9	9	10	11	12	13	13	14	15	16	17	18	19	20	21
90				5	6	6	7	8	8	9	10	11	11	12	13	14	15	15	16	17	18	19	20
95				5	5	6	7	7	8	9	9	10	11	12	12	13	14	15	16	17	18	19	19
100				5	5	6	6	7	8	8	9	10	10	11	12	13	14	14	15	16	17	18	19
105					5	6	6	7	7	8	9	9	10	11	12	12	13	14	15	16	17	18	18
110					5	5	6	6	7	8	8	9	10	10	11	12	13	14	14	15	16	17	18
115					5	5	6	6	7	7	8	9	9	10	11	12	12	13	14	15	16	17	18
120						5	5	6	7	7	8	8	9	10	10	11	12	13	14	14	15	16	17
125						5	5	6	6	7	8	8	9	9	10	11	12	12	13	14	15	16	17
130						5	5	6	6	7	7	8	8	9	10	11	11	12	13	14	15	15	16
135						5	5	5	6	6	7	8	8	9	10	10	11	12	13	13	14	15	16
140							5	5	6	6	7	7	8	9	9	10	11	11	12	13	14	15	16
145							5	5	6	6	7	7	8	8	9	10	10	11	12	13	14	14	15
150							5	5	5	6	6	7	8	8	9	9	10	11	12	12	13	14	15
155								5	5	6	6	7	7	8	9	9	10	11	11	12	13	14	15
160								5	5	6	6	7	7	8	8	9	10	10	11	12	13	14	14
165								5	5	5	6	6	7	8	8	9	9	10	11	12	12	13	14
170								5	5	5	6	6	7	7	8	9	9	10	11	11	12	13	14
175									5	5	6	6	7	7	8	8	9	10	10	11	12	13	14
180									5	5	6	6	6	7	8	8	9	9	10	11	12	13	13
185									5	5	5	6	6	7	7	8	9	9	10	11	11	12	13
190										5	5	6	6	7	7	8	8	9	10	10	11	12	13
195										5	5	6	6	7	7	8	8	9	10	10	11	12	13
200										5	5	5	6	6	7	7	8	9	9	10	11	12	12

Years to Boring Height

Site Index	5	6	7	8	9	10-11	12-13	14-17	18-24	25-41	42
Correct yrs	23	21	20	19	18	17	16	15	14	13	12

SiteTools Version 3.2m -- Research Branch, British Columbia Ministry of Forests
Date: March 11, 2002
Site Index Equation: Alberta Forest Service (1985)

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Table of Site Index by Breast Height Age and Height
Species: Sb – Black Spruce - Provincial

Top Height (m)																							Age
28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	@ bh
Site Index (m)																							
																							10
49	50																						15
43	44	45	46	48	49	50																	20
39	40	41	42	43	44	45	46	48	49	50													25
36	37	38	39	40	41	42	43	44	45	46	47	48	49	50									30
33	34	35	36	37	38	39	40	41	43	44	45	46	47	48	49	50							35
31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50				40
29	30	31	32	34	34	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50			45
28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	50
27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	55
26	27	28	29	30	31	32	33	34	35	36	37	38	38	39	40	41	42	43	44	45	46	47	60
25	26	27	28	29	30	31	32	33	33	34	35	36	37	38	39	40	41	42	43	44	45	46	65
24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	70
23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	75
22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	80
22	23	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	85
21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	90
20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	95
20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	100
19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	105
19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	110
18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	115
18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	120
18	19	19	20	21	22	23	24	25	26	27	28	29	30	31	32	34	35	36	37	38	39	40	125
17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	130
17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	135
17	17	18	19	20	21	22	23	24	25	26	27	28	29	30	32	33	34	35	36	37	38	39	140
16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	39	145
16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	150
16	17	17	18	19	20	21	22	23	24	25	27	28	29	30	31	32	33	34	35	36	37	38	155
15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	33	34	35	36	37	38	160
15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	37	38	165
15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	170
15	15	16	17	18	19	20	21	22	23	24	26	27	28	29	30	31	32	33	34	35	36	37	175
14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	30	31	32	33	34	35	36	37	180
14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	33	34	35	36	37	185
14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	35	36	37	190
14	15	15	16	17	18	19	20	22	23	24	25	26	27	28	29	30	31	32	33	34	35	37	195
13	14	15	16	17	18	19	20	21	22	23	25	26	27	28	29	30	31	32	33	34	35	36	200

Years to Boring Height

Site Index	5	6	7	8	9	10-11	12-13	14-17	18-24	25-41	42
Correct yrs	23	21	20	19	18	17	16	15	14	13	12

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Figure 7-57 Sb – Black Spruce – Provincial

Table of Site Index by Breast Height Age and Height
Species: Ss- Sitka Spruce - Provincial

Age @ bh	Top Height (m) 5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
	Site Index (m)																
10	24	29	33	37	40	44	47	50	53	56	59	62	65	68			
15	16	20	23	25	28	31	33	36	38	40	43	45	47	49	51	53	55
20	12	15	17	19	22	24	26	28	30	32	34	35	37	39	41	42	44
25	10	12	14	16	18	19	21	23	24	26	28	29	31	32	34	35	37
30	8	10	12	13	15	16	18	19	21	22	24	25	27	28	29	31	32
35	7	8	10	11	13	14	15	17	18	19	21	22	23	24	26	27	28
40	6	7	9	10	11	12	14	15	16	17	18	20	21	22	23	24	25
45	6	7	8	9	10	11	12	13	14	15	17	18	19	20	21	22	23
50	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
55	5	5	6	7	8	9	10	11	12	13	14	15	16	17	18	18	19
60		5	6	7	8	8	9	10	11	12	13	14	14	15	16	17	18
65		5	5	6	7	8	9	9	10	11	12	13	13	14	15	16	17
70			5	6	7	7	8	9	9	10	11	12	13	13	14	15	16
75			5	5	6	7	7	8	9	10	10	11	12	13	13	14	15
80			5	5	6	6	7	8	8	9	10	10	11	12	13	13	14
85				5	5	6	7	7	8	9	9	10	10	11	12	13	13
90				5	5	6	6	7	7	8	9	9	10	11	11	12	13
95					5	5	6	7	7	8	8	9	9	10	11	11	12
100					5	5	6	6	7	7	8	8	9	10	10	11	12
105						5	5	6	6	7	8	8	9	9	10	10	11
110						5	5	6	6	7	7	8	8	9	9	10	11
115						5	5	5	6	6	7	7	8	8	9	10	10
120							5	5	6	6	7	7	8	8	9	9	10
125							5	5	5	6	6	7	7	8	8	9	9
130								5	5	6	6	7	7	8	8	9	9
135								5	5	6	6	6	7	7	8	8	9
140								5	5	5	6	6	7	7	8	8	9
145									5	5	6	6	6	7	7	8	8
150									5	5	5	6	6	7	7	8	8
155									5	5	5	6	6	6	7	7	8
160										5	5	5	6	6	7	7	8
165										5	5	5	6	6	6	7	7
170											5	5	6	6	6	7	7
175											5	5	5	6	6	7	7
180											5	5	5	6	6	6	7
185												5	5	5	6	6	7
190												5	5	5	6	6	6
195												5	5	5	6	6	6
200													5	5	5	6	6

Years to Boring Height

Site Index	10–11	12-17	18-22	23-28	29-33	34-38	39-44	45-49	50+
Correct yrs	10	9	8	7	6	5	4	3	2

SiteTools Version 3.2m – Research Branch, British Columbia Ministry of Forests
Date: February 27, 2002
Site Index Equation: Nigh (1997)

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Table of Site Index by Breast Height Age and Height
Species: Ss- Sitka Spruce - Provincial

Top Height (m) 22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	Age @ bh
Site Index (m)																
																10
57	59	61														15
46	47	49	51	52	54	55	57									20
38	40	41	43	44	46	47	48	50	51	52	54	55				25
33	35	36	37	39	40	41	42	44	45	46	47	49	50	51	52	30
29	31	32	33	34	35	37	38	39	40	41	42	44	45	46	47	35
26	28	29	30	31	32	33	34	35	36	38	39	40	41	42	43	40
24	25	26	27	28	29	30	31	32	33	35	36	37	38	39	40	45
22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	50
20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	55
19	20	21	22	23	23	24	25	26	27	28	29	30	31	32	33	60
18	19	19	20	21	22	23	24	25	26	26	27	28	29	30	31	65
17	17	18	19	20	21	22	23	23	24	25	26	27	28	29	30	70
16	16	17	18	19	20	21	21	22	23	24	25	26	26	27	28	75
15	16	16	17	18	19	20	20	21	22	23	24	24	25	26	27	80
14	15	16	16	17	18	19	19	20	21	22	23	23	24	25	26	85
13	14	15	16	16	17	18	19	19	20	21	22	23	23	24	25	90
13	13	14	15	16	16	17	18	19	19	20	21	22	22	23	24	95
12	13	14	14	15	16	16	17	18	19	19	20	21	22	22	23	100
12	12	13	14	14	15	16	16	17	18	19	19	20	21	22	23	105
11	12	12	13	14	14	15	16	17	17	18	19	20	20	21	22	110
11	11	12	13	13	14	15	15	16	17	17	18	19	20	20	21	115
10	11	12	12	13	13	14	15	16	16	17	18	18	19	20	21	120
10	11	11	12	12	13	14	14	15	16	16	17	18	19	19	20	125
10	10	11	11	12	13	13	14	15	15	16	17	17	18	19	20	130
9	10	10	11	12	12	13	14	14	15	16	16	17	18	18	19	135
9	10	10	11	11	12	13	13	14	14	15	16	16	17	18	19	140
9	9	10	10	11	12	12	13	13	14	15	15	16	17	17	18	145
9	9	10	10	11	11	12	12	13	14	14	15	16	16	17	18	150
8	9	9	10	10	11	12	12	13	13	14	15	15	16	17	17	155
8	9	9	10	10	11	11	12	12	13	14	14	15	16	16	17	160
8	8	9	9	10	10	11	12	12	13	13	14	15	15	16	17	165
8	8	9	9	10	10	11	11	12	12	13	14	14	15	16	16	170
7	8	8	9	9	10	10	11	12	12	13	13	14	15	15	16	175
7	8	8	9	9	10	10	11	11	12	12	13	14	14	15	16	180
7	7	8	8	9	9	10	10	11	12	12	13	13	14	15	15	185
7	7	8	8	9	9	10	10	11	11	12	13	13	14	15	15	190
7	7	8	8	9	9	10	10	11	11	12	12	13	14	14	15	195
7	7	7	8	8	9	9	10	10	11	12	12	13	13	14	15	200

Years to Boring Height

Site Index	10-11	12-17	18-22	23-28	29-33	34-38	39-44	45-49	50+
Correct yrs	10	9	8	7	6	5	4	3	2

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Table of Site Index by Breast Height Age and Height
Species: Ss- Sitka Spruce - Provincial

Age @ bh	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54
	Top Height (m)																
	Site Index (m)																
10																	
15																	
20																	
25																	
30	53	55															
35	48	49	50	52	53	54											
40	44	45	46	47	48	49	51	52	53								
45	41	42	43	44	45	46	47	48	49	50	51	52					
50	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52		
55	36	37	38	39	40	41	42	42	43	44	45	46	47	48	49	50	51
60	34	35	36	37	37	38	39	40	41	42	43	44	45	46	47	48	49
65	32	33	34	35	36	37	38	38	39	40	41	42	43	44	45	46	47
70	30	31	32	33	34	35	36	37	38	39	40	40	41	42	43	44	45
75	29	30	31	32	33	34	34	35	36	37	38	39	40	41	42	43	44
80	28	29	30	30	31	32	33	34	35	36	37	38	39	39	40	41	42
85	27	28	29	29	30	31	32	33	34	35	36	36	37	38	39	40	41
90	26	27	27	28	29	30	31	32	33	34	34	35	36	37	38	39	40
95	25	26	27	27	28	29	30	31	32	33	33	34	35	36	37	38	39
100	24	25	26	27	27	28	29	30	31	32	33	33	34	35	36	37	38
105	23	24	25	26	27	27	28	29	30	31	32	33	33	34	35	36	37
110	23	23	24	25	26	27	28	28	29	30	31	32	33	34	34	35	36
115	22	23	24	24	25	26	27	28	29	29	30	31	32	33	34	35	35
120	21	22	23	24	25	25	26	27	28	29	30	30	31	32	33	34	35
125	21	22	22	23	24	25	26	26	27	28	29	30	31	31	32	33	34
130	20	21	22	23	23	24	25	26	27	28	28	29	30	31	32	33	34
135	20	21	21	22	23	24	25	25	26	27	28	29	30	30	31	32	33
140	19	20	21	22	22	23	24	25	26	26	27	28	29	30	31	32	32
145	19	20	20	21	22	23	24	24	25	26	27	28	29	29	30	31	32
150	19	19	20	21	22	22	23	24	25	26	26	27	28	29	30	31	31
155	18	19	20	20	21	22	23	24	24	25	26	27	28	28	29	30	31
160	18	18	19	20	21	22	22	23	24	25	26	26	27	28	29	30	31
165	17	18	19	20	20	21	22	23	24	24	25	26	27	28	29	29	30
170	17	18	19	19	20	21	22	22	23	24	25	26	26	27	28	29	30
175	17	17	18	19	20	20	21	22	23	24	24	25	26	27	28	29	30
180	16	17	18	19	19	20	21	22	23	23	24	25	26	27	28	28	29
185	16	17	18	18	19	20	21	21	22	23	24	25	26	26	27	28	29
190	16	17	17	18	19	20	20	21	22	23	24	24	25	26	27	28	29
195	16	16	17	18	19	19	20	21	22	22	23	24	25	26	27	27	28
200	15	16	17	18	18	19	20	21	21	22	23	24	25	25	26	27	28

Years to Boring Height

Site Index	10–11	12-17	18-22	23-28	29-33	34-38	39-44	45-49	50+
Correct yrs	10	9	8	7	6	5	4	3	2

Table of Site Index by Breast Height Age and Height
Species: Ss- Sitka Spruce - Provincial

55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	Age @ bh
Top Height (m)																
Site Index (m)																
																10
																15
																20
																25
																30
																35
																40
																45
																50
																55
50	51															60
48	49	50	51													65
46	47	48	49	50	51											70
45	45	46	47	48	49	50										75
43	44	45	46	47	48	49	50	51								80
42	43	44	45	45	46	47	48	49	50							85
41	42	43	43	44	45	46	47	48	49	50						90
40	41	41	42	43	44	45	46	47	48	49	50					95
39	40	41	41	42	43	44	45	46	47	48	49	50				100
38	39	40	41	41	42	43	44	45	46	47	48	49	50			105
37	38	39	40	41	42	42	43	44	45	46	47	48	49	50		110
36	37	38	39	40	41	42	43	44	44	45	46	47	48	49	50	115
36	36	37	38	39	40	41	42	43	44	45	46	46	47	48	49	120
35	36	37	38	39	39	40	41	42	43	44	45	46	47	48	49	125
34	35	36	37	38	39	40	41	42	42	43	44	45	46	47	48	130
34	35	36	36	37	38	39	40	41	42	43	44	45	46	46	47	135
33	34	35	36	37	38	39	40	40	41	42	43	44	45	46	47	140
33	34	35	35	36	37	38	39	40	41	42	43	44	45	45	46	145
32	33	34	35	36	37	38	39	39	40	41	42	43	44	45	46	150
32	33	34	35	35	36	37	38	39	40	41	42	43	44	45	45	155
32	32	33	34	35	36	37	38	39	40	40	41	42	43	44	45	160
31	32	33	34	35	36	36	37	38	39	40	41	42	43	44	45	165
31	32	33	33	34	35	36	37	38	39	40	41	42	42	43	44	170
30	31	32	33	34	35	36	37	38	38	39	40	41	42	43	44	175
30	31	32	33	34	35	35	36	37	38	39	40	41	42	43	44	180
30	31	32	32	33	34	35	36	37	38	39	40	41	41	42	43	185
29	30	31	32	33	34	35	36	37	38	38	39	40	41	42	43	190
29	30	31	32	33	34	35	35	36	37	38	39	40	41	42	43	195
29	30	31	32	32	33	34	35	36	37	38	39	40	41	42	43	200

Years to Boring Height

Site Index	10-11	12-17	18-22	23-28	29-33	34-38	39-44	45-49	50+
Correct yrs	10	9	8	7	6	5	4	3	2

Figure 7-58 Ss – Sitka Spruce - Provincial

Table of Site Index by Breast Height Age and Height
Species: Sw – White Spruce and Englemann Spruce – Provincial

Age @ bh	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
	Site Index (m)																						
10	23	27	31	34	36	39	42	44	47	49													
15	16	19	22	24	27	29	31	33	35	37	39	40	42	44	45	47	49	50					
20	13	15	17	19	21	23	25	26	28	30	31	33	34	36	37	39	40	42	43	44	46	47	48
25	10	12	14	16	17	19	21	22	24	25	27	28	29	31	32	33	35	36	37	38	40	41	42
30	8	10	12	13	15	16	18	19	20	22	23	24	26	27	28	29	30	32	33	34	35	36	37
35	7	9	10	11	13	14	15	17	18	19	20	22	23	24	25	26	27	28	30	31	32	33	34
40	6	8	9	10	11	12	14	15	16	17	18	19	20	22	23	24	25	26	27	28	29	30	31
45	6	7	8	9	10	11	12	13	14	15	16	18	19	20	21	22	23	24	25	26	27	28	29
50	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
55	5	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	20	21	22	23	24	25
60		5	6	7	7	8	9	10	11	12	13	14	15	15	16	17	18	19	20	21	22	23	24
65		5	5	6	7	8	8	9	10	11	12	13	13	14	15	16	17	18	19	20	21	22	23
70			5	6	6	7	8	9	9	10	11	12	13	13	14	15	16	17	18	19	20	21	22
75			5	5	6	7	7	8	9	9	10	11	12	13	13	14	15	16	17	18	19	20	21
80				5	6	6	7	7	8	9	10	10	11	12	13	13	14	15	16	17	18	19	20
85				5	5	6	6	7	8	8	9	10	10	11	12	13	14	14	15	16	17	18	19
90					5	5	6	7	7	8	9	9	10	11	11	12	13	14	15	15	16	17	18
95					5	5	6	6	7	7	8	9	9	10	11	12	12	13	14	15	16	16	17
100						5	5	6	6	7	8	8	9	10	10	11	12	12	13	14	15	16	17
105						5	5	6	6	7	7	8	8	9	10	10	11	12	13	13	14	15	16
110							5	5	6	6	7	7	8	9	9	10	11	11	12	13	14	15	15
115							5	5	6	6	7	7	8	8	9	10	10	11	12	12	13	14	15
120								5	5	6	6	7	7	8	9	9	10	10	11	12	13	14	14
125								5	5	6	6	7	7	8	8	9	9	10	11	12	12	13	14
130								5	5	5	6	6	7	7	8	8	9	10	10	11	12	13	13
135									5	5	6	6	6	7	8	8	9	9	10	11	11	12	13
140									5	5	5	6	6	7	7	8	8	9	10	10	11	12	13
145										5	5	6	6	6	7	7	8	9	9	10	11	11	12
150										5	5	5	6	6	7	7	8	8	9	10	10	11	12
155											5	5	6	6	6	7	7	8	9	9	10	11	12
160											5	5	5	6	6	7	7	8	8	9	10	10	11
165												5	5	6	6	6	7	8	8	9	9	10	11
170												5	5	5	6	6	7	7	8	8	9	10	11
175												5	5	5	6	6	7	7	8	8	9	10	10
180													5	5	5	6	6	7	7	8	9	9	10
185													5	5	5	6	6	7	7	8	8	9	10
190														5	5	6	6	6	7	7	8	9	9
195														5	5	5	6	6	7	7	8	8	9
200														5	5	5	6	6	7	7	8	8	9

Years to Boring Height

Site Index	5	6	7	8	9	10	11	12-13	14-15	16-17	18-20	21-25	26-33	34-47	48+
Correct yrs	30	27	24	22	20	19	18	17	16	15	14	13	12	11	10

SiteTools Version 3.2m – Research Branch, British Columbia Ministry of Forests
Date: March 11, 2002
Site Index Equation: Goudie (1984) (natural)

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Table of Site Index by Breast Height Age and Height
Species: Sw – White Spruce and Englemann Spruce – Provincial

28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	Age @ bh
Site Index (m)																							
																							10
																							15
49																							20
43	44	45	47	48	49	50																	25
39	40	41	42	43	44	45	46	47	48	50													30
35	36	37	38	39	40	41	43	44	45	46	47	48	49	50									35
32	33	34	35	36	37	38	40	41	42	43	44	45	46	47	48	49	50						40
30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50			45
28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	50
26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	55
25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	60
24	25	26	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	65
22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	70
21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	75
21	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	80
20	21	22	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	85
19	20	21	22	23	24	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	90
18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	95
18	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	100
17	18	19	20	21	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	39	105
16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	110
16	17	18	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	38	115
15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	120
15	16	17	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	34	35	36	37	125
14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	130
14	15	16	17	17	18	19	20	21	22	23	24	25	26	28	29	30	31	32	33	34	35	36	135
13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	35	36	140
13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	145
13	14	14	15	16	17	18	19	20	21	22	23	24	25	26	28	29	30	31	32	33	34	35	150
12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	33	34	35	155
12	13	14	15	16	17	17	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	160
12	12	13	14	15	16	17	18	19	20	21	22	23	24	26	27	28	29	30	31	32	33	34	165
11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	29	30	31	32	33	34	170
11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	32	33	34	175
11	12	12	13	14	15	16	17	18	19	20	22	23	24	25	26	27	28	29	30	31	32	34	180
10	11	12	13	14	15	16	17	18	19	20	21	22	23	25	26	27	28	29	30	31	32	33	185
10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	27	28	29	30	31	32	33	190
10	11	12	12	13	14	15	16	18	19	20	21	22	23	24	25	26	27	29	30	31	32	33	195
10	10	11	12	13	14	15	16	17	18	19	21	22	23	24	25	26	27	28	29	31	32	33	200

Years to Boring Height

Site Index	5	6	7	8	9	10	11	12-13	14-15	16-17	18-20	21-25	26-33	34-47	48+
Correct yrs	30	27	24	22	20	19	18	17	16	15	14	13	12	11	10

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Figure 7-59 Sw – White and Englemann Spruce – Provincial

7.22. Appendix 22: Stump and Breast Height Diameter Tables for the British Columbia

7.22.1. Merchantable Tree Species[8]

The following tables are designed to be used in the estimation of diameters breast height outside bark (DBH) from stump diameter inside bark (DSIB) measured at a fixed height above ground level (SH). Each table was derived from a regression equation that was fitted on butt diameter measurements of the same trees that were used in the Ministry of Forests and Range metric volume equations.

The regression equations are of the following form:

$$DBH = DSIB + b_0 * DSIB * (2.3 - SH) + b_1 * DSIB * 1n\left[(SH + 1.0)/2.3\right]$$

where DBH and DSIB are in centimetres. SH is measured in metres and can range from 0.15 to 1.05 m. For a given stump cruise, all DSIB measurements should be at a given stump height to facilitate computer compilation.

The constant b_0 and b_1 for the various species and zones are listed below in Table 7.22.1.

A spreadsheet to calculate breast height using the above equation can be found at the following website:

Cruising Calculations

7.22.2. Constants for Species and Zones (Table 7.22.1)

Table 7.22.1—Constants for Species and Zones

Species	Age*	Zone[b]	No. of Observations	B0	B1	SEE[c]
Douglas-fir	MAT.	ABC	2027	0.192451	0.656977	5.24
Douglas-fir	IMM.	ABC	1180	0.155107	0.564107	1.77
Douglas-fir	ALL	D-L	9978	0.189385	0.712098	3.62
Red Cedar	MAT.	ABC	1988	0.032043	0.585026	5.70
Red Cedar	IMM.	ABC	1297	0.055116	0.706639	2.98
Red Cedar	ALL	D-L	4669	0.059052	0.655006	4.16
Red Cedar	ALL	A-QCI	200	0.0297088	.404490	5.96
Hemlock	MAT.	ABC	4058	0.064571	0.534355	4.68
Hemlock	IMM.	ABC	2167	0.077996	0.438284	1.73
Hemlock	ALL	D-L	5466	0.100771	0.504787	2.94
Hemlock	ALL	A-QCI	323	0.0508525	0.360565	6.50
Spruce	MAT.	ABC	1197	0.021123	0.530663	8.23

[8] A. Kozak, Faculty of Forestry, University of British Columbia and S. A. Omule, Research Branch, Ministry of Forests, February 1989.

Species	Age*	Zone[b]	No. of Observations	B_0	B_1	SEE[c]
Spruce	IMM.	ABC	980	0.046301	0.580005	4.23
Spruce	ALL	D-J	13755	0.065728	0.575037	3.11
Spruce	ALL	KL	11494	0.062808	0.442810	1.46
Spruce	ALL	A-QCI	184	0.0299746	0.413498	6.48
Balsam	ALL	ABC	2548	0.057484	0.573054	4.84
Balsam	ALL	D-J	11760	0.073625	0.477491	2.02
Balsam	ALL	KL	2307	0.073358	0.431277	1.24
Yellow-Cedar	ALL	A-L	905	0.037211	0.460492	2.03
Yellow Cedar	ALL	A-QCI	106	0.0217802	0.289677	3.61
White Pine	ALL	ABC	275	0.057377	0.561538	3.32
White Pine	ALL	D-L	774	0.056953	0.449184	1.76
Lodgepole pine	ALL	A-J	8318	0.056984	0.374589	1.23
Lodgepole pine	ALL	KL	5259	0.051075	0.337046	0.91
Yellow pine	ALL	A-L	2023	0.154163	0.638001	3.18
Larch	ALL	A-J	2520	0.190001	0.682016	4.06
Larch	ALL	KL	811	0.078977	0.532930	0.91
Cottonwood	ALL	A-J	996	0.117130	0.565108	3.91
Cottonwood	ALL	KL	2137	0.136074	0.498340	1.80
Alder	ALL	A-L	1556	0.055705	0.374983	1.34
Maple	ALL	A-L	416	0.064992	0.421552	0.72
Birch	ALL	A-J	923	0.070797	0.455765	1.60
Birch	ALL	KL	750	0.070901	0.407800	0.84
Aspen	ALL	A-J	2204	0.103886	0.492890	1.55
Aspen	ALL	KL	4100	0.097907	0.469721	1.50
Whitebark pine	ALL	A-L	148	0.036171	0.482541	1.66

*Age: IMM. = immature, up to 120 years old, MAT. = mature, more than 120 years old, ALL = all ages.

[b]Zone: A = North and central coast region, B = Southern coast region, C = South Coast transition belt, D = South western interior dry belt, E = West Kootenay region, F = East Kootenay region, G = central Columbia region, interior wet belt, H = Nechako, Fraser plateau region, I = Central interior, J = North west plateau region, Stikine, Skeena, K = North Central Region, Cassiar, Omineca, L = North eastern plains region.

[c]SEE: = Standard error of estimated DBH, for all diameter classes

(cm). Note - QCI = Queen Charlottes PSYU

7.22.3. Butt Taper - Mature - FIZ A, B and C – Coast (Table 7.22.2)

Table 7.22.2—Butt Taper - Mature - FIZ A, B and C – Coast

dbh (ob)	F*		C*		H*		B		S*		Y	
(cm) @ 1.3 m	dib	dob	dib	dob	dib	dob	dib	dob	dib	dob	dib	dob
06	6	7	8	9	7	8	8	8	8	8	7	8
08	8	9	11	11	10	10	10	10	11	11	10	10
10	10	12	14	14	12	13	13	13	14	14	12	13
12	12	14	17	17	15	15	15	16	16	17	15	15
14	14	17	19	20	17	18	18	18	19	19	17	18
16	16	19	22	22	19	20	20	21	22	22	20	20
18	18	21	25	25	22	23	23	23	24	25	22	23
20	20	24	27	28	24	25	25	26	27	27	25	25
22	22	26	30	31	27	28	28	29	30	30	27	28
24	24	28	33	34	29	30	31	31	33	33	30	31
26	26	31	36	37	32	33	33	34	35	36	32	33
28	28	33	38	39	34	35	36	36	38	38	35	36
30	30	35	41	42	36	38	38	39	41	41	37	38
32	32	38	44	45	39	40	41	41	43	44	39	41
34	34	40	47	48	41	43	43	44	46	47	42	43
36	36	43	49	51	44	45	46	47	49	49	44	46
38	38	45	52	54	46	48	48	49	51	52	47	48
40	40	47	55	56	49	50	51	52	54	55	49	51
42	42	50	58	59	51	53	53	54	57	58	52	53
44	44	52	60	62	53	55	56	57	60	60	54	56
46	46	54	63	65	56	58	58	60	62	63	57	59
48	48	57	66	68	58	60	61	62	65	66	59	61
50	50	59	69	70	61	63	64	65	68	69	62	64
55	55	65	75	77	67	69	70	71	74	75	68	70
60	59	71	82	84	73	76	76	78	81	82	74	76
65	64	77	89	92	79	82	83	84	88	89	80	83
70	69	83	96	99	85	88	89	91	95	94	86	89
75	74	89	103	106	91	94	95	97	101	103	92	95
80	79	94	110	113	101	102	104	108	108	110	99	102
85	84	100	116	120	103	107	108	110	115	116	105	108
90	89	106	123	127	109	113	114	117	122	123	111	114
95	94	112	130	134	115	120	121	123	129	130	117	121
100	99	118	137	141	121	126	127	130	135	137	123	127
105	104	124	144	148	127	132	133	136	142	144	129	133
110	109	130	151	155	134	138	140	142	149	151	136	140
115	114	136	158	162	140	145	146	149	156	158	142	146
120	119	142	164	169	146	151	152	155	162	164	148	153

* Mature - Forest Inventory Zones - A, B, C, - Coast (table shows diameter at stump height of 0.3 m).

dbh (ob)	Pw		Pl		Ac		Alder		Maple		Birch	
(cm) @ 1.3 m	dib	dob	dib	dob	dib	dob	dib	dob	dib	dob	dib	dob
06	8	8	7	7	7	7	7	7	7	7	7	7
08	10	10	9	10	9	10	9	9	9	10	9	10
10	13	13	11	12	11	12	11	12	11	12	11	12
12	15	16	13	14	13	14	13	14	14	14	14	15
14	18	18	16	17	15	17	16	17	16	17	16	17
16	20	21	18	19	18	19	18	19	18	19	18	19
18	23	23	20	21	20	21	20	21	20	22	20	22
20	25	26	22	24	22	24	22	24	23	24	23	24
22	28	28	24	26	24	26	25	26	25	26	25	27
24	30	31	27	28	26	28	27	28	27	29	27	29
26	33	34	29	31	29	31	29	31	29	31	30	31
28	35	36	31	33	31	33	31	33	32	34	32	34
30	38	39	33	36	33	36	33	35	34	36	34	36
32	40	41	36	38	35	38	36	38	36	38	36	39
34	43	44	38	40	37	40	38	40	38	41	39	41
36	45	46	40	43	40	43	40	42	41	43	41	43
38	48	49	42	45	42	45	42	45	43	45	43	46
40	50	52	44	47	44	47	45	47	45	48	45	48
42	53	54	47	50	46	50	47	49	47	50	48	51
44	55	57	49	52	48	52	49	52	50	53	50	53
46	58	59	51	54	51	55	51	54	52	55	52	55
48	60	62	53	57	53	57	54	56	54	57	55	58
50	63	65	56	59	55	59	56	59	56	60	57	60
55	69	71	61	65	60	65	61	65	62	66	62	66
60	76	77	67	71	66	71	67	71	68	72	68	72
65	82	84	72	77	71	77	72	76	73	78	74	78
70	88	90	78	83	77	83	78	82	79	84	79	84
75	94	97	83	89	82	89	84	88	84	90	85	90
80	101	103	89	95	88	95	89	94	90	96	91	96
85	107	110	94	100	93	101	95	100	96	102	96	102
90	113	116	100	106	99	107	100	106	101	108	102	108
95	102	123	106	112	104	113	106	112	107	114	108	115
100	126	129	111	118	110	118	111	118	112	120	113	121
105	132	135	117	124	115	124	117	123	118	126	119	126
110	139	142	122	130	121	130	123	129	124	131	125	133
115	145	148	128	136	126	136	128	135	129	137	131	139
120	151	155	133	142	132	142	134	141	135	143	136	145

* Mature - Forest Inventory Zones - A, B, C, - Coast (table shows diameter at stump height

7.22.4. Butt Taper - All Ages - FIZ D to J – Interior (Table 7.22.3)

Table 7.22.3—Butt Taper - All Ages - FIZ D to J – Interior

dbh (ob)	F		C		H		B		S		Pw	
(cm) @ 1.3 m	dib	dob	dib	dob	dib	dob	dib	dob	dib	dob	dib	dob
06	6	7	8	8	7	7	7	7	8	8	7	7
08	8	10	11	11	9	9	9	10	10	11	9	10
10	10	12	14	14	11	12	11	12	13	13	12	12
12	12	15	16	17	13	14	14	15	15	16	14	15
14	14	17	19	19	15	17	16	17	17	18	16	17
16	17	20	22	22	18	19	18	19	20	21	19	20
18	19	22	24	25	20	21	21	22	22	24	21	22
20	21	25	27	28	22	23	23	24	25	26	23	25
22	23	27	30	31	24	26	25	27	27	29	26	27
24	25	30	32	33	26	28	27	29	30	32	28	30
26	27	32	35	36	29	31	30	31	32	34	30	32
28	29	35	38	39	31	33	32	34	35	37	33	35
30	31	37	40	42	33	35	34	36	37	39	35	37
32	33	40	43	44	35	38	37	39	40	42	37	39
34	35	42	46	47	37	40	39	41	42	45	40	42
36	37	45	48	50	39	42	41	44	45	47	42	44
38	39	47	51	53	42	45	43	46	47	50	44	47
40	41	49	54	55	44	47	46	48	50	53	47	49
42	43	52	56	58	46	50	48	51	52	55	49	52
44	45	54	59	61	48	52	50	53	55	58	51	54
46	47	57	62	64	50	54	53	56	57	60	54	57
48	49	59	65	67	53	56	55	58	60	63	56	59
50	51	62	67	69	55	59	57	60	62	66	58	62
55	57	68	74	76	60	65	63	66	69	72	64	68
60	62	74	81	83	66	71	69	73	75	79	70	74
65	67	80	87	90	71	77	74	79	81	85	76	80
70	72	87	94	97	77	82	80	85	87	92	82	86
75	77	93	101	104	82	88	86	91	93	98	88	92
80	82	99	108	111	88	94	92	97	100	105	93	99
85	87	105	114	118	93	100	97	103	106	112	99	105
90	93	111	121	125	99	106	103	109	112	118	105	111
95	98	117	128	132	104	112	109	115	118	125	110	117
100	103	124	134	139	110	118	114	121	125	131	117	123
105	108	130	141	145	115	124	120	127	131	138	122	129
110	113	136	148	152	121	130	126	133	137	144	128	136
115	118	142	155	159	126	135	132	139	143	151	134	142
120	123	148	161	166	131	141	137	145	149	157	140	148

* All Ages - Forest Inventory Zones - D to J - Interior (table shows diameter at stump height of 0.3 m).

dbh (ob)	Pl		Py		Larch		Ac		Birch		Aspen	
(cm) @ 1.3 m	dib	dob	dib	dob	dib	dob	dib	dob	dib	dob	dib	dob
06	7	7	6	7	6	8	7	7	7	7	7	7
08	9	10	9	10	8	11	9	10	9	10	9	10
10	11	12	11	12	10	14	11	12	11	12	11	12
12	13	14	13	15	12	16	13	14	14	15	13	14
14	16	17	15	17	14	19	15	17	16	17	15	17
16	18	19	17	20	16	22	18	19	18	19	17	19
18	20	21	19	22	18	24	20	21	20	22	19	21
20	22	24	21	25	20	27	22	24	23	24	22	24
22	24	26	23	27	22	30	24	26	25	27	24	26
24	27	28	25	30	24	33	26	28	27	29	26	29
26	29	31	28	32	26	35	29	31	30	31	28	31
28	31	33	30	35	28	38	31	33	32	34	30	33
30	33	36	32	37	30	41	33	35	34	36	32	36
32	36	38	34	40	32	43	35	38	36	39	35	38
34	38	40	36	42	34	46	37	40	39	41	37	40
36	40	43	38	45	36	49	40	43	41	43	39	43
38	42	45	40	47	38	52	42	45	43	46	41	45
40	44	47	42	50	40	54	44	47	45	48	43	48
42	47	50	45	52	42	57	46	50	48	51	45	50
44	49	52	47	55	44	60	48	52	50	53	48	52
46	51	54	49	57	46	62	51	54	52	55	50	55
48	53	57	51	59	48	65	53	57	55	58	52	57
50	56	59	53	62	50	68	55	59	57	60	54	60
55	62	65	58	68	56	75	60	65	62	66	59	66
60	67	71	64	74	61	81	66	71	68	72	65	72
65	72	77	69	81	66	88	71	77	74	78	70	77
70	78	83	74	87	71	95	77	83	79	84	76	83
75	83	89	80	93	76	102	82	89	85	90	81	89
80	89	95	85	99	81	109	88	95	91	96	86	95
85	94	100	90	105	86	115	93	101	96	102	92	101
90	100	106	95	111	91	122	99	107	102	108	97	107
95	106	112	101	118	96	129	104	113	108	115	103	113
100	111	118	106	124	101	136	110	118	113	121	108	120
105	117	124	111	130	106	143	115	124	119	127	113	125
110	122	130	117	136	111	149	121	130	125	133	119	131
115	128	136	122	142	116	156	126	136	131	139	124	137
120	133	142	127	149	121	163	132	142	136	145	130	143

* All Ages - Forest Inventory Zones - D to J - Interior (table shows diameter at stump height of 0.3 m).

7.22.5. Butt Taper - All Ages - FIZ K and L – Interior (Table 7.22.4)

Table 7.22.4—Butt Taper - All Ages - FIZ K and L – Interior

dbh (ob)	H		B		S		Pl	
(cm) @ 1.3 m	dib	dob	dib	dob	dib	dob	dib	dob
06	7	7	7	7	7	7	7	7
08	9	9	9	9	9	10	9	9
10	11	12	11	12	12	12	11	12
12	13	14	13	14	14	15	13	14
14	15	17	16	17	16	17	15	16
16	18	19	18	19	18	19	18	18
18	20	21	20	21	21	22	20	21
20	22	23	22	24	23	24	22	23
22	24	26	24	26	25	27	24	25
24	26	28	27	28	28	29	26	28
26	29	31	29	31	30	31	29	30
28	31	33	31	33	32	34	31	32
30	33	35	33	35	34	36	33	34
32	35	38	36	38	37	39	35	37
34	37	40	38	40	39	41	37	39
36	39	42	40	42	41	43	40	41
38	42	45	42	45	44	46	42	44
40	44	47	44	47	46	48	44	46
42	46	50	47	50	42	51	46	48
44	48	52	49	52	50	53	48	50
46	50	54	51	54	53	56	51	53
48	53	56	53	57	55	58	53	55
50	55	59	56	59	57	60	55	57
55	60	65	61	65	63	66	61	63
60	66	71	67	71	69	72	66	69
65	71	77	72	77	75	78	71	75
70	77	82	78	82	80	84	77	80
75	82	88	83	88	86	91	82	86
80	88	94	89	94	92	97	88	92
85	93	100	94	100	97	103	93	98
90	99	106	100	106	103	109	99	103
95	104	112	106	112	109	115	104	109
100	110	118	111	118	115	121	110	115
105	115	124	117	124	120	127	115	121
110	121	130	122	130	126	133	121	126
115	126	135	128	135	132	139	126	132
120	131	141	133	141	138	145	132	138

* Table shows diameter at stump height of 0.3 m.

dbh (ob)	Larch		Ac		Birch		Aspen	
(cm) @ 1.3 m	dib	dob	dib	dob	dib	dob	dib	dob
06	7	8	6	7	7	7	7	7
08	9	10	8	9	9	9	9	10
10	12	13	10	11	11	12	11	12
12	14	15	12	14	13	14	13	14
14	16	18	14	16	15	16	15	17
16	19	20	16	18	18	19	17	19
18	21	23	18	20	20	21	19	22
20	23	25	20	23	22	23	22	24
22	26	28	22	25	24	26	24	26
24	28	30	24	27	26	28	26	29
26	31	33	26	29	29	30	28	31
28	33	35	28	32	31	33	30	34
30	35	38	30	34	33	35	32	36
32	38	40	32	36	35	38	35	38
34	40	43	34	39	37	40	37	41
36	43	45	36	41	40	42	39	43
38	45	48	39	43	42	45	41	45
40	47	50	41	45	44	47	43	48
42	49	53	43	48	46	49	45	50
44	52	55	45	50	48	52	47	53
46	54	58	47	52	51	54	50	55
48	56	60	49	54	53	56	52	57
50	59	63	51	57	55	59	54	60
55	64	69	56	62	61	64	59	66
60	70	75	61	68	66	70	65	72
65	76	81	66	74	72	76	70	78
70	82	88	71	79	77	82	75	84
75	88	94	76	85	83	88	81	90
80	94	100	81	91	88	94	86	96
85	100	106	86	96	94	100	92	102
90	105	113	91	102	99	105	97	108
95	111	119	96	108	105	111	102	114
100	117	125	101	113	110	117	108	120
105	123	132	106	119	116	123	113	126
110	129	138	111	125	121	129	119	132
115	135	144	116	130	127	135	124	138
120	140	150	121	136	132	141	129	144

* Table shows diameter at stump height of 0.3 m.

7.22.6. Butt Taper - Immature - FIZ A, B and C – Coast (Table 7.22.5)

Table 7.22.5—Butt Taper - Immature - FIZ A, B and C – Coast

dbh (ob)	F		C		H		S	
(cm) @ 1.3 m	dib	dob	dib	dob	dib	dob	dib	dob
06	6	7	9	9	7	7	8	8
08	8	10	11	12	9	10	11	11
10	10	12	14	15	11	12	13	13
12	12	14	17	18	13	14	16	16
14	14	17	20	20	16	17	18	19
16	16	19	23	23	18	19	21	21
18	18	21	26	26	20	21	24	24
20	20	24	28	29	22	24	26	27
22	22	26	31	32	24	26	29	29
24	24	29	34	35	27	28	32	32
26	26	31	37	38	29	31	34	34
28	28	33	40	41	31	33	37	37
30	30	36	42	44	33	36	39	40
32	32	38	45	47	35	38	42	42
34	34	40	48	50	38	40	45	45
36	36	43	51	53	40	43	47	48
38	38	45	54	55	42	45	50	50
40	41	48	57	58	44	47	53	53
42	43	50	59	61	46	50	55	56
44	45	52	62	64	49	52	58	58
46	47	55	65	67	51	54	60	61
48	49	57	68	70	53	57	63	64
50	51	59	71	73	55	59	66	66
55	56	65	78	80	61	65	72	73
60	61	71	85	87	66	71	79	79
65	66	77	92	95	72	77	85	86
70	71	83	99	102	77	83	92	93
75	76	89	106	109	83	89	99	99
80	81	95	112	117	88	95	105	106
85	86	101	120	124	94	101	112	113
90	91	107	127	131	99	106	118	119
95	96	113	134	138	105	112	125	126
100	101	119	142	146	110	118	131	132
105	106	125	149	153	116	124	138	139
110	111	131	156	160	121	130	144	146
115	116	137	163	168	127	136	151	152
120	121	142	170	175	133	142	158	159

* Table shows diameter at stump height of 0.3 m.

7.22.7. Timber Type Label Information

Timber type labels have traditionally followed inventory naming conventions. The fields within the inventory labels are presented below:

Major Species: A species is major if it comprises 20 percent or more of the total gross volume.

Species #1: Leading species in terms of gross volume in the type. **Species #2:** Second leading species in terms of gross volume in the type. **Species #3:** Third leading species in terms of gross volume in the type.

Minor Species: A minor species comprises less than 20 percent of the gross volume for the type. Usually identified by brackets in the label.

Age Class

Code	Age Class Limits
1	1-20 years
2	21-40 years
3	41-60 years
4	61-80 years
5	81-100 years
6	101-120 years
7	121-140 years
8	141-250 years
9	250+ years

Height Class (metres)

Code	Height Class Limits (metres)
1	0-10.4
2	10.5-19.4
3	19.5-28.4

Code	Height Class Limits (metres)
4	28.5-37.4
5	37.5-46.4
6	46.5-55.4
7	55.5-64.4
8	64.5 +

Site Class

Site is determined for all productive forest types by the application of sample tree age and height measurements in the Site Index Tables for British Columbia – All Species (Appendix 21).

	Code
G	good site
M	medium site
P	poor site
L	low site

Type Identity

The recognized classes of cover on forest land are Immature, Mature, Mature Residual, Not Satisfactorily Restocked (NSR), Non-commercial (NC), and Non-Productive Forest.

Code	Identity	Description
1	Immature (Imm.)	Coniferous trees younger than 121 years with the exception of deciduous which must be younger than 41 years to be classed as immature.
2	Mature (Mat.)	Coniferous trees older than 120 years with the exception of deciduous species where the age break is more than 40 years.

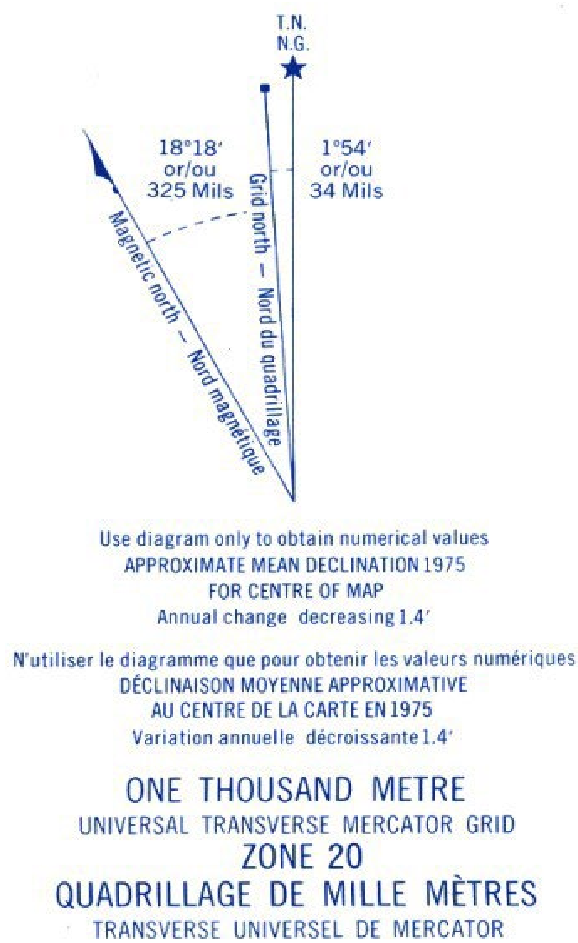
Code	Identity	Description
3	Mature Residual (Mat. R.)	Types disturbed 26 to 75 percent; supporting remnants of the original forest stand where the most significant element of the surviving stand is classed as mature.
4	NSR	Denuded areas that do not meet minimum stocking requirements of approximately 750 healthy, well-distributed seedlings or juvenile stems per hectare.
5	Non-Commercial (NC)	This cover class is used very sparingly being confined almost exclusively to deciduous brush growing on productive sites. On occasion it may be used to describe stands usually disturbed, of very low quality that cannot be, as a practical matter, classified as commercial, NSR or DSD.
6	Non-Productive Forest	Forest land of very low productivity presenting no commercial possibilities in the foreseeable future.

7.23. Appendix 23: True North, Magnetic North and Grid North

The following is an explanation prepared by Ted Vint, RFT – West Fraser Mills Ltd

There are three different definitions of North, commonly seen in forestry mapping. Which one is relevant depends on whether one is looking at a compass or map (and what map projections are used to align the map, or are displayed as grids on the map). A cruise grid design is best done in alignment with true north.

- **True North** can be found on a map where there are meridians (north-south running lines) that run straight at the earth's actual North Pole. The best example of this would be the Geographic Coordinate System, in which the grid is made up of lines of latitude and longitude. The BC Albers projection also has meridians that lead to true north.
- **Magnetic North** is the direction to the magnetic north pole, which is constantly changing. A magnetic declination calculator is available at http://geomag.nrcan.gc.ca/apps/mdcal-eng.php, which will give the current declination for any location, as compared to true north. Declination values could also come from other sources, like federal government topographic maps, which give the declination in relation to grid north (see blue diagram to right).
- **Grid North:**
  a. **The Universal Transverse Mercator (UTM) projection** grid leads to 'grid north', which only matches true north at the centre of each UTM Zone. Grid north differs more and more from true north, as one moves east or west of the central meridian of the UTM Zone.
  b. **The BC Albers projection** grid also leads to its own 'grid north', which only matches true north at its central meridian (at 126° Longitude). Grid north differs more and more from true north, as one moves east or west of the central meridian.



The edges of a map could potentially align with either true north or grid north.

- The example below shows a cruise grid aligned with the lines of latitude and longitude (in green), and illustrates how North on the UTM grid (red) can be several degrees different from the True North of the geographic grid.

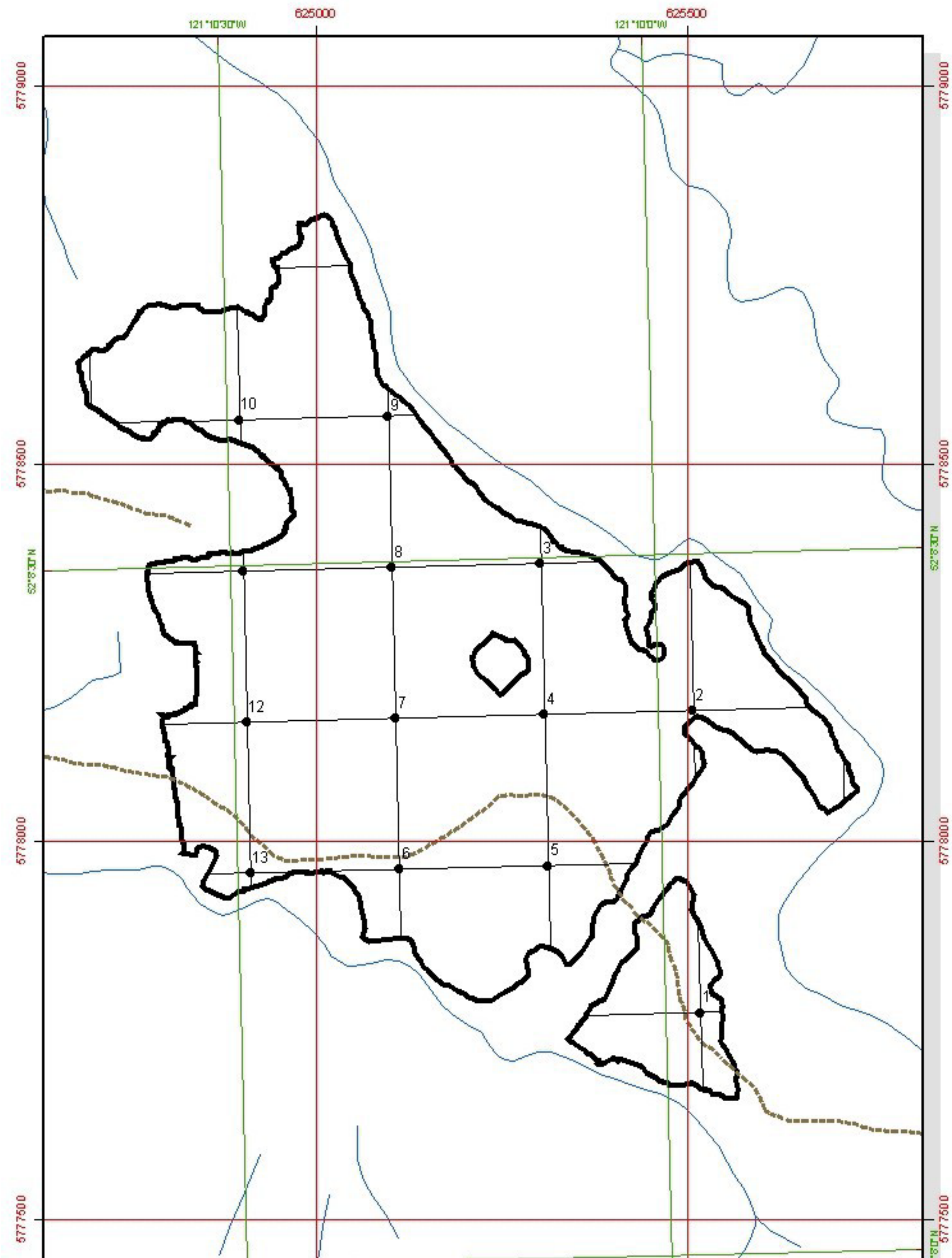


Figure 7-60 Map showing difference between True North and Grid North