BRITISH COLUMBIA

Ministry of Forests

Revenue Branch

MEMORANDUM

File: 308-07/CRUI

March 25, 2002

To: Regional Managers

From: Bill Howard
Director
Revenue Branch

Re: ***Cruising Manual***

The new *Cruising Manual* becomes effective April 1, 2002, and can be downloaded from the following Internet site on that date:

http://www.for.gov.bc.ca/revenue/manuals/cruising/index.htm

The annual change descriptions are included.

Comments or questions about the manual should be referred to Maarten Prinsze, Cruising Policy Forester, Revenue Branch at 250-387-8357, or Don Rorison, Cruising Projects Specialist, Revenue Branch at 250-356-7674.

Any public or hard copy requests for the manuals or amendments should be referred to Crown Publications, 521 Fort Street, Victoria, British Columbia, V8W 1E7 (telephone 250-386-4636, facsimile 250-386-0221).

W Howard

Bill Howard
Director
Revenue Branch

pc: Don Rorison, Cruising Projects Specialist, Revenue Branch
Region and District Cruising Coordinators

REVENUE BRANCH

Cruising Manual

Effective April 1, 2002

BRITISH COLUMBIA

This manual is intended for the use of individuals or companies when conducting business with the British Columbia Government. Permission is granted to reproduce them for such purposes. This manual and related documentation and publications, are protected under the *Federal Copyright Act.* They may not be reproduced for sale or for other purposes without the express written permission of the Province of British Columbia.

Annual Highlights

2002 Change Descriptions

The *Cruising Manual* is available on the Internet at:

http://www.for.gov.bc.ca/revenue/manuals/cruising/

Section	Highlight
Chapter 1	Terms of Reference, Authority for the *Cruising Manual.*
Chapter 2	*Coast Appraisal Manual* and *Interior Appraisal Manual* references and housekeeping.
2.1.2	The minimum number of plots and trees/plot are not a compilation check concern if the sampling error is achieved for clearcut cutting authority areas.
2.1.2.2, 7.	Single tree selection harvesting options are: a. S.E. based on the cut trees, b. 2 plots/ha with 2 cut trees/plot, or c. 100 percent cruise.
2.1.2.3	Comparative cruising procedures and checklist are included in the manual. A minimum of 6.0 plots/timber type are required in the new cutting authority areas.
2.1.2.4	Areas that are unsafe to cruise will apply the adjacent cruise information from the same timber types.
2.7.1.2	Count plots not permitted in partial cut cruises due to the high probability that measure information could be missing for cut trees. Figure 2.2 – Sample FS 205 illustrating how to record count plot data if appraisal and utilization levels differ.
3.1.6.1	Added Internet option to calculate azimuth bearings from UTM coordinates when combining GPS and conventional traverse data.
3.4.1.6	Half plots are not permitted in the Interior after March 31, 2002. Border plots cannot be used in count plots.
3.5.3	Figure 3.8 – Illustrations of where to measure tree heights when tops are broken or trees are forked.

3.5.4.2	Down trees with pieces removed will be measured if 50 percent or more of their gross volume is on site.
3.5.6.3	Exception to the green or red needle rule for interior sub-alpine fir (*abies lasiocarpa*) using indications and contraindications. Pathology must be called on dead potential trees on the coast and hemlock in the interior if they will use the log grade algorithms for appraisal.
3.5.9	Age in 10's by plot or type may be used, provided that the correct loss factors are used consistent with Table 17, Tree Class Modification of Loss Factor Tables.
3.6	• a reminder to calibrate instruments regularly, • borderline tree measurement variations subject to a 1 percent variation in plot radius and a one percent variation in horizontal distance, • minimum utilization size trees subject to a 1 percent variation, • species tolerance is 1 in 50 trees checked, • digital cameras recommended as a dispute resolution tool, and • time limits set for the dispute resolution mechanism.
Chapter 4	Housekeeping.
Chapter 5	Housekeeping.
Chapter 6	Housekeeping.
6.3.2	Figure 6.5 – Interior Log Grade Algorithm – a new flowchart developed for Interior Hemlock partition cutting authorities.
Chapter 7	Housekeeping.
7.1	Position 39 to 53 – website to access UTM coordinates.
Chapter 8	Housekeeping.
8.6.2	Stump cruising – procedure for measuring stumps longer than 1.3 m above the highside ground.
Chapter 9	Coastal Guidelines – housekeeping and updates.

Table 3	Degrees of freedom table updated for consistency with compilation program.
A.1	Site Index curves reference to Appendix 10.
A.2	Magnetic Declination Table updated.
A.4.2.1	Figure A.3, Figure A.4 and Figure A.5 – pathological indicators/non-indicators.
A.7.3	Figure A.39 – mechanical damage.
A.8.2	Figure A.41 and Figure A.42 – New interior log grade algorithm.
A.10	New appendix – Site Index Tables for British Columbia – All Species
Forms	Figure F.3 – Provincial Cruise Plan and Map Check List Figure F.4 – Provincial Office Check of Field Cruise Data Figure F.6 – Provincial Compilation Check Form Figure F.7 – Provincial Comparative Cruise Checklist

Forest Service (FS) forms are available at the following site:

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

Table of Contents

1 Introduction

1.1 Terms of Reference 1-2

2 Cruise Design

2.1 Cruise Objective 2-2
2.1.1 Cruise Plans 2-2
2.1.2 Scale-Based Stumpage Assessment - Timber Sales or Cutting Permits 2-4
2.1.2.1 Clearcutting Sampling Requirements 2-5
2.1.2.2 Partial Cutting Sampling Requirements 2-5
2.1.2.3 Comparative Cruises 2-7
2.1.2.4 Unsafe to Cruise 2-9
2.1.3 Cruise-Based Stumpage Assessment - Timber Sales or Cutting Permits 2-9
2.1.4 Standards for Re-cruising 2-10
2.2 Types of Cruise 2-11
2.2.1 100-Percent Cruise 2-11
2.2.2 Sampling Patterns-General 2-11
2.2.2.1 Systematic Sampling 2-11
2.2.2.2 Cruising Rights of Way 2-12
2.2.2.3 Cruising Patch Cuts 2-12
2.2.2.4 Moving Plots 2-13
2.2.2.5 Probability Proportional to Prediction 2-13
2.3 Sampling Errors 2-14
2.4 Variable-Plot (Prism) Sampling 2-15
2.4.1 Plot Sample Size 2-15
2.4.2 Prism Sampling 2-15
2.5 Fixed Area Plot Sampling 2-16
2.5.1 Fixed Sample Size 2-16
2.6 Statistical Concepts 2-17
2.6.1 Probability Factor "t" 2-17
2.6.2 Coefficient of Variation (CV) 2-18
2.6.3 Stratification 2-19
2.6.3.1 Forest Typing 2-20
2.6.3.2 Minimum Plots Per Type 2-21
2.6.3.3 Calculation of Number of Samples 2-22
2.7 Double-Sampling 2-23
2.7.1 Type of Plots 2-23

2.7.1.1 Measured Plots 2-23
2.7.1.2 Count Plots 2-23

3 Field Procedures

3.1 General Provisions 3-2
3.1.1 Signatures 3-2
3.1.2 Tie-Points 3-2
3.1.2.1 Options for selecting the Point of Commencement (POC) 3-2
3.1.3 Strip-Lines 3-2
3.1.4 Plot-Centres 3-3
3.1.5 Slopes 3-3
3.1.5.1 Slope Percent 3-3
3.1.5.2 Distance Slope Correction 3-3
3.1.6 Traversing 3-4
3.1.6.1 Combined GPS and Conventional Traverse Procedure 3-7
3.1.7 Mapping 3-9
3.1.7.1 Cruise Plan Map Standards 3-9
3.1.7.2 Final Cruise Map Standards 3-10
3.2 One Hundred Percent Cruises 3-11
3.3 Fixed-Area Plot Cruises 3-12
3.3.1 Circular Plots 3-12
3.3.2 Rectangular Plots 3-12
3.3.3 Borderline Trees (Fixed-Area Plots) 3-12
3.4 Variable (Prism) Plot Cruises 3-13
3.4.1 Sampling Procedures 3-13
3.4.1.1 BAF Selection 3-14
3.4.1.2 Prism Slope Correction 3-14
3.4.1.3 Borderline Trees (Prism Plots) 3-14
3.4.1.4 Leaning or "Down" Trees 3-16
3.4.1.5 Hidden Trees 3-17
3.4.1.6 Half Plots 3-17
3.4.1.7 "Boundary" or "Border" Plots (Plots Falling On Type or Block Boundaries) 3-17
3.5 Tree Measurements - Prism and Fixed-Area Plots 3-20
3.5.1 Marking Trees 3-20
3.5.2 Species 3-20
3.5.3 Heights 3-20
3.5.3.1 Leaning Trees 3-22
3.5.3.2 Deciduous Tree Heights 3-23
3.5.3.3 "One Hundred Percent" Height Measurements 3-23
3.5.3.4 "Sample-Height" Heights (Height/Diameter Curves) 3-23
3.5.4 Diameters 3-26
3.5.4.1 High Side 3-26
3.5.4.2 Diameter at Breast Height 3-26
3.5.5 Pathology 3-29

3.5.6 Tree Classes 3-29
3.5.6.1 Tree Class 1 (Residual) 3-29
3.5.6.2 Tree Class 2 (Suspect) 3-29
3.5.6.3 Tree Class 3 (Dead Potential) 3-30
3.5.6.4 Tree Class 4 (Dead Useless) 3-31
3.5.6.5 Tree Class 5 (Veteran) 3-32
3.5.6.6 Tree Class 6 (Live Useless) 3-32
3.5.6.7 Tree Class 7 (Veteran Dead Potential) 3-32
3.5.6.8 Tree Class 8 (Immature) 3-32
3.5.6.9 Tree Class 9 (Immature Dead Potential) 3-32
3.5.7 Quality 3-33
3.5.8 Damage Codes 3-33
3.5.9 Ages 3-33
3.6 Check Cruising 3-35
3.6.1 Data Replacement and Responsibility for Data 3-35
3.6.2 Objectives of Check Cruising 3-35
3.6.2.1 Risk Management 3-36
3.6.3 Allowable Non-Sampling Errors 3-37
3.6.3.1 Tree Data 3-37
3.6.3.2 Quality (Coast)- as they affect grade 3-41
3.6.3.3 Slopes 3-41
3.6.4 Allowable Non-Sampling Errors - Original Versus Check Plots 3-42
3.6.4.1 Net Volume Standard 3-42
3.6.5 Standards for Some Basic Cruise Functions 3-42
3.6.6 Check Cruising Dispute Mechanism 3-43

4 Cruise Compilation Procedures

4.1 Input 4-2
4.1.1 Cruise Tally Sheet (FS 205) 4-2
4.1.1.1 Plot Record (Card Type 9) 4-2
4.1.1.2 Individual Tree Records (Card Type 2) 4-2
4.1.1.3 Sample Tree Details (Card Type 3) 4-2
4.1.2 Map Area Statement (FS 121) 4-2
4.1.2.1 Cruise Identity (Card Type A) 4-2
4.1.2.2 Compilation Standard (Card Type B) 4-3
4.1.2.3 Type Description (Card Type C) 4-3
4.1.2.4 Block Description (Card Type D) 4-3
4.1.2.5 Height/DBH Description (Card Type E) 4-3
4.1.2.6 Harvesting Method Description (Card Type F) 4-3
4.1.2.7 Silviculture Treatment Unit Description (Card Type G) 4-3
4.2 Compilation Programs 4-4
4.2.1 Height-DBH Relationships for Stump Cruises and Severe Damage Timber Cruises 4-4
4.2.1.1 Height-DBH Regression Program 4-4
4.2.2 Volume and Taper Equations 4-5

4.2.3 Net Volume Factors 4-7
4.3 Volume Compilation - Fixed Area Plot Cruising 4-8
4.4 Log Grade Volume Compilation 4-9
4.5 Volume Compilation - Variable-Plot Cruising 4-10
4.5.1 Compilation Methods - Using a Single Prism and Full Sweep (360°) 4-11
4.5.2 Compilation Methods - Using 2 Different Prisms And Full Sweep (360°) 4-12
4.5.3 Compilation Methods - Using One Prism With Full And Half-Sweeps 4-13
4.5.4 Compilation Methods - Using Count-Plots 4-13
4.6 Computer Compilation Output 4-15
4.6.1 Summary of Required/Optional Reports 4-16
4.6.2 FS 221 – Percent Reduction 4-17
4.6.3 Valid Compilation Programs 4-18

5 Cruise Analysis

5.1 Cruise Statistics 5-2
5.2 Interpretation 5-3

6 Ministry of Forests Cruise Tally Sheet (FS 205)

6.1 Form Design - General 6-2
6.2 Entry of Data in Divided Spaces or Numbered Columns 6-5
6.3 Front Side of Cruise Tally Sheet (FS 205 HVA 2002/04) 6-6
6.3.1 Card Type 9 6-6
6.3.2 Card Type 2 6-13
6.3.3 Card Type 3 6-24
6.4 Reverse Side of Cruise Tally Sheet (FS 205 HVA 2002/04) 6-25
6.4.1 Miscellaneous 6-25

7 Ministry of Forests Map Area Statement (FS 121)

7.1 Card Type A 7-2
7.2 Card Type B 7-11
7.3 Card Type C 7-17
7.4 Card Type D 7-22
7.5 Card Type E 7-24
7.6 Card Type F 7-28
7.7 Card Type G 7-30

8 Stump Cruising

8.1 Introduction 8-2
8.1.1 General Procedures 8-2
8.1.2 Stump Cruising - Volume Calculations 8-3
8.1.3 Sampling Errors 8-4
8.2 Boundaries 8-5
8.3 Measurement Methods 8-6
8.3.1 Method 1: Areas Less than 10 ha 8-6
8.3.2 Method 2: Areas Greater than or Equal to 10 ha 8-6
8.4 Tree Heights 8-7
8.4.1 Stump Cruise Tally Sheet (FS 205S) 8-7
8.4.1.1 Card Type 9 8-7
8.4.1.2 Card Type 3 8-8
8.4.2 Major Species (20 percent or more of the UTH area gross volume) 8-9
8.4.3 Minor Species (less than 20 percent of the UTH area gross volume) 8-9
8.4.3.1 Option 1 8-10
8.4.3.2 Option 2 8-10
8.4.3.3 Option 3 8-10
8.5 Timber Available For Measuring 8-11
8.5.1 Tally Card - FS 205S 8-11
8.5.2 Field Measurements 8-11
8.6 Timber Not Available For Measuring 8-12
8.6.1 Tally Card FS 205S 8-12
8.6.2 Stump Measurements 8-12
8.6.3 Roads and Land Clearing 8-13
8.6.4 Measurement Options 8-13
8.6.4.1 Option 1 8-13
8.6.4.2 Option 2 8-14
8.6.4.3 Option 3 8-14
8.7 All Stumps Removed From the UTH Area (i.e., Land Cleared, Road has Been Built) 8-15
8.7.1 Option 1 8-15
8.7.2 Option 2 8-15
8.7.3 Option 3 8-15
8.8 Portions Of Trees Removed (i.e., Shake Blocks or Special Forest Products Removed From a Segment Of Tree(s)) 8-16

9 Regional Guidelines

9.1 Vancouver Forest Region Operational Cruising Requirements 9-2
9.1.1 Information Sources Regarding Policy and Procedures 9-2
9.1.2 Tenures Requiring an Operational Cruise 9-2
9.1.3 Submission of Cruise Plans 9-2
9.1.3.1 Individual Cruise Plans 9-2

9.1.3.2 Annual Cruise Plans 9-4
9.1.4 Acceptability of Cruise Data 9-5
9.1.4.1 Check Cruising 9-5
9.1.4.2 Use of Older Cruise Data 9-6
9.1.5 Technical Criteria 9-7
9.1.5.1 Sampling Error Requirements 9-7
9.1.5.2 Sampling Patterns 9-9
9.1.5.3 Plot Data 9-9
9.1.5.4 Prism Size (Basal Area Factor) 9-11
9.1.5.5 Heights 9-12
9.1.5.6 Field Marking and Procedures 9-12
9.1.5.7 Diameter at Breast Height Measurement (DBH) 9-13
9.1.5.8 Block Label - Mature and Immature 9-15
9.1.5.9 Plot Establishment 9-15
9.1.6 Timber Typing 9-17
9.1.7 Cruising of Cutting Authority Area Amendments 9-17
9.1.8 Cruise Reports 9-18
9.1.8.1 Cruise Compilations 9-18
9.1.8.2 Form and Content of Cruise Reports 9-21
9.1.9 Re-compilations 9-22
9.1.10 Cruising Damaged Stands and Exceptional Circumstances 9-22
9.1.11 Sampling in Unsafe Conditions 9-23

Tables

Table 1 Correction Table for Chaining Short Horizontal Distances T-2
Table 2 Plot Radii Slope Allowance T-3
Table 3 Distribution of "t" T-5
Table 4 Constants for Species and Zones T-7
Table 5 Butt Taper - Mature - FIZ A, B and C - Coast T-8
Table 6 Butt Taper - All Ages - FIZ D to J - Interior T-10
Table 7 Butt Taper - All Ages - FIZ K and L - Interior T-12
Table 8 Butt Taper - Immature - FIZ A, B and C - Coast T-14
Table 9 to 16 ..... T-15
Table 17 Cruise Compilation Loss Factor Table T-16
1 Tree Farm Licences T-16
2 Other Tenures T-19
4 Tabular Listing Of Table Numbers T-20
Table 18 Risk Group Ratings by Pathological Indicators T-32
Table 19 Sound Wood Factors for Saprot T-40

Appendices

A.1 Site Index and Age Correction Tables A-2
A.1.1 Use of Site Index Tables for BC to Determine the Age Corrections at Breast Height A-2

A.2 Magnetic Declination and Annual Change for 2002 ..... A-4
A.3 Forest Inventory Zones A-6
A.3.1 List of Regions and Districts A-7
A.4 Pathological Classification of Trees A-8
A.4.1 Class of Trees A-8
A.4.1.1 Suspect Trees A-8
A.4.1.2 Residual Trees A-9
A.4.2 Signs and Defects Indicative of Decay in Standing Trees A-10
A.4.2.1 Conks A-10
A.4.2.2 Blind Conks A-12
A.4.2.3 Scars A-17
A.4.2.4 Fork or Pronounced Crook A-23
A.4.2.5 Frost Cracks A-28
A.4.2.6 Mistletoe Trunk Infections A-29
A.4.2.7 Large Rotten Branches A-30
A.4.2.8 Dead or Broken Top A-31
A.4.3 Abnormalities which are not Recorded A-32
A.4.3.1 External Evidence of Butt Rot not Associated with Suspect Abnormalities A-32
A.4.3.2 Flutes A-32
A.4.3.3 Candelabra Branches A-33
A.4.3.4 Branch Fans A-33
A.4.3.5 Black Knots A-34
A.4.3.6 Burls and Galls A-34
A.4.3.7 Sweep A-35
A.4.3.8 Exposed Roots A-35
A.4.3.9 Other A-36
A.4.4 Some Common Decays of Forest Tree Species in British Columbia A-38
A.4.4.1 Indian Paint Fungus A-39
A.4.4.2 Pine Root Fungus A-41
A.4.4.3 Picture Conk A-43
A.4.4.4 Conk Fungus A-45
A.4.4.5 Red Belt Fungus A-47
A.4.4.6 Velvet-Top Fungus A-49
A.4.4.7 Sulphur Fungus A-51
A.4.4.8 Spongy Butt Rot Complex A-53
A.4.4.9 Bleeding Conk A-55
A.4.4.10 False Tinder Fungus A-57
A.4.4.11 Poria Obliqua A-59
A.5 Woods Safety and Emergency Procedure A-61
A.5.1 Ground to Air Signals A-61
A.5.2 Emergency Signals - downed aircraft, ground emergency, etc. A-61
A.5.3 Food Drop Signals A-62
A.5.4 Fire Fighting and Water Dropping Signals A-62
A.5.5 Basic First Aid A-63
A.5.6 If You Must Leave Your Partner in the Bush A-64

A.5.6.1 Make Sure They are Comfortable and Treat All Injuries Before you Leave A-64
A.5.6.2 Leave Them With A-64
A.5.6.3 Tell Them Your Plans A-65
A.5.6.4 Mark Their Location Well With Flagging, etc. (you may have to return in the dark) A-65
A.5.6.5 Flag or Blaze Your Way out Using Your Compass. Take Aerial Photo Having Marked Their Location Before Leaving A-65
A.5.6.6 If Lost A-65
A.5.6.7 Flare Kit Instructions A-66
A.6 Abbreviations and Symbols A-67
A.7 Damaged Stands A-68
A.7.1 Pest Damage A-68
A.7.1.1 Bark Beetle Codes A-68
A.7.1.2 Bark Beetle Descriptions A-69
A.7.1.3 Attack codes for balsam, white pine, yellow pine and lodgepole pine A-69
A.7.1.4 Blister Rust Code 4 (Risk Group 2, White Pine) A-70
A.7.1.5 Attack Codes for Spruce, Douglas Fir A-71
A.7.1.6 Defoliators (Path/Tree Class = Risk Group, All Species) A-72
A.7.2 Fire Damage A-72
A.7.2.1 Light Damage - Code A A-72
A.7.2.2 Moderate Damage - Code B A-73
A.7.2.3 Heavy Damage - Code C A-73
A.7.3 Down Trees A-74
A.7.3.1 Sampling Down Trees A-75
A.7.4 Extremely Damaged Stands (Windthrow, Flood Damaged, Fire, Insects or Disease) A-76
Appendix 8 Interior Log Grade Algorithm A-78
A.8.1 Assumption A-78
A.8.2 Procedures A-78
Appendix 9 Region and District Codes A-81
Appendix 10 Site Index Tables for British Columbia – All Species A-84
A.10.1 Coast A-85
A.10.2 Interior A-89
A.10.3 Provincial – Coast and Interior A-91

Forms

FS 693 Provincial Cruise Plan F-2
FS 694 Provincial Cruise Plan and Map Check List F-4
FS 695 Provincial Office Check of Field Cruise Data F-5
FS 696 Provincial Field Check Cruise Summary F-6
FS 697 Provincial Compilation Check Form F-7
FS 698 Provincial Comparative Cruise Checklist F-8
Acknowledgements F-9

Glossary

Index

Table of Figures

Figure 2.1 Cruise Plan Map....2-3
Figure 2.2 Cruise Tally Sheet (FS 205) – Card Type 9....2-24
Figure 3.1a Cruise strip line traverse notes (front)....3-5
Figure 3.1b Cruise strip line traverse notes (back)....3-6
Figure 3.2 Final Cruise Map....3-8
Figure 3.3 In, Out and Borderline trees....3-13
Figure 3.4 Borderline Tree Measurements - Variable Plot....3-15
Figure 3.5 Plan view of leaning or....3-17
Figure 3.6 Border plot procedure....3-18
Figure 3.7 An example of a border plot that must be dropped because 180 degrees isn't available for measurement....3-19
Figure 3.8 Example of where to measure the height on trees with a broken top or fork/crook....3-21
Figure 3.9 Measuring height of leaning trees....3-22
Figure 3.10 Crown classes....3-25
Figure 3.11 DBH in relation to high side....3-28
Figure 4.1 Illustration of Basal Area/Hectare....4-12
Figure 4.2 Required/optional reports....4-16
Figure 6.1 Cruise Tally Sheet – FS 205 HVA 2002/04 (front side)....6-3
Figure 6.2 Cruise Tally Sheet – FS 205 HVA 2002/04 (back side)....6-4
Figure 6.3 Determination of percent twist....6-18
Figure 6.4 Algorithm Flowchart (page 1)....6-22
Figure 6.5 Algorithm Flowchart (page 2)....6-23
Figure 7.1 Front Side of Map Area Statement Form (FS 121 HRV 99/01)....7-3
Figure 7.2 Reverse Side of Map Area Statement Form (FS 121 HVR 96/11)....7-21
Figure 7.3 Height/Diameter Description Card....7-24
Figure 7.4 Height/Diameter Description Card....7-26
Figure 8.1 Examples of recommended stump measurements....8-16
Figure 8.2 Examples of risk group determinations for stumps....8-17
Figure 8.3 FS 205S Ministry of Forests Stump Cruise Tally Sheet (side 1 of 2)....8-18
Figure 8.4 FS 205S Ministry of Forests Stump Cruise Tally Sheet (side 2 of 2)....8-18
Figure 9.1 Example of live limb....9-10
Figure T.1 Forest Inventory Zone Series Numbers....T-31
Figure T.2 Sound wood factors for saprot....T-40
Figure A.1 Forest inventory zones....A-6
Figure A.2 Residual trees....A-9
Figure A.3 Example of schweinitzii....A-12
Figure A.4 Example of blind conk in a knot....A-13
Figure A.5 Non-blind conk in a knot....A-14
Figure A.6 Host list....A-16
Figure A.7 Blind conk and sound knot....A-17
Figure A.8 Closed scars....A-18
Figure A.9 Open scars....A-18
Figure A.10 Cankers caused by fungi....A-21

Figure A.11 Scars caused by rock slides and falling rocks. A-21
Figure A.12 Types of forks and crooks which are recorded. A-25
Figure A.13 Fork or crook and/or dead or broken top. A-26
Figure A.14 Fork/crook. A-27
Figure A.15 Appearance of frost crack on standing trees. A-28
Figure A.16 Trunk infections of mistletoe. A-29
Figure A.17 Trunk infections of mistletoe. A-29
Figure A.18 Rotten branches. A-30
Figure A.19 Flutes. A-32
Figure A.20 Candelabra branches. A-33
Figure A.21 Branch fans. A-33
Figure A.22 Black knots. A-34
Figure A.23 Burls and galls. A-34
Figure A.24 Sweep. A-35
Figure A.25 Exposed roots. A-35
Figure A.26 Bird damage. A-36
Figure A.27 Illustrates forks and crooks which are not suspect. A-37
Figure A.28 Indian paint fungus. A-39
Figure A.29 Pine root fungus. A-41
Figure A.30 Picture conk. A-43
Figure A.31 Conk fungus. A-45
Figure A.32 Red belt fungus. A-47
Figure A.33 Velvet-top fungus. A-49
Figure A.34 Sulphur fungus. A-51
Figure A.35 Spongy butt rot complex. A-53
Figure A.36 Bleeding conk. A-55
Figure A.37 False tinder fungus. A-57
Figure A.38 Poria obliqua. A-59
Figure A.39 Damage Call Matrix for Uprooted, Ice Damaged and Wind Sheared Trees. A-75
Figure A.40 Example of mechanical damage. A-77
Figure A.41 Interior Log Grade Algorithm - this table converts the third of a tree into log number. A-79
Figure A.42 Partition Hemlock. A-80
Figure A.43 Forest Region and District Boundaries. A-83
Figure A.44 Fdc – Coastal Douglas-Fir. A-86
Figure A.45 Hwc – Western Hemlock - Coast. A-88
Figure A.46 Fdi – Interior Douglas-Fir ere. A-89
Figure A.47 Hwi – Interior Western Hemlock. A-90
Figure A.48 Act – Black Cottonwood - Provincial. A-92
Figure A.49 At - Trembling Aspen - Provincial. A-93
Figure A.50 Ba – Amabilis Fir – All Balsam Species - Provincial. A-95
Figure A.51 Cw – Westerm Redcedar - Provincial. A-97
Figure A.52 Dr – Red Alder - Provincial. A-98
Figure A.53 Lw – Western Larch – Provincial. A-99
Figure A.54 Pli – Lodgepole Pine - Provincial. A-100

Figure A.55 Pw – Western White Pine – Provincial. A-101
Figure A.56 Py – Ponderosa Pine – Provincial. A-102
Figure A.57 Sb – Black Spruce – Provincial. A-103
Figure A.58 Ss – Sitka Spruce - Provincial. A-105
Figure A.59 Sw – White and Englemann Spruce - Provincial. A-106
Figure F.1 FS 693 - Provincial Cruise Plan (Page 1 of 2). F-2
Figure F.2 FS 693 - Provincial Cruise Plan (Page 2 of 2). F-3
Figure F.3 FS 694 - Provincial Cruise Plan and Map Check List. F-4
Figure F.4 FS 695 - Provincial Office Check of Field Cruise Data. F-5
Figure F.5 FS 696 - Provincial Field Check Cruise Summary F-6
Figure F.6 FS 697 - Provincial Compilation Check Form. F-7
Figure F.7 FS 698 – Provincial Comparative Cruise Checklist. F-8

Introduction 1

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 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.

Implementation of the procedures and standards is a regional responsibility and the manual provides for sufficient flexibility that special circumstances can be accommodated. The appropriate Regional office should be consulted periodically for any revisions to the manual, for copies of Regional 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 any cruise is based on statistical concepts and the cruise provides 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 and loss factors 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.

1.1 Terms of Reference

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

The *Forest Act*, Section 105, requires adherence to the policies and procedures approved for the forest regions by the Minister of Forests. The *Coast Appraisal Manual* and *Interior Appraisal Manual*, approved by the Minister of Forests, contains the policies and procedures for determining stumpage rates charged for Crown timber.

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, Revenue Branch.

Cruise Design 2

2.1 Cruise Objective

The objective is to obtain an unbiased estimate of the volume and quality of timber on a cutting authority area to a specified confidence interval or sampling intensity. The area cruised may be one or several cutting blocks that will be covered under one cutting permit and subject to one appraisal. Unless special circumstances indicate otherwise, a systematic design for plot layouts must be used. All species listed under Section 6.3.2 of this manual shall be cruised and the minimum sampling error requirements will be based on all species.

The cruise plan and the accuracy requirements are affected by the timber appraisal.

1. For scale-based sales, the cruise provides the basis for determining the stumpage rate while the amount billed is based on the scale.

   For cruise-based sales, both the estimate of the stumpage rate and billing are based on the cruise.

2. In special cases, such as salvage sales, small sales and right-of-way sales, cruising standards may be varied by the Regional Manager in accordance with Chapters 4 and 6 of the *Coast Appraisal Manual* and *Interior Appraisal Manual.*

2.1.1 Cruise Plans

It is *mandatory* for licensees, consultants and Forest Service contractors to submit plans to the Ministry of Forests district office at least 30 days prior to the commencement of a cruise.

This includes submission of cruise plans for all cut block(s), including amendments to existing cutting permits. The 30 days will commence on the date the plan is received and date stamped at the district office (see the attached *sample* Cruise Plan format in the Forms chapter). If the licensee or consultant has not received a response after providing at least 30 days notice then the cruise plan will be considered acceptable.

Cruise plans must be submitted to the appropriate district manager on either the prescribed Ministry of Forests format or on a format designed by the licensee or consultant, but containing all of the information requested by the Ministry of Forests.

A cruise plan (see the Forms chapter - FS 693 Provincial Cruise Plan) prepared by the licensee must be submitted to the district office prior to the commencement of field work. Bias in the cruise planning phase will result in rejection of the cruise plan and will result in corrections to any fieldwork that has been done. Attach a location map and forest cover map for the cruise area to assist with access and timber type verification.

Refer to Figures F.1 and F.2 (http://www.for.gov.bc.ca/revenue/manuals/cruising/forms.htm) for the cruise plan form and Figure F.3 (http://www.for.gov.bc.ca/revenue/manuals/cruising/forms-01.htm) for the cruise plan check form.

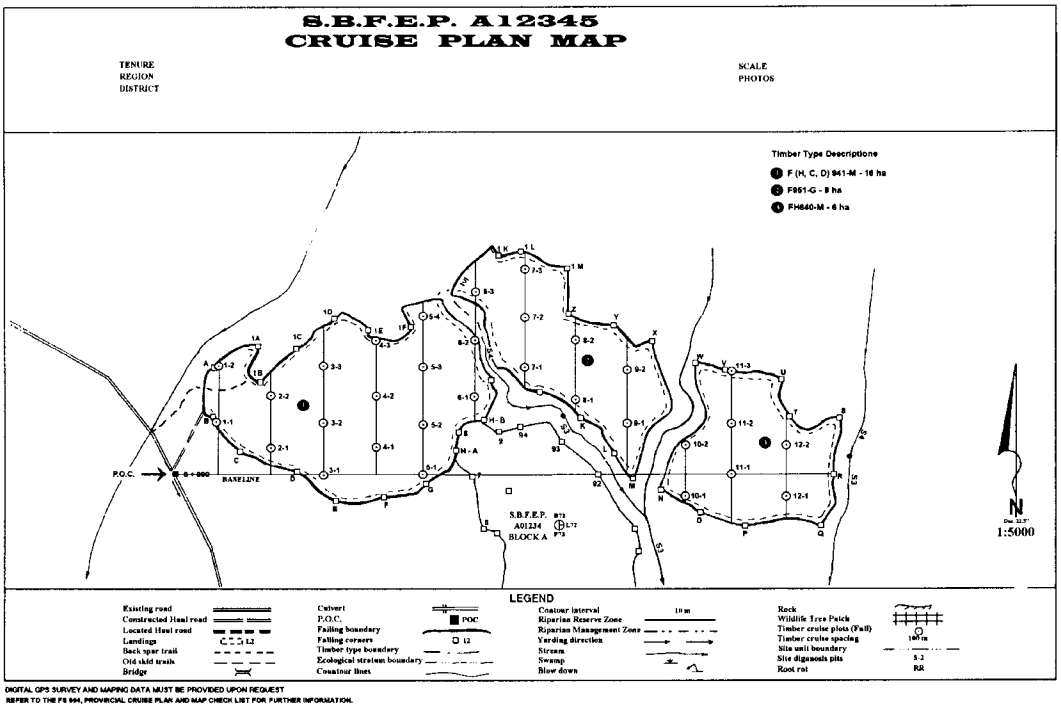


Figure 2.1 Cruise Plan Map.

The cruise plan map must contain the information in Section D of the Provincial Cruise Plan and Map Checklist (FS 694).

2.1.2 Scale-Based Stumpage Assessment - Timber Sales or Cutting Permits

General Conditions:

- all species listed under Section 6.3.2 of this manual shall be cruised,
- the minimum tree sizes are specified in Chapter 6,
- all references to "plots", "cruise plots", and "measure plots" must be interpreted as Full Measure Plots unless specified otherwise,
- Sampling Error objective is based on full measure and count plots (unless specified otherwise),
- all plots must originate from the harvest area. Plots in areas 100 percent reserved from cutting must not be used in the compilation. If an area is reserved after cruising, the sampling error requirements may be waived if it is evident that the sampling error objective would have been achieved prior to the placement of the reserve, and
- all measure and count plot data originating from the harvest area must be used in the cruise compilation.

Sampling Error Objective:

1. The scale-based cutting authorities sampling error objective is 15.0 percent at 2 standard errors based on the total stand (before reduction).
2. The minimum number of trees per plot must be achieved in the following situations:

   a. where the sampling error is waived (i.e., 1 plot per hectare), or

   b. where partial cut harvesting is planned.

   The number of trees per plot is not a compilation check concern for clearcutting if 15.0 percent sampling error is achieved.
3. Count plots that contain tree species that have not been measured in a full measure plot in the same timber type must be converted to measure plots.
4. The maximum grid spacing:

   - cutting authorities less than 250 ha - 200 m square grid, and
   - cutting authorities greater than or equal to 250 ha - 250 m square grid.

Sections 2.1.2.1 to 2.1.2.3 are subject to the requirements listed under Section 2.1.2 unless otherwise stated.

2.1.2.1 Clearcutting Sampling Requirements

1. Clear cutting is defined as: the area clearcut is 90 percent or more of the total net cruise area.
2. The required average minimum number of trees per plot is:
   - Variable Plot – 4.0 trees, excluding live and dead useless, and
   - Variable Plot – 6.0 trees if there are 6 or more species or as determined by the Regional Manager if sampling error is not achieved, and
   - Fixed Area – 10.0 trees, excluding live and dead useless.
3. For cruises that meet the sampling objective, the number of count plots must not exceed the number of measure plots unless a minimum of one measure plot per hectare has been used.
4. Silviculture systems that qualify for clearcutting specifications are:
   a. clearcut,
   b. seed tree,
   c. coppice (deciduous only),
   d. Riparian Management Zones (RMZ) which will be partially cut and represent less than 10 percent of the cruise area, and
   e. group selection where the patch cuts average > or = 1 ha.

Refer to the following web page for FPC definitions and illustrations of clear-cut and partial-cut silviculture systems:

http://www.for.gov.bc.ca/tasb/legsregs/fpc/fpcguide/system/ss1.htm

2.1.2.2 Partial Cutting Sampling Requirements

1. Partial cutting is defined as: the area clearcut is less than 90 percent of the total net cruise area.
2. Count plots may be used provided that the sampling error is achieved based on the full measure plots only.
3. The required average minimum number of trees per plot is:
   - Variable Plot – 6.0 trees, excluding live and dead useless,
   - Fixed Area – 15.0 trees, excluding live and dead useless, and

- Cutblocks cruised prior to April 1, 2000 for inclusion in a clear-cut cutting authority area as approved by the Ministy of Forests in an operational plan can be included with a partial-cut cutting authority area. The tree count criteria required in Section 2.1.2.1 (2) will be acceptable but all other minimum sampling criteria must be achieved.

4. All plots must originate from the harvest area. Areas where no cutting is prescribed such as RMZ's with 100 percent retentions are to be excluded from the cruise.

5. Silviculture systems that qualify for partial cutting specifications are:

   a. shelterwood,

   b. selection,

   c. patch cut, where the patches average < 1 ha,

   d. patch cut with reserves,

   e. intermediate cuttings, and

   f. any silviculture system that prescribes "faller selection" *must* meet the partial cutting sampling standards regardless of the partial cut percent.

6. If a range of leave tree or cut tree stems per hectare are reported in a silviculture prescription then the average of the highest and lowest number will be used to determine the percent reduction input into the cruise compilation.

7. Single tree selection – less than or equal to 20 percent of the stand volume will be harvested and the silviculture system does not qualify as group selection or patch cut. The trees must be marked prior to cruising.

   The cruising options are as follows:

   a. establish variable plots and the 15.0 percent sampling error requirement will be based on the cut trees,

   b. two measure plots per hectare with an average of 2.0 cut trees per plot, or

   c. 100 percent cruise.

2.1.2.3 Comparative Cruises

Refer to the *Interior Appraisal Manual* for situations when comparative cruise data may be used in appraisals.

1. Definitions:

   - the new cutting authority area is the cutting authority area that will be appraised, and
   - the parent cutting authority area is the existing cutting authority area from which cruise data will be borrowed.

2. Procedures for ensuring cruise data is comparable.

   The new and parent cutting authorities must originate from the same biogeoclimatic (BEC) subzone. The parent cruise data must not be older than five (5) years for immature timber and ten (10) years for mature timber. Cruise plots are established in the new cutting authority area and the compilation of these plots is compared to the parent compilation. If the comparative cruise data meets the criteria in 3. below and in the Provincial Comparative Cruise Checklist, then the plots in the new cutting authority area will be added to the plots in the parent cutting authority area and all plots recompiled. If the recompilation meets 15.0 percent sampling error at the 95 percent confidence interval, then the recompiled cruise data may be used in appraisals.

   If directed by the District Manager, the licensee will provide a cruise versus scale comparison by species upon completion of harvesting of the new cutting authority area.

3. Field procedures for cruise plots located in the new cutting authority area:

   a. the number of plots required is a minimum of six plots for each timber type or 1 plot per hectare if the timber type is less than 6 ha. The plots must be established using a systematic grid,

   b. all cruise plots will be full measure variable radius plots. Plot size must be consistent throughout the type and must be chosen so that there is a minimum average of six merchantable coniferous trees (live and dead potential) per plot,

   c. tree heights and diameters must be measured for every tree in the plots,

   d. all trees within each plot must be tallied as per the requirements of the *Cruising Manual*,

   e. there must be a minimum of two dominant or co-dominant tree ages measured for the merchantable species at each plot, and

f. if the new cutting authority area has sufficient samples to achieve the 15.0 percent sampling error at the 95 percent confidence interval then the cruise data may be used in an appraisal.

4. Office Procedures:

   a. The licensee must submit to the District Manager:

      - a completed copy of the Provincial Comparative Cruise Checklist. A copy of the checklist is in the Forms chapter,
      - all field cruise cards and the cruise compilations with data listings for the parent and new cutting authorities,
      - the cutting permit summary page and all of the harvesting method summary pages for the parent and new cutting authorities, and
      - two maps – one location map that shows where the new cutting authority area is located in comparison to the parent cutting permit and one cruise plan map for the new cutting authority area.

   b. the collected cruise data for the new cutting authority area must be compiled using the most recent version of an approved cruise compilation program,

   c. the district will review the submitted information to ensure that the parent and new cruises meet the standards in the Provincial Comparative Cruise Checklist,

   d. it is acceptable to select timber types from different parent cruises. If there is more than one type in the new cruise, the selected parent cruise(s) must be recompiled using the comparative parent type averages and the new cruise type areas, and

   e. the district will compare the cutting permit or timber type summary page of the new cutting authority area with the summary page from the parent cutting authority area. The following acceptable parameters must be achieved in order for the parent and new cruise or type to be considered comparable.

Criteria	Acceptable Parameter
Location of parent cutting permit in relation to the new cutting permit.	The same biogeoclimatic subzone.
Minimum number of plots per timber type.	A minimum of 6 measure plots per timber type or 1 plot per hectare per timber type in the parent and the new cruise.

Criteria	Acceptable Parameter
Species Composition.	Within ± 5 percent major species and ± 10 percent minor species.
Merchantable volume/hectare.	Parent and new cruise must be within 10 percent.
Age of timber.	Species by timber type must have similar maturity class.
Lumber Recovery Factors.	Merchantable species must be within 5 LRF points.
Merchantable volume/tree.	Parent and new cruise must be within 10 percent and where the new cruise is less than 0.20 m^3/tree, the parent cruise must be less than 0.20 m^3/tree.

2.1.2.4 Unsafe to Cruise

When there is a high down tree component to a stand of timber or heavy fire damage has occurred and it is unsafe for cruisers to sample the stand, then apply cruise data from the adjacent cruise plots in the same timber type where it is safe to cruise. The sampling intensity will be sufficient to meet the minimum sampling requirements for the cruise. The unsafe areas will be mapped in the cruise plan, field notes and the final cruise map. If it is unsafe to sample the damaged portions of the stand to determine the damage percentages, then the damage percentages should be performed by a certified photo interpreter. A damage assessment may be performed using other procedures subject to mutual agreement by the licensee and the District Manager.

2.1.3 Cruise-Based Stumpage Assessment - Timber Sales or Cutting Permits

For cruise-based sales, sufficient samples must be established to meet the following sampling error objectives:

1. Plus or minus 8.0 percent sampling error at 2 Standard Errors (S.E.) for all stands except in 2. below. Count plots may be used provided that a plus or minus 12.0 percent sampling error at 2 S.E. is achieved with measured plots and 8.0 percent with count and measure plots combined.

2. Proposed cut areas where the stands are comparatively very valuable or patchy must be reviewed by the Regional Revenue Manager, or his designate, to determine whether the above rules should be accepted or the number of sampling points increased.

3. Refer to the *Provincial Cruise Based Policy* at the following Internet site:

   Ministry of Forests Home Page

http://www.for.gov.bc.ca/tasb/manuals/policy/resmngmt/rm8-16.htm

2.1.4 Standards for Re-cruising

A recruise is necessary if any of the following criteria are met or exceeded.

1. If the cruise is of mature timber (> 120 years) and 10 years has elapsed since the fieldwork was performed.
2. If the cruise is of immature timber (< 121 years) and 5 years has elapsed since the fieldwork was performed.
3. Catastrophic (severe damage) losses have occurred at any time after the field work was performed.
4. Any major amendments are proposed to the original cruise area. Refer to the current *Coast Appraisal Manual* or *Interior Appraisal Manual*, Section 2.3, 2.
5. As determined by the Regional Manager or their designate.

2.2 Types of Cruise

2.2.1 100-Percent Cruise

The Regional Manager may direct that for certain forest stands and valuable species, a 100-percent cruise is required.

2.2.2 Sampling Patterns-General

Samples within cutting blocks from previous operational cruises of the area may be used in the sampling plan if they meet the standards set in this manual.

Referring to the following types of sampling methods, systematic sampling in conjunction with a grid to locate the plots must be used for appraisal type cruises unless permission is granted by the Regional Manager to use one of the other sampling patterns.

2.2.2.1 Systematic Sampling

In systematic sampling, plots are at fixed intervals with a minimum of two full measure plots per timber type. One full measure plot in a timber type is acceptable if falling boundary amendments isolate some plots after cruising. The sampling intensities (hectare per plot ratios) must be consistent and the base sampling grid spacing must be the same for each timber type.

In addition:

1. The cruise grid should be aligned in cardinal directions (i.e., North/South or East/West) unless otherwise approved in a cruise plan, and the grid should be referenced to the point of commencement (P. of C.) and should use 1/2 of the grid interval.

2. The maximum plot spacing listed in Section 2.1.2 (4) will ensure adequate coverage of the area for timber typing and tree and terrain information.

3. The sampling grid horizontal distances must be equidistant between plots and strips, and a staggered grid is recommended.

4. Where plots must be added to an existing cruise area, they must be positioned in a systematic random way so they cover the entire cruise area. The following method is recommended for adding plots to an existing cruise:

    a. determine the number of additional plots required using the coefficient of variation from the original cruise. Adding 10 percent is recommended for a safety margin,

b. determine the new grid for the cutting authority area to obtain the additional number of plots required,

c. lay the new grid over the original grid with the new plot that is nearest the original P. of C. plot over top of the original P. of C. plot. Use the same cruise grid orientation,

d. disregard the overlapping plot and locate the new plots on the cruise map, and

e. determine the bearings and distances to the new plots from the nearest original plots. This will reduce the amount of traversing required to establish the new plots.

The new grid must be submitted with a cruise plan to the Ministry of Forests district office for approval at least 30 days prior to the commencement of field work.

2.2.2.2 Cruising Rights of Way

The following procedure is recommended for cruising road rights of way:

1. Widening existing rights of way - establish border plots at systematic intervals along alternating sides of the right of way using the right of way boundary as the split line. Refer to Section 3.4.1.7 regarding the correct use of border plots.

2. New rights of way - establish rectangular or square fixed area plots at systematic intervals. The plots must cover the entire width of the rights-of-way.

   Variable plots are acceptable provided that a prism basal area factor is used that should not sample trees outside of the rights-of-way and meets the minimum tree count requirements listed in Section 2.1.2.1.

2.2.2.3 Cruising Patch Cuts

The following sampling procedure must be used for cruising patch cut, patch cut with reserves and group selection silviculture systems:

1. overlay a 100 m grid on the cruise plan map after the patch cuts are accurately located within the block and mapped.

2. increase or reduce the grid interval in multiples of 5 m until a minimum of one plot per hectare is obtained in the harvest areas.

3. individual patch cut falling corners may be used as tie points for the cruise plots with the bearing and distance to each plot documented in the cruise plan.

4. sampling must be confined to the harvest area, therefore use border plots if timber outside the boundary influences a full plot.

5. if the cruise was originally designed for a silviculture system not listed above then Section 2.2.2.3 does not apply.

2.2.2.4 Moving Plots

Plots can be moved in the following situations if documented in the cruise plan:

1. Patch cut or group selection cruises to ensure that the sampling intensity can be achieved.

2. Very irregular shaped blocks to ensure that a single strip is not established down the centre of the cruise area. The entire sample area must be eligible for sampling.

Plots may be moved in multiples of 10 m until all of the trees in the plot are inside the cutting area. The option to move plots must be documented in the cruise plan. Border plots are not permitted if the option to move plots is used, refer to Section 3.4.1.7 for the use of border plots.

2.2.2.5 Probability Proportional to Prediction

"Three P" sampling (Probability Proportional to Prediction) is a sampling technique which randomly selects the sample trees but one basic requirement is that each tree in the entire sale area must be estimated. This method is often used to increase efficiency in comparison to a 100 percent cruise. Three-P sampling is currently being reviewed for potential applications in appraisal cruising.

2.3 Sampling Errors

Cutting authorities must include all commercial species.

In timber cruising a complete record of all trees of merchantable size on the sale is seldom practical, so sampling becomes necessary. The object of sampling is to estimate the volume on only a portion of the area, and convert this to a total area basis.

In sampling there are two major sources of error:

Sampling error or errors in quantities of measurements. Sampling error is the difference between results that would have been obtained by a 100 percent cruise and the result that is obtained by a sample cruise. That is they are errors caused by samples not being absolutely representative of the natural variable conditions over the entire area.

1. The sampling error can be calculated and has been set at (Sections 2.2.1 and 2.2.2):

   - plus or minus 15 percent (19 times out of 20) for scale-based sales, and
   - plus or minus 8 percent (19 times out of 20) for cruise-based sales.

2. Measurement error or errors in qualities of measurements.

   The calculated sampling error can be seriously misleading if the basic data is unreliable.

   If reliable volume estimates are to be obtained measurement errors must be controlled. Constant care and checking is required on all direct measurements (see Section 3.6, Check Cruising).

   The population sampled is the cutting unit and, therefore, all samples on which the stand statistics are based must be systematically located within the proposed cutting boundary so that the forest area is adequately sampled.

2.4 Variable-Plot (Prism) Sampling

2.4.1 Plot Sample Size

In the fixed-area plot method of sampling, accurate boundary location is time-consuming and small diameter classes are sampled more intensively than large diameter classes. This occurs because the probability of tree selection is proportional to tree frequency.

"*Prism*" sampling (also known as "point" sampling, "plotless" sampling or "variable-plot" sampling) overcomes these two disadvantages, since the probability of tree selection is proportional to basal area and the large diameter trees therefore, are sampled with the same intensity as the small diameter trees.

The controlling factors for selecting the prism 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 high sample variance. 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.

2.4.2 Prism Sampling

The choice of plot size will influence the amount of sampling required to achieve the sampling error because sampling intensity depends on 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

included and the equation for determining the number of plots required becomes:

$$n = \frac{t^2 \times CV^2}{E^2}$$

2.5 Fixed Area Plot Sampling

2.5.1 Fixed Sample Size

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:

$$\frac{t^2 x CV^2}{E^2}\left(\frac{N-n}{N}\right) where$$

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:

$$n=\frac{t^2 x CV^2 x N}{N x E^2 + t^2 x CV^2} where$$

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.

2.6 Statistical Concepts

2.6.1 Probability Factor "t"

The value of "t" used in the above equations depends on the degrees of freedom (number of plots required minus 1 or n-1), and the desired probability. The desired probability has been specified as 2 S.E. or t.05.

Referring to the table of t.05 (Table 3) the probability factors are very close to 2, except for a small number of plots. The first approximation is done using a probability factor of 2. The probability factor for the resulting "n" is then used to calculate a new "n". This process is repeated until "n" (to the nearest whole number) no longer changes.

Calculate the number of 0.1 ha plots required for a sampling error of + 15 percent at 2 S.E. for a 40 ha timber sale with a coefficient of variation (CV) of 40 percent.

$$n=\frac{t^2 xCV^2 xN}{NxE^2+t^2 xC^2}=\frac{(2)^2 x(40)^2 x(40x10)}{(40x10)x(15)^2+(2)^2 x(40)^2}$$

$$n=\frac{6400x400}{90000+6400}=\frac{2560000}{96400}$$

$$=27 plots$$

Referring to the table of t.05 for 27-1 or 26 degrees of freedom, the probability factor is 2.056. Therefore, the new "n" is:

$$n=\frac{(2.056)^2 x(40)^2 x(40x10)}{(40x10)x(15)^2+(2.056)^2 x(40)^2}=28 plots$$

Again referring to the table of t.05 for 28-1 or 27 degrees of freedom, the probability factor is 2.052 and the new "n" is 28 plots. Therefore, 28 plots would be the number used.

2.6.2 Coefficient of Variation (CV)

Coefficient of variation may be difficult to estimate and is unique for each type, and also varies with the standard of utilization, gross or net volume, plot size (CV decreases as plot size increases) and shape, and the pattern of sampling. The coefficient of variation may be estimated as follows:

1. From plots previously measured in the same locality.
2. From plots measured in connection with the pre-examination, silvicultural examination, etc.
3. A general knowledge of the timber types on the sales.

By definition the coefficient of variation is the standard deviation expressed as a percentage of the mean volume. The volume of an individual plot minus the mean volume of a group of plots is termed a residual. The sum of the residuals squared, divided by the number of plots minus one, is the variance and the square root of the variance is the standard deviation. The standard deviation is a measure of the dispersion of the plots about the sample mean.

The standard deviation may be calculated by squaring the residuals with the use of a desk calculator and in practice the following method is preferred:

Plot #	Plot Volume	Plot Vol Squared	
1	119	14161	Standard deviation (SD)
2	130	16900	
3	79	6241	$=\sqrt{\frac{\left(\Sigma(x^2)-\frac{(\Sigma x)^2}{n}\right)}{(n-1)}}$
4	215	46225	
5	46	2116	
6	223	49729	
7	164	26896	
8	317	100489	
9	160	25600	$=\sqrt{\frac{362145-\frac{2123^2}{16}}{16-1}}$
10	42	1764	
11	77	5929	
12	105	11025	
13	54	2916	
14	151	22801	Coefficient of Variation (CV)
15	108	11664	
16	133	17689	$=\frac{SD}{mean}x100$
Sum	2123	362145	
Mean	133		$=\frac{73}{133}$ x 100 = 55 percent

In prism cruising the volume per hectare is obtained directly, rather than volume per plot. The use of volume per hectare rather than volume per plot in the above calculations is valid.

When advantage cannot be taken of a sample-based estimate, then CV can be roughly estimated using general knowledge of the timber types. The steps involved are:

1. Estimate the range of volumes per hectare likely to be encountered. Convert this to volume per plot for the plot size to be used in the cruise.

2. Divide the range by 4 to obtain an estimate of the standard deviation (4 is suggested since the number of samples required is unknown and it is an average value for 16 or more samples).

3. Estimate the mean sample volume.

4. Divide the standard deviation by the mean sample volume to obtain an estimate of the coefficient of variation; convert this to percent.

For Example: It is estimated that the volume will range from 3 to 15 m^3 per plot. Therefore, the range is 15 - 3 = 12 m^3. The average sample volume is estimated to be 6 m^3.

Thus:

$$c = \frac{12/4}{6} x\,100 = \frac{3}{6} x\,100 = 50\ percent$$

This short-cut method provides a rough approximation of CV, and may only be used when a sample-based estimate of CV cannot be obtained. For an approximation of CV based on prism cruising the range and average volume per hectare can be used in the calculations.

Sample-based estimates of CV (provided 16 or more samples are used) are worth recording as "experience", and may be used for design purposes on nearby sales of comparable timber type.

2.6.3 Stratification

Coefficient of variation (and number of plots required) is directly related to the range of individual plot volumes. The smaller this range is in a population, the more efficient the sampling. The object is to increase sampling efficiency by stratifying larger populations (i.e., a timber sale or cutting permit) into smaller populations (timber types) in such a manner that each one of the timber types has a lesser variation than the larger population.

Consider the following:

1. Are there two or more distinctive timber types that can be identified and can readily be mapped.

2. The timber types can be readily mapped as a result of ground examination.

3. The following attributes should be considered when stratifying timber:

    - Major species composition,
    - age, particularly younger and older immature and mature,
    - height of major species, and
    - crown closure.

2.6.3.1 Forest Typing

Forest types must be kept fairly broad. There is a common tendency to overtype which nullifies any increases in sampling error achievement. Overtyping also increases the need for borderplots and the moving of plots.

Forest types must not be smaller than 1 ha. Brush patches smaller than 1 ha are normally left in the forest type and sampled. Non-productive types, and other small areas reserved from harvesting, should be typed the same as the silviculture prescription (SP). All types that contain merchantable timber must be sampled unless the timber is reserved from harvesting in an approved SP.

Typing for cruising may differ from typing for the SP. If the SP typing occurs before cruising, the typing will be very similar (except for brush patches smaller than 1 ha). If the SP typing occurs after cruising, there may be significant differences.

A map showing all forest and non-forest types must accompany the cruise plan and must be submitted prior to the commencement of field work. Modifications to the cruise plan typing can only be made when supported by the fieldwork and documented in the field traverse notes.

If typing changes after the cruising field work, due to reserves for example, cruisers may need to revisit the cruise plots in the field to ensure they are not influenced by these changes. Good traverse note taking, to identify potential reserves, will reduce the need for cruisers to re-visit cruise plots.

2.6.3.2 Minimum Plots Per Type

If the sampling error requirement has not been waived or there has not been a boundary amendment after the cruise has been completed the following requirements must be met:

- For the Block Method of Compilation, a minimum of two measure plots per timber type are required within a block.
- The Average Line Method of Compilation requires a minimum of two measure plots per timber type in the cutting permit.

This is to enable the calculation of sampling statistics.

The second plot in small timber types will be located according to the following procedure to ensure that a minimum of two measure plots are located in the timber type:

1. Locate the second plot one half of the inter-plot spacing along the stripline in the current direction of travel from the single plot in the type. If the plot is still not in the timber type, then
2. Locate the second plot one quarter of the inter-plot spacing along the stripline in the current direction of travel from the single plot in the type. If the plot is still not in the timber type, then
3. Continue steps 1. or 2. at ninety degrees clockwise from the stripline until the second plot can be established.

Use the following methodology for stratification:

1. Forest types must be distinguished before the cruise commences based on:
   a. aerial photograph interpretation, or
   b. the most recent forest cover maps,
2. Field inspection or sampling.

   The type lines must be documented in the traverse notes.
3. If the transition from one timber type to another is very gradual and not detected in the field, then the type line must be drawn equidistant from dissimilar plots.
4. If non-forest types are stratified out of the harvest area, then they must not be sampled.

2.6.3.3 Calculation of Number of Samples

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	ha	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	2 732	0.36	40	14.4
	40		7 604	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 *percent* at 2 S.E., the required number of samples is:

$$n = \frac{t^2 xCV^2 xN}{NxE^2 + t^2 xCV^2} = \frac{(2)^2 x(38)^2 x400}{400x(15)^2 + (2)^2 x(38)^2}$$

$$= \frac{4x1444x400}{400x225+1444} = \frac{5776x400}{90000+5776} = \frac{2310400}{95776}$$

$$= 24$$

The probability factor for n-1 or 23 is then used to calculate a new "n", which equals 26. These 26 samples are then distributed among the three types as follows:

$$n_1 = \frac{PCV_1}{PCV} x\, n \text{ etc.} = F\text{–}Pl; n = \frac{12.9}{37.8} x\, 26 = 9$$

$$Pl; n = \frac{10.5}{37.8} x\, 26 = 7 \qquad Pl\text{–}F; = \frac{14.4}{37.8} x\, 26 = 10$$

Exact estimates of type size, volume and coefficient of variation are not necessary in advance of cruising to predict sampling requirements. Reasonable approximation are sufficient 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 volume of the cut blocks, 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.

2.7 Double-Sampling

As the name implies double-sampling consists of sampling certain characteristics within a sample instead of measuring those characteristics throughout the sample. Double-sampling improves the volume estimate by species.

2.7.1 Type of Plots

Double-sampling requires the use of two types of prism plots, the measured plot and the count plot. The measure and count plots together represent the main sample. Fixed-radius plots may not be used in this form of double-sampling.

2.7.1.1 Measured Plots

The measured plots are conventional samples in which all variables for each tree are measured, identified, recorded and represent the subsample in the double-sampling cruise.

2.7.1.2 Count Plots

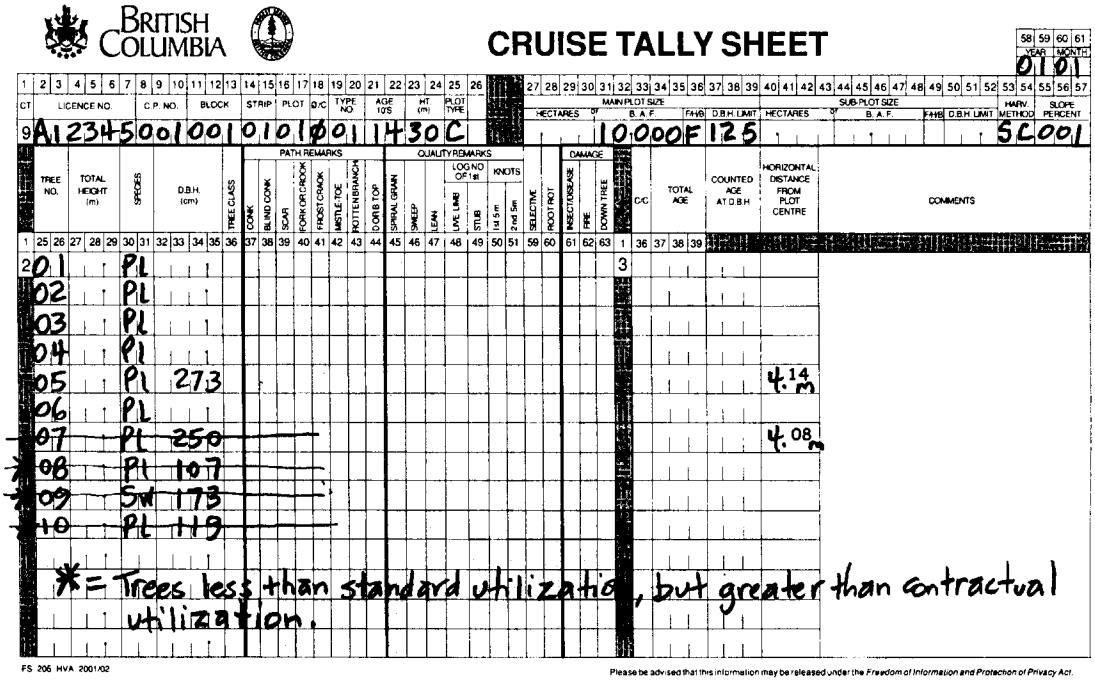
Count plots are samples in which only trees by species are tallied. All live and dead potential trees which are to be included in the compilation are noted. Do not include any tree below the lower dbh to be compiled for that species or tree class 4 (dead useless) or tree class 6 (live useless) trees. Half plots and border plots are not permitted in count plots. These plots must be converted to measure half and border plots.

Count plots are not permitted in faller selection or mark to cut or leave cruises due to the effect on the double sampling ratio when a percent reduction is applied since diameters are not recorded in count plots. There is a high probability that measure information will be missing for count trees.

It is not possible to compile a double sampled cruise with a species recorded in a count plot by a species which has not been sampled in a measured plot. A cruiser who finds in a count-plot, a tree species which has not been sampled in a measured-plot in the same timber type, and which may not be sampled in the remaining measured-plots, must change the count-plot to a measured-plot to ensure that a measured tree of that species is tallied.

If, at the compilation stage, an unmeasured species is found to have been recorded in a count plot, refer the matter to the Regional Manager or designate to resolve the problem.

Figure 2.2 illustrates how count plots must be recorded if they are used for cutting authorities that have different appraisal and utilization requirements.



BRITISH COLUMBIA

CRUISE TALLY SHEET

CT	LICENCE NO.	C.P. NO.	BLOCK	STRIP	PLOT	D/C	TYPE NO.	AGE (DS)	HT (m)	PLOT TYPE	MAIN PLOT SIZE HECTARES	MAIN PLOT SIZE BAF	FHB	D.B.H. LIMIT	SUB-PLOT SIZE HECTARES	SUB-PLOT SIZE BAF	FHB	D.B.H. LIMIT	HARV. METHOD	SLOPE PERCENT	YEAR	MONTH
9	A12345	001	001	0101	01			1430	C		10.000	F		125						5C	001	01	01

TREE NO.	TOTAL HEIGHT (m)	SPECIES	D.B.H. (cm)	TREE CLASS	PATH REMARKS: CONK	BLIND CONK	SCAR	FORK OR CROOK	FROST CRACK	MISTLETOE	ROTTEN BRANCH	DORIB TOP	QUALITY REMARKS: SPIRAL GRAIN	SWEEP	LEAN	LOG NO OF 1s	KNOTS: LIVE LIMB	STUB	1st 5m	2nd 5m	SELECTIVE	PROOT ROT	DAMAGE: INSECT/DISEASE	FIRE	DOWN TREE	D/C	TOTAL AGE	COUNTED AGE AT D.B.H	HORIZONTAL DISTANCE FROM PLOT CENTRE	COMMENTS
201		PL																								3				
02		PL																												
03		PL																												
04		PL																												
05		PL	273																										4.14 m	
06		PL																												
07		PL	250																										4.08 m	
08		PL	107																											
09		SW	173																											
10		PL	119																											

*= Trees less than standard utilization, but greater than contractual utilization.

FS 205 HVA 2001/02

Please be advised that this information may be released under the *Freedom of Information and Protection of Privacy Act*.

Figure 2.2 Cruise Tally Sheet (FS 205) – Card Type 9.

Field Procedures 3

3.1 General Provisions

3.1.1 Signatures

Stumpage rates are estimated on the data collected by timber cruisers. Therefore cruise tally sheets (FS 205 and industry versions) must be signed (or initialled) and dated by the cruiser who in so doing, accepts responsibility for the information contained on the card. This assists the check cruiser to sample a representative proportion of each cruiser's work.

3.1.2 Tie-Points

The cruise must originate from valid tie points such as unique photo and map locations like creek junctions, road locations, falling corners and GPS positions. All of the cruise strips must be linked together and to the boundary line. If the boundary traverse is completed after the cruise, it must be tied to the cruise in at least 2 places.

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.

The first plot on a cruise grid will be located in the sample area and should be 0.5 the grid spacing on a North bearing from the POC. If North does not work, try East, if East does not work then try South, if South does not work then try West. If the above options do not work then use full grid spacing starting at North, then East, then South, then West. Continue using multiples of 0.5 grid spacing and cardinal bearings commencing at North until a plot can be located in the sample area. A staggered grid is recommended.

3.1.2.1 Options for selecting the Point of Commencement (POC)

1. Always pick the closest trim feature (creek junction etc.) to the access the cruisers plan to use.

2. Always pick the closest GPS station to the access the cruisers plan to use.

3. In the case of patch-cuts, the POC for each patch will be from the nearest plot in the adjacent patch.

3.1.3 Strip-Lines

The strip-line 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. The line should be marked with plastic marking tape so it is easily visible.

3.1.4 Plot-Centres

When the required distance has been measured along the strip line, a stake, tree or equally effective marker must be established at the plot centre where the compass person marks the chainage. If the chainage is at a tree, mark the plot centre with an "X" at the point where the chainage touches the tree.

A reference point (RP) must be established on the nearest live tree to plot centre (PC). The bearing and horizontal distance from the RP to the PC must be written on the reference tree and tally card. The RP will be used to determine PC for check cruising purposes. Refer to the *Regional Cruising Guidelines* for any additional requirements and use of reference trees.

3.1.5 Slopes

3.1.5.1 Slope Percent

Record the most severe slope measurement from the plot centre to a point 15 m horizontal distance within the harvest area. Plot slope must be recorded in measure and count plots. The plot slope must be measured within the harvest area in border plots.

3.1.5.2 Distance Slope Correction

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 3.6.2.1 or refer to Table 1.

The formula used to correct for slope is:

$$\text{COS}\left[\text{TAN}^{-1}\left(\frac{\text{slope\%}}{100}\right)\right] = \text{slope correction factor} \leq 1.000$$

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,
- $\text{COS}\left[\text{TAN}^{-1}\left|\frac{59}{100}\right|\right| = 0.8613$, 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,
- $\text{COS}\left[\text{TAN}^{-1}\left|\frac{74}{100}\right|\right| = 0.8038 \qquad 0.8038^{-1} = 1.2441$, and
- 50 m x 1.2441 = 62.205 m slope distance will give 50 m horizontal distance. Refer to Table 1 for Correction Table.

3.1.6 Traversing

All cutting permits require a closed or GPS traverse of each cut-block. 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 any established district policy on boundary marking where the cruise area is located (e.g., *Forest Practices Code Boundary Marking Guidebook*). Traverse notes shall include tree species and diameters recorded for all stations, tie - points and other boundary references. Refer to Section 3.6.2.1 for the tolerances. The original strip line, type line, boundary traverse notes and GPS coordinates must be made available to the check cruisers upon request.

The following cruise strip line traverse notes illustrate a recommended format for note taking.

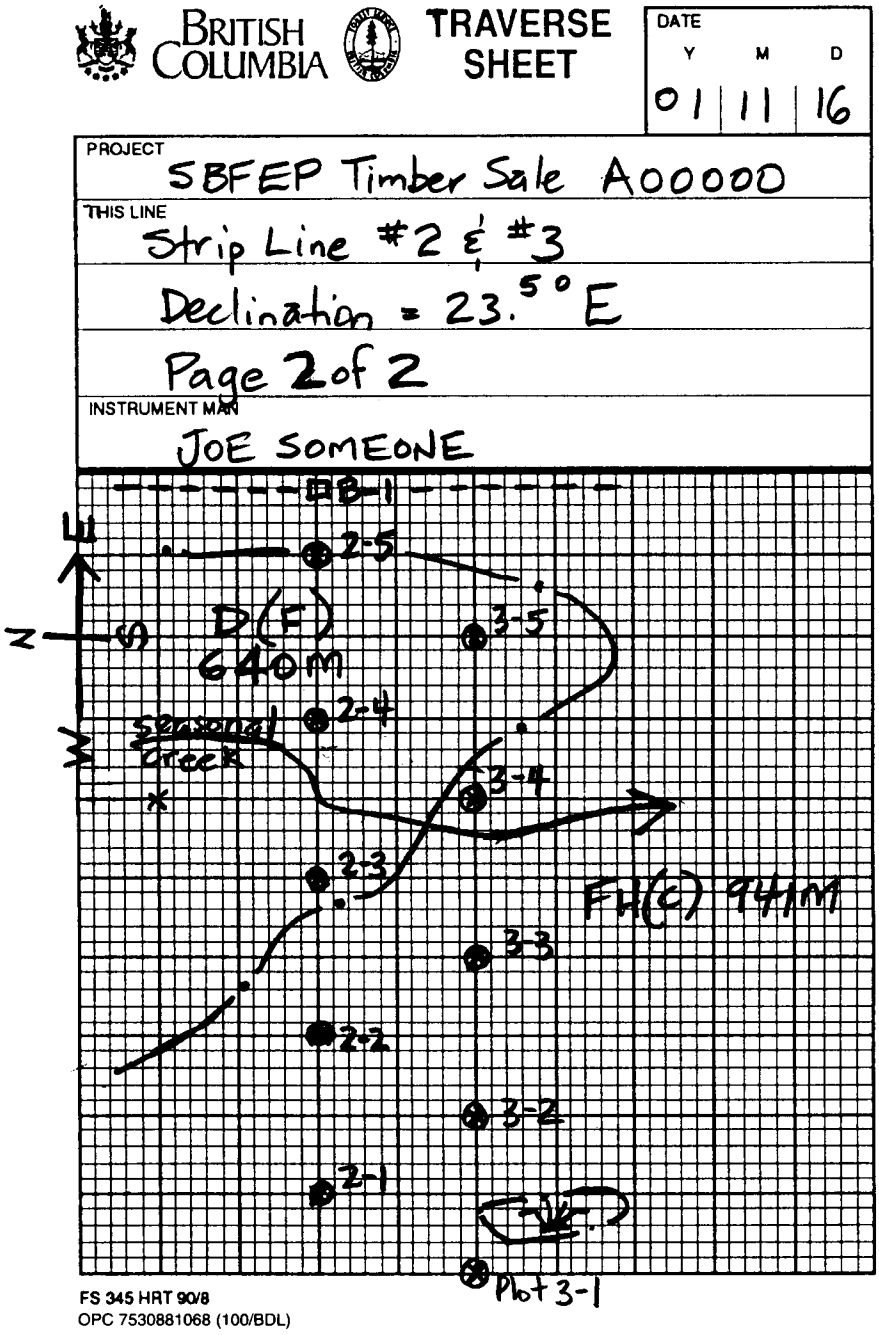


Figure 3.1a Cruise strip line traverse notes (front).

STATION	FORE BEARING	BACK BEARING	SLOPE %	SLOPE DISTANCE	HORIZONTAL DISTANCE	COMMENTS
0+90	→ See page 2					
	90	271	+4	40	40	
0+50						
	90	270	0	15	15	
0+35	= edge of swamp @ 0+40					
	90	271	0	35	35	
0+00	= PLOT 3-1					
4+40	= Falling Corner B-1 (hemlock, 25cm dbh)					
	90	270	+3	40	40	
4+00	= PLOT 2-5 (Border Plot, ref. tree 1.05 m @ 5°)					
	90	270	+2	50	50	
3+50						
	90	269	0	50	50	
3+00	= PLOT 2-4 (reference tree 1.50 m @ 70°)					
	90	270	0	50	50	
2+50	= Seasonal Creek					
	90	270	+5	50	50	
2+00	= PLOT 2-3 (reference tree 2.65 m @ 65°)					
	90	270	+3	20	20	
1+80	= Cross timber type into D(F) 640 M					
	90	271	+4	30	30	
1+50						
	90	270	+3	50	50	
1+00	= PLOT 2-2 (reference tree 1.42 m @ 180°)					
	90	270	0	20	20	
0+80						
	90	271	+5	40	40	
0+40						
	90	270	+3	40	40	
0+00	= PLOT 2-1 (reference tree 2.81 m @ 45°)					

Figure 3.1b Cruise strip line traverse notes (back).

3.1.6.1 Combined GPS and Conventional Traverse Procedure

To calculate the closing error for traverses where you 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://mascot.gdbc.gov.bc.ca/mascot/, 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 1 percent closure error requirement in Section 3.6.4.

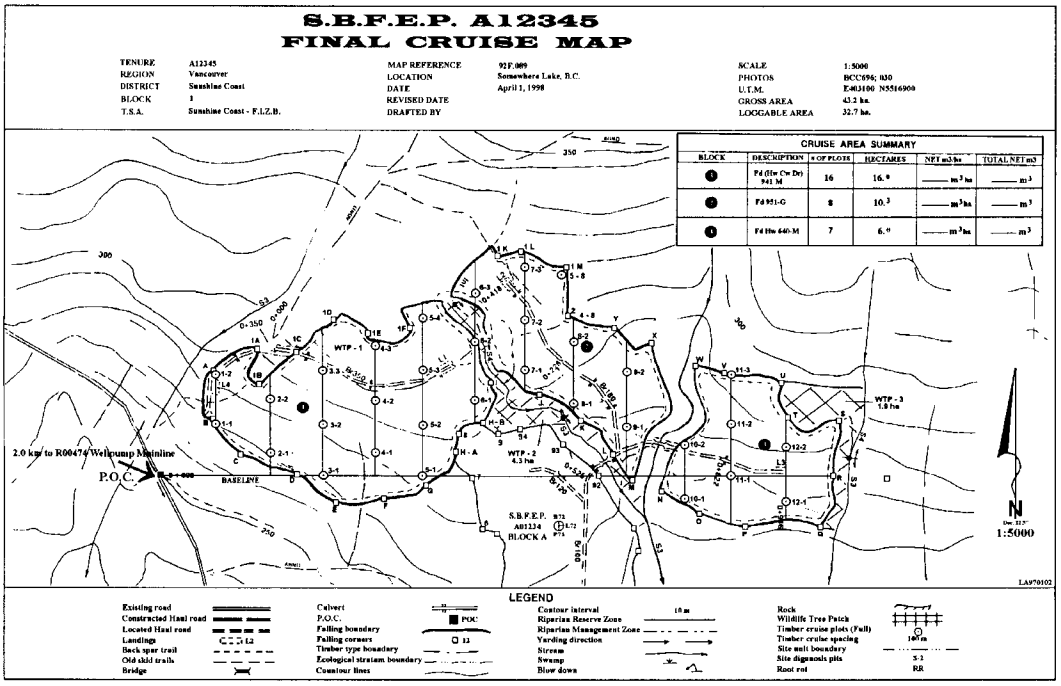


Figure 3.2 Final Cruise Map.

References:	*Standard Procedures for Line and Polygon Mapping Using Global Positioning Technology* Ministry of Forests web site: http://www.for.gov.bc.ca/resinv/standard/fri_man.htm
	Forest Practices Code of BC Act *Boundary Marking Guidebook* Ministry of Forests web site: http://www.for.gov.bc.ca/tasb/legsregs/fpc/fpcguide/bound/boundtoc.htm

3.1.7 Mapping

The minimum mapping standards for the cruise plan and final map are as per Sections 3.1.7.1 and 3.1.7.2 (also see Figures 2.1 and 3.2).

3.1.7.1 Cruise Plan Map Standards

1. The cruise map will be legible and of good quality 1:5 000 or 1:10 000 scale.
2. The map will provide neat and clear lines, lettering and numbers.
3. The cruise map and Cruise Area Summary shall include the following:
   a. tenure,
   b. forest region and district,
   c. scale used,
   d. timber supply area,
   e. north arrow and declination,
   f. cut block(s) must be identified as mature or immature,
   g. timber type lines and description, including a forest cover map of the cruise and adjacent areas,
   h. plots must be numbered (measure and count identified), and
   i. types, area and summary.

j. existing and proposed roads,

k. adjacent logging and burn history,

l. inventory region and compartment number,

m. UTM grid (Small Business Tenures),

n. Forest Inventory Zone, and

o. PSYU.

3.1.7.2 Final Cruise Map Standards

Cruise maps must accompany the compilation report, and must be produced as required under Section 3.1.7.1 plus:

1. Scale of 1:5000, 1:10000 or as approved by the District Manager.
2. Plots used in the compilation are to be clearly indicated and numbered on the map.
3. Locations of baselines, boundary tie lines, and actual strip line location with direction of travel must be indicated,
4. Contour lines are recommended and must be indicated in such a fashion that they are clearly legible and indicative of local topographic features.
5. Physiographic features must be shown.
6. Legal survey features must be shown.
7. Forest and non-forest type boundaries must be clearly indicated.
8. Status clearance boundaries and cutting boundaries must be shown.
9. Any other features of significance with respect to the sale of Crown timber (i.e., windfall areas, fire areas, insect or disease infestations, fish-bearing streams), and contour logging considerations must also be shown.
10. Digital GPS Survey and mapping data must be provided upon request by the Ministry of Forests if GPS technology is used.

3.2 One Hundred Percent Cruises

The boundary of the 100 percent cruised sale must be well marked and each tree numbered or marked. In order to not miss trees a systematic procedure of tree measurement should be adopted:

1. Dividing the area into strips (maximum width 20 m) will help to ensure no trees are missed.

    - the denser the stocking the narrower the strips, and
    - the steeper the slope the narrower the strips.

3.3 Fixed-Area Plot Cruises

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, but half plots are not.

3.3.1 Circular 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 given in Table 2. The formula for calculating these corrections is in Section 3.1.5.2.

3.3.2 Rectangular 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 given in Table 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.

3.3.3 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 DBH is inside the plot. In practical terms, the tree's plot radius is measured from the centre (middle) of the tree at DBH to the plot centre.

3.4 Variable (Prism) Plot Cruises

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

3.4.1 Sampling Procedures

The cruiser holds the prism exactly over plot centre and looks at a tree across the upper edge of the prism, and so views it simultaneously above the prism and also 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. The prism will be "swept" around plot centre and all live and dead trees equal or larger than the minimum specified size for the "in plot" trees recorded.

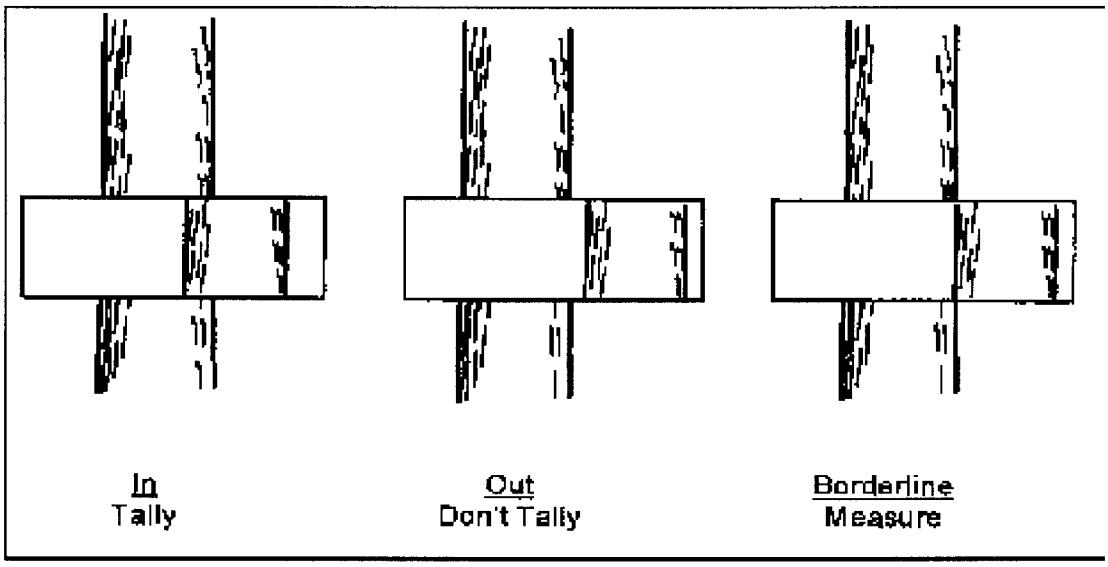


Figure 3.3 "In", "Out" and "Borderline" trees.

When two prisms are being used on the same plot, each prism will be "swept" through 360° about the plot centre. It is vital that only the appropriate trees be recorded for each sweep. Assume two prisms having basal area factors of 2 and 4 are being used. In this case on the 2 basal area sweep only those trees whose diameters are 17.5 cm and over and less than 27.5 cm DBH, will be recorded. Trees whose diameters are 27.5 cm or greater will not be recorded even if they appear to be "in". Conversely on the 4 basal area sweep, trees whose diameters are less than 27.5 cm will not be recorded even if the appear to be "in". Therefore, on the tally sheet it is vital to record the basal area factors used and the tree diameters to which they apply.

3.4.1.1 BAF Selection

The choice of the proper BAF is based upon two principal considerations:

1. The visibility of the trees that should be "in".

2. The number of trees counted at each point.

The prism size must not be changed at plot centre to include or exclude certain trees or to achieve a specific tree count as that constitutes bias. The intentional use of more than one prism size in a timber type will result in rejection of the cruise.

3.4.1.2 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 Section 3.1.5.2 for the slope distance correction factor formula). In borderline situations, trees are to be measured as described in the following section.

3.4.1.3 Borderline Trees (Prism Plots)

The status of borderline trees in measure and count-plots must be checked by measuring the horizontal distance from the plot centre to the face of the tree trunk at DBH. Add one half of the tree diameter to the horizontal distance to determine the horizontal distance from the tree to the plot centre. In prism cruising every tree has its own plot radius depending on its diameter and the angle of the prism being used (see Table 4.1). The plot radius factor times DBH gives the appropriate plot radius for any tree. The trees plot radius, distance from the sample plot centre and the prism size determine whether the tree is "in" or "out" of the plot radius. A tree is "in" the plot if at least half of the diameter of the tree measured at DBH is inside the plot. Volume equations are based on DBH, therefore, the prism must be sighted on the tree at breast height in sampling.

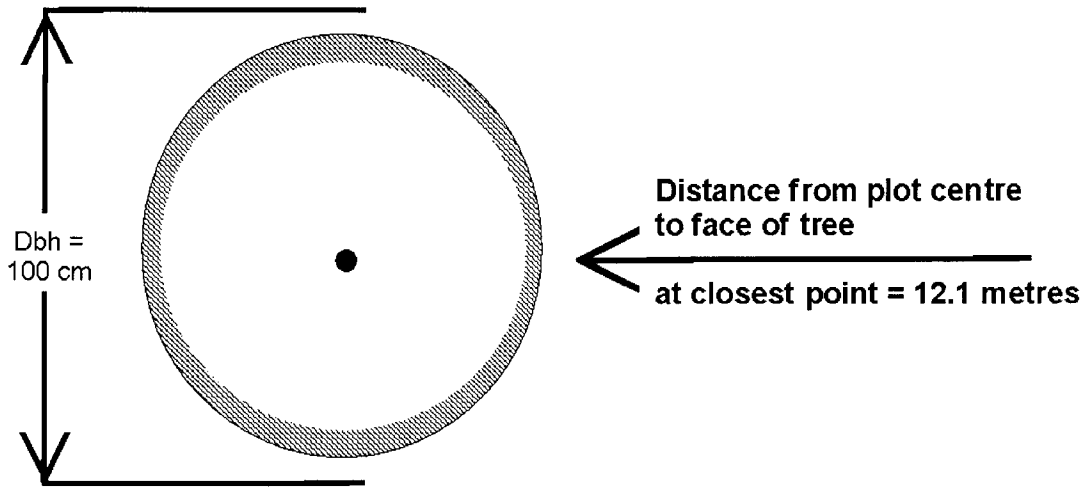


Figure 3.4 Borderline Tree Measurements - Variable Plot.

BAF 16 Prism

$$PRF = \frac{1}{2\sqrt{16}} = 0.125$$

Plot radius of 100 cm tree = 0.125 x 100 = 12.5 m.

$$\text{Distance to centre of tree} = 12.1\text{ m} + \left| \frac{100\text{ cm}}{2} = 0.5\text{ m} \right| = 12.6\text{ m}.$$

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

The following table gives plot radius factors for a selection of prism basal area factors.

Basal Area Factor	Plot Radius Factor	Basal Area Factor	Plot Radius Factor
1	0.5000	12.25	0.1429
2	0.3536	13	0.1387
3	0.2887	14	0.1336
4	0.2500	15	0.1291
5	0.2236	16	0.1250
6	0.2041	18	0.1179
6.25	0.2000	20	0.1118
7	0.1890	20.25	0.1111
8	0.1768	24	0.1021
9	0.1667	25	0.1000
10	0.1581	30.25	0.0909
11	0.1508	32	0.0884
12	0.1443	64	0.0625

For example, a tree having a DBH of 28 cm, sighted with a 4 BAF prism, will have a plot radius of 7 m. Therefore, if the horizontal distance from the plot centre to the tree centre is 7 m or less the tree is "in" and will be tallied. If the distance is greater than 7 m the tree is "out" and is not tallied. All "borderline" trees must be measured and the measurements recorded for checking purposes.

3.4.1.4 Leaning or "Down" Trees

Regardless of the direction of a tree's lean or position on the ground, the horizontal distance must be measured from the centre of the top side of the tree at DBH to the plot centre in order to decide whether a tree is "in" or "out". The position of the point of germination has no bearing on this decision.

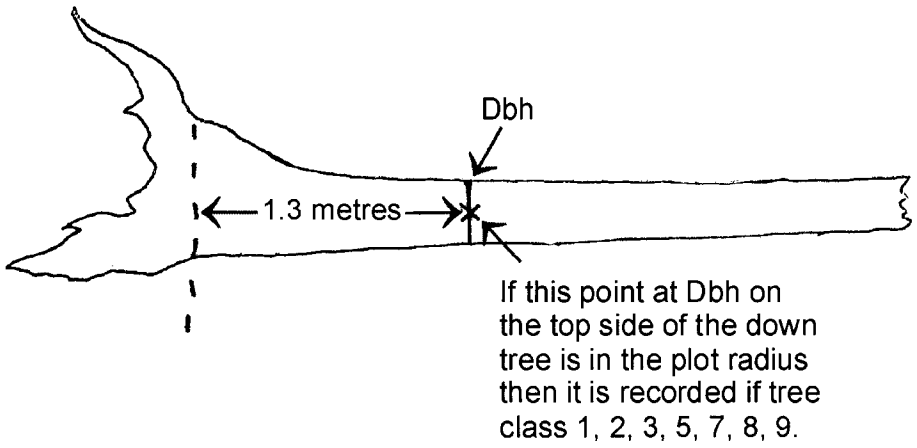


Figure 3.5 Plan view of leaning or "down" trees.

3.4.1.5 Hidden Trees

Trees may be obscured by undergrowth or other trees. In these cases the prism may be moved off the sample centre, maintaining the same distance to the tree in question. However, it may still be difficult to sight the tree at breast height. If the tree qualifies as an "in" tree by sighting above breast height, it would also be an "in" tree if sighted at breast height, unless the tree leans toward the observer.

If a tree cannot be sighted by the above procedures it must be treated as a borderline tree, the trees plot radius calculated and the distance from the plot centre to the tree measured.

3.4.1.6 Half Plots

Half plots are not permitted in the Interior after April 1, 2002.

3.4.1.7 "Boundary" or "Border" Plots (Plots Falling On Type or Block Boundaries)

Plots which are located on or adjacent to timber type lines or harvesting boundaries inside the sample area, are split through the plot centre parallel to the type line. The trees inside the sample area are recorded and the plot recorded as a B for border/half plot. Border plots cannot be used in count plots.

Plot centres which fall *outside* the sample area will be dropped.

To determine if a full plot would sample outside the stratum or cutting boundary, multiply the diameter of the largest tree (excluding live and dead useless) in the full plot by the prism plot radius factor (PRF). If this critical distance is greater than the distance to the stratum or cutting boundary then establish a border plot.

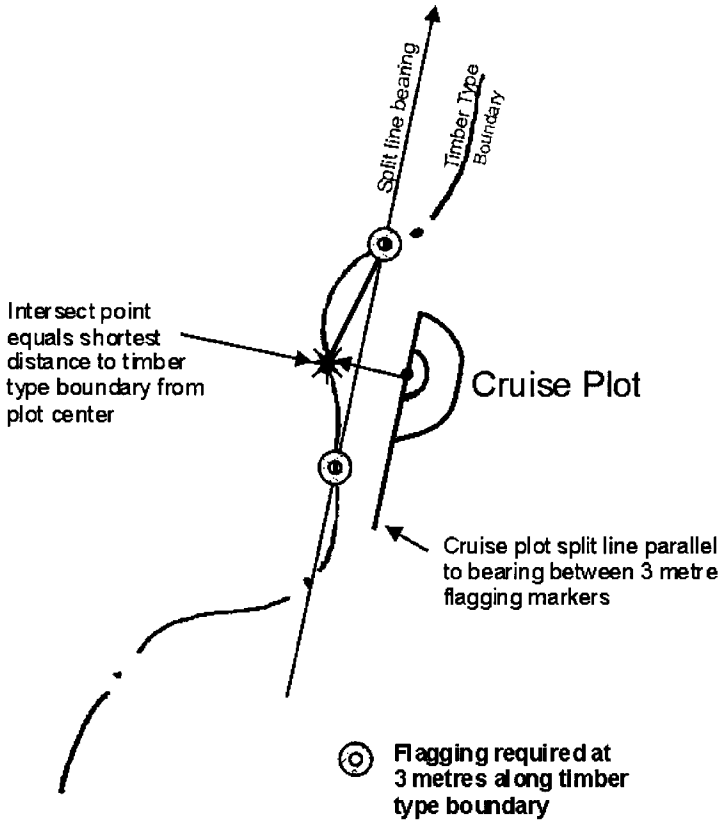


Figure 3.6 Border plot procedure.

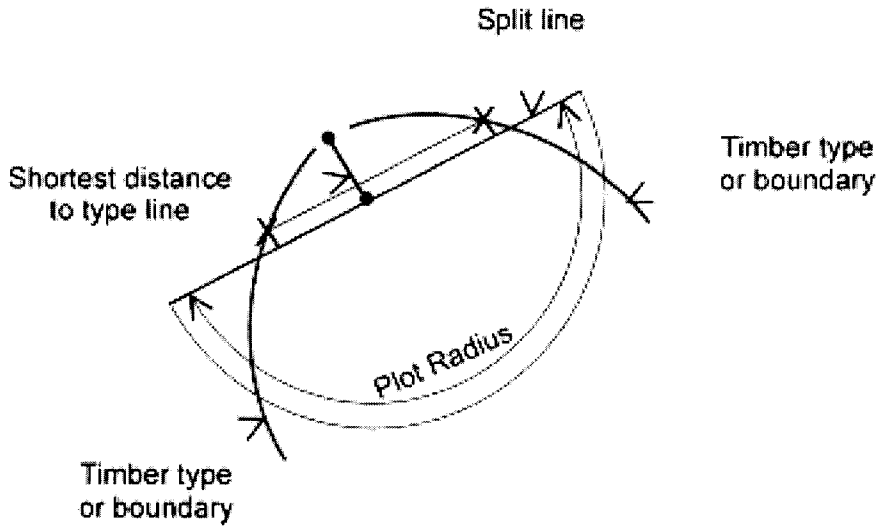


Figure 3.7 An example of a border plot that must be dropped because 180 degrees isn't available for measurement.

3.5 Tree Measurements - Prism and Fixed-Area Plots

3.5.1 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 should be numbered; "out" trees should have an "X". In count plots, only the first tree must be numbered, with an arrow painted on that tree indicating whether the tree tally goes clockwise or counter clockwise. Live useless and dead useless stems are not tallied in count plots.

3.5.2 Species

All living and dead, standing and down trees which are listed in Section 6.3.2 (except dead and down useless) and which meet or exceed the utilization limit must be recorded when present in a plot. Section 6.3.2 gives a complete list of the commercial tree species and the proper use of genus and species codes.

3.5.3 Heights

The "One Hundred Percent method" must be used on all scale and cruise based tenures cruised after March 31, 1997. The Sample Height method is restricted to use in stump cruises or where severe damage due to windshear or freezing has occurred. Severely damaged stands must be identified on the cruise plan and submitted to the Regional Manager or their designate for sampling alternatives. Project the original height of trees with broken tops (as per Figure 3.8 below).

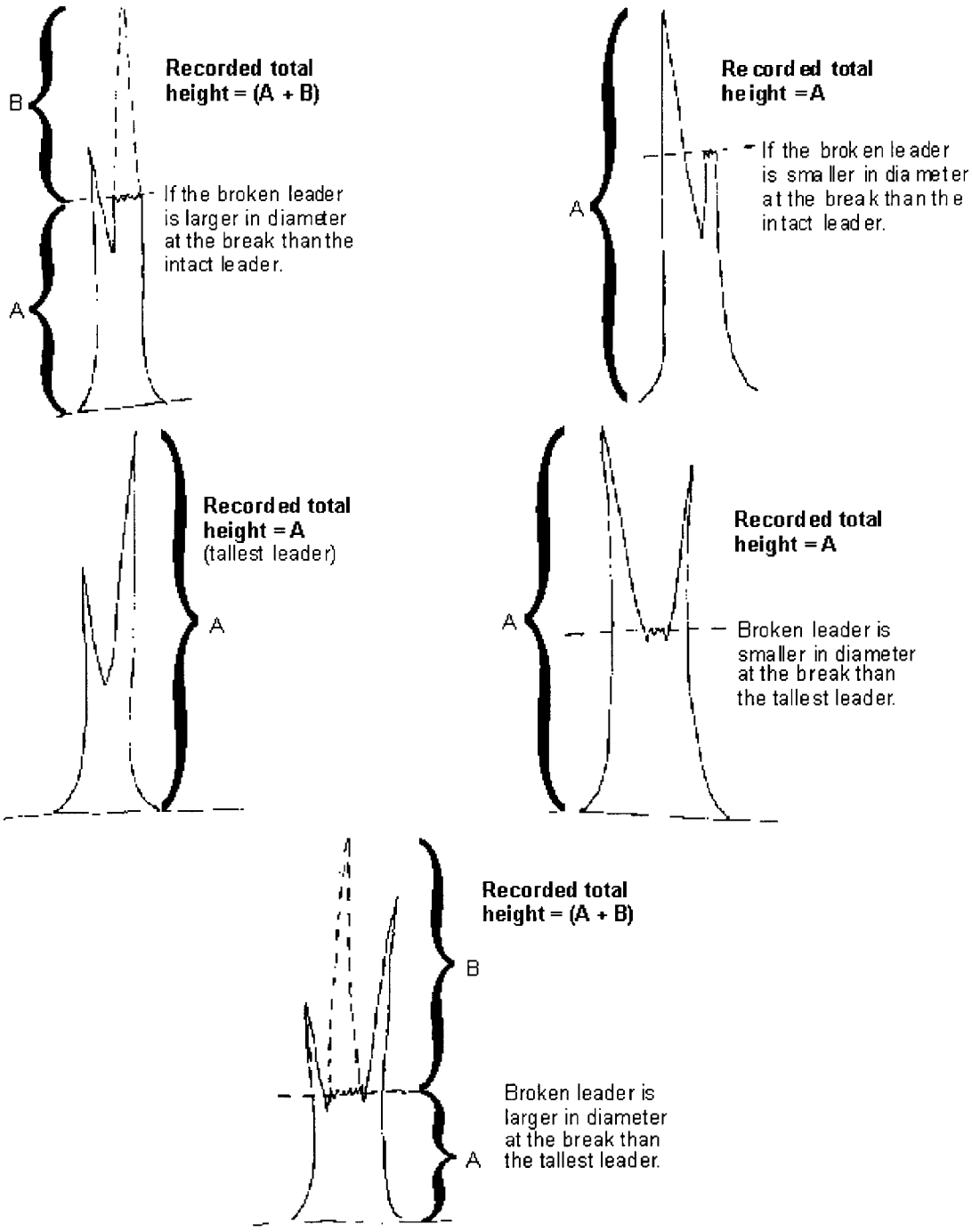


Figure 3.8 Example of where to measure the height on trees with a broken top or fork/crook.

3.5.3.1 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 3.9). The angle A must be 90 degrees.

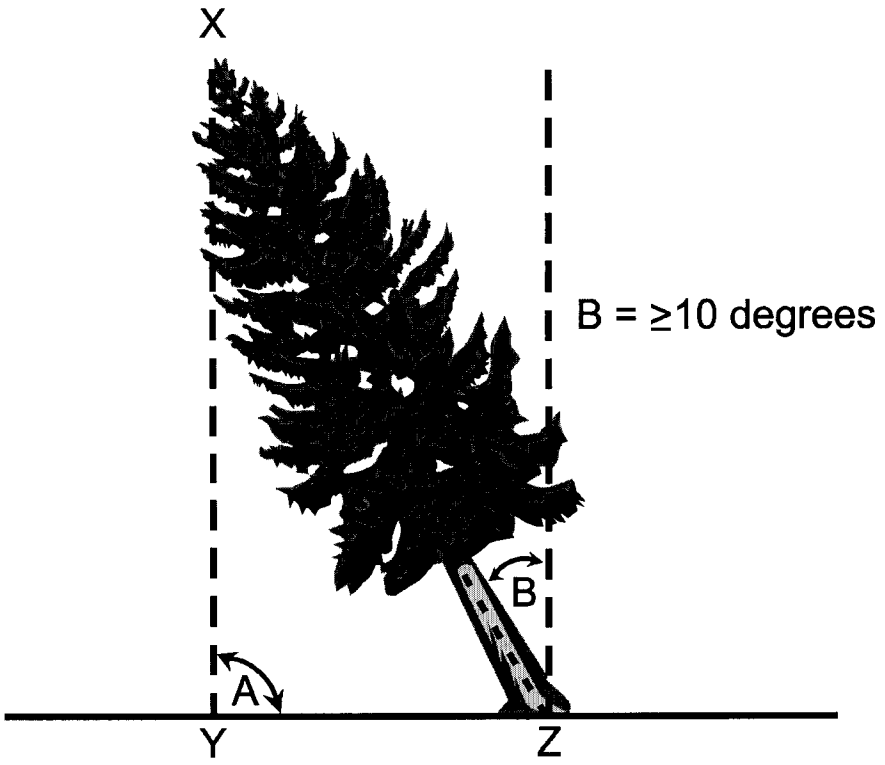


Figure 3.9 Measuring height of leaning trees.

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:

$$\text{Tree Length (m)} = \sqrt{\left(\text{length XY}_{(m)}\right)^2 + \left(\text{length YZ}_{(m)}\right)^2}$$

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

3.5.3.2 Deciduous Tree Heights

Maintain adequate distance from the tree when measuring the highest point on deciduous trees by ensuring that the angle from the cruiser's eye to the highest point is less than 100 percent. This will assist in distinguishing the highest point on the tree from lower branching or forks.

3.5.3.3 "One Hundred Percent" Height Measurements

This is the mandatory method of tree height determination.

With the 'One Hundred Percent' height measurement method all trees tallied in C.T. 2 have their heights either *measured or estimated* and entered in columns 27 - 29 (Total Height - metres) between the tree number and species on the Cruise Tally Sheet. The use of a clinometer or electronic measuring device is recommended for tree height measurements and estimates. These measured and estimated heights are used to calculate the volume of the trees within the plot, as opposed to constructing a height curve from height samples.

Estimated heights are obtained for the remaining trees by comparing their height to one or more measured heights.

In plots where there is a high variation of tree heights, more measured height samples may have to be taken to maintain the desired degree of accuracy for the trees.

3.5.3.4 "Sample-Height" Heights (Height/Diameter Curves)

The "sample-height" method only collects heights for some of the tallied trees. This method predicts average height from a height/diameter curve and is restricted to use in stump cruises and severely damaged stands.

Height Sample Size

In general, at least 20 sample trees from each species in each site class on the cutting permit or timber sale must be measured for height. These sample heights must be evenly distributed throughout each type or site-class (i.e., at least one sample height per plot). If it appears that a certain species exhibits the same height/DBH relationship in two or more forest types in the same cutting unit, it is permissible to develop a common height - DBH curve; the tree heights for a given species must be similar throughout the diameter range common to the species. In this case only a total of 20 sample trees need be taken within the two or more forest types. The "same height/diameter relationship" means an average height variation that does not exceed 3 percent over the full range of diameters between two sets of data.

Height Sample Selection (Height/Diameter 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 (see Section 6.3.3, Positions 25-26 for details).

If the sample tree has also been measured for height and/or age, it must be recorded with the same number, species and DBH. These heights will be used to calculate a height/diameter curve. If the height sample tree is taken outside the plot it will only be recorded in the "Sample Tree Detail" and given numbers 99, 98, 97, etc. to prevent confusion with sample trees inside the plot boundaries.

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. Under the assumption that these stems died as a result of low vigour and/or pathological depletion, their growth rate would be less than average, hence incorporation of their heights into a general species population height curve could unduly bias that species' height 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 (refer to Section 8.3 for additional information).

Height Sample Distribution (Height/Diameter Curves)

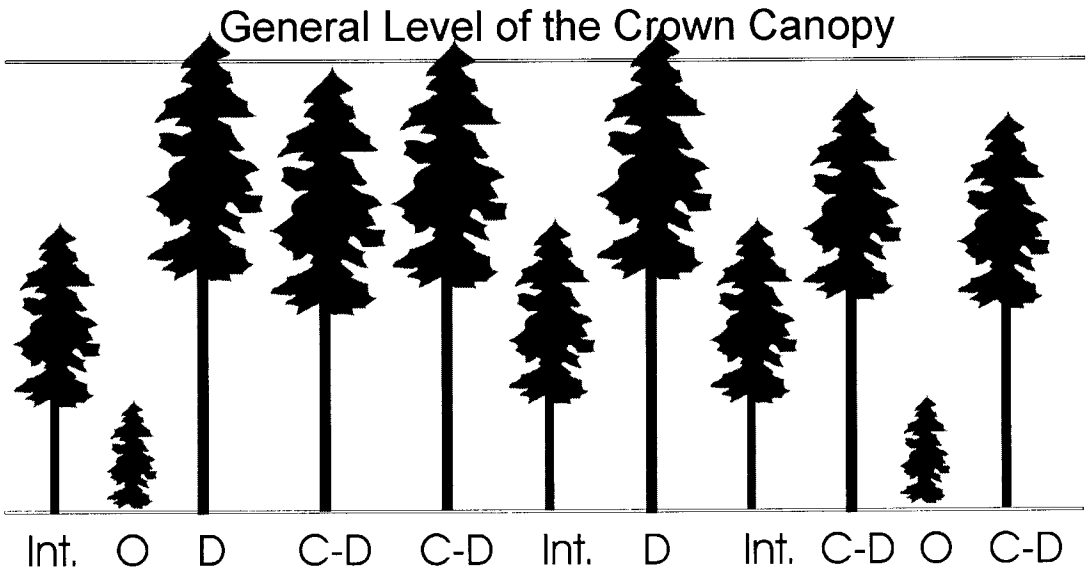
Measurements of height and DBH are required so that height DBH relationships can be developed and, therefore, height sample trees must cover the range of heights and diameters in the stand. Each height curve must represent only one species and have at least 2 sample trees for each 10 cm DBH class. The reference point for diameter and height is the high side of the tree as shown in Figure 3.11 of this chapter.

Height samples must be distributed as follows in the normal mature types 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 (Figure 3.10) 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 — 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 3.10 Crown classes.

Height Sample Measurements

Tree heights will be measured from the ground on the high side of the tree. The total height of lodgepole pine and broad leaf species is measured to the highest point of the crown, not at the point where the main bole commences natural forking. In general, the lower the reading, the more precise the measurement so try to keep the reading below 100 percent. The most important aspect of taking a tree height is seeing clearly to the top and breast height 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 horizontal plane (i.e., uphill or downhill).

2. Regeneration and underbrush.

3. Tree length of leaning trees must be measured if they lean more than 10 (ten) degrees from vertical.

Paint an "S" on the sample tree facing the direction that the sample tree height was measured from, and must be measured at a 90 degree angle from the direction of the lean.

3.5.4 Diameters

3.5.4.1 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 the DBH from the high side of the ground and *not* from the top of the obstacle.

If high side is lower than the point of germination (POG), then measure DBH from the POG.

If the lower portion of the stem has sweep, pistol grip or the tree is on the ground, then measure DBH along the curve and parallel to the centre line of the tree.

3.5.4.2 Diameter at Breast Height

The diameter of all trees of minimum DBH and larger specified in Chapter 6 will be measured with a diameter tape at a point 1.3 m (DBH) above the high side (see Figure 3.11). Diameter will be measured and recorded to the nearest 0.1 cm. Paint a line at DBH, preferably facing plot centre.

A tree that is forked below DBH will be measured as two trees. If the diameter tape can not be wrapped around the circumference of the tree at DBH 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.

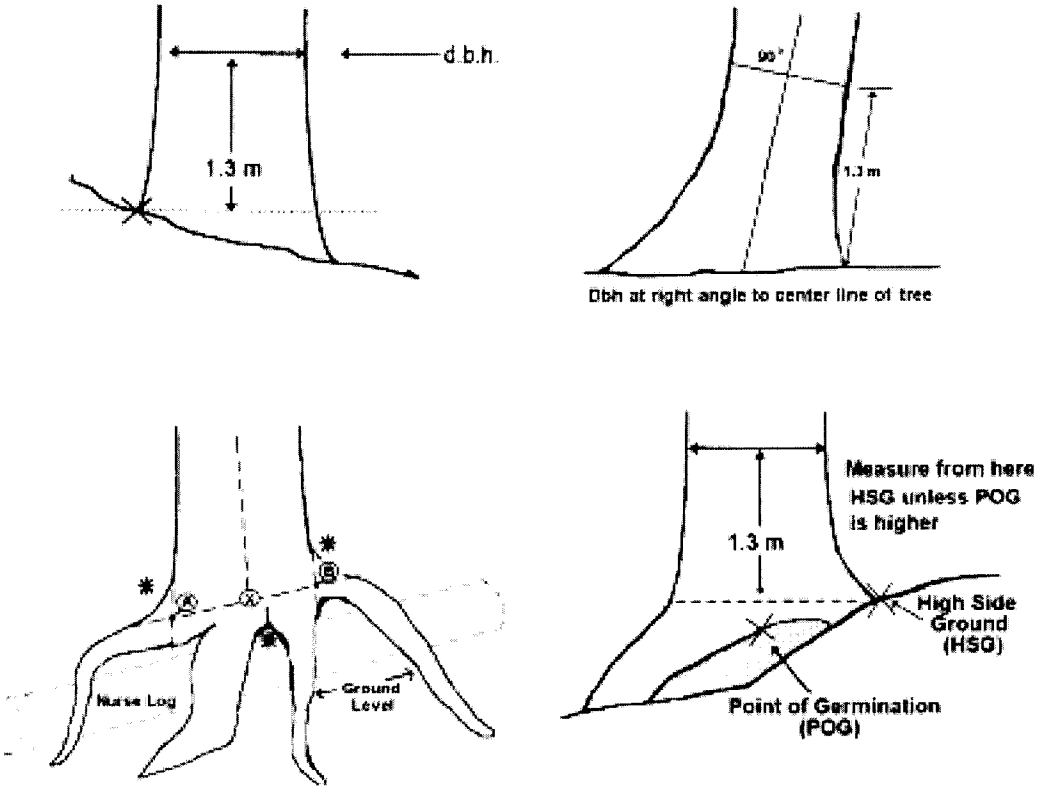
A tree that is forked at or above DBH will be measured as one tree. If there is swelling at DBH due to the fork, measure the tree at the nearest available location and estimate the diameter at DBH. Note on the tally card that the diameter has been estimated.

If there are burls, galls or swelling obstructing a normal taper measurement for a tree at DBH, 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 DBH.

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

Down trees that have been cut into pieces or that have had pieces removed will be measured if 50 percent or more of their gross volume is still on site. If the DBH section is missing, then the DBH will be estimated. The plot radius for down trees will be measured consistent with Section 3.4.1.4.



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

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

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

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

Figure 3.11 DBH in relation to high side.

3.5.5 Pathology

Pathological indicators are recorded when observed on the bole or a merchantable secondary leader (see Section A.4.2) of the tree. The exceptions are *Phaeolus Schweinitzii*, which will occur on the ground near the base of the tree and scars on the root collars. There are qualifications to many of the suspect characters such as age of scars, position of fork or crook, size of rotten branches, etc (please refer to Appendix 4, for a detailed description of pathology).

3.5.6 Tree Classes

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 before classification as Residual or Suspect.

> Refer to Appendix 4 for diagrams and further information about residual and suspect trees.

3.5.6.1 Tree Class 1 (Residual)

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

3.5.6.2 Tree Class 2 (Suspect)

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 infection), rotten branches, dead or broken top.

All pathological indicators must be recorded for each tree where they occur in order for the computer 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 Table 18 for risk group assignments by pathological indicators.

3.5.6.3 Tree Class 3 (Dead Potential)

Dead standing or down timber which is estimated to contain at least 50 percent of its original gross volume in sound-wood 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.

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 has not hardened over and is still sticky to the touch.
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.

Down stems in this class will be determined as "in" or "out" by measuring from DBH on the tree where it lies to the plot centre (see Section 3.4.1.4, Leaning or "Down" Trees). For net merchantable volume compilation, dead potential stems will have the highest Risk Group factor for that particular species.

The 50 percent or more firmwood rule is the key consideration. Consider the resistance to decay of the species and the local climate (refer to Table 19 for the Sound Wood Factors for saprot and formulas to assist in the determination of 50 percent soundwood content).

Decay should be determined at various intervals on the tree. Tables are available to estimate cross-sectional area of decay. For example, the outer one-third of a tree represents one half the volume. Also, the bottom third of a tree contains approximately one half of its volume. Other tables are available which show the percentage of volume of the tree in each 10 m log. By estimating percent firmwood in each 10 m log, the firmwood percent of the tree can be determined.

1. Dead Standing

   Decay percent is difficult to assess on standing trees, "Sounding" with an axe or equivalent implement can be helpful. Before sounding, look for overhead hazards that may be dislodged.

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 therefore be influenced by the tree species involved as well as by local climatic conditions. C, Cy, F, S, P and L are the most decay resistant species and are less likely to exhibit extensively 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 called on all dead potential trees on the coast and dead potential hemlock in the hemlock partitions in the interior for the log grade algorithms.

3.5.6.4 Tree Class 4 (Dead Useless)

Dead standing trees that have less than 50 percent of their original gross volume in firmwood content or otherwise fails to meet the criteria of a dead potential tree as described in Section 3.5.6.3 will be classified as "dead useless" trees. Only dead useless standing trees will be tallied (dead useless down trees are *not* tallied). Dead useless trees are considered standing if they are leaning into another tree. Dead useless standing trees will not be compiled for volume, but along with Live Useless trees, provide a record of snag density in the stand for appraisal purposes. Only trees equal or greater than 3 m high and equal or greater than the minimum utilization diameter must be tallied. Estimate their actual observed height and the original DBH, not an estimate of the stems original height.

3.5.6.5 Tree Class 5 (Veteran)

A veteran is defined as a mature living tree (121 years or older for all species except deciduous greater than 40 years or Cottonwood and Aspen in FIZ K & L greater than 80 years) in a main stand which has been classified as immature (less than 121 years) (e.g., a former remnant of a mature Douglas fir stand in an immature stand of lodgepole pine).

A reasonable number of veteran ages should be sampled along with the age drilling of the main stand component.

3.5.6.6 Tree Class 6 (Live Useless)

Live Useless trees are trees that have only one or two live limbs. They are combined with TC 4 for the compilation of percent snags. This tree class must not be confused with a Tree Class 2 tree, which has 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.

3.5.6.7 Tree Class 7 (Veteran Dead Potential)

This class is a combination of Veteran and Dead Potential so that the correct loss factor tables are applied in the compilation. The guidelines for TC 3 and TC 5 apply.

3.5.6.8 Tree Class 8 (Immature)

An immature is defined as an immature tree (less than 121 years, etc.) within a mature stand. This classification enables the correct loss factor tables to be applied in the compilation.

3.5.6.9 Tree Class 9 (Immature Dead Potential)

This class is a combination of Immature and Dead Potential so that the correct loss factors are applied in the compilation. The guidelines for TC 3 and TC 8 apply.

3.5.7 Quality

Stem quality information forms the basis for a computerized grading system. Quality remarks are also used for the experimental interior Douglas Fir quality and the interior log grade algorithms (refer to Appendix 8). 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 class information will be collected on all commercial living and dead potential trees (refer to Chapter 6, Positions 45-51, required on the coast for immature, partial harvest cutting authorities, woodlots, Small Business Forest Enterprise Program Timber Sales).

3.5.8 Damage Codes

Standard cruising methods as outlined in Chapter 6 and Appendix 7 of the *Cruising Manual* are to be followed.

Damage codes are to be used when damage is identifiable.

Code the trees as they appear at the time of the cruise with no attempt to guess what the future condition of the trees will be.

3.5.9 Ages

Measurements of age should concentrate on co-dominant trees as the purpose is to obtain average stand age. Two to three trees should be bored for age 1.3 m above high side on each plot when the type is near a loss factor age-change (younger immature/older immature, older immature/mature or mature/over mature) or individual species have a different age.

For 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 average age in 10's on the Cruise Tally Sheet is required for all measure and count plots. This age is used in each plot to assign the correct loss factor table, determine maturity and for stratification.

Age in 10's by plot or by timber type is acceptable. The correct loss factors must be applied to each tree consistent with the tree class modification of loss factor tables in Table 17.

It is important that height as well as age be taken on each age sample tree because the height is used to estimate the years to boring height to obtain total age.

The age correction to Dbh is found in the most recent copy of the site index curves that can be purchased from Crown Publications at the following Web Site:

http://www.crownpub.bc.ca/cat_view.cgi/CP.02.01.40.20

In older immature stands with scattered veterans, however, age counts of the older portion of the stand are important in order to distinguish the veterans from the younger trees. Refer to the back of Table 17 for the correct application of the age in 10's and tree class combinations that must be recorded.

Age of sample trees is determined by a ring count from an increment borer core, taken at diameter breast height (DBH).

The pith must be included in at least half the sample tree cores on each plot. 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 rebored.

"Age bored at 1.3 m must be accompanied by a sample tree height. The Site Index is then determined by using the bored height age (1.3 m trees above high side) and the height of the sample tree. The Total Age of the Age Sample Tree is determined by adding the boring height age to the years to boring height (as determined by the Site Index)."

Tree class 3, 7 and 9 trees – record age as counted and corrected. Do not add the number of years that the tree has been dead.

3.6 Check Cruising

If requested by the Ministry of Forests for checking purposes the licensee or consultant shall submit the originals of the cruise tally sheets, cruise map and traverse notes. If magnetic data is requested it must contain the Map Area Statement completed as per Chapter 7 and be followed with the tally sheet data listed in numerical order, and shall be submitted in ASCII format on 3 ½" floppy disks (regional exceptions may exist).

3.6.1 Data Replacement and Responsibility for Data

If an independent check cruise has been performed, then the original cruise data must be intact with any changes noted on the original cruise tally sheet.

The independent check cruiser will complete the back of the tally sheet "Checked By" and "Signature" boxes and note under the "Remarks" box that they evaluated the original data.

The independent check cruise must be done so that the Ministry of Forests check cruiser can determine whether the original or the independent cruiser was responsible for the final data. The independent check cruise must be done prior to the Ministry of Forests check cruise.

The check cruise data will replace the original cruise data for all cruises that are rejected and the data will be entered into the cruise compilation program. If the cruise is acceptable, but specific data is missed or added by the check cruiser, then that data will be added or deleted on the original cruise tally card. The correction will be initialled by the check cruiser and the back of the original tally card will be signed and dated by the check cruiser.

3.6.2 Objectives of Check Cruising

The purpose of check cruising is to verify that field observations and measurements were taken and noted correctly. Checking includes traverse notes, compass notes and tally sheets.

Certain guiding principles will be the basis for all aspects of cruising:

1. All measurements shall be accurately and carefully taken. Personal bias must be eliminated and each classification determined fairly and honestly.

2. Magnitude of sampling errors should be calculable.

3. All measurements must be made with instruments of proven accuracy, and they must be calibrated regularly.

The field check should be performed while the production cruisers are on site provided that an acceptable cruise plan was submitted to the appropriate district office at least 30 days in advance of the commencement of field work. The cruising agency must be given the opportunity to attend the check cruise.

3.6.2.1 Risk Management

The risk management principles for check cruising include emphasizing check cruising on parameters that have significant impact in the appraisal. The following parameters should be checked:

1. Check 10 percent of the cruise plots in the cruise or a minimum of 5 measure (or 4 measure and 2 count) plots and 20 trees, including their tree heights and diameters.

2. Randomly select plots to check each cruiser's work.

3. Compare the cruise plan map with the cruise strip traverse notes and the final cruise map to verify that the timber type lines and cutting boundaries are correct. Verify that the cruise plots used in the compilation are not within wildlife tree patches and non-forest areas, and that these areas are mapped according to the traverse notes. It is important to determine the reason for the addition or deletion of all cruised plots. If the placement of wildlife tree patches (WTP's) causes a cruise plot to be deleted, and it appears that the location of the WTP is not environmentally sound, an explanation by the licensee is required. It is recommended that a written explanation be obtained defending the location of the WTP.

4. At least one plot interval distance check per cruiser.

5. Emphasis in the plot measurements must include tree count, trees species, tree heights risk groups, diameters at breast height (DBH), and plot slope.

6. Boundary and type-line checks will qualify as a check cruise.

The following should be used in establishing check cruising priorities:

1. Cruiser's past performance,

2. Cruiser's experience,

3. High value timber (as determined by species selling prices in the *Coast Appraisal Manual* or *Interior Appraisal Manual*),

4. Licensee's Allowable Annual Cut in the district.

Upon request, a copy of the Ministry of Forests check cruise comparison shall be submitted to the licensee or consultant in a format acceptable to the Regional Manager or their designate.

Check cruising is required for all cruise based sales.

3.6.3 Allowable Non-Sampling Errors

Any one of the items listed in Section 3.6 can lead to either the remeasurement of the entire cruise or the specific parameters that were exceeded.

These standards are defined as the maximum allowable measurement error or variation in any measured quantity before such a measurement is considered to be incorrect. Individual standard parameters are to determine whether bias has occurred or not. When an item has a *two part standard*, both parameters must be exceeded before the item is classed as incorrect.

The individual items to be checked and the acceptable limits of error are:

3.6.3.1 Tree Data

1. **Number of Stems**:

    a. Fixed Area and Prism Plots - not more than plus or minus 1 stem in 50 trees checked from the true number for all plots checked (measure and count-plots).

This tolerance (1 stem in 50 trees) is to be applied as follows.

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

    b. The stem count will include all merchantable trees except live useless or dead useless trees in this check parameter,

    c. all borderline trees must be checked by actual measurement from the plot centre and measurement of the diameter to determine whether the tree is "in" or "out",

d. all borderline trees are to be measured as per Section 3.3 and 3.4 of the *Cruising Manual*,

e. if the borderline "out" tree has not been measured and found to be "in" on the check-cruise it will be counted as a "missed" tree,

f. if the borderline "in" tree has not been measured and found to be "out" on the check-cruise it will be counted in the incorrect stem count,

g. 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 percent variation from the check plot radius and the original horizontal distance measured for the tree does not exceed one percent variation from the check horizontal distance, and

h. trees of minimum utilization sizes of 12 cm (coast**al immature**), 12.5 cm (interior Pl), and 17.5 cm are allowed 1 percent variation in diameter at breast height.

Dead useless and live useless tree counts are a check cruising item for interior appraisal cruises for snag percent. One in fifty trees are the maximum tolerance.

Trees incorrectly identified as dead potential versus dead useless or live useless versus live potential contribute to an incorrect stem count. If safe to do so, dead potential trees should be chopped into at three or more locations to verify percent sound wood content and the calculations shown on the tally sheet.

2. **Species Identification:** the tolerance for species variations is 1 in 50 trees checked excluding tree class 4 and 6 (useless) trees.

Number of Trees Checked	Number of Species Errors Allowed
1 to 50	1
51 to 100	2
101 to 150	3

3. **Heights:**

   a. any intentional bias to tree height measurements will result in rejection,

   b. use a clinometer and measuring tape or an electronic measuring device to check all tree heights. The accuracy of electronic measuring devices must be demonstrated prior to the commencement of check cruising if they will be used for the true height, and

   c. a minimum of 20 tree heights must be checked. If the total cruise does not have 20, then check a minimum of 50 percent of the heights.

      All Tree Heights - Average absolute variation must not exceed 5 percent.

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

$$\text{Absolute Variation} = \frac{6.0}{171.0} = 3.51 \text{ percent}$$

4. **Pathological Indicators and Risk Groups:** no more than 10 percent of all trees checked in a cutting authority area can have a risk group change.

5. **Damage Codes:** if they effect the risk group or an appraisal variable.

   a. No more than 5 percent of all trees checked can have a missing or extra damage code, and

   b. missing or extra damage codes that result in a risk group change will contribute to Section 3.6.3.1, 4.

6. **Ages:** Refer to Section 3.5.9.

   a. The age in 10's and tree classes must result in the correct application of the loss factors consistent with the Tree Class Modification of Loss Factor Tables at the end of Table 17.

b. 95 percent of all trees must be placed in the correct immature and mature class for loss factors,

c. Coast - age in 10's of 13 and 14 - all tree classes must be verified since tree classes 1, 2, 3, 8 and 9 contribute to the percent second growth reporting (see Chapter 6, Positions 21 and 22).

7. **Breast Height:** when this limit is exceeded, the true position is used for a. and b. below. 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.

Diameter at Breast Height (DBH)			
•	All live and dead potential trees as measured with a steel or equally accurate DBH tape..	a. b.	At least 90 percent of individual stems checked must be within 2 percent of true DBH. Average absolute variation of all DBH's checked must be within plus or minus 2 percent.
•	DU trees can be estimated.	a.	Estimate to the nearest 5 cm class.

8. Strip Lines or Tie Lines to Prism or Fixed-area Plots:

Plus or minus 3 percent of horizontal distance.

Bearing-strip to strip or plot to plot and plot centre reference:

Plus or minus 2^{o} - this translates to 3.49 m in 100 m using the formula:

(100 * (tan 2 degrees)) = 3.49 percent

Therefore, 3.49 percent * 100 m = 3.49 m.

Plot centre reference	Plus or minus 1 percent of horizontal distance
Radius - fixed area plots	Plus or minus 1 percent of horizontal distance
Radius - prism plots	Plus or minus 1 percent of horizontal distance
Length and width: fixed rectangular plots	Plus or minus 1 percent of horizontal distance

Boundary Traverse	Cruise-Based	Scale-Based
Closure error	Plus or minus 0.7 percent	Plus or minus 1 percent
Area error	Plus or minus 1 percent	Plus or minus 1.5 percent
Inter-station distance	Plus or minus 1 percent	Plus or minus 2 percent

3.6.3.2 Quality (Coast)- as they affect grade

1. **Pathological indicators:** 90 percent of the individual indicators that occur in the middle or lower third must be coded in the correct third.

2. **Quality indicators:**

   a. by Check Plot – greater than or equal to 90 percent of all quality indicators checked must be within plus or minus one code change.

   b. for All Check Plots – greater than or equal to 90 percent of all quality indicators checked must be within plus or minus one code change. The exceptions are:

      - knot codes 5 and 6 must be correct or they contribute to the number of incorrect codes, and

      - spiral Grain – if the check code is greater than 4 and the original is less than 5, or vice versa, then it is an error. Codes 5 to 9 will generate Y-Grade in all cases.

3.6.3.3 Slopes

Slope:

1. **Plots:** ≥ 90 percent of the individual plots checked must be within plus or minus 5 slope percentage points of the slope measured by the check cruiser.

   A flagging tape tied at 15 m horizontal distance from plot centre at the steepest ground with the plot slope written on the flagging tape is recommended to assist in the check cruise process.

2. **Block or Cutting Permit**: the average variation of all slopes checked must be within plus or minus 5 slope percent.

3.6.4 Allowable Non-Sampling Errors - Original Versus Check Plots

Compile original and check plots as separate cruises on the most recent cruise compilation software.

3.6.4.1 Net Volume Standard

The following standards may be used to adjudicate marginal pass/fail check cruises.

	Allowable Error
1. Individual checked plot volumes	• ≥ 90 percent of the individual plot volumes must be within 7 percent of their true plot volume.
2. Total volume for all checked plots	• Average variation must be within 5 percent of true plot volume as determined by the check- cruiser. Minimum of 5 plots.
3. LRF's (Interior only)	• LRF must be plus or minus 1 percent of true LRF for all plots checked.

Any one of the foregoing items, which are outside the permissible measurement standard, are grounds for redoing the work.

3.6.5 Standards for Some Basic Cruise Functions

a. Sample location must be sufficiently accurate to enable relocation of the samples at a future date. Fixed-area plots are subject to the standards in Section 3.3,

b. adequate records must be kept of all data so that they may be traced to their specific sources for evaluation in their primary or later applications,

c. the sampling design must meet the standards of Chapter 2,

d. inadequate identification of plot centres, sample trees and strip lines in the field may also lead to rejection of the cruise, and

e. forest typing must meet the criteria listed in Section 2.6.3.1 to ensure consistency of forest typing within cut blocks and among multiple cut blocks.

3.6.6 Check Cruising Dispute Mechanism

It is strongly recommended that the licensee and cruiser be present at the check cruise.

Where the licensee and ministry check-cruiser do not agree on aspects of the cruise the following procedure is to be followed.

It is recommended that check cruisers carry digital cameras with them in the field so that they can send digital photos to region, branch and third party cruising staff as a method to resolve disputes.

Step 1	The Ministry of Forests representative (MOF) sends the check cruise results to the licensee within one (1) week of the field check.
Step 2	If the cruise is rejected, the MOF attends the site with the original cruiser to attempt resolution of the dispute if necessary.
Step 3	The licensee submits a written complaint to the District Manager (DM) within 30 days.
Step 4	The DM or designate responds within 30 days.
Step 5	If the licensee appeals the District Manager's decision, then the Regional Manager or designate must hear the appeal. The licensee must make the application to the Regional Manager within 30 days of the District Manager's decision.

This page is intentionally left blank.

Cruise Compilation Procedures 4

Because of numerous field observations, complex compilation requirements and a multitude of final reports for appraisal and operational purposes, the system has been oriented towards electronic computers with the facility to quickly and easily summarize the cruise data for each cutting permit or timber sale. Uniformity in the treatment of this data is one of the primary objectives of the system.

4.1 Input

The map area statement (FS 121) and tally sheet (FS 205) are the ministry format used for collection of cruise data. Cruisers may use their own versions of these forms. However, the ministry format and data sequence must be observed when submitting magnetic data for check compilation purposes.

4.1.1 Cruise Tally Sheet (FS 205)

The Ministry of Forests Cruise Tally Sheet (FS 205) has been designed so that the information from one sample plot can be directly key punched (Chapter 6).

4.1.1.1 Plot Record (Card Type 9)

Each plot record (Card Type 9) is identified by plot location within a timber sale or cutting permit, the forest type where it occurs, the average age and height of the co-dominant and dominant trees which is used to designate loss factors, volume table and calculation of site index. Also recorded here are plot type plot size or basal area factor, harvesting method and slope percent (Section 6.3.1).

4.1.1.2 Individual Tree Records (Card Type 2)

Individual Tree Records (Card Type 2) show species code, DBH, tree class, pathological and quality remarks (Section 6.3.2).

4.1.1.3 Sample Tree Details (Card Type 3)

Sample Tree Details (Card Type 3) include species code, DBH, crown class and measured height and ages (Section 6.3.3). This information is required for all stump cruises and any damage cruises that require height/diameter curves.

4.1.2 Map Area Statement (FS 121)

This form provides area information, cutting specification and height/DBH method for the cutting permit or timber sale (Chapter 7).

4.1.2.1 Cruise Identity (Card Type A)

This card establishes the location and describes the nature of the cutting permit or timber sale (Section 7.1).

4.1.2.2 Compilation Standard (Card Type B)

This card defines the standard of compilation and the output required for the sale (Section 7.2).

4.1.2.3 Type Description (Card Type C)

This card contains the type description and silviculture treatment units along with the type number which corresponds to that on the record for every stratum in the cutting permit or timber sale (Section 7.3).

4.1.2.4 Block Description (Card Type D)

The sampling plan is made on the basis of the timber sale or cutting permit which may consist of several sub-units, namely blocks or settings. This card allows the printout, if desired, by species of the net volume for each type in the sub-unit block (Section 7.4).

4.1.2.5 Height/DBH Description (Card Type E)

This card allows the amalgamation of sample trees for the same species in 2 or more types. Minor species should not be amalgamated. The 100 percent height method must be used. If a species for a given type has sufficient sample trees (see Section 3.5.7.1) or if a local height/DBH curve is provided, this card need not be used but if a species does not have sufficient heights then this card must be used to designate how the heights for each sample tree (Card type 2) will be calculated (Section 7.5).

4.1.2.6 Harvesting Method Description (Card Type F)

The sampling plan is made on the basis of the timber sale or cutting permit which may consist of several harvesting methods.

4.1.2.7 Silviculture Treatment Unit Description (Card Type G)

The treatment units are user coded so that reports are titled by the user definition.

4.2 Compilation Programs

4.2.1 Height-DBH Relationships for Stump Cruises and Severe Damage Timber Cruises

Height-DBH relationships (curves or equations) by species must be used to determine the height for local conditions. Careful height measurement to the nearest 0.1 m and diameter measurements to the nearest 0.1 cm must be made on at least 20 sample trees of each major species in each type included in the cruise. Each major species must have its own curve. If minor species are present (refer to Section 8.4.3).

4.2.1.1 Height-DBH Regression Program

This program uses the height sample trees only to calculate regression constants, standard errors of the estimate for height and volume and the bias for both height and volume for the following equations.

1. Parabola $H=a+bD+cD^2$
2. Conditioned Parabola $H=1.3+bD+cD^2$
3. Hyperbola $a + \frac{b}{D} + cD$
4. Conditioned Hyperbola $1.3 - \frac{bD}{(D+1)} + cD$
5. Weibull $H=a*\left[1.0-e^{\left(-b*D^c\right)}\right]$
6. Conditioned Weibull $H=1.3+a*\left[1.0-e^{\left(-b*D^c\right)}\right]$

Where a, b and c are regression constants:

- E is natural logarithm,
- H is Total height, and
- D is DBH.

The program selects for the particular set of height sample trees under consideration, the equation which provides the lowest standard error of the estimate for volume. At this point the user has the option to override the computer selection and insert one of the other equations if the equation selected does not on inspection meet the requirements of fit over the range of DBH's.

If the curve with the lowest standard error generates a negative height at 10 cm DBH, the next best curve shall be selected.

Limitations:

1. There must be twenty height sample trees before the constants can be calculated for an equation.

2. The program will only automatically calculate the height sample trees for a particular type. It will not group height sample trees into one equation for like species on the same site from another forest type unless Card Type E is coded with those instructions (see Section 7.5).

4.2.2 Volume and Taper Equations

The 1994 Kozak taper equations Version 4.1 are used to predict log diameters within each tree. These equations are a subroutine in the cruise compilation program.

The information necessary in this subroutine:

1. Species Code

1	=	F
2	=	C
3	=	H
4	=	B
5	=	S
6	=	Y
7	=	Pw
8	=	Pl
9	=	Py

10	=	L
11	=	Ac
12	=	D
13	=	Mb
14	=	E
15	=	At
16	=	Pa

2. Forest Inventory Zone.

Zone	Code
A, B, C	1
D, E, F, G, H, I, J	2
K, L	3

3. DBH - diameter at breast height (high side) outside bark (nearest 0.1 cm).

4. HT - Total height (nearest 0.1 m).

5. SH - Stump height for utilization (nearest 0.1 m).

6. TD - Top diameter for utilization (nearest 0.1 cm).

7. GOL - Log length for log breakdown. In the interior of BC the lumber recovery factors are based on 5 m logs.

Information provided by this subroutine:

1. Number of GOL metre long logs plus one short from the top of the tree.

2. Volume for each log (1, 2, etc.).

3. Top diameter inside bark for each log.

4. Length of top log.

5. Butt diameter inside bark of first log.

6. Total volume between stump height and top diameter.

7. Total volume between ground level and top of the tree.

8. Bark thickness at breast height.

A more complete description of the derivation of this taper equation can be found in the *Canadian Journal of Forest Research* by A. Kozak, entitled "*A Variable-Exponent Taper Equation*", Volume 18, 1988.

4.2.3 Net Volume Factors

The *Cruise Compilation Loss Factor Table Manual* specifies the loss factor tables to be used in the "*Metric Diameter Class Decay, Waste and Breakage Factors*", 1976, Ministry of Forests.

The proper application of the factors is outlined in the preamble preceding the tables. Suffice to note:

1. The factors are generally by species, age and Forest Inventory Zone.

2. Ministry of Forests local factors are published within this book and when available they must be used in preference to the Forest Inventory Zone factor for that species.

3. The age classes to which the loss factors (Forest Inventory Zone or local) apply are shown at the top of each table.

4. The factors usually consist of three Risk Groups, each group containing a percent loss for decay, waste and breakage. Some species may have only 1 or 2 Risk Group factors.

5. The table number of the loss factor used in compilation shall be entered on the output sheet, preferably the Plot Summary.

Dead potential trees (standing or down) will be compiled for volume using the Group III loss factors or the Group II factors for species where no Group III factors are available.

Dead and live useless trees (standing only) will not be compiled for volume but must be recorded as they provide a record of the number of snags per hectare.

In applying the loss factors it must be emphasized that they must be applied individually and in the correct order to the gross merchantable volume of the log or tree.

4.3 Volume Compilation - Fixed Area Plot Cruising

Total cutting authority area volume will be based on compiling the volume of each plot, as this information is necessary in order to calculate the sampling error of the cruise. If the cutting authority area has been stratified, a total volume for each type will be compiled separately.

Type volume is the average volume (i.e., sum of plot volumes divided by number of plots measured) multiplied by the possible number of plots that could be included in the type of cutting authority area. If volume per hectare is required, this is the average plot volume divided by plot size. Cutting authority area or type volume is then volume per hectare times cutting authority area or type area.

4.4 Log Grade Volume Compilation

The cruise compilation program calculates:

1. For the interior, lumber and chip recoveries for:
    - 5 m logs,
    - stud logs with top diameter less than 20 cm inside bark,
    - small logs are logs with a top diameter of less than 30 cm inside bark, and
    - large logs are logs with a top diameter of 30 cm or more.
2. For the coast appraisal zone, volumes by log grades for 10 m log length.

4.5 Volume Compilation - Variable-Plot Cruising

In Variable-Plot (prism) cruising, since the radius of the plot varies directly with the diameter of the individual trees being measured, every tree has its own plot size. The area of the plot is directly proportional to the basal area of the tree diameter it represents. Therefore, the relationship of the basal area of one tree to its plot area is the same as the relationship projected to a hectare basis. Basal area per hectare, for a given prism, is the same for every tree regardless of diameter 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 m. Therefore, a 30 cm tree is counted if it falls within 6 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 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 diameter, contributed 6.25 m^2 of basal area per hectare. The Basal Area Factor of the prism used was 6.25. Therefore, total basal area per hectare can be calculated directly by multiplying stem count per point x basal area factor, and this 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, and enough tree heights to be able to assign a height to all trees which have been measured for DBH. There are several possible methods of calculating volume per hectare, depending on the method of sampling used and the kind and amount of information required (e.g., total volume per hectare, volume per hectare by species, number of trees per hectare either total, by species or by diameter classes).

4.5.1 Compilation Methods - Using a Single Prism and Full Sweep (360°)

1. A common method of prism cruising is to use the prism simply as a range finder (i.e., to use the prism to determine which trees are to be tallied on the sample). All "in" trees are then recorded by species and DBH and enough sample trees measured for height to permit the derivation of height-diameter relationships (i.e., height -DBH curves or equations). The number of trees per hectare that each counted tree represents is then calculated by first multiplying the plot radius factor times the tree diameter to give the area or plot size each tree with that particular diameter represents and second, by dividing the area of one hectare by the tree's "plot" area.

   Here is the formula for trees per hectare (TPH):

$$tph = \frac{10{,}000 x baf}{\pi\left(\frac{dbh}{2}\right)^2}$$

   The volume of a tree of given DBH and height is determined from a standard volume equation (Newton's) and multiplied by the number of trees per hectare which each counted tree represents (e.g., a prism having a basal area factor of 4, plot radius factor of 0.25) counts one mature fir tree in the Interior (residual) which has a 30 cm DBH and is 21 m tall. Each 30 cm DBH, tree represents 56.59 trees per hectare. The whole stem volume of this tree is 0.525 m^3.

   Therefore, the whole stem volume per hectare represented by this one counted tree is $56.59\,t/ha \times 0.525\,m^3/t = 29.73\,m^3/ha$. It is then necessary to reduce this volume to gross and then net merchantable volume by calculating first the gross volume between stump-height and minimum utilization diameter, dib, for the toplog to determine the gross merchantable volume and then applying the loss factors for decay, waste 2 and breakage (or, in some cases, decay and breakage only) to arrive at the net merchantable volume.

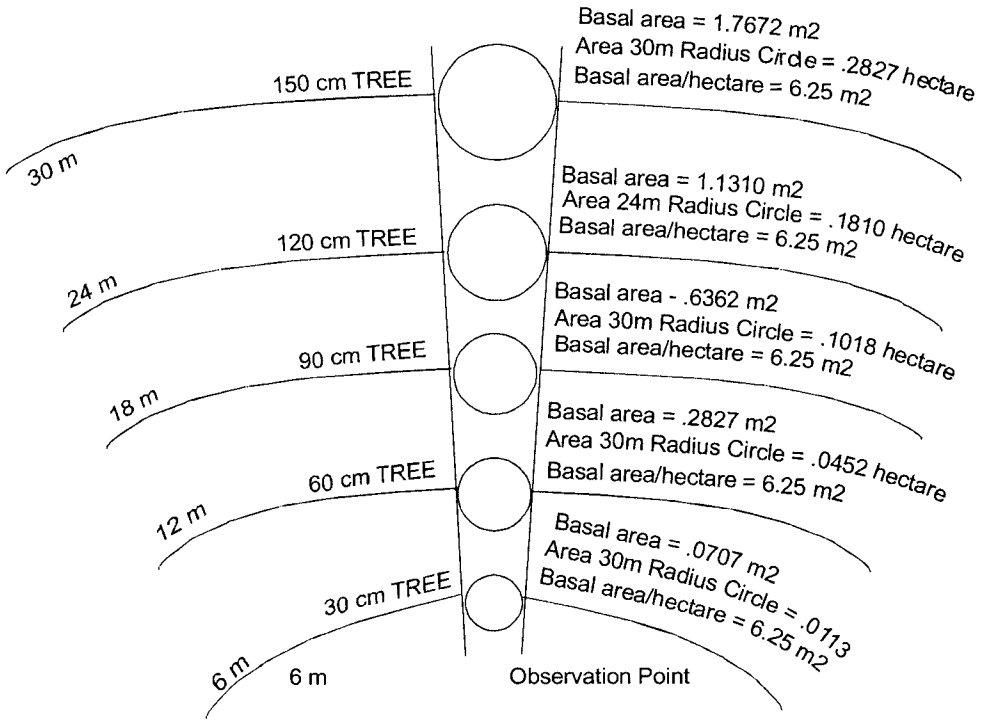


Figure 4.1 Illustration of Basal Area/Hectare.

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.

4.5.2 Compilation Methods - Using 2 Different Prisms And Full Sweep (360°)

It is important to remember that when two different prisms are used, the trees included by each prism will be handled separately. If compiling is done by determining the number of trees per hectare represented by each counted tree, then care must be taken to use the plot radius factor corresponding to the prism used for each DBH range.

4.5.3 Compilation Methods - Using One Prism With Full And Half-Sweeps

If full sweeps are used, the stem count at each sampling point is converted to basal area per hectare. When half-sweeps are used the stem count at each sampling point is doubled by the computer and then converted to basal area per hectare. Therefore in calculating volume per hectare for trees included by a half-sweep the following procedure is required:

Calculate the plot radius for each tree by multiplying tree DBH by the prism plot radius factor (PRF). The area of the plot calculated from this plot radius is divided into the area of one hectare. This resulting value is the number of trees per hectare that a given tree represents for a full sweep plot (360^{o}). However, when a half-sweep (180^{o}) is used, the number of trees represented by each counted tree are on a half hectare basis and so the resulting number of trees represented by each counted tree must be doubled by the compilation program to bring the answer up to a per hectare basis.

It is important to note that in calculating volume for the trees counted on the half-sweep, the compilation program multiplies the prism BAF used by two, since the prism basal area factor is for one hectare. For example, consider a 30 cm DBH tree counted using a prism with a basal area factor of 4. The plot radius for this tree is 7.5 m and the plot area is 0.01767 ha. However, if the tree is included in a half-sweep the plot area is only 0.00883 ha or the same plot area as for a 30 cm DBH tree included in a full sweep using a prism with a basal area factor of 8.

The computer compilation program makes the appropriate adjustment.

4.5.4 Compilation Methods - Using Count-Plots

Where count plots are recorded in addition to measured plots, volumes calculated from measured tree data by species are modified by multiplying each species volume by the total species stem count of the measured and count-plots and the number of measured plots and dividing by the species stem count of the measured plots and by the total number of measured and count plots. Where sample plots have been stratified by timber type, the calculations are made for each type using only the data of measured and count-plots which are located within the type area.

A double sampling ratio (DSR) is calculated to prorate species volumes by timber type when count plots are included in a prism cruise.

Assume a timber type includes two full measure and two count plots using a BAF 10 prism in the following example:

Full meaure plot	#1 - 4 Fir	Total = 9 Fir
Full measure plot	#2 - 5 Fir	
Count plot	#1 - 6 Fir	Total = 8 Fir
Count plot	#2 - 2 Fir	
Total	17 Fir	

$$DSR_{(fir)} = \frac{\text{Number measure plots}}{\text{Total number plots}} \text{ x } \frac{\text{Total \# trees for species x Average Basal Area Factor}}{\text{\# measure trees for species x Average Basal Area Factor}}$$

$$= \frac{2}{4} \text{ x } \frac{17 \text{ x } 10}{9 \text{ x } 10}$$

$$DSR_{(fir)} = 0.9444$$

4.6 Computer Compilation Output

The cruise compilation shall accurately represent the area and volume to be appraised and shall be compiled on the most recent version of the cruise compilation program approved by the Revenue 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 Regional Manager or their designate.

For cruises compiled by electronic data processing methods, the following basic data will be submitted with the volume compilation for either/or both Coast and Interior timber sales or cutting permits.

4.6.1 Summary of Required/Optional Reports

001 a	Edit report (data listing) of cruise data or 3.5 diskette	Required - electronic
001 b	Scattergram of Card Type 2's and Card Type 3's	Required if ht/dia curves used - electronic
003 a	Scattergram of Sample Trees - Regression Coefficients	Required if ht/dia curves used - electronic
003 b	Original scattergram and regression coefficients if suggested curve is overridden. Provide a written explanation and computer report of actual keyed values	Required if ht/dia curves used - electronic
004 a	Edit checks if calculating heights from height curves	Required if ht/dia curves used - electronic
004 b	Double Sampling Ratios	Required – hard copy and electronic
005 a	Percent Reduction input values	Required – hard copy and electronic
005 b	Cruise Statistics	Required – hard copy
006	Extended Forest Type Stand and Stock Tables	Clearcut - optional – electronic and/or hard copy Partial cut - required – electronic and/or hard copy upon request
006	Partial Cut Damage Reports	Required – hard copy upon request
007	Stand and Stock Tables	Clearcut – optional – electronic Partial - required – electronic and/or hard copy upon request
007	Partial Cut Damage Reports	Required – hard copy upon request
008	Volume and Lumber Recovery Information (Interior compilations)	Required – hard copy
009	Volume Summary	Required - hard copy and/or electronic
009	Partial Cut Damage Reports	Required – hard copy upon request
011	Plot Summary	Required – hard copy and/or electronic
012	Plot Summary by Maturity (Coast compilations only)	Required - electronic
015 a	Harvesting Method and Appraisal Summary	Required - hard copy and/or electronic upon request
015 b	Second and Old Growth Summary (Coast compilations only)	Required - hard copy and/or electronic

Figure 4.2 Required/optional reports.

> If percent reduction is being applied, two sets of reports will be required. The original reports before percent reduction applied and the reports after percent reduction has been applied. Also required are the keyed input values for the percent reduction.

All reports may be submitted in portable document format (PDF) on compact disk if acceptable to the Regional Manager.

4.6.2 FS 221 – Percent Reduction

http://www.for.gov.bc.ca/isb/forms/lib/FS221.PDF

This form enables the cruising officer to be able to reduce the stems and volumes by percentage points. The reduction can be accomplished by a number of methods when the Forest Type Stand and Stock Table output from FVLCR006 has been analysed. The approved methods of reduction for the dbh classes are:

1. By species, timber type/block, risk group/tree class and treatment unit.
2. By species, timber type/block and treatment unit
3. By species, risk group/tree class 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.

    Douglas Fir - use F1 for quality class 1 and F2 for quality class 2. The species columns must be completed.

    b. Position 3-4 - Timber Type

    These are the numeric codes of the timber type.

    c. Position 5 - Risk Group or Tree Class (mandatory)

    These are codes with the following breakdown.

Enter	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

Enter	3	Tree class 3 - Dead Potential
	4	Tree Class 4 - Dead Useless
	6	Tree Class 6 - Live Useless
	7	Tree Class 7 - Veteran Dead Potential
	9	Tree Class 9 - Older Immature Dead Potential

d. Position 6 - Silviculture Treatment Units A to F - This is the unit letter,

e. Position 7-9 - Block Number - This is the block number,

f. Position 10 - Damage Code - This field corresponds to the damage types – Blowdown = B, Fire =F, Insect =I. These codes will result in a 100 percent cut of the trees with a tally sheet damage type code consistent with the entry in position 10 of the percent reduction worksheet,

g. Position 13-14 - Percent Reduction for dbh classes (10 cm class = 7.5 - 12.4 cm)

   These are whole numbers only.

   100% reduction corresponds to all trees will be retained from harvest.

h. Position 15-80 - Percent reduction for 15 - 275 cm dbh classes.

   See item g.

4.6.3 Valid Compilation Programs

The valid compilation programs are:

- Claymore Consulting,
- Forest Data Tools,
- Industrial Forest Services,
- Olympic Resource Management, and
- Timberline Forest Consulting.

Cruise Analysis 5

5.1 Cruise Statistics

The following cruise statistics are calculated for net volume and basal area for each cutting authority area:

1. Timber Type and Cutting Permit - the average line method is used in all compilations for the calculation of timber type and cutting permit statistics.

    - Mean,
    - Standard Deviation - measured plots only are used in the calculation,
    - Coefficient of Variation - % - weighted by the proportional net volume of the timber types within the cutting permit for measured plots only. Also reported for each species in the cutting permit summary,
    - Standard Error of the Mean - %, and
    - 95 percent Confidence Interval - weighted by proportional area of the timber types within the cutting permit. Calculated for measured and all plots. Also reported for each species in the cutting permit summary.

2. Block - the block method uses the average volumes and basal areas for the plots within the timber types within the block. The average line method uses the plots within the timber types.

    - Mean,
    - Standard Deviation - measured plots only are used in the calculation,
    - Coefficient of Variation - % - weighted by the proportional net volume of the timber types within the block for the block method and timber types within the cutting permit for the average line method. Measured plots only are used in the calculation,
    - Standard Error of the Mean - %, and
    - 95 percent Confidence Interval - % - weighted by proportional area of the timber types within the blocks.

Since fixed area plots are a sample without replacement, they require an adjustment known as the Finite Population Correction. The factor is multiplied by the standard error of the mean calculation for fixed area cruises. The factor is set to 1.0 for variable plot (prism) sampling.

5.2 Interpretation

The 95 percent confidence interval provides a measure of the error due to sampling chance in the volumes reported in a cruise. Provided that there is not any measurement (non-sampling) error, the reported volumes should be within the confidence limits calculated, 19 times out of 20. The calculated volume is assumed to be the correct volume for administrative purposes.

Detailed formula and sample calculations are included in the Chapter 8 of the *Cruise Compilation Manual.*

This page is intentionally left blank.

Ministry of Forests Cruise Tally Sheet (FS 205) 6

6.1 Form Design - General

All information on the FS 205 is required on all facsimiles of the FS 205, Cruise Tally Sheet.

Measurements taken on samples established in timber sales, cutting permits, etc. will be recorded on a Cruise Tally Sheet that provides the information in this chapter. The front side of the form identifies the plot, records the plot sizes and individual tree measurements while the reverse side provides space for the coding information, remarks and signatures.

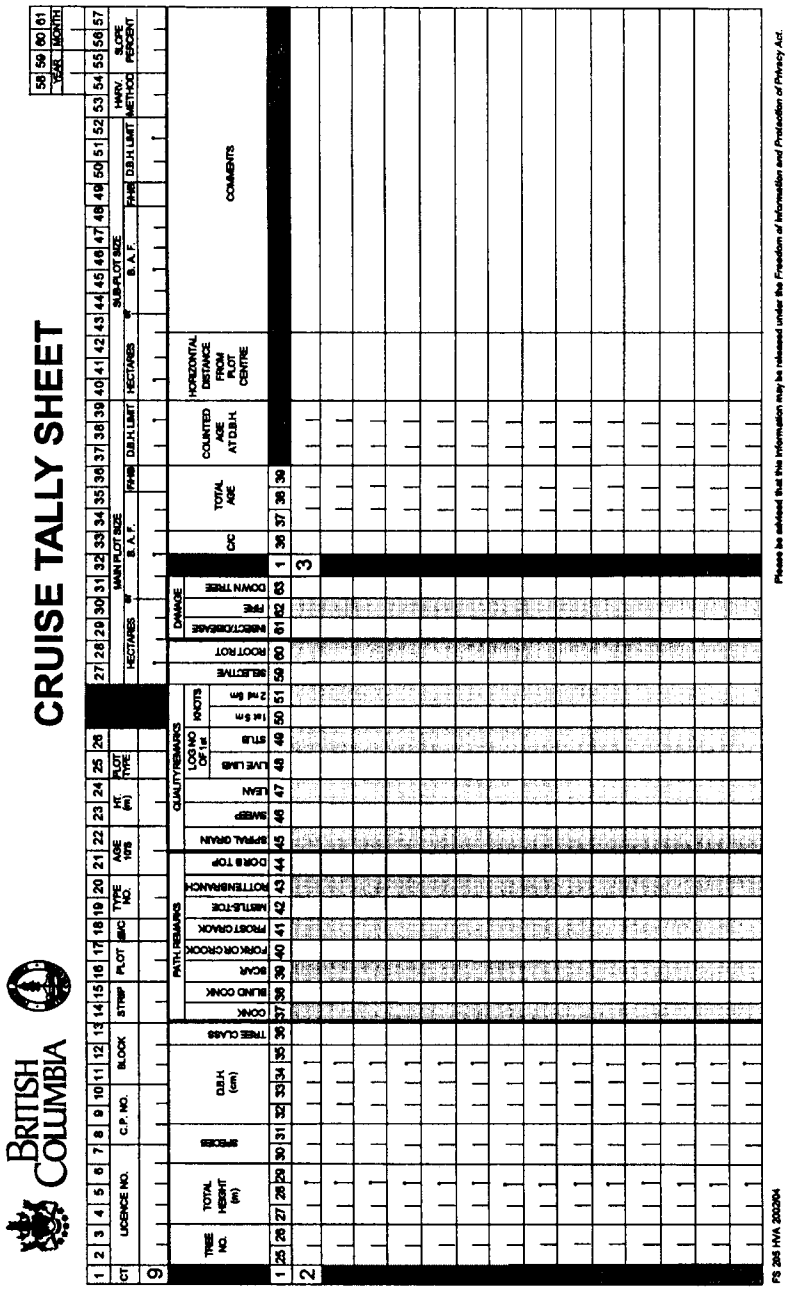


Figure 6.1 Cruise Tally Sheet – FS 205 HVA 2002/04 (front side).

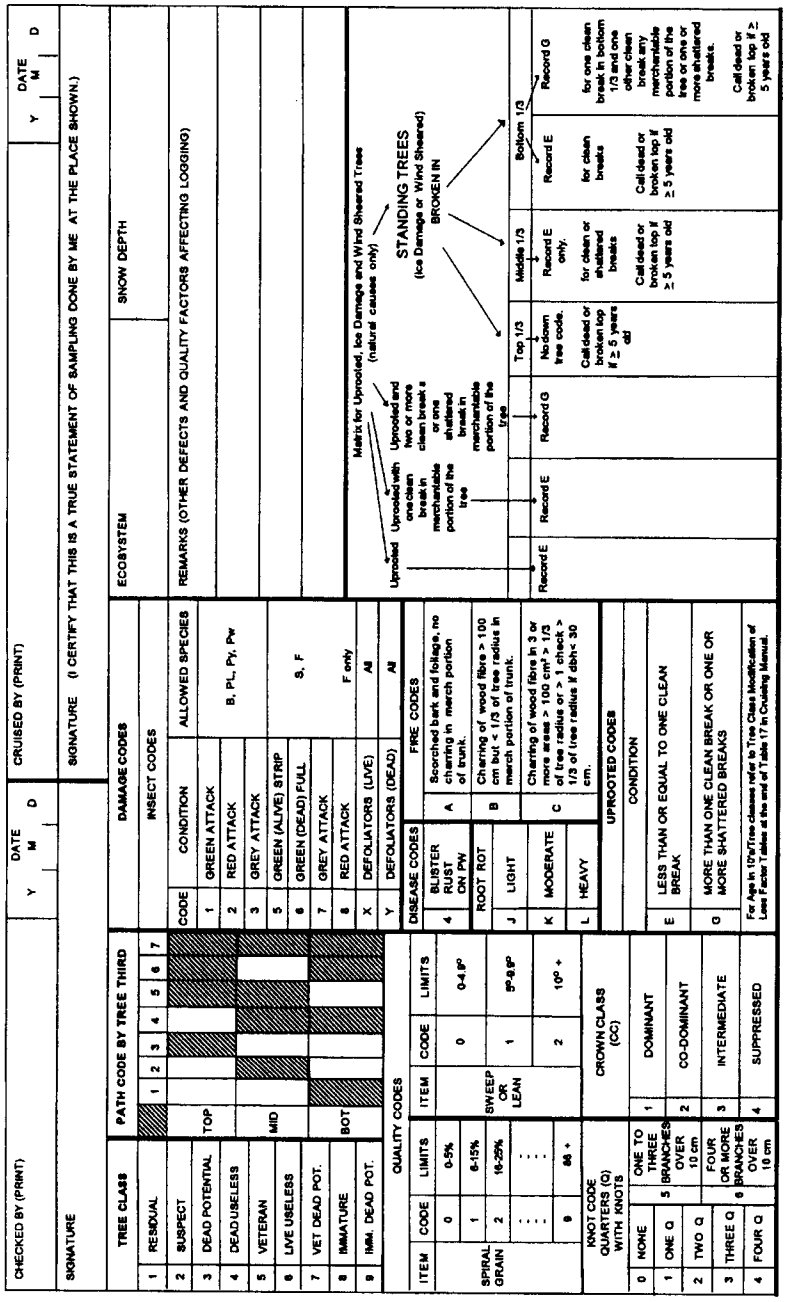


Figure 6.2 Cruise Tally Sheet – FS 205 HVA 2002/04 (back side).

6.2 Entry of Data in Divided Spaces or Numbered Columns

Alphabetic fields are left justified as in the species code whereas numeric fields are right justified. It is not absolutely necessary that zeros be entered in spaces not required but their use helps avoid errors in placing the digit in its correct column and it is extremely important that this error is not made. For example, if columns for an item are 8, 9 and 10 and the magnitude of the item ranges from 0 to 999, then column 10 will be used for the units digit, column 9 for the tens digit and column 8 for the hundreds digits. For example:

	8	9	10
4 entered as	0	0	4
54 entered as	0	5	4
954 entered as	9	5	4

6.3 Front Side of Cruise Tally Sheet (FS 205 HVA 2002/04)

6.3.1 Card Type 9

Position 2 - 61 Identity Information

This card is to be completed for every new plot. The data on this card gives the location of the plot, forest type in which it occurs, average age and height, and the plot type.

If more than one sheet is required to code all the tree measurements on a given plot, the strip and plot number should be repeated on the second sheet.

Position 2-7 Licence Number

Enter:

1. For X type licences:

Position:	2	X
	3	Region
	4 and 5	Year
	6 and 7	District No. (Region = 00)

2. A56789 for licence A56789.

3. TFL001 for TFL 1
   TFL038 for TFL 38.

4. L0001 for licence to cut.

5. TL0421 for Timber Licence TL 421.

6. If Unauthorized Timber Harvesting use the ERA case file number in positions 2 to 10.

Position 8 to 10 Cutting Permit

Enter:

- can be either left or right oriented. Each tally sheet must be entered in the same format,
- 001 for Cutting Permit #1 (right oriented) (zero entries may be left blank),
- 38 for Cutting Permit #38 (left oriented), and
- A for Cutting Permit A.

-"X" type = sequential numbering -- CP 001 for the first District or Region compilation for that fiscal year and CP 002 for the next cruise in the same District or Region in the same fiscal year, etc.
-"Y" licence numbers -- **cannot** have a cutting permit. These positions must be left blank.
-"A" licence numbers -- might or might not have a cutting permit number, BUT if there is not a cutting permit number, the positions cannot be left blank. There must be at least one zero in one of these three positions.

Position 11 to 13 Block (within the Cutting Permit)

Enter:

- can be either left or right oriented. Each tally sheet must be entered in the same format,
- 001 for Block #1 (right oriented) (zero entries may be left blank),
- 38 for Block #38 (left oriented), and
- A for Block A (left oriented).

Position 14 to 15 Strip Number or Letter (Number or Letter of Strip on which Plot is Located)

Enter 01 for strip #1.

Strips should be numbered or lettered consecutively without duplication for a Block.

Position 16 to 17 Plot Number or Letter

Will accept alpha/numeric designations, either left or right oriented.

Enter 01 for plot #1.

Plots are to be numbered consecutively without duplication on a strip.

Position 18 O/C This Field Must Be Entered

Enter:

O if original measurements.

C if check cruise measurements.

Position 19 to 20 Type Number

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

Position 21 to 22 Age in 10's This Field Must Be Entered

Enter the average total age in tens of co-dominants of the first major species in the plot. Following are the age limits with the age class code:

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 that these age class limits be observed as they govern the proper selection of loss factors.

Coast

The second growth reporting in the 015B - All Harvesting Method Summary will include tree classes 1, 2, 3, 8 and 9 when the age in 10's for the plot is 13 or 14.

Three scenarios for *trees* (not plot age) 121 to 140 years old are provided for further clarification:

1. *Trees* that are 121 to 140 years old in an immature plot (age in 10's less than or equal to 12) will continue to be tree class 5 trees. Tree class 5 trees *will not* be included in the second growth percent.

2. Trees that are 121 to 140 years of age in a plot of an age in 10's greater than or equal to 15 will not be included in the second growth percent. They will continue to be tree class 1, 2, and 3 trees.

3. Trees that are 141 years plus in a plot of an age in 10's 13 or 14 must be recorded as tree class 5 or 7 trees.

Loss factor assignments and log grade algorithm predictions will not be effected by this change to the percent second growth reporting in the 015B report.

Position 23 to 24 Height in Metres

Enter the height to the nearest 1 m for the dominant and co-dominant trees of the major species in the plot. This classification applies to the plot area only and is based on sample tree heights taken on the plot.

Position 25 Plot Type

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

Position 26 This column is not in use.

Positions 27 to 39 Main Plot Size (this field must be entered)

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

Position 27 to 30 Hectares (Fixed Plot)

Enter plot size in hectares for circular or rectangular shaped fixed plots: Leave blank if prism plots are used.

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

Positions 31 to 35 Basal Area Factor (BAF Variable Plots) m^2/ha

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

Imperial/Diopter Conversions

BAF (m^2/ha) = BAF (sq. ft./acre) x 0.229568
where 1 square foot per acre = 0.229568 m^2/ha

BAF (m^2/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).

Position 36 Prism Sweep

Enter:

- F (full 360° plot) - All trees,
- H (half 360° plot) - Every second tree, and
- B (border 180° plot) - All trees in measured 1/2 of plot.

Position 37 to 39 DBH Limit

The minimum DBH to which the trees on the main plot are measured to meet minimum sampling requirements for appraisal purposes. Examples:

Interior	Coast
1. PL with other species code 12.5 cm	1. Immature - code 12.0 cm
2. PL absent from cruise area - code 17.5 cm	2. Mature - code 17.5 cm

The MAS determines the compilation level of the cruise. 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 Map Area Statement (MAS) Section 7.2, Positions 19 to 21.

Positions 40 to 52 Sub-Plot Sizes

In stands with an excessive number of stems in the lower diameter classes, a sub-plot may be established for these lower diameter classes. To prevent unnecessary error, the same sub-plot size should be maintained throughout the timber type. The sub-plot size should never equal or be larger than the main plot size.

Position 40 to 43 Hectares (Fixed Plot)

Smaller plot areas may be required and the following are acceptable in addition to any listed under the main plot (Positions 27 to 30).

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

Position 44 to 48 Basal Area Factor (BAF) Variable Plots

See description as per Main Plot entries in Positions 31 to 35.

Position 49 Prism Sweep

See description under Main Plot entries in position 36.

Positions 50 to 52

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

Position 53 to 54 Harvesting Method

The harvesting method which will be used:

HC	=	helicopter clear-cut
HS	=	helicopter selective
CC	=	cable clear-cut
CS	=	cable selective
LC	=	sky line clear-cut
LS	=	sky line selective
HO	=	horse
SC	=	ground skidding-clear-cut
SS	=	ground skidding-partial cutting
SP	=	specified operation

Position 55 to 57 Slope Percent

Record the most severe slope measurement in any direction to a point 15 m horizontal distance from plot centre. If slope is missing, it will be compiled as a zero. Plot slope in a border plot must be measured from within the 15 m arc in the plot. Plot slope must be recorded in count plots.

Position 58 to 61 Date

Record the year and month that the fieldwork was performed. This information will be entered in the compilation.

6.3.2 Card Type 2

Position 1 Tree Details

This card contains the individual tree details or quality and size measurements.

Positions 2 to 24 Common to Card Type 9

Position 25 to 26 Tree Number

Number consecutively preferably from 1 for each plot (no duplicate numbers on any plot). Plot trees selected as sample trees maintain the same number in Sample Tree Details.

Positions 27 to 29 Total Height

When a height is measured or estimated and entered here, it will be used in the calculation of that individual tree's volume. The height must be recorded to the nearest 0.1 m.

Positions 30 to 31 Species

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 should only be used when positive identification can be made in the field and the appraisal requires it, however, they must be combined by genus for the harvest method summary. Species specific symbols for *abies amabilis* and *lasciocarpa* must be entered for Interior cruises.

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*	**B**	
Alpine fir	*A. lasiocarpa*		Bl
Amabilis fir	*A. amabilis*		Ba
Grand fir	*A. grandis*		Bg
Birch	*Betula*	**E**	
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*		Hm
Western hemlock	*T. heterophylla*		Hw
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**

Common Name of Genus/Species	Scientific Name of Genus/Species	Genus Symbol*	Species Symbol*
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
Englemann 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 the standard to be used 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.

Positions 32 to 35 DBH

Enter the diameter in centimetres and decimal centimetres at breast height (1.3 m above the high side) of each tree equal to or above the contract specification. Whole numbers are recorded as decimals (e.g., 12.0 not 12).

Position 36 Tree Class (see Section 3.5.6 for Detailed Descriptions)

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

Positions 37 to 44 Pathological Remarks

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) blocks representing the bottom third, the middle (MID) block the middle third, and the top (TOP) block the top third. The shading indicates in which third or thirds the defects occur based on the codes 1 through 7. The applicable numerical code is shown to the left of the blocks. Thus, 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 suspect characters listed must be noted where they occur.

Refer to the Cruise Compilation Loss Factor Table for pathological occurrence by species and forest inventory zones.

Examples:

1. A suspect tree has conks on the middle and upper thirds of the trunk and an open basal scar on the lower third. Under "Conk" enter "5" and under "Scar" enter "1".

2. A suspect tree has a fork on the middle third, blind conks on the upper third and a broken top. Under "Fork" enter "2", under "Blind Conk" enter "3" and under "D. or B. Top" enter "3".

3. A suspect 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".

Positions 45 to 51 Quality Remarks 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.

Quality remarks must include information on all items indicated under this heading. Codes are indicated in the "Quality Code" box on the back of the plot sheet.

Position 45 Spiral Grain

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 provide the next best evidence of the characteristic.

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

- Determine 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 DBH as a guide for estimation.

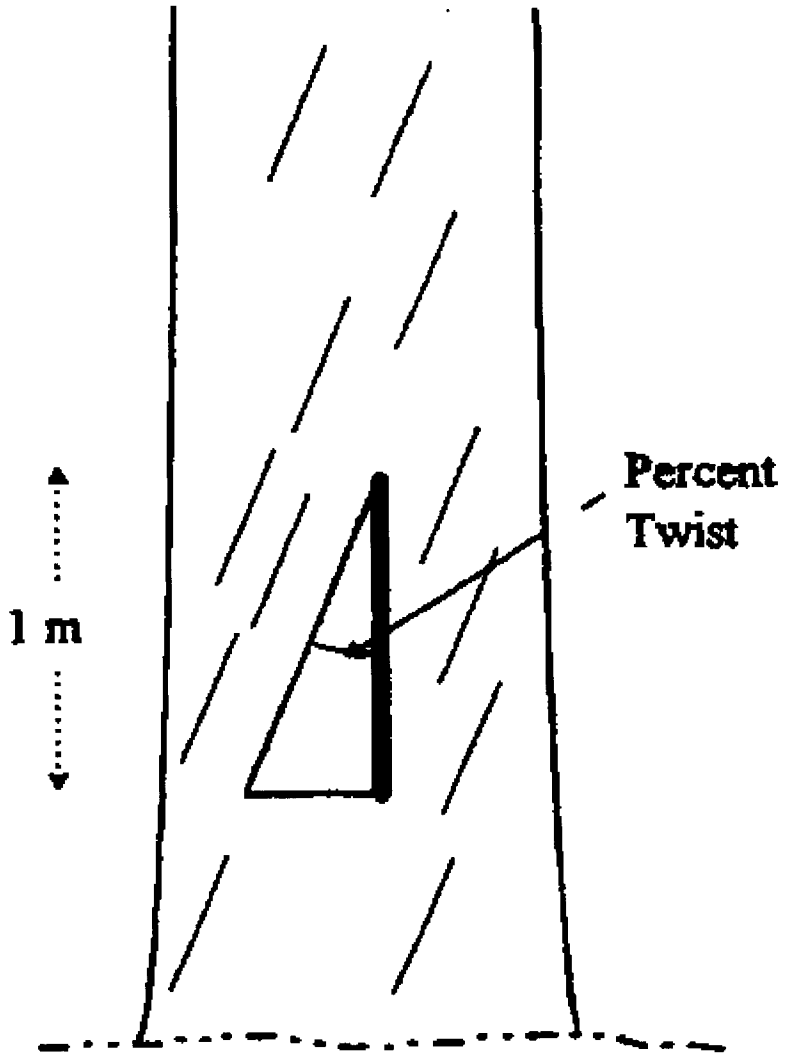


Figure 6.3 Determination of percent twist.

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 +

Position 46 Sweep

Currently not required.

Position 47 Lean

Currently not required.

Log Number

"Logs" are individual 5 m lengths and are numbered starting at the top of a 30 cm "stump".

Position 48 Live Limb (Grade Change)

Definition: The 5 m log where quality changes from: *no knots* to *knots or knot indicators* or from *small knots* to *large knots* or from *well spaced knots* to *excessive knots*.

The purpose of recording live limb is to identify the first grade change as you move up the tree.

This will assist the log grade algorithm to better determine the cruise grade distribution produced by the cruise compilation program.

If the branching is consistent in frequency and size from the base to the utilization top of the tree, record live limb as a one (1).

The grades on trees smaller than 60 cm DBH are not affected by the live limb code. On deciduous trees, live limb is recorded as the 5 m log where the natural forking starts. Record live limb for the dead potential tree classes.

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 Crown or at some point below.

Any stub, live or dead branch, is considered when identifying the log number of the first stub (see the following Section for discussion of epicormic branching).

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 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. 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 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.

Positions 52 to 56

These columns are not in use.

Position 59 Selective Cutting

L	leave tree
Blank or C	cut tree

Position 60 Miscellaneous - optional data collection.

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 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 50 percent lumber,

c. coding is the same as pathological indicator tree positions,

d. also see Position 45, spiral grain for code definitions, and

e. knot code 6 (see Section 6.3.2, Position 50 and 51) in the first 5 m log will grade the first log lumber reject and a knot code 6 in the second 5 m log will grade the second log lumber reject.

Refer to Appendix 8 for a more detailed description of the algorithm.

The partition hemlock portion (Section 10.2) of the algorithm is for appraisal purposes. Section 10.1 is still for testing purposes.

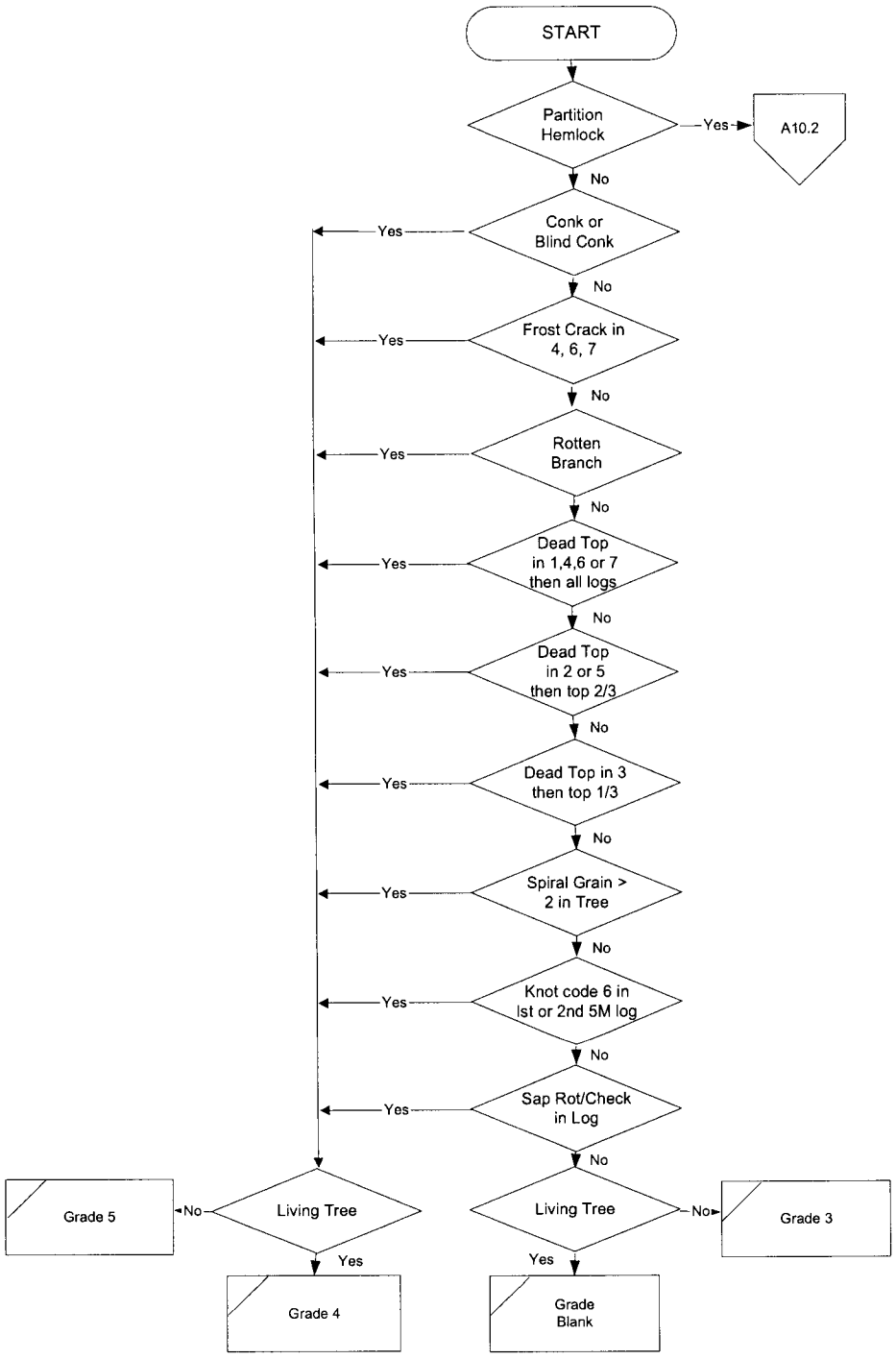


Figure 6.4 Algorithm Flowchart (page 1).

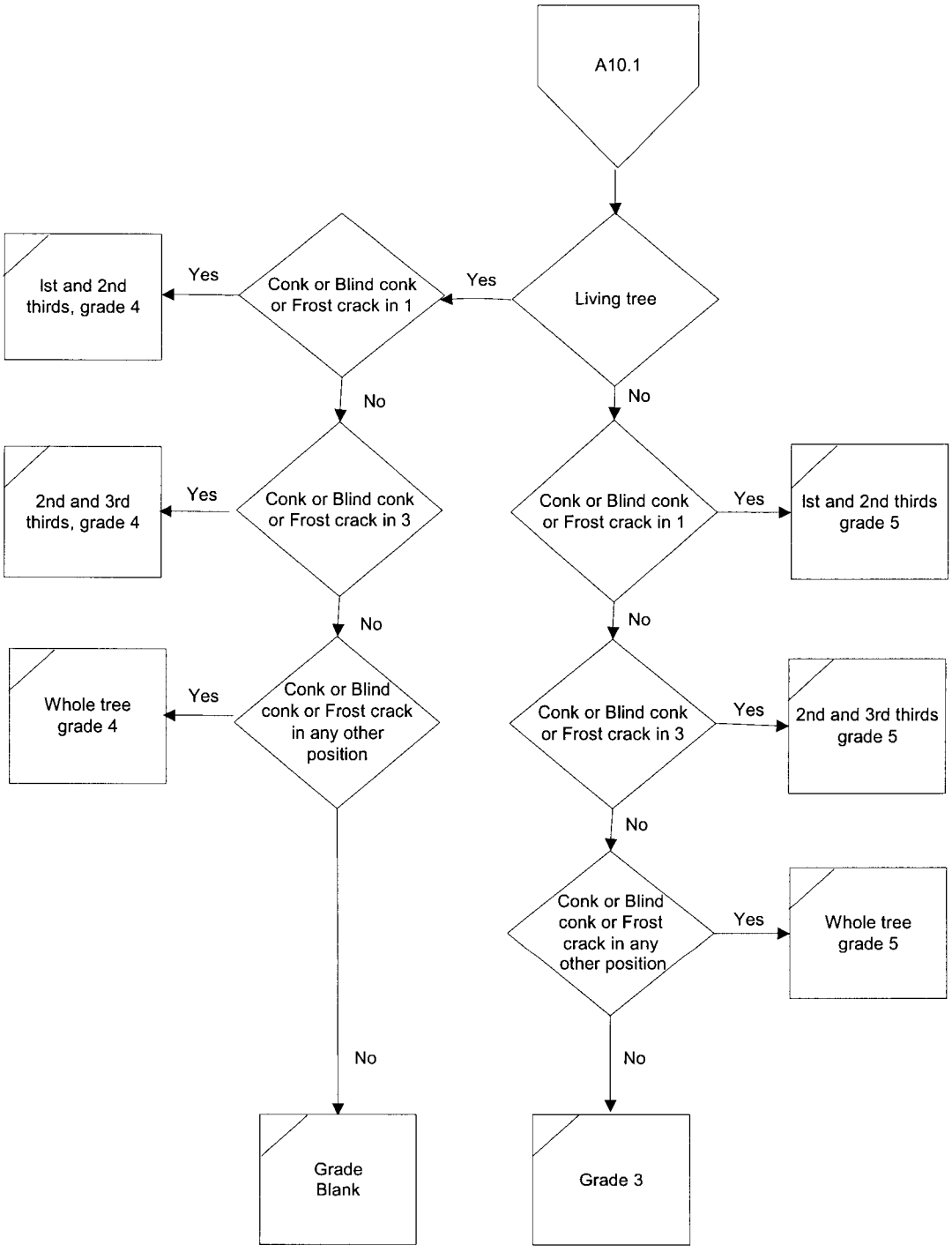


Figure 6.5 Algorithm Flowchart (page 2).

Positions 61 to 63 Damage Codes (see Section A.7.1)

Damage codes are to be used at all times, and shall be recorded as they appear 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.

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

Position 61 Insect and Disease Codes (see Appendix 7)

Position 62 Fire Damage Codes (see Section A.7.2)

Position 63 Down Trees (see Section A.7.3)

6.3.3 Card Type 3

Position 1 Sample Tree Details

At least two to three sample trees should be measured in a prism plot (see Section 3.5.3) for stump cruising and damage cruises where height/diameter curves may be required. Only reliably measured trees should be entered as no estimations will be entertained in this section of the plot record. The readings after column 40 will not be keypunched but they should be entered for checking purposes. Sample tree details may be entered on count-plots.

Counted Age at DBH

This is the Breast Height Age referenced above.

Horizontal Distance from Plot Centre

This is the measured distance from the plot centre to the face of standing trees at DBH plus half the DBH and on the top side at mid point for down trees.

6.4 Reverse Side of Cruise Tally Sheet (FS 205 HVA 2002/04)

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

6.4.1 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 All Cruise Tally Sheets (FS 205 and industry versions) must be signed and dated by the cruiser in charge, and in so doing, accepts responsibility for the information contained on the card.
Checked By	Signature All Cruise Tally Sheets (FS 205 and industry versions) must be signed and dated by the check cruiser, and in so doing, accepts responsibility for the information contained on the card.

This page is intentionally left blank.

Ministry of Forests Map Area Statement (FS 121) 7

The Map Area Statement consists of seven cards A, B, C, D, E, F, and G which are to be completed for every new Cutting Permit in a TSHL or TFL; if none then for the Licence Number of the Timber Sale, Timber Berth or Licence, etc. being cruised and on which the sampling plan was based.

7.1 Card Type A

Positions 2 to 80

Cruise Identity Card - this card establishes the location of the cruise from the broadest area (Forest Region) to the most exact (UTM Grid Co-ordinates) and describes the nature of the sale.

Position 2 to 7 Licence Number

Enter:

1. For X type licences:

Position	2	X
	3	Region
	4 and 5	Year
	6 and 7	District No. (Region = 00)

2. CF0001 for Community Forest Agreement.

3. A56789 for licence A56789.

4. TFL001 for TFL 1
   TFL038 for TFL 38.

5. L0001 for licence to cut.

6. TL0421 for Timber Licence TL 421.

7. If Unauthorized Timber Harvesting use the ERA case file number in Positions 2 to 10.

Position 8 to 10 Cutting Permit

Enter 001 for CP1 or 01A for CP1A. Use sequential numbering for X type licences.

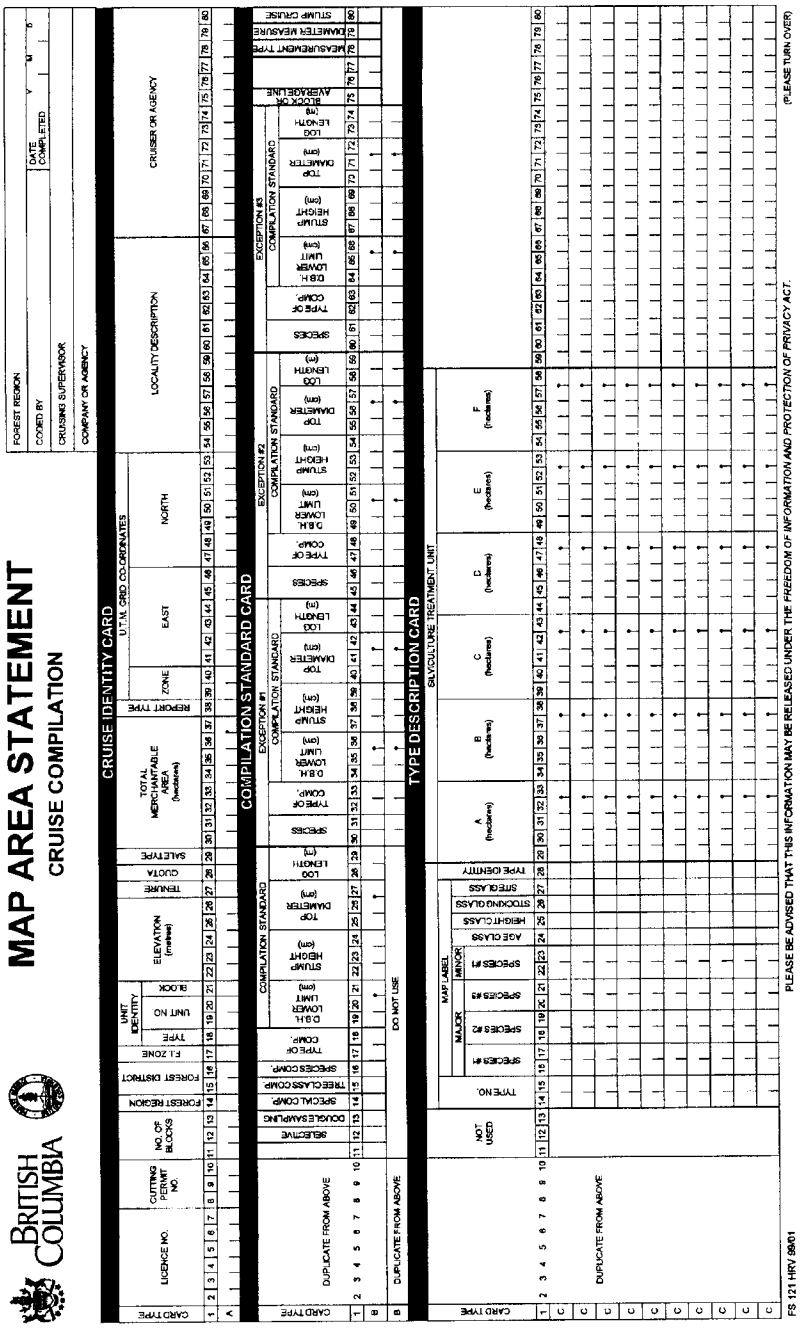


Figure 7.1 Front Side of Map Area Statement Form (FS 121 HRV 99/01).

Position 11 to 13 Number of Blocks

Enter 001 for one Block
010 for ten Blocks

Position 14 to 16 Forest Regions and Districts

Enter:

Code	Region
1	Vancouver
2	Prince Rupert
3	Kamloops
4	Prince George
5	Nelson
6	Cariboo

Every district has a number unique to the forest region. If the sale is located within two or more districts, code it by the district with supervisory responsibility.

Refer to Appendix 9 for detailed district coding.

Position 17 Forest Inventory Zones

The province is divided into 12 Forest Inventory Zones:

- A, B, C are all Coast zones, and
- D to L are all Interior zones.

The correct zone is vital for the application of volume equations and loss factors.

If more than 1 FIZ exists in a cruise, use the FIZ with the greatest area.

Unit Identity (Positions 18 to 21)

Position 18 Type (of Unit)

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

Enter:

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.

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

Position 19 to 20 Number (of the Units)

See Table 17.

Position 21 Block Number (of the Unit)

Enter Zero if unit has no block numbers (see Table 17).

Position 22 to 26 Elevation

Record the elevation of the centre of the sale to the nearest 50 m. Do not leave blank or zero. Must have at least a 1 entered.

Position 27 Tenure

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
T.F.L. Cutting Permits	Y
Woodlot Licences	1
Community Forest Agreements	4
Interior	
Forest Licences	W
C.G. 1914 to date - stumpage & royalty	T
C.G. 1914 to date - stumpage including royalty	2
Road Permits	3
Community Forest Agreements	4
Timber Sales & Licences to Cut	5
T.F.L. Cutting Permits	6
Woodlot Licences	7
All	
Timber Sale Licence Major	8
Unauthorized Timber Harvest	9

Position 28 Quota Type

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

Enter:

D	for Regional Manager 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

Position 29 Sale Type

Leave blank if none of the following apply.

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

Positions 30 to 37 Total Merchantable Area (Hectares)

Enter the number of merchantable hectares for each Cutting Block within a Cutting Permit or for the Cutting Permit within a Forest Licence or for each Timber Sale, Timber Licence, Licence to Cut, etc. right oriented (e.g., 157.5 ha enter as 00001575).

Position 38 Ministry of Forests - Appraisal Information

A	=	compilation to be used for appraisal purposes - reports titled "For Appraisal Purposes."
blank or other	=	*Not* for appraisal purposes - reports titled "Not for Appraisal Purposes".

Position 39 to 53 UTM Co-ordinates

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

http://mascot.gdbc.gov.bc.ca/mascot/

1. Scroll down to *Graphic Based Access*, click *Query By Map* to next screen.
2. Click on correct *Quadrant* to next screen.
3. Click on correct *Zone* to next screen.
4. Locate the *UTM and Zone* at the bottom of the map.

In the Universal Transverse Mercator (UTM) projection the spheroid is divided into 60 zones, each 6° of longitude in width numbered eastward from the 180° meridian through Greenwich. Four zones numbered 8, 9, 10 and 11 cover British Columbia.

The approximate centre of the cut block should be referenced with this system (*Standard System of Mapping for British Columbia*, Geographic Data BC, Ministry of Environment, Lands and Parks).

Positions 54 to 66 Locality Description

Enter a brief description where the sale is located (e.g., 15 km N.E. of Pr. George, FADEAR CR. LT 2315).

Positions 67 to 80 Cruised By

Enter first initial and last name or cruising agency name.

7.2 Card Type B

Position 1

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

Positions 2 to 10 Common to Card Type A.

Position 11 Damage Reporting

Blank	All damage reporting

Position 12 Partial cutting indicator

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

Position 13 Double Sampling Indicator

Enter:

0	0 = all plots to be used
1	count-plots not to be used

Position 14 Special Compilation

WET AND DRY BELT DOUGLAS FIR ZONES		
	Biogeoclimatic Zone	**Biogeoclimatic Subzone and Variant**
Wet Belt	ICH (Interior Cedar Hemlock)	dw, dk, mw, mm, mk, mc, wk, vk, vc
Code = 1	SBS (Sub-Boreal Spruce)	dh, dw, dk, mh, mw, mm, mk, mc, wk, vk
	IDF (Interior Douglas Fir)	mw, ww
	ESSF (Englemann Spruce - Subalpine Fir)	dc, dk, dv, mw, mv, mm, mk, mc, wv, wm, wk, wc, vc, vv
	SBPS (Sub-Boreal Pine - Spruce)	mk, dc, mc
Dry Belt	ICH (Interior Cedar Hemlock)	xw
Code = 2	IDF (Interior Douglas Fir)	undifferentiated, dk1, dk2, dm2, xh, xw, xm, dm1
	ESSF (Englemann Spruce - Subalpine Fir)	xc
	MS (Montane Spruce)	xk, dc, dk, dm, xv
	SBPS (Sub-Boreal Pine - Spruce)	xc
	PP (Ponderosa Pine)	xh, dh

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.

Enter:

(blank)	if Coast compilation
0	if Interior compilation is required by the three quality classes. *This option has been disabled.*
1	if interior fir is present and sale is in the Wet Belt.
2	if interior fir is present and sale is in the Dry Belt.

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 cruise data.

Position 15 Tree Class Combinations

This column states which tree classes will be included in the final volume.

Blank or 0	useless volumes excluded - if only residual, suspect and dead potential tree volumes are required,
1	useless volumes included - if residual, suspect, dead potential plus live and dead useless volumes are required. Do Not use for appraisal purposes. Reports will be titled "Not for Appraisal Purposes".

Position 16 Species Compilation

This column indicates whether all the species on the sale are to be compiled in the same manner or whether an exception is required. For example:

1. Cedar poles or veneer for only Douglas Fir (not programmed as yet).

2. The stump height, top dib, DBH limit or log length could be altered for one species on the sale (i.e., in the Interior, lodgepole pine is compiled to 12.5 cm plus, while all other species are compiled to a 17.5 cm DBH).

Enter:

0	if all species are to be compiled in the same manner.
1	if all species are to be compiled the same with an exception.

Positions 17 to 18 Type of Compilation (majority of species)

The code for the appropriate end product or combination of products is entered. Present appraisals require option 3 for the interior, option 4 for hemlock partition, and option 32 for the coast.

3.	Lumber including all logs.
4.	Hemlock Partition
32.	Coast Integrated Company - with Peeler segregation

Compilation Standard

Specify the utilization level required. This will be for the majority of the species.

Positions 19 to 21 DBH Lower Limit

Specify to the nearest 0.1 cm the minimum DBH to be compiled.

Coast:	Mature (121 yrs +) = 17.5 cm Immature (< 121 yrs) = 12.0 cm	Interior	Lodgepole Pine = 12.5 cm Other Species = 17.5 cm

Positions 22 to 24 Stump Height

Specify Stump Height required to the nearest cm (e.g., standard utilization = 30 cm).

Positions 25 to 27 Top Diameter

Specify top dib for the tree to the nearest 0.1 cm

Coast	Mature (121 yrs +) = 15 cm Immature (<121 yrs) = 10 cm
Interior	10 cm

Red cedar (Interior only):

- if greater than 50 percent of the red cedar net volume is in trees less than 141 years the top diameter inside bark is 10 cm, and
- if greater than or equal to 50 percent of the red cedar net volume is in trees greater than 140 years the top diameter inside bark is 15 cm.

Positions 28 to 29 Log Lengths (to the nearest metre)

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 Kalum Forest 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.

Positions 30 to 44

Exception Number 1.

Compilation for a species may require a different type of compilation; Lower DBH Limit (i.e., PL = 12.5 cm DBH). Stump height, top dib, and log length.

Positions 45 to 59

Exception Number 2 (i.e., Cedar 160 years = 15 cm top) Stump height, top dib, and log length.

Positions 60 to 74

Exception Number 3.

> Positions 30 to 74 on second line allows three more exceptions for one compilation.

Position 75 Block or Average Line Method (Type Average) of Compilation

A	average line (type average) method.
B	block method.

The average line (type average) method of compilation uses all plots from the timber type that is common to all blocks of cruise.

The block method uses only the plots in the timber type within the block or the plots in the timber type within the harvest method. Only one method must be used for an appraisal cruise.

The average line method is the default method.

The block method must be used for the following types of compilations:

1. Percent reduction by block.
2. Cutting permit compilations where immature and mature block combinations occur.
3. Other compilations approved by the Regional Manager in the cruise plan.

Position 78 Stump Diameter Measurement Type

Code "C" for centimetres.

Code "R" for rads.

Stump height must be in centimetres.

Position 79 Diameter Measurements

Code "I" for inside bark.

Position 80

Code "S" for stump cruise.

7.3 Card Type C

Position 1 Type Description

This card contains the type number (corresponds to positions 19 and 20 on Card Type 9), the map or stratum label for the type and the area of the type in hectares for every type island within the Cutting Block, Cutting Permit, Timber Sale, Berth or Lease.

Positions 2 to 10

Common to Card Type A and B.

Positions 11 to 13

These columns are not in use.

Positions 14 to 15 Type Number

This is the number given to similar type islands within the sale. Each Map Label, which differs in some respect, requires a new Type Number with the numbers starting at 1 for the unit under consideration. Several type islands with the same map label will have the same type number. The type numbers must be zero filled (e.g., 01, 02, etc.).

Map Label (Positions 16 to 27)

Major Species

A species is major if it comprises 20 percent or more of the total Gross volume.

Positions 16 to 17 Species #1

Leading species in terms of gross volume for the type.

Positions 18 to 19 Species #2

Second leading species in terms of gross volume.

Positions 20 to 21 Species #3

Third leading species in terms of gross volume.

Positions 22 to 23 Minor Species

A minor species comprises less than 20 percent of the gross volume for the type. A new type number should be assigned very infrequently when the only difference in the stratum is the first minor species.

Position 24 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

Position 25 Height Class (metres)

Code	Height Class Limits (metres)
1	0-10.4
2	10.5-19.4
3	19.5-28.4
4	28.5-37.4
5	37.5-46.4
6	46.5-55.4
7	55.5-64.4
8	64.5 +

Position 26 Stocking Class

Code	Description
0	Immature Stands Mature Stands
1	Mature Residual-Disturbed 26 to 75 percent by area or volume
2	Stocking Class 1 to 76 or more trees per hectare 27.5 cm + DBH.
3	Stocking Class 2 - Fewer than 76 trees per hectare 27.5 cm + DBH.

Position 27 Site Class

Site is determined for all productive forest types by the application of sample tree age and height measurements to the site index tables in Appendix 1.

	Code
G	good site
M	medium site
P	poor site
L	low site

The site is established on the first species in order of predominance regardless of the percentage composition of the stand or the number of species in the label.

Position 28 Type Identity

The recognized classes of cover on forest land are Immature, Mature, Mature Residual, Not Satisfactorily Restocked (NSR), Non-commercial (NC), Non-Productive Forest and Disturbed-Stocking Doubtful (DSD).

However, program will only accept code 1, 2 or 3.

A map note may distinguish the various types of Non-Forest Lands but only one code (6) is assigned to this classification.

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.
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.

In cases where there is reasonable doubt as to whether the area is NSR the category DSD should be used. Ground examination to verify NSR areas is desirable.

Code	Identity	Description
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	Disturbed, Stocking Doubtful (DSD)	Denuded areas where there is reasonable doubt as to whether the area is NSR.

Positions 29 to 58

Record the merchantable timbered hectares for each timber type (stratum) and silviculture treatment unit in the cutting block, cutting permit, Timber Sale or Timber Licence to the nearest 0.1 ha.

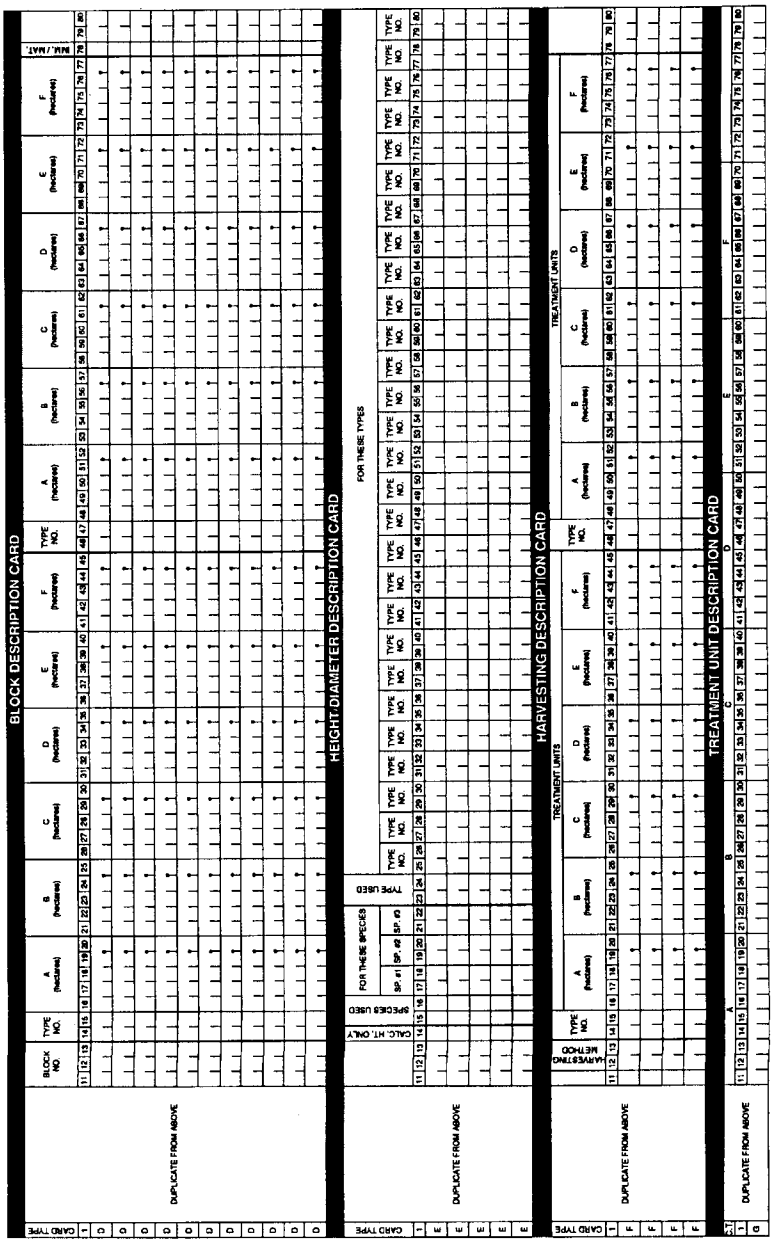


Figure 7.2 Reverse Side of Map Area Statement Form (FS 121 HVR 96/11).

7.4 Card Type D

Position 1

Block Description

The sampling plan and the appraisal is made on the basis of the Timber Sale or Cutting Permit which may consist of several separate sub-units, namely blocks or settings. If for operational purposes an estimate by species is required of the net volume for each type in these sub-units (blocks) the Card Type D must have an entry for each type separately within each block. The number of blocks entered must equal the numerical entry in positions 11 to 13 of Card Type A.

Positions 2 to 10

Common to all Card Types.

Positions 11 to 13 Block No.

Enter the Block Number within the Cutting Permit or Timber Sale. Each block identified must have a unique number or letter.

Position 14 to 15 Type No.

Enter the Type Number of a type island, which is contained or partially contained by this Block. The numbers must correspond to Type Numbers defined by a previous card C. The type No. must be zero filled (e.g., 01, 02, etc.).

Position 16 to 45 Silviculture Treatment Units

Enter the number of merchantable hectares of the block, which is part of this type and silviculture treatment unit. The sum of all of the areas for one type should equal the area specified for that type on the Card Type C.

Position 46 to 47 Type No.

See description for Position 14 to 15.

Position 48 to 77 Silviculture Treatment Units

See description for Position 16 to 45.

Position 78 Coast - Block Growth Indicator

I	Immature
M	Mature

If the percent immature reported in the block summary is 50 percent or more, then the block must be compiled to immature utilization standards by coding this indicator as I. If the percent immature is reported as less than 50 percent, then the block must be compiled to mature utilization standards by coding this indicator as M.

7.5 Card Type E

Position 1

Height/DBH Description - Stump Cruises & Severely Damaged Stands

This card is not needed if there is a sufficient number of sample trees (20 or more) to calculate a height/DBH equation for a species within a stratum or forest type. However, this card must be used for any of the following situations, which occur usually through the minor position of the species in the type or the type itself in the Cutting Permit. This usually means the collection of enough sample heights to establish a curve becomes impractical.

1. The sample trees for one major species occurring in two or more types (keep in mind the rules in Section 3.5.3.2) can be combined into one equation, which will be applied against all trees of that species for the designated types.

2. The sample heights for two or more different species exhibiting similar growth characteristics can be combined into one equation so that all trees of the species indicated will have their heights calculated by this one equation.

3. One species may be so minor that no sample heights were taken and this card can designate which height equation should be used to calculate heights for this species. It is recommended that all minor species sample trees be measured or estimated where gathering enough height samples is not practical.

Examples:

HEIGHT/DIAMETER DESCRIPTION

CARD TYPE			CALC. HT. ONLY	SPECIES USED		FOR THESE SPECIES			TYPE USED														
						SP. #1	SP. #2	SP. #3		TYPE NO.	TYPE NO.	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 7.3 Height/Diameter Description Card.

Example 1.	One height/diameter 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 (Card Type 2) in Type 1 with no heights will have their heights calculated by this one equation.
Example 2.	One height/diameter 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 and will have characteristics implied by the Site Code and Type Identity specified for Type 3. All Pa, Pw and Py trees (Card Type 2) in Type 3 and 4 with no heights will have their heights calculated by this one equation.
Example 3.	The height/diameter equation for PA in Type 3 is to be used to calculate the tree heights of all L and Pa trees in Type 3 with no heights.

If examples 2 and 3 were submitted in the same compilation, a height/diameter equation used would be produced from the grouped set of data defined by example 2. Example 3 would use this equation as described above. In addition, example 3 cannot request that the equation for species Pw or Py of Types 3 or 4 be used or that the equation for species Pa, Pw or Py of Type 4 be used because this equation is labelled for species Pa of Type 3.

Example 4.	When wanting to make one curve for all the species and there are too many species for one line, it 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 make one curve. The column 14 can be either 0 or 1.

Position 2 to 10

Common to all Card Types.

Position 11 to 13

Not used.

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/diameter equation. The height from this curve will be used for all the plot trees of these same species and types.
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 the species (columns 15 to 22) and all the types (columns 23...).

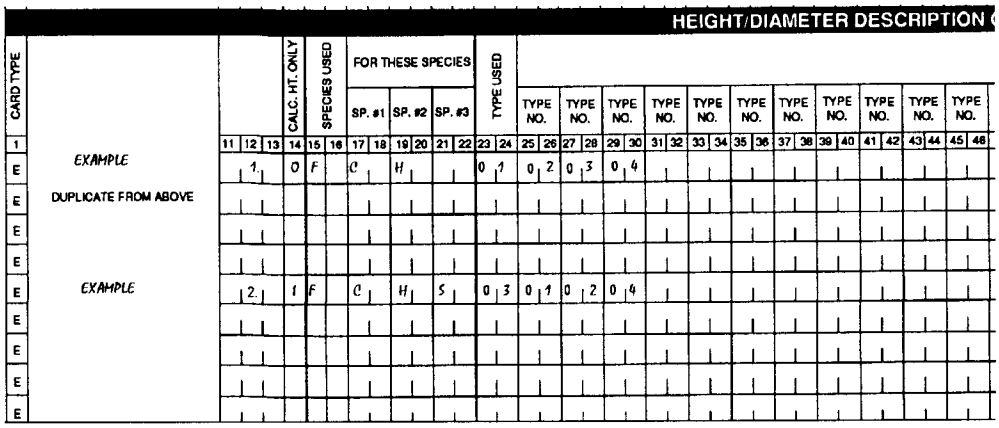


Figure 7.4 Height/Diameter Description Card.

Card column *14* makes the difference in 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 make a curve. The heights for all F, C, H in types 1, 2, 3, 4 on card type 2 will be applied from this curve.
Example 2.	if column 14 is *1* it means: the sample trees from the first species- F - (columns 15 and 16) in the first type -3- (columns 23 and 24) *only* will be used to make a curve. The heights from this curve will *then* be applied to *all* the species in *all* the types as listed on that line.

Position 15 to 16 Species Used

If only one species is involved, enter that species. If more than one species is involved, enter the major species. All trees of the species in positions 17 to 22 and type No. in positions 23 to 80 will use this same equation.

Position 17, 18, 19 to 20, 21 to 22 For These Species

Enter the species, if any, which are to be grouped with the species entered in the Species Used position.

Position 23 to 24 Type Used

If only one type is involved, enter that type. If more than one type is involved, enter the type that has the Site Code and Type Identity (Card Type C fields) values which best describe the whole group being combined.

Positions 25 to 26, 27 to 28, ..., 78 to 80 for These Types

Enter the types, if any, whose species are to be involved in the grouping.

Type numbers must be zero filled (e.g., 01, 02, etc.).

7.6 Card Type F

Position 1

Harvesting Method Description

The sampling plan and the appraisal is made on the basis of the cutting authority area which may consist of several separate sub-units, namely Harvesting Methods.

Position 2 to 10

Common to all Card Types.

Position 11

This column is not in use.

Position 12 to 13 Harvesting Method

Enter the Harvesting Method Code within the cutting authority area.

HC	=	helicopter clear-cut
HS	=	helicopter selective
CC	=	cable clear-cut
CS	=	cable selective
HO	=	horse
SC	=	ground skidding clear-cut
SS	=	ground skidding partial cutting
SP	=	specified operation
LC	=	Skyline clear-cut
LS	=	Skyline selective

Position 14 and 15 Type No.

Enter the Type Number of a type island, which is contained or partially contained by this Method. The numbers must correspond to Type Numbers defined by a previous Card Type C. The type No. must be zero filled (e.g., 01, 02, etc.).

Position 16 to 45

Enter the number of merchantable hectares of the Harvest Method, which is part of this type and silviculture treatment unit. The sum of all of the areas for one type should equal the area specified for that type on the Card Type C.

Position 46 and 47

See description for Positions 14 and 15.

7.7 Card Type G

Silviculture Treatment Unit Description – Positions 11 – 20, 21 – 30, 31 – 40, 41 – 50, 51 – 60, 61 – 70, and 71 - 80

Enter up to six user coded descriptions so that individual treatment unit summaries will be identified by the coded description.

Stump Cruising 8

8.1 Introduction

The methods described in this chapter are prioritised 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,
- utilization standards will be based on whether the unauthorized timber harvesting (UTH) occurred in Coastal or Interior administrative areas. Refer to Chapter 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 Regional Cruising Coordinator in the respective forest region.

8.1.1 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 in the absence of any timber due to unauthorized harvesting. 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.

- Normally, Crown cutting authorities specify a 30 cm stump height,
- the following information should 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,
    - data listing or plot summaries and evidence of data reconciliation,
    - age in 10's reported on tally card, to determine which loss factors were used in the compilation,

- traverse sheets should all be signed and type of instruments used recorded,
- the notes recorded correctly and ground slope recorded which is required to calculate horizontal distance.*(i.e., HD = Cos(1/Tan(slope%/100))*, 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.

8.1.2 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 high side to an equivalent dbh outside bark (dob). DBH is equal to 1.3 m height on the tree at the high side of the ground. 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.

Tree heights are measured from an adjacent and similar timber type 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 height diameter 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 that the area is located in. 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 diameter 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 of Forests Inventory decay and taper data collected for all commercial species and the data is partitioned into Forest Inventory Zones. In some circumstances local factors apply to a portion of a FIZ. All volumes are reported in cubic metres by species and summed.

8.1.3 Sampling Errors

Potential sources of sampling errors are:

- variation between the decay, waste and breakage for the Forest Inventory Zone 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. 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 diameter 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.

8.2 Boundaries

- Locate legal survey posts and confirm the boundary location. Re-establish cut block boundaries from original traverse notes if necessary,
- closed traverse the UTH area to the tolerances set out in Section 3.6.2.1 of the *Cruising Manual* (CM) under cruise based allowable errors, and
- if the unauthorised harvest will result in an administrative penalty under Section 117 of the *Forest Practices Code*, then a closed traverse of the area will be required since the penalty levied is in dollars per hectare.

8.3 Measurement Methods

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

8.3.1 Method 1: Areas Less than 10 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 ha, method 2 may be used.

8.3.2 Method 2: Areas Greater than or Equal to 10 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 percent of the area. A grid spacing of 60 m should be sufficient to ensure a plot coverage of 10 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 tree represented by an "in the plot stump"(i.e., pith of stump is within 11.28 m of plot centre).

8.4 Tree Heights

Tree heights must be selected from a similar timber type and nearest adjacent area wherever possible. Adjacent height curve equations from existing data may be acceptable if the data is validated in the field.

8.4.1 Stump Cruise Tally Sheet (FS 205S)

8.4.1.1 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 AOU codes are defined in the FTAS users manual. The ERA file number must be recorded in the locality description boxes in Card Type A of the Map Area Statement.

Complete the FS 205S 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. Also see Section 7.2 of the *Cruising Manual* for the correct coding of the map area statement stump cruise codes.

If the stump cruise is 100 percent measure, enter a plot area in positions 27 to 30. Calculate the plot area as follows:

$$\frac{\text{Total stump cruise area}}{\text{Number of tally cards}} = \text{plot size in hectares}$$

> The sum of the plot areas must equal the total stump cruise area.

The stump cruise tally sheet, Card Type 3 tree heights must be assigned unique tree numbers from the Card Type 2's on the same tally sheet. The tree heights may be entered on a separate tally sheet if necessary, however the plot must be used in the determination of the plot size calculation and assigned a unique plot number.

8.4.1.2 Card Type 3

Position 2 – 24

Common to Card Type 1 and 2.

Position 25 and 26 Tree Number

Sample trees must be numbered 99, 98, 97, etc. to prevent confusion with stumps numbered on the plot.

Position 27 – 29 Total Height

Enter the calculated height plus correction if any as arrived at from the readings in the green shaded columns in the right-hand columns.

Position 30 and 31 Species

As per "Tree Details" (see Section 6.3.2).

Position 32 – 35 DBH

As per "Tree Details" (see Section 6.3.2).

Position 36 C/C Crown Class

Enter the Crown class for the tree by number code as shown in the box on the reverse side of the field sheet.

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.

Position 37 – 39 Total Age (see Section 3.5.9.1)

The age of at least three codominant 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.

In order to do this, measure the total height for each tree that will be sampled for age (total height is from "high-side" to the trees top or highest point). If the age of the forest type is not within the above limits, the age of at least one codominant sample tree for each major species must be established for each forest type.

Each age is calculated 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 Curves and Tables for BC – Coast Species* (February, 1991) or *Site Index Curves and Tables for BC - Interior Species* (June, 1994) (see Appendix 1). Go to the bottom of the appropriate Site Index Table and note the "Years to bh" (Years to boring height) correction value.
4. Total Age – the sum of the Breast Height Age and the Correction.

Position 40 Partial Cutting

L	Leave tree.
Blank or C	Cut tree.

8.4.2 Major Species (20 percent or more of the UTH area gross volume)

A minimum of 20 tree heights per major species per timber type evenly distributed throughout the full range of diameters at breast height (dbh) represented on the UTH area.

8.4.3 Minor Species (less than 20 percent of the UTH area gross volume)

The following options are listed in the order of preference.

8.4.3.1 Option 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 diameter curve.

8.4.3.2 Option 2

Combine the minor species with another species within the same timber type and with a similar height/diameter relationship.

8.4.3.3 Option 3

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 for assignment for the minor species stump.

8.5 Timber Available For Measuring

This method can be used if the timber is safe to measure and the cruiser or scaler can confirm which tree originated from which stump.

The following points apply to all options under Section 8.5.

8.5.1 Tally Card - FS 205S

Use the FS 205S stump cruise tally sheet unless the timber is being 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. The first three characters identify the administrative organization unit (AOU), the next two characters identify the fiscal year, and the last four characters identify the number of the incident in that AOU for the reporting year. The AOU codes are defined in the "FTAS Users Manual". The ERA file number must be recorded in the locality description boxes in Card Type A of the Map Area Statement.

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 of the cruise compilation. Also see Section 7.2 of the *Cruising Manual* (CM) for the correct map area statement stump cruise codes.

8.5.2 Field Measurements

If performing a cruise of the felled trees, complete the FS 205 cruise tally sheet 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 take the stump height into account when determining dbh. Use the FS 205S stump tally sheet if the decision is made to measure 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.

8.6 Timber Not Available For Measuring

The following options apply if the timber has been removed from the UTH area, it is unsafe to measure the timber, or the scaler is unable to determine which tree originated from which stump. If this situation has occurred, use this measurement method for the whole stump cruise.

8.6.1 Tally Card FS 205S

The following points apply to all of the options under Section 8.5.

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 AOU codes are defined in the FTAS users manual. The ERA file number must be recorded in the locality description boxes in Card Type A of the Map Area Statement.

Complete the FS 205S 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. Also see Section 7.2 of the *Cruising Manual* for the correct coding of the map area statement stump cruise codes.

8.6.2 Stump Measurements

Measure and record stump height to the nearest centimeter above the ground on the high side of the stump. Measure and record stump diameters inside bark (d.i.b.) as the average of the maximum and minimum measurements (see Figure 8.1).

If stumps are longer than 1.3 m above the high-side ground, measure the stump at 1.3 m outside the bark above the high-side ground, and record the diameter inside bark by estimating the bark thickness.

The measurement type must be consistent for the entire stump cruise. Check one of the diameter measurement type boxes "rads" (radius class units) or "centimetres" on the card type 9 of the stump cruise tally sheet (FS 205S).

8.6.3 Roads and Land Clearing

If there are skid trails, roads or cleared areas present on the UTH area and the stumps have been removed from these areas or are so badly damaged that they cannot be measured, determine the area covered by the skid trails, roads or cleared areas. Do not sample the area of the skid trails or roads. Move any samples when the plot center is on the road or cleared area 12 m (approximately 1 plot radius) North. If this fails try East, then South, then West. If this fails, increase distance to 24 m.

If the plot area is influenced by the road or cleared area, use the following border plot method:

Plot centres which fall within the stratum to be stump cruised but partially cover the skid road, road or cleared area will be made into border plots.

Divide the plot through the plot centre and parallel to the type line and measure the half which is entirely within the stratum to be sampled.

Refer to Section 3.4.1.7 for a diagram of the border plot procedure.

8.6.4 Measurement Options

The following options are listed in order of preference. Use Option 1 if it is feasible. If Option 1 is not feasible (adjacent information is not representative or unavailable or the area is too large), then proceed to the next option.

8.6.4.1 Option 1

Conduct a 100 percent stump cruise to determine the gross and net volume if the UTH area is < 10 ha.

Classify all of the stumps according to their maturity in relation to the stand, their defect and whether they are live or dead. See also Section 3.5.6 of the *Cruising Manual* or the back of the FS 205 cruise tally sheet for the definition of the allowable tree classes. The correct tree class is necessary to ensure that the correct loss factor tables are used in the compilation.

Record scar and/or frost crack on the FS 205S if the stump has heart rot showing and the diameter of the rot is greater than 50 percent of the diameter of the stump (see Figure 8.2). This will ensure that the stump is moved into risk group 2. Coding scar will move all species into risk group 2 except Hemlock in FIZ A and FIZ C, which will require coding both scar and frost crack. Spruce in FIZ A, B and C will require coding both scar and frost crack to move them into risk group 2.

Record dead stumps that have sap rot that extends more than 1/6 the stumps diameter as tree class 4 (dead useless) as this indicates less than 50 percent sound wood content (see Figure 8.2).

Record conk if present on the outside perimeter of the stump or phaeolus schweinitzii is growing on the ground near the base of the stump or on the exposed root. Recording conk will move the stump into the highest risk group.

8.6.4.2 Option 2

Establish 400 m^2 fixed area (11.28 m radius) plots on a systematic grid to determine the gross volume if the UTH area is ≥ 10 ha.

Classify all of the stumps according to their maturity in relation to the stand, their defect and whether they are live or dead. See also Section 3.5.6 of the *Cruising Manual* or the back of the FS 205 cruise tally sheet for the definition of the allowable tree classes. The correct tree class is necessary to ensure that the correct loss factor tables are used in the compilation.

Record scar and/or frost crack on the FS 205S if the stump has heart rot showing and the diameter of the rot is greater than 50 percent of the diameter of the stump (see Figure 8.2). This will ensure that the stump is moved into risk group 2. Coding scar will move all species into risk group 2 except Hemlock in FIZ A and FIZ C, which will require coding both scar and frost crack. Spruce in FIZ A, B and C will require coding both scar and frost crack to move them into risk group 2.

Record dead stumps that have sap rot that extends more than 1/6 the stumps diameter as tree class 4 (dead useless) as this indicates less than 50 percent sound wood content (see Figure 8.2).

Record conk if present on the outside perimeter of the stump or phaeolus schweinitzii is growing on the ground near the base of the stump or on the exposed root. Recording conk will move the stump into the highest risk group.

8.6.4.3 Option 3

Use adjacent cruise information for the gross and net volume per hectare if the timber in the UTH area is the same as the timber type in the adjacent cruise information.

8.7 All Stumps Removed From the UTH Area (i.e., Land Cleared, Road has Been Built)

8.7.1 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 equally space the plots along that edge.

8.7.2 Option 2

Use adjacent cruise information for the net volume per hectare if the timber types were the same on the forest cover map.

8.7.3 Option 3

Use aerial photographs (approximate scale 1:3000 is recommended) taken before (pre) and after (post) the UTH occurred. Ensure that pre and post 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 should be utilized to 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) found on site.

2. Field staff must attend the site and measure tree heights and diameters at breast height (dbh) for all species identified on the pre-harvest aerial photos as 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 collected for the removed trees must be plotted onto a height diameter curve by species (x-axis dbh, y-axis height). The height/diameter relationship can now be used to interpolate tree diameters for the tree heights provided by the photo interpreter for the removed trees.

4. Using the tree heights provided by the photo interpreter and the diameters interpolated from the height diameter curve, compute a net volume using Option 8 in the mainframe cruise compilation program (TSO) for the UTH area.

8.8 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 as per 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 Block Type Summary Report of the residue and waste systems reports.

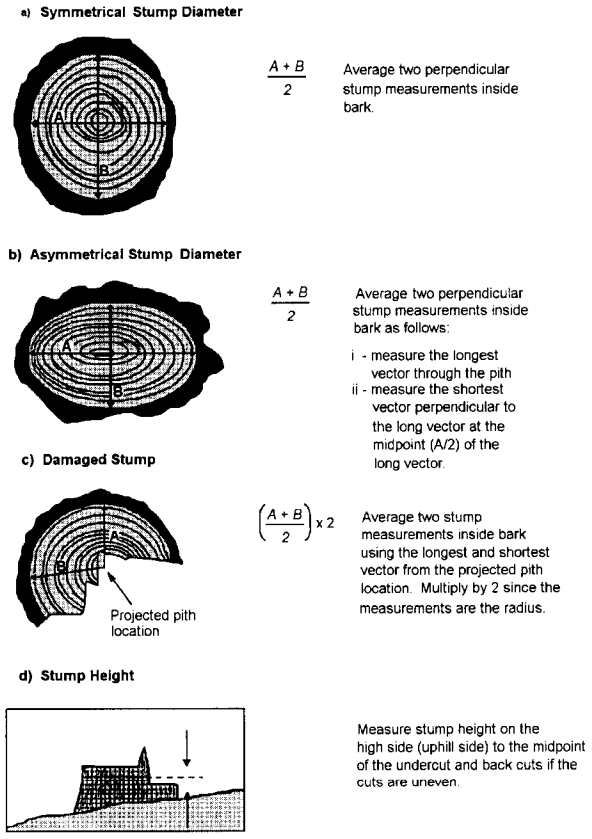
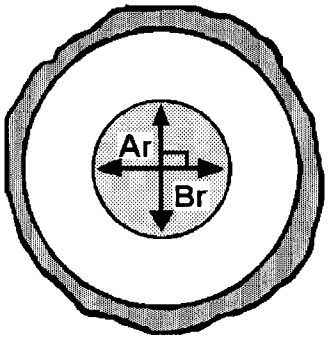


Figure 8.1 Examples of recommended stump measurements.

a) Stumps with heartrot > 50% of stump diameter



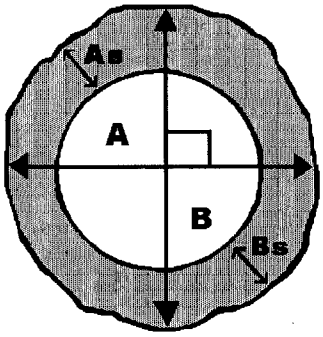
i determine stump diameter inside bark using long and short vectors - $\frac{A + B}{2}$

ii determine the rot diameter using long and short vectors

$$- \frac{Arot + Brot}{2}$$

iii if the rot diameter is greater than 1/2 the stump diameter, record scar or scar & frost cract (refer to Section 8.541) 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 8.2 Examples of risk group determinations for stumps.

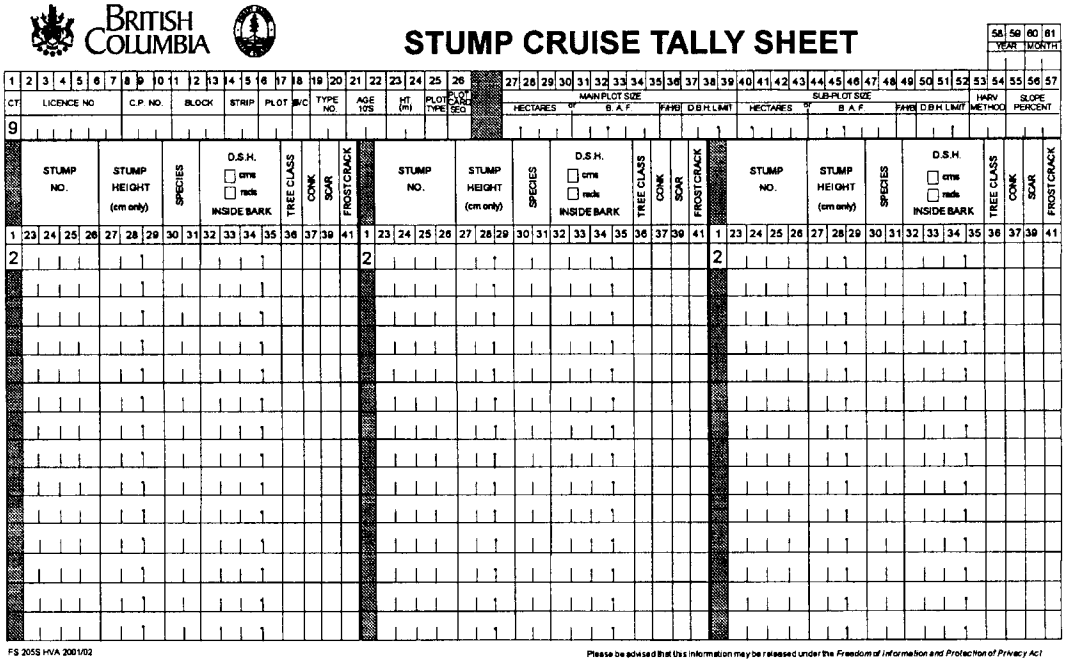


Figure 8.3 FS 205S Ministry of Forests Stump Cruise Tally Sheet (side 1 of 2).

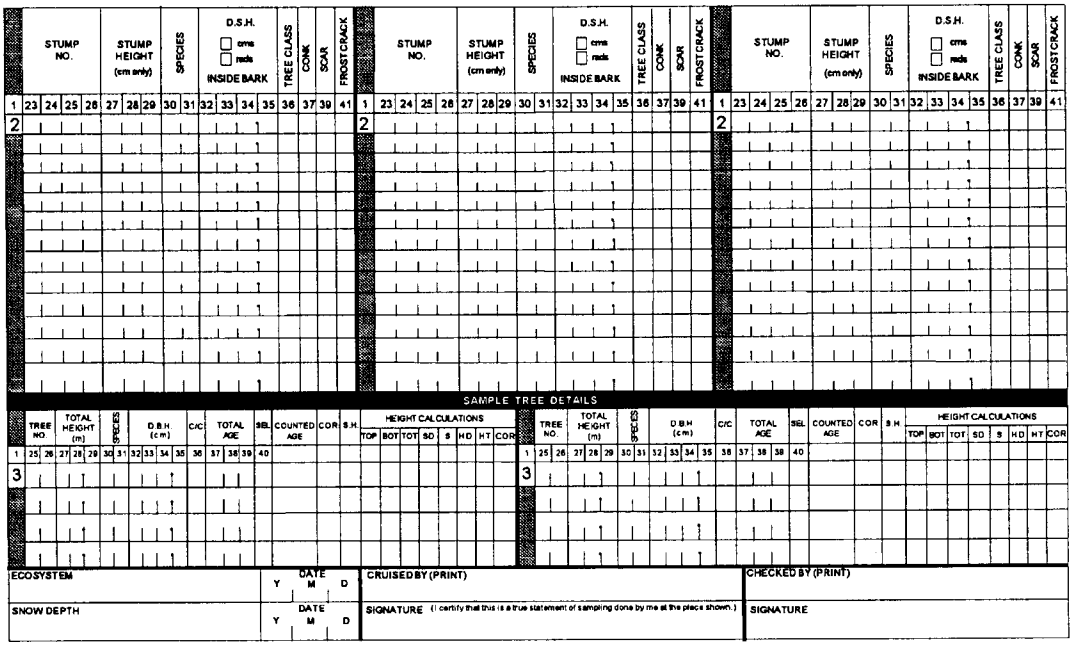


Figure 8.4 FS 205S Ministry of Forests Stump Cruise Tally Sheet (side 2 of 2).

Regional Guidelines 9

Chapter 9 will be updated as the Regional Guidelines become available.

9.1 Vancouver Forest Region Operational Cruising Requirements

9.1.1 Information Sources Regarding Policy and Procedures

Current cruising policies and procedures are outlined in the following publications and circulars:

1. Ministry of Forests, *Cruising Manual.*
2. Operational Cruising Requirements for the Vancouver Forest Region (Chapter 9.1 of the *Cruising Manual*).
3. Information letters as a result of the Vancouver Region Cruising Seminars.
4. *Ministry of Forests Policy Manual.*
5. *Forest Act.*

9.1.2 Tenures Requiring an Operational Cruise

All tenures subject to a stumpage appraisal must normally be cruised. The regional manager may grant exemption to this requirement in specific cases.

9.1.3 Submission of Cruise Plans

9.1.3.1 Individual Cruise Plans

Licensees should submit cruise plans to the Ministry of Forests district office 30 days prior to commencement of a cruise. This includes submission of cruise plans for all amendments to existing cutting permits and for all blocks that have more than four plots added to the old cruise information. The 30 days will commence on the date the plan is received (stamped) at the district office.

District staff are not required to approve or disapprove cruise plans.

Submission of cruise plans is required to allow the district to know how much cruising is being done, when and where, so they can conduct the necessary check cruising.

The following information is mandatory on a cruise plan:

- tenure, including block numbers,

- area (ha) by block,
- plot grid (i.e., 100 m by 100 m),
- number of measure and count plots or ratio of measure plots to count plots,
- dates of cruising,
- cruise plan map,
- block maturity (if known), and
- who the cruiser(s) will be (if known).

All other information is optional, unless specified by the district in a small business contract, but will assist the district in carrying out a check cruise.

Cruise plans must be submitted to the appropriate district manager containing all mandatory information listed above. The Provincial Cruise Plan form is located in this manual, in the chapter called Forms, however, any form that includes the necessary information is acceptable.

Cruise plans may be faxed to the district office.

The scale of the cruise plan map may be from 1:5 000 to 1:20 000.

Once a cutting authority area has been selected for check cruising, the licensee must bring along or supply the district with a map and compass notes which allow the ministry check cruiser to check actual plot locations, timber types, POC(s) and tie-point(s).

9.1.3.2 Annual Cruise Plans

An alternative to providing individual cruise plans for each block is for the licensee to provide an annual cruise plan. Both the licensee and district must agree upon use of the annual cruise plan option.

The annual cruise plan must include a map (i.e., 1:50,000) showing the location of all the blocks.

For each block, the following information is required:

- gross hectares (from the Forest Development Plan),
- net hectares (from the Forest Development Plan),
- tenure,
- accessibility,
- maturity, and
- plot grid.

At the start of each month, the licensee must provide a monthly update listing the blocks cruised during the previous month. Maps of each block showing the plot locations must be provided upon request from the district.

For each block cruised, the licensee will provide:

- information required in the annual cruise plan,
- block number,
- block maturity (immature, mature or combination),

- geographic location,
- actual net area cruised,
- number of cruise plots established, and
- names of the cruisers.

> The licensee will note any changes (additions or deletions) to the annual cruise plan, and if applicable, explain why they used a different plot grid.

Blocks cruised under the annual cruise plan option will be subject to check cruising at anytime up to issuance of the Cutting Permit (CP). Blocks will not normally be checked once the CP has been submitted to the district for appraisal. The 30 day rule will not be applied.

Timing of check cruises should be flexible, considerate of work schedules, and be based on a spirit of co-operation.

The time between the cruise and check cruise must be taken into account, especially in immature blocks, where diameter and height could change significantly over a year.

9.1.4 Acceptability of Cruise Data

9.1.4.1 Check Cruising

Benefit of the Doubt

Cruising and its related measurements can involve subjectivity.

Decisions based on opinion or a range of acceptable values, where no clear decision can be made based on fact, will be accepted based on the adage "the benefit of the doubt goes to the operator". Due diligence must be recognized by the check cruiser. Due diligence is the standard of care that a reasonably prudent person would take in those particular circumstances. The intent of "Benefit of the Doubt" is not to condone poor quality work errors.

With the submission of cruise plans in accordance with the 30-day rule, the Ministry of Forests will have the capability to initiate and carry out a check cruise while the cruisers are on site. This does not preclude a check cruise at any time after the cruise is completed.

Where the cruise plan has been submitted 30 days prior to commencement of cruising, and no check is carried out while the cruisers are on site, the basic field data will not normally be contested at a later date, subject to "Use of Older Cruise Data" below.

The tolerance for species identification is changed to:

Species Identification	
Trees Checked	**Allowable Error**
1 to 50	1 tree incorrectly identified
51 to 100	2 trees incorrectly identified
101 to 150	3 trees incorrectly identified

9.1.4.2 Use of Older Cruise Data

1. In mature stands where increment is very slow and decay would offset the growth after the cruise was carried out, the cruise data will be considered acceptable if the cruising was done within the last 10 years.

2. In immature stands where increment is normal, old data should be considered for updating after five (5) years or at the discretion of the District Manager.

3. New cruise data must be collected if there is a major change in the stand condition as a result of fire, insect, disease or wind throw (refer to Section 9.1.11 - Cruising Damaged Stands and Exceptional Circumstances).

Notwithstanding the above, policy changes may necessitate cruise data to be updated.

Where there is doubt as to the applicability of the cruise data, it is the prerogative of the District Manager to request evidence that the cruise data still accurately depicts the stand parameters.

When a re-cruise is necessary, it will be mandatory that a cruise plan be submitted to the District Manager.

9.1.5 Technical Criteria

All distances in this circular are horizontal distances (corrected for slope).

9.1.5.1 Sampling Error Requirements

Where the sampling error requirement is achieved there is no required minimum number of trees per plot.

When the count plots are used in conjunction with full measure plots, all information must be used for determining if the sampling error requirement has been met, provided that a ratio of three (3) count plots to one (1) full measure plot is not exceeded.

The options for dealing with an orphan (not recorded in a measure plot) species in a count plot after completion of the fieldwork are:

- Change the orphan species to a species with a similar tree form and value,
- Delete all the count plots in that timber type from the compilation, and
- Return to the field and convert the count plot to a measure plot.

The standards for judging whether the sampling error requirement was met will be the standards in place at the time the cutting authority area was cruised.

Scale Based - Clear-cut and Selection Logging

Sampling Error Requirement = 15 percent sampling error at two (2) standard errors (95 percent confidence level).

The sampling error requirement will be waived where:

1. For cutting authorities of 20 ha or larger in size, a 100 m by 100 m, or equivalent, systematic grid (1 plot per hectare) has been established and a ratio of one count plot to one full measure plot has not been exceeded.
2. For cutting authorities less than 20 ha in size, a 100 m by 100 m, or equivalent, systematic grid (1 plot per hectare) of full measure plots has been established.

An average of four (4.0) trees per plot is the minimum requirement for clear-cuts.* An average of six (6.0) trees per plot is the minimum requirement for selection logging for one plot per hectare.* If two plots per hectare (70 m x 70 m or equivalent, systematic grid) are established and a ratio of one count plot to one full measure plot is not exceeded, an average of four (4.0) trees per plot is acceptable for selection logging.*

* Excludes live useless and dead useless trees.

> The number of trees per plot is calculated to the nearest tenth and not rounded up to the nearest whole number (i.e., 3.6 does not round up to 4).

> If the block was cruised prior to January 1, 2000, and the original intent was clear-cut logging, an average of four trees per plot will be acceptable for selection logging at one plot per hectare.

Cruise Based Sales

Cruise based sales will only be approved when the Regional Manager, or delegated district manager is satisfied that:

1. The loss factors, taper equations, and grade/quality standards proposed for use are appropriate, and that
2. Utilization will be improved compared to scale based sales, or
3. Administration will be simplified.

> Sampling Error Requirement = 8 percent sampling error at two (2) standard errors (95 percent confidence level).

Count plots may be used in determining if the above requirement has been met. Proposed cruise based sales where the timber is very valuable or patchy, will be reviewed by the Regional Manager or designate, to determine if the above requirement should be accepted or changed.

For more information on cruise-based sales and their requirements, refer to Section 8.16 of the *Ministry of Forests Policy Manual*, which is located on the Internet at:

http://www.for.gov.bc.ca/tasb/manuals/policy/resmngmt/rm8-16.htm

9.1.5.2 Sampling Patterns

The cruise grid must be square or rectangular and oriented in cardinal directions (N-S, & E-W) (unless otherwise approved by the district in a cruise plan). Do not use a staggered grid.

To determine your plot locations start at the south-west corner of the block and measure in one-half (1/2) of your grid distance at N45E to set your base plot. Using the base plot lay your plot grid on the map oriented in cardinal directions (N-S & E-W) to determine your plot locations. You can start anywhere on the edge of the block and tie-in to the nearest plot. Plot locations determined by plot grids that cover the entire map sheet are also acceptable. The district must approve use of a different method for randomly determining your base plot.

The direction of travel between plots is at the discretion of the cruiser, but must be clear to the ministry check cruiser.

Collection of slope information necessitates the implementation of fully systematic cruise designs in order to assure representative sampling over the entire cutting area.

A minimum of two (2) full measure plots per cutting authority area is required.

A minimum of one (1) full measure plot per timber type is required although two or more is recommended. Plots should proportionally represent timber type areas.

9.1.5.3 Plot Data

All information on the Ministry of Forests cruise tally sheet (FS 205) relevant to the appraisal and compilation of the data must be collected.

It is recommended that quality remarks (live limb, stub, knots, and spiral grain) be collected on all cruises in case they end up being required for appraisal purposes.

Where age collection is necessary, sufficient ages must be taken to record the appropriate tree class for proper loss factor determination.

Quality Remarks

Quality remarks (live limb, stub, knots and spiral grain) should be collected on all cruises, but will not be grounds for rejecting a cruise on cutting authorities where the cruise grades will not be used in the appraisal.

Quality remarks that exceed the allowable non-sampling errors in Section 3.6 of the *Cruising Manual* will be grounds for rejecting a cruise where the cruise grades will be used in the appraisal (SBFEP sales, woodlots, immature cutting authorities and partial harvesting cutting authorities).

It is strongly recommended that quality remarks be called accurately on all cutting authorities in case cruise grades end up being required for the appraisal. Not calling quality remarks on the initial cruise could result in having to re-visit the cutting authority area.

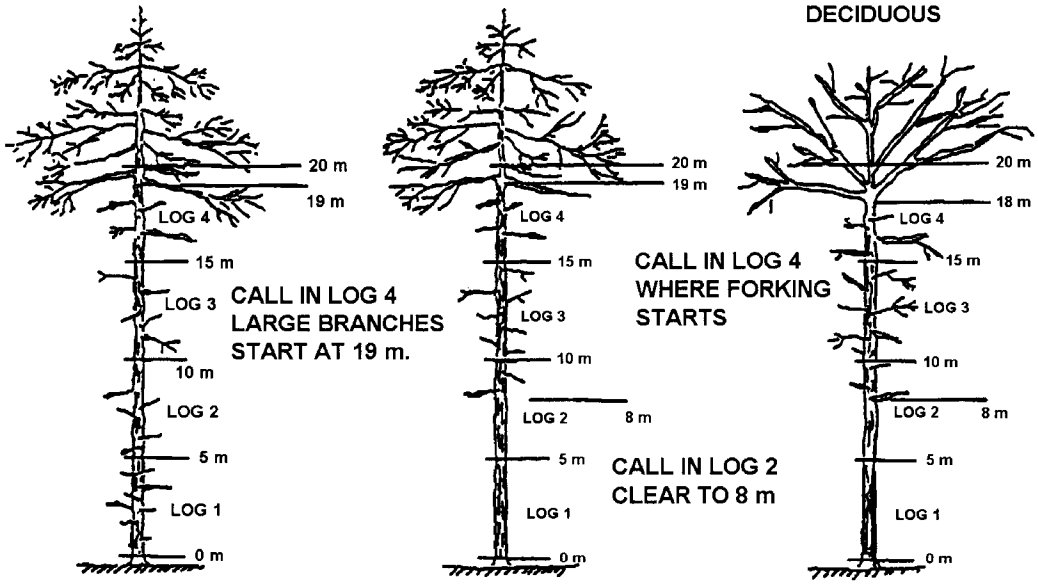


Figure 9.1 Example of live limb.

Live Limb (Grade Change)

Live limb (grade change) is defined as the 5 m log where quality changes from:

- no knots to knots or knot indicators,
- from small knots to large knots, or
- from well spaced knots to excessive knots.

The purpose of recording live limb is to identify the first grade change as you move up the tree.

This will assist the log grade algorithm to better determine the cruise grade distribution produced by the cruise compilation program.

If the branching is consistent in frequency and size from the base of the tree to the utilization top diameter of the tree, record live limb as a one (1).

The grades on trees smaller than 55 cm dbh are not affected by the live limb code.

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

Pathological Indicators

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

If the pathological indicator is close to the 10 cm top diameter, use your judgement and call it either above or below.

Benefit of the doubt goes to the cruiser.

Fork or Crook Versus Dead or Broken Top

If there is a merchantable log (3 m long to the utilization top diameter) above the crook, you call the injury a fork or crook.

If a merchantable log does not exist above the crook, call it a dead or broken top. Definite forking is always called a fork or crook and not a dead or broken top.

Benefit of the doubt goes to the cruiser.

9.1.5.4 Prism Size (Basal Area Factor)

Any prism size (BAF) may be used provided that a prism is available for use during a check cruise.

The same prism size (BAF) should be used throughout a timber type but since the use of more than one prism size (BAF) does not necessarily constitute bias, each situation (where more than one prism is used in a timber type) should be assessed individually.

However, prism size (BAF) cannot be changed at plot centre to include or exclude certain trees, or to achieve a pre-determined number of trees in a plot, as that constitutes bias.

9.1.5.5 Heights

The 100 Percent Height Method must be used on all scale and cruise based tenures.

Use of the Sample Height (height curve) Method is only allowed for stump cruises and stands which are severely damaged due to wind shear or shatter due to freezing (i.e., most of the trees have their tops broken off). Use the sample height method must be identified in the cruise plan and approved by the district.

9.1.5.6 Field Marking and Procedures

Tie Points

The cruise must be tied to at least one (1) and preferably two (2) tie points. They must be good photo ties, falling corners, GPS positions, or unique map locations. Tie points must be linked to the cruise grid with an accurate traverse.

The use of axes has long been an accepted practice in timber cruising. Safety concerns have been raised regarding the mandatory use of axes in timber cruising. Therefore, the use of axes in timber cruising is not mandatory. Using an axe to blaze reference trees, sound trees to assess percent decay or chop into trees to determine their percent soundwood content is at the discretion of the cruiser or their employer. Please note that the check cruiser may use an axe to make their final determination.

Point of Commencement (POC)

Mark your POC on the boundary or edge of the area being cruised and tie-in to the nearest plot on the plot grid.

Cruise Lines (Striplines)

Cruise lines should be tied to the block boundary, where available.

Cruise lines should be established using a compass with a clinometer and tape, or an electronic measuring device.

Plot Centres

Plot centre must be marked (i.e., wire flag, stake, spike, etc.) for all plots (full measure and count). Moving plots centre (i.e., to a tree or rock) is not permitted.

The strip and plot number must be marked on the plot centre and/or the reference tree.

A reference tree must identify the bearing and distance to plot centre. The information on the reference tree must also be noted on the cruise card in case the information is missing or unreadable.

Slope

Record the most severe plot slope measurement from plot centre to a point 15 m horizontal distance. Plot slope must be taken within the harvest area.

It is not necessary to hang a ribbon at the point where the plot slope was taken.

Plot slope must be recorded in both measure and count plots.

Tree Identification

All trees determined to be within a measure plot will be numbered, where safely possible, with paint or a tag with the number facing plot centre.

The dbh will be marked at 1.3 m above the ground on the high side with a paint stripe facing plot centre.

For count plots, number the first tree and paint an arrow on that tree showing the direction of travel. Number enough trees so that plot can be checked.

Borderline tree measurements must be recorded on the cruise card or on the tree. Trees measured out should be marked with OUT or an X on the stem facing plot centre.

9.1.5.7 Diameter at Breast Height Measurement (DBH)

1. Coniferous Species

    a. Mature

        A stand of timber that has an average age greater than 120 years.

        Minimum DBH is 17.5 cm at 1.3 m above the ground on the high side.

    b. Immature

        A stand of timber that has an average age less than 121 years.

        Minimum DBH is 12.0 cm at 1.3 m above the ground on the high side.

2. Deciduous Species

    a. Mature

        A stand of timber that has an average age greater than 40 years.

        Minimum DBH is 17.5 cm at 1.3 m above the ground on the high side.

b. Immature

A stand of timber that has an average age less than 41 years.

Minimum DBH is 12 cm at 1.3 m above the ground on the high side.

Age in Tens must be recorded on each cruise card to help ensure that the block is correctly compiled as mature or immature and that the correct loss factors are used for each tree in the compilation.

Second Growth Clarification

Effective April 1, 1999 the *Coast Appraisal Manual* (Section 2.7) revised the definition of second growth timber to the following:

Second growth coniferous timber, for the purposes of timber pricing, is defined as being less than 141 years old.

The volume of mature and second growth 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 (see Section 3.2.2(6) of the *Coast Appraisal Manual.*

We must be careful not to confuse the above definition of second growth coniferous timber with immature. Only trees under 121 years old are considered to be immature. Trees between 121 years and 140 years old, while now defined as second growth for appraisal purposes, will remain as mature trees for determination of loss factors, utilization standards and grade algorithms.

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

1. All trees less than 141 years old contribute to the second growth percentage for appraisal purposes.

2. All trees from 121 to 140 years old will be compiled using mature loss factors.

3. If over 50 percent of the net volume in a block is in trees over 120 years old it is considered a mature block and will be compiled accordingly (17.5 cm dbh and 15 cm top).

4. If the plot contains any trees that are from 121 to 140 years old, record the age in tens as 13 or 14. Older trees will be classed as tree class 5 (veteran) or tree class 7 (veteran dead potential) while trees less than 121 years old will be recorded as tree class 8 (immature) or tree class 9 (immature dead potential).

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

9.1.5.8 Block Label - Mature and Immature

Each block must be compiled as mature or immature. All types within a block must be cruised and compiled to the same utilization standards (immature or mature).

Net volume will be the determining factor as to whether the block will be compiled as immature or mature.

Blocks that are definitely mature can be cruised to mature standards (Section 9.1.6.7) while blocks that are definitely immature or borderline immature/mature should be cruised to immature standards (Section 9.1.6.7) and net volume used to determine whether it will be compiled to immature or mature utilization standards.

9.1.5.9 Plot Establishment

Half Plots

The use of half plots is optional but must be consistent. If the decision is made to use half plots, they must be used on all plots with 11 or more "IN" trees (live useless and dead useless excluded) based on an initial sweep.

If the decision is made not to use half-plots, they cannot be used on any plots no matter how many trees are in the plot.

When establishing a half plot, all trees, including standing live useless and dead useless, are included for numbering the trees. Start with the first tree that has at least half of its stem to the right of due north and consecutively number all "IN" trees moving clockwise around the plot. If two trees are exactly in line when looking out from plot centre record the tree closer to plot centre first.

Odd Number Plots	Measure and record only the odd number trees.
Even Number Plots	Measure and record only the even number trees.

Tree count errors on half plots are doubled for determining if the stem count meets the ministry's standards in Section 3.6 of this manual.

Border Plots

The plot must be established if the plot centre falls inside the area to be sampled and a half-circle (180 degrees) plot can be established without sampling outside the area/type the plot is inside.

Plot centres that fall adjacent to timber type lines or harvesting boundaries may have to be split through the plot centre parallel to the type line or boundary to avoid sampling outside the area/type the plot centre is in.

To determine if a full plot would sample outside the timber type or cutting boundary, multiply the diameter of the largest tree (excluding live and dead useless) in the full plot by the prism plot radius factor (PRF). If this critical distance is greater than the distance to the timber type or cutting boundary then a full plot will sample outside the area/type being sampled.

Establish a full plot if the timber outside the area/type being sampled is the same as the timber inside the area/type being sampled. A border plot must be established if the timber outside the area being sampled is different than the timber inside the area/type being sampled.

For border plots measure and record the trees within the half-circle (180 degrees) of the plot completely within the area/type being sampled and record the plot type as B for Border Plot.

See Figure 3.7, Figure 3.8, and Figure 3.9 in Section 3.4.1.7 of the *Cruising Manual* for further information on how to establish a border plot.

If a count plot ends up being established as a border plot record it is a border plot with the actual number of trees in the border plot. However, somewhere on the cruise card, instruct the compiler to double up each "IN" tree and compile it as a full circle plot because the compilation program cannot compile border plots that are count plots.

Moving Plots

Unless absolutely necessary, cruise plots must not be moved.

Cruise plots can only be moved in exceptional circumstances such as very irregular shaped blocks or very small patch cuts where the required sampling intensity cannot be achieved without those plots.

Cruise plots cannot be moved unless the plot centre is outside the area to be sampled or a border plot cannot be established without sampling outside the area/type that the plot centre is in.

9.1.6 Timber Typing

Timber typing is to be based on species, volume and age, and may be based on field data or air-photo typing. A cruise may be rejected due to obviously wrong or biased timber typing.

Modification of planned timber type lines is permitted when supported by field data.

Any area, containing merchantable timber that will be harvested, must be cruised and compiled.

Where special management zones exist timber typing may be based on those special management zones.

9.1.7 Cruising of Cutting Authority Area Amendments

Please refer to Section 2.3(2) of the current *Coast Appraisal Manual.*

If accumulated amendments (either addition or deletion of area containing merchantable timber) made to the cutting authority area, at any time from the effective date of the initial appraisal or reappraisal, exceed 25 ha or 25 percent of the merchantable area, whichever is less, the entire cruise must be recompiled and the stumpage rate re-determined.

The following criteria will be used to determine if an amendment to a cutting authority area requires cruising:

1. If the amendment will cause the cutting authority area to be re-appraised, then all amendments (which have not been cruised) will have to be cruised using the same grid from the cutting authority area and the entire cruise re-compiled.

2. All other amendments do not have to be cruised.

Amendments must be submitted to the forest district with the following information:

- size (ha) of amendment,
- map,
- volume by species, and
- appraisal information (i.e., roads, bridges and any other required information).

9.1.8 Cruise Reports

9.1.8.1 Cruise Compilations

Cruises must be compiled using the current (latest) version of a compilation program, which has been approved by the Ministry of Forests.

For more information on the specifications for the reports and how cruise data must be compiled, refer to the Ministry of Forests, *Cruise Compilation Manual.*

All plots established within the external boundaries of the block are to be used in the compilation. When leave patches or reserves are marked out after cruising, remove the area of the leave patches or reserves, but use the plots located within the leave patches or reserves in the compilation.

Please note the following:

1. Summaries must be given for the entire application area.

2. Where more than one block exists, individual block summaries must be supplied.

3. Each block must be labelled as mature or immature for compilation purposes and to establish the utilization level for residue and waste purposes.

4. Average Line is the default compilation method.

   The block method must be used for the following types of compilations:

   a. where percent reduction is done by block, and

   b. cutting authorities where immature and mature block combinations occur.

   Use of the block method for other types of compilations requires approval by the Regional Manager, or their designate.

Schedule "A" (Timber Licence) and "B" (Crown) Land Splits

Schedule "A" and "B" lands in a Tree Farm Licence (TFL) can be cruised, compiled and appraised together, but a separate summary page is required for both.

Schedule "A" and "B" lands not in a TFL can be cruised together, but must have separate compilations because they must be appraised separately.

Rights-of-Way Within the Block

Right-of-way(s) within the cut blocks must be cruised and compiled unless the right-of-way volume has been removed.

The area and net volume of right-of-way(s) within the block must be included for appraisal purposes unless the right-of-way(s) volume has been removed under a different timber mark, or assigned a different timber mark.

All plots established within the external boundaries of the block are to be used in the compilation. When the right-of-way volume inside the block has been removed under a different mark, remove the area of the right-of-way, but use the plots in the compilation.

For Small Business Forest Enterprise Program timber sales, right-of-way(s) area and net volume will only be included in the compilation and for appraisal purposes when the licensee will harvest the right(s)-of-way.

Cruise Compilation Reports

The following is a summary of all reports which are currently produced, whether each report is mandatory, mandatory under certain circumstances or optional, and whether a hard copy and/or electronic copy of the report is required.

No. 001 Edit Report	a.	Edit Report (Data Listing) of cruise data. Mandatory – electronic.
	b.	Scattergram of Card Type 2's and Card Type 3's. Mandatory if height curves are used – electronic.
No. 3 – Calculate Height/Diameter Equations Report	a.	Regression coefficients of different height curves. Mandatory, if height curves are used – electronic.
	b.	Original scattergram and regression coefficients. Mandatory, if height curves are used and suggested curve is overridden – electronic. A written explanation with the computer report of actual keyed values is required.
No. 004 Create Heights Report	a.	Edit Check Listing Mandatory, only if height curves are used - electronic.
	b.	Double Sampling Ratios Mandatory, only if Double Sampling is used - electronic.
No. 5 Cruise Statistics Report		Mandatory - electronic.
No. 6 Extended Stand and Stock Table Report		Optional - electronic (may be required by the district in selective logging SBFEP timber sales).
No. 7 Stand and Stock Tables Report		Optional - electronic.
No. 009 Summary Page Report		Mandatory - hard copy and electronic.

No. 011 Plot Summary Report		Mandatory - electronic.
No. 012 Plot Summary by Maturity Report		Mandatory, if Coast Compilation - electronic.
No. 015 Harvesting Method Summary Report	a.	Harvesting Method and Appraisal Summaries (slope, damage, and % immature). Mandatory - hard copy and electronic.
	b.	Second and Old Growth Summaries. Mandatory, if Coast Compilation - hard copy and electronic.

If a percent reduction is being applied, the following is required:

1. The original harvest method summary report (015 a. and b.) before the percent reduction was applied.

2. All mandatory reports after the percent reduction was applied.

3. The input values for the percent reduction.

9.1.8.2 Form and Content of Cruise Reports

Upon request from the district, the licensee must supply the original cruise cards along with the electronic data disk mentioned in Section 9.1.9.1.

1. Information as indicated in Section 9.1.9.2 must be included.

2. Historic information as indicated below must be given:

   a. name of company or individual(s) performing the cruise,

   b. date(s) of cruise, and

   c. name of company that computed the cruise data.

3. Cruise map(s) must accompany the report and comply with Ministry of Forests cartographic standards, as documented in the Ministry of Forests, *Visual Identifier Standards Guide*. The map should be produced at a scale of 1:5 000 and include the following:

   a. tenure,

   b. forest region and district,

   c. scale,

   d. timber supply area,

   e. north arrow,

   f. blocks must be identified by their block number and whether they are Mature or Immature,

   g. tie-points,

   h. timber type lines and timber type descriptions,

   i. area by type, block and cutting authority area,

   j. plot location, plot numbers and types,

   k. cutting boundaries, and

   l. any other features of significance with respect to the sale of Crown timber such as areas of blowdown, fire damage, insect or disease infestations, fish-bearing streams and special management zones.

9.1.9 Re-compilations

All re-compilations must be done using the current (latest) version of a compilation program that has been approved by the Ministry of Forests.

9.1.10 Cruising Damaged Stands and Exceptional Circumstances

Cruising standards and techniques must be indicated on the cruise plan and may be amended by the District Manager.

9.1.11 Sampling in Unsafe Conditions

Unsafe working conditions can arise in cruising of salvage logging areas, and in certain other situations.

For unsafe working conditions, it is recommended that the cruise plots in the unsafe area be dropped and cruise information from the fringes of the unsafe area, or similar timber in the cutting authority area, or similar timber in the vicinity of the cutting authority area be used for appraisal purposes.

This page is intentionally left blank.

Tables

Table 1 Correction Table for Chaining Short Horizontal Distances

% Slope	Chainage Plus Slope Allowance									
				Horizontal Distance in Metres						
	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
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

Table 2 Plot Radii Slope Allowance

Table 2 - Plot Radius - Page T-3									
% 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
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

Table 2 - Plot Radius - Page T-3									
% 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
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

Radii for plot sizes smaller than those given in the table can be measured by holding the tape horizontally.

Table 3 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

Stump and Breast Height Diameter Tables for the British Columbia Merchantable Tree Species (Tables 4 to 8)[1]

The following tables (Tables 4 to 8) 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 metric volume equations.

The regression equations are of the following form:

$$DBH = DSIB + b_0\ DSIB\ (2.3 - SH) + b_1\ DSIB\ \ln\left[(SH + 1.0) / 2.3\right]$$

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 in Table 4. A map of the British Columbia forest inventory zones is shown in Appendix 4.

[1] A. Kozak, Faculty of Forestry, University of British Columbia and S. A. Omule, Research Branch, Ministry of Forests, February 1989.

Table 4 Constants for Species and Zones

Species	Age*	Zone[b]	No. of Observations	B_0	B_1	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
Redcedar	MAT.	ABC	1988	0.032043	0.585026	5.70
Redcedar	IMM.	ABC	1297	0.055116	0.706639	2.98
Redcedar	ALL	D-L	4669	0.059052	0.655006	4.16
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
Spruce	MAT.	ABC	1197	0.021123	0.530663	8.23
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
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
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).

Table 5 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 of 0.3 m).

Table 6 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).

Table 7 Butt Taper - All Ages - FIZ K and L - Interior

(Table shows diameter at stump height of 0.3 m)

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

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 8 Butt Taper - Immature - FIZ A, B and C - Coast

(Table shows diameter at stump height of 0.3 m)

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 9 to 16

Tables 9 to 16 do not exist at this time.

Table 17 Cruise Compilation Loss Factor Table

It is the Policy of Revenue Branch to utilize, for Appraisal, the loss factor tables listed in this manual. This list is the reference for Cruise Compilation and the auditing of Cruise Compilations.

1 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).

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.*

Vancouver Region

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. 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. All others FIZ "B"

TFL 39 Blocks 1, 2, 4, 5	Company decay and waste factors for mature. All other maturity classes are FIZ "B". Mature is 121 years +.
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. All others FIZ "C"
TFL 44	Company decay and waste factors and FIZ "B" breakage factors for mature. All other maturity classes are FIZ "B". Mature is 121 +.
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 (Queen Charlottes) - All FIZ "A".
TFL 54	Nootka locals for hemlock. All others FIZ "B".

Prince Rupert Region

TFL 1	Skeena (Terrace) - locals for Balsam. All others FIZ "A" or "J".
TFL 41	Skeena (Terrace) - locals for Hemlock and Balsam. All others FIZ "A".
Old TFL 51	(Now Cranberry TSA).
Skeena (Kitwanga)	locals for Hemlock and Balsam. All others FIZ "J".

Kamloops Region

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, Cedar and Hemlock. All others FIZ "D". Area #2 (old TFL 16) - Kamloops local for Fir. All others FIZ "D".

Prince George Region

TFL 30	Monkman locals for Cedar, Hemlock, Balsam, and Spruce. All others FIZ "I"
TFL 42	Stuart locals for Balsam and Spruce. All others FIZ "I"
TFL 48	All FIZ "L"
TFL 53	Naver locals for Hemlock, Balsam and Spruce. All others FIZ "H, I"

Nelson Region

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".

Cariboo Region

TFL 5	All FIZ "H".
TFL 52	Cottonwood locals for Cedar, Hemlock, Balsam and Spruce. All others FIZ "I".

2 Other Tenures

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 only authorized exceptions are:

1. 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.

2. 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.

3. The use of FIZ C and the Vancouver locals for the crown portion of the E & N lands in the South Island Forest District.

4. The Greater Vancouver Water District uses the Vancouver PSYU locals for hemlock and balsam.

5. 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.

All references are to mature factors unless otherwise indicated.

4 Tabular Listing Of Table Numbers

The following listing is provided for easy reference and compilation edit checks.

	Mature						OI.	MAT.	
PSYU/ SSA / TSA /TFL	**#**	**F**	**C**	**H**	**B**	**S**	**PL**	**PL**	**FIZ**
Public Sustained Yield Units									
Adams	01		95	87					G
Alsek	02								K
Arrowhead	03		93	89					G
Ashnola	04	98							D
Babine	05				93	99			I
Barriere	06		95	87					G
Barton Hill	07	98							D
Bell Irving	08			91					J
Big Bar	09	99							D
Big Valley	10				92	98			I
Blueberry	11								L
Botanie	12	98							D
Boundary	13								A K
Bowron	14		96	90	92	98			I
Burns Lake	15								H I
Canoe	16		92	86					G
Carp	17				91	97			I
Chilko	18						98		B H
Cottonwood	19		98	90	92	98			I

	Mature						OI.	MAT.	
PSYU/ SSA / TSA /TFL	**#**	**F**	**C**	**H**	**B**	**S**	**PL**	**PL**	**FIZ**
Public Sustained Yield Units									
Cranbrook	20								F
Creston	21								E
Crooked River	22				91	97			I
Dean	23								A
Dease - Proposed	25								K
Dewdney: Chilliwack Portion Yale Portion Harrison Portion	26 - 1 - 2 - 3			 99 95 99	 99 98 99				 C D C C
Eagle	27		94	85					G
Edgewood	28								E G
Fernie	29								F
Finlay	30					96			I K
Fontas - Proposed	31								L
Fort Nelson - Proposed	32								L
Granby	33								E
Hecate	34								A J
Kamloops	35	98							D G
Ketchika - Proposed	36								K
Kettle	37					95		97	E
Kinbasket	38		92	86					G

	Mature						Ol.	MAT.	
PSYU/ SSA / TSA /TFL	**#**	**F**	**C**	**H**	**B**	**S**	**PL**	**PL**	**FIZ**
Public Sustained Yield Units - cont'd									
Kingcome	39		99	98					A B
Klappan - Proposed	40								K
Kluskus	41								H
Kotcho - Proposed	42								L
Lac La Hache	43	99	98						D G H
Lardeau	44		91	84					G
Liard - Proposed	45								L
Longworth	46		96	90	92	98			G
Moberly	47								L
Monkman	48		96	90	92	98			I
Morice	49		13	12	93	99			H J
Nakusp	50		91	84					G
Narcosli - P.H.A. #5	51								H
Naver	52			90	92	98			H I
Nechako - P.H.A #1	53								H I
Nehalliston - P.H.A. #2	54								G
Nicola	55	98							D
Niskonlith - P.H.A. #2	56								D G
Nootka	57			96					B
North Thompson	58		97	88					G
Okanagan	59	98	94	85					D E

	Mature						Ol.	MAT.	
PSYU/ SSA / TSA /TFL	**#**	**F**	**C**	**H**	**B**	**S**	**PL**	**PL**	**FIZ**
Public Sustained Yield Units - cont'd									
Ootsa	60								H
Parsnip	61				91	97			I
Peace - P.H.A. #7	62								L
Purden	63		96	90	92	98			I
Quadra	64								B
Queen Charlotte	65								A
Quesnel Lake	66		98	90	92	98			D G H
Raft	67		97	88					G
Rivers Inlet	68								A
Robson	69		96	90	92	98			G
Salmo	70								E G
Salmon Arm	71		94	85					G
Shuswap	72		95	87					G
Sikanni - Proposed	73								L
Similkameen	74	98							D
Skeena	75								
Terrace Portion	-1			94	96				A J
Kitwanga Portion	-2			93	95				J
Hazelton Portion	-3			92	94				J
Slocan	76		91	84					G
Smithers	77		13	12	93	99			I J

	Mature						Ol.	MAT.	
PSYU/ SSA / TSA /TFL	**#**	**F**	**C**	**H**	**B**	**S**	**PL**	**PL**	**FIZ**
Public Sustained Yield Units - cont'd									
Soo	78			97	97				C
Spallumcheen	79		94	85					G
Stikine	80			91					K
Stuart Lake	81				91	97			I
Stum	82	99					98		H
Takla	83				91	97			I
Taku - Proposed	84								K
Upper Kootenay	85								F
Vancouver	86			99	99				C
Wapiti	87								L
Westlake	88				92	98			H I
Williams Lake	89	99							D H
Willow River	90			90	92	98			I
Windermere	91								F
Yalakom	92	99							D
Special Sale Area									
Fort St James	S02				91	97			I
Prince George - Quesnel	S04	99			92	98			H I G
Tree Farm Licence									
TFL 1 - Terrace	01				96				A J
TFL 3	03		91	84					G

	Mature						OI.	MAT.	
PSYU/ SSA / TSA /TFL	**#**	**F**	**C**	**H**	**B**	**S**	**PL**	**PL**	**FIZ**
Public Sustained Yield Units - cont'd									
TFL 5	05								H
TFL 6	06		99	98					B
TFL 8	08					95		97	E
TFL 10	10								B
TFL 13	13								F
TFL 14	14		91	84					G
TFL 15	15								D
TFL 18	18		97	88					G
TFL 19	19			96					B
TFL 23	23		91	84					G
TFL 25	25								
Dean PSYU	-1		99	98					A
Quadra PSYU	-2		99	98					B
South Island	-3								B
Queen Charlotte Is. (Old TFL 24)	-4								A
TFL 26	26			99	99				C
TFL 30	30		96	90	92	98			I
TFL 33	33		94	85					G
TFL 35	35								D G
TFL 37	37		99	98	Kingcome Locals				B

	Mature						OI.	MAT.	
PSYU/ SSA / TSA /TFL	**#**	**F**	**C**	**H**	**B**	**S**	**PL**	**PL**	**FIZ**
Tree Farm Licence - cont'd									
TFL 37	37 Company breakage factors for all maturity classes								B
TFL 38	38			97	97				B
TFL 39 Blks 1,2,4,5	39 Company DW & FIZ "B" breakage factors for mature.								B
Blks 3,6 & 7	39 Company DW & FIZ "A" breakage factors for mature.								A
TFL 41	41			94	96				A
TFL 42	42				91	97			I
TFL 43	43								
Northern Blocks	-1		99	98					A
Fraser Block	-2			99	99				C
Homathko Block	-3								B
TFL44	44 Company DW & FIZ "B" breakage factors for mature.								B
TFL 45	45								
old TFL 17	-1		99	98					A
old TFL 36	-2								B
TFL 46	46			96					B
TFL 47	47								
majority	-1		99	98					B
4 small islands	-2		99	98					A
Queen Charlottes	-3								A

	Mature						OI.	MAT.	
PSYU/ SSA / TSA /TFL	**#**	**F**	**C**	**H**	**B**	**S**	**PL**	**PL**	**FIZ**
Tree Farm Licence - cont'd									
TFL 48	48								L
TFL 49	49								
old TFL 9 & 32	-1	98	94	85					D
old TFL 16	-2	98							D
TFL 51 - Kitwanga	51	93	95						J
TFL 52	52		98	90	92	98			I
TFL 53	53			90	92	98			H, I
TFL 54	54			96					B
TFL 55	55		93	89					G
TFL 56	56		93	89					G
Watersheds									
G. Van. W. D.	01			99	99				C

Parks	#	FIZ	Parks	#	FIZ
Apex Mountain	01	D	Manning	22	D
Birkenhead Lake	02	C	Monashee	23	G
Bowron Lake	03	G	Mount Assiniboine	24	F
Boya Lake	04	K	Mount Edziza	25	J
Cape Scott	05	A	Mount Revelstoke	26	G
Cathedral	06	D	Mount Robson	27	G
Champion Lakes	07	E	Mount Seymour	28	C
Crooked River	08	I	Muncho Lake	29	L
Cultus Lake	09	C	Naikoon	30	A
Darke Lake	10	D	Pacific Rim	31	B
Elk Falls	11	B	Sasquatch	32	C
Eneas Lakes	12	D	Silver Star	33	D
Garibaldi	13	C	Skagit River	34	C D
Glacier	14	G	Stagleap	35	E
Golden Ears	15	C	Stone Mountain	37	L
Hamber	16	G	Strathcona	38	B
Kikomun Creek	17	F	Tweedsmuir	39	H
Kokanee Glacier	18	G	Wells Gray	40	G
Kootenay	19	G	White Pelican	41	H
Liard River Hot Springs	20	L	Yoho	42	G
Little Qualicum Falls	21	B	Other - not specified	99	

Tree Class Modification Of Loss Factor Tables

Tree Classes for Determination of Decay, Waste and Breakage Factors

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
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	OI
8	YI	M	YI	8	OI	M	OI
9	OI	M	OI	9	OI	M	OI
10	OI	M	OI	10	OI	M	OI
11	OI	M	OI	11	OI	M	OI
12	OI	M	OI	12	OI	M	OI
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	OI	3	YI	M	YI
4	OI	M	OI	4	YI	M	YI
5	M	M	OI	5	OI	M	OI
6	M	M	OI	6	OI	M	OI
7	M	M	OI	7	OI	M	OI
8	M	M	OI	8	OI	M	OI
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

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	ON
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 Table 17 for Local Loss Factor Table Numbers for a specific PSYU/SSA/TSA/TFL.

Figure T.1 Forest Inventory Zone Series Numbers.

Table 18 Risk Group Ratings by Pathological Indicators

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.	Bowron, Longworth, Monkman, Purden, Robson PSYU's and TFL30
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	

Species	Location	Age Group	Age Range	Risk Group 1	Risk Group 2	Rick Group 3
Fd	All FIZ	Immature	1-80	Any indicator		
	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

Species	Location	Age Group	Age Range	Risk Group 1	Risk Group 2	Risk Group 3
B	All FIZ	Immature	1-80	Any indicator		
		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
	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

Species	Location	Age Group	Age Range	Risk Group 1	Risk Group 2	Risk Group 3
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 and Pa	All FIZ	Immature	1 - 80	Any indicator		
		Old Immature	81 - 120	No indicators	Any indicator	
		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	

Species	Location	Age Group	Age Range	Risk Group 1	Risk Group 2	Risk Group 3
S	All FIZ	Immature	1 - 80	Any indicator		
	FIZ A, B, C	Old Immature	81 - 120	Any indicator		
	FIZ D to L	Old Immature	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	
		Mature	121 +	No indicators	Any other than conk or blind conk	Conk or blind conk

Species	Location	Age Group	Age Range	Risk Group 1	Risk Group 2	Risk Group 3
Ac	FIZ A to J	Immature	1-20	Any indicator		
	FIZ K, L	Immature	21-40	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		

Species	Location	Age Group	Age Range	Risk Group 1	Risk Group 2	Risk Group 3
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	
	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 - 80	Any indicator		
		Old Immature	81 - 120	Any indicator		
		Mature	121 +	No indicators	Any	

Species	Location	Age Group	Age Range	Risk Group 1	Risk Group 2	Risk Group 3
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	

Table 19 Sound Wood Factors for Saprot

	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 estimated diameter inside bark at the top of first third of tree.

Tree Volumes by Third

1st Third 50% = 1/2
2nd Third 33% = 1/3
3rd Third 17% = 1/6

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 = $100 - \frac{Volume\ of\ Rot}{Volume\ of\ Tree\ or\ Log}$

Figure T.2 Sound wood factors for saprot.

Appendices

A.1 Site Index and Age Correction Tables

Refer to Appendix 10 for the current site index curves for use in appraisal cruising.

A.1.1 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 (FS 205).
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.

Table A.1 Age Class Limits

Age and Height Limits for Age in Tens					
Age	**Limits**	**Age**	**Limits**	**Age**	**Limits**
10	1-10	100	91-100	190	181-190
20	11-20	110	101-110	200	191-200
30	21-30	120	111-120	210	201-210
40	31-40	130	121-130	220	211-220
50	41-50	140	131-140	230	221-230
60	51-60	150	141-150	240	231-240
70	61-70	160	151-160	250	241-250
80	71-80	170	161-170	260	251-260
90	81-90	180	171-180	270	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

A.2 Magnetic Declination and Annual Change for 2002

Latitude and Longitude for selected points for Magnetic Declination determination and Annual Change					
Region	Location	Latitude	Longitude	Declination	Annual
		in degrees, minutes		2002	Change
Vancouver	Chilliwack	49,10	121,57	18 59 E	6.2 W
Vancouver	Haney	49,13	122,36	19 09 E	6.2 W
Vancouver	Abbotsford	49,03	122,17	19 01 E	6.2 W
Vancouver	Vancouver	49,15	123,07	19 17 E	6.3 W
Vancouver	Squamish	49,45	123,07	19 28 E	6.5 W
Vancouver	Powell River	49,51	124,32	19 48 E	6.5 W
Vancouver	Campbell River	50,01	125,20	20 01 E	6.6 W
Vancouver	Port McNeill	50,35	127,06	20 31 E	6.9 W
Vancouver	Gold River	49,41	126,07	20 01 E	6.5 W
Vancouver	Nanaimo	49,10	123,56	19 25 E	6.2 W
Vancouver	Tofino	49,07	125,53	19 45 E	6.3 W
Vancouver	Duncan	48,47	123,42	19 13 E	6.1 W
Vancouver	Port Alberni	49,14	124,58	19 39 E	6.3 W
Vancouver	Sayward	50,23	125,58	20 16 E	6.8 W
Vancouver	Holberg	50,39	128,01	20 39 E	6.9 W
Vancouver	Port Renfrew	48,33	124,25	19 17 E	6.0 W
Vancouver	Massett	54,01	132,06	22 22 E	8.4 W
Vancouver	Queen Charlotte City	53,15	128,31	21 51 E	8.1 W
Vancouver	Klemtu	52,35	128,31	21 32 E	7.8 W
Vancouver	Hagensborg	52,23	126,33	21 13 E	7.7 W
Vancouver	Security Bay	51,22	127,28	20 53 E	7.2 W
Vancouver	Alison Sound	51,15	127,00	20 47 E	7.2 W
Vancouver	Pemberton	50,19	122,48	19 38 E	6.7 W
Vancouver	Boston Bar	49,52	121,26	19 09 E	6.5 W
Vancouver	Stuart Island	50,22	125,08	20 07 E	6.8 W
Vancouver	Sewell Inlet	52,53	131,59	21 49 E	7.9 W
Vancouver	Franklin River	49,00	124,45	19 31 E	6.2 W
Vancouver	Rivers Inlet	51,41	127,15	21 00 E	7.4 W
Prince Rupert	Burns Lake	54,21	126,31	22 11 E	8.7 W
Prince Rupert	Houston	54,27	126,37	22 15 E	8.8 W
Prince Rupert	Smithers	54,47	127,11	22 30 E	9.0 W
Prince Rupert	Hazelton	55,13	127,35	22 47 E	9.2 W
Prince Rupert	Terrace	54,31	128,36	22 29 E	8.7 W
Prince Rupert	Prince Rupert	54,18	130,20	22 29 E	8.6 W
Prince Rupert	Stewart	55,57	130,00	23 20 E	9.4 W
Prince Rupert	Lower Post	55,55	128,32	23 16 E	9.5 W
Prince Rupert	Dease Lake	58,27	130,02	24 49 E	10.9 W
Prince Rupert	Atlin	59,35	133,41	25 08 E	11.1 W
Kamloops	Chase	50,49	119,41	19 10 E	7.0 W
Kamloops	Lillooet	50,40	121,56	19 36 E	6.9 W
Kamloops	Merritt	50,07	120,47	19 07 E	6.6 W
Kamloops	Princeton	49,28	120,30	18 47 E	6.3 W
Kamloops	Penticton	49,30	119,35	18 34 E	6.3 W
Kamloops	Vernon	50,16	119,16	18 49 E	6.7 W
Kamloops	Salmon Arm	50,42	119,16	19 00 E	6.9 W
Kamloops	Kamloops	50,40	120,19	19 15 E	6.9 W
Kamloops	Clearwater	51,39	120,02	19 37 E	7.4 W

Latitude and Longitude for selected points for Magnetic Declination determination and Annual Change					
Region	Location	Latitude	Longitude	Declination 2002	Annual Change
		in degrees, minutes			
Prince George	Valemount	52,50	119,15	19 58 E	8.0 W
Prince George	McBride	53,18	120,10	20 26 E	8.3 W
Prince George	Hixon	53,52	122,35	21 16 E	8.6 W
Prince George	Prince George	53,55	122,45	21 19 E	8.6 W
Prince George	Bear Lake (Hart Hwy)	54,30	122,40	21 37 E	9.0 W
Prince George	Vanderhoof	54,01	124,01	21 37 E	8.6 W
Prince George	Kenny Dam	53,36	124,58	21 33 E	8.4 W
Prince George	Ft. St. James	54,26	124,15	22 53 E	8.9 W
Prince George	Takla Landing	55,29	125,58	22 45 E	9.4 W
Prince George	Manson Creek	55,40	124,29	22 38 E	9.6 W
Prince George	Aiken Lake	56,26	125,45	23 19 E	10.0 W
Prince George	Bear Lake (Driftwood)	56,12	126,51	23 18 E	9.8 W
Prince George	Mackenzie	55,18	123,10	22 10 E	9.4 W
Prince George	Fort Ware	57,26	125,38	23 58 E	10.7 W
Prince George	Ingenika Point	56,47	124,52	23 25 E	10.3 W
Prince George	Ingenika Mine	56,42	125,11	23 24 E	10.2 W
Prince George	Dawson Creek	55,46	120,14	21 43 E	9.8 W
Prince George	Chetwynd	55,42	121,38	22 03 E	9.7 W
Prince George	Tumbler Ridge	55,07	120,55	21 33 E	9.4 W
Prince George	Fort St. John	56,15	120,51	22 11 E	10.1 W
Prince George	Beaton River (settl.)	57,23	121,25	23 04 E	10.9 W
Prince George	Pink Mountain	57,02	122,31	23 07 E	10.6 W
Prince George	Fort Nelson	58,48	122,43	24 26 E	12.0 W
Prince George	Muncho Lake	58,59	125,47	25 05 E	11.8 W
Prince George	Nelson Forks	59,30	124,01	25 14 E	12.4 W
Nelson	Beaverdell	49,26	119,05	18 25 E	6.3 W
Nelson	Castlegar	49,19	117,39	17 59 E	6.2 W
Nelson	Cranbrook	49,30	115,46	17 27 E	6.3 W
Nelson	Creston	49,06	116,31	17 34 E	6.1 W
Nelson	Flathead	49,22	114,37	16 58 E	6.2 W
Nelson	Golden	51,18	116,58	18 36 E	7.2 W
Nelson	Grand Forks	49,02	118,27	18 06 E	6.1 W
Nelson	Invermere	50,31	116,02	17 57 E	6.8 W
Nelson	Kalso	49,55	116,54	18 00 E	6.5 W
Nelson	Mica Creek	52,05	118,34	19 26 E	7.6 W
Nelson	Nakusp	50,14	117,48	18 24 E	6.7 W
Nelson	Nelson	49,29	117,17	17 57 E	6.3 W
Nelson	Revelstoke	50,59	118,12	18 51 E	7.1 W
Nelson	Sparwood	49,43	114,53	17 12 E	6.4 W
Cariboo	Quesnel townsite	52,57	122,30	20 47 E	8.1 W
Cariboo	Farwell Canyon	51,49	122,34	20 15 E	7.5 W
Cariboo	mid - Horsefly Lake	52,24	121,02	20 12 E	7.8 W
Cariboo	100 Mile House Townsite	51,39	121,17	19 54 E	7.4 W
Cariboo	Chilanko Forks Settlement	52,07	124,04	20 41 E	7.6 W

Internet Site:

http://www.geolab.nrcan.gc.ca/geomag/e_cgrf.html

A.3 Forest Inventory Zones

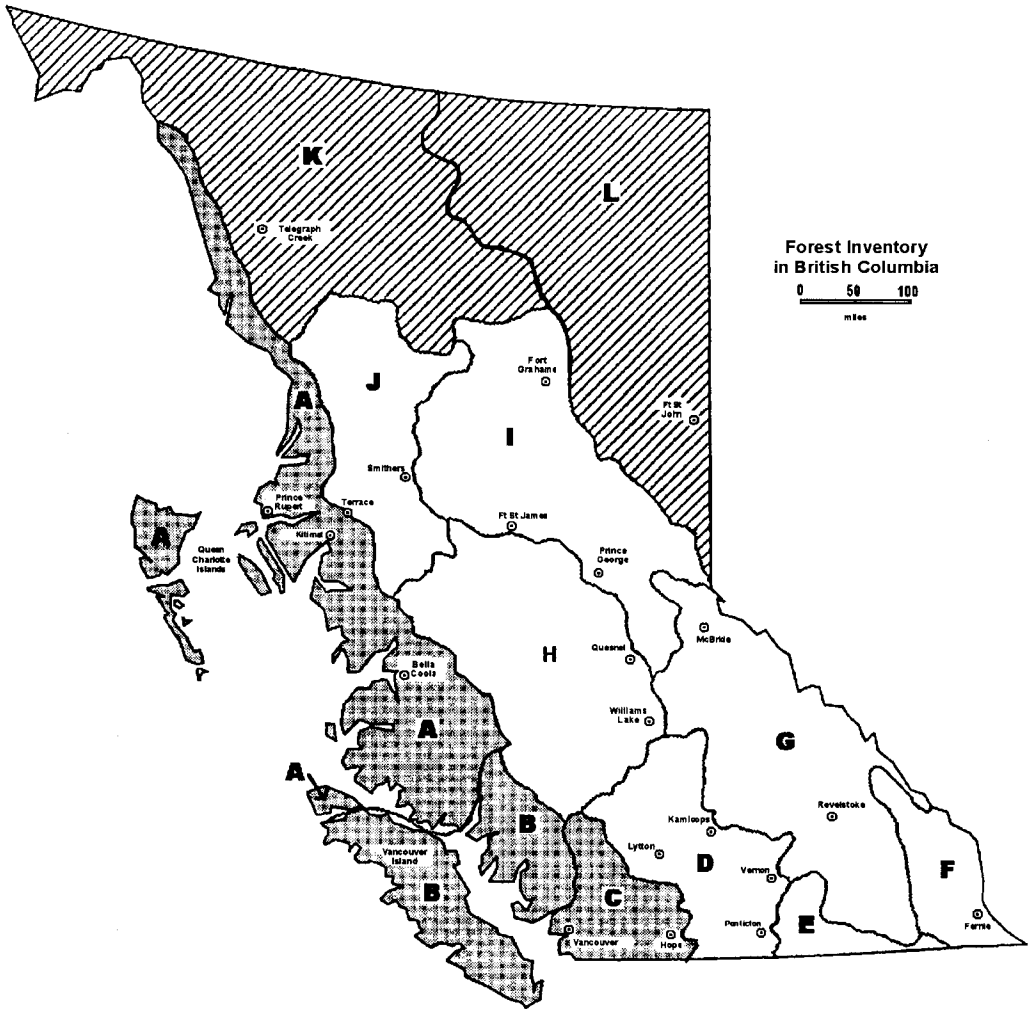


Figure A.1 Forest inventory zones.

Refer to large scale maps from Ministry of Sustainable Resources Management to confirm Forest Inventory Zone Zonal and Local geographic locations.

A.3.1 List of Regions and Districts

Regions and Districts	Location
Cariboo Forest Region (RCA) Chilcotin Forest District (DCH) Horsefly Forest District (DHO) Quesnel Forest District (DQU) Williams Lake Forest District (DWL) 100 Mile House Forest District (DMH)	**Williams Lake** Alexis Creek Horsefly Quesnel Williams Lake 100 Mile House
Kamloops Forest Region (RKA) Clearwater Forest District (DCL) Kamloops Forest District (DKA) Lillooet Forest District (DLI) Merritt Forest District (DME) Penticton Forest District (DPE) Salmon Arm Forest District (DSA) Vernon Forest District (DVE)	**Kamloops** Clearwater Kamloops Lillooet Merritt Penticton Salmon Arm Vernon
Nelson Forest Region (RNE) Arrow Forest District (DAR) Boundary Forest District (DBO) Columbia Forest District (DCO) Cranbrook Forest District (DCB) Invermere Forest District (DIN) Kootenay Lake Forest District (DKL)	**Nelson** Castlegar Grand Forks Revelstoke, Golden Cranbrook Invermere Nelson
Prince George Forest Region (RPG) Dawson Creek Forest District (DDC) Fort Nelson Forest District (DFN) Fort St. James Forest District (DJA) Fort St. John Forest District (DJO) Mackenzie Forest District (DMK) Prince George Forest District (DPG) Robson Valley Forest District (DRV) Vanderhoof Forest District (DVA)	**Prince George** Dawson Creek Fort Nelson Fort St. James Fort St. John Mackenzie Prince George McBride Vanderhoof
Prince Rupert Forest Region (RPR) Bulkley/Cassiar Forest District (DBC) Kalum Forest District (DKM) Kispiox Forest District (DKI) Lakes Forest District (DLA) Morice Forest District (DMO) North Coast Forest District (DNC)	**Smithers** Smithers, Dease Lake Terrace Hazelton Burns Lake Houston Prince Rupert
Vancouver Forest Region (RVA) Campbell River Forest District (DCR) Chilliwack Forest District (DCK) Mid Coast Forest District (DMC) Port McNeill Forest District (DPM) Queen Charlotte Islands Forest District (DQC) South Island Forest District (DSI) Squamish Forest District (DSQ) Sunshine Coast Forest District (DSC)	**Nanaimo** Campbell River Rosedale Hagensborg Port McNeill Queen Charlotte Islands Port Alberni, Duncan Squamish Powell River

A.4 Pathological Classification of Trees

Within mature stands, or stands approaching maturity, (i.e., older immature stands) individual trees contain varying amounts of decay. Thus, 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. Recent pathological studies have shown that two broad classes of living trees are clearly recognizable in stands of this character. As the classification of trees is made on the basis of the presence or absence of external signs of decay, it is anticipated that each class of tree so defined will represent a different potential loss factor within the stand.

A.4.1 Class of Trees

All living trees measured on each sample plot will be classed as:

- residual, or
- suspect.

A.4.1.1 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.

1. Conks.
2. Blind conks (swollen knots).
3. Scars.
4. Fork or pronounced crook.
5. Frost crack.
6. Trunk infections or mistletoe.
7. Rotten branches.
8. Dead or broken top.

"Suspect" classifications will be made on the basis of the above signs of decay only; no other abnormalities are to be used.

See Table 18 for Pathological Occurrence by Species and Forest Inventory Zones.

A.4.1.2 Residual Trees

Residual trees are living trees which bear none of the external indications of decay listed above.

It must be pointed out that these signs and defects are expressive of decay in the stand, rather than in individual trees. 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.



1 Conk



2 Trunk Mistletoe



3 Frost Crack



4 Fork



5 Scar



6 Dead or Broken Top

Figure A.2 Residual trees.

A.4.2 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 Section A.4.1.1. These indicators are to be called on all live and dead potential (except dead potential in the Interior) trees from the base of the tree to the **a 10 cm top** including secondary leaders which contain a merchantable log (3 m long to a 10 cm top). Refer to Figure A.9 for a diagram. Do not record pathological indicators above 10 cm diameter. Not shown are large rotten branches and blind conks.

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 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 except do not record sap rot fungi as conk.

A.4.2.1 Conks

Conks are the fruiting bodies (sporophores) of decay fungi and are definite and reliable indicators of decay. Conks 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. For current cruising purposes, only specific root, butt and heart rot conks are suspect indicators. Slash conks are not suspect indicators (see Figure A.3 for a list of host species for selected decay fungi).

It is important to be able to differentiate between the fruiting of slash fungi that occur on dead branches and wounds of living trees and those that occur on the roots, live branches and trunks of living trees. It is necessary to be able to recognize the conks of the major heart rotting fungi found on living conifers and hardwoods. On conifers, the main conks to recognize are, *Echinodontium tinctorium, Phellinus (Fomes) pini, Phaeolus (Polyporous) schweinitzii and Fomitopsis (Fomes) pinicolii.* On hardwoods, the main conks are Phellinus igniarius and Phellinus tremulae. See the following host list for major and some minor heartwood decay species.

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 is the mushroom-shaped to bracket-like sporophore of *P. schweinitzii* that is annual but may persist for more than two years. Before calling conks on living branches in the upper crown, there must be fruiting bodies of the heart rot fungus evident in the stand. Slash conks that occur on dead wood of living trees can be both annual (small, thin, leathery) and perennials, are often more numerous and occur anywhere on the tree. The slash conks that occur on old exposed wounds are not allowed as suspect indicators. An exception is the conk of *F. pinicola*, which is common on dead trees but may also occur on large, old wounds as studies have found its occurrence indicates significant decay. However, *F. pinicola* that occurs on dead branches is not a suspect indicator.

Conks vary in size and shape and therefore are hard to spot, particularly when they are just developing or occur on the upper trunk. Conks of *E. tinctorium* and *Phellinus pini*, frequently appear as a small hoof-like or shelf-like structure on the underside of dead branch stubs on the middle 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.

Conks of Phaeolus schweinitzii

P. schweinitzii is the cause of brown cubical root and butt rot of most conifers but 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 conk is mid-way between:

1. Two living susceptible trees only one tree is considered to be infected.
2. A highly susceptible species (e.g., Douglas-fir) and a less susceptible species (e.g., red cedar), the most susceptible species is considered to be infected.
3. 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.

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:

- call 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, and
- do not call small knots and knot indicators on any species.

Large holes left by fallen large rotten branches may not be blind conk suspect indicators.

Root and butt rots

Armillaria spp.

- *Abies amabilis*
- *A. grandis*
- *A. lasiocarpa*
- *Chamaecyparis lawsoniana*
- *Larix decidua*
- *L. leptolepis*
- *L. occidentalis*
- *Picea abies*
- *P. engelmannii*
- *P. glauca*
- *P. sitchensis*
- *Pinus contorta*
- *P. monticola*
- *P. muricata*
- *P. nigra*
- *P. pinaster*
- *P. ponderosa*
- *P. radiata*
- *P. resinosa*
- *P. sylvestris*
- *Pseudotsuga menziesii*
- *Taxus brevifolia*
- *Thuja plicata*
- *Tsuga heterophylla*
- *Alnus rubra*
- *Betula papyrifera*
- *Populus X canadensis*
- *P. nigra*
- *P. tremuloides*
- *P. trichocarpa*
- *Quercus garryana*
- *Salix* sp.

Heterobasidion annaosum

- *Abies amabilis*
- *A. grandis*
- *Picea glauca*
- *P. sitchensis*
- *Pseudotsuga menziesii*
- *Thuja plicata*
- *Tsuga heterophylla*
- *Acer macrophyllum*
- *Alnus rubra*

Phellinus weirii

- *Abies amabilis*
- *A. grandis*
- *A. lasiocarpa*
- *Chamaecyparis nootkatensis*
- *Larix occidentalis*
- *Picea sitchensis*
- *Pinus contorta*
- *P. monticola*
- *P. ponderosa*
- *Pseudotsuga menziesii*
- *Thuja plicata*
- *Tsuga heterophylla*

Phaeolus schweinitzii

- *Larix* spp.
- *Picea* spp.
- *Pinus* spp.
- *Pseudotsuga menziesii*
- *Thuja plicata*
- *Tsuga heterophylla*

Inonotus tomentosus

- *Abies amabilis*
- *Picea engelmannii*
- *P. glauca*
- *P. sitchensis*
- *Pinus contorta*
- *P. monticola*
- *Tsuga heterophylla*

Rhizina undulata

- *Larix occidentalis*
- *Picea engelmannii*
- *P. glauca*
- *P. sitchensis*
- *Pinus contorta*
- *Pseudotsuga menziesii*
- *Tsuga heterophylla*

Heart rots

Echinodontium tinctorium

- *Abies* spp.
- *Thuja plicata*
- *Tsuga heterophylla*
- *T. mertensiana*

Phellinus igniarius

- *Acer* spp.
- *Alnus* spp.
- *Arbutus menziesii*
- *Betula* spp.
- *Cornus nuttallii*
- *Malus* spp.
- *Populus* spp.
- *Salix lasiandra*

Phellinus pini

- *Abies* spp.
- *Larix occidentalis*
- *Picea* spp.
- *Pinus* spp.
- *Pseudotsuga menziesii*
- *Thuja plicata*
- *Tsuga heterophylla*
- *T. mertensiana*

Stereum sanguinolentum

- *Abies amabilis*
- *A. grandis*
- *A. lasiocarpa*
- *Larix occidentalis*
- *Picea glauca*
- *P. sitchensis*
- *Pinus contorta*
- *P. monticola*
- *P. ponderosa*
- *Pseudotsuga menziesii*
- *Thuja plicata*
- *Tsuga heterophylla*
- *T. mertensiana*

Figure A.6 Host list.

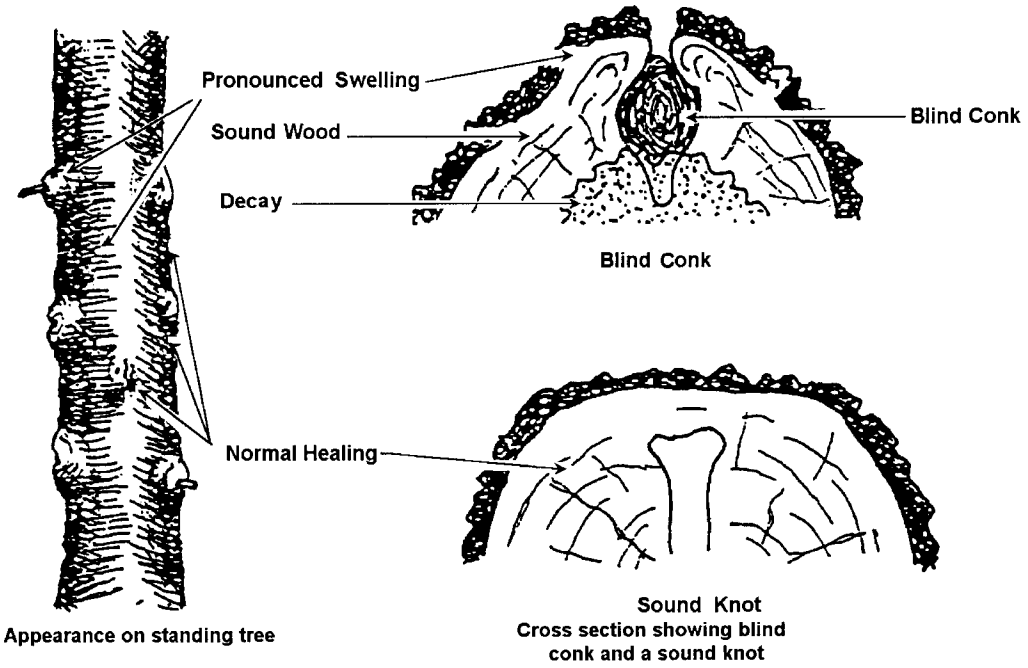


Figure A.7 Blind conk and sound knot.

A.4.2.3 Scars

A scar is an injury caused by external forces which has damaged the cambial layers of the tree and 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 called.

Open scars:

- open scars appear as areas of exposed wood of varying sizes and shapes (see Figure A.9), 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.

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 A.8).



Figure A.8 Closed scars.

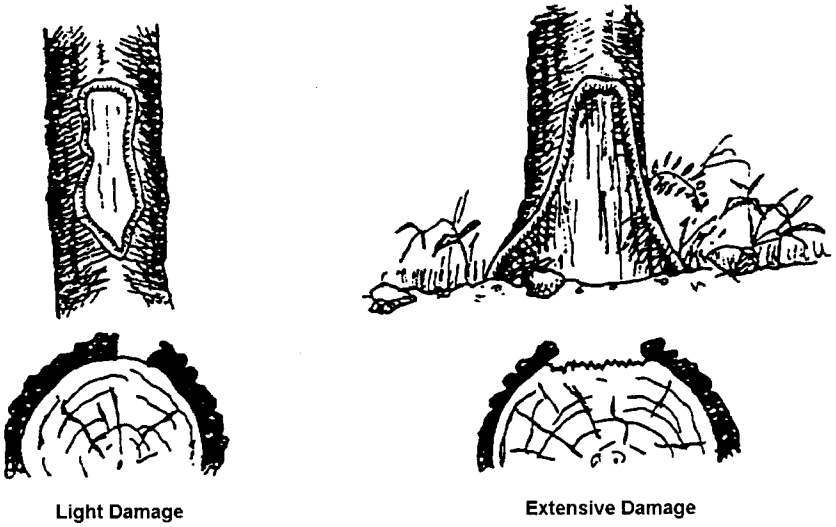


Figure A.9 Open scars.

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.

Causes of scars:

Scars may be caused by many external forces, such as:

1. Fire:

    - 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,

    - fire scars are usually confined to the base of the tree, and

    - 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 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.

2. Lightning:

    - 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 falling tree:

    - 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.

4. Machinery damage:

    - machinery can cause extensive damage, especially where selective logging has occurred, and
    - 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:

   - 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:

   - high winds or heavy snows may cause the above to break from the main stem creating exposed wood.

7. Falling rocks (see Figure A.11):

   - rock slides or individual rock movement can cause extensive damage to trees in their path,

   - scars caused by rocks are usually confined to the basal portion of the trunk on the uphill side, and

   - falling rocks may in some instances scar trees a considerable height above the ground, either due to snow levels at the time of injury or bouncing rocks on steeper slopes.

8. Animal/bird damage:

   - wood must be exposed,

   - bear, moose, deer etc. can cause damage by removing areas of bark and cambium from the trunks of many trees,

   - rodents and beavers also cause damage to trees by gnawing on areas of the trunk,

   - woodpecker holes of considerable size provide entrance for wood rotting fungi, however, sap sucker holes are *not* scars, and

   - care must be taken to exclude superficial damage caused by these agents.

9. Cankers caused by fungi (see Figure A.10):

   - only cankers with exposed weathered wood are called, and

   - 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.

The calling of scars as pathological indicators:

- a scar which extends from the first or second third of the tree into the upper 1/3 of the tree on which the top is dead will be classified as a scar "4" by convention, and
- scars occurring completely below the point of germination either on the lower trunk or root collar adjacent to the trunk will be classified as a scar.

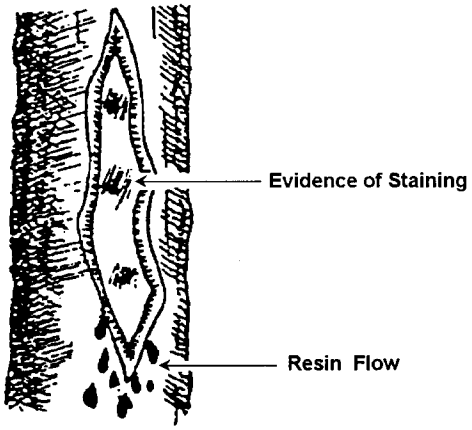


Figure A.10 Cankers caused by fungi.

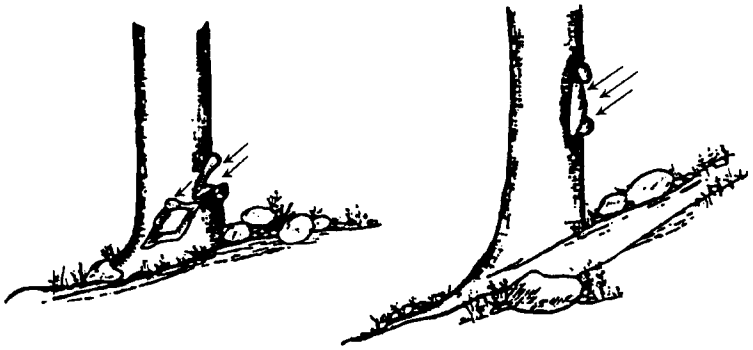


Figure A.11 Scars caused by rock slides and falling rocks.

Age of scar:

- a scar shall be not recent in origin. This is interpreted as the injury having not occurred within approximately the past five years,
- 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 called 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 or second third of the tree into the upper 1/3 of the tree on which the top is dead will be classified 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 classified as a scar, and
- do not record scars above utilization top diameter.

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 called.

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.

A.4.2.4 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 are to be called between the root collar and the minimum top diameter specified in the cutting authority document.

Forks are called 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 A.12, 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 (see Figure A.12, Example C and D).

Crooks are called if:

1. There is at least a 10 percent diameter change in the bole above and below the crook (see Figure A.12, 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 A.12, Example E). Offsets less than 50 percent must be sharply crooked over a short length of the bole.

Some forks and crooks are not called (see Figure A.27). 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 called 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 top diameter specified in the Timber Utilization Policy (Coast or Interior).

5. Flattening of the top of the tree caused by wind or natural outgrowth.

6. Candelabra branches in coniferous species.

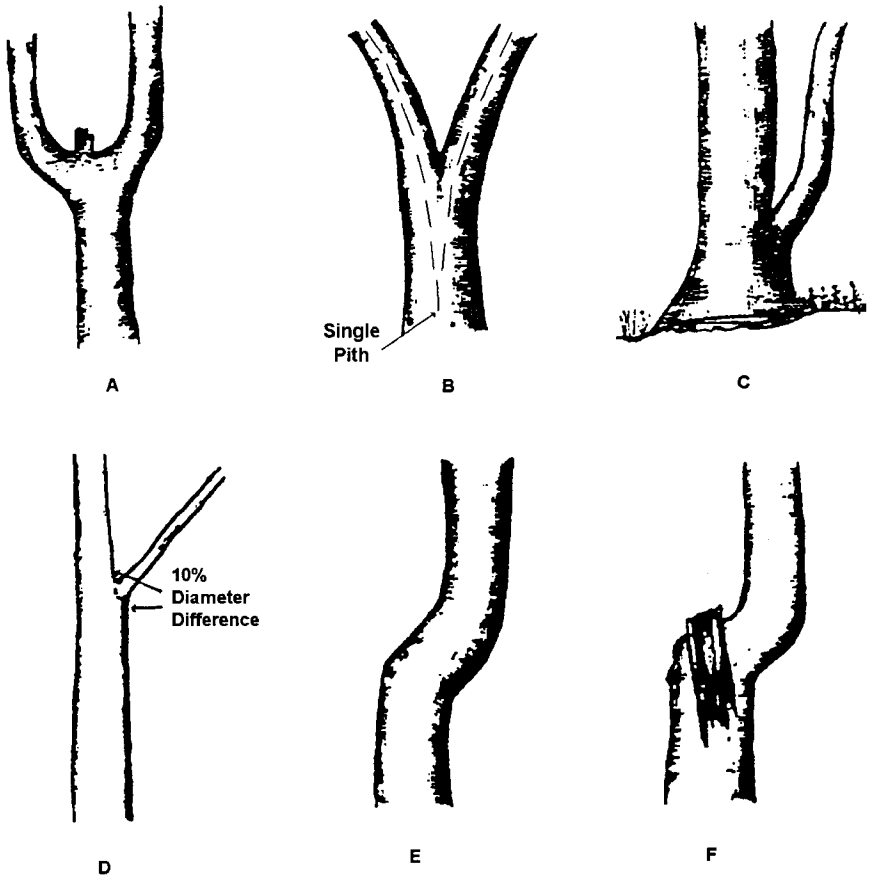


Figure A.12 Types of forks and crooks which are recorded.

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.

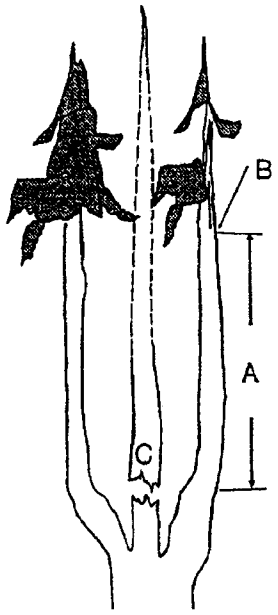


Figure A.13 Fork or crook and/or dead or broken top.

1. If the 'forked' leaders exceed the dimensions of a log as defined by the Utilization Standards (i.e., "A" is estimated to be greater than 3 m, and "B" is greater than 10 cm dib) call the pathological defect as a 'fork'.

2. If the leader material is relatively small in size (i.e., less than 3 m in length) call 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 the estimated top of log to utilization.
'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.

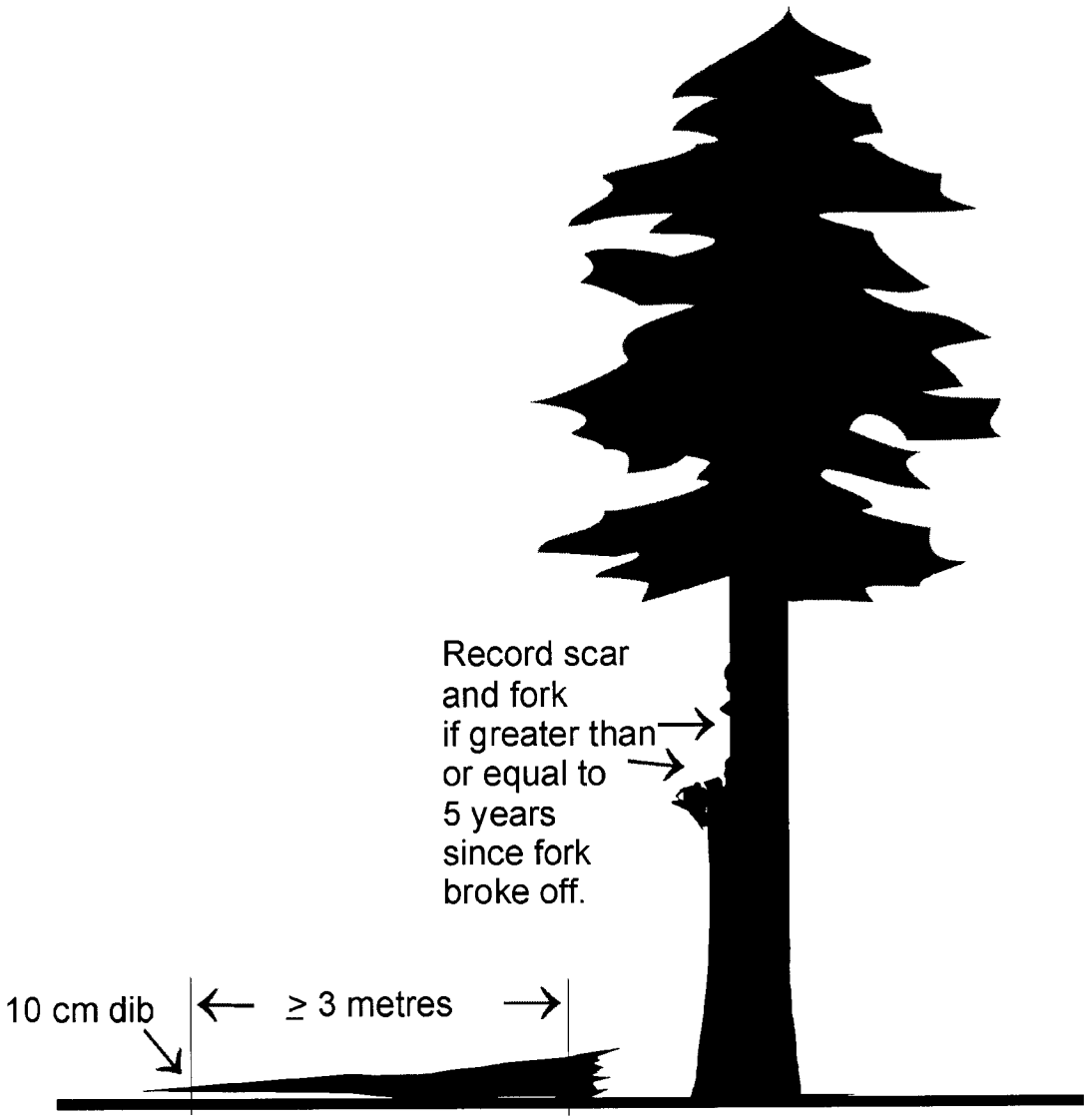


Figure A.14 Fork/crook.

A.4.2.5 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 A.15),
- 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.

Frost cracks are often associated with severe basal decay.

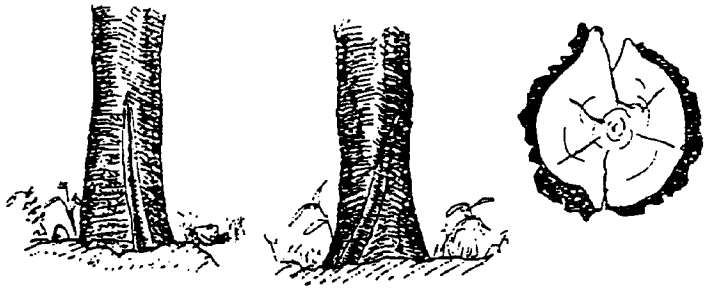


Figure A.15 Appearance of frost crack on standing trees.

A.4.2.6 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 A.14).

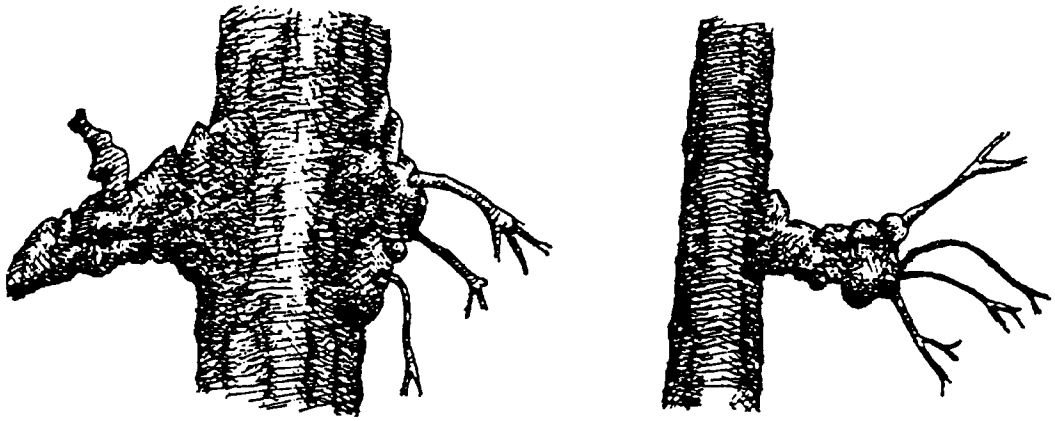
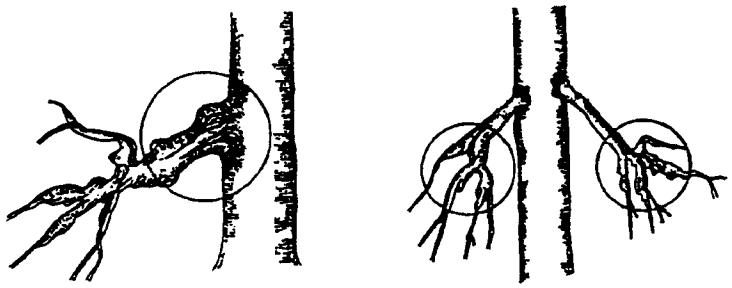


Figure A.16 Trunk infections of mistletoe.

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 include mistletoe on living limbs or limbs that are swollen only at some distance from the trunk. Include only those branch infections in which the swelling has clearly extended to trunk (Figure A.17).



Suspect branch infection extending to the trunk of the tree.

Branch infection which is not suspect.

Figure A.17 Branch infections of mistletoe.

A.4.2.7 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 overmature trees (see Figure A.18).

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.

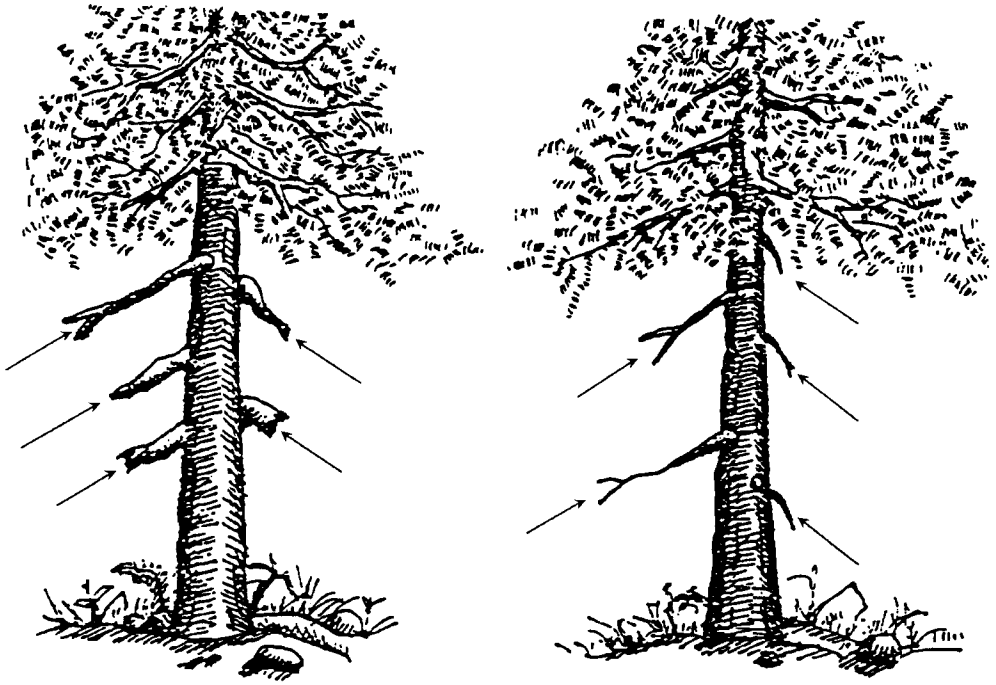


Figure A.18 Rotten branches.

A.4.2.8 Dead or Broken Top

Definition:

- where the tree top or complete stem has died due to various physiological causes.

Causes of dead tops

Dead tops may be caused by several factors such as:

- insect attack,
- drought conditions,
- sun scald, and
- physiological death.

The calling of dead tops:

- a dead top must be obviously weathered, indicating that death occurred at least five (5) years ago and below utilization top before it will be called as a pathological indicator, and

Causes of broken tops

- wind breakage,
- snow damage, and
- damage from falling trees, etc.

Broken tops must be obviously weathered (see scar criteria) before being called as a pathological indicator.

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 A.13).

Where there is not any evidence of a broken top in the stem at the fork/crook position and neither of the leaders are merchantable, record fork/crook.

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 called as a pathological indicator.

A.4.3 Abnormalities which are not Recorded

The following abnormalities are not indicative of decay and are, therefore, not recorded.

A.4.3.1 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.

A.4.3.2 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 (Figure A.19).



Figure A.19 Flutes.

A.4.3.3 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 (Figure A.20). Do not call defect on candelabras.

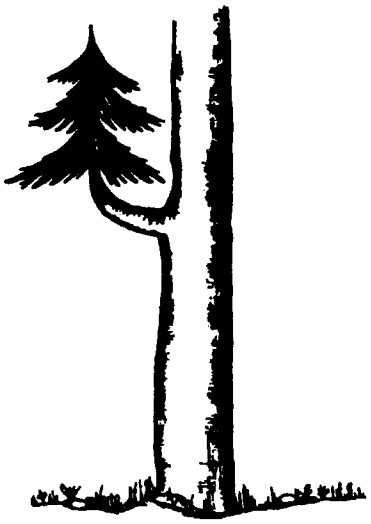


Figure A.20 Candelabra branches.

A.4.3.4 Branch Fans

Branch fans which appear most commonly as 'fans' of branches originating from burl-like swellings on the trunks (Figure A.21) are not Suspect.

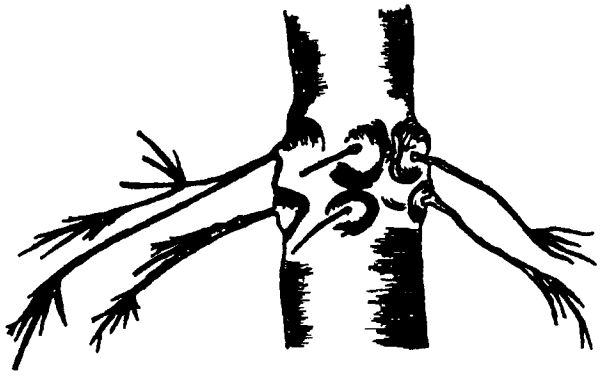


Figure A.21 Branch fans.

A.4.3.5 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 (Figure A.22).



Figure A.22 Black knots.

A.4.3.6 Burls and Galls

Burls and galls develop from abnormal cell growth in trees and although formidable in appearance, have no decay significance (Figure A.23).

Scars will be tallied on burls.

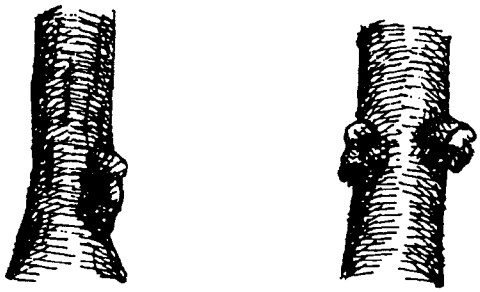


Figure A.23 Burls and galls.

A.4.3.7 Sweep

Sweep which is a slight curvature or distortion of the trunk has no decay significance (Figure A.24).



Figure A.24 Sweep.

A.4.3.8 Exposed Roots

Exposed roots and buttress roots have no established decay significance unless scarring is present above mean ground level (Figure A.25).



Figure A.25 Exposed roots.

A.4.3.9 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 (Figure A.26).

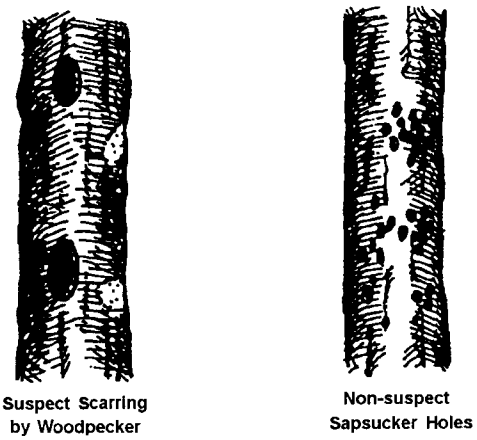


Figure A.26 Bird damage.

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 A.27 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.

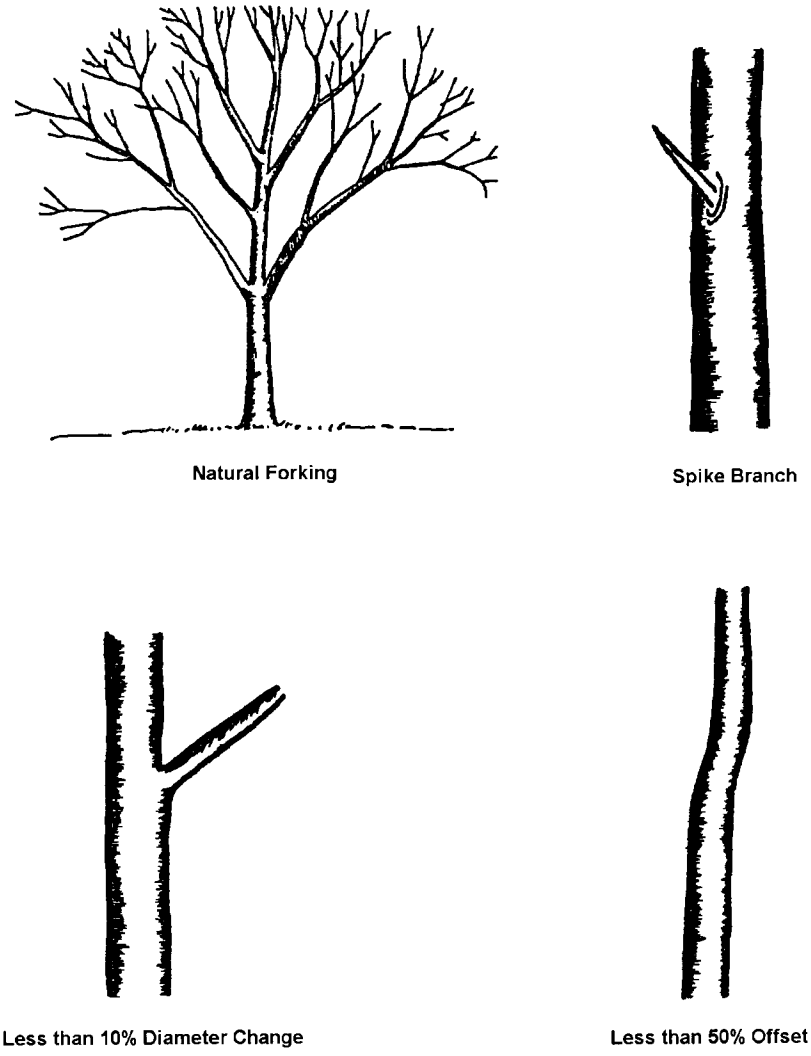


Figure A.27 Illustrates forks and crooks which are not suspect.

A.4.4 Some Common Decays of Forest Tree Species in British Columbia

Brief descriptions of some of the major decays of commercial tree species in British Columbia have been included 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 of major significance. Descriptions of eleven of these have been included.



Figure A.3 Example of Schweinitzii.

A.4.2.2 Blind Conks

Blind conks are pronounced swellings or depressions around knots caused mainly by *P. pini* on conifers and *P. tremulae* on aspen and if identified correctly, are definite indicators of decay (see Figure A.4). 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 species in the coast-interior transition zone (e.g., Boston Bar). Therefore over-mature trees with basal branch stubs should be examined for blind conk.



Figure A.4 Example of blind conk in a knot.

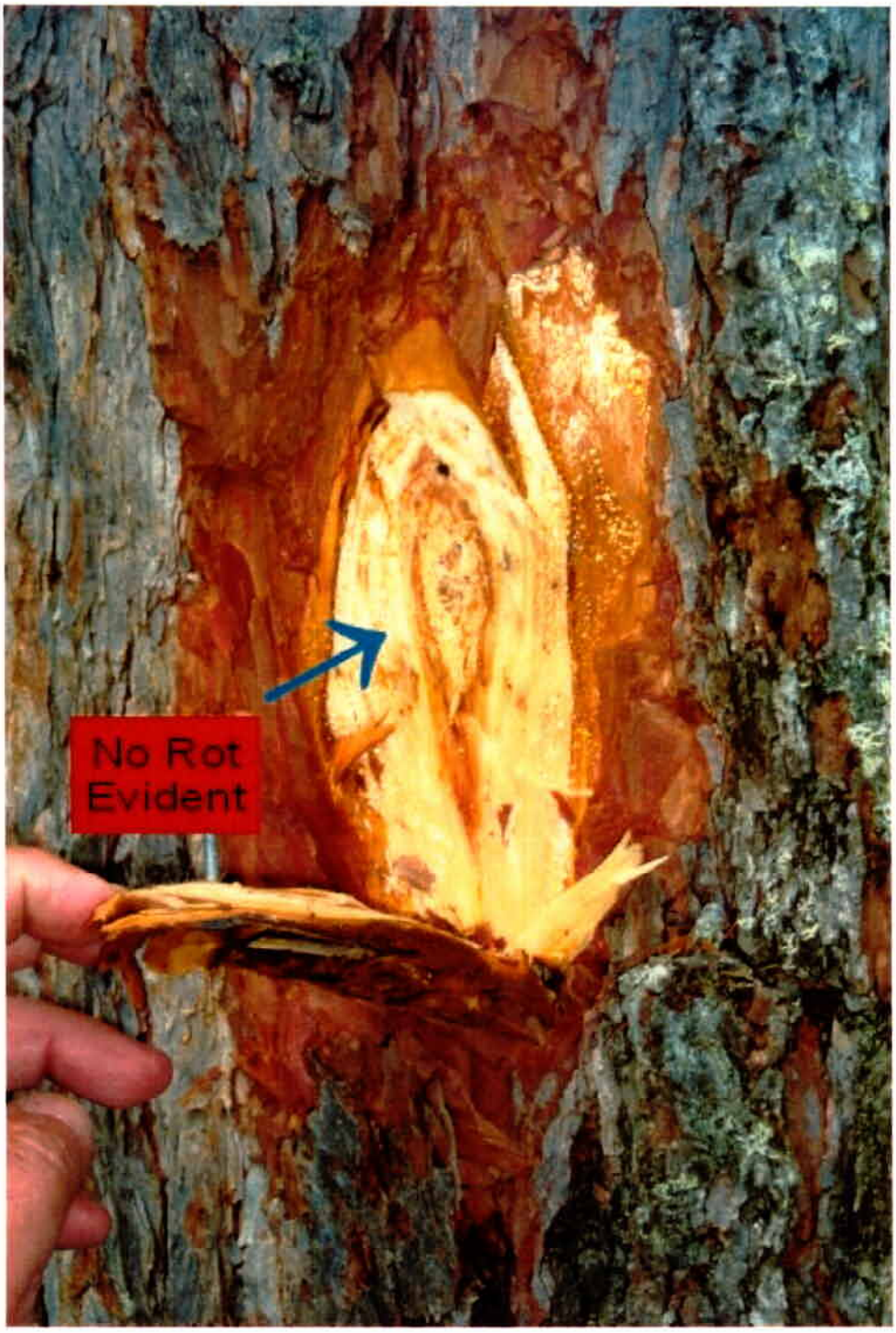


Figure A.5 Non-blind conk in a knot.

A.4.4.1 Indian Paint Fungus

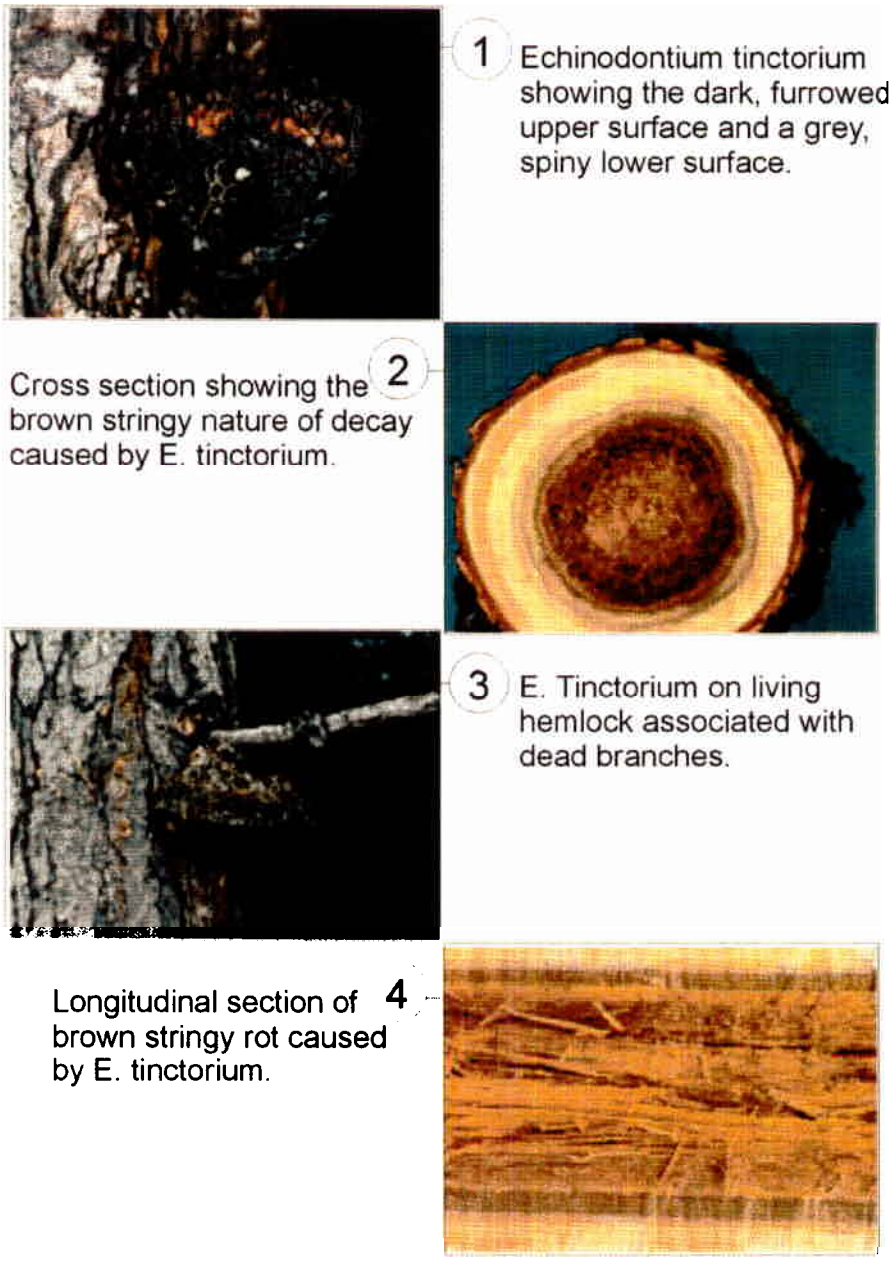


Figure A.28 Indian paint fungus.

Scientific name (fungus):	Echinodontium tinctorium (Ell. & Ever).
Common name (decay):	Brown stringy trunk rot.
Hosts:	Reported on a large number of coniferous hosts. Of major importance in British Columbia only on western hemlock, alpine fir and amabilis fir. Reported from the coast only at higher elevations and in the north.
Sporophores:	Perennial, hard, woody, sessile, ungulate: upper surface black, furrowed; context brick-red; lower surface grey.
Decay:	The incipient stage may appear as a 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 in 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.

A.4.4.2 Pine Root Fungus



1 Upper and lower surfaces respectively of bracket-like sporophores of Fomes annosus, the pine root fungus.

Resupinate sporophore of F. annosus on the under surface of an exposed root. 2





3 Cross section of advanced decay caused by F. annosus showing the white spongy nature of the rot.

Longitudinal section of decay caused by F. annosus showing the numerous elongated pits. Black flecks, commonly associated with advance decay rot are not evident here. 4



Figure A.29 Pine root fungus.

Scientific name (fungus):	Heterobasidion annosum (Fr.:Fr.) Bref.
Common name (decay):	Annosus root and butt rot
Hosts:	Occurs on most hardwoods and conifers. Common in western hemlock. Range is generally west of the coast mountains and in the ICH biogeoclimatic zone.
Sporophores:	Perennial, woody to leathery, sessile, ungulate or bracket-like to resupinate; upper surface dark-coloured to black, zones, margin acute; context 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 or slower extent cellulose. Generally confined to the roots and butt sections.
Remarks:	Sporophores generally produced on dead material or on the undersurface of roots exposed to the atmosphere. Capable of causing extensive root rot in young stands. Also occurs as a common decay of mature timber.

A.4.4.3 Picture Conk



1 Typical sporophores of Fomes applantus.

Section of white mottled rot caused by F. Applantus showing the white mycelial accumulations and zone lines. 2



Figure A.30 Picture conk.

Scientific name (fungus):	Ganoderma Applanatum (Pers.) Pat. Fomes applanatus Pers.
Common name (decay):	White mottled rot, Applanatus rot.
Hosts:	Known to occur on conifers, but more frequent on hardwoods in all regions of BC.
Sporophores:	Perennial, leathery to woody, sessile, applanate; upper surface light brown to grey, often shiny; context dark brown; lower surface white, turning dark brown when bruised; poroid, pores regular.
Decay:	The incipient stage may appear as a light stain or infected wood may have a bleached appearance and be difficult of detection. 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 (the picture conk). Brownish spores may be carried to the upper surface giving a dusty brown appearance to the sporophore.

A.4.4.4 Conk Fungus



❶ Typical sporophores of Fomes pini, the conk fungus.

Cross section of advanced decay caused by F. pini showing the honeycomb nature of the rot. ❷





❸ Fruiting body on living Douglas fir.

Fruiting body on dead branch. ❹



Figure A.31 Conk fungus.

Scientific name (fungus):	Phellinus pini (There:fr) Ames. Fomes pini (Thore) Lloyd, formerly referred to as Trametes pine (Thore) Fr.
Common name (decay):	Conk rot, white-pitted rot, red ring rot, pecky rot, honeycomb rot, etc.
Hosts:	Occurs essentially on all conifers in British Columbia, very common in hemlock, spruce and Douglas fir. Also known to occur on hardwoods.
Sporophores:	Perennial, wood to punky, sessile, ungulate, occasionally effused-reflexed if on branches; upper surface dark brown, 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 heartrot, 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.

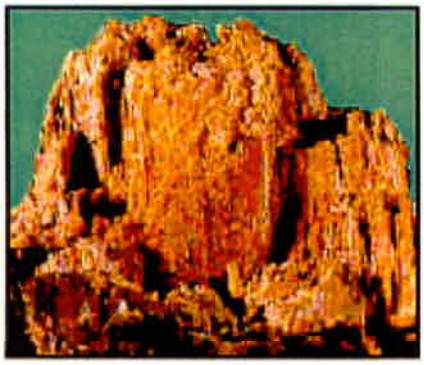
A.4.4.5 Red Belt Fungus



❶ **The red belt fungus, Fomes pinicola, showing the bracket-like nature of the sporophore.**

Typical sporophores of F. pinicola on recently killed western hemlock. ❷





❸ **Section of decay caused by F. pinicola showing the typical brown cubical formations and white mycelial felts.**

Figure A.32 Red belt fungus.

Scientific name (fungus):	Fomitopsis pinicola (SW.:Fr) P. Karst. Fomes pinicola (sw.) Cke.
Common name (decay):	Brown crumbly rot.
Hosts:	Common on most conifers and hardwoods.
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.

A.4.4.6 Velvet-Top Fungus



1 Sporophore of P. schweinitzii attached to an underground root and growing through the duff.

Cross section of decay caused by P. schweinitzii showing the typical dark brown cubical formations. 2





3 Longitudinal section of decay caused by P. schweinitzii showing the dark brown cubical formations.

Figure A.33 Velvet-top fungus.

Scientific name (fungus):	Phaelous schweinitzii (Fr.:Fr.) Pat. Polyporus schweinitzii Fr.
Common name (decay):	Brown cubical butt rot.
Hosts:	On conifers, common in Douglas fir, spruce and pine. Occasionally found on hardwoods found in all regions in BC.
Sporophores:	Annual, spongy to leathery, stipitate; upper surface reddish-brown; velvety with concentric rings and a light yellow 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, reddish-brown in colour. An odour of anise is often associated with advanced decay.
Entrance:	Roots.
Activity:	A cellulose-destroying heartrot, 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.

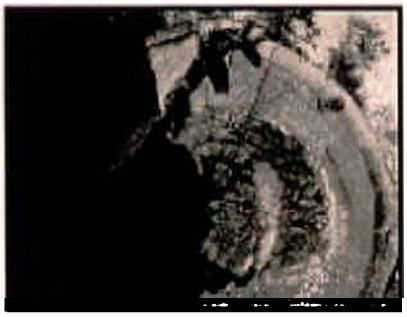
A.4.4.7 Sulphur Fungus



❶ Typical sporophore of P. sulphureus, showing the fan-shaped nature.

Sporophores of P. sulphureus fruiting at the base of an infected tree. ❷





❸ Cross section of decay caused by P. sulphureus showing the typical brown cubical formation and thick white mycelial felt in the shrinkage cracks.

Longitudinal section of brown cubical trunk rot caused by P. sulphureus showing the white mycelial felts. ❹

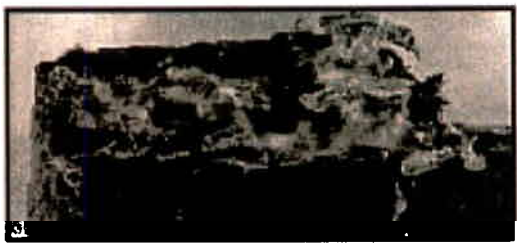


Figure A.34 Sulphur fungus.

Scientific name (fungus):	Laetiporus sulphureus (Bull.:Fr) Murrill. Polyporus sulphureus (bull.)
Common name (decay):	Brown cubical trunk rot.
Hosts:	Common on most hardwoods and conifers, including oak, true fir, Douglas fir and spruce in all regions in BC.
Sporophores:	Annual, spongy to leathery, sessile or stalked (stem eccentric), applanate to bracket-like; upper surface orange-yellow; context white; lower surface sulphur-yellow; poroid, pit regular. Old sporophores 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 mycelial felts may develop in the shrinkage cracks.
Entrance:	Scars, dead branch stubs.
Activity:	A cellulose decomposing heartrot and occasionally saprot. May occur in the butt or trunk, generally the latter.
Remarks:	Sporophores develop infrequently on living trees but are easily recongnized by their shape, size and colour. They decompose quickly following insect attack and weathering and seldom remain on the host past one season.

A.4.4.8 Spongy Butt Rot Complex



❶ Resupinate sporophore of the spongy butt rot on the surface of an old stump.

Cross section of spongy butt rot. ❷





❸ Cross section of spongy butt rot showing the laminate and stringy nature of decay.

Figure A.35 Spongy butt rot complex.

Scientific name (fungus):	The three fungi most commonly involved in the complex are Corticium galactinum (Fries) Bur, Odontia bicolor (Alb. and Schw. ex. Fr.) Bres., and Poria subacida (Beck) Sacc.
Common name (decay):	Spongy butt rot, feather rot, white stringy butt rot.
Hosts:	Occurs in conifers and hardwoods. Common in true fir, spruce and hemlock found in all regions of BC.
Sporophores:	Superficially similar in the three species: annual to perennial, resupinate, white, yellow or buff. The surface of C. galactinum smooth and waxy, O. bicolor cracked with age and covered with short fragile evenly-distributed teeth and P. subacida small pores.
Decay:	The incipient stage may appear as a light stain. Later, small white pits develop and coalesce to form masses of white spongy 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 or lesser extent cellulose decomposing heartrot and saprot generally confined to the roots and butt.
Remarks:	Poria subacida which formerly was considered the sole causal fungus is in some hosts 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; common in mature age classes. Sporophores of the three fungi associated with this rot are generally on the undersurface of old logs.

A.4.4.9 Bleeding Conk

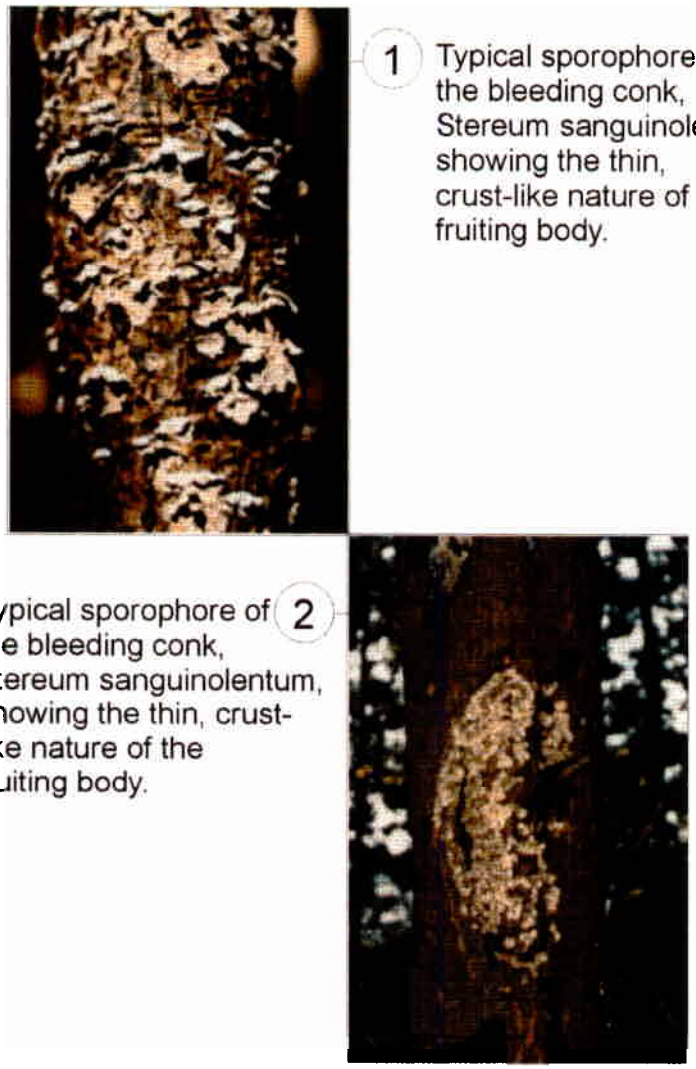


Figure A.36 Bleeding conk.

Scientific name (fungus):	Stereum sanguinolentum A. & S. ex. Fr.
Common name (decay):	Red heart rot.
Hosts:	Occurs on conifers. Very common in true fir, pine and white spruce. Found throughout the range of hosts in British Columbia.
Sporophores:	Annual, leathery, resupinate to effused-reflexed, forming thin crust-like layers; lower surface grey to light brown, turning blood red when bruised, surface roughened.
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. Mycelial sheets, white to buff in colour, may develop.
Entrance:	Broken tops and scars of living trees.
Activity:	A lignin and generally to a slower or less extent cellulose destroying heartrot, generally found in the trunk.
Remarks:	A very important decay-producing fungus, also occurs commonly as a slash destroyer. Sporphores develop occasionally on living trees, but are of limited value as indicators of defect owing to their infrequent occurrence, small size and colour.

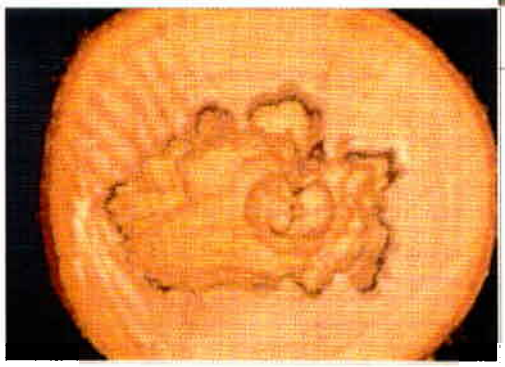
A.4.4.10 False Tinder Fungus



1 Hoof-shaped sporophores Fomes igniarius; deeply zoned grey-black upper surface.

Hoof-shaped sporophores Fomes igniarius; deeply zoned grey-black upper surface. 2





3 Yellow-white stringy advanced decay with included black zone in aspen.

Figure A.37 False tinder fungus.

Scientific name (fungus):	Phellinus igniarius (L.:Fr) Quél. Fomes igniarius (L.) Gill.
Common name (decay):	white trunk rot or white heart rot.
Hosts:	Occurs mainly on hardwoods. Common in aspen and birch.
Sporophores:	Perennial conks are usually hoof-shaped, but sometimes shelflike 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. Undersurface is brown with mouths of tubes small and circular in outline. Context or interior of conk is rusty-brown, often interspersed with silver-grey 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; and in the advanced stage all soft, punky wood irrespective of colour is included.
Entrance:	Unknown - probably branches and wounds.
Activity:	Sporophores from on standing trees and on slash; the presence of a single sporophore generally indicates a considerable volume of decay.

A.4.4.11 Poria Obliqua



1 Internal view of the Poria oblique - decay complex.

Section view of sterile conk on birch. Note black zone lines and canker-like appearance of the stem. 2





3 Longitudinal section showing advanced decay.

Figure A.38 Poria obliqua.

Scientific name (fungus):	Poria obliqua (pers.) Bres.
Hosts:	Occurs on hardwoods. This sample was found on wester paper birch (Betula papyrifera).
Decay:	A heart rot in living birches similar to that caused by Fomes igniarius. Fine black zone lines are a feature of the advanced stage (Example 3).
Appearance:	Black, warty, rough, clinkerlike sterile conks are produced on living trees, appearing to issue from knots and wounds. The conks in this illustration appears in the centre of a conspicuous canker. The context or interior of the conk is rusty-brown.

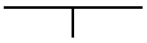
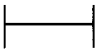
A.5 Woods Safety and Emergency Procedure

A.5.1 Ground to Air Signals

Wherever possible, a smoke fire should be used to attract aircraft. Use toilet paper, poles, rolled tents, etc., to make signals.

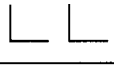
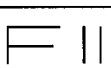
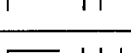
A.5.2 Emergency Signals - downed aircraft, ground emergency, etc.

In most cases personnel should remain at the scene of any wreck, unserviceable aircraft or ground accident in back areas. If the trip has been properly planned and E.T.A.'s left at party headquarters, every effort will be made to start a search if personnel become overdue.

Serious inury, require doctor	
Drop here, all O.K.	
Negative	
Yes	
Require Helicopter	
Require food	
Require radio and/or batteries	
Which way do we go?	
Am proceeding in this direction	
All O.K.	
Not understood	
Require fuel	

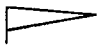
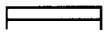
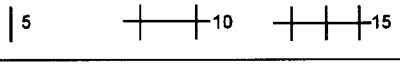
A.5.3 Food Drop Signals

In pre-dropping operations these signals are to be left at drop site. When check flight is made later, pilot is able to determine if ground crew found previous drops okay. The signals are solely for food drops. If any emergency has developed, signals in (Section A.5.2) above are to be used.

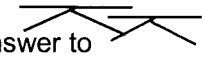
Everything O.K. No drops required	
Drop again 1 parcel	
Drop again 2 parcels	
Drop again 3 parcels	

A.5.4 Fire Fighting and Water Dropping Signals

It is possible district personnel may be involved in forest protection duties where aircraft are being used for water bombing or other protection duties. The Protection Branch has specified certain air-ground signals to be used as follows:

Require saw	
Require pump	
Require hose	
Require hand tools	
Require men	
Water dropping target -	Centre of target between two balloons or like indicators. Distance between balloons indicates length of target.

Air to Ground Signals

Proceed to Target Circle three times	Answer to  , fire, or target here.
Low pass over drop area Revving motors	Take cover - air drop coming
Pass over drop area Wobbling wings	Finished dropping or signals recognized

A.5.5 Basic First Aid

Sprains	Simple: wrap with elastoplast or bandage, cold compress, and elevate and rest. Serious: Treat as a break.	
Diarrhea	Black tea and burnt toast.	
Food Poisoning	Induce vomiting - salt water and finger, continue until clear, and drink lots of milk and water.	
Bleeding - Control by:	1.	Pad and pressure on wound (more pads on top as required).
	2.	Elevation of wound.
	3.	Pressure on major artery above wound may be necessary in extreme cases.
Broken Bones	1. 2.	Immobilize before moving Use lots of padding. Splints can be made from boards, saplings, air mattresses, tallybag, etc.
Burns	1. 2.	Soak in cold water to relieve pain Cover with sterile gauze

Artificial Respiration	Mouth-to-Mouth Method - *start immediately!*	
	1. 2. 3. 4. 5. 6.	Clear throat, tongue not swallowed. Tilt head back. Pinch nostrils. Cover patient's mouth with yours and blow. Remove your mouth so they can exhale while you inhale. Repeat 4 and 5.
In all cases treat for shock -	1. 2. 3. 4. 5.	Warmth - especially if cold and wet Air - loosen clothing at neck and waist Rest - lie on back, raise legs Shelter Stimulants - tea, coffee, milk (no alcohol) - avoid if internal injuries present.

A.5.6 If You Must Leave Your Partner in the Bush

A.5.6.1 Make Sure They are Comfortable and Treat All Injuries Before you Leave

A.5.6.2 Leave Them With

- shelter - in case of rain,
- water,
- food,
- fire, wood, kindling, and matches,
- knife and axe,
- flare kit,
- extra clothing - both over and under,
- tallybag, and
- watch.

A.5.6.3 Tell Them Your Plans

- direction and route you are taking,
- estimated time of return,
- what you will do when you reach your fly camp or truck, and
- reassure them before you leave.

A.5.6.4 Mark Their Location Well With Flagging, etc. (you may have to return in the dark)

A.5.6.5 Flag or Blaze Your Way out Using Your Compass. Take Aerial Photo Having Marked Their Location Before Leaving

A.5.6.6 If Lost

1. Remain calm.
2. Take stock of what you have with you.
3. Sit down, relax - then try to figure out where you are.
4. Use your compass.
5. Proceed to high point to obtain idea of lay of land and to be more readily spotted.
6. If you have not discovered your position by 7:00 p.m., admit you are lost.
7. Prepare to spend the night out:
    a. check instructions in flare kit,
    b. prepare smoke signal fire - lay out ground to air signals if necessary,
    c. make a shelter, build a fire, and
    d. keep busy but prevent exhaustion and exposure.

Exposure - body energy is dissipated much more rapidly under tension or stress, particularly when a person is cold and wet, this results in exhaustion and eventual collapse. Do not attempt further travel under these conditions. Build a fire in a sheltered spot and get warm.

    e. conserve food.

A.5.6.7 Flare Kit Instructions

To attract attention:

- pick an opening and/or hilltop if possible,
- aim in front of approaching aircraft,
- fire flare vertically, and
- watch where flare lands in case of fire.

If lost:

- space out your flares - at least 1/2 hour apart.

Save at least two (2) for the next morning.

> Remember: Dusk and dawn are the best times for spotting flares. Search crews will stop about 10 p.m. and wait until morning to restart.

> Stay put when you have been spotted: Unless directed otherwise by search party. Keep ground to air signals in your hard hat.

A.6 Abbreviations and Symbols

Basal area factor	BAF
Close utilization	CU
Coefficient of variation	CV
Decay and breakage	DB
Decay, waste 2 and breakage	DW2B
Diameter at breast height	dbh
Diameter at stump height	dsh
Diameter inside bark	dib
Diameter outside bark	dob
Plot radius factor	PRF
Standard deviation	S.D.
Standard error	S.E.

A.7 Damaged Stands

Trees are assigned damage codes so as to apply 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 damaged code categories so as to enable cost and value adjustments in appraisal.

Each code has a different effect in compilation. Damage codes result in the modification of risk group and corresponding adjustments to net volume.

Depending on the patchiness of the beetle attack, or fire and wind damage, consideration should be given when drawing up the sampling plan as to whether these patches should be treated as "types" and be a part of the stratification.

A.7.1 Pest Damage

The following section applies for all cruises. Standard cruising methods as outlined in the *Cruising Manual* are to be followed with all beetle attack trees on the sale area coded in accordance with the *Bark Beetle Code*.

A.7.1.1 Bark Beetle Codes[1]

When Bark Beetle codes are recorded, the compilation program modifies the risk group. The compilation reports state the volume affected by this damage.

Trees are coded as they appear at the time of the cruise with no attempt to guess what the future condition of the trees will be.

[1] L. Safranyik, D.M. Shrimpton, H.S. Whitney, Management of Lodgepole Pine to Reduce Losses from Mountain Pine Beetle, 1974, Forestry Technical Report 1, Environment Canada.

A.7.1.2 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).[2]

Douglas fir beetle attacks Douglas fir and sometimes western larch.[3]

Spruce beetle attacks mainly white and Englemann spruce in the Interior.[4]

Western pine beetle attacks ponderosa pine.

Western balsam bark beetle attacks mainly subalpine fir (*Abies lasiocarpa*).

A.7.1.3 Attack codes for balsam, white pine, yellow pine and lodgepole pine

Code	Description
1	Green Attack
2	Red Attack
3	Grey Attack

These attack codes (based on crown and bole symptoms) are applicable to the mountain pine beetle (PL, PY, PW), the western pine beetle (PY) and western balsam bark beetle (B).

In large, active infestations of these beetles, trees which have strip attacks and unsuccessful full attacks due to tree resistance will generally be low in numbers. Therefore, additional codes are not necessary to identify them for the purpose of normal timber sale or inventory cruising.

Any evidence of bark beetle attack in a green tree must be tallied as a green attack bark beetle code.

---

[2] R.O. Wood, Foliage Changes of Three Pine Species, Pacific For. Res. Centre, Internal Report BC-17.

[3] L.H. McMullen, 1977, Douglas Fir Beetle, Pacific For. Res. Centre, Pest Leaflet A.

[4] C.B. Cottrel, 1978, Spruce Beetle, Pacific For. Res. Centre, Pest Leaflet B.

Green Attack Code 1 (Risk Group 2, Balsam and the Pines)

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. For lodgepole pine, green attacked trees are common from late July to late May in most areas. White pine and yellow pine infested by mountain pine beetle often start discolouring by fall or mid-spring.

Red Attack Code 2 (Risk Group 2, Balsam and the Pines)

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.

Grey Attack Code 3 (Has to be dead = Highest Risk Group, Balsam and the Pines)

This code will represent trees which are dead and have grey 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.

A.7.1.4 Blister Rust Code 4 (Risk Group 2, White Pine)

Normally used in stands where white pine is a major species (more than 20 percent of the volume) which is seriously infected with blister rust. This code can be used in a normal old growth H-C type containing a few scattered PW veterans.

All other insect attack codes take precedence over Blister Rust, Code 4.

A.7.1.5 Attack Codes for Spruce, Douglas Fir

Code	Description
5	Green (Alive) Strip Attack – S and F
6	Green (Dead) Full Attack – S and F
7	Grey Attack – S and F
8	Red Attack – Fir only

The first three codes are applicable to the spruce and fir beetle. Spruce foliage turns yellowish for a brief period in the winter season following an attack before the needles drop off the tree. Therefore, the species was not included in the red attack. Infested trees with faded crowns should be included in the green (dead) full attack.

Green (Alive) 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. In the case of Douglas fir, strip attacked (green alive) in well established infestations are usually much less common than Green (dead) fully attacked trees. The loss factors are unaffected by this code.

Green (Dead) 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 and has to be dead, Fir and 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 these trees to the highest 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. For bole and crown symptoms of infestation, consult the publication on Douglas fir Beetle[3] under the headings Damage and Detection. The compilation program downgrades these trees to Risk Group 2. If they have conk or blind conk or are tree class 3, 7, or 9 they will be compiled as Risk Group 3.

A.7.1.6 Defoliators (Path/Tree Class = Risk Group, All Species)

This damage category includes hemlock looper, budworms, moths and other defoliators. If the classification is doubtful, assess the cambium on the north side at DBH.

- Code X - trees with living cambium. Tree classes 1, 2, 5, 6, 8, and
- Code Y - trees with dry cambium. All tree classes are allowed.

All other insect attack codes take precedence over defoliator, codes x and y except code 4, Blister Rust.

A.7.2 Fire Damage

Standard cruising methods as outlined in the *Cruising Manual* are to be followed in conjunction with the following classifications and their codes.

A.7.2.1 Light Damage - Code A

Damage consisting of scorched bark and foliage but no charring in the merchantable portion of the stem.

Classification: No change to the tree classification for light fire damage trees.

Bark scorching greater than or equal to 5 years after the date that the fire was declared mopped up by the Ministry of Forests does not qualify for the fire damage coding.

A.7.2.2 Moderate Damage - Code B

Damage consisting of some shallow charring of wood fibre in the merchantable portion of the stem.

Classification: Assign the tree class and record the pathological indicators as normal. The compilation program will down grade risk group 1 trees to risk group 2.

A.7.2.3 Heavy Damage - Code C

Damage 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 also qualify for heavy damage.

Classification: Assign the tree class and record the pathological indicator as normal. The compilation program will down grade these trees to the highest risk group.

> Trees are coded as they appear at the time of the cruise only and not at the anticipated time of harvesting.

Definitions:

Merchantable section	is the section of the stem between 30 cm stump and the 10 cm top diameter.
Charring	is the actual destruction of wood by fire. There must be identifiable damage to a surface area greater than100 cm^2.
Shallow charring	is charring which is greater than 100 cm^2 in surface area and less than one-third of the radius of the tree.
Extensive shallow charring	is charring in the bottom third of the tree that has 3 or more areas (each at least 100 cm^2) of exposed and charred wood fibre or the cumulative total of charred areas is greater than 300 cm^2.
Deep charring	is where charring is deeper than one-third of the radius of the tree.
Multiple deep checks	is where more than 1 check is deeper than one-third of the radius of the tree.

1. Surface checking may occur as the result of fire damage but this does not affect tree classification.
2. Trees are coded as they appear at the time of the cruise and not at the anticipated time of harvesting.

A.7.3 Down Trees

The following Damage Codes will be entered in column 63 of the Tally Sheet (FS 205).

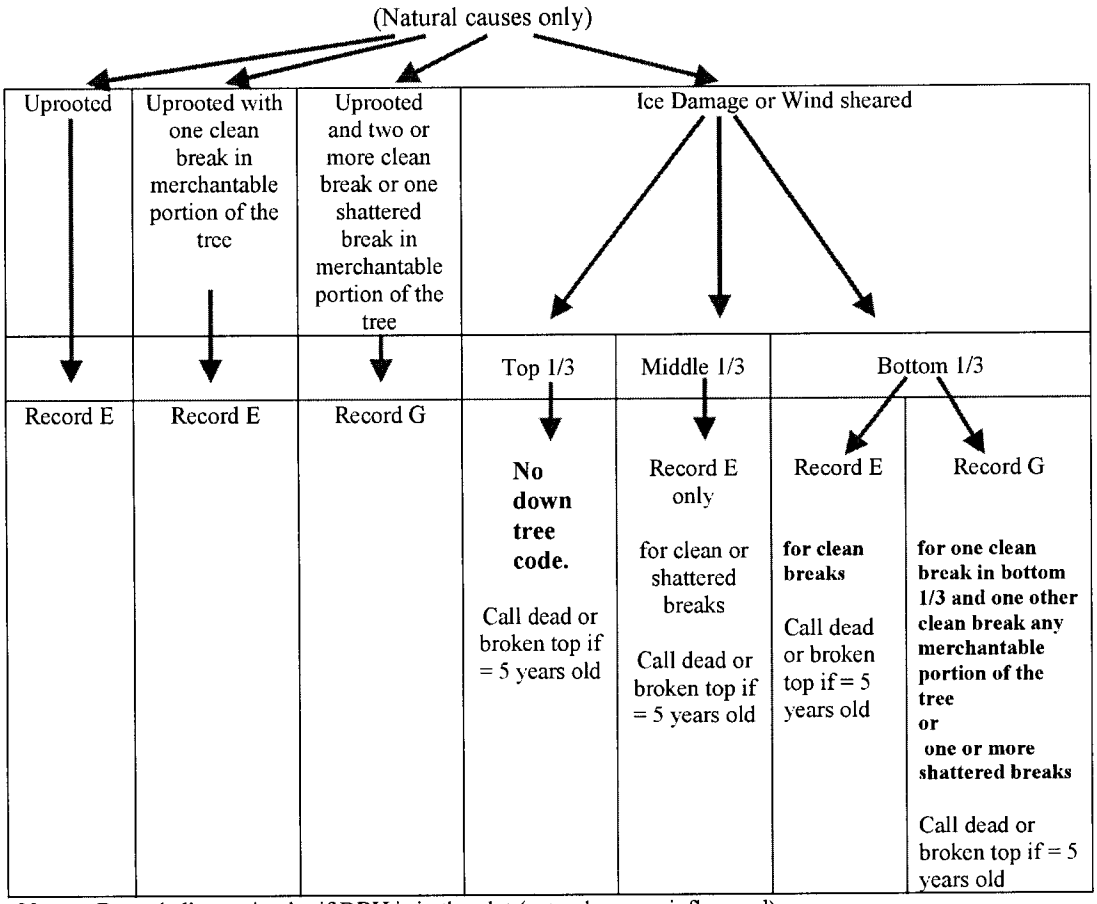
Code	Condition of Down Trees
E	The tree may have one clean break in the merchantable portion of the stem. The compilation program will assign the risk group by tree class and pathological indicators.
G	The tree must have two or more clean breaks or one or more shattered breaks within the merchantable portion of the stem. The compilation program will down grade these trees to the highest risk group.

Definitions:

Clean break is a break in the merchantable portion of the stem which can be bucked out in a length equivalent to the diameter of the stem at the break.

Shattered break is a break more severe than a clean break.

Damage Call Matrix for Uprooted, Ice Damaged and Wind Sheared Trees



Note: Record all trees in plot if DBH is in the plot (natural or man influenced)
Damage codes can only be recorded for natural occurrences. No codes for hand felled or mechanical influences.
Do not record uprooted TC 4 or TC 6.

Figure A.39 Damage Call Matrix for Uprooted, Ice Damaged and Wind Sheared Trees.

A.7.3.1 Sampling Down Trees

Down trees are defined as trees that have been uprooted, blown down, ice damaged or wind sheared. Standard cruise methods as outlined in the *Cruising Manual* are to be followed consistent with the following criteria:

- fixed or variable plots can be used for both standing and down trees,
- trees will be coded as of the time of cruising,

- do not record uprooted tree class 4 and 6 trees,
- the allowable tree classes for all codes are 1, 2, 3, 5, 7, 8, and 9,
- all trees with red, green or brown needles are classified as living trees,
- all uprooted trees, assign the appropriate down tree code,
- if tree is partially uprooted and supported by another standing tree assign the appropriate down tree code, and
- if tree is partially uprooted and self-supporting do not assign a down tree code.

Examples of Broken or Shattered Trees:

- if < 5 years since the damage and the tree is broken or shattered in the top third *do not* code as a down tree or dead/broken top,
- if ≥ 5 years since the damage and the tree is broken or shattered in the top third larger than utilization diameter, code dead or broken top *only*. If broken above utilization diameter do not tally down tree code or dead or broken top,
- if < 5 years since the damage and the tree is broken or shattered in the middle third, code E only and do not record dead or broken top,
- if ≥ 5 years since the damage and the tree is broken or shattered in the middle third, code E only and tally dead or broken top in 2nd third, and
- if < 5 years since the damage and the tree is broken in the lower third, code E or G and do not tally a dead or broken top,
- if ≥ 5 years since the damage and the tree is broken in the lower third, code E or G and tally a dead or broken top.

A.7.4 Extremely Damaged Stands (Windthrow, Flood Damaged, Fire, Insects or Disease)

Where damage conditions are such that a stand cruise procedure becomes too costly in terms of recoverable values from the salvageable material, the Regional Manager has the following options of estimating the volume and quality of both the damaged and undamaged wood left on the area:

1. Applying an estimated damage factor (derived either by aerial or ground reconnaissance) to an earlier cruise of the area when the stand was undamaged.

2. Applying an estimated damage factor to volumes derived from the inventory map and average lines for the area.



Figure A.40 Example of mechanical damage.

Appendix 8 Interior Log Grade Algorithm

The Interior Log Grade Algorithm is for the ministry compilation program. Industry compilers may also include it.

A.8.1 Assumption

Pathological and quality indicators on the tree can predict grade.

A.8.2 Procedures

1. The compilation program utilizes the table below for allocation of path in thirds to the logs.

2. Conk, blind conk, frost crack, rotten branch, D & B top and spiral grain, 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.

4. If four or more branches over 10 cm in the first 5 m of the tree, record knot code 6 in position 50 on the cruise tally card. If four or more branches over 10 cm in the second 5 m of the tree record knot code 6 in position 51 of the cruise tally card.

The body of the table contains the log number that is affected (e.g., a code of 3 (top third) in a 6 log tree affects 5 and 6). Knot Code 6 is the exception; it applies to the 5 m log where the large knots occur.

The tree thirds that are affected in the tree will be converted to 5 m logs depending on the merchantable height of the tree. Refer to Appendix 10 of the *Cruise Compilation Manual* for the matrix that converts tree thirds to the number logs.

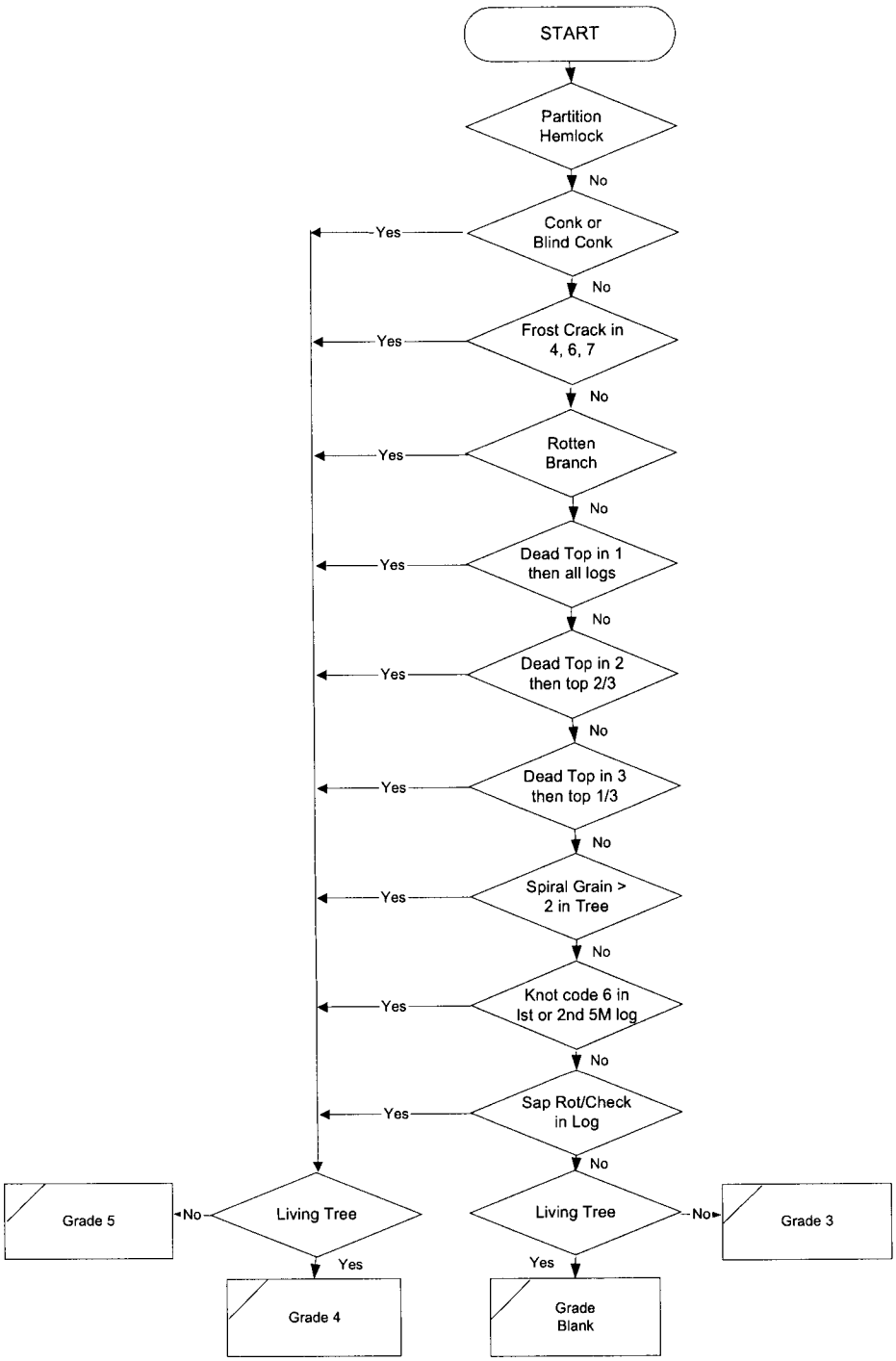


Figure A.41 Interior Log Grade Algorithm - this table converts the third of a tree into log number.

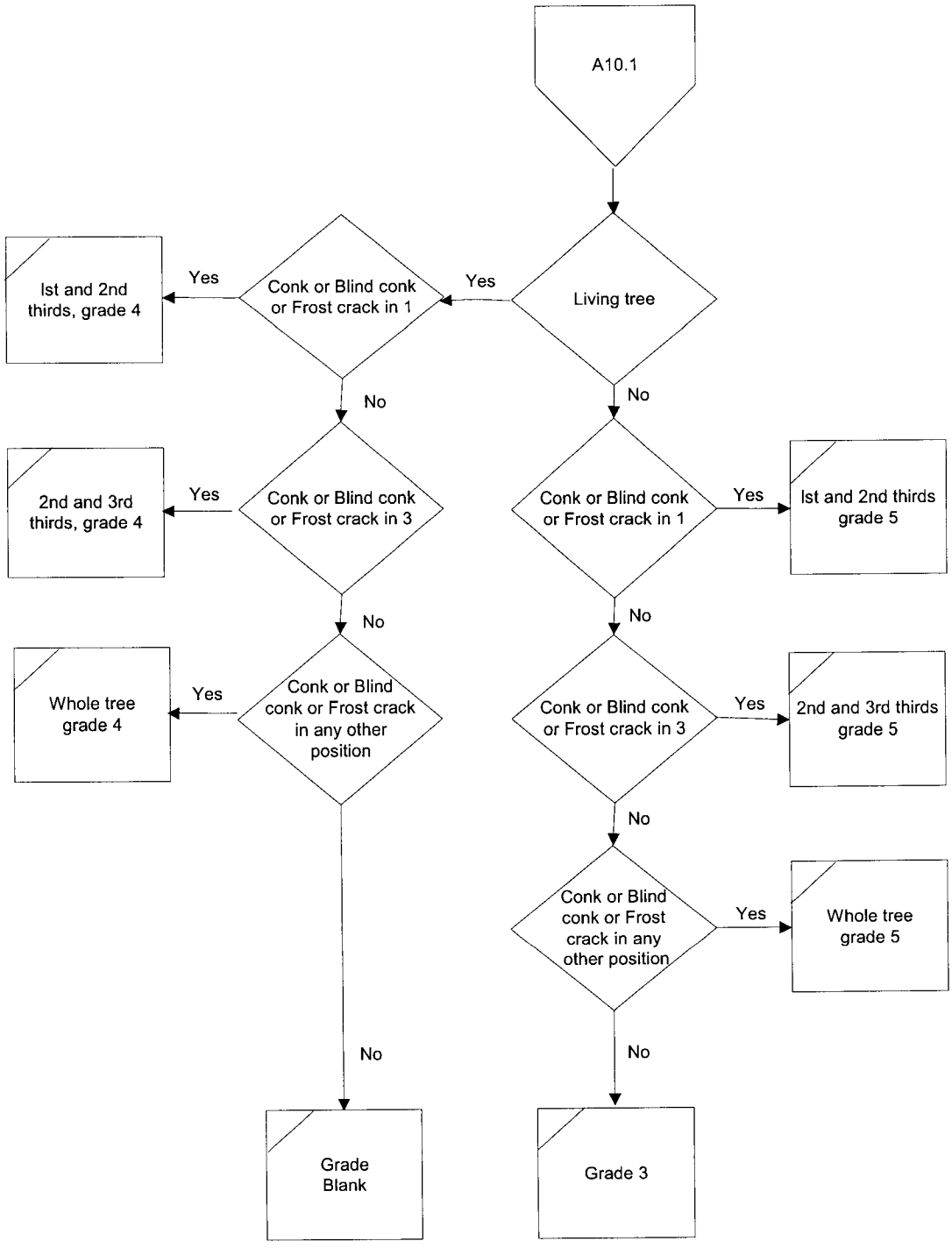


Figure A.42 Partition Hemlock.

Appendix 9 Region and District Codes

Region	Number	District	Number
Vancouver	1	Chilliwack	01
		Squamish	03
		Sunshine Coast	05
		Duncan (South Island)	06
		Port Alberni (South Island)	07
		Campbell River	08
		Port McNeill	09
		Mid-Coast	0A
		Queen Charlotte	0B
Prince Rupert	2	Lakes	01
		Morice	02
		Bulkley (Bulkley/Cassiar)	03
		Kispiox	04
		Kalum	05
		North Coast	08
		Cassiar (Bulkley/Cassiar)	09
Kamloops	3	Clearwater	01
		Kamloops	02
		Salmon Arm	03
		Vernon	04
		Penticton	05
		Merritt	06
		Lillooet	07
Prince George	4	Prince George	01
		Robson Valley	03
		Vanderhoof	04
		Fort St. James	05
		MacKenzie	06
		Dawson	07
		Fort St. John	08
		Fort Nelson	09
Nelson	5	Cranbrook	01
		Invermere	02
		Golden (Columbia)	03
		Revelstoke (Columbia)	04
		Arrow	05
		Boundary	06
		Kootenay	07

Region	Number	District	Number
Cariboo	6	Quesnel Williams Lake Horsefly 100 Mile House Chilcotin	01 02 03 04 05

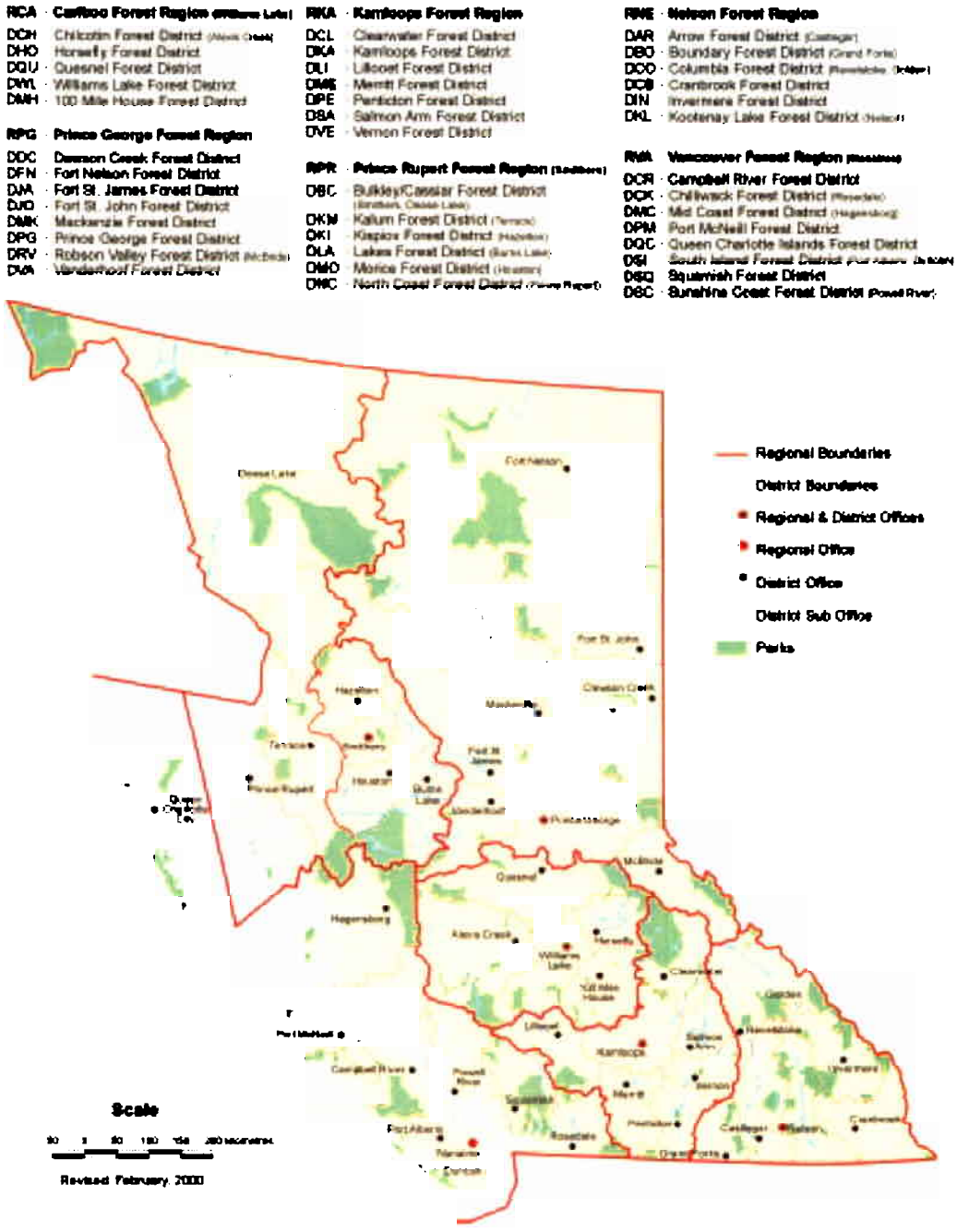


Figure A.43 Forest Region and District Boundaries.

Appendix 10 Site Index Tables for British Columbia – All Species

A.10.1 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)

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

Table of Site Index by Breast Height Age and Height
Species: Fdc – Coastal Douglas-fir

Age	Top Height (m)																									Age
	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63
	Site Index (m)																									
5																										5
10																										10
15																										15
20																										20
25																										25
30																										30
35	49	50	51																							35
40	44	45	46	48	49	50	51																			40
45	41	42	43	44	45	46	47	48	49	50																45
50	38	39	40	41	42	43	44	45	46	47	48	49	50													50
55	36	37	38	38	39	40	41	42	43	44	45	46	47	48	49	50	48	49								55
60	34	35	36	36	37	38	39	40	41	42	43	44	45	46	47	48	46	47	48	49						60
65	33	34	34	35	36	37	38	39	40	41	42	43	44	44	45	46	44	45	46	47	48	49				65
70	32	32	33	34	35	36	36	37	38	39	40	41	42	43	44	45	43	44	44	46	46	47	48	49		70
75	31	31	32	33	34	34	35	36	36	37	38	39	40	41	42	43	42	42	43	44	45	46	46	47	48	75
80	30	30	31	32	33	33	34	35	35	36	37	38	39	40	41	42	40	41	42	43	44	45	45	46	47	80
85	29	30	30	31	32	33	33	34	35	35	36	37	38	39	40	41	39	40	41	42	43	44	44	45	46	85
90	28	29	30	30	31	32	32	33	34	35	35	36	37	38	39	40	39	39	40	41	42	43	43	44	45	90
95	28	28	29	30	30	31	32	32	33	34	34	35	36	37	38	39	38	38	39	40	41	42	42	43	44	95
100	27	28	28	29	30	30	31	32	32	33	34	34	35	36	37	38	37	38	38	39	40	41	41	42	43	100
105	26	27	27	28	29	29	30	31	31	32	33	33	34	35	36	37	36	37	38	38	39	40	40	41	42	105
110	26	27	27	28	28	29	30	30	31	31	32	33	33	34	35	36	35	36	37	38	38	39	39	40	41	110
115	26	26	27	27	28	28	29	30	30	31	31	32	33	33	34	35	34	35	36	37	38	38	39	39	40	115
120	25	26	26	27	27	28	29	29	30	30	31	32	32	33	34	35	34	35	36	37	37	38	38	39	40	120
125	25	26	26	26	27	28	28	29	29	30	31	31	32	33	34	34	33	34	35	36	37	37	38	38	39	125
130	24	25	26	26	27	27	28	28	29	30	30	31	31	32	33	34	33	34	35	36	36	37	37	38	39	130
135	24	25	25	26	26	27	28	28	29	29	30	30	31	32	33	34	33	33	34	35	36	36	37	37	38	135
140	24	24	25	25	26	26	27	28	28	29	29	30	31	31	32	33	32	33	34	35	35	36	36	37	38	140
145	24	24	24	25	25	26	27	27	28	28	29	30	30	31	32	33	32	32	33	34	35	35	36	36	37	145
150	24	24	24	25	25	26	26	27	27	28	28	29	30	30	31	32	31	32	33	34	34	35	35	36	37	150
155	23	24	24	24	25	25	26	26	27	27	28	29	29	30	31	32	31	31	32	33	34	34	35	35	36	155
160	23	23	24	24	24	25	26	26	26	27	28	28	29	30	31	31	30	31	32	33	33	34	34	35	36	160
165	23	23	23	24	24	25	25	26	26	27	27	28	29	29	30	31	30	30	31	32	33	33	34	34	35	165
170	23	23	23	24	24	24	25	26	26	26	27	28	28	29	30	30	29	30	31	32	32	33	33	34	34	170
175	23	23	23	23	24	24	25	25	26	26	27	27	28	28	29	30	29	29	30	31	32	32	33	33	34	175
180	22	23	23	23	24	24	24	25	25	26	26	27	27	28	29	29	28	29	30	30	31	32	32	33	33	180
185	22	22	23	23	23	24	24	25	25	25	26	26	27	27	28	29	28	28	29	30	31	31	32	32	33	185
190	22	22	22	23	23	24	24	24	25	25	26	26	27	27	28	28	27	28	29	29	30	31	31	32	32	190
195	22	22	22	23	23	23	24	24	25	25	26	26	27	27	28	28	27	27	28	29	30	30	31	31	32	195
200	22	22	22	22	23	23	24	24	25	25	26	26	27	27	28	28	27	27	28	29	29	30	30	31	32	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 3

Table of Site Index by Breast Height Age and Height
Species: Fdc – Coastal Douglas-fir

Age	Top Height (m)																									Age
	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63
	Site Index (m)																									
5																										5
10																										10
15																										15
20																										20
25																										25
30																										30
35	49	50	51																							35
40	44	45	46	48	49	50	51																			40
45	41	42	43	44	45	46	47	48	49	50																45
50	38	39	40	41	42	43	44	45	46	47	48	49	50													50
55	36	37	38	38	39	40	41	42	43	44	45	46	47	48	49	50	48	49								55
60	34	35	36	36	37	38	39	40	41	42	43	44	45	46	47	48	46	47	48	49						60
65	33	34	34	35	36	37	38	39	40	41	42	43	44	44	45	46	44	45	46	47	48	49				65
70	32	32	33	34	35	36	36	37	38	39	40	41	42	43	44	45	43	44	44	46	46	47	48	49		70
75	31	31	32	33	34	34	35	36	36	37	38	39	40	41	42	43	42	42	43	44	45	46	46	47	48	75
80	30	30	31	32	33	33	34	35	35	36	37	38	39	40	41	42	40	41	42	43	44	45	45	46	47	80
85	29	30	30	31	32	33	33	34	35	35	36	37	38	39	40	41	39	40	41	42	43	44	44	45	46	85
90	28	29	30	30	31	32	32	33	34	35	35	36	37	38	39	40	39	39	40	41	42	43	43	44	45	90
95	28	28	29	30	30	31	32	32	33	34	34	35	36	37	38	39	38	38	39	40	41	42	42	43	44	95
100	27	28	28	29	30	30	31	32	32	33	34	34	35	36	37	38	37	38	38	39	40	41	41	42	43	100
105	26	27	27	28	29	29	30	31	31	32	33	33	34	35	36	37	36	37	38	38	39	40	40	41	42	105
110	26	27	27	28	28	29	30	30	31	31	32	33	33	34	35	36	35	36	37	38	38	39	39	40	41	110
115	26	26	27	27	28	28	29	30	30	31	31	32	33	33	34	35	34	35	36	37	38	38	39	39	40	115
120	25	26	26	27	27	28	29	29	30	30	31	32	32	33	34	35	34	35	36	37	37	38	38	39	40	120
125	25	26	26	26	27	28	28	29	29	30	31	31	32	33	34	34	33	34	35	36	37	37	38	38	39	125
130	24	25	26	26	27	27	28	28	29	30	30	31	31	32	33	34	33	34	35	36	36	37	37	38	39	130
135	24	25	25	26	26	27	28	28	29	29	30	30	31	32	33	34	33	33	34	35	36	36	37	37	38	135
140	24	24	25	25	26	26	27	28	28	29	29	30	31	31	32	33	32	33	34	35	35	36	36	37	38	140
145	24	24	24	25	25	26	27	27	28	28	29	30	30	31	32	33	32	32	33	34	35	35	36	36	37	145
150	24	24	24	25	25	26	26	27	27	28	28	29	30	30	31	32	31	32	33	34	34	35	35	36	37	150
155	23	24	24	24	25	25	26	26	27	27	28	29	29	30	31	32	31	31	32	33	34	34	35	35	36	155
160	23	23	24	24	24	25	26	26	26	27	28	28	29	30	31	31	30	31	32	33	33	34	34	35	36	160
165	23	23	23	24	24	25	25	26	26	27	27	28	29	29	30	31	30	30	31	32	33	33	34	34	35	165
170	23	23	23	24	24	24	25	26	26	26	27	28	28	29	30	30	29	30	31	32	32	33	33	34	34	170
175	23	23	23	23	24	24	25	25	26	26	27	27	28	28	29	30	29	29	30	31	32	32	33	33	34	175
180	22	23	23	23	24	24	24	25	25	26	26	27	27	28	29	29	28	29	30	30	31	32	32	33	33	180
185	22	22	23	23	23	24	24	25	25	25	26	26	27	27	28	29	28	28	29	30	31	31	32	32	33	185
190	22	22	22	23	23	24	24	24	25	25	26	26	27	27	28	28	27	28	29	29	30	31	31	32	32	190
195	22	22	22	23	23	23	24	24	25	25	26	26	27	27	28	28	27	27	28	29	30	30	31	31	32	195
200	22	22	22	22	23	23	24	24	25	25	26	26	27	27	28	28	27	27	28	29	29	30	30	31	32	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 4

Figure A.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)

Table of Site Index by Breast Height Age and Height
Species: Hwc – Western Hemlock - Coast

Age @ bh	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																	10
15	52	54	55	56													15
20	44	46	47	48	50	51	52	54	55								20
25	38	40	41	42	44	45	46	47	49	50	51	52	53	54			25
30	34	35	36	37	39	40	41	42	43	45	46	47	48	49	50	51	30
35	30	31	32	34	35	36	37	38	39	41	42	43	44	45	46	47	35
40	27	28	29	31	32	33	34	35	36	37	38	39	40	41	43	44	40
45	25	26	27	28	29	30	31	32	33	34	35	36	37	39	40	41	45
50	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	50
55	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	55
60	20	21	22	23	24	25	26	27	27	28	29	30	31	32	33	34	60
65	19	20	21	22	22	23	24	25	26	27	28	29	30	30	31	32	65
70	18	19	20	21	21	22	23	24	25	26	26	27	28	29	30	31	70
75	17	18	19	20	20	21	22	23	24	24	25	26	27	28	29	29	75
80	17	17	18	19	20	20	21	22	23	24	24	25	26	27	28	28	80
85	16	17	17	18	19	20	20	21	22	23	23	24	25	26	27	27	85
90	15	16	17	17	18	19	20	20	21	22	23	23	24	25	26	26	90
95	15	16	16	17	18	18	19	20	20	21	22	23	23	24	25	26	95
100	14	15	16	16	17	18	18	19	20	20	21	22	23	23	24	25	100
105	14	15	15	16	17	17	18	19	19	20	21	21	22	23	23	24	105
110	14	14	15	15	16	17	17	18	19	19	20	21	21	22	23	24	110
115	13	14	14	15	16	16	17	18	18	19	20	20	21	22	22	23	115
120	13	14	14	15	15	16	17	17	18	18	19	20	20	21	22	22	120
125	13	13	14	14	15	16	16	17	17	18	19	19	20	21	21	22	125
130	12	13	14	14	15	15	16	16	17	18	18	19	20	20	21	21	130
135	12	13	13	14	14	15	16	16	17	17	18	19	19	20	20	21	135
140	12	12	13	14	14	15	15	16	16	17	18	18	19	19	20	21	140
145	12	12	13	13	14	14	15	16	16	17	17	18	18	19	20	20	145
150	11	12	13	13	14	14	15	15	16	16	17	18	18	19	19	20	150
155	11	12	12	13	13	14	14	15	16	16	17	17	18	18	19	20	155
160	11	12	12	13	13	14	14	15	15	16	16	17	18	18	19	19	160
165	11	11	12	12	13	13	14	15	15	16	16	17	17	18	18	19	165
170	11	11	12	12	13	13	14	14	15	15	16	17	17	18	18	19	170
175	11	11	12	12	13	13	14	14	15	15	16	16	17	17	18	19	175
180	11	11	11	12	12	13	13	14	14	15	16	16	17	17	18	18	180
185	10	11	11	12	12	13	13	14	14	15	15	16	16	17	17	18	185
190	10	11	11	12	12	13	13	14	14	15	15	16	16	17	17	18	190
195	10	11	11	12	12	12	13	13	14	14	15	15	16	17	17	18	195
200	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

Table of Site Index by Breast Height Age and Height
Species: Hwc – Western Hemlock - Coast

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	63	64														
35	48	49	50	51	53	60	61	62								
40	46	46	47	48	49	47	46	48	60	61	62					
45	42	43	44	46	46	44	45	46	47	48	49	60	61	62		
50	39	40	41	42	43	42	42	43	45	46	47	48	48	49	60	61
55	37	38	39	40	41	40	41	42	43	44	45	46	46	47	48	49
60	35	36	37	38	39	38	39	40	41	42	43	44	45	46	46	47
65	33	34	35	36	37	36	37	38	39	40	41	42	43	44	45	46
70	32	33	34	35	35	34	35	36	37	38	39	40	41	42	43	44
75	30	31	32	33	34	32	33	34	35	36	37	38	39	40	41	42
80	29	30	31	32	33	31	32	33	34	35	36	37	38	39	40	41
85	28	29	30	31	32	30	31	32	33	34	35	36	37	38	39	40
90	27	28	29	30	31	29	30	31	32	33	34	35	36	37	38	39
95	26	27	28	29	30	28	29	30	31	32	33	34	35	36	37	38
100	25	26	27	28	29	27	28	29	30	31	32	33	34	35	36	37
105	24	25	26	27	28	26	27	28	29	30	31	32	33	34	35	36
110	24	24	25	26	27	25	26	27	28	29	30	31	32	33	34	35
115	23	24	24	25	26	25	25	26	27	28	29	30	31	32	33	34
120	23	23	24	25	25	24	25	26	27	27	28	29	30	31	32	33
125	22	23	23	24	25	24	24	25	26	27	28	29	30	31	32	33
130	22	22	23	24	24	23	24	25	26	27	28	29	30	31	32	32
135	21	22	22	23	24	23	23	24	25	26	27	28	29	30	31	32
140	21	21	22	23	23	22	23	24	25	25	26	27	28	29	30	31
145	21	21	22	22	23	22	22	23	24	25	25	26	27	28	29	30
150	21	21	21	22	22	21	22	23	24	24	25	26	27	28	28	29
155	20	21	21	21	22	21	22	22	23	24	25	26	27	27	28	29
160	20	20	21	21	22	21	21	22	23	24	24	25	26	27	28	29
165	20	20	20	21	21	20	21	22	23	23	24	25	26	27	28	29
170	19	20	20	21	21	20	21	22	22	23	24	25	26	27	28	29
175	19	19	20	20	21	20	20	21	22	23	24	25	26	27	28	28
180	19	19	19	20	21	20	20	21	22	23	24	24	25	26	27	28
185	19	19	19	20	20	20	20	21	22	22	23	24	25	26	27	28
190	19	19	19	19	20	20	20	21	21	22	23	24	25	26	27	28
195	19	19	19	19	20	20	20	21	21	22	23	24	25	26	27	27
200	18	19	19	20	20	21	21	22	22	23	24	24	25	25	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

Page 3

Table of Site Index by Breast Height Age and Height
Species: Hwc – Western Hemlock - Coast

Age @ bh	Top Height (m) 55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70
Site Index (m)																
10																
15																
20																
25																
30																
35																
40																
45																
50																
55																
60	60	61														
65	48	49	60	61												
70	46	47	48	49	50	51										
75	45	46	47	47	48	49	50									
80	43	44	45	46	46	48	49	50	50	51						
85	42	43	44	45	46	47	48	48	49	50	50					
90	41	41	42	43	44	45	46	47	48	48	49	50	51			
95	39	40	41	42	43	44	45	46	47	48	48	49	50	51		
100	38	39	40	41	42	43	44	45	46	47	48	48	49	50	50	
105	37	38	39	40	41	42	43	44	45	46	47	48	48	49	50	50
110	36	37	38	39	40	41	42	43	44	45	46	47	48	48	49	50
115	35	36	37	38	39	40	41	42	43	44	45	46	47	48	48	49
120	34	35	36	37	38	39	40	41	42	43	44	45	46	47	47	48
125	34	34	35	36	37	38	39	40	41	42	43	44	45	46	47	47
130	33	34	35	35	36	37	38	39	40	41	42	43	44	45	46	47
135	33	33	34	35	36	36	37	38	39	40	41	42	43	44	45	46
140	32	33	34	34	35	36	36	37	38	39	40	41	42	43	44	45
145	31	32	33	34	34	35	35	36	37	38	39	40	41	42	43	44
150	31	31	32	33	33	34	34	35	36	37	38	39	40	41	42	43
155	30	31	32	32	33	34	34	35	35	36	37	38	39	40	41	42
160	30	30	31	32	32	33	33	34	35	35	36	37	38	39	40	41
165	29	30	31	31	32	33	33	34	34	35	36	37	38	39	40	41
170	29	29	30	31	32	32	33	33	34	35	36	37	38	39	40	41
175	28	29	30	30	31	32	32	33	34	35	36	37	38	39	40	41
180	28	28	29	30	31	31	32	33	33	34	35	36	37	38	39	40
185	28	28	29	29	30	31	32	32	33	34	35	36	37	38	39	40
190	28	28	29	29	30	31	31	32	33	34	35	36	37	38	39	40
195	28	28	29	29	30	31	31	32	33	34	35	36	37	38	39	40
200	28	28	29	30	31	31	32	32	33	34	35	36	37	38	39	39

Years to Boring Height

Site Index	10-13	14-20	21-27	28-34	35-42	43-49	50+
Correct yrs	8	7	6	6	4	3	2

Page 4

Figure A.45 Hwc – Western Hemlock - Coast.

A.10.2 Interior

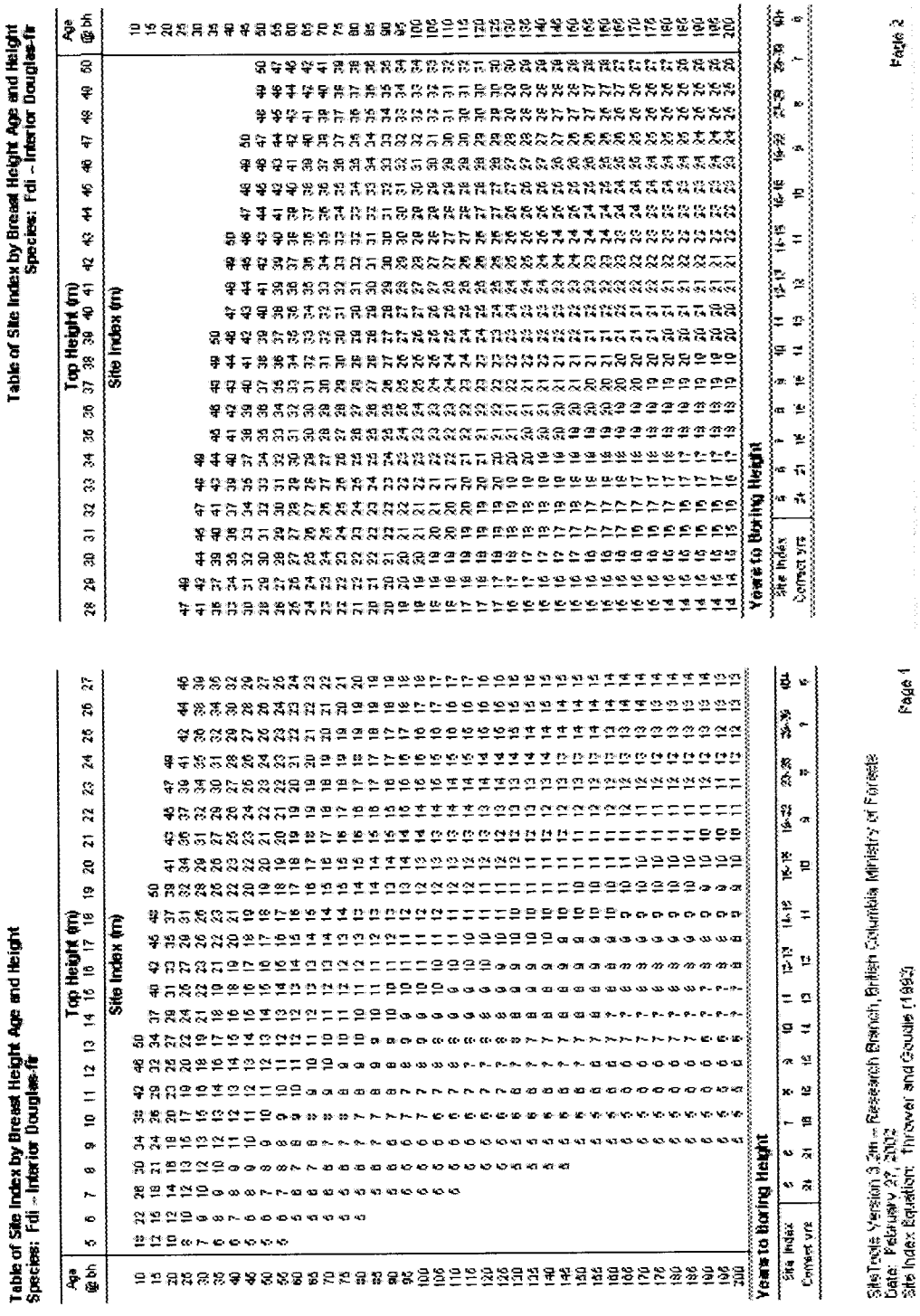


Figure A.46 Fdi – Interior Douglas-Fir.

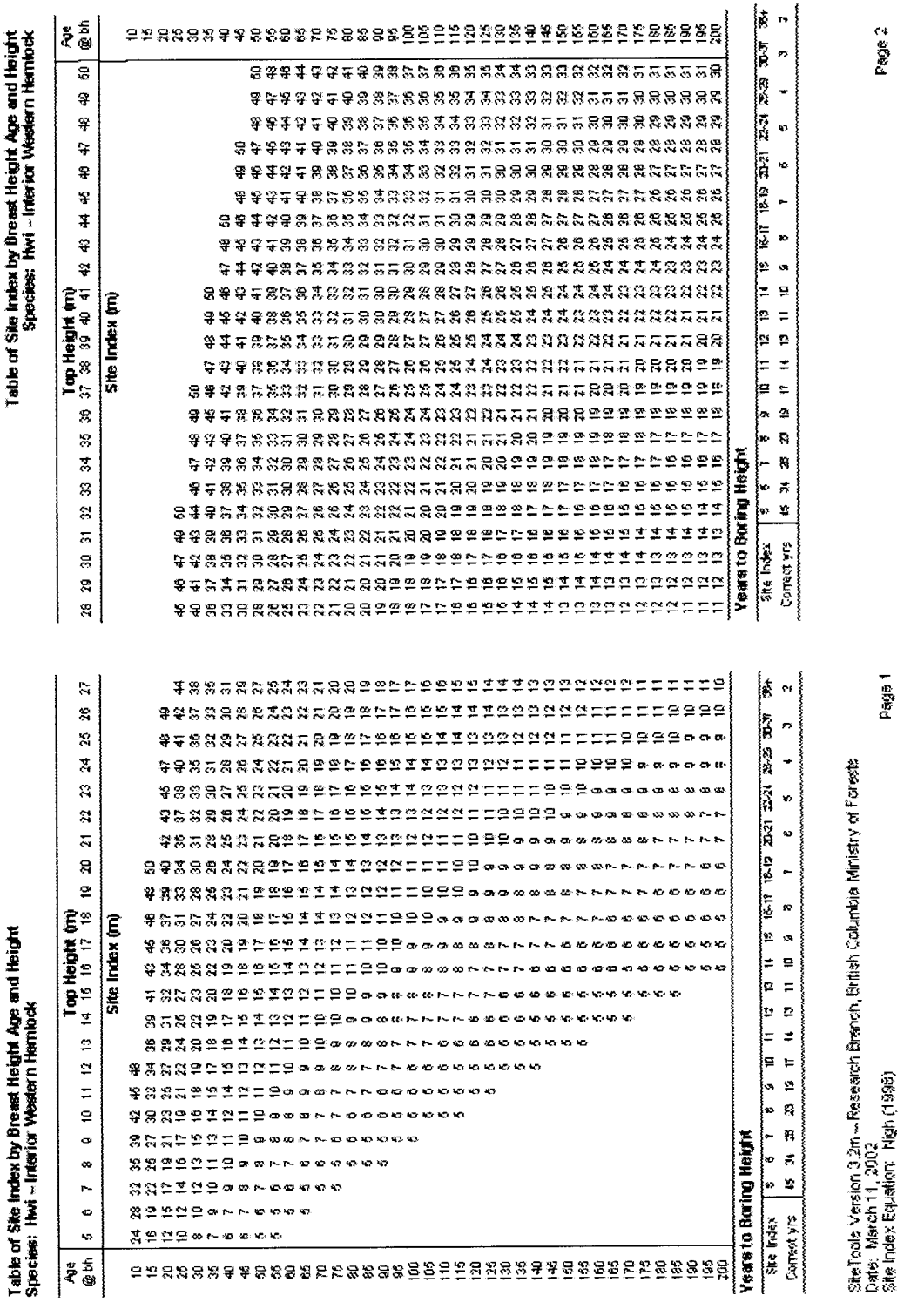


Figure A.47 Hwi – Interior Western Hemlock.

A.10.3 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												
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)

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

Table of Site Index by Breast Height Age and Height
Species: Act – Black Cottonwood - Provincial

Age	Top Height (m)																						Age
	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	
	Site Index (m)																						
10	62	64	65	66	67	68	70	71	72	73	74	75	76	78	79	80	81	82	83	84	85	86	10
15	52	53	54	55	56	57	58	59	61	62	63	64	65	66	67	68	69	70	71	72	73	74	15
20	45	46	47	48	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	20
25	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	25
30	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	30
35	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	55	35
40	32	33	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	53	40
45	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	45
50	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	50
55	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	55
60	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	42	43	44	45	46	47	48	60
65	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	42	43	44	45	46	47	65
70	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	46	70
75	23	24	25	26	27	28	29	30	31	32	34	35	35	36	37	38	39	40	41	42	43	45	75
80	22	23	24	25	26	27	28	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	80
85	21	22	23	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	41	42	43	44	85
90	21	22	23	24	25	26	27	28	29	30	31	32	33	35	36	37	38	39	40	41	42	43	90
95	20	21	22	23	24	25	26	27	28	30	31	32	33	34	35	36	37	38	39	41	42	43	95
100	19	20	21	22	23	25	26	27	28	29	30	31	32	33	35	36	37	38	39	40	41	42	100
105	19	20	21	22	23	24	25	26	27	28	30	31	32	33	34	35	36	37	38	40	41	42	105
110	18	19	20	21	22	23	24	26	27	28	29	30	31	32	34	35	36	37	38	39	40	41	110
115	17	18	19	21	22	23	24	25	26	27	29	30	31	32	33	34	35	36	37	38	40	41	115
120	17	18	19	20	21	22	23	25	26	27	28	29	30	32	33	34	35	36	37	38	40	41	120
125	16	17	18	19	21	22	23	24	25	26	28	29	30	31	32	34	35	36	37	38	39	40	125
130	16	17	18	19	20	21	22	24	25	26	27	28	30	31	32	34	35	36	37	38	39	40	130
135	15	16	17	18	20	21	22	23	24	26	27	28	29	30	32	33	34	35	36	38	39	40	135
140	14	16	17	18	19	20	22	23	24	25	26	28	29	30	31	33	34	35	36	37	38	40	140
145	14	15	16	17	19	20	21	22	24	25	26	27	29	30	31	32	33	35	36	37	38	39	145
150	13	15	16	17	18	19	21	22	23	24	26	27	28	29	31	32	33	34	36	37	38	39	150
155	13	14	15	16	18	19	20	22	23	24	25	27	28	29	30	32	33	34	35	37	38	39	155
160	12	14	15	16	17	18	20	21	22	24	25	26	28	29	30	31	33	34	35	36	38	39	160
165	12	13	14	15	17	18	19	21	22	23	25	26	27	29	30	31	32	34	35	36	37	39	165
170	12	13	14	15	16	18	19	20	22	23	24	26	27	28	30	31	32	33	35	36	37	38	170
175	11	12	13	15	16	17	19	20	21	23	24	26	27	28	29	31	32	33	35	36	37	38	175
180	11	12	13	14	15	17	18	20	21	22	24	25	27	28	29	31	32	33	34	36	37	38	180
185	10	11	12	14	15	16	18	19	21	22	24	25	26	28	29	30	32	33	34	35	37	38	185
190	10	11	12	13	15	16	17	19	20	22	23	25	26	27	29	30	31	33	34	35	37	38	190
195	10	11	12	13	14	16	17	19	20	22	23	24	26	27	29	30	31	33	34	35	36	38	195
200	9	10	11	12	14	15	17	18	20	21	23	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

Page 3

Table of Site Index by Breast Height Age and Height
Species: Act – Black Cottonwood - Provincial

Years to Boring Height

Site Index (m)	All S.I.'s
Correct yrs	2

Page 4

Figure A.48 Act – Black Cottonwood - Provincial.

Figure A.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	Top Height (m) 5	6	7	8	9	10	11	12	13	14	15	16	17	18
	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)

Table of Site Index by Breast Height Age and Height
Species: Ba – Amabilis fir – All Balsam Species - Provincial

Top Height (m) 19	20	21	22	23	24	25	26	27	28	29	30	31	32	Age @ bh
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

Table of Site Index by Breast Height Age and Height
Species: Ba – Amabilis fir – All Balsam Species - Provincial

Age	Top Height (m) 33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	Age
	Site Index (m)																												
10																													10
15																													15
20																													20
25																													25
30																													30
35																													35
40																													40
45	33																												45
50	31	32	33																										50
55	30	31	31	32																									55
60	28	29	30	31	32	33																							60
65	27	28	29	29	30	31	32																						65
70	26	27	27	28	29	30	31	32																					70
75	25	25	26	27	28	29	30	31	32																				75
80	24	25	25	26	27	28	29	30	31	32																			80
85	24	24	24	25	26	27	28	29	30	31	32																		85
90	23	23	24	24	25	26	27	28	29	30	31	32																	90
95	22	22	23	24	24	25	26	27	28	29	30	31	32																95
100	21	21	22	23	24	24	25	26	27	28	29	30	31	32															100
105	21	21	22	22	23	24	24	25	26	27	28	29	30	31	32														105
110	20	20	21	22	22	23	24	24	25	26	27	28	29	30	31	32													110
115	20	20	20	21	22	22	23	24	24	25	26	27	28	29	30	31	32												115
120	19	20	20	21	21	22	23	23	24	25	26	27	28	29	30	31	31	32											120
125	19	19	20	21	21	22	23	24	24	25	26	27	27	28	29	30	31	32											125
130	18	19	20	20	21	22	22	23	24	25	25	26	27	28	29	29	30	31	32										130
135	18	18	19	20	20	21	22	23	23	24	25	26	26	27	28	29	30	30	31	32									135
140	17	18	19	19	20	21	21	22	23	24	24	25	26	27	27	28	29	30	31	31	32								140
145	17	18	18	19	20	20	21	21	22	23	24	25	25	26	27	28	28	29	30	30	31	32							145
150	17	17	18	19	19	20	21	21	22	23	23	24	25	26	26	27	28	29	30	30	30	31							150
155	16	17	18	18	19	20	20	21	22	22	23	24	24	25	26	27	27	28	29	29	30	31	32						155
160	16	17	17	18	19	19	20	21	21	22	23	23	24	25	26	26	27	28	28	29	29	30	31						160
165	16	16	17	18	18	19	20	20	21	22	22	23	24	24	25	26	27	27	28	28	29	30	31	32					165
170	16	16	17	17	18	19	19	20	20	21	22	23	23	24	25	25	26	27	27	28	29	29	30	31	32				170
175	15	16	16	17	18	18	19	20	20	21	21	22	23	23	24	25	26	26	27	28	28	29	30	31	31	32			175
180	15	16	16	17	17	18	19	19	20	21	21	22	22	23	24	25	25	26	27	27	28	29	29	30	31	31	32		180
185	15	15	16	17	17	18	18	19	20	20	21	21	22	22	23	24	25	25	26	27	27	28	29	29	30	31	31	32	185
190	15	15	16	16	17	17	18	19	19	20	21	21	22	22	23	24	24	25	26	27	28	28	29	30	30	31	32	33	190
195	14	15	15	16	17	17	18	18	19	20	20	21	22	22	23	24	24	25	26	27	27	28	29	30	30	31	32	33	195
200	14	15	15	16	16	17	18	18	19	19	20	21	21	22	23	23	24	25	26	26	26	27	28	29	30	30	31	32	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

Table of Site Index by Breast Height Age and Height
Species: Ba – Amabilis fir – All Balsam Species - Provincial

Age	Top Height (m) 33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	Age
	Site Index (m)																												
10																													10
15																													15
20																													20
25																													25
30																													30
35																													35
40																													40
45																													45
50																													50
55																													55
60																													60
65																													65
70																													70
75																													75
80																													80
85																													85
90																													90
95																													95
100																													100
105																													105
110																													110
115																													115
120																													120
125																													125
130																													130
135																													135
140																													140
145																													145
150																													150
155																													155
160																													160
165																													165
170																													170
175																													175
180																													180
185																													185
190																													190
195																													195
200																													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

Figure A.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	Top Height (m) 6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
	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		6	6	6	7	7	8	8	9	10	10	11	12	12	13	14	14
110		6	6	6	7	7	8	8	9	10	10	11	11	12	13	13	14
115		6	6	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)

Table of Site Index by Breast Height Age and Height
Species: Cw – Western Redcedar - Provincial

Age @ bh	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																	10
15	54	56															15
20	46	47	48	50	52	53	55										20
25	38	40	41	43	44	46	47	49	50	52	53						25
30	33	35	36	38	39	40	42	43	44	46	47	48	50	51	52		30
35	30	31	32	34	35	36	37	39	40	41	42	44	45	46	47	48	35
40	27	28	29	30	32	33	34	35	36	37	39	40	41	42	43	44	40
45	25	26	27	28	29	30	31	32	33	34	35	37	38	39	40	41	45
50	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	50
55	22	23	23	24	25	26	27	28	29	30	31	32	33	34	35	36	55
60	20	21	22	23	24	25	26	27	28	28	29	30	31	32	33	34	60
65	19	20	21	22	23	24	25	26	26	27	28	29	30	30	31	32	65
70	19	19	20	21	22	23	23	24	25	26	27	28	28	29	30	31	70
75	18	19	19	20	21	22	22	23	24	25	25	26	27	28	29	30	75
80	17	18	19	19	20	21	22	22	23	24	25	25	26	27	28	29	80
85	17	17	18	19	19	20	21	22	22	23	24	25	25	26	27	28	85
90	16	17	17	18	19	20	20	21	22	22	23	24	25	25	26	27	90
95	16	16	17	18	18	19	20	20	21	22	22	23	24	25	25	26	95
100	15	16	17	17	18	19	19	20	21	21	22	23	23	24	25	25	100
105	15	16	16	17	17	18	19	19	20	21	21	22	23	23	24	25	105
110	15	15	16	16	17	18	18	19	20	20	21	22	22	23	23	24	110
115	14	15	15	16	16	17	17	18	19	19	20	20	21	22	22	23	115
120	14	15	15	15	16	17	18	18	19	19	20	20	21	21	22	23	120
125	14	14	15	15	16	17	17	18	19	19	20	20	21	22	22	23	125
130	14	14	15	15	15	16	17	18	18	19	19	20	21	21	22	22	130
135	13	14	14	15	15	16	16	17	17	18	18	19	20	20	21	21	135
140	13	14	14	15	15	16	16	17	17	18	18	19	19	20	21	21	140
145	13	13	14	15	15	16	16	17	17	18	19	19	20	20	21	21	145
150	13	13	14	14	15	16	16	17	17	18	18	19	19	20	21	21	150
155	13	13	14	14	15	15	16	16	17	18	18	19	19	20	20	21	155
160	12	13	14	14	15	15	16	16	17	17	18	18	19	20	20	21	160
165	12	13	13	14	14	15	15	16	17	17	18	18	19	19	20	20	165
170	12	13	13	14	14	15	15	16	16	17	17	18	19	19	20	20	170
175	12	13	13	14	14	15	15	16	16	17	17	18	18	19	19	20	175
180	12	12	13	14	14	15	15	16	16	17	17	18	18	19	19	20	180
185	12	12	13	13	14	14	15	15	16	16	17	18	18	19	19	20	185
190	12	12	13	13	14	14	15	15	16	16	17	17	18	18	19	19	190
195	12	12	13	13	14	14	15	15	16	16	17	17	18	18	19	19	195
200	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

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		61														
35	60	60	48	49	50	51	48	49	50	48	49	50	48	49	50	48
40	46	46	44	45	46	47	48	49	50	48	49	50	48	49	50	48
45	42	43	41	42	43	44	45	46	47	48	49	50	48	49	50	48
50	39	40	41	42	43	44	45	46	47	48	49	50	48	49	50	48
55	37	38	39	40	40	41	42	43	44	45	46	47	48	49	50	48
60	35	36	37	37	38	39	40	41	42	43	44	45	46	47	47	46
65	33	34	35	36	36	37	38	39	40	41	42	43	44	45	46	46
70	32	32	33	34	35	36	37	37	38	39	40	41	42	43	44	45
75	30	31	32	32	33	34	35	36	37	38	38	39	40	41	42	43
80	29	30	31	31	32	33	34	35	36	36	37	38	39	40	41	42
85	28	29	30	31	31	32	33	34	35	35	36	37	38	39	40	41
90	27	28	29	30	30	31	32	33	34	34	35	36	37	38	39	40
95	27	27	28	29	30	30	31	32	33	33	34	35	36	37	38	39
100	26	27	27	28	29	29	30	31	32	32	33	34	35	36	37	38
105	25	26	27	27	28	28	29	30	31	31	32	33	34	35	36	36
110	25	25	26	27	27	28	29	29	30	30	31	32	33	34	35	35
115	24	25	25	26	27	27	28	29	29	30	31	31	32	33	34	34
120	24	24	25	25	26	26	27	28	28	29	30	30	31	32	33	33
125	23	24	24	25	25	26	26	27	28	28	29	30	31	32	32	33
130	23	23	24	24	25	25	26	26	27	27	28	29	30	31	31	32
135	23	23	23	24	24	25	25	26	26	27	27	28	29	30	31	31
140	22	23	23	23	24	24	25	25	26	26	27	28	28	29	30	31
145	22	22	23	23	23	24	24	25	25	26	26	27	28	28	29	30
150	22	22	22	23	23	24	24	25	25	25	26	27	27	28	29	30
155	21	22	22	22	23	23	24	24	25	25	26	26	27	28	28	29
160	21	21	22	22	22	23	23	24	24	25	25	26	27	27	28	29
165	21	21	21	22	22	22	23	23	24	24	25	25	26	27	27	28
170	21	21	21	22	22	22	23	23	24	24	25	25	26	26	27	28
175	21	21	21	21	22	22	23	23	23	24	24	25	25	26	27	27
180	20	21	21	21	22	22	22	23	23	24	24	25	25	26	26	27
185	20	21	21	21	22	22	22	23	23	24	24	25	25	26	26	27
190	20	21	21	21	22	22	22	23	23	24	24	25	25	26	26	27
195	20	20	21	21	21	22	22	22	23	23	24	24	25	25	26	26
200	20	20	21	21	21	22	22	22	23	23	24	24	25	25	26	26

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 3

Table of Site Index by Breast Height Age and Height
Species: Cw – Western Redcedar - Provincial

Age @ bh	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																	10
15																	15
20																	20
25																	25
30																	30
35																	35
40																	40
45																	45
50																	50
55																	55
60	49																60
65	47	48	49														65
70	46	46	47	48	46	49	46	49									70
75	43	44	45	47	46	47	47	46	46	49							75
80	42	43	43	44	45	46	46	47	47	47	48						80
85	40	41	42	43	44	44	44	46	46	46	47	48					85
90	39	40	41	41	42	43	44	44	45	45	46	46	48	48			90
95	38	38	40	40	41	42	43	43	44	44	45	45	46	47	49		95
100	37	37	38	38	40	41	42	42	43	43	44	44	45	46	47	48	100
105	36	36	37	38	38	39	40	41	42	42	43	43	44	45	46	47	105
110	35	35	36	36	37	38	39	40	40	41	42	42	43	44	45	46	110
115	34	35	35	36	36	37	38	39	39	40	41	41	42	43	44	45	115
120	34	34	34	35	35	36	37	38	38	39	40	40	41	42	43	44	120
125	33	33	34	34	35	35	36	37	37	38	39	39	40	41	42	43	125
130	32	33	33	34	34	35	35	36	37	37	38	38	39	40	41	42	130
135	32	32	33	33	34	34	35	35	36	36	37	38	38	39	40	41	135
140	31	32	32	33	33	34	34	35	35	36	36	37	38	38	39	40	140
145	31	31	32	32	33	33	34	34	35	35	36	36	37	38	38	39	145
150	30	31	31	32	32	33	33	34	34	35	35	36	36	37	38	39	150
155	30	30	31	31	32	32	33	33	34	34	35	35	36	37	38	38	155
160	29	30	30	31	31	32	32	33	33	34	34	35	35	36	37	38	160
165	29	29	30	30	31	31	32	32	33	33	34	34	35	36	36	37	165
170	28	29	29	30	30	31	31	32	32	33	33	34	34	35	36	37	170
175	28	28	29	29	30	30	31	31	32	32	33	33	34	35	35	36	175
180	27	28	28	29	29	30	30	31	31	32	32	33	33	34	35	35	180
185	27	27	28	28	29	29	30	30	31	31	32	32	33	34	34	35	185
190	26	27	27	28	28	29	29	30	30	31	31	32	32	33	34	34	190
195	26	26	27	27	28	28	29	29	30	30	31	31	32	33	33	34	195
200	25	26	26	27	27	28	28	29	29	30	30	31	31	32	33	33	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 4

Figure A.51 Cw – Westerm Redcedar - Provincial.

Table of Site Index by Breast Height Age and Height
Species: Dr – Red Alder - Provincial

Age @ bh	Top Height (m)																								Age @ bh
	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	
	Site Index (m)																												
10	13	16	18	21	23	26	29	31	33	36	38																		10
15	10	12	13	15	17	19	21	22	24	26	28	30	31	33															15
20	8	10	11	13	14	16	17	19	20	22	23	25	26	28	29	31	32												20
25	7	9	10	11	13	14	15	17	18	19	21	22	23	25	26	27	28	30											25
30	7	8	9	11	12	13	14	15	17	18	19	20	21	23	24	25	26	27	29	30									30
35	7	8	9	10	11	12	13	15	16	17	18	19	20	21	22	24	25	26	27	28	29								35
40	6	7	9	10	11	12	13	14	15	16	17	18	19	20	21	22	24	25	26	27	28	29							40
45	6	7	8	9	10	11	12	13	14	15	16	18	19	20	21	22	23	24	25	26	27	28	29						45
50	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29					50
55	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	21	22	23	24	25	26	27	28					55
60	6	7	8	9	10	11	12	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29				60
65	6	7	8	9	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	24	25	26	27	28				65
70	6	7	7	8	9	10	11	12	13	14	15	16	17	18	19	19	20	21	22	23	24	25	26	27	28	29			70
75	6	6	7	8	9	10	11	12	13	14	15	16	17	17	18	19	20	21	22	23	24	25	26	27	27	28			75
80	6	6	7	8	8	10	11	12	13	14	15	15	16	17	18	19	20	21	22	23	24	24	25	26	27	28			80
85	5	6	7	8	8	10	11	12	13	14	14	15	16	17	18	19	20	21	22	22	23	24	25	26	27	28	29		85
90	5	6	7	8	9	10	11	12	13	13	14	15	16	17	18	19	20	20	21	22	23	24	25	26	27	28	28		90
95	5	6	7	8	9	10	11	12	12	13	14	15	16	17	18	19	19	20	21	22	23	24	25	26	26	27	28	29	95
100	5	6	7	8	9	10	11	11	12	13	14	15	16	17	18	19	20	21	22	22	23	24	25	25	26	27	28	29	100

Years to Boring Height

Site Index Correct yrs	≤ 6 5	7-14 4	15-21 3	22-28 2	29+ 1

SiteTools Version 3.2m – Research Branch, British Columbia Ministry of Forests
Date: February 27, 2002
Site Index Equation: Nigh and Courtin (1998)

Figure A.52 Dr – Red Alder - Provincial.

Table of Site Index by Breast Height Age and Height
Species: Lw – Western Larch - Provincial

Site Index (m)

Age @ bh	Top Height (m) 6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
10	20	23	26	29	32	35	38	41	44	47	50											
15	16	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	26	28	29	30	31	33	34	35	36	38	39	40	41	43
30	9	11	12	13	15	16	17	18	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	38
35	8	9	11	12	13	14	15	16	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37
40	7	8	9	10	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35
45	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33
50	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
55	5	6	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
60		5	6	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
65			5	6	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29
70				5	6	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
75					5	6	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
80						5	6	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
85							5	6	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
90								5	6	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
95									5	6	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
100										5	6	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
105											5	6	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
110												5	6	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
115													5	6	6	7	8	9	10	11	12	13	14	15	16	17	18	19
120														5	6	6	7	8	9	10	11	12	13	14	15	16	17	18
125															5	6	6	7	8	9	10	11	12	13	14	15	16	17
130																5	6	6	7	8	9	10	11	12	13	14	15	16
135																	5	6	6	7	8	9	10	11	12	13	14	15
140																		5	6	6	7	8	9	10	11	12	13	14
145																			5	6	6	7	8	9	10	11	12	13
150																				5	6	6	7	8	9	10	11	12
155																					5	6	6	7	8	9	10	11
160																						5	6	6	7	8	9	10
165																							5	6	6	7	8	9
170																								5	6	6	7	8
175																									5	6	6	7
180																										5	6	6
185																											5	6
190																												5
195																												
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

SiteTools Version 3.2m – Research Branch, British Columbia Ministry of Forests
Date: March 11, 2002
Site Index Equation: Milner (1992)

Page 1

Table of Site Index by Breast Height Age and Height
Species: Lw – Western Larch - Provincial

Site Index (m)

Age @ bh	Top Height (m) 26	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																								10
15																								15
20																								20
25	44	46	47	48	50																			25
30	39	40	41	43	44	45	46	47	48	49	50													30
35	35	36	37	39	40	41	42	43	44	45	46	47	48	49	50									35
40	32	33	34	35	37	38	39	40	41	42	43	44	45	46	47	48	49	50						40
45	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50			45
50	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	50
55	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	55
60	24	26	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	60
65	23	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	65
70	22	22	23	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	70
75	21	22	22	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	75
80	20	21	22	22	23	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	80
85	19	20	21	22	22	23	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	85
90	19	20	20	21	22	22	23	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	90
95	18	19	20	20	21	22	22	23	24	24	25	26	27	28	29	30	31	32	33	34	35	36	37	95
100	18	19	19	20	21	21	22	23	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	100
105	17	18	19	20	20	21	22	22	23	24	25	26	27	28	28	29	30	31	32	33	34	35	36	105
110	17	18	19	19	20	21	21	22	23	24	24	25	26	27	28	28	29	30	31	32	33	34	35	110
115	16	17	18	19	19	20	21	22	22	23	24	25	26	26	27	28	29	30	31	31	32	33	34	115
120	16	17	17	18	19	19	20	21	22	22	23	24	25	26	26	27	28	29	30	31	31	32	33	120
125	16	16	17	18	18	19	20	21	21	22	23	24	24	25	26	27	27	28	29	30	31	32	33	125
130	15	16	17	17	18	19	19	20	21	22	22	23	24	25	25	26	27	28	29	30	31	31	32	130
135	15	16	16	17	18	18	19	20	20	21	22	23	23	24	25	26	26	27	28	29	30	31	32	135
140	15	15	16	17	17	18	19	19	20	21	22	22	23	24	25	25	26	27	28	29	30	31	32	140
145	14	15	16	16	17	18	18	19	20	20	21	22	23	24	24	25	26	27	28	29	30	31	32	145
150	14	15	15	16	17	17	18	19	19	20	21	22	22	23	24	25	26	27	28	29	30	31	32	150
155	14	14	15	16	16	17	18	18	19	20	21	21	22	23	24	24	25	26	27	28	29	30	31	155
160	13	14	15	15	16	17	17	18	19	19	20	21	22	22	23	24	25	26	27	28	29	30	31	160
165	13	14	14	15	16	16	17	18	18	19	20	21	21	22	23	24	25	26	27	28	29	30	31	165
170	13	13	14	15	15	16	17	17	18	19	20	20	21	22	23	24	25	26	27	28	29	30	31	170
175	13	13	14	14	15	16	16	17	18	19	19	20	21	22	23	24	25	26	27	28	29	30	31	175
180	13	13	14	14	15	15	16	17	18	18	19	20	21	22	22	23	24	25	26	27	28	29	30	180
185	13	13	14	14	15	15	16	17	17	18	19	20	21	21	22	23	24	25	26	27	28	29	30	185
190	13	13	14	14	15	15	16	16	17	18	19	20	20	21	22	23	24	25	26	27	28	29	30	190
195	13	14	14	15	15	16	16	17	18	19	19	20	21	21	22	23	24	25	26	27	28	29	30	195
200	13	14	14	15	16	16	17	17	18	19	19	20	21	21	22	23	24	25	26	27	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	6

Page 2

Figure A.53 Lw – Western Larch – Provincial.

Table of Site Index by Breast Height Age and Height
Species: Pli – Lodgepole Pine - Provincial

Site Index (m)

Age @ bh	Top Height (m) 5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
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	31	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	32	33	34	36	37	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	24	25	26	27	28	29	30	32
40	6	7	8	9	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29
45	6	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	8	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
60	5	6	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
65	5	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	25
70	5	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	24	25
75		5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	24	25
80		5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	24	25
85		5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	24	25
90		5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	24	25
95			6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	24	25
100			5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
105			5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
110			5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
115				6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
120				6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
125				6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
130				5	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
135				5	6	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
140				5	6	7	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
145				5	6	7	8	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
150				5	6	7	8	9	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
155				5	6	7	8	9	10	12	13	14	15	16	17	18	19	20	21	22	23	24	25
160				5	6	7	8	9	10	11	13	14	15	16	17	18	19	20	21	22	23	24	25
165				5	6	7	8	9	10	11	12	14	15	16	17	18	19	20	21	22	23	24	25
170					6	7	8	9	10	11	12	13	15	16	17	18	19	20	21	22	23	24	25
175					5	6	7	8	9	10	11	12	13	15	16	17	18	19	20	21	22	23	24
180					5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
185					5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
190					5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
195					5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
200					5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23

Years to Boring Height

Site Index	5	6	7	8	9	10-11	12-14	15-17	18-21	22-26	27-30	31+
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 (1995)

Page 1

Table of Site Index by Breast Height Age and Height
Species: Pli – Lodgepole Pine - Provincial

Site Index (m)

Age @ bh	Top Height (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																								10
15																								15
20	46	47	48	49																				20
25	40	41	42	44	45	46	47	48	50															25
30	36	37	38	40	41	42	43	44	46	47	48	50												30
35	33	34	36	37	38	39	40	41	42	43	44	46	47	48	50									35
40	31	32	33	34	36	37	38	39	40	41	42	43	44	45	46	47	48	50						40
45	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	50			45
50	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	50
55	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	55
60	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	60
65	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	65
70	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	70
75	24	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	75
80	23	24	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	80
85	22	23	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	85
90	22	22	23	24	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	90
95	21	22	22	23	24	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	95
100	21	21	22	23	23	24	25	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	100
105	21	21	22	22	23	24	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	105
110	20	21	21	22	23	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	110
115	20	20	21	22	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	115
120	20	20	21	21	22	23	24	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	120
125	19	20	20	21	22	23	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	125
130	19	19	20	21	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	130
135	19	19	20	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	135
140	18	19	19	20	21	22	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	140
145	18	18	19	20	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	145
150	18	18	19	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	150
155	17	18	18	19	20	21	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	155
160	17	17	18	19	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	160
165	17	17	18	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	165
170	16	17	17	18	19	20	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	170
175	16	16	17	18	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	175
180	15	16	16	17	18	19	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	180
185	15	15	16	17	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	185
190	15	15	16	16	17	18	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	190
195	14	15	15	16	17	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	195
200	14	14	15	16	16	17	18	19	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	200

Years to Boring Height

Site Index	5	6	7	8	9	10-11	12-14	15-17	18-21	22-26	27-30	31+
Correct yrs	16	14	12	11	10	9	8	7	6	5	4	3

Page 2

Figure A.54 Pli – Lodgepole Pine - Provincial.

Figure A.55 Pw – Western White Pine – Provincial.

Table of Site Index by Breast Height Age and Height
Species: Py – Ponderosa Pine - Provincial

Age @ bh	Top Height (m) 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	22	27	32	37	42	47																	
15	14	18	21	25	28	31	34	38	41	44	47	50											
20	11	13	15	18	21	23	26	28	31	33	35	38	40	42	45	47	49						
25	9	11	13	16	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	31	33	34	36	37
40	6	7	8	9	10	11	12	13	15	16	17	18	19	21	22	23	24	26	27	28	29	31	32
45	5	6	7	8	9	10	11	12	13	14	15	16	18	19	20	21	22	23	24	25	26	27	28
50	5	6	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
55		5	6	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
60		5	5	6	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
65			5	5	6	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
70			5	5	5	6	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
75					5	5	6	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
80					5	5	5	6	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
85						5	5	5	6	6	7	8	9	10	11	12	13	14	15	16	17	18	19
90							5	5	5	6	6	7	8	9	10	11	12	13	14	15	16	17	18
95									5	5	6	6	7	8	9	10	11	12	13	14	15	16	17
100											5	5	6	6	7	8	9	10	11	12	13	14	15
105													5	5	6	6	7	8	9	10	11	12	13
110															5	5	6	6	7	8	9	10	11
115																	5	5	6	6	7	8	9
120																			5	5	6	6	7
125																					5	5	6
130																							5
135																							
140																							
145																							
150																							
155																							
160																							
165																							
170																							
175																							
180																							
185																							
190																							
195																							
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	23	24	25	26	27
Correct yrs	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	-1	-2	-3	-4	-5	-6	-7	-8

SiteTools Version 3.2m – Research Branch, British Columbia Ministry of Forests
Date: March 11, 2002
Site Index Equation: Haiti and Somerville (1980)

Page 1

Table of Site Index by Breast Height Age and Height
Species: Py – Ponderosa Pine - Provincial

Age @ bh	Top Height (m) 26	27	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																										10
15																										15
20																										20
25																										25
30																										30
35																										35
40																										40
45																										45
50																										50
55																										55
60																										60
65																										65
70																										70
75																										75
80																										80
85																										85
90																										90
95																										95
100																										100
105																										105
110																										110
115																										115
120																										120
125																										125
130																										130
135																										135
140																										140
145																										145
150																										150
155																										155
160																										160
165																										165
170																										170
175																										175
180																										180
185																										185
190																										190
195																										195
200																										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														

Page 2

Figure A.56 Py – Ponderosa Pine – Provincial.

Table of Site Index by Breast Height Age and Height
Species: Sb – Black Spruce - Provincial

Age @ bh	Top Height (m) 5	6	7	8	9	10	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	47	48	49	50	Age @ bh
	Site Index (m)																																														
10	17	20	23	25	27	29	32	34	35	37	39	41	43	44	46	47	49																														10
15	13	15	17	19	21	23	25	27	28	30	31	33	34	36	37	39	40	41	43	44	45	46	48	49	50																						15
20	10	12	14	16	18	19	21	23	24	25	27	28	29	31	32	33	35	36	37	39	40	41	42	44	45	46	48	49	50																		20
25	8	10	12	13	15	16	18	19	20	22	23	24	26	27	28	30	31	32	33	35	36	37	38	40	41	42	43	45	46	47	48	49	50														25
30	8	9	10	12	13	15	16	17	18	20	21	22	23	25	26	27	28	30	31	32	33	34	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50										30
35	7	8	9	11	12	13	15	16	17	18	20	21	22	23	24	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50						35
40	6	7	8	9	11	12	13	14	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	47	48	49	50				40
45	5	6	7	8	9	10	11	12	13	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	47	48	49	50		45
50	5	6	7	8	9	10	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	47	48	49	50	50
55	5	6	7	8	9	10	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	47	48	49	50	55
60		6	6	7	8	9	10	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	47	48	49	60
65		6	6	7	8	9	10	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	47	48	49	65
70		6		6	7	8	9	10	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	47	48	49	70
75				6	7	8	9	10	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	47	48	49	50	75
80				6	7	8	9	10	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	47	48	49	50	80
85				6	7	8	9	10	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	47	48	49	50	85
90					6	7	8	9	10	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	47	48	49	50	90
95					5	6	7	8	9	10	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	47	48	49	95
100					5	6	7	8	9	10	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	47	48	49	100
105						6	7	8	9	10	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	47	48	49	50	105
110						6	7	8	9	10	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	47	48	49	50	110
115						5	6	7	8	9	10	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	47	48	49	115
120						5	6	7	8	9	10	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	47	48	49	120
125						5	6	7	8	9	10	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	47	48	49	125
130						5	6	7	8	9	10	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	47	48	49	130
135							6	7	8	9	10	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	47	48	49	50	135
140							6	7	8	9	10	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	47	48	49	50	140
145							6	7	8	9	10	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	47	48	49	50	145
150							5	6	7	8	9	10	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	47	48	49	150
155							5	6	7	8	9	10	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	47	48	49	155
160							5	6	7	8	9	10	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	47	48	49	160
165							5	6	7	8	9	10	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	47	48	49	165
170								6	7	8	9	10	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	47	48	49	50	170
175								6	7	8	9	10	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	47	48	49	50	175
180								5	6	7	8	9	10	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	47	48	49	180
185								5	6	7	8	9	10	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	47	48	49	185
190									5	6	7	8	9	10	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	47	48	49	190
195									5	6	7	8	9	10	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	47	48	49	195
200									5	6	7	8	9	10	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	47	48	49	200

Years to Boring Height																																														
Site Index	5	6	7	8	9	10-11	12-13	14-17	18-24	25-41	42	2	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	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)

Page 1

Figure A.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)

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

Table of Site Index by Breast Height Age and Height
Species: Ss- Sitka Spruce - Provincial

Age @bh	Top Height (m) 38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54
	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

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
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	42	43	44	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 A.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	Top Height (m) 6	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	18	19	22	24	27	29	31	33	35	37	39	40	42	44	45	47	48	50					
20	13	15	17	18	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	29	30	31	32	33
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	6	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
55	6	6	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
60		6	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
65		6	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
70			6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
75			6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
80				6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
85				6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
90					6	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
95					6	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
100					6	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
105						8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
110						8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
115						8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
120							9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
125							9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
130							9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
135								10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
140								10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
145								10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
150									11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
155									11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
160									11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
165									11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
170										13	14	15	16	17	18	19	20	21	22	23	24	25	26
175										13	14	15	16	17	18	19	20	21	22	23	24	25	26
180										13	14	15	16	17	18	19	20	21	22	23	24	25	26
185										13	14	15	16	17	18	19	20	21	22	23	24	25	26
190											14	15	16	17	18	19	20	21	22	23	24	25	26
195											14	15	16	17	18	19	20	21	22	23	24	25	26
200											14	15	16	17	18	19	20	21	22	23	24	25	26

Years to Boring Height																							
Site Index	5	6	7	8	9	10	11	12-13	14-15	16-17	18-20	21-25	26-30	31-40	41+								
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, 2003
Site Index Equation: Goudie (1984) (natural)

Page 1

Table of Site Index by Breast Height Age and Height
Species: Sw – White Spruce and Englemann Spruce – Provincial

Age @ bh	Top Height (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
	Site Index (m)																							
10																								10
15																								15
20	49																							20
25	43	44	45	47	48	49	50																	25
30	39	40	41	42	43	44	45	46	47	48	50													30
35	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50								35
40	32	33	34	35	36	37	38	40	41	42	43	44	45	46	47	48	49	50						40
45	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50			45
50	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	50
55	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	55
60	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	60
65	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	65
70	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	70
75	21	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	75
80	20	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	80
85	19	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	85
90	19	19	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	90
95	18	18	19	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	95
100	17	18	18	19	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	100
105	17	17	18	18	19	20	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	105
110	16	17	17	18	18	19	20	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	110
115	16	16	17	17	18	18	19	20	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	115
120	15	16	16	17	17	18	18	19	20	20	21	22	23	24	25	26	27	28	29	30	31	32	33	120
125	15	15	16	16	17	17	18	18	19	20	20	21	22	23	24	25	26	27	28	29	30	31	32	125
130	14	15	15	16	16	17	17	18	18	19	20	20	21	22	23	24	25	26	27	28	29	30	31	130
135	14	14	15	15	16	16	17	17	18	18	19	20	20	21	22	23	24	25	26	27	28	29	30	135
140	13	14	14	15	15	16	16	17	17	18	18	19	20	20	21	22	23	24	25	26	27	28	29	140
145	13	13	14	14	15	15	16	16	17	17	18	18	19	20	20	21	22	23	24	25	26	27	28	145
150	12	13	13	14	14	15	15	16	16	17	17	18	18	19	20	20	21	22	23	24	25	26	27	150
155	12	12	13	13	14	14	15	15	16	16	17	17	18	18	19	20	20	21	22	23	24	25	26	155
160	11	12	12	13	13	14	14	15	15	16	16	17	17	18	18	19	20	20	21	22	23	24	25	160
165	11	11	12	12	13	13	14	14	15	15	16	16	17	17	18	18	19	20	20	21	22	23	24	165
170	10	11	11	12	12	13	13	14	14	15	15	16	16	17	17	18	18	19	20	20	21	22	23	170
175	10	10	11	11	12	12	13	13	14	14	15	15	16	16	17	17	18	18	19	20	20	21	22	175
180	9	10	10	11	11	12	12	13	13	14	14	15	15	16	16	17	17	18	18	19	20	20	21	180
185	9	9	10	10	11	11	12	12	13	13	14	14	15	15	16	16	17	17	18	19	19	20	21	185
190	9	9	9	10	10	11	11	12	12	13	13	14	14	15	15	16	16	17	18	18	19	20	20	190
195	8	9	9	9	10	10	11	11	12	12	13	13	14	14	15	15	16	17	17	18	19	19	20	195
200	8	8	9	9	9	10	10	11	11	12	12	13	13	14	14	15	16	16	17	18	18	19	20	200

Years to Boring Height																							
Site Index	5	6	7	8	9	10	11	12-13	14-15	16-17	18-20	21-25	26-30	31-40	41+								
Correct yrs	30	27	24	22	20	19	18	17	16	15	14	13	12	11	10								

Page 2

Figure A.59 Sw – White and Englemann Spruce - Provincial.

Forms

The following forms with FS numbers are provided in a fillable format that can be downloaded from the Internet. The FS 693 Provincial Cruise Plan and FS 698 Provincial Comparative Cruise Checklist are the only forms that are available to the public. The FS 694 Provincial Cruise Plan and Map Check List, FS 695 Provincial Office Check of Field Cruise Data, FS 696 Provincial Field Check Cruise Summary, and FS 697 Provincial Compilation Check Form are available for in service only.

The sites are located under:

Internet	http://www.for.gov.bc.ca/pscripts/ISB/FORMS/forms.asp
Intranet (In Service)	http://wwwinternal.for.gov.bc.ca/iscripts/ISB/FORMS/forms.asp

FS 693 Provincial Cruise Plan

PROVINCIAL CRUISE PLAN

TENURE: C.P.:	CRUISE BASE OR SCALE BASE

A. ATTENTION:

District Manager:

Licensee: | Contact:

Geographic Location:

TSA: | PSYU: | FIZ: | Inv. Reg. No: | Compt. No:

Coast: | Immature: | Mature: | Both:

B. CRUISING AGENCY: | **COMPILING AGENCY:**

Name: | Name:

Address: | Address:

C. TENTATIVE CRUISE DATES:

From: | To:

Proposed Years of Logging: | Access:

D. HARVESTING SYSTEM:

Harvesting System: | Selective Harvesting[1]

Systematic Grid: | Partial Cut Area (ha)[2]

1. Segregate silv. system (patch clearcut, seed tree, note avg. opening size).

DAMAGE CRUISE: (indicate the type of damage .. insects, fire, etc)

E. PLOT NO:

Measure Plots: | Count Plots: | Estimated C.V.: | S.E. Waived (Y/N):

Grid Spacing (in m) | by | 200 x 200 m if cruise < 250 ha; 250 x 250 m if cruise ≥ 250 ha

PLOT TYPE: Prism/Relascope: | Fixed Area: | Plot Size (ha):

BORDER PLOTS (BP) (Y/N) | Sampling Error Requirement Waived ☐ Yes ☐ No

10 m Off-set (Y/N) | DIAMETER LIMITS

F. MINIMUM DIAMETER LIMITS:	COAST		INTERIOR	
	Mature	Immature	Species (cm to)	Exemption (cm)
Field Tally				
Compilation - Appraisal (cm)				
Compilation - Utilization (cm)				

G. MARKING	Ribbon Colour	Paint Colour	Axe Blaze	Other (tags)
Boundaries				
Baseline				
Strips				
Plot Centre				
Tie Points				
Non Forest Types				
Riparian Areas				
Wildlife Tree Patches				
Other				

H. TREE HEIGHTS: (TOTAL HEIGHT METHOD IS MANDATORY)

Height Estimation Method (ocular, vertex, etc.) | Height Measuring Instrument (clino, hypsometer, etc.)

I. OTHER:

Comments:

Note The original traverse notes must be provided to Forest Service staff upon request.:

Figure F.1 FS 693 - Provincial Cruise Plan (Page 1 of 2).

SECTIONS J, K, L (TO BE FILLED OUT WHEN REQUIRED)

J. STRATIFIED SYSTEMATIC SAMPLING: (Calculate sampling requirements for each timber type)

				A	B	C	D	E	F	G	H
Type No.	Type Description	BEC Subzone /Variant	Plot/Prism size	Type Area (ha)	Average m^3/ha	Estimated Vol/Type m^3	Type Vol. % of Total Vol.	Estimated Type CV	Weighted Type CV	Total Plots/CP	Grid Spacing
1										Refer to	
2										Sections	
3										2.4, 2.5	
4										Provincial	
5										Cruising	
6										Manual	
7											
			Tot. Ha's		Tot. Vol.		Tot. Weighted CV				

EXPLANATION OF FORMULA

C = A X B

$$D = \frac{C}{\text{Sum C1...7}} \times 100$$

E = cruising manual, section 2.62

Variable Plot F = D X E

Fixed Plot F = A X E

G = cruising manual section 2.4, 2.5

$$H = \sqrt{\frac{\text{Total hectares} \times 10{,}000}{\text{G (number of plots)}}}$$

K. SOURCE OF CV ESTIMATES

Type 1: _____
Type 2: _____
Type 3: _____
Type 4: _____
Type 5: _____
Type 6: _____
Type 7: _____

L. INSTRUCTIONS FOR SECTIONS

A Enter district and tenure information.
B Enter the name and address of the cruising and compiling agencies.
C Enter the tentative start and completion dates of the field work.
D Enter yes beside applicable headings.
E Enter the number of plots and the grid spacing.
F Enter the diameter limits measured and compiled to, and prism BAF.
G Enter the colour(s) of paint and flagging used, and the type of blazing and plot tags.
H Enter the appropriate height estimation method, and height measuring instrument used.
I Enter remarks if required. Signature and date are mandatory.
J OPTIONAL. Enter data ONLY if stratified systematic sampling is used. Type description – include: species/ age class/ height class/ site quality.
K OPTIONAL. Enter source of CV estimates.

ATTACH: CRUISE PLAN MAP. Drawn to 1:5,000 or 1:10,000 scale, topography, (streams and roads), air photo numbers, strips and baselines, plot locations, boundaries, area in the merch and total by cut block, label the cut block (mature or immature). MUST BE SUBMITTED WITH THIS FORM.

AERIAL PHOTOGRAPH: Submit a copy with timber typing.

FS 693 HVA 2002/04

DISTRICT TO FORWARD COPY TO REGION

Figure F.2 FS 693 - Provincial Cruise Plan (Page 2 of 2).

FS 694 Provincial Cruise Plan and Map Check List

PROVINCIAL
CRUISE PLAN AND MAP CHECK LIST

TENURE: ___ ___
C.P.: ___ ___

		YES	NO	N/A
A.	**TENURE and CRUISING AGENCY INFORMATION (Cruise Design -- Parts A to C)**			
1.	Licensee's name shown?			
2.	Tenure and Cutting Permit numbers shown?			
3.	TSA, PSYU, FIZ, Region and Compartment Numbers indicated.			
4.	Cruising and Compiling Agencies indicated.			
B.	**HARVESTING and SAMPLING SYSTEM INFORMATION (Cruise Design -- Parts D to G, J and K)**			
11.	Harvesting and sampling system acceptable? (Part D)			
12.	Number of plots and plot type acceptable? (Part E)			
13.	Diameter Limits acceptable? (Part F)			
14.	Boundary marking acceptable? (Part G)			
C.	**TREE HEIGHTS AND HEIGHT METHOD (Cruise Design -- Part H)**			
15.	Tree height measuring instrument and estimation method indicated?			
D.	**CRUISE PLAN MAP and PLOT ESTABLISHMENT INFORMATION (Cruise Plan Map)**			
16.	Tenure Information adequate? (I.e. Licence, CP, FIZ zone, UTM Grid No's, Reg. and Compt. No's...etc..)			
17.	Acceptable map scale? (1:5 000, 1:10 000)			
18.	Map area statement clearly shown? (Timber type descriptions and areas indicated?)			
19.	Timber types on the cruise plan map and forest cover map of the cruise and surrounding area provided?			
20.	Minimum of 2 plots per type?			
21.	Sufficient number of plots per type or 100 m grid and SE waived?			
22.	Consistent plot and/or strip spacing within each type? (Maximum grid - 200m if cruise < 250 ha or 250m if cruise ≥ 250 ha).			
23.	Plots well distributed within each type?			
24.	Prism and/or fixed area plot size consistent in each type?			
25.	Cut block boundaries and forest types clearly delineated on map?			
26.	Baseline established and tied to a well defined geographical feature or a legal survey mark if possible.			
27.	P.O.C. established?			
28.	Strips tied to cutblock boundaries?			
29.	Plots and strips clearly marked?			

Note: There may be some exceptions to the above criteria. If in doubt check Chapters 2 and 3 of the *Cruising Manual*, or contact the Regional Cruising Coordinator.

Remarks: _____

Accepted:	**Rejected:**	**Date:**
Action:		
Signature:		
Approval/rejection letter sent by:		**Date:**

FS 694 HVA 2001/12

Figure F.3 FS 694 - Provincial Cruise Plan and Map Check List.

FS 695 Provincial Office Check of Field Cruise Data

PROVINCIAL
OFFICE CHECK OF FIELD CRUISE DATA

TENURE: ____ ____
C.P.: ____ ____

A. CRUISE PLAN and FINAL CRUISE MAP	YES	NO	N/A
1. Is Cruise Plan approved?			
2. Was the Cruise Plan followed?			
3. Is the FINAL Cruise Map acceptable			

B. PLOT CARDS	YES	NO	N/A
4. Are all of the plot cards submitted?			
5. Is each plot card properly filled out?			
6. Is each plot card SIGNED and DATED? (*Cruising Manual*, Section 3.1.1)			
7. Is the prism (or fixed area plot) size consistent within each timber type?			
8. Do the plot locations by type, strip and cutblock concur with the final cruise map?			
9. If count plots are used, indicate the count/measure ratio	COUNT	MEASURE	

C. MERCHANTABLE STEM COUNT:

PRISM CRUISES (*Cruising Manual*, Section 2.1.2.1) Double the tree count in border.
1. Clearcut logging. "Minimum" average of 4 merchantable trees per plot if SE 15% not achieved.
2. Partial cut logging. "Minimum" average of 6 merchantable trees per plot if SE 15% not achieved.

FIXED AREA CRUISES
1. Clearcut logging. "Recommended" average tree count is not less than 10.
2. Partial cut logging. "Recommended" average tree count is not less than 15.

	Type 1	Type 2	Type 3	Type 4	Type 5	Type 6	Type 7	TOTAL
10. Total Number of Plots								
11. Average Number of stems per plot.								
12. No. Plots with < than the recommended average stem no.								
13. Average No. of Stems per plot per type acceptable? (Y/N)								

D. HEIGHTS	YES	NO	N/A
14. Are the height calculations done correctly?			
15. Are sufficient samples taken for each major (≥20%) species?			
16. Have 100% of the heights been taken for all minor species (<20%)?			

E. AGES	YES	NO	N/A
17. Are adequate age samples collected?			
18. Are age/height corrections done properly?			
19. Are the maturity classes correct?			

Remarks:

Accepted:	Rejected:	Date:
Action:		
Signature:		
Approval/rejection letter sent by:		Date:

FS 695 HVA 2002/04

Figure F.4 FS 695 - Provincial Office Check of Field Cruise Data.

FS 696 Provincial Field Check Cruise Summary

PROVINCIAL
FIELD CHECK CRUISE SUMMARY

TENURE: ____ ____
C.P.: ____ ____

IS CHECK CRUISE REQUIRED? _____ (Note: **If no**, inform licensee.)

Cruised by: _____ **Cruise Date:** _____ **# plots:** _____

Checked by: **Check Date:** **# plots:**

A. PLOT ESTABLISHMENT & DISTANCE MEASUREMENT:	ACCEPTABLE (Y/N)	CRUISING MANUAL REFERENCE
1. Distance AND Bearings between plots		Sec. 3.6.2.1, 8
2. Plot establishment		Sec. 3.6.2.1, 8
3. Sample trees marked		Sec. 3.5.3.3
4. Age samples representative of stand		Sec. 3.5.9, 3.6.2.1, 6
5. Boundaries checked: (*Indicate Yes, No or NOT Checked*)		Sec. 3.6.2.1, 8
B. SPECIES IDENTIFICATION		**Sec. 3.6.2.1, 2**
6. % of Stems incorrectly identified:		
C. NUMBER OF STEMS:		**Section 3.6.2.1, 1**
7. **FIXED AREA PLOTS**		
i. % of Plots where stem count difference is **> 1 STEM IN 50**		
ii. % Average absolute variation of all stems counted		
8. **PRISM PLOTS**		
i. Variation of all stems counted		
D. BREAST HEIGHT:		**Section 3.6.2.1, 7**
9. Total Number of Stems Checked:		
10. Number of Stems **> 5% HIGH or < 5% LOW**		
11. Average Error of All Samples:		
E. DIAMETERS:		**Section 3.6.2.1, 7**
12. Number of Diameters Checked		
13. % of Diameters in Error by **> ± 2%:**		
14. Average Error of All Samples:		
F. PATHOLOGICAL INDICATORS/DAMAGE CODES:		**Section 3.6.2.1, 4**
15. Number of Plots with **> 1 Risk Group Change**		
16. % Risk Group changes --- all trees.		
17. % trees checked with incorrect fire/blowdown/insect codes		
G. HEIGHT SAMPLES:		**Section 3.6.2.1, 3**
17. Height samples representative of stand		
18. **100% HEIGHT METHOD**		
i. # of heights checked		
ii. % Average absolute variation of all heights checked.(*Measured & Estimated*)		
H. AGES:		**Section 3.6.2.1, 6**
19. 95% of ALL trees in correct maturity class for loss factor deductions		
I. QUALITY (Coast Immature Only)		**Section 3.6.2.2**
20. i. % trees with path incorrectly coded in 1st and 2nd third		
ii. % of quality indicators ± 1 code change		
iii. Spiral grain – code > 4 does not require checking		
iv. Knots and knot indicators - # of 5 m log quarters > 2 quarters difference		
J. IS THERE ANY BIAS OBSERVED IN THIS CRUISE?		**Section 3.6, 3.65**

Accepted:	**Rejected:**	**Date:**
Action:		
Signature:		
Approval/rejection letter sent by:		**Date:**

FS 696 HVA 99/07 NOTE: ANY UNACCEPTABLE FINDINGS MAY BE GROUNDS FOR REJECTION.

Figure F.5 FS 696 - Provincial Field Check Cruise Summary.

FS 697 Provincial Compilation Check Form

PROVINCIAL
COMPILATION CHECK FORM

TENURE: ___ ___
C.P.: ___ ___

A. CRUISE/TENURE INFORMATION		
1. Cruise Type [Scale Base, Cruise Base, Partial Cut]		
2. Cruise System [Prism or Fixed Area Plots or Mixed (both)]		
3. Partial Cut or Clearcut (Section 2.1.1 of the Cruising Manual)		
4. a) Forest Inventory Region Number		
b) Forest Inventory Compartment Number		
c) Forest Inventory Zone (FIZ)		
d) Public Sustained Yield Unit (PSYU)		
B. MAP AREA STATEMENT	**YES**	**NO**
5. Net Merchantable Area		ha
6. a) Do the map merchantable areas agree with compilation?		
b) Do the number and area of the Cutblocks on the map agree with the compilation?		
c) Do the number and area of the Timber Types on map agree with compilation?		
C. FIR LRF'S	**YES**	**NO**
7. a) Type of Compilation..... WET or DRY Belt Fir (see Chapter 7, Position 14 of the Cruising Manual)		
b) Proper Fir LRF's used? (Wet Belt/Dry Belt)		
c) Does the compilation type agree with the PHSP?		
D. PLOT SUMMARIES AND LOSS FACTORS	**YES**	**NO**
8. Is there more than one plot size per type?		
9. Have the correct Forest Inventory Loss Factors been used for each species?		
10. Are the plots in the compilation only from the harvest area?		
E. SPECIAL COMPILATIONS *(Complete as required)*	**YES**	**NO**
11. DAMAGE COMPILATIONS (Insect, Fire, Blowdown) (All damage compiled see 015B - All Harvesting Method Summary Report)		
12. FALLER'S SELECTION		
a) First compilation submitted (NO REDUCTIONS)?		
b) Has licensee's proposed treatment been approved?		
c) Is the second compilation consistent with the PHSP?		
F. SAMPLE ERROR ACHIEVEMENT	**YES**	**NO**
13. HAS THE PROPER S.E.% BEEN ACHIEVED?(See Reverse Side or Sections 2.1.1 - 2.1.2 Cruising Manual)		
G. APPRAISAL DATA SHEET --- CRUISE DATA	**YES**	**NO**
14. Is the cruise data entered on the Appraisal Data Sheet the same as the compilation? (IF NOT, EXPLAIN)		
15. Is the compilation version number correct?		
16. Was this cruise field checked?		

REMARKS :

Accepted:	Rejected:	Date:
Action:		
Signature:		
Approval/rejection letter sent by:		Date:

FS 697 HVA 2002/04

DISTRICT TO FORWARD COPY TO REGION

Figure F.6 FS 697 - Provincial Compilation Check Form.

FS 698 Provincial Comparative Cruise Checklist

PROVINCIAL
COMPARATIVE CRUISE CHECKLIST

FOREST REGION _____

FOREST DISTRICT _____

PARENT LICENCE: _____
PARENT C.P.: _____
NEW LICENCE: _____
NEW C.P.: _____

A. FIELDWORK	YES	NO
1. Fieldwork date (Parent cruise: mature must be less than 10 years/ Immature less than 5 years)		
2. Biogeoclimatic (BEC) Subzone – The same BEC subzone		
3. Frequency of plots – Minimum of 6 measure plots per timber type or 1 plot per hectare in the parent and new.		
B. DATA	**YES**	**NO**
4. Is there a location map provided showing proximity of parent and new cruises?		
5. Is the new Cruise Plan Map acceptable – systematic grid?		
6. Are all of the plot cards submitted for the new cruise properly completed and signed?		
7. Is the data collected to the *Cruising Manual* standards?		
8. Is there an average of 6 trees per plot in the new cruise?		
9. Were all of the tree diameters and heights measured in the new cruise?		
10. Are at least 2 ages measured of co-dominant and dominant trees per plot in the new cruise?		
C. COMPILATION	**YES**	**NO**
11. Were all summary pages submitted for the parent and new cruise?		
12. Cruise compilation version – parent and new must be compiled on the most recent version.		
13. Standard utilization specifications – parent and new must be compiled to standard utilization.		
14. Species composition – must be within ± 5% for major species and ± 10% for minor species.		
15. Merchantable Vol/ha – must be within ± 10%		
16. Are the maturity classes similar for the parent and the new cruises?		
17. Lumber Recovery Factors – must be within ± 5 LRF points.		
18. Merchantable Vol/Tree – must be within ± 10%, not less than 0.20.		
19. If new cruise is less than 0.20 m^3/tree, the parent cruise must be less than 0.20 m^3/tree.		
20. Recompiled parent cruise meets +/- 15%?		
21. New plots added to the recompilation of the parent cruise?		

Notes:
1. References – Section 4.2 of the *Interior Appraisal Manual* and Section 2.1.2.3 of the *Cruising Manual*.
2. Attach the original copy of this checklist to the cutting permit application.

REMARKS : _____

Submitted by Licensee: (signature)

Approved by Region: (signature)

Approval/rejection letter sent by: **Date:**

FS 698 HVA 2002/04
DISTRICT TO FORWARD COPY TO REGION

Figure F.7 FS 698 – Provincial Comparative Cruise Checklist.

Acknowledgements

1. The colour photographs that are in Section A.4.4 were contributed by the Canadian Forest Service.

2. The Forms, Risk group rating tables and Interior Site Index Tables were compiled by the Kamloops Forest Region.

3. The Down Tree Matrix was provided by the Kamloops Forest District.

This page is intentionally left blank.

Glossary

Accuracy	The nearness of a measurement to the actual value of the variable being measured.
AAC (Allowable Annual Cut)	The rate of harvest determined by the Chief Forester for Timber Supply Areas (TSA's) and Tree Farm Licences (TFL's), and by the District Manager for Woodlot Licences (WL's), and the rate of harvest specified for a licence or in a management plan.
Absolute Variation	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).
BAF (Basal Area Factor)	Basal Area Factor or "BAF". Prisms come in a wide variety of sizes. They are classified by "diopter" size. The size denotes the basal area per hectare that each "in" tree represents (i.e., an 8 prism which tallies 7 trees in a plot would give a basal area (in timber) of 56 m^2/hectare).
Bias	Measurement bias occurs when the mean of the measured values differs from the mean of the actual values. Sampling bias occurs when certain sampling units are more likely to be included than others (lack of randomness). Statistical bias occurs when the expected value of the statistic differs from the population parameter.
Boring-Height	The boring-height is the distance from the ground (high-side) up the tree to where an age is taken with an increment-borer. It is always taken at dbh (1.3 m) above high-side.
Breakage	Breakage is defined as any piece broken at both ends and shorter than 3 m which results from normal falling or yarding/forwarding operations.

Breast-Height	The location on a tree where its diameter (dbh) is taken. It is located exactly 1.3 m above "high-side".
Catastrophic Losses	Damage to timber from fire, windfall, insects or disease that inflicts losses well above the norm reflected in the forest inventory for the locality or region.
Cardinal	North, South, East and West.
Closure Error	In a closed traverse, the closure error is the distance between the start and end of the traverse, divided by the length of the traverse, and is usually expressed in percent. It can also be calculated by taking the square root of the sum of the squared sum of latitudes plus the squared sum of departures. A closure error of 1 percent will result in an area error of approximately 2 percent.
Coast	The Coast is defined as that geographic area included within the Vancouver Forest Region, as established by the *Forest Act* and *Regulations*, and that part of the Prince Rupert Forest Region west of the Cascade Mountains Administrative Line from Tweedsmuir Park to the State of Alaska. There is one exception to the above delineation, where timber in that portion of the Kalum Forest District, lying west of the Cascade Mountains Administrative Line is appraised using the *Interior Appraisal Manual.*
Coefficient of Variation (CV)	A relative measure of variation, equal to the sample standard deviation expressed as a percentage of the sample mean.
Confidence	An expression of accuracy of sample estimates, usually assessed by confidence intervals, a specified proportion of which, such as 95 percent confidence intervals, contain the true population parameters.
Count-Plot	A prism plot where only the number of "in" trees by species is noted. No individual tree measurements are taken. Enhanced count-plots have some measurements taken as required (i.e., diameters or heights).
Crown-Class	Trees are classified into four crown classes. They are dominant, co-dominant, intermediate and overtopped (see Section 3.5.3.2).

Cut Block	A discrete area covered by a form of licence and logged according to an approved harvesting plan.
Cutting Authority Area	The authority to harvest Crown timber, as provided by the *Forest Act*. (Cutting authority area means a Timber Sale Licence, a Licence to Cut, a Road Permit, or a cutting permit issued under a Tree Farm Licence, Forest Licence, Timber Licence or a Woodlot Licence.)
Cutting Specifications	The timber cutting specifications contained in the Minimum Utilization Standards of the cutting authority area.
DBH (Diameter Breast Height)	The outside-bark diameter of a tree taken at breast-height (1.3 m above the high side of the ground).
Decay, Waste and Breakage (DWB)	Factors to reduce the gross merchantable volume to a net utilizable volume and to approximate the provincial volume depletion due to decay, firmwood waste and breakage due to harvesting. The statutory authority to allow for DWB is in the *Forest Act*, Part 2, Section 7(3)iv.
DIB (Diameter Inside Bark)	The inside-bark diameter of a tree. It can be anywhere along the stem of the tree from the base to the top.
Diopter	One way 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: $\text{baf} = 10{,}000 / \left\lceil 1 + \left\lvert \frac{200}{\text{diopters}} \right\rvert^{2} \right\rceil .$
Double-Sampling	This sampling method incorporates a second sampling procedure where only some of the characteristics of the main sampling method are noted. An example is measure and count-plots established on a cut-block. The major reason for using this method is the savings in time and therefore money because the count-plots take much less time to put in.
Endemic Losses	Damage to timber from normal populations of insects or disease that inflicts average losses over the long term for the locality or region. The forest inventory provides net merchantable volumes which reflect "endemic" (average or normal) losses.

Enhanced Count Plot	A count plot where some individual tree species measurements or specific tree attributes are measured to improve the estimate for the species or specific attributes.
Fixed-Area Plot Sampling	A sampling method where a fixed amount of area is sampled in each plot within a stratum. All trees above minimum utilization are tallied regardless of their distance from plot center. All plots within a stratum must be the same size and shape.
Forest Inventory Zone	British Columbia is segregated into 12 forest inventory zones. All commercial tree species were sampled for volume and decay by the Inventory Branch of the Ministry of Forests (now the Ministry of Sustainable Resources Management). All regions of the province were sampled and areas of similar timber types and climatic conditions were grouped into a common Forest Inventory Zone to produce DWB factors.
GPS (Global Positioning System)	A method of accurately determining or relocating a ground position using the signal from several satellites simultaneously. A small portable computer evaluates the time for each signal to reach it and then computes a three dimensional location.
High-Side	The position where the ground meets the tree on the (uphill side – side of the stump adjacent to highest ground), ignoring any root flare, obstacles, vegetation, and loose matter that has accumulated at the base of the tree.
Interior	The Interior is defined as the entire province of British Columbia, with the exception of the Vancouver Forest Region, as established by the *Forest Act* and *Regulations*, and that part of the Prince Rupert Forest Region west of the Cascade Mountains Administrative Line from Tweedsmuir Park to the State of Alaska. There is one exception to the above delineation, where timber in that portion of the Kalum Forest District, lying west of the Cascade Mountains Administrative Line is appraised using the *Interior Appraisal Manual.*
Licensee	The holder of the cutting authority area.
Log Grade	Those log grades that are defined in the *Scaling Regul*ation.
Major Species	Comprises 20 percent or more of total gross volume in a timber type, cut-block or cutting permit.

Minor Species	Comprises less than 20 percent of the total gross volume in a timber type, cut-block or cutting permit.
Mean (Mode & Median)	The "mean" of a set of measurements is the sum of all measurement values divided by the number of measurements. The "mode" of a set of measurements is the value which occurs most often or with the greatest frequency. The "median" of a set of measurements arranged in an increasing order of magnitude is the middle value (or arithmetic mean of the two middle values).
Mean Absolute Variation	The arithmetic mean of a set of absolute variations.
Variation:	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).
Mean Absolute Variation:	The arithmetic mean of a set of absolute variations.
Minimum Utilization Standards	The standards of timber cutting and log utilization specified in the cutting authority area.
100% Cruise	A cruise in which every tree is measured. There are no samples or estimates.
Partial Cutting	A variety of silviculture systems in which a stand may be cut to ensure regeneration. In a Partial Cutting system, 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.
Pathological Indicators	They include conk, blind conk, scar, fork or crook, frost crack, mistletoe, rotten branch, and dead or broken top.
Percent Reduction	In reference to partial cutting, this refers to a specified percent reduction of the total cruise volume which is targeted to be left or to be cut and removed.

PRF (Plot Radius Factor)	In prism cruising, each tree has its own plot radius. This is a function of tree diameter (dbh) and prism baf size. The plot radius factor (prf) times the dbh gives the appropriate plot radius for any tree. The prf formula is: $prf = 0.5 / \sqrt{baf}$
Plot Sampling	The estimation of volumes and grades by species within a cut-block from sample plot measurements, and the determination of the sampling error associated with the plot estimates.
Precision	The closeness, to each other, of repeated measures of the same quantity, expressed as Sampling Error or Standard Error of the sample estimate.
Recompilation	A second or subsequent cruise compilation with some plots added or deleted, or both.
Residual	Living trees with none of the eight pathological indicators.
Risk-Group	As the name implies, this is simply a grouping by expected "risk" or probability of average decay, waste and breakage, for volume deduction by individual tree. These take the form of from one to three "risk-groups" which are individually specified for each tree species by age and location (Forest Inventory Zone) in the Province. Each risk-group (by species and location) keys to a loss factor table with volume deductions for decay, waste, and breakage. The pathological indicators place each tree into a tree-class. Various tree-classes are grouped together into one of three risk groups which in turn determine the severity of the deductions for volume.
Sampling Error (S.E.)	The expressing of the accuracy of the sampling of the cruise. It is calculated as a percent of an estimated mean to a desired probability.
Site-Class	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 in tree height (metres) attained at the breast-height age of 50 years.

SD (Standard Deviation)	The Standard Deviation is 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. On the average, about two-thirds of the unit values of a normal population will be within one standard deviation of the mean. About 95 percent will be within two standard deviations and about 99 percent within 2.6 standard deviations.
Stratum	A specified portion of a subpopulation area for which separate volumes and sampling statistics are calculated. A subpopulation may be made up of one or many strata.
Stratification	The process of delineating strata boundaries within a subpopulation, where each stratum has unique characteristics such as species composition, height, stand volume or age.
Strip-Line	A ribboned line running through the forest and tied to a base-line and/or boundary at one or both ends. Cruise plots are located at regular intervals along each strip.
Stumpage	Stumpage is the price that is paid to the provincial government for the right to harvest timber from Crown land. The amount of stumpage that is charged for the timber depends upon the appraised value of the stand and, in some cases, a price bid above this value.
Suspect	A living tree with one or more pathological indicators.
Tie-Point	An important point from which a boundary, base-line or cruise strip is "tied" into (e.g., legal lot corner (I.P.); creek and road junction (mapped)).
Timber Supply Area	Large contiguous areas of Crown land on which an annual allowable cut is calculated.
Top-Height	The mean height of the 100 trees per hectare of largest diameter.
Tree-Class	A series of classes (nine) primarily used for age/maturity and live/dead classification. This classification puts each tree into the appropriate risk-group for volume deduction.

True	Refers to height, diameter, number, sum, plot volume, LRF, or other variable. The "true" value is determined by the Forest Service.
Variance	The mean of squared deviations of observations about a sample mean. (These deviations or differences from the mean are called residuals).
Waste	In the timber cruising compilation programme, decay, waste and breakage are deducted from the gross tree volume. The waste component is the firmwood volume associated with 5 m logs in a tree which contain less than 50 percent of their gross scale in firmwood volume. These logs are assumed to be left on the cut-block and so their remaining firmwood volume is then classified as waste.

Index

A

Age
  Classes, 6-8
  Codes, 7-19, A-3
  Measurements, 3-34, A-3
Area, 3-9, 3-37
  Standard, 3-37
  Traversing, 3-3, 3-4

B

Basal Area Factors (BAF), 3-14, 3-16, 6-10
Borderline Trees, 3-13, 3-14
Breakage, 3-29, 4-7

C

Check
  Compilation, 4-4, 4-9
  Field Work, 3-35
Coefficient of Variation, 2-17
Compilation Program, 4-4
Conventional Traverse Procedure, 3-7
Count Plots, 2-23
  double sampled cruise, 2-23
  faller selection or mark, 2-23
Crook, A-23
Crown Classes, 3-25
Cruise Based Sales, 2-9

D

Damage Codes, 3-29, A-68
  Disease, 6-24, A-68
  Down Trees, 6-24
  Fire, 6-24, A-72
  Insects, 6-24, A-68
Dead or Broken Top, A-31
Decay, 3-29, 4-7
Deciduous, 7-8, 7-20
Deductions
  Breakage, 4-7
  Decay, 4-7
  Waste, 4-7
Diameters (DBH), 3-40
Diopter, 6-10
Double Sampling, 4-12
Double-sampling, 2-23

F

FIZ Zones, A-6
Fork or Crook, A-23
Frost Crack, A-28
FS 121, 7-1
FS 205, 6-2

G

GPS, 3-7
  azimuth bearings, 3-7
Grading
  Quality, 3-33

H

Half Plots
  not permitted after April 1, 2002, 3-17
Heights, 7-18
  Measurements, 3-26
  One Hundred Percent, 3-20
  Sample Height, 3-23
  Sample Size, 3-23, 4-2

I

Isogonic/Isoporic Charts, A-5

L

Loss Factor Tables, 4-7

M

Mapping
Field Work, 3-35
Map Area Statement, 7-1
Standards, 3-9, 3-36
Measured Plots, 2-23
Minimum Utilization Standards, 2-18, 3-20

O

Objectives, 2-2
One Hundred Percent Cruises, 3-11, 3-20
Optional in Interior, 6-17

P

Pathology, 3-29, 6-16
Percent Reduction, 4-16
Plot
Radius, 6-10
Plot Radius Factor (PRF), 4-11
Plots
Count, 2-2, 3-14, 3-36, 4-13, 6-9
Establishment, 3-2
Fixed, 3-12
Half-sweep, 4-13, 6-9
Prism, 2-15, 3-13, 4-11
Radius, 3-14
Sample Size, 2-15
Slope Correction, 3-3, 3-14

Q

Quality, 3-41, 6-17
Knots, 6-20
Lean, 6-19
Live Limb, 6-19
Spiral Grain, 6-17
Stub, 6-20
Sweep, 6-19

R

Reference Trees, 3-3
Reports
Forest Service, 4-16
Licensee, 4-16
Risk Groups, 3-29, 4-7

S

Safety, A-61
Sampling
Down Trees, A-74
Sampling Error, 2-14
Selective Cutting, 6-21
Site Index Tables for British Columbia
All Species, A-84
Slope, 3-3, 3-41, 6-12
Slope Correction
Horizontal Distance, 3-3
Plot Radius, 3-14
Species, 4-5
Standards
Check Cruising, 3-35
Compilation, 4-15
Statistics, 2-17
Formulas, 2-17
Stratification, 2-19
Stump and Breast Height Diameter
Tables, T-6
Stumpage Rates
Cruise Based, 2-2
Scale Based, 2-2
Stumps, 3-34
Stumps:, 3-24, 3-26, 3-33

T

Traversing, 3-4
Tree Classes, 3-29
Trees per Hectare (TPH), 4-10
Typing, 2-20

V

Value, 2-17

W

Waste, 3-29, 4-7