National Forest Inventory – British Columbia

Change Monitoring Procedures for Provincial and National Reporting

Prepared by the
Ministry of Sustainable Resource Management
Terrestrial Information Branch

for the
Resources Information Standards Committee

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The Government of British Columbia provides funding of the Resources Information Standards Committee work, including the preparation of this document. The Resources Information Standards Committee supports the effective, timely and integrated use of land and resource information for planning and decision making by developing and delivering focussed, cost-effective, common provincial standards and procedures for information collection, management and analysis. Representatives to the Committee and its Task Forces are drawn from the ministries and agencies of the Canadian and the British Columbia governments, including academic, industry and First Nations involvement.

The Resources Information Standards Committee evolved from the Resources Inventory Committee which received funding from the Canada-British Columbia Partnership Agreement of Forest Resource Development (FRDA II), the Corporate Resource Inventory Initiative (CRII) and by Forest Renewal BC (FRBC), and addressed concerns of the 1991 Forest Resources Commission.

For further information about the Resources Information Standards Committee, please access the RISC website at: http://srmwww.gov.bc.ca/risc/.

Terrestrial Ecosystem Task Force

The Vegetation Inventory Working Group was formed in 1993 and issued their final report in March 1995 on a “Proposed New Inventory” for British Columbia. The Ministry of Forests, Resources Inventory Branch, in cooperation with the Ministry of Environment and other Ministry of Forests branches and consultants, developed the suite of Vegetation Resources Inventory Procedures based on the recommendations in that report. Many individuals were involved in writing the original version of the various Vegetation Resources Inventory Procedures documents.

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Addendum to CMI Ground Sampling Procedures for the Provincial Change Monitoring Inventory Program, Version 1.2, RISC 2002

1. Title change
   The title of the document has been changed to better reflect the use of these procedures. These procedures are primarily designed for the collection of the data required for British Columbia’s contribution to Canada’s National Forest Inventory.

2. Section 2.1 - Access notes
   Additional text was added to the procedures to emphasize the importance of collecting detailed access notes as many samples are being revised by others.

3. Section 2.5 - Inaccessible sampling procedures
   Added wording for when a portion of a sample or line transect is inaccessible. If the inaccessible portion of the sample or transect is visible it is preferable to estimate the attributes on the inaccessible portion rather than not collect any data.

4. Section 3.6 - Collection of intended sample co-ordinates
   Added wording for the collection of the “intended” sample co-ordinates. It has been identified that the original intended co-ordinates of the ground samples is not being consistently populated in the sample data base. In order to collect this data consistently it has been decided to record the co-ordinates during the sample collection. Crew’s using field cards are to record the values in the comments section while the handheld program has been modified to collect the data directly.

5. Table 4.3 - Crown class descriptions
   Slight revision to class descriptions to clarify that light interception can also be influenced by overstory shrubs and other obstructions as well as trees.

6. Section 4.7 - Determination of in/out or stumps
   The determination of whether a stump is “In or Out” has been changed from measuring at the top of the stump to measuring at the “point of germination” to be consistent with other fixed plot procedures.

7. Section 4.8 - Collection of physiological ages for site trees
   It has been decided to make the collection of physiological ages for projects optional as the information is currently not used and no use is anticipated. Individual projects can still collect the information if required.

8. Section 6.3 - Applying small tree grades to dead trees
   Additional text was added for the grading of small dead trees.

9. Section 7.3 - Recording of aspect

March 31, 2003
Wording added to procedures document “if the aspect is due north the aspect will be recorded as “0” degrees”.

10. Section 7.4 - Web address for plant species codes

The current web address for plant species codes has been added to the text.

11. Section 7.4 - Estimating plant cover values

Additional text and two figures were added to assist in the interpretation of plant canopy cover values.

12. Section 7.4 - Measuring surface substrates, forest floor organics and soil bulk density sampling

New procedures for the measurement of surface substrates, forest floor organics and the collection of soil bulk density samples has been added to the text of the document. These procedures were field tested in 2002 and have now been added to the current standard.

13. Section 7.5 - Succession interpretations

Additional wording added to text regarding succession interpretation if more than one site condition exists within the sample plot. The text stresses that the succession interpretation should best describe the IPC location if it comprises a significant portion of the plot.

14. Section 8.3 - Minimum piece size for odd shaped CWD

Note that odd shaped CWD must meet the minimum piece size before it is measured. For instance, an odd shaped piece must be equivalent to the minimum area at the transect for round pieces which is 44.2 square centimetres before it is measured as CWD. The piece is measured perpendicular to the length at the point of crossing.

15. Chapter 8 - Woody debris

The procedures for the measurement of small woody debris (SWD) and fine woody debris (FWD) were field tested in 2002. These procedures have now been added to the current standard. Changes as necessary occur throughout the chapter.

16. Section 9.4 - Range transects

It has been decided that the range shrub transects will not be collected for the National Forest Inventory – British Columbia sampling. The coverage of shrubs is collected in the ocular plant estimates collected on the Tree and Shrub Layers (Card ET) which meets the needs of most projects. The references to shrub cover measurements has been removed from this chapter.

17. Section 9.3 – References for plant species code lists

The current web address for plant species codes and for species of “doubtful life form” has been added to the text.

18. Appendix C - Inventory tree code list

The tree species code list has been updated to “version 4.3”. There are only a few minor differences from the past version 4.1; which involves the addition of codes for several
“exotic” tree species that may be found on crown land. The web address to access the latest version(s) is also included.

19. Appendix I - magnetic declination values
   The declination table has been updated to 2003 values.
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1. Introduction

The Provincial Change Monitoring Inventory [CMI] is being developed to meet Provincial needs and to meet the needs of the National Forest Inventory. These procedures are being piloted in year 2000 using the procedures which follow. The procedures developed for the Ministry of Sustainable Resource Management "Vegetation Resources Inventory" form the basis for the CMI. As the sample design is different, it has been necessary to modify some of the VRI procedures to suit the CMI design.

The introduction, background, process and principles within chapter 1 will be revised after the "pilot" period to reflect the design changes.

Background

The Forest Resources Commission recommended a review of the provincial resource inventory process in its report The Future of our Forests. The Resources Inventory Committee (RIC) was established with the objective of achieving common standards and procedures and it, in turn, established several task forces. One of these task forces, the Terrestrial Ecosystems Task Force, set up the Vegetation Inventory Working Group and charged its members with:

... making recommendations pertaining to the vegetation inventory ... (and) ... designing and recommending standards and procedures for an accurate, flexible ... inventory process.

The Vegetation Inventory Working Group recommended a photo-based, two-phased vegetation inventory program:

- Phase I: Photo Interpretation
- Phase II: Ground Sampling

The Ministry of Forests, assisted by the Ministry of Environment, Lands and Parks, is implementing the recommendations in the Vegetation Resources Inventory.

Vegetation Resources Inventory Process

The Vegetation Resources Inventory is designed to answer two questions:

1. Where is the resource located?
2. How much of a given vegetation resource (for example, timber or coarse woody debris) is within an inventory unit?

The Vegetation Resources Inventory is carried out in two phases. Phase I (Photo Interpretation) involves estimating vegetation polygon characteristics, from existing information, aerial photography, or other sources. No sampling is done in Phase I. Phase II (Ground Sampling) provides the information necessary to determine how much of a given characteristic is within the inventory area. Ground samples alone cannot be collected in
sufficient numbers to provide the specific locations of the land cover characteristics being inventoried.

The ground measurements are used to estimate the proper total for the population. The relationship between the polygon estimates and ground samples is used to adjust the Phase I, photo-interpreted polygon estimate. The total for the population is then distributed into the adjusted description for each polygon.

**Principles of the Ground Sampling Process**

1. The Change Monitoring Inventory will cover the entire “Forested” land base of British Columbia, irrespective of ownership or vegetation values.
2. Sample plots will be selected randomly from a Provincial grid.
3. Moving plots to more typical locations is never acceptable. Sample plots must be placed where they fall. Special procedures will be used when this constitutes a temporary or permanent safety hazard.
4. All data attaches to the Integrated Plot Centre.
5. The ground sampling must be done correctly and carefully. Errors in the ground samples are translated directly into errors in the inventory. Accuracy is the watchword.
6. Quality of answer includes the concepts of no bias and small sampling error. It is achieved by ensuring the following:
   - No bias
     - The sampling processes are statistically valid.
     - The calculation and adjustment procedures are valid and documented.
     - Inventory sampling is done separately by inventory unit, so that updates and reinventories can be done at arbitrary intervals, then unbiasedly combined for a provincial estimate.
     - Rounding and vague definitions are avoided.
   - Small sampling error
     - Initial estimates are used to reduce sampling error and cost.
     - The selection method may be combined with traditional stratification to ensure a sample that stabilizes more quickly than a random sample and that ensures controlled sample sizes in all land types.
7. Measurements are made to a known level of precision. Estimates made at the sample plot are acceptable where measurements cannot be taken.
8. All measurements are to be completed and recorded in the field.
How to Use This Document

This document deals with the ground sampling component of the Change Monitoring Inventory. It describes procedures for the location and establishment of sample plots, and the collection of data related to:

- trees
- site, soils, plants and succession
- coarse woody debris
- range resources

The major activities associated with the ground sampling process are illustrated in Figure 1.1. Sample tally sheets for recording field information are also included in this document.

A brief background is provided in Section 1 to explain the rationale behind the procedures. The remainder of the document describes the procedures or methods required for ground sampling.

- Section 2 and 3 describe the procedures required to locate and establish sample plots.
- Section 4 explains the measurement and recording of tree information at the Integrated Plot Centre.
- Sections 5 and 6 describe the call grading and net factoring criteria, guidelines, and rules.
- Section 7 describes the procedures required to gather site, soils, plants and succession information.
- Section 8 contains the procedures for measuring coarse woody debris, and
- Section 9 describes the procedures for measuring range resources.

Each of these sections contains a brief introduction, objectives, general procedures, and detailed procedures. Definitions, examples, and tips are also provided.

A glossary of terms and a detailed index are included in this document to ensure the usability of the document as a reference tool.
Figure 1.1 — Major activities in the ground sampling process.
2. Field Orientation and Navigation

Introduction

This section outlines the steps needed to traverse from a geographically located feature (the tie point) to the Integrated Plot Centre. The field crew is responsible for selecting suitable tie points, navigating to the reference point and integrated sample plot centre, and recording the information on the field cards. The route must be suitably marked to locate the plot centre and to aid revisitation in the near future (5-10 years).

Objectives

1. To locate the Integrated Plot Centre within the area of interest at the given UTM co-ordinates for the sample.
2. To mark and document the cluster location and navigation points to allow for short and long-term sample relocation.
3. To facilitate no special treatment of the plots, the plot marking and tree marking will be hidden as much as practical.

General Procedures

Office Preparation

1. Prepare and become familiar with area characteristics, Integrated Plot Centre, and access prior to field visitation.
   • Identify the location of the Integrated Plot Centre on the photo.
   • Identify the location of the Integrated Plot Centre on the map.
   • Determine the relative accuracy of the map:photo relationship.
2. Locate a potential tie point and alternatives on the map and photograph.

Field Location

1. Locate and confirm a tie point in the field and mark the Tie Point reference.
2. Navigate to the reference point.
3. Ensure you are in the correct ground position as indicated on the photo.
4. Drive the Reference Pin fully into the ground.
5. Blaze and tag the Reference Tree and measure the bearing and distance to the Reference Pin. Place tag at ground level.
6. Measure the final 15.00 m to the Integrated Plot Centre.
7. Drive a pin fully into the ground. This is the Integrated Plot Centre.

A simple illustration of the components of field orientation and navigation is contained in Figure 2.1.
Figure 2.1 — Components of field orientation and navigation.

Field Cards for this Section

**Header Card (CH)** (Appendix A, Figures A.1 and A.2)
polygon ID, project ID, sample plot, date, crew, general notes and access details.

**Compass Card (CP)** (Appendix A, Figures A.3 and A.4)
Tie Point Tree, Reference Pin Location, Reference Tree, GPS, location, field survey notes.

**Cluster Layout (CL)** (Appendix A, Figures A.5 and A.6)
Integrated plot details, sample cluster details.
Detailed Procedures
Because the sample plots must be relocatable for quality control and other purposes, it is important to follow standard procedures of location, marking, and recording. The following procedures are designed to be used with current field survey tools, such as compass, clinometer, and distance-measuring equipment. Traditional survey methods should still be used as the primary method of plot location with GPS used to assist in confirming the location.

Now that the selective availability of GPS has been turned off, the use of GPS to locate sample plot locations is another tool that can be used. It is recommended that the use of GPS only be used up to the location of the reference point. It is important to remember there is still error in GPS readings, especially in dense timber and on steep slopes. The crew will still need to confirm that the sample is in the correct location.

GPS data will be recorded at the access point (if required), tie point, and the Integrated Plot Centre. Detailed standards and procedures for GPS data collection can be found in the document: “Ministry of Forests Procedures and Guidelines for Operational Forest Resource Survey and Mapping Using Global Positioning System Technology (Version 3.0, February 2001).” This Document is available on the Ministry website.

2.1 Locating and Marking the Tie Point
A tie point is selected and marked to ensure it can be found again with reasonable effort using the field crew’s documentation.

Office Preparation
1. Locate the tie point:
   • The field crew is responsible for the selection of a suitable tie point. A tie point should have the following characteristics:
     – must be locatable on the ground
     – should be locatable on the appropriate mid-scale aerial photo
     – should be locatable on the appropriate forest cover area map
     – should permit efficient access to the sample
   • Some possible locations are:
     – major road junction (use the intersection of the road centrelines)
     – pre-located corrected GPS coordinates
     – bridge on a stream crossing (on small creeks use the centreline of the bridge at the middle of the creek; on larger streams specify which edge of the stream was used)
     – definite timber boundary features on the photo (use caution when using cutblock edges as there may have been additional harvesting, or the map placement may be inaccurate)
     – singular tree or small clump of trees
major creek junctions
- well-defined swamps, ponds, or lake edges

2. Locate the sample:
- The sample location will be marked on the forest cover map and field aerial photo by the project manager(s) prior to sampling.
- Observe the sample location and potential tie point locations on the map and the photo [in stereo]. Select primary and secondary tie point locations.

Note: Radial-line plotters may be used to transfer the potential tie point locations from the document aerial photo to the field map. Confirm the accuracy of the tie point location.

Field Location
1. Describe the access point:
- The back of the Header field card provides space for the crew to record access notes to aid in relocation of the sample. The notes should include a narration of the route traveled from a known location (for example the junction of a highway and a secondary road) to the tie point, in enough detail to aid relocation by a different crew for remeasurement in approximately 5 to 10 years.

Note: An increasing number of samples are being visited by various field crews, which may or may not have GPS capability or GPS data was not available at the site. Extra effort should be made in providing detailed access notes for future visitation.

Figure 2.2 — Example of completed access notes.
In some instances the tie point will not be directly accessible. For example, the crew may need to land at a helispot in a swamp and navigate to the tie point using rough bearings and distances; or the crew may walk to the corner of a “cutblock” and then traverse from this point. At this point record the following:

- Record GPS file number in the field for ‘GPS Access Point.’
- Describe the location. If more detail is required, use the Comments section on the CP field card.
- Note the bearing(s) and distance(s) from the access point to the tie point in the Comments section.

2. **Establish the tie point in the field:**
   - Confirm the tie point location or select an alternative.
   - Select a Tie Point Tree or stump of suitable size (20+ cm) so that the stem will be present for a number of years (not beside a road where it may be removed during road maintenance).
   - Where no suitable trees or stumps are available, use another feature, such as a rock cut, boulder, and so on. A small rock cairn can aid relocation.

3. **Mark the tie point tree for relocation of the samples in the short term (up to 5 – 10 years):**
   - Make the tie point visible to a field crew conducting surveys, but not overly visible to the general public. For example:
     - if available the tree should be greater than 20 cm in diameter
     - choose conifers over deciduous, cedars over other conifers
     - limb the complete stem to shoulder height
     - remove understorey vegetation around the tree, if practical
     - if appropriate, blaze the tree above breast height taking care not to girdle the tree
     - blaze tree on 4 sides
     - spray paint the blazed surfaces
     - ribbon the tree bole
Figure 2.3 — Marking the tie point tree.

- Record the species, diameter, azimuth and distance from the Tie Point Tree to the tie point on the Compass Card (CP). (Completing the Compass Card is discussed in Section 3.5.)
- Measure the bearing and horizontal distance from the face of the Tie Point reference to the tie point. Where the tie point is a singular tree; this tree may be blazed and marked. The bearing is recorded as “000” and the distance is 0.0 m.
- Securely nail the aluminum identification tag with aluminum nails (Figure 2.4) at the base of the tree below potential felling height (0.3 m) as shown in Figure 2.3. If practical, the tag should face the tie point location. Record the number on the compass card (CP).

Note: Tree marking, blazing, and ribboning must be coordinated with the appropriate land manager or owner.

Figure 2.4 — Example of tag for the reference tree.

4. Mark the field photo and field map (Figure 2.5):
  - Locate the selected tie point and pin-prick the location on the field photo.
  - Record the following information on the back of the photo: project identity; plot sample number; azimuth directions and distances from tie point to Integrated Plot Centre.
• Locate and mark the tie point and the ground sample point on the field map.
• Record the same information as above on the map.

**Note:** The tie point must be placed in its relative position on the map. It is not enough to specify a road junction on both the photo and map without making sure that the map is accurate in its relative placement of that road junction.

---

**Figure 2.5 — Marking the aerial photo and ground sample point.**

5. **Collect GPS data at the tie point location and record the file ID:**

   When GPS data cannot be collected, move to an area where data can be collected (such as an opening). Measure the distance and bearing from the point where GPS data was gathered back to the tie point and record in the appropriate section on the Compass Card.

**2.2 Navigating to the Reference Point**

From the Tie Point navigate to the Reference Point location.

**Procedures**

1. Locate the Reference Point using appropriate methods (for example, nylon survey chain).
2. Use offsets to traverse around unsafe or difficult situations.
3. Correct all measured distances to the horizontal.
4. Flag the tie line well enough to be easily followed. Flagging is to aid in short-term relocation of the Integrated Plot Centre (within one field season).
5. Evaluate the location. When you find that the air photo and ground location agree, proceed with establishing the Reference Point and Reference Tree. When you arrive at the Reference Point and find that the air photo and ground location do not agree, evaluate the problems and find the correct sample location. The objective is to find the **correct ground location** as per the given UTM co-ordinates of the sample point. You will not be “moving” the plot location if there is a conflict, you will be “finding” it. The map, GPS, and other tools are aids in finding the correct location.

   • There are a number of possible sources of error:
     – wrong starting point
     – incorrect bearing
     – wrong compass declination
– significant local magnetic attraction
– error in base map

• Some possible solutions are:
  – Return to the tie point and re-run the tie line.
  – Select another tie point and traverse from this point to the sample.
  – If the original calculations are in error you may be able to establish the location relative to known features near you and calculate the distance and bearing to the correct location.

2.3 Establishing the Reference Point and Reference Tree

The purpose of establishing a Reference Point is to eliminate potential small-scale bias for the Integrated Plot Centre location. The Reference Point will also help in relocating the Integrated Plot Centre. In standard forest conditions the reference point marking and reference tree will be marked as follows. If the sample occurs on sensitive areas the project manager will designate that hidden plot procedures are employed (Appendix I).

Procedures

1. Measure from the Tie Point along the predetermined azimuth direction towards the location of the Integrated Plot Centre, using appropriate field methods.

2. Stop 15.00 m short of the full distance. Establish the Reference Pin at this point. For example, if the Integrated Plot Centre location is 380 m from the tie point, establish the Reference Pin at 365 m from the tie point.

3. Drive the pin firmly into the ground until top of pin is level with the ground surface. If the pin can not be embedded to this depth, remove the excess length (with a pipe cutter or hacksaw). If appropriate, establish a small rock cairn at the pin location.

4. Choose a suitable Reference Tree (greater than 20 cm in diameter, if possible). The Reference Tree should be reasonably close, in relatively good health, with a high probability of survival, and with particular distinguishing features when possible (such as a forked tree, aspen in spruce stand, veteran in immature stand). The Reference Tree should not be a tree in the sample plots.

5. Measure the bearing and distance from the tag on the Reference Tree to the Reference Pin.

6. Record the Reference Tree details on the Compass Card (discussed in Section 3.5).

7. Mark the tree with flagging tape and blaze on four sides above DBH. The blazing should be visible but not severe enough to kill the tree. Paint the blazes to enhance visibility and to protect the tree from insects and pathogens.

8. Nail a prenumbered metal tag with aluminum nails to the base of the tree below where the tree would be cut if it was harvested, and facing the Reference Pin. If site conditions make this impossible, the tag location is at the discretion of the crew. The tag is scribed as shown in Figure 2.4. Record the tag number on the Header Card (CH).
2.4 Establishing the Integrated Plot Centre

From the Reference Point, measure to the Integrated Plot Centre.

Procedures

1. Accurately measure the remaining 15.00 m along the correct bearing to the Integrated Plot Centre to eliminate any possible small-scale bias in placing the centre (Figure 2.6).

This point becomes the Integrated Plot Centre regardless of the site or conditions. The plot centre may be in an open forest, a rocky area, a road, a creek, or inside a standing tree.

Note: If you feel that the site is unsafe or poses an undue hazard, the plot cluster or portion of a plot cluster may be dropped (see Section 2.5). The project supervisor will review other means of completing all or some of these hazardous plots.

2. Drive a pin fully into the ground at the Integrated Plot Centre. If site conditions make it impossible or inappropriate to imbed the aluminum pin at the Integrated Plot Centre, place it as close as possible to the plot centre, and record the offset distance and bearing from the pin to the plot centre on the Cluster Layout (CL) card (Figure A.5).

3. Collect GPS data at the Integrated Plot Centre. When GPS data cannot be collected at the plot centre, move to an area where data can be collected, such as an opening. Measure the distance and bearing from the point where data was collected back to the Integrated Plot Centre. Record these measurements in the appropriate section on the Cluster Layout card.

![Figure 2.6 — Layout of Reference Pin and Integrated Plot Centre.](image-url)
2.5 When the sample is inaccessible

In some instances, the complete sample or some part will not be accessible because of factors such as dangerous slopes, denied access, or physical safety concerns. It may be readily apparent from the tie point or earlier that the area is inaccessible, or only as the sample location is approached. In some cases, small unmapped local features such as beaver ponds and water bodies may be encountered. The field crew is not expected to sample beyond what is considered reasonable and safe. For example, if the water level is above the "boot tops," then estimate the attributes if possible or drop the plot if reasonable estimates cannot be made. **The safety of the field crew is the first priority.**

Complete as much information as possible on the field cards, maps, and photos to the point where field work was terminated. It is appropriate to estimate the portion of a sample not physically accessible [for example if the last few metres of a line transect is inaccessible but it can be seen that no pieces or a few pieces have to be estimated it is preferable to record the estimate(s) rather than recording the line portion as not sampled]. In another example, if $\frac{1}{2}$ of the large tree plot is accessible and $\frac{1}{2}$ is not accessible but can be estimated it is preferable to estimate the inaccessible portion.

When all or part of a sample is dropped, complete the CH card and return it to the project manager. Specify why the cluster or plots cannot be established, for example:

- access to plot is too dangerous
- plot would be located in an unsafe area
- plot would be located in a river or lake
- permission denied to access private land

Provide detailed comments as required.
3. Plot Establishment

Introduction

This section outlines the layout of plots and measurement procedures at the Integrated Plot. For more detailed procedures refer to the appropriate sections.

Objectives

To establish sample plots for the Change Monitoring Inventory.

Definitions

The Change Monitoring Inventory sample design is a single cluster consisting of an Integrated Plot located at the centre of the cluster. The location of the cluster is predetermined, using statistically appropriate procedures, at the project planning stage.

The Integrated Plot Centre is the location around which the detailed sample information will be collected. All attributes are attached to the plot centre point. Data is collected on the following major items using the sampling methods listed.

Table 3.1 – Summary of data collected at IPC and sampling method employed.

<table>
<thead>
<tr>
<th>Data</th>
<th>Sampling Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Large tree attributes</td>
<td>fixed area plots (5.64 m and 11.28 m radius)</td>
</tr>
<tr>
<td>top height tree</td>
<td>fixed area (5.64 m radius)</td>
</tr>
<tr>
<td>Site tree attributes</td>
<td>Fixed area 0.04 ha quadrants</td>
</tr>
<tr>
<td>wildlife tree attributes</td>
<td>fixed area</td>
</tr>
<tr>
<td>small trees and stumps</td>
<td>fixed area (2.50 m radius)</td>
</tr>
<tr>
<td>vegetation species and percent</td>
<td>fixed area</td>
</tr>
<tr>
<td>coverage</td>
<td></td>
</tr>
<tr>
<td>ecological site</td>
<td>centre point</td>
</tr>
<tr>
<td>Soils</td>
<td>point</td>
</tr>
<tr>
<td>old growth designation</td>
<td>point</td>
</tr>
<tr>
<td>coarse woody debris</td>
<td>line transect</td>
</tr>
<tr>
<td>range resources</td>
<td>line transect and fixed area</td>
</tr>
</tbody>
</table>
**General Procedures**

1. Confirm that the Integrated Plot Centre is in the correct location.

2. Assess safety considerations.

4. Determine and carry out the sequence of activities.
   - Assess the site vegetation and determine the most efficient sequence of measurements to ensure that specific values are not degraded by other activities. For example, on a site that has forage value, plants of interest may be trampled if tree heights are measured first.

5. Record the Integrated Plot characteristics (for example, project and sample ID, type of plot, plot radii).

*Figure 3.1 — Layout of sampling plots and transects and summary of data collected.*

- Integrated Plot Centre (IPC) — all attributes are attached to the location of the plot centre point
- 2.5 m fixed-radius — small tree and stump data
- 5.64 m fixed-radius — tree detail; top height tree; herbs, grasses, bryoids
- 0.04 hectare quadrants — site tree details
- within 10 m fixed-radius — estimated tree and shrub cover percentage, ecological data, soil pit
- 11.28 m fixed radius — tree details,
- Approximately 25 m radius — succession interpretations
- 24 m transects — coarse woody debris transects, range transects
- 0.399 m radius — range micro-plots along the transects at 6 m and 12 m
Field Cards for this Section

Header Card (CH) (Appendix A, Figures A.1 and A.2)
Polygon ID, project ID, sample plot, date, crew, notes

Compass Card (CP) (Appendix A, Figures A.3 and A.4)
Tie-Point Tree, Reference Pin Location, Reference Tree, GPS, file numbers, field survey notes

Cluster Layout (CL) (Appendix A, Figures A.5 and A.6)
Integrated plot details sample cluster details

Detailed Procedures

Depending on the sequence of measurements, perform the functions described below.

3.1 Establishing the Plots at the Integrated Plot Centre

Tree Detail Plot
1. Establish a 5.64m fixed-radius plot (Figure 3.2), for trees 4.0 cm DBH and larger.
2. Establish an 11.28m fixed-radius plot (Figure 3.2) for trees 9.0 cm DBH and larger.
3. Number the trees sequentially clockwise in quadrants from the north.
4. Make detailed measurements on the selected “in” trees for diameter, length, grade, wildlife tree attributes, damage agents, loss indicators, and other details.
Small Tree and Stump Plot (2.50 m fixed-radius)

1. Establish a 2.50 m fixed-radius plot, centred on the Integrated Plot Centre (Figure 3.3).

2. Count live trees less than 4.0 cm DBH and more than 30 cm in length. Record in two predetermined classes.

3. Collect stump data (larger than 4.0 cm top diameter inside bark) on this plot.

Top Height Tree Plot (5.64 m fixed-radius plot)

1. Establish a 5.64 m fixed-radius plot, at the Integrated Plot Centre (Figure 3.4). The top height tree plot is never split.

2. Measure a top-height tree, if a suitable tree is available within this plot.

3. Determine the species composition (by basal area) for the sample cluster.

4. Measure a site tree of the species leading in basal area, if a suitable tree is available within each quadrant.
5. Measure a site tree of the next species in order of basal area, if a suitable tree is available within each quadrant.

The first tree selected at the IPC is the top height tree; for example this tree may be a cedar tree. After completing the cluster, the leading species by basal area for the cluster is determined to be Cedar. The cedar tree may also be the "leading species tree" and the data will be recopied on the field card into the leading species information data fields. Alternatively, if the cluster leading species by basal area is hemlock, then the cedar tree may be the second site tree and the data will be recopied as required.

![Diagram showing top-height tree 5.64 m fixed-radius plot.](image)

**Figure 3.4 — Top-height tree 5.64 m fixed-radius plot.**

**Ecological Data Plots**

1. Establish a full fixed-radius plot (10 m radius) – centred on the Integrated Plot Centre – to measure trees and shrubs (Figure 3.5).
2. Establish a full fixed-radius plot (5.64 m radius) to measure herbs, grasses, and bryoids.
3. Within a 25 m radius of the Integrated Plot Centre determine succession and old-growth characteristics of the Integrated Plot Centre within the 11.28 m plot.
4. Establish a soil pit describing the Integrated Plot Centre within the 10 m radius plot.
Soil pit describing plot centre (within the 10 m plot), but as close as possible to the IPC.

Figure 3.5 — Ecological data collection plot layout.

Coarse Woody Debris Line Transects

1. Establish a 24 m horizontal line transect from the Integrated Plot Centre along a previously selected random bearing (Figure 3.6).

2. Measure all coarse woody debris greater than 7.5 cm diameter at the point of intersection.

3. Include detailed measurements at the transect crossing point on diameter, tilt angle, and decay class. Also record species and piece description.

4. Establish a second 24 m transect from the Integrated Plot Centre at plus 90° from the first line and take measurements again.

Figure 3.6 — Coarse woody debris line transect layout.
Forage Production Micro-Plots and Shrub Transects

Forage Production Plots

1. Establish four plots of 0.399 m radius on the coarse woody debris transects at 6 m and 12 m from the Integrated Plot Centre (Figure 3.7).
2. Determine the forage utilization.
3. Collect and label samples of forbs and graminoids.

Shrub Transects

4. Identify the shrub species and measure foliar cover intercepts along the full length of the transect lines, if possible.

![Figure 3.7 — Shrub transects and forage production micro-plots layout.](image)

3.2 Taking Ground Photographs

A series of ground photos will be taken at each Integrated Plot using a quality 35 mm camera with flash. The use of disposable cameras is not recommended. The print negatives will be digitally scanned and stored as files for reference by various future users. If digital cameras are available, they can be used to create the files directly.

Objectives

The photos will be available as digital data for:

- initial assessment by potential users who may want to sub-sample on these locations for other values; and
- “capturing” some information that is not directly measured.

Procedure

Take a minimum of eight photos at each Integrated Plot location. The required photos are as follows:

1. a close-up of the Integrated Plot Centre pin
2. a photo along the first random-bearing transect line
3. a photo along the second random bearing transect line
4. a photo along the reverse of the first random-bearing transect line
5. a photo along the reverse of the second random-bearing transect line
6. a photo representative of the sample vegetation and structure at the IPC
7. a photo of the forest canopy directly overhead at the IPC
8. a photo of the soil profile that has been described in the soil pit.

Do not cut trees or vegetation to provide an unobstructed view.

Take the photo before taking measurements if the site may be damaged during sampling.

1. Photograph the Integrated Plot Centre Pin at a steep angle (about 60°) above the pin showing the pin and the ground for approximately one metre or more around the pin so the vegetation can be seen (Figure 3.8). Include something to record the plot number, particularly on this photo.

2. Photograph the random-bearing transects from a position behind the plot centre pin (Figure 3.9).
   - Include the Integrated Plot Centre Pin in the foreground, if possible.
   - Include something for relative scale determination.
   - Try to include the various crown levels with a “portrait” (vertical) format, if required.

3. For a representative photo, photograph a portion of the plot which the crew considers representative of the sample vegetation and structure (Figure 3.10). Include the IPC and an item for scale in the photo.

4. Photograph any other unusual features that you think would be of interest to users of this data. You may wish to illustrate issues about the sampling process, such as when rules do not seem clear or appropriate. Make notes about these photos so the points can be addressed later.

5. Try to include people in each photo for scale. Use a scale in any close-up photos.

6. Include the plot number in the photo.

7. Record the photos taken (roll and photo number) and any comments on the (CH) Header Card.
Figure 3.8 — Ground photo showing Integrated Plot Centre pin.

Figure 3.9 — Ground photo along the first transect line.
Figure 3.10 — Ground photo showing representative view.
3.3 Completing the Header Card (CH)

A Header Card (CH), must be completed for all sample clusters. In addition, data must be recorded to identify each individual field card in case cards are separated. Some of the information is completed prior to sample establishment and some information during or as soon as possible after sample cluster completion. In all cases the Header Card must be completed even if the sample was inaccessible and not completed.

Procedure

1. Record the following information on the Header (CH) card and all other field cards:

| DATA ID | The Data ID (Project ID and Plot Sample #) must be recorded on all field cards (front and back), notes, sample collections, tree age cores, and so on. |
| PAGE — OF — | If the field cards provide inadequate space to record data, additional cards may be used as required. |

2. The following information will be completed at another time:

| FIELD CHECK BY | The full name of the person conducting a field check of the plot, and date of check. (This is not an Audit check.) |
| OFFICE CHECK BY | The full name of the person conducting the office check of the plot, and date of check. |

3. Record the following information on the CH field card:

| DATA ID | This section provides primary identification of the sample cluster. The values are assigned prior to field sampling and provided to the field crew. Values may also be entered by the project supervisor prior to field sampling. |
| PROJECT ID | The province has been divided into a number of inventory units. Record the code provided. |
| PLOT SAMPLE # | Each sample cluster is assigned a number. Record the number provided. |
| POLYGON IDENTIFIER | A unique value is assigned to all polygons within the province. Enter the number provided. In most cases this number is not available at this time but will be entered at some future date. |
**Plot Type**
The plot type coding for monitoring samples consists of three characters as follows:

Character 1 - type of sampling
- F = Provincial Change Management Inventory sample
- M = Management level monitoring sample

See Table 3 for field cards for each project type.

Character 2 - intent of sample
- O = Original
- R = Re-measurement
- A = Audit
- M = Matching

Character 3 - measurement number
- 1 = first measurement
- 2 = second measurement,
  and so on

**Note:** Typical examples of coding are as follows:
- FO1 = initial full Change Monitoring Inventory sample

<table>
<thead>
<tr>
<th><strong>Measurement Date</strong></th>
<th>The date the sample cluster measurements were initiated. Use this format: 1999-AUG-12.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Crew Initials</strong></td>
<td>Record crew members in order of responsibility for the work done, Person #1 is the crew leader. A record of crew initials (usually 3 initials as assigned) will be maintained by the MoF, and if overlaps occur a numeric value may be added (for example, JSF1 and JSF2).</td>
</tr>
<tr>
<td><strong>Field Responsibility</strong></td>
<td>Record the full name of the person with primary responsibility for collection of each type of data (tree data and ecological data).</td>
</tr>
<tr>
<td><strong>Plot Cluster Record</strong></td>
<td>This section provides a record of the information collected for a sample cluster. Check Yes or No for the information completed for each plot.</td>
</tr>
<tr>
<td>• <strong>Integrated</strong></td>
<td>Check No if the sample was inaccessible or unsafe. In the Notes section, provide reasons the sample was dropped or suggestions for accessing or completing the sample.</td>
</tr>
<tr>
<td>• <strong>Range, Ecological, CWD</strong></td>
<td>Check the plots completed.</td>
</tr>
<tr>
<td>• <strong>Photos</strong></td>
<td>Record number of photos taken.</td>
</tr>
</tbody>
</table>
• **TYPICAL: TREES, ECOLOGY**

Check (Yes or No) to indicate if the tree data or ecological data are typical of the plot being sampled. For example, the Integrated Plot or one or more of the Auxiliary Plots may be located in a wetland microsite within an upland forest and not typical of the plot being sampled, in the opinion of the crew.

Note that in all cases the sample will not be moved.

**NOTES**
Enter any comments relevant to the cluster measurements (such as photo notes, procedure problems).

**PHOTO RECORD**
Record the ground photos taken. If additional photos were collected, provide a short description with roll number and photo number. If no photos were taken, mark a “---” through both boxes and the reason photo’s were not taken.

---

**CMI Ground Sample Types**

The following table illustrates the field cards completed for various CMI ground sampling types. To provide consistent data across the province, a standard set of field data is preferred. The opportunity to collect additional data or portions of additional field cards is available and would be identified through the Project Implementation Plan (PIP).

---

**Table 3.2 – Field cards for Ground Sample Types**

<table>
<thead>
<tr>
<th>Sample</th>
<th>Field Cards</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
<td>Code</td>
</tr>
<tr>
<td>MMI</td>
<td>M</td>
</tr>
<tr>
<td>CMI-Full</td>
<td>F</td>
</tr>
</tbody>
</table>

March 31, 2003
3.4 Completing the Compass Card (CP)

The Compass Card (CP) provides an additional means of relocating samples in the short and long term (20 years or more).

**Procedures**

Complete a Compass Card(s) for each sample cluster. Record as much information as possible. In addition to the Data ID, at a minimum record the following:

<table>
<thead>
<tr>
<th><strong>MAP NO. / POLYGON NO.</strong></th>
<th>Forest cover map and temporary polygon numbers.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>FLIGHT LINE / PHOTO NO.</strong></td>
<td>Airphoto numbers on which the tie point and sample are located.</td>
</tr>
<tr>
<td><strong>TIE POINT / REFERENCE POINT DETAILS</strong></td>
<td>Record the Tie Point and Reference Point details, and offset Reference Pin where applicable. Record the Species, Diameter (DBH in cm), the azimuths and distances from the Tie Point Tree to tie point location and Reference Point Tree to Reference Point Location. In some cases a tie point or reference tree will not be available. In these cases the crew could use a rock feature as a reference [record “ROC” in the species record] or any other identifiable feature such as telephone pole, hydro tower [record “OTH” in the species record and specify the feature in the comments section].</td>
</tr>
<tr>
<td><strong>COMMENTS</strong></td>
<td>Record any special features of the tree (e.g., major fork). Record other features of the Tie Point. If there is no Tie Point Tree, describe the Tie Point (e.g., junction of Loss Creek Main and Branch 300; northeast corner of Cutblock 11 on Branch 302; northwesterly edge of snowslide track).</td>
</tr>
<tr>
<td><strong>GPS FILE ID</strong></td>
<td>Record offset GPS reading, if applicable</td>
</tr>
<tr>
<td><strong>STRAIGHT LINE BEARING AND DISTANCE TO IPC</strong></td>
<td>Record the horizontal distance and azimuth from the Tie Point to the Integrated Plot Centre.</td>
</tr>
<tr>
<td><strong>NAVIGATION NOTES</strong></td>
<td>Map the features along the tie line. Record Vegetation or timber type changes, creek locations (names, if known), rock bluffs, etc.</td>
</tr>
<tr>
<td><strong>ACCESS POINT LOCATION</strong></td>
<td>Record description, GPS file ID.</td>
</tr>
</tbody>
</table>
3.5 Completing the Cluster Layout (CL) Card

A Cluster Layout card (CL) will be completed for all clusters. The card provides a location to record detail on the features around the Integrated Plot Centre and the features associated with the sample cluster.

Procedure

Record the following information on the CL field card:

<table>
<thead>
<tr>
<th>GPS INTEGRATED PLOT CENTRE</th>
<th>Record the file number in the GPS Integrated Plot Centre field. Record offset GPS reading, if applicable. If a GPS reading was not available at the site record in the comments section why no data was collected. Record offset Integrated Plot Pin details, if applicable. <strong>Recording the “intended” or target UTM co-ordinates:</strong> Field cards – on the field card record the “intended” UTM co-ordinates in the comments section on the back of the CL card. Handheld – the handheld program will collect the “intended” UTM co-ordinates.</th>
</tr>
</thead>
<tbody>
<tr>
<td>SLOPE PROFILE</td>
<td>Sketch the cross section including Integrated Plot Centre which best describes the local topography.</td>
</tr>
<tr>
<td>INTEGRATED PLOT DETAILS</td>
<td>Map distinctive features within the plot such as water bodies, rock outcrops, site series boundaries, B.C. Land Cover classification boundaries.</td>
</tr>
<tr>
<td>SAMPLE CLUSTER DETAILS</td>
<td>Map distinctive features within the sample cluster area which may aid in plot relocation, such as creek locations, road locations, polygon boundaries. Map the Reference Pin location and tie point location if it is close to the Integrated Plot Centre.</td>
</tr>
<tr>
<td>COMMENTS</td>
<td>Record any comments which may aid in relocation of the plot, or other items of interest.</td>
</tr>
</tbody>
</table>
4. Inventory Cruising

Introduction
This section deals with the identification and collection of detailed tree information from which volume can be calculated, quality can be assessed, and site potential can be determined. Trees are sampled using a combination of fixed-radius plots.

Objectives
- To collect attributes for the calculation of tree and stand volumes.
- To collect site index information.
- To assess and collect tree attributes for:
  - future growth and yield assessment,
  - wildlife,
  - decay research, and
  - forest health information.

General Procedures
Tree measurements are discussed in this section as they appear on the field cards, but the field crew is free to measure attributes in the most efficient sequence. Net factoring and call grading are discussed in a separate section. The steps are discussed in the following order:

1. Establish plot layout and identify (tag) trees to measure.
2. Identify and record tree attributes.
3. Assess and record wildlife use.
4. Record damage agent and severity codes.
5. Identify and record tree loss indicators.
6. Establish fixed-radius plot for small tree and stump data.
7. Classify and tally small trees by species.
8. Measure and record stump data.
9. Establish a fixed-radius plot for top height and quadrants for site tree measurements.
10. Determine leading species composition (by basal area) for the sample cluster.
11. Select and record top height tree, leading, second species and other major species tree data.
12. Identify and record additional measurements on other major species, if required.
Field Cards for this Section

Tree Details (TD) (Appendix A, Figures A.11 and A.12)
Tree number, species, status, DBH, remaining bark, length, net factor, grades, stem map

Tree Loss Indicators (TL) (Appendix A, Figure A.13)
Damage agent, severity, loss indicators, location and frequency, and wildlife codes

Small Tree, Stump, and Site Tree Data (TS) (Appendix A, Figure A.14)
Small tree, stump, height and age information.

Detailed Procedures

4.1 Establishing Plot Layout

Selecting the Sampling Method
The sampling design accommodates the use of fixed-radius plots for the sample cluster.

- Fixed-Radius Plots – will be used in all situations.

The design specifies a series of fixed radius plot sizes

Objectives

The primary objective is to have an accurate tally of trees at all points. (The definition of ‘tree’ can be found in Section 4.2.) A secondary objective is to have an efficient number of trees for analysis.

Measuring Borderline Trees “In” and “Out”

An objective of the inventory is to correctly determine which trees are within the plot. The centre of a tree at "point of germination" will be used to check the borderline distance.

Fixed-Radius Plots
1. Correct all measurements to horizontal distance.
2. Use the central point of the tree stem at "point of germination" to determine if the tree is “in” or “out” of the sample. This central point is generally equated with the tree pith.

4.2 Identifying and Recording Tree Attributes

Record the following measurements in the appropriate fields on the Tree Details (TD) field card. The fields to be recorded are listed and described below.

For purposes of this inventory, a tree is defined as:

- a species identified as a tree by the botanists on this project, regardless of the size to which it does (or might) grow. Refer to Appendix C: The Change Monitoring Inventory Tree Code List;
- longer than 1.3 m, having roots attached to the bole or an identifiable root collar; and
• greater than or equal to 4.0 cm at DBH.

**TREE NUMBER**

All trees will be numbered to identify them in the field and on the field cards. The plots will be re-measured in the future and are subject to audit cruising, and numbering the trees in a consistent sequence will enhance the chances of a successful remeasurement program. Trees will be tagged so that the plot will not be treated in a “special” manner by other visitors to the site.

**Marking the Plot Circumference**

1. Using a plot tape, measure the 5.64 metre and 11.28 metre plot radius from the plot centre stake. 
   • On sloping plots apply a slope correction to the radius. See “Plot and Sub-plot Radii Slope Allowance Table”. [Appendix F - Calculating Slope allowances]
2. Measure the plot radius to accurately determine the plot circumference, mark this circumference with plot string as required.
3. Check trees close to the circumference with the plot tape. These trees are called line trees. Include line trees in the plot when at least half their base at the "point of germination" is inside the plot.

**Dividing the Plot into Sectors**

Divide the plot into 8 pie-shaped, 0.005 ha (45 degrees) sectors. These are the tagging sectors. Tagging sectors are later combined into pairs in order to have 0.01 quadrants [site sectors] for the selection of site trees.

Sector 1, is always the first sector clockwise from due north. The additional sectors are numbered clockwise from sector 1.

**Tagging Trees**

Tag all living (standing and fallen) and dead (standing only) trees that have a DBH of 4.0 cm and greater within the 5.64 metre radius sub-plot and trees with a DBH of 9.0 cm and greater between the 5.64 metre and 11.28 meter area. Use the pre-numbered aluminum tags provided in sets of 1 to 500. Do not duplicate tag numbers in a plot.

**Tagging by Sectors**

1. Start with sector 1. In this sector, affix the tags so that they face the plot centre. If the tag will be highly visible in this location move the tag around the tree at a height equivalent to high side until the tag is less visible.
2. Tag the trees near the plot centre first; then continue tagging outward by moving side-to-side across the pie-shaped sector.
3. As you reach the circumference of sector 1, make the last sideways pass in the direction of sector 2 so that the last tree tagged in sector 1 is, as near as possible to the first tree you will tag in sector 2.
4. Begin tagging sector 2. In this sector, affix the tags so that they face the circumference, not the plot centre as in sector 1.

5. Tag the trees near the circumference first, then continue tagging inward by moving side-to-side across the pie-shaped sector.

6. Make sure the last tree you tag in this sector is the one closest to the plot centre.

7. Repeat the procedures used in sectors 1 and 2 for the remaining sectors. Remember that tags in odd-numbered sectors face the plot centre while those in even-numbered sectors face the circumference.

### Attaching Tags to Trees

1. Affix tags at the base of the tree (at the high side or highest point of the ground on the uphill side) and mark the breast height location, which is 1.3 metres above the base of the tree on the uphill side. Use a 1.3-metre long dbh stick to measure the correct height.

2. Nail the tag to the base of the tree:
   - use 6 cm aluminum nails;
   - drive the nail slightly upward so the tag hangs away from the tree;
   - drive the nail into the trunk just enough to hold the tag securely and yet allow for radial growth.

### Tagging Forked Trees

Here are special rules for tagging forked trees:

1. Tag the stem as a single tree if:
   - the fork occurs above 1.3 m, and
   - the stem has a dbh of at least 4 cm within the 5.64 metre sub-plot or has a dbh of at least 9.0 cm if the stem is between the 5.64 metre and 11.28 metre area.

2. Tag each stem separately if:
   - the fork occurs below 1.3 m, and
   - two or more of the fork's stems have a dbh of 4 cm or greater within the 5.64 metre sub-plot or have a dbh of at least 9.0 cm if the stems are between the 5.64 metre and 11.28 metre area. Use consecutive numbers when you tag (tag the stem farthest to the left first and finish with the stem farthest to the right) these stems.
   - Locate the tag at high side ground level directly below the fork so it is evident which tag belongs to each stem.

3. Tag the stem as a single tree if:
   - the fork occurs below 1.3 m, and
   - only one of the fork's stems has a dbh of 4 cm or greater within the 5.64 metre sub-plot or have a dbh of at least 9.0 cm if the stems are between the 5.64 metre and 11.28 metre area.

### Recording Tree Sector Numbers

All trees will have the sector number recorded to assist relocation at the time of re-measurement. The sector number will be recorded in the spare column (S1) on the right side of the TD field card.
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**TREE SPECIES**

Assign a species code to all trees, measuring all trees regardless of commercial value at the time of the survey. A list of tree species recognized in the inventory is in Appendix C: The Change Monitoring Inventory Tree Code List. This list is consistent with the VRI tree species list. The data custodian for the tree species list is the Director, Ministry of Forests Research Branch.

*Note:* It has been decided *not to measure* the willow “tree species” on the large tree or small tree plots. The ecological component will still collect data on these species.

**Procedure**

1. Record on the field card the tree number and a species code (up to 3-characters) for the tree being measured.

2. Code all species as accurately as possible using the Change Monitoring Inventory Tree Code List (Appendix C). If possible identify the species. If the species cannot be identified with confidence, record the genus, if known. If the genus is not known, record the appropriate code (such as Xc for an unknown conifer).

**TREE CLASSES**

Assigning tree classes allows for reporting trees in categories and reflects some potential for future growth.

**Procedure**

1. Record for each tree whether it is live or dead, standing or fallen.

2. Use the codes described in Table 4.1.

**Table 4.1 – Tree Status Codes.**

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Live/Dead</strong></td>
<td></td>
</tr>
<tr>
<td>L</td>
<td>Live trees have enough foliage to keep them alive (live cambium is present), and are rooted into the ground. Lack of foliage for some species, of course, is no indication of death during some seasons.</td>
</tr>
<tr>
<td>D</td>
<td>Dead trees are obviously dead, or roots are separated from the ground and expected to die very shortly.</td>
</tr>
<tr>
<td><strong>Standing/Fallen</strong></td>
<td></td>
</tr>
<tr>
<td>S</td>
<td>Standing trees are self supporting (that is, the tree would remain standing if all supporting materials were removed).</td>
</tr>
<tr>
<td>F</td>
<td>Fallen trees are not self-supporting.</td>
</tr>
</tbody>
</table>
**Diameter Breast Height (DBH)**

Measure and record the diameter of all live/dead, standing/fallen trees equal to or greater than 4.0 cm DBH.

**Procedure**

1. Determine high side ground level at the base of the tree.
2. High side is defined as the highest point of mineral soil or a humus layer around the base of the tree, no lower than the point of germination. Breast height is 1.3 m above high side measured parallel to the tree bole.
3. Measure the DBH in cm and tenths at 1.3 metres from the ground on the high side (Figure 4.1).
4. Use a stake marked at 1.3 m to accurately locate DBH on straight stems. On curved stems measure along the curve parallel to the centre of the tree.
5. Paint a dot on the tree, or mark a dot, where DBH was measured, preferably facing the plot centre.
6. Record the DBH with a tight diameter tape, outside the bark, making no allowance for missing bark.
7. If there is abnormal swelling or obstructions at DBH measure above and below the location and average the values as appropriate. This would be recorded as an estimated value.
8. Record whether the DBH was measured (M) or estimated (E).

![Figure 4.1 — DBH in relation to high side ground (HSG). (X indicates point of germination).](image-url)
REMAINING BARK PERCENTAGE

The percentage of bark remaining is required to determine the actual wood volume of the tree. The impact on wood volume will be minor when small amounts of bark are missing, but could become significant when large areas of bark are missing, particularly on thick-barked species.

Procedure

1. For each DBH measurement, record the percentage of bark remaining at DBH to the nearest percent, for example:
   - bark: 100% record as - -
   - bark: 90% record as 90
   - bark: 13% record as 13
   - no bark present: record as 00

   **Note:** It does not matter if the diameter tape touches the exposed wood or not.

2. Calculate the bark remaining.

   A simple way to obtain the percentage of bark remaining is to observe the length along the diameter tape where the bark is missing, and subtract to find the amount remaining. Calculate the percentage of bark remaining using the following formula:

   \[
   \text{Remaining bark \%} = \left(\frac{\text{length of tape with bark}}{\text{total length of tape}}\right) \times 100\%
   \]

   See Figure 4.2 for an example.

   ![Figure 4.2 — Measurement of remaining bark.](image)

   **Example A**
   - Diameter = 112 cm (on tape)
   - 16 cm missing

   **Example B**
   - Diameter = 160 cm (on tape)
   - 85 cm missing

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EXAMPLE A

On a 112.0 cm tree, bark is absent from 79 cm on the tape to 95 cm, a distance of 16 cm ($95 - 79 = 16$). The percent bark remaining is then calculated using the formula.

\[
\text{Remaining bark \%} = \left( \frac{\text{length of tape with bark}}{\text{total length of tape}} \right) \times 100\%
\]

\[
\text{Remaining bark \%} = \left( \frac{\text{112} - 16}{112} \right) \times 100\%
\]

\[
= \left( \frac{96}{112} \right) \times 100\%
\]

\[
= 85.7\% \text{ (Record 86\%)}
\]

EXAMPLE B

On a 160.0 cm tree, bark is missing over 85.0 cm. The percent bark remaining is calculated using the formula.

\[
\text{Remaining bark \%} = \left( \frac{\text{length of tape with bark}}{\text{total length of tape}} \right) \times 100\%
\]

\[
= \left( \frac{160 - 85}{160} \right) \times 100\%
\]

\[
= \left( \frac{75}{160} \right) \times 100\%
\]

\[
= 46.9\% \text{ (Record 47\%)}
\]

TREE LENGTH

Measure the length of each tree within the integrated plot, including broken and fallen trees.

Measure all trees except where the measurement is physically obstructed, it is unsafe to make the measurement, or when an accurate measurement is impossible. In such cases estimate the tree length.

For trees with broken tops, see discussion of Broken Tops below. For odd-shaped trees see Figure 4.3.

Procedure

1. Estimate the tree length before measuring as a check on your calculations.

2. Measure the length of the tree from the ground level on the high side along the stem to the top of the stem. Record length to the nearest 0.1 m.

3. For broken stems, measure the length that allows the most appropriate application of taper functions for calculating the volume of the tree.
4. For fallen broken trees, record the length of the stem to the break. Measure the portion of the tree from the root collar to the top of the last connected portion (the pieces must be physically attached so that if one part is moved the next part will move).

5. Record whether the length was measured (M) or estimated (E).

![Diagram of odd-shaped trees]

**Figure 4.3 — Measurement of odd-shaped trees.**

**CROWN CLASS**

Crown class is a ranking by crown position of a tree in relation to other trees in the immediate area surrounding the tree being measured. The crown class will be useful in future growth models.

**Procedure**

1. Assign a crown class code to all **standing live** trees using the descriptions in Table 4.2.

2. Dead trees and fallen live trees will **not** have a crown class assigned, mark a dash through the field card boxes.

3. On trees with a broken or dead top assess the remaining live portion of the crown as to its present interception of light in the immediate area around the measured tree. For example, a tree was formerly in a dominant crown position but the top of the crown has died back and only the lower limbs are alive. This crown would most likely be ranked in the intermediate or suppressed position based on the current light interception of the remaining crown.
Table 4.2 – Crown class codes.

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>D</td>
<td><strong>Dominant</strong> Trees with crowns that extend above the general level of the crown canopy (may include trees, shrubs or other obstructions) immediately around the measured trees. They are somewhat taller than the codominant trees, and have well-developed crowns, which may be somewhat crowded on the sides, receiving full light from above and partly from the side.</td>
</tr>
<tr>
<td>C</td>
<td><strong>Codominant</strong> Trees with crowns forming the general level of the crown canopy (may include trees, shrubs or other obstructions) immediately around the measured trees. The crown is generally smaller than those of the dominant trees and is usually more crowded on the sides, receiving full light from above and little from the sides.</td>
</tr>
<tr>
<td>I</td>
<td><strong>Intermediate</strong> Trees with crowns below, but extending into, the general level of the crown canopy (may include trees, shrubs or other obstructions) immediately around the measured trees. The crowns are usually small and quite crowded on the sides, receiving little direct light from above but none from the sides.</td>
</tr>
<tr>
<td>S</td>
<td><strong>Suppresssed</strong> Trees with crowns entirely below the general level of the crown canopy (may include trees, shrubs or other obstructions) around the measured trees, receiving no direct light either from above or from the sides.</td>
</tr>
</tbody>
</table>

**HEIGHT TO LIVE CROWN**

Measure the height to the live crown for future research. *Height to live crown* is the distance along the bole from the high side ground level to the crown base. The primary objective is to estimate the “effective” extent of live crown for growth projections.

**Procedure**

1. Determine the crown base. The crown base is normally the location on the stem where live branches occupy about three-quarters of the stem circumference. If this is obviously not an effective definition, then use your judgment as to the effective crown length.
2. Record the height to live crown for all live trees to the nearest metre.
3. Record trees that are dead or have no effective crown (those having only a few green branches) as dashes ( -- ).

**CLASSIFICATION OF RESIDUAL TREES**

Classify all trees assessed on the large tree plot as to whether it is a residual from a former stand. In making this assessment refer to the general area around the plot. The definition of a residual is as follows:

A residual tree is defined as a living remnant of a former stand; in even-aged stands, the occasional (< 25 per ha) large stem of an older age class than the stand as a whole. Typically these trees may have larger diameters, a higher incidence or indications of
decay, thicker bark, larger branching and "ragged" or flat tops. These trees must be clearly residual. Uneven-aged stands do not generally have residual trees.

Procedure

1. Determine if the tree is a residual as per the given definition.
2. In the spare column [S2 - column 56] record a "R" if the tree is a residual. If the tree is "not" a residual record a dash [-].

**BROKEN TOPS**

Measure all broken trees to the location of the broken top. For the compilation program to apply appropriate form factors to the tree stem, the diameter at the breakage point **OR** the original (projected) length of the potential tree must be recorded. If the broken top is available on the ground then a direct measure of diameter or actual “projected” height may be possible to measure.

Procedure

1. Measure the length of the tree stem to the break. For shattered stems, estimate the length after folding in shattered wood to make a whole diameter.
2. Choose one of the following options, depending on which can be most reliably estimated:
   - estimate the diameter of the stem at the break
   - estimate the original unbroken height of the tree
3. Record the broken top diameter (in cm) or the projected height (in m) on the field card. All trees with broken tops must have only one of these fields completed.

### 4.3 Assessing Tree Attributes for Wildlife

Trees provide present or future habitat for the maintenance or enhancement of wildlife. All trees in the integrated plot will be assessed for a number of visual attributes such as appearance, crown condition, bark retention, and wood condition. These and other tree attributes, such as DBH, length, and percent sound, can be correlated to estimate wildlife habitat potential.

Live trees and standing dead trees are assessed. They provide nest cavities and platforms, nurseries, dens, roosts, hunting perches, foraging sites, and display stations. Birds, mammals, amphibians, and various invertebrates use trees, and some species are highly dependent upon the specialized habitat provided by certain types of trees.

While knowledge of the size and abundance of live and dead trees permits an interpretation of the habitat suitability of a particular stand, specific wildlife-related data for each tree sampled is much more useful. A record of actual wildlife use of individual trees provides information on the preference of wildlife species for trees with certain characteristics.
Procedure
1. Assess each standing or fallen live tree and standing dead tree selected and numbered for measurement in the variable- or fixed-radius plot for wildlife attributes, using the categories and codes listed below.
2. Record the appropriate codes on the Tree Details (TD) Card in the Wildlife Codes section.
3. Fallen dead trees are not assessed.

Visual Appearance
Classify the visual appearance and record the appropriate code (1 to 9) using the shape of the tree stem as the dominant characteristic (Figure 4.4).

![Figure 4.4 — Visual appearance codes.](image)

Crown Condition
Examine the crown in relation to a normal live crown (lower crown loss due to self pruning is not included). Record code (1 to 7) from Table 4.3.

Table 4.3 — Crown condition codes.

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>All foliage, twigs, and branches present.</td>
</tr>
<tr>
<td>2</td>
<td>Some or all foliage lost, possibly some twigs lost, all branches usually present, possible broken top.</td>
</tr>
<tr>
<td>3</td>
<td>No foliage, up to 50% of twigs lost, most branches present, possible broken top.</td>
</tr>
<tr>
<td>4</td>
<td>No foliage or twigs, up to 50% of branches lost, top usually broken.</td>
</tr>
<tr>
<td>5</td>
<td>Most branches gone, some sound branch stubs remain, top broken.</td>
</tr>
<tr>
<td>6</td>
<td>No branches, some sound and rotting branch stubs, top broken.</td>
</tr>
<tr>
<td>7</td>
<td>No branches, minimum of rotting branch stubs, top broken.</td>
</tr>
</tbody>
</table>
**BARK RETENTION**

Classify the proportion of bark remaining, and code (1 to 7) from Table 4.4.

**Table 4.4 – Bark retention codes.**

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>All bark present.</td>
</tr>
<tr>
<td>2</td>
<td>Bark lost on damaged areas only (&lt;5% lost).</td>
</tr>
<tr>
<td>3</td>
<td>Most bark present, bare patches, some bark may be loose (5%–25% lost).</td>
</tr>
<tr>
<td>4</td>
<td>Bare sections, firm and loose bark remains (26%–50% lost).</td>
</tr>
<tr>
<td>5</td>
<td>Most bark gone, firm and loose bark remains (51%–75% lost).</td>
</tr>
<tr>
<td>6</td>
<td>Trace of bark remains (76%–99% lost).</td>
</tr>
<tr>
<td>7</td>
<td>No bark (100% lost).</td>
</tr>
</tbody>
</table>

**WOOD CONDITION**

Classify the wood texture (soundness) of the tree, and code (1 to 8) from Table 4.5.

**Table 4.5 – Wood condition codes.**

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>No decay.</td>
</tr>
<tr>
<td>2</td>
<td>Probable limited internal decay and/or deformities.</td>
</tr>
<tr>
<td>3</td>
<td>Limited decay, wood essentially hard.</td>
</tr>
<tr>
<td>4</td>
<td>Wood mostly hard but decay spreading, soft wood present.</td>
</tr>
<tr>
<td>5</td>
<td>Balance of hard and soft wood, spongy sections.</td>
</tr>
<tr>
<td>6</td>
<td>More soft and spongy wood than hard wood.</td>
</tr>
<tr>
<td>7</td>
<td>No more hard wood, all soft or spongy, powdery sections.</td>
</tr>
<tr>
<td>8</td>
<td>Hollow shell, outer wood mostly hard or firm.</td>
</tr>
</tbody>
</table>

**LICHEN LOADING**

Assess all live or dead, standing trees for lichen loading on the branches within 4.5 m of the ground or root collar.

Assign a rating from 0 to 5 based on comparison with the appropriate set of photos contained in *Estimating the Abundance of Arboreal Forage Lichens* (Armleder et al. 1992). A value of 0 indicates no lichens, whether it is a live tree with branches and foliage or a dead tree. If a tree has lichens but none are below the 4.5 m mark, a rating of zero will be given.
**WILDLIFE USE**

**Activity**

Record wildlife use as a two-part alpha code. When indicators or wildlife use of sampled trees is observed, record the following codes in the first field: Feeding (F_); Open nesting (O_); Cavity nesting (C_); Marking (M_); Denning (D_); Perching (P_).

**User**

If you can determine whether usage is by a mammal (_M), bird (_B), reptile (_R), or amphibian (_A), record it as a second code letter.

For example, a feeding bird (FB), nesting amphibian (NA), denning mammal (DM).

If only the activity can be determined but not the responsible group, record only the first alpha code.

**FEEDING (F __ )**

Feeding trees are very important to many wildlife tree users. Many woodpeckers feed on bark beetles; other birds glean insects from tree trunks, branches, and foliage; and hawks and eagles use trees as hunting and feeding perches.

Record if feeding behaviour or indicators are observed. Indicators might include the following:

1. Pileated Woodpeckers excavate large rectangular feeding holes
2. Red-breasted and Yellow-bellied Sapsuckers drill horizontal patterns of sapwells
3. Three-toed and Black-backed Woodpeckers scale off bark to feed on insects
4. Porcupines gnaw on large sections of bark (diagonal tooth marks are often apparent)
5. Rabbits, hares, and squirrels feed on the base of young trees (squarish “windows” or girdling at the base)
6. Squirrel cone caches or basal accumulations of cone bracts from squirrel feeding

**NESTING (CAVITY NESTING C __ OR OPEN NESTING O__ )**

1. Record if evidence of cavity nesting (C__).

Cavity nests might be difficult to detect, but their locations are predictable to some extent. Many woodpeckers (including Three-toed, Black-backed, Hairy and Pileated Woodpeckers, and flickers) prefer live hardwoods as nesting trees and often excavate their cavity underneath branches. Nuthatches and chickadees build their nests in broken-off standing dead trees, or in broken branch holes, often directly below the breakage point where stem rots have entered the tree and softened the heartwood. Trees with cavity nests are important to retain because they may be used over many years by a variety of species. During the breeding season, the begging calls of nestlings are easy to detect.
Test a tree with a cavity nest by carefully and safely striking it to determine if the nest is occupied. If a wildlife species responds and can be identified, note the species presence in the Comments section using the specific species code (see User Species Codes below).

- Cavity nesters have perfectly round or oval nest holes
- Pileated Woodpecker and the Common Flicker have oval holes due to their large size
- Downy Woodpeckers, Chickadees and Nuthatches have small round holes
- Brown creepers have hammock nests under the loose bark
- Some ducks, owls, and squirrels nest in abandoned woodpecker holes

2. Record if evidence of open nesting (O__).

Raptors and herons build large platform-style stick nests. Open nests of eagles, hawks, owls, and herons are usually situated in the upper part or crown of live and dead trees. Many of these nests are used by the same or different pairs over many years; therefore, nest trees for open nesters have a very high habitat value.

MARKING (M__)

Record evidence of marking, such as claw marks by grizzly or black bears, and antler rubbing by deer or elk. These trees are used mostly for communication of territorial boundaries and during courtship.

DENNING (D__)

Record evidence of denning by bears, squirrels, bats, or other mammals. Other mammals that use wildlife trees for denning include marten, fisher, weasels, skunks, and raccoons. Bears often hibernate in the hollow trunks of large standing trees, especially western redcedars. Entrances to tree dens can be basal or arboreal. Sometimes loggers discover dens while working; care should be taken not to destroy or injure the bears.

PERCHING (P__)

Perching and roosting trees are also essential habitat elements for wildlife tree users.

Characteristic perch trees of aerial foraging and hawking birds have prominent dead branches that provide a good view of the surrounding area. Perching use may be observed, particularly on tall trees with good vantage, especially near riparian edges. Plucking spots where raptors feed are especially important. They can be identified by “whitewash” and the remains of prey in the vicinity.

Roost trees are often in sheltered locations and have natural or excavated cavities. Roosts provide shelter from predators and inclement weather, some provide the environmental conditions appropriate for raising young. Roosting sites in trees include cavities, hollows, beneath bark, and in foliage.

NOTHING OBSERVED (--)

Record if no wildlife use is evident or observed.
User Species Codes

If a positive identification can be made of species that are using wildlife trees in the plot, record the wildlife species codes in the comments section on the back of the Cluster Layout card. Record the common species name.

Use the 6-character species codes for wildlife species, found in the *Vertebrates of British Columbia: Scientific and common names, v. 2.0, 13 July 1998* available from the following web site: <http://www.elp.gov.bc.ca/wld/spi/taxonomy/index.htm>.

If a positive identification can be made: The first letter of the code identifies the species as mammal (M), bird (B), reptile (R) or amphibian (A); the remaining 4 letters are from the first 2 letters each of the genus and species names, or of the common names in the case of birds.

For example:

M-LEAM mammal, snowshoe hare (*Lepus americanus*)

B-BLGR bird, Blue Grouse

R-THEL reptile, western garter snake (*Thamnophis elegans*)

A-BUBO amphibian, western toad (*Bufo boreas*)

If a positive identification cannot be made: Species groups begin with the 4-letter group code with the letter “U” followed by 3 letters derived from the common name of the species group.

For example:

B-UWOO unidentified woodpecker

M-UMOU unspecified mouse

4.4 Assessing Damage Agents and Severity

Note: The assessment of damage agents and loss indicators share some common elements but they are separate and distinct processes (perhaps recorded by separate people). Tree loss indicators are discussed in Section 4.5.

The Change Monitoring Inventory will sample for damage agents and severity on individual trees to provide an assessment of forest health. The sample will identify the agent or agents that cause the damage and quantify severity of the damage. The data is recorded on the Tree Loss Indicator (TL) field card. Damage agent types include abiotic, disease, insects, treatments, vegetation, and wildlife.

The damage agent and severity information will be used to determine:

- causes of tree mortality related to damage agents;
- stand growth reductions related to damage agents;
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- species succession as related to damage agents;
- incidence and extent of the damage agent conditions;
- relationships between vegetation (forest) cover and damage agent conditions, used to derive a BEC forest cover hazard and risk rating;
- forest level yield projection and planning procedures (such as stratification of data by damage type, damage intensity, or damage risk class); and
- the relationship between damage agent and estimation of sound (undecayed) wood volume as determined through the net factoring and hidden defect processes.

**Procedure**

1. Assess damage agent(s) or conditions, and damage severity (ies) on all numbered trees, **dead or alive**, within the integrated plot. You will also assess new live species occurring on the Auxiliary Plots. For stumps in the 2.50 metre fixed radius plot, assign a damage code for root diseases.
   - Use the *Field Guide To Pests of Managed Forests in British Columbia* (Fink et al. 1989) to help identify damage agents and conditions. See Appendix D for damage agent codes, and Appendix E for damage severity and mortality condition codes and standards.

2. Record the damage agents for each tree on the Tree Loss Indicators (TL) Field Card.
   - Use a 1-, 2-, or 3-letter code, depending on your confidence in the identification. The damage agent codes are hierarchical and enable coding from very general (type or category) to specific (species). The first letter indicates the type of damage agent: abiotic (A), disease (D), insect (I), mites (M), treatment (T), vegetation (V), and wildlife (W). The second and third letters indicate the specific agent, if it can be determined.
   - For example, Armillaria root disease is coded DRA (D = disease, R = root rot, A = Armillaria). If unable to identify the specific disease, only that it is a root disease, record DR. If you cannot determine that it is a root disease, but you are certain it is a disease (not an insect or other damage agent), record D for disease.

3. When the tree has more than two damage agents, list at least the most important two damage agents on the TL card. If you wish to list more than two damage agents repeat the tree number on successive rows.

4. Record the damage severity using the codes listed in Appendix E: Damage Severity and Mortality Condition Codes and Standards.

5. Record “0” if no damage agent is observed.

6. In many instances damage may be evident, such as forks and scars and the damage agent is not known. In these instances record a (U) in the damage agent fields.

### 4.5 Assessing Tree Loss Indicators

Specific loss indicators signify the potential presence of decayed wood. The loss indicators (previously known as pathological indicators) to be measured are: conks, blind conks, frost cracks, scars, forks, crooks, large rotten branches, dead tops, root rot, soundings, direct observation, and broken tops. The specific indicator, its extent, and frequency are recorded on the TL field card. Rules and measurements are used to calculate the net factor (sound wood volume) of variable length logs.

March 31, 2003
The inventory design for measurement and description of loss indicators attempts to adopt the traditional definitions and procedures of British Columbia and the Pacific Northwest wherever possible. The objective is to maintain a system that is compatible with current and past inventories, but will also meet future needs.

The estimation of sound wood for each variable length log will be determined through the net factoring and hidden defect processes discussed in a separate section.

**Procedure**

1. Record loss indicators for all live trees within the Integrated Plot and for new species occurring on the Auxiliary Plots. The collection of primary loss indicators, such as; stem decay, root decay, blind conk, frost cracks, soundings and direct observations for dead trees on the IPC plot is optional. Crews are to collect the significant indicators, especially those indicators that affect net factoring or call grading decisions.

2. Enter the appropriate code for the loss indicator (see Table 4.6 for codes and description).

3. Enter a “+” if the location of the loss indicator is above high side ground level or “−” if below high side ground level.

4. Measure the position of each loss indicator on the stem of each numbered tree from ground level on the high side of the tree, to the nearest 0.1 m. Record the lower and upper extents as “From” – “To”.

5. If an indicator is a point feature, such as a singular conk, record the location once under the “From” column with a frequency of “1”.

6. If the indicator occurs more than once and is best described as a series, record the frequency as the number of times the loss indicator occurred in a particular interval.

7. If it is necessary to record more than three loss indicator occurrences, list the tree number as often as required on the TL card.

8. Record multiple occurrences of loss indicators which do not have common causes as separate occurrences. The intent is to localize the loss indicator (for example a tree with basal scars from logging and a scar in the upper crown from a rubbing tree stem would be entered as separate occurrences).

**Note:** Loss indicators are only recorded for the main stem on trees forked above DBH.

### Table 4.6 – Loss indicator codes.

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>DD __</td>
<td>Unknown stem decay (conk)</td>
</tr>
<tr>
<td></td>
<td>DDE is a known stem decay (<em>Echinodontium tinctorium</em>)</td>
</tr>
<tr>
<td>DR __</td>
<td>Unknown root decay</td>
</tr>
<tr>
<td></td>
<td>DRA is a known root decay (<em>Armillaria ostoyae</em>)</td>
</tr>
<tr>
<td>BNK</td>
<td>Blind Conk</td>
</tr>
</tbody>
</table>
NGC  |  Frost Crack
SCA  |  Scar
FRK  |  Fork
CRO  |  Crook
LRB  |  Large Rotten Branch
DTP  |  Dead Top
BTP  |  Broken Top
SNG  |  Sounding
OTH  |  Other (cause is known, but no appropriate code)
DIR  |  Direct observation (decay or missing wood seen without cause observed)

**LOSS INDICATOR – STEM DECAY (DD _) AND ROOT DISEASE (DR _)**

Only specific root, butt, and heart-rot conks are considered to be loss indicators. Slash conks that occur on dead branches and wounds of living or dead trees are not considered as loss indicators. (Refer to Appendix D: Damage Agent Codes for stem decay and root disease conk codes.)

**Stem Decays (Conks) Observed on Bole (DD _)**

Conks refer to the fruiting bodies (sporophores) of stem decay fungi and are definite and reliable indicators of decay. Typically conks are thick, hard, woody-like perennial structures. Fruiting bodies can occur anywhere on the main stem and/or branches, but they appear most frequently around knots and on the underside of dead branch stubs and live branches.

Record the following:

1. The code for the species of conk
   - The loss indicator codes for conks are hierarchical. They are taken from the Forest Damage Agent and Condition Codes. The code identifies stem decay damage agents as DD_. The species of conk is then identified by the third letter. The codes for specific stem decays are shown in Appendix D.
2. Length to any single or isolated conk.
   - The frequency is 1.
3. If multiple conks in one section of the stem, record:
   - species of conk (should only be one species in each multiple occurrence)
   - length to the lowest in the series; length to the highest
   - frequency as to the number of conks in the series
   - if conk series are widely separated record as two series

**Stem Decays (Root Rot) Observed on Roots or Ground (DR _)**

Root Rot refers to fruiting bodies which are located on the roots and are associated with stem decay.
Typically fruiting bodies are short-lived, soft, and fragile. Often you may be able to see an indication of root rot decay directly on the roots.

Record the following:

1. The code for the species of root rot
   - The loss indicator codes for root rots are hierarchical. They are taken from the Forest Damage Agent and Condition Codes. The code identifies stem decay damage agents as DR_. The species of conk is then identified by the third letter. The codes for specific root rots are shown in Appendix D.

2. Length for any single or isolated root rot indicator is recorded as “0” (ground level).
   - The frequency is 1.

3. If multiple root rot indicators are observed, record:
   - species of root rot (should only be one species in each multiple occurrence)
   - length from “0” to “0”
   - frequency of indicators in the series

LOSS INDICATOR – BLIND CONK (BNK)

Blind conks are pronounced swellings or depressions around knots, usually caused by *P. pini* (DDP) on conifers, and *P. tremulae* (DDT) on aspen. Blind conks are definite indicators that decay is extensive in the tree stem.

Evidence of conks should be found in the surrounding stand before recording blind conk as an indicator.

Blind conks are identified as follows:

- stem swellings and stem depressions thought to be where the tree attempts to heal over decay emerging through a knot or branch stub.
- bright yellow to buff-coloured material found by chopping into basal branch stubs. This form is most often found in the interior of the province and crews will be directed by the project supervisor regarding procedures for chopping into trees.

**Note:** Verifying the existence of blind conk is the only situation where we allow crews to chop into live trees on the plot.

Record the following:

1. The loss indicator code BNK
2. For a single occurrence record:
   - the length to blind conk
   - the frequency as “1”
3. For multiple blind conks in one area of the stem, record:
   - length to the lowest; length to the highest
   - the frequency as the number in the series, including the lowest and highest
LOSS INDICATOR – FROST CRACK (NGC)
Frost cracks result from deep radial splitting of the trunk, caused by uneven expansion of moisture in the tree after a sudden and pronounced drop in temperature. The cracks usually originate at the base of the trunk and may extend many metres up the tree, following the longitudinal grain of the tree. The wound will often spiral up the tree following the movement of moisture.

Frost cracks are often reopened and extended by wind stresses or refreezing. Repeated healing of the cambium produces pronounced callous tissue, giving a ribbed appearance to the wound.

Record the following:
1. The loss indicator code NGC
2. For a single frost crack, record:
   • lowest extent (may be a negative value if it extends below ground on high-side)
   • the highest extent.
   • the frequency as “1”
3. For multiple frost cracks on one section of the stem, record:
   • lowest extent and highest extent of the series
   • frequency as the number of frost cracks in the series

LOSS INDICATOR – SCAR (SCA)
A scar is an injury caused by external forces that damage the cambium or heartwood of the tree exposing the tree to wood decay fungi. A scar can occur anywhere on the main stem or root collar of the tree. Scars on branches or candelabras are not recorded.

A scar may be “open” meaning the wood is exposed, or “closed” meaning that the bark has grown over the injury.

Record the following:
1. The loss indicator code SCA
2. For an individual scar record:
   • lower extent of the scar (may be a negative number if it extends below ground on high side)
   • upper extent of the scar
   • the frequency as “1”
3. For multiple scars along one section of the stem, record:
   • lowest extent of the lowest scar in the series; highest extent of the highest scar
   • frequency as to the number in the series
LOSS INDICATOR – FORK (FRK)
A fork is caused by damage to the leader of a tree that results in more than one branch (leaders) competing for apical dominance. The damage to the leader—from external forces, physiological factors, animals or insects (weevil) — exposes the stem to potential wood or decay fungi.

The following conditions are **not considered forks**:

- natural branching in deciduous trees
- small sharply angled branches or spikes, unless associated with a noticeable offset or diameter change at the location
- flattening of the tree tops caused by wind or physiological conditions where no terminal leaders are evident
- candelabra branches

If the secondary leader is visible, record the following:

1. Loss indicator code FRK (no minimum size limit)
2. Location of fork (the divergence of the stems); frequency as “1”
3. Distinct forks (record as separate occurrences)
4. Multiple forks within a reasonable range and a probable common cause (record upper and lower occurrence and number observed)

LOSS INDICATOR – CROOK (CRO)
A crook is caused by damage (mechanical, physiological, animal or insect attack) to the leader of a tree. Crooks potentially expose the wood to decay fungi.

To be recorded as a crook, it must meet the following conditions:

- The diameter of the main stem changes noticeably from the normal taper, and indicates that an injury has occurred.
- The stem must be offset severely enough to indicate that damage has occurred to the main stem.

Record the following:

1. Loss indicator code CRO
2. For a single occurrence, record  
   - height of each individual crook  
   - frequency as “1”
3. For multiple crooks in a section of the stem, record:  
   - length to the lowest crook; length to the highest  
   - frequency as the number of crooks

LOSS INDICATOR – LARGE ROTTEN BRANCH (LRB)
Large rotten branches are defined as those with a diameter inside the bark greater than 10 cm at the base. They have obvious signs of heart rot, and typically appear as short, rotten
branches on overmature trees. They should not be confused with branches that have died through normal causes.

Record the following:

1. The loss indicator code LRB
2. For a singular occurrence, record:
   • the height to the central point of the branch
   • frequency as “1”
3. For multiple occurrences record:
   • the length to the central point of the lowest branch in the series
   • the length to the central point of the highest branch
   • the frequency as the number in the series (including the highest and lowest)

LOSS INDICATOR – DEAD TOP (DTP)
A dead top can be caused by any number of external injuries, physiological stresses, insects, or diseases. The top should be obviously dead with no green needles or leaves present.

Record the following:

1. The loss indicator code DTP
2. Length to the base of the dead top (top of live crown), length to the top of the tree; frequency as “1”

LOSS INDICATOR- BROKEN TOP (BTP)
A broken top is the product of an external force or condition resulting in the top of the tree breaking away from the main bole.

Broken tops can be caused by a variety of causes: wind breakage, snow damage, mechanical damage from other falling trees, and so on.

Record the following:

1. The loss indicator code BTP
2. The length to the break (estimate by folding back any jagged parts of the stem to form a complete stem); frequency as “1”

LOSS INDICATOR – SOUNDING (SNG)
Every tree on every plot is sounded. Sounding the tree involves striking the bole near the base of the tree with a blunt instrument. A hollow sound indicates a large amount of potential rot. Bore the tree to confirm the presence of rot.

Record the following:

1. The loss indicator code “SNG” whenever the tree “sounds” hollow. If subsequent boring indicates no decay or decay is present, the “SNG” loss indicator code is left on the field card. Record in the comments section that no decay was found.
National Forest Inventory – British Columbia

2. Frequency and length are not recorded

**LOSS INDICATOR – OTHER (OTH)**

Sometimes rot or missing wood can be observed directly, and the cause is **known**. However, there is no appropriate loss indicator code.

Examples of “Other” may be hollow trees, butt rot, or sap rot on a live tree. In all these examples the cause is **known**.

Record the following:

1. Loss indicator code OTH
   - In the Comments, state the reason for the loss
2. Location and frequency, if appropriate

**Note:** If this type of loss occurs frequently an appropriate code will be assigned in the future.

**LOSS INDICATOR – DIRECT OBSERVATION (DIR)**

Sometimes rot or missing wood can be observed directly, but the cause is **not** known.

An example of “Direct Observation” may be hollow trees where the cause is **unknown**.

Record the following:

1. Loss indicator code DIR
   - Make a comment in the Comments section if you think it is appropriate to do so.
2. Location and frequency, if appropriate

**Note:** If this type of loss occurs frequently an appropriate code will be assigned in the future.

### 4.6 Stem Mapping

Several tree stems in the Integrated Tree Plot will be stem mapped to aid relocation of the IPC pin in the case the pin is removed from the ground. **The stem mapping data is recorded on the TL field card.**

**Procedure**

1. Select three suitable trees at various aspects around the plot centre.
2. Measure and record the azimuth from the Plot Centre Pin to the centre of the tree on the side of the tree (to the nearest degree). Insert an aluminium nail at the point of measurement on the side of the tree.
3. Measure and record the horizontal distance from the Plot Centre Pin to the side of the tree (to 0.01 m).
Note: In some locations there may be no tagged trees within the plot. If trees are present that are less than the minimum diameter for tagging the largest stems can be tagged and measurements would be taken from these stems. If only stumps are available then tag the appropriate stumps and take measurements from these stumps or a combination of small trees and stumps as required. In some instances, with no trees or stumps available, rocks or other features may be used to facilitate relocating the IPC. Record any abnormal situations in the comments section.

4.7 Measuring Small Trees and Stumps

Small Trees
A 2.50 m fixed-radius small-tree plot will be established at all Integrated Plot locations. The purpose of this plot is to establish relative numbers of small diameter live trees that are not otherwise sampled by the variable radius plot (or the 5.64 m fixed-radius tree plot). The plot size is kept small to reduce measurement error. Measurements are recorded on the TS field card.

Procedure
1. At the Integrated Plot Centre establish a 2.50 m fixed-radius plot. The edge of this plot may be marked temporarily to ensure accurate measurements.
2. Count the live trees, less than 4.0 cm DBH and taller than 30 cm. Record the total number by species and by length class. Small trees must have their point of germination within the fixed plot radii to be measured as "in" trees.

Note: The dot tally columns on the field card are provided for your convenience in recording. Sum the data by classes and record the totals on the field card.

<table>
<thead>
<tr>
<th>Species</th>
<th>Length</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>31 cm to 1.3 m</td>
</tr>
<tr>
<td>Cw</td>
<td>2</td>
</tr>
<tr>
<td>Hw</td>
<td>6</td>
</tr>
<tr>
<td>Fdc</td>
<td>1</td>
</tr>
<tr>
<td>Dr</td>
<td>11</td>
</tr>
</tbody>
</table>

Plots with Clumps of Trees or Sucker Growth from Stumps
In some instances, particularly with deciduous species, clumps of stems originating from a common root system or stump that is vegetatively alive are encountered. Some or all of these stems could potentially grow into trees at some time in the future. The sampling intent is to identify the stems which express apical dominance to the best judgement of the field crew.
Procedure
1. Count the number of stems that appear to express apical dominance. The intent is not to examine each stem in detail but to arrive at a reasonable assessment of numbers within each class.

Stumps
The Change Monitoring Inventory is attempting to sample the biomass of above-ground vegetation both living and dead. This includes measuring the biomass in self-supporting stumps (defined as less than or equal to 1.3 m in length and 4.0 cm top diameter or greater) in the 2.5 m fixed-radius plot on the integrated plot. The centre of the stump must lie within the plot (Figure 4.5). Only stumps which are vegetatively dead are recorded.

Stems greater than 1.3 m in length are measured as “trees” in the variable or fixed plot.

Treat stumps with roots detached from the ground as “coarse woody debris.”

Procedure
1. Select stumps to tally in the 2.5 m plot. Stump must be 4.0 cm top diameter inside bark with the germination point of the stump inside the plot boundary.

2. In a clockwise direction from the north, record the following information for all stumps 4.0 cm or greater:
   • Species — to the level that can be determined by the field crew.
   • Frequency of stumps — usually “1”, but if numerous stumps are in the plot (such as after spacing) record them by groups with the same characteristics.
   • Average diameter inside the bark.
   • Length to nearest 0.1 m (must be less than 1.3 m).
   • Estimate the percent sound wood for the stump.
   • Wildlife codes
     – bark retention code
     – wood texture
   • Wildlife use
     – enter appropriate code(s) if wildlife use observed
   • Root rot species
     – if root rot is present, record the damage agent code (if no root rot is found, then record a dash).
3. To measure the length of broken stumps, visually fold down the broken sections to compensate for the missing parts. Level out the wood on the cross section as you view it from the side to determine stem length (Figure 4.6). A similar process is used for broken tree length measurements.

4.8 Recording Age/Height [Length] Tree Data

Age/height tree data is recorded on the Small Tree, Stump, and Site Tree Data (TS) card and the Auxiliary Plot Tree Data (TA) card.

Objective
Age/height trees are measured to determine age and height for the leading and second species in the cluster and to determine site index.

**General Procedures**

The following types of trees are measured for age and height (length):

**Standard selection types:**

- **Top height** (Type = T): largest DBH tree in the 0.01 ha plot measure within a 5.64 metre radius of the plot center, regardless of species.
- **Leading species** (Type = L): largest DBH tree in each 0.01 ha quadrant of the 11.28 metre plot, of leading species by basal area.
- **Second species** (Type = S): largest DBH tree in each 0.01 ha quadrant of the 11.28 metre plot, of second species having more than 20% of the basal area in the plot.
- **Other major species** [Type = O]: Largest DBH tree in each 0.01 ha quadrant of the 11.28 metre plot, of all species, other than the leading or second leading species, having more than 20% of the basal area in the plot.

The leading species and second species and other major species are determined from the basal area of the live trees [excluding residuals] equal to or greater than 4.0 cm DBH tallied at the IPC plot within the 5.64 and the 11.28 metre plots. The tree species with the greatest basal area is the leading species; similarly the species with the second largest basal area is the second leading species. On fixed radius plots collected on electronic field data recorders the basal area calculations are performed within the program. When paper field cards are used an excel spreadsheet and a paper worksheet have been produced to calculate the basal area of all species in the field or at the field office [see Appendix J - Calculating Basal areas in the Field].

The following criteria are used to select T trees:

- within the 0.01 ha plot (within 5.64 m radius from plot centre)
- largest DBH tree
- must be alive
- dominant or co-dominant
- of any tree species

The following criteria are used to select L, S and O trees:

- within the 0.01 ha quadrant (north-east, south-east, south-west or north-west quadrants)
- largest DBH tree of L, S or O tree species
- must be alive
- dominant or co-dominant
not a residual of a former stand

If any potential T, L, or S tree meets the above criteria, the age and height must be measured and recorded on the field card. The following figure shows how the information is recorded (Fig. 4.7). [NOTE - the following figure 4.7 has not been updated at this time to reflect the CMI data collection. The leading species trees are recorded as multiple "L" trees, similarly for the second leading species "S" and any other "O" major tree species. The random tree is not collected]

**Figure 4.7: Recording of Height and Age Information on the TS and TA field card**

**Non-standard selection type X:**

- X extra (Type = X) an alternate tree outside 0.01 ha plot

These additional trees may be selected in a non-standard manner at the discretion of the field crew. This flexibility is provided for special cases where the field crew feels that adequate information cannot be provided following the standard procedure alone. For example, the cluster is located in a patch of recently killed trees or a tree is unsafe to measure. For this to be of any practical use, comments must be supplied to explain why the tree was selected.

**Suitability of Age and Height**

A tree may meet the above selection criteria and still not provide a suitable age and/or height for site determination. The age and height are still recorded in these instances with an "N" placed in the appropriate column. An explanation must be given in the comments section as to why the age and/or height are not suitable.

The S/H (suitable for height) and S/A (suitable for age) columns are to be filled out for all T, L, S and O trees selected. These columns indicate whether the age or height is suitable to be used in compiling age, height and site index for the sample. In these columns, a "Y" means the item is suitable and an "N" means it is not suitable.

The age and height data may also be used for special purposes, such as ecological correlation studies. These studies may require additional screening for tree suitability. The screening will rely on the physiological age values, age prorate information and additional crew comments to screen trees with rot or suppression or other damage.

Examples of reasons for a tree not being suitable for height:

- significant broken top (projected length is recorded in the comments for broken top trees)
- significant dead top
- fork or crook that significantly affects height growth
• abnormally high amount of scarring or other damage that may have affected height growth [for example - significant mistletoe infection]

**Note:** *Significant* refers to a reduction in the length of the tree compared to what it would be if undamaged. The reduction is great enough that a reliable site index estimate could not be obtained from the tree measurements.

The only reason for a tree not being suitable for age:

• residual [see the following definition]

  A *residual* tree is defined as a living remnant of a former stand; in even-aged stands, the occasional (< 25 per ha) large stem of an older age class than the stand as a whole. Typically these trees may have larger diameters, a higher incidence or indications of decay, thicker bark, larger branching and "ragged" or flat tops. These trees must be clearly residual. Uneven-aged stands do not generally have residual trees.

**Procedure for Selecting Top Height, Leading Species, and Second Species Trees**

The procedure outlined in this section describes the methods used to select and measure age/height trees.

1. Complete the sample cluster using standard procedures.

2. Determine the leading and second species and other major species by basal area for the cluster using the basal area information.

3. Establish a 0.01 hectare plot (5.64 m radius) at IPCand the four 0.01 ha quadrants.

4. Select age / height trees in the 0.01 ha plot or quadrant as follows:

   (a) at the IPC:
   
   • largest DBH, live, dominant or co-dominant tree regardless of species (T tree)

   (b) within each quadrant
   
   • largest DBH, live, dominant or co-dominant tree of leading species (L tree)
   • largest DBH, live, dominant or co-dominant tree of second species (S tree)
   • largest DBH, live, dominant or co-dominant tree of all other major species (O tree)

   (c) within the sample cluster
   
   • if residual tree(s) are present select one "representative" residual tree (V tree)

5. Select additional dominant and co-dominant trees (if applicable)

   • extra tree outside 0.01 plot (X tree)

6. Measure and record tree height for each selected tree.

   • Measure and record the length of the tree along the stem from high side ground. If the tree is broken off, measure and record the length to the break
• determine suitability for height and enter code in S/H column [Yes or No]. If the height is "not suitable" record in the comments the factor(s) which make the height "not suitable" and if possible estimate a projected height.

7. Measure age and radial increment for each selected tree.
   • determine suitability for age and enter code in S/A column[Yes or No]

**Measuring Height, Age, and Growth Information**

Age is an important measurement in cruising because it helps in determining the site index and projected rate of growth.

In each Integrated Plot a top height tree, a leading species tree, a second species site tree, and other trees of all major species will be bored to determine age.

**Procedure for Direct Measurement of DBH Age**

1. Count the whorls above DBH and add one to calculate the age of the tree.
   • Enter the code WHO
   • Record the age

2. Rather than damaging a small tree on the plot, select a tree of similar apparent age from outside the plot. This would frequently happen with trees of less than 2 m in length. The replacement tree should be outside the 10 m fixed-radius plot, if possible. Determine the DBH age by cutting or boring.
   • Enter the code OUT
   • Record the length and diameter for the originally selected top height tree, but record the age from the tree selected from outside the plot.

3. In instances where trees do not reach DBH, use either of the above procedures, as appropriate.
   • Enter the code as appropriate (WHO or OUT)
   • Record the total age for the tree
   • Record bored height as 0.0

**Procedure for Measuring Age on Bored Trees**

1. Bore the tree at DBH facing plot centre, if possible. If DBH cannot be bored conveniently, record the height of boring; corrections will be made later.

2. Determine the age by a ring count from an increment borer core, if possible, and enter the data in the field count section on the tally card. The count will be the number of full rings. It is up to the field crew to determine when diameter growth has essentially stopped for the season.

3. The pith should be included in sample tree cores as often as possible to ensure accuracy, particularly in stands less than 80 years old. If you can get within a few years of the pith (relative to the tree age) and can confidently estimate the remainder, there is no need to rebore the tree or use a “physiological” age calculation. Record the actual age counted on the increment borer core at the level where the tree was bored. Adjustments for years to reach that point will be done in the office compilation.
4. On large trees, or trees that have rotten centres, record the code for rot, age of the sound portion, and the length of sound core. The computer will calculate an approximate age using these measurements. Be careful to measure only inside bark length along the core.

Note: Age relationships can also be derived from actual stump counts if working near felled road rights-of-way or logged areas.

5. Collect all tree cores in labeled “straws”.
   - It is the crew’s responsibility to accurately record field age data. The initial determination will be made in the field and confirmed in the lab by National Forest Inventory staff.
   - Record at least the following on the straw in waterproof felt marker or on attached labels: Sample Number, Plot (for example, IPC), tree type (T, S, O) and tree number (for example, Sample 27, IPC, TH, Tree #3).
   - Detailed instructions for the handling, storage and shipment of tree age cores is documented in Appendix L.

Procedure for Measuring Radial Increments

1. Make radial increment measurements on all trees counted for age at the same level on the stem.
2. Bore on the side facing the plot centre, at DBH if possible.
3. When it is not practical to take the increment in this direction, take it at two points at right angles on the bole of the tree (at the same height as the age boring) and average them.
4. Record the radial increment (in mm) for 5, 10, and 20 years using full rings.

Procedure for Measuring Physiological Age

The collection of physiological age information is “optional” for VRI projects. The information is currently not used in the ground sampling adjustment process. Individual projects may collect the information if a need is determined.

The collection of physiological age information is “optional” for VRI projects. The information is currently not used in the ground sampling adjustment process. Individual projects may collect the information if a need is determined.

1. If a sample tree for age measurement was suppressed in its early years, record the unsuppressed (physiological) age as calculated for that tree. The intent is to give an age that would be typical for the tree size if the tree had not undergone unusual suppression (or, more rarely, unusual growth).
2. Determine the physiological age as follows:
   • Enter the PHY code to indicate that a physiological age is used. The computer will calculate the age for you if you have not entered the age yourself.
   • For small trees, where you can interpolate accurately across the suppressed section, simply count “equivalent” rings.
   • For larger trees, particularly where centre sections are missing, leave the boring height age blank, and:
– Count the number of years along the section closest to the bark. As with small trees, account for any clearly atypical growth sections by interpolation.

– Enter the length of the core over which you have counted the partial age. The computer will use this data to calculate the “missing rings.”

– If you have a good estimate of the tree age it would also be useful to have that in the notes section.
## Recording Height, Age, and Growth Information

See Section 4.2, “Identifying and Recording Tree Attributes,” for a complete description of codes. The following details are recorded on the TS field card:

<table>
<thead>
<tr>
<th><strong>TREE NO.</strong></th>
<th>Tree number as recorded in tree measurement plot.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>TYPE</strong></td>
<td>T = top height tree, L = Leading species, S = second species, O = Other major species tree, V = residual tree, X = Additional tree.</td>
</tr>
<tr>
<td><strong>SPECIES</strong></td>
<td>Tree species code.</td>
</tr>
<tr>
<td><strong>CROWN CLASS (C. CL.)</strong></td>
<td>Record crown class code (D, C, I, S).</td>
</tr>
<tr>
<td><strong>BORING (OB) DIAMETER (cm)</strong></td>
<td>Diameter outside bark at location of increment boring.</td>
</tr>
<tr>
<td><strong>TREE LENGTH (m)</strong></td>
<td>Measured length of the tree to 0.1 m.</td>
</tr>
<tr>
<td><strong>SUITABLE HEIGHT</strong></td>
<td>Record a “Y” for “yes” if the tree height has not been significantly affected and is suitable for calculating a reliable site index estimate. Record a “N” for “no” of the tree height has been significantly affected.</td>
</tr>
<tr>
<td><strong>BORED HEIGHT (m)</strong></td>
<td>Height (above high side ground level) where boring was made.</td>
</tr>
<tr>
<td><strong>MEASURE CODE</strong></td>
<td>If the crew did not physically measure to the pith, this code indicates the reason. Acceptable codes are:</td>
</tr>
<tr>
<td></td>
<td>ROT = Core of tree rotten or missing.</td>
</tr>
<tr>
<td></td>
<td>WHO = Total age determined from whorl count rather than boring.</td>
</tr>
<tr>
<td></td>
<td>CRC = Increment borer cannot reach centre (tree too large).</td>
</tr>
<tr>
<td></td>
<td>OUT = Age and radial increments determined from similar tree outside of plot, all other measurements for the tree within the plot.</td>
</tr>
<tr>
<td></td>
<td>PHY = Physiological age is recorded or calculated on that tree. Usually due to atypical growth ring patterns.</td>
</tr>
<tr>
<td><strong>FIELD AGE COUNT</strong></td>
<td>Repeat the Tree No. For each type, and record the actual age (number of rings) at boring height in the lower-left corner of the card.</td>
</tr>
<tr>
<td><strong>OFFICE BORED HEIGHT AGE</strong></td>
<td>Increment cores are recounted in the office under magnification. Enter the recounted age in this data field.</td>
</tr>
<tr>
<td><strong>GROWTH (mm)</strong></td>
<td>Growth for last 5, 10, and 20 years.</td>
</tr>
<tr>
<td><strong>PRORATE DATA</strong></td>
<td>When a full boring is not possible record the actual measurements.</td>
</tr>
<tr>
<td>• LENGTH (CM)</td>
<td>Length of increment core, from outer edge inward, upon which the ring count was made.</td>
</tr>
<tr>
<td>• RING COUNT</td>
<td>Actual or representative count of tree rings along that core length.</td>
</tr>
<tr>
<td><strong>DIRECT AGE CORRECTION</strong></td>
<td>Number of full years of tree growth below the boring height, if it can be determined directly on that tree.</td>
</tr>
<tr>
<td><strong>PHYSIOLOGICAL AGE</strong></td>
<td>Physiological age at the bored height determined by the crew. Record PHY in “Measure Code” field. It is not always necessary to enter this information. Optional for VRI projects.</td>
</tr>
<tr>
<td><strong>SUITABLE AGE</strong></td>
<td>If the tree is a “Residual” then the tree is recorded as “N” for “not” suitable. All other trees are recorded as “Y” for “yes” as suitable for age.</td>
</tr>
</tbody>
</table>
Examples of Recording Age Information

1. Normal tree where the increment borer can reach the tree pith (enter — - — — in the Measure Code field)

   

   \[ \text{Bark} \]

   \[ \text{Counted Age} = 96 \text{ yrs.} \]

   count to last complete growth ring under the bark.

   

   \[ \text{Figure 4.8— Recording age for full boring.} \]

2. Tree with rotten or missing core (ROT)

   

   \[ \text{Bark} \]

   \[ \text{Ring count} = 81 \text{ yrs.} \]

   \[ \text{Length} = 17.2 \text{ cm} \]

   

   \[ \text{Rotten or missing} \]

   

   \[ \text{Figure 4.9 — Recording age for tree with missing core (ROT).} \]
3. Trees where increment borer cannot reach centre of the tree (CRC)

Bark

Ring count = 213 yrs.
Length = 32.0 cm

4. Out-of-plot tree taken for sample age (OUT)

If the selected sample trees are too small to be bored without damaging the tree, or the length of the plot trees is less than 2 m, a representative tree of the same species from outside the plot (outside the 10.0 m plot at the Integrated Plot Centre) can be cut down and counted, or bored. The preference in young stands (less than 2 m in height) would be to count the age as close as practical to the ground.
5. Tree age determined directly from count of branch whorls (WHO)

![Tree #1](image1)  \[1.3\text{ m}\]  \[1.3\text{ m}\]  \[Tree #2\]

**Figure 4.12 — Recording age using whorl count.**

6. Physiological Age Measurement (code as PHY)

**Calculation of physiological age:**

1. non-supressed growth rate \((\text{47 years} \div 20.0\text{ cm} = 2.35\text{ years/cm})\)
2. physiological age \((2.35\text{ years/cm} \times 25.0\text{ cm} = 59\text{ years})\)

![Non-suppressed growth](image2)  \[47\text{ yrs.}\]  \[20.3\text{ cm}\]

![Suppressed growth](image3)  \[76\text{ yrs.}\]

**Figure 4.13 — Recording physiological age.**
Literature Cited


5. Net Factoring

Introduction

This section outlines the steps needed to assess the net volume of trees on the Integrated Sample Plot.

*Call grading* and *net factoring* are processes used to assess timber quality and net tree volume. They are applied to the tree as the cruiser sees it. No attempt is made to predict grade based on falling breakage or any manufacturing process, or to predict volume loss without direct evidence. The two processes are related but will be presented separately for presentation ease.

The Provincial Change Monitoring Inventory will employ the same Net Factoring procedures as developed for the Vegetation Resources Inventory.

Objectives

To provide a rule-based estimate of net tree volume.

Definitions

*Net Factoring* involves estimating the net volume of sound wood (gross volume less decay) of variable log lengths. These net volumes are based on: (1) direct measurements (includes visual estimates and physical measurements); or (2) standard, rule-based deductions associated with loss indicators.

The net factoring process is based on *only* making allowances for decay on consistently measurable or detectable features. Some trees will contain decay but will not have any visible symptoms. These “hidden” decay losses will be determined through a separate sampling process.

*Pencil bucking* is the imaginary sectioning of trees into potential logs.

General Procedures

- Standard rule-based deductions will be used to determine the extent of the defect and the calculation of the net factor (% sound wood).
- *Pencil bucking* is used to identify grade changes in a tree and to localize where the net factor (% sound wood) is applied. Pencil bucking is the imaginary sectioning of trees into potential logs.
- Net factoring is for sound wood loss only (decay or missing wood). No additional deductions are made for anticipated breakage, manufacturing loss, or splits and fractures.
- When calculating log volumes the diameter of the log will be the DBH when dealing with the bottom log, or will be estimated at the midpoint of the log when dealing with
upper sections of the tree. This may be slightly different than with some of the scaling conventions.

**Field Cards for this Section**

**Tree Details (TD)** (Appendix A, Figures A.11 and A.12)
log grades, lengths, % sound

**Tree Loss Indicators (TL)** (Appendix A, Figure A.13)
damage agent, severity, loss indicator, location, frequency

**Auxiliary Plot Card (TA)** (Appendix A, Figures A.15 and A.16)
trees on Auxiliary Plots

**Detailed Procedures**

**5.1 Net Factoring Procedures**

All trees in the Integrated Plot and new species found in the Auxiliary Plots will have net factors calculated for each log.

1. Complete the tree loss indicators information prior to the net factor process.
2. In conjunction with the grading rules, determine the applicable log lengths for each tree.
3. Using measurements and rule-based deductions, calculate the net volume (net factor) for each log section.
4. Where loss indicators are located on the tree below high side ground or extend below high side ground, consider the application as if the indicator was in the first log length. For example, a frost crack that extends from minus 0.5 m to plus 1.5 m is calculated as a 2 m frost crack with losses applied to the first log. Similarly a root rot conk present on the ground is applied to the first log length.
5. Measure all volume calculations from high side ground.
6. Since net factoring is a priority when major defects exist it is desirable that the defect be isolated as a log. If this process creates a unrealistic description of the tree, incorporate the defect into a longer log.
7. Unobserved decay will be deducted as a “hidden” factor, derived through a separate sampling process.
8. Assign a net factor to each log graded. If the log has no major defects, and you detect no measurable sound wood loss, the net factor is 100%, recorded as two dashes (--).
Change Monitoring Procedures for Provincial and National Reporting

Note that volume deductions (net factoring), by log, will only be made where:

- a loss indicator is present, such as conk, frost crack, or blind conk
- decayed or missing wood is visible such as open scars, sap rot
- sounding of the stem indicates decay, and subsequent boring provides a relative decay ratio
- root rot is observed

5.2 Calculating Volume

In assessing the percent deduction of a log, you will need to calculate volumes. Logs are considered cylindrical, and depending on the type of defect, the decayed portion is considered to be rectangular (such as scars), cylindrical (such as conks), or conical (such as butt rot). The following conventions and formulas shown in Table 5.1 will be used in the calculations.

Diameter: length of a straight line passing through the centre of a circle.

Radius: line extending from the centre of a circle to the circumference (½ diameter).

L = length; W = width; D = depth; R = radius; \( \pi = 3.14 \) (to 2 decimal places).

Table 5.1 – Formula for calculating volume.

<table>
<thead>
<tr>
<th>Shape</th>
<th>Formula</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rectangular solid</td>
<td>Volume = L * W * D</td>
</tr>
<tr>
<td>Cylinder</td>
<td>Volume = ( \pi R^2 ) * L</td>
</tr>
<tr>
<td>Cone</td>
<td>Volume = ((1/3) \pi R^2 ) * L</td>
</tr>
</tbody>
</table>

Units must be consistent (all cm or all m).
### 5.3 Applying Deduction Rules

Table 5.2 – Summary of procedures for determining net factor for loss indicators.

<table>
<thead>
<tr>
<th>Defect</th>
<th>Form</th>
<th>Method</th>
<th>Deduction area</th>
<th>% Sound of Deduction Area</th>
<th>Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Heart Rot Conk (DD_)</td>
<td>Cylindrical</td>
<td>Rule</td>
<td>4 m above conk 6 m below conk</td>
<td>50% Y</td>
<td></td>
</tr>
<tr>
<td>2. Root rot (DR_)</td>
<td>Conical</td>
<td>Rule</td>
<td>3 m</td>
<td>81% Y</td>
<td></td>
</tr>
<tr>
<td>3. Blind Conk (BNK)</td>
<td>Cylindrical</td>
<td>Rule</td>
<td>4 m above conk 6 m below conk</td>
<td>50% Y</td>
<td></td>
</tr>
<tr>
<td>4. Frost crack (NGC)</td>
<td>Other</td>
<td>Rule</td>
<td>extent of frost crack</td>
<td>calculated assigned*</td>
<td></td>
</tr>
<tr>
<td>5. Scar (SCA)</td>
<td>Rectangular</td>
<td>Calculate</td>
<td>extent of scar</td>
<td>calculated assigned*</td>
<td></td>
</tr>
<tr>
<td>6. Cat face (SCA)</td>
<td>Conical</td>
<td>Calculate</td>
<td>extent of scar</td>
<td>calculated assigned*</td>
<td></td>
</tr>
<tr>
<td>7. Fork (FRK)</td>
<td>Other</td>
<td>Rule</td>
<td>if decay present: 1 m below</td>
<td>50% Y</td>
<td></td>
</tr>
<tr>
<td>8. Crook (CRO)</td>
<td>Other</td>
<td>Rule</td>
<td>if decay present: 1 m below</td>
<td>50% Y</td>
<td></td>
</tr>
<tr>
<td>9. Rotten branch (LRB)</td>
<td>Cylindrical</td>
<td>Rule</td>
<td>1 m above 1 m below</td>
<td>50% Y</td>
<td></td>
</tr>
<tr>
<td>10. Dead top (DTP)</td>
<td>Other</td>
<td>Calculate</td>
<td>live crown to top of tree</td>
<td>calculated assigned*</td>
<td></td>
</tr>
<tr>
<td>11. Broken top (BTP)</td>
<td>Other</td>
<td>Rule</td>
<td>broken off portion remaining stem 1.0 m of decay below break</td>
<td>00 00 N assigned*</td>
<td></td>
</tr>
<tr>
<td>12. Sounding (SNG)</td>
<td>Other</td>
<td>Calculate</td>
<td>various</td>
<td>calculated assigned*</td>
<td></td>
</tr>
<tr>
<td>13. Direct Observation (DIR)</td>
<td>Other</td>
<td>Rules</td>
<td>various</td>
<td>calculated assigned*</td>
<td></td>
</tr>
<tr>
<td>14. Other (OTH)</td>
<td>Other</td>
<td>Rules</td>
<td>various</td>
<td>calculated assigned*</td>
<td></td>
</tr>
</tbody>
</table>

* Assigned by cruiser in the field

### 1. HEART ROT CONK (DD_)

Inventory conventions assume that conk rot extends 4 m above the conk and 6 m below it. This is normally a 10 m Y grade log with a net factor of 50%.

For example, an H grade tree with a conk at 12 m could be graded “H” grade for 6 m, “Y” for 10 m (net factor 50%), then “H” grade again starting 4 m above the conk.

The rule for heart rot conk is as follows:
Table 5.3 – Deduction rule for Heart Rot Conk.

<table>
<thead>
<tr>
<th>Form</th>
<th>Cylindrical</th>
</tr>
</thead>
<tbody>
<tr>
<td>Method</td>
<td>Rule</td>
</tr>
<tr>
<td>Deduction area</td>
<td>4 m above conk; 6 m below</td>
</tr>
<tr>
<td>% Sound of deduction area (net factor)</td>
<td>50%</td>
</tr>
<tr>
<td>Grade</td>
<td>Y</td>
</tr>
</tbody>
</table>

For multiple conks, where the lengths between conks are less than the 10 m minimum, decay is assumed to extend 4 m above the top conk and 6 m below the lowest conk. The length is given a net factor of 50% and a grade of Y.

If you can measure more severe decay, pencil buck the affected portion and grade it a Y with a greater net factor. This is done in at least 1 m increments.

**Note:** Other major defects, such as frost cracks associated with conk, can be assumed to be cylindrical in nature as well, with the same net factor and grade.

2. ROOT ROT (DR_ )

All root rots are assumed to be conical in nature. Unless otherwise observed, the inventory convention is that the cone of rot extends 3 m from the ground and that the ratio of the diameter of the rot to the diameter of the butt is 75% (¾).

The deduction (for the 3 m section) is a constant, with the net factor always equal to 81% for that section.

The rule for root rot is as follows:

Table 5.4 – Deduction rule for Root Rot.

<table>
<thead>
<tr>
<th>Form</th>
<th>Conical</th>
</tr>
</thead>
<tbody>
<tr>
<td>Method</td>
<td>Rule</td>
</tr>
<tr>
<td>Deduction area</td>
<td>0 — 3 m</td>
</tr>
<tr>
<td>% Sound of deduction area (net factor)</td>
<td>81%</td>
</tr>
<tr>
<td>Grade</td>
<td>Assigned</td>
</tr>
</tbody>
</table>

**Formula**

\[
\text{Net Factor} = \left( \frac{\text{volume of log} - \text{volume of decay}}{\text{volume of log}} \right) \times 100\%
\]
Shortcut Formula

Since the relative size of the defect is constant, the decayed percentage for the first 3 m is a constant of 19%. The simple form of the equation is:

\[
\text{Net Factor is } = 100\% - \left[19\% \times \left(\frac{\text{length of decay}}{\log \text{length}}\right)\right]
\]

**EXAMPLE**

Log length: 8 m; Rot extends: 3 m

Since the relative size of the defect is constant, the decayed percentage for the first 3 m is always 19%.

\[
\text{Net Factor} = 100\% - \left[19\% \times \left(\frac{3}{8}\right)\right]
\]

\[
= 100\% - \left[19\% \times 0.35\right]
\]

\[
= 100\% - 7\%
\]

= 93%

**Figure 5.1 — Example of net factor calculation for Root Rot.**

Note: Schweinitzii butt rot is listed in the Forest Health Damage codes (Appendix D) as a "stem rot" coded as DDS. If Schweinitzii butt rot is encountered the net factoring process will still apply the loss as a "root rot [0.6 metre deduction]". The loss indicator would be DR and noted in the comments as "Schweintizii".

3. **BLIND CONK (BNK)**

Interior and transition zones: typically bright orange rot is visible when knots are cut open. Coastal zone: typically excessive swelling of the bole or a collapsed bole.

The rule for blind conk is as follows:

**Table 5.5 – Deduction rule for Blind Conk**

<table>
<thead>
<tr>
<th>Form</th>
<th>Cylindrical</th>
</tr>
</thead>
<tbody>
<tr>
<td>Method</td>
<td><strong>Rule same as conk</strong></td>
</tr>
<tr>
<td>Deduction area</td>
<td>4 m above conk; 6 m below</td>
</tr>
<tr>
<td>% Sound of deduction area (net factor)</td>
<td>50%</td>
</tr>
<tr>
<td>Grade</td>
<td><strong>Y</strong></td>
</tr>
</tbody>
</table>
4. FROST CRACK (NGC)

The rule for frost crack is as follows:

**Table 5.6 – Deduction rule for Frost Crack.**

<table>
<thead>
<tr>
<th>Form</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deduction area</td>
<td>Rule</td>
</tr>
<tr>
<td>% Sound of deduction area (net factor)</td>
<td>Sum of frost crack length(s)/log length * 10%. Maximum deduction 40% (Net factor would be 60% sound).</td>
</tr>
<tr>
<td>Grade</td>
<td>Assigned</td>
</tr>
</tbody>
</table>

**Note:** Frost crack(s) that run across the grain of the log, may result in a lower grade. This would be due to the percent of merchantable lumber volume loss, rather than the percent of sound wood loss.

**EXAMPLE**

log length: 12 m;
Two frost cracks are located as follows: 6 m long (from 0 m to 6 m) 8 m long (from 4 m to 12 m)

Deduction = \[
\left( \frac{\sum \text{crack lengths}}{\text{log length}} \right) \times 10\%
\]

Calculation of Net Loss Factor

Net loss = \[
\left( \frac{\sum \text{crack lengths}}{\text{log length}} \right) \times 10\%
\]

= \left[ \frac{8 + 6}{12} \right] \times 10\%

= 12\% volume loss

**Figure 5.2 — Example of net factor calculation for Frost Cracks.**
5. SCAR (SCA)

The rule for scar is as follows:

Table 5.7 – Deduction rule for Scar.

<table>
<thead>
<tr>
<th>Form</th>
<th>Rectangular</th>
</tr>
</thead>
<tbody>
<tr>
<td>Method</td>
<td>Calculate</td>
</tr>
<tr>
<td>Deduction area</td>
<td>Extent of scar</td>
</tr>
<tr>
<td>% Sound of deduction area (net factor)</td>
<td>Calculated</td>
</tr>
<tr>
<td>Grade</td>
<td>Assigned</td>
</tr>
</tbody>
</table>

Indicator is **present** and rot or missing wood is **evident**.

Calculate the net factor using one of the following two methods, depending on whether or not the depth of rot can be measured.

**Method 1: When depth of rot can be measured (for example, butt scars)**

Assume the scar is rectangular:

\[
\text{Decay volume} = \text{length} \times \text{width} \times \text{depth}
\]

Assume the log is cylindrical (diameter DBH for butt logs, midpoint for other logs):

\[
\text{Log volume} = \pi \times \text{radius}^2 \times \text{length}
\]

**Formula**

\[
\text{Net Factor} = \left[ \frac{\text{volume of log} - \text{decay volume}}{\text{volume of log}} \right] \times 100\%
\]

**Note:** To have a net factor less than 90% is rare for a scar.
### EXAMPLE

<table>
<thead>
<tr>
<th>Description</th>
<th>Calculation</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Log length: 10 m; diameter: 100 cm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Scar: length 10 m, width 20 cm, depth 10 cm</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>1. Volume of Decay</strong></td>
<td>(V = L \times W \times D) (volume of rectangle)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(= 10 \text{ m} \times 0.2 \text{ m} \times 0.1 \text{ m})</td>
<td>(0.2 \text{ m}^3)</td>
</tr>
<tr>
<td><strong>2. Volume of Log</strong></td>
<td>(V = \pi R^2 L) (volume of cylinder)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(= \pi \times (0.5 \text{ m})^2 \times 10 \text{ m})</td>
<td>(7.8 \text{ m}^3)</td>
</tr>
<tr>
<td><strong>3. Net Factor</strong></td>
<td>[\frac{7.8 - 0.2}{7.8}] \times 100%</td>
<td>97%</td>
</tr>
</tbody>
</table>

Figure 5.3 — Example of net factor calculation for Scar with known depth.
Method 2: When depth of rot cannot be measured

1. Estimate width and measure length of scar on log
2. Calculate circumference of log at the scar ($\pi * D$)
3. Calculate “Length” deduction = $\frac{1}{2} \left[ \frac{\text{width of scar}}{\text{circumference of log}} \right] * \text{scar length}$
4. Net Factor = $\left[ \frac{\text{length of log} - \text{decay " length"}}{\text{length of log}} \right] * 100\%$

**EXAMPLE**

log length: 10 m; diameter: 60 cm; scar 6 m in length, 20 cm wide

Decay Length = $\frac{1}{2} \left[ \frac{\text{length of log} - \text{decay " length"}}{\text{length of log}} \right] * 100\%$

= 0.32 m

Net Factor = $\left[ \frac{10 \text{ m} - 0.32 \text{ m}}{10 \text{ m}} \right] * 100\%$

= 97%

Figure 5.4 — Example of net factor calculation for Scar with unknown depth.
6. CAT FACE (SCA)

The rule for cat face is as follows:

Table 5.8 – Deduction rule for Cat Face.

<table>
<thead>
<tr>
<th>Form</th>
<th>Cylindrical/Conical</th>
</tr>
</thead>
<tbody>
<tr>
<td>Method</td>
<td>Calculate</td>
</tr>
<tr>
<td>Deduction area</td>
<td>Extent of Scar</td>
</tr>
<tr>
<td>% Sound of deduction area (net factor)</td>
<td>Calculated</td>
</tr>
<tr>
<td>Grade</td>
<td>Assigned</td>
</tr>
</tbody>
</table>

Cat face is a scar (SCA) or missing section of wood that allows measurement of decayed or missing wood.

There are two methods of dealing with this form of internal decay, depending on whether the associated heart rot is cylindrical or conical in nature, and that decision must be made by the cruiser on-site.

**Method 1: Formula for Cylindrical Defect**

\[
\text{Net Factor} = \left( \frac{\text{volume of log} - \text{volume of decay}}{\text{volume of log}} \right) * 100\%
\]

**Shortcut Cylindrical Formula**

\[
\text{Net Factor} = \left( 1 - \left( \frac{\text{length of decay}}{\text{log length}} \right) \right) ^{\frac{1}{2}} \left( \frac{\text{radius of decay}}{\text{radius log}} \right) * 100\%
\]
EXAMPLE
Cylindrical Defect

Log length: 10 m; Cylindrical cat face for 6.0 m

Sound wood = 20 cm (solid outer ring of wood)

Diameter = 200 cm (radius = 100 cm [1.0 m])

Net Factor = \[
1 - \left( \frac{(0.80 \text{ m})^2 \times \left( \frac{6}{10} \right)}{(1.0 \text{ m})^2} \right) \times 100\%
\]

= [1 - (0.384)] \times 100\%

= 62\%

Figure 5.5 — Example of net factor calculation for Cat Face (cylindrical defect).
Method 2: Formula for Conical Defect

\[
\text{Net Factor} = \left[ \frac{\text{volume of log} - \text{volume of decay}}{\text{volume of log}} \right] \times 100\% 
\]

Shortcut Conical Formula

\[
\text{Net Factor} = 1 - \left( \frac{1}{3} \right) \left( \frac{\text{radius of decay}}{\text{radius of log}} \right)^2 \left( \frac{\text{length of decay}}{\text{log length}} \right) \times 100\% 
\]

**EXAMPLE (Conical)**

defect length not equal to log length

Conical cat face for **5.0 m** of **8.0 m** log

Sound wood 20 cm (solid outside radius, therefore 80 cm defective core)

Diameter = 200 cm (radius = 1.0 m)

\[
\text{Net Factor} = \left[ 1 - \left( \frac{1}{3} \right) (0.64)(0.63) \right] \times 100\% \\
= \left[ 1 - \left( \frac{1}{3} \right) (0.64)(0.63) \right] \times 100\% \\
= \left[ 1 - 0.13 \right] \times 100\% \\
= 87\%
\]

Figure 5.6 — Example of net factor calculation for Cat Face (conical depth).
Method 3: Uses table 5.9, butt rot guide for length deductions

1. Find the ratio \( \frac{\text{diameter of decay}}{\text{DBH}} \)

2. Use Butt Rot table for ratio of butt rot.

Note: to develop consistency in the net factoring process individuals should not interpret between the butt rot ratios. Determine the nearest ratio and apply the selected value.

3. Express length deduction as percentage of log length.

Another option of conical defect associated with butt rot is to use the butt rot guide for length deductions.

Butt rot is generally included with the log for its maximum grade length. However, if the rot lowers the grade of the butt log, take a short log (minimum 3 m) and assign a grade and net factor to that short log.

The Butt Rot Guide (Table 5.9) gives the conical butt rot ratios by log length. Note that the net factor may determine the grade, based on the percent lumber recovery or other grade requirements. Deductions and grade considerations are based on rot/DBH ratio. Calculate the ratio to the nearest \( \frac{1}{4} \) diameter, determine the deduction from the table below, and reduce the log volume by the deduction.

**Table 5.9 – Butt Rot guide for length deductions.**

<table>
<thead>
<tr>
<th>Ratio</th>
<th>Length</th>
<th>Deduction</th>
<th>Grade Consideration*</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \frac{1}{4} ) diameter</td>
<td>1.8–2.4 m</td>
<td>0.2 m</td>
<td>0.6 m</td>
</tr>
<tr>
<td>( \frac{1}{2} ) diameter</td>
<td>3.6–4.2 m</td>
<td>0.4 m</td>
<td>1.8 m</td>
</tr>
<tr>
<td>( \frac{3}{4} ) diameter</td>
<td>5.4–6.0 m</td>
<td>1.2 m</td>
<td>3.6 m</td>
</tr>
<tr>
<td>4/4 diameter</td>
<td>7.2 m</td>
<td>2.4 m</td>
<td>4.2 m</td>
</tr>
</tbody>
</table>

*Grade consideration describes how much of a piece will not produce lumber.
EXAMPLE

The butt rot length is not visible, therefore we need a process to determine deduction length.

Rot diameter = 55 cm; DBH = 102 cm; log length = 10 m

\[
\text{Ratio} = \frac{\text{rot diameter}}{\text{log diameter}} = \frac{55}{102} \approx \frac{1}{2}
\]

Using the table, butt rot extends from 3.6 m to 4.2 m.

The deduction is 0.4 m length.

Net Factor = \( \frac{10 - 0.4}{10} \times 100 \)

= 96%

Figure 5.7 — Example of net factor calculation for Cat Face (using butt rot table).

7. FORK (FRK)

In most cases, the position of the fork will signify a change of grade. If the fork is major, both in size and impact on grade, it may be pencil bucked out in 1 m lengths with a grade of Y assigned to that section and a net factor of 100%.

If decay is visible the rules for fork are as follows:

Table 5.10 – Deduction rule for Fork.

<table>
<thead>
<tr>
<th>Form</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>Method</td>
<td>Rule</td>
</tr>
<tr>
<td>Deduction area</td>
<td>1 m below</td>
</tr>
<tr>
<td>% Sound of deduction area (net factor)</td>
<td>50%</td>
</tr>
<tr>
<td>Grade</td>
<td>Y</td>
</tr>
</tbody>
</table>

8. CROOK (CRO)

In most cases, the position of the crook will signify a change of grade. If the position of the crook will result in a change of grade, both in size and impact on grade, it may be pencil bucked out in 1 m lengths with a grade of Y assigned to that section and a net factor of 100%.

If decay is visible the rules for crook are as follows:
Table 5.11 – Deduction rule for Crook.

<table>
<thead>
<tr>
<th>Form</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>Method</td>
<td>Rule</td>
</tr>
<tr>
<td>Deduction area</td>
<td>1 m below</td>
</tr>
<tr>
<td>% Sound of deduction area (net factor)</td>
<td>50%</td>
</tr>
<tr>
<td>Grade</td>
<td>Y</td>
</tr>
</tbody>
</table>

9. ROTTEN BRANCH (LRB)

Larger rotten branches/knots (≥ 10 cm inside bark) are a significant indicator of cylindrical rot.

The rule for rotten branches is as follows:

Table 5.12 – Deduction rule for Rotten Branch.

<table>
<thead>
<tr>
<th>Form</th>
<th>Cylindrical</th>
</tr>
</thead>
<tbody>
<tr>
<td>Method</td>
<td>Rule</td>
</tr>
<tr>
<td>Deduction area</td>
<td>1 m above the rotten branch; 1 m below</td>
</tr>
<tr>
<td>% Sound of deduction area (net factor)</td>
<td>50%</td>
</tr>
<tr>
<td>Grade</td>
<td>Y</td>
</tr>
</tbody>
</table>

Note: For multiple, overlapping rotten branches/knots (less than 2 m apart), deduction extends 1 m above and below the series.

10. DEAD TOPS (DTP)

(Broken tops are handled separately.)

Dead tops are usually associated with sap rot, but rot must be visible before a net factor can be applied.

The rule for dead tops is as follows:

Table 5.13 – Deduction rule for Dead Tops.

<table>
<thead>
<tr>
<th>Form</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>Method</td>
<td>Calculate</td>
</tr>
<tr>
<td>Deduction area</td>
<td>From top of live crown to tree length</td>
</tr>
<tr>
<td>% Sound of deduction area (net factor)</td>
<td>Calculated</td>
</tr>
<tr>
<td>Grade</td>
<td>Assigned</td>
</tr>
</tbody>
</table>
**Note:** Dry checked wood may affect grade, but will not affect the sound wood content (net factor).

Sap rot depth is to be estimated at the midpoint of the dead top.

**Formula**

\[
\text{Net Factor} = \left( \frac{\text{volume of sound cone}}{\text{volume of cone}} \right) \times 100\%
\]

**Shortcut Formula**

\[
\text{Net Factor} = \left( \frac{\text{radius soundwood}}{\text{radius total}} \right)^2 \times 100\%
\]

**EXAMPLE**

Midpoint diameter 20 cm (10 cm radius)

2 cm depth of sap rot (giving 8 cm radius of sound wood)

\[
\text{Net Factor} = \left( \frac{8 \text{ cm}}{10 \text{ cm}} \right)^2 \times 100\% = 64\%
\]

**Figure 5.8 — Example of net factor calculation for Dead Tops.**

11. BROKEN (MISSING) TOPS (BTP)

The tree is graded and net factored normally to the broken top (pencil buck at the break). The missing portion is graded as “N” and net factored as “00” (no sound wood).

**Table 5.14 — Deduction rule for Broken Tops.**

<table>
<thead>
<tr>
<th>Form</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>Method</td>
<td>Rule</td>
</tr>
<tr>
<td>Deduction area</td>
<td>from break to original top</td>
</tr>
<tr>
<td>% Sound of deduction area (net factor)</td>
<td>00 = no sound wood</td>
</tr>
<tr>
<td>Grade</td>
<td>N (nothing)</td>
</tr>
</tbody>
</table>

Broken tops, particularly on hemlock and balsam, are usually associated with rot, but rot must be observed on the stem (or broken top if it is on the ground nearby) before a net factor can be applied.

Rot associated with logs below the broken top is assumed to run 1 m below the break.
Table 5.15 – Deduction rule for Rot Associated with Broken Tops.

<table>
<thead>
<tr>
<th>Form</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>Method</td>
<td>Rule</td>
</tr>
<tr>
<td>Deduction area</td>
<td>1 m below the break</td>
</tr>
<tr>
<td>% Sound of deduction area (net factor)</td>
<td>00</td>
</tr>
<tr>
<td>Grade</td>
<td>Y</td>
</tr>
</tbody>
</table>

Formula

\[
\text{Net Factor} = \left( \frac{\text{last log length} - 1.0}{\text{last log length}} \right) * 100\%
\]

**EXAMPLE**

Last log length is 10 m up to a broken top

\[
\text{Net Factor} = \left( \frac{10 \text{ m} - 1.0 \text{ m}}{10 \text{ m}} \right) * 100\% = 90\%
\]

Figure 5.9 — Example of net factor calculation for Broken Tops.

12. SOUNDING FOR DECAYED OR MISSING WOOD (SNG)

“Sound” all measured trees in the Integrated Plot and new species on the Auxiliary Plots. Only if the tree gives a hollow sound, bore the tree with an increment borer on the side facing the plot centre and record the loss indicator “SNG.” Even if the boring does not reveal any decay, the “SNG” code is still left as recorded.

Decay discovered by boring will not be used for net factoring except in the case of sounded trees. For instance, discovering decay by boring a top height tree, which did not sound hollow, would not result in a deduction.

Measure the sound wood.

Determine the ratio of decay to tree DBH. If there are no other indicators, assume that the rot is conical in nature and apply the deduction in Table 5.9 Butt Rot Guide for Length Deductions.

13. DIRECT OBSERVATION (DIR)

Sometimes rot or missing wood can be observed directly without, but the cause is not known.

The rule for direct observation is as follows:
Table 5.16 – Deduction rule for Direct Observation.

<table>
<thead>
<tr>
<th>Form</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>Method</td>
<td>Rules</td>
</tr>
<tr>
<td>Deduction area</td>
<td>Various</td>
</tr>
<tr>
<td>% Sound of deduction area (net factor)</td>
<td>Calculated</td>
</tr>
<tr>
<td>Grade</td>
<td>Assigned</td>
</tr>
</tbody>
</table>

14. OTHER (OTH)

Sometimes rot or missing wood can be observed directly, and the cause is known. However, there is no appropriate loss indicator code.

The rule for Other is as follows:

Table 5.17 – Deduction rule for Other.

<table>
<thead>
<tr>
<th>Form</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>Method</td>
<td>Rules</td>
</tr>
<tr>
<td>Deduction area</td>
<td>Various</td>
</tr>
<tr>
<td>% Sound of deduction area (net factor)</td>
<td>Calculated</td>
</tr>
<tr>
<td>Grade</td>
<td>Assigned</td>
</tr>
</tbody>
</table>

15. MULTIPLE DEFECTS

In general, the assignment of net factors to trees with multiple defects is left to the professional judgment of the cruiser, based on the net factoring procedures discussed here.

However, several concepts should be noted:

- Net factors less than 50% will only occur with severe:
  - cylindrical butt rot
  - sap rot
  - missing wood
- Severe frost cracks/scars associated with conk on the lower bole can be assumed to be connected and treated as cylindrical rot, with a net factor of 50%.
- Sound sections 3 m or longer between defects can be treated as separate logs. Sound sections less than 3 m are incorporated with the log section above or below.
EXAMPLE
of isolated section between defects

Conk at 12 m and 24 m. This creates a 2 m section between the defect areas, so we can combine all three sections into one log.

Deduction length \(= 2 \times (6 + 4) = 20 \text{ m}\)

Log Length (from 6 m — 28 m) = 22 m

Conk Deduction 50% (of 20 m) = 10 m

Grade (all 3 sections) = Y

Net Factor
\[
= \left[ \frac{\text{length of log} - \text{length of deduction}}{\text{length of log}} \right] \times 100\% 
\]

Net Factor
\[
= \left[ \frac{23 \text{ m} - 10 \text{ m}}{23 \text{ m}} \right] \times 100\%
\]

= 54.5% Record as 55%

Note: The same procedure should be used whenever grade is assigned, particularly for butt rot and/or cat face.

Note: If the upper conk were at 25 m, it would create a 3 m log between the two defects. This log would be treated as a separate sound log with its own grade. This would create three separate logs, each with its own grade and net factor (a more detailed description of the tree).

Figure 5.10 — Example of isolated sections between defects.
6. Call Grading

Introduction
This section outlines the steps needed to assess the quality of measured trees. The call grading criteria and procedures as developed for the "Vegetation Resources Inventory" will be employed in the Provincial Change Monitoring Inventory.

Objectives
To provide a rule-based estimate of tree quality.

Definitions
Call grading is the procedure used to assign one of the Change Monitoring Inventory (CMI) grades (modified coastal log grades) to standing and fallen timber. Grading is a hierarchical process. The grade extends up the tree as long as the grade rules allow. When a knot or other defect is encountered or the diameter can no longer support that grade, the grade changes for the next portion of the tree.

Some trees are too small to meet the minimum log sizes for CMI grades. These small trees are assigned a small-tree grade developed for use in the Change Monitoring Inventory.

Variable length call grading recognizes only a minimum length (see Section 6.1) and allows the cruiser to pencil buck (the imaginary sectioning of a portion of the tree) at grade changes rather than at predetermined log lengths.

General Procedures
- The cruiser should be able to grade the log into at least the correct major category. The major categories are lumber, peeler, sawlog, shingle, and utility chipper.
- CMI grades are assigned to logs based on size, quality, and soundwood recoverability.
- Grades are assigned using the hierarchy of CMI grades. Start at the first grade in the hierarchy. If the log cannot meet that grade, move to the next in the list until the grade can be met.
- A log cannot be “one grade or another,” it can be only one grade. It is not a choice of market preference, current harvesting practices, accessibility, or other factors. A log is the highest grade it qualifies for within the hierarchy.
- Grades are assigned to ALL trees (live or dead, standing or fallen) selected within the integrated plot. Some trees will also be measured in the auxiliary plots, if a live stem of that species did not occur on the integrated plot.
- Small trees are assigned a small tree grade developed for use in the Change Monitoring Inventory.
Field Cards for this Section

Tree Details (TD) (Appendix A, Figures A.11 and A.12)
Log grades, lengths, % sound

Tree Loss Indicators (TL) (Appendix A, Figure A.13)
Damage agent, severity, loss indicator, location, frequency

Auxiliary Plot Card (TA) (Appendix A, Figures A.15 and A.16)
Trees on Auxiliary Plots

Detailed Procedures

6.1 Call Grading Procedures

For standing or Fallen Trees, Live or Dead

1. Measure all log lengths from the high-side ground level.

2. Determine the highest grade the bottom log would satisfy, based on grading rules and characteristics of the minimum log lengths for that species.

Table 6.1 – Minimum log lengths (in m) by grade and species (highest grade at left).

<table>
<thead>
<tr>
<th>Category</th>
<th>Lumber</th>
<th>Peeler</th>
<th>Sawlog</th>
<th>Shingle</th>
<th>Utility Chipper</th>
</tr>
</thead>
<tbody>
<tr>
<td>GRADES [D,F,G]</td>
<td>B,C</td>
<td>[H I J]</td>
<td>[K L M]</td>
<td>[U X Y]</td>
<td></td>
</tr>
<tr>
<td>Douglas-fir</td>
<td>5</td>
<td>5</td>
<td>5 4 5</td>
<td>-</td>
<td>5 3 1</td>
</tr>
<tr>
<td>Cedar</td>
<td>5</td>
<td>-</td>
<td>5 4 5</td>
<td>4</td>
<td>5 3 1</td>
</tr>
<tr>
<td>Hemlock</td>
<td>5</td>
<td>-</td>
<td>5 4 5</td>
<td>-</td>
<td>5 3 1</td>
</tr>
<tr>
<td>Balsam (Abies)</td>
<td>5</td>
<td>-</td>
<td>5 4 5</td>
<td>-</td>
<td>5 3 1</td>
</tr>
<tr>
<td>Spruce</td>
<td>4</td>
<td>-</td>
<td>4 4 4</td>
<td>-</td>
<td>5 3 1</td>
</tr>
<tr>
<td>Pine/Larch</td>
<td>5</td>
<td>-</td>
<td>5 4 5</td>
<td>-</td>
<td>5 3 1</td>
</tr>
<tr>
<td>Cypress/Yew</td>
<td>4</td>
<td>-</td>
<td>4 4 4</td>
<td>-</td>
<td>5 3 1</td>
</tr>
<tr>
<td>Deciduous</td>
<td>-</td>
<td>5</td>
<td>- 5 -</td>
<td>-</td>
<td>5 — 1</td>
</tr>
</tbody>
</table>

3. Add to that log in 1-metre increments until the top diameter of the log (measured as diameter inside bark [DIB]) or the log quality results in a grade change.

Maintain that log grade as long as possible if the next grade would be a lower one in the hierarchy.

Change the grade as soon as possible if the next log grade would be a higher one in the hierarchy.

4. Record the grade and the length. For example, an H grade 16 m log is “H 16”.

5. Follow the same procedure for the next log up the tree.
6. The last grade on the tree will normally be carried to the top of the tree and “99” recorded (except when top of tree is broken off), regardless of utilization limits (applies to grades J, U, X, Y). Do not attempt to grade the top log based on top diameter or on the fact that it may be a short log due to utilization top diameter.

7. For grading in immature stands where the first log is a J and the quality of the remaining stem is similar, call the whole tree J (J99). Similarly for grades U, X, and Y.

8. If the tree has certain defects (such as excessive butt rot, fork, conk, rotten branches) you may want to isolate for grading those portions of the tree.

For Broken or Cut Stems

If the stem is over 1.3 m tall, grade and net factor it like any other “tree” with a broken top. The stem will have to be graded on its length and recoverability (usually it will be an X or Y grade). If the length is less than 1.3 m it is a “stump” or CWD, not a “tree”. Stumps are measured in the 2.50 m plot and are not graded. CWD is measured on the line transect and is not graded. The missing or unconnected portion is always graded as “N-99-00”.

For Small Trees

Trees that do not meet the minimum log size of 5 m to a 10 cm top diameter (U grade) are assigned a small tree grade developed for use in the Change Monitoring Inventory. Assign a single grade to the entire tree, using the following codes:

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>P</td>
<td>Pretty good</td>
</tr>
<tr>
<td>Q</td>
<td>Questionable</td>
</tr>
<tr>
<td>R</td>
<td>Reject</td>
</tr>
</tbody>
</table>

- Pretty good:
  - Straight and good form.
  - Well spaced/distributed knots or branches.

- Questionable:
  - Slight sinuosity, minor crooks, and so on
  - Small knots

- Reject:
  - Major sinuosity or deformity.
  - Large knots/uneven distribution of knots or branches

Note:
- For broken top trees, record the small tree grade to the break, and record “N-99-00” to the broken-off portion.
- Dead trees are assessed on their condition at the time of the survey. For example a dead tree with straight and good form with no checking could still be graded as a “P” grade. Trees with very minor checking could be “Q” grade if they meet the other grade criteria. Trees with moderate to severe checking should be graded as “R” grade.

6.2 Grading Conventions and Guidelines

Conventions

- Trees with conk or blind conk will have the affected portion graded as “Y” grade.
The last grade on the tree will normally be carried to the top of the tree and is coded as “99” regardless of utilization limits (this applies to J,U,X,Y and small tree grades).

If the top of the tree is broken off (missing), the missing portion is graded as “N” (Nothing) and net factored as “00” (0% sound wood).

Guidelines

1. Heart Rot
   - Conk, blind conk, and rotten branches have specific lengths and grades applied.
     Conk      Y 4 m above, 6 m below, 50% sound
     Blind Conk Y 4 m above, 6 m below, 50% sound (like conk)
     Rotten Branch Y 1 m above, 1 m below, 50% sound

   - Scars
     Severe cylindrical cat face should be pencil bucked at the top of the cat face, with that length and net factor used to determine the grade.

2. Butt Rot
   - Butt rot is generally included with the log for its maximum grade length.
   - Refer to the Butt Rot Guide for Length Deductions table. Note that the net factor may determine the grade, based on the % lumber recovery or other grade requirements. The table also provides a guide for “grade considerations,” which is how much of the piece will not produce lumber.

<table>
<thead>
<tr>
<th>Ratio</th>
<th>Length</th>
<th>Deduction</th>
<th>Grade Consideration*</th>
</tr>
</thead>
<tbody>
<tr>
<td>¼ diameter</td>
<td>1.8–2.4 m</td>
<td>0.2 m</td>
<td>0.6 m</td>
</tr>
<tr>
<td>½ diameter</td>
<td>3.6–4.2 m</td>
<td>0.4 m</td>
<td>1.8 m</td>
</tr>
<tr>
<td>¾ diameter</td>
<td>5.4–6.0 m</td>
<td>1.2 m</td>
<td>3.6 m</td>
</tr>
<tr>
<td>4/4 diameter</td>
<td>7.2 m</td>
<td>2.4 m</td>
<td>4.2 m</td>
</tr>
</tbody>
</table>

*Grade consideration describes how much of a piece will not produce lumber.
3. **FROST CRACKS**

- Pencil buck at the top of the frost crack(s) for log length.
- Assign a percentage loss (based on 10% per frost crack, if they run the length of the log) with a maximum total deduction of 40% (net factor of 60%).

**Note:** The angle, position, or net factor will determine the appropriate grade based on % lumber recovery and/or % merchantable.

4. **OCCASIONAL LARGER KNOTS (OLK)**

All sawlog grades (H, I, J, U and X grades) can have occasional larger knots (OLK's). Occasional larger knots are allowed to the extent of one per 3 meters of log length [two per 3 meters for X grade logs over 50 centimeters top diameter] and must be located where knot sizes for portions of the logs are specified.

For example, if a grade requirement allows 4 cm knots over the entire log, then occasional larger knots can be anywhere on the log. Where the requirement allows larger knots on a portion of the log then the occasional larger knots must be within this portion only.

5. **SUN CHECKS AND/OR INSECT DAMAGE**

- A check is a separation of the wood, at right angles to the annular rings that runs through the heart of the log. There is no soundwood deduction for sun checks or insect damage.
- Grade considerations, particularly % lumber, are applied.
- No soundwood deduction for sun checks or insect damage.

**Formula for Grade Consideration Calculation of Sound % Lumber**

\[
\% \text{ Recovered} = \left( \frac{\pi r^2}{\pi R^2} \right) \times 100\%
\]

where \( r = \text{radius of sawable lumber portion, and} \)
\( R = \text{radius of tree} \)
EXAMPLE

Diameter = 50 cm; Radius of tree (R) = 25 cm; Sun check = 5 cm

Radius of sawable lumber portion (r) = 20 cm

Whole tree is sun checked

\[
\text{\% Recovered} = \left( \frac{\pi r^2}{\pi R^2} \right) \times 100\%
\]

\[
= \left( \frac{r^2}{R^2} \right) \times 100\%
\]

\[
= \left( \frac{20^2}{25^2} \right) \times 100\% \text{ OR } \left( \frac{40^2}{50^2} \right) \times 100\%
\]

(These give the same mathematical result.)

= 64\% lumber recovery

The appropriate grade is X (J grade would require 75\% lumber; U grade would require 66\% lumber).

Figure 6.1 — Example of grade calculation for sun checked logs.

6. TWIST

- There is no soundwood deduction for twist.
- Grade considerations, however, are applied.
- The amount of twist is measured along 30 cm at the mid-point of the log. The percentage of twist is calculated by dividing this amount by the diameter at the top of the log. With the exception of J grade, there are maximums of both of these values, as shown below. Twist must be less than both of these restrictions. For example, a D grade must deviate by no more than 6 cm over the 30 cm distance, and the deviation divided by the top diameter must be no more than 4%.
- The displacement of twist over 30 cm is also observed.
- Twist comprises two factors: percentage of top diameter; and maximum displacement over 30 cm. Table 6.3 shows the maximum values for specific grades. If the parameters are not met, the next lower grade applies.

**Table 6.3 – Maximum twist displacement by grade.**

<table>
<thead>
<tr>
<th>Grades</th>
<th>% of top diameter</th>
<th>Maximum displacement (over 30 cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lumber D, F, G</td>
<td>4%</td>
<td>6 cm</td>
</tr>
<tr>
<td>Peeler B, C</td>
<td>7%</td>
<td>8 cm</td>
</tr>
<tr>
<td>Sawlog H</td>
<td>7%</td>
<td>8 cm</td>
</tr>
<tr>
<td>Sawlog I</td>
<td>10%</td>
<td>9 cm</td>
</tr>
<tr>
<td>Sawlog J</td>
<td>10%</td>
<td>No limit</td>
</tr>
<tr>
<td>Utility U, X</td>
<td>13%</td>
<td>13 cm</td>
</tr>
</tbody>
</table>

**Note:** “Waterline to waterline” (180 degree twist) over 2 m is automatically Y grade.

- If twist only appears on a portion of a tree – it should be pencil bucked out with the appropriate grade, length, and net factor applied.

**EXAMPLE 1**

**Calculations**

Estimated top DIB: 60 cm for log section
Severe twist 8 cm (along 30 cm section)

\[
\frac{8 \text{ cm twist}}{60 \text{ cm top}} \times 100\% = 13\%
\]

This log is graded as U, since this is the first grade met in the hierarchy (other defects may lower the grade further).

**EXAMPLE 2**

**Calculations**

Estimated top DIB 25 cm for log section
Minor twist, 2 cm displacement

\[
\frac{2 \text{ cm twist}}{25 \text{ cm top}} \times 100\% = 8\%
\]

This log is graded as J, since this is the first grade met in the hierarchy.

**Figure 6.2 — Examples of grade calculation for twist.**
7. **CEDAR SHINGLE CRITERIA**

Cedar will not be graded as a shingle if it can make a sawlog grade. If a log, due to heart rot or butt rot, has less than 75% soundwood, but meets slab thickness requirement for that grade, the log becomes shingle grade.

If logs are unsuitable for lumber manufacture due to, shape (heavy fluting), heart rot (less than 75% lumber), or splits (creating triangular or “U” shaped slabs), but otherwise meet the grade criteria, then:

<table>
<thead>
<tr>
<th>initial grade</th>
<th>changes to</th>
</tr>
</thead>
<tbody>
<tr>
<td>D grade</td>
<td>K grade</td>
</tr>
<tr>
<td>F grade</td>
<td>L grade</td>
</tr>
<tr>
<td>H/I grade</td>
<td>M grade</td>
</tr>
</tbody>
</table>

8. **SURFACE CLEAR**

Logs which are free of knots and knot indicators are valued for use in specialty forest products, such as window and door stock. A typical log grade criteria will be written as “90% surface clear”. In application this indicates 10% of the log may have knots or knot indicators on any surface [from the top of the log] with the remaining 90% of the log being clear of knots or knot indicators. Similarly, a log grade that requires 80% surface clear may have 20% of the log with knots or knot indicators on any surface [from the top of the log] with the remaining 80% of the log being clear of knots or knot indicators.

### 6.3 Inventory Call Grading Criteria

**Fir/Pine/Larch Grades and Grade Requirements**

**Table 6.4 – Fir/Pine/Larch Grades and Grade Requirements.**

<table>
<thead>
<tr>
<th>D GRADE</th>
<th>Fir/Pine/Larch</th>
</tr>
</thead>
<tbody>
<tr>
<td>Min. top diameter inside bark</td>
<td>76 cm</td>
</tr>
<tr>
<td>Min. log length</td>
<td>5 m</td>
</tr>
<tr>
<td>Min. percentage lumber</td>
<td>75%</td>
</tr>
<tr>
<td>Min. percentage clear lumber</td>
<td>50%</td>
</tr>
<tr>
<td>Max. twist over 30 cm of length</td>
<td>4% of top diameter, Max. deviation 6 cm</td>
</tr>
</tbody>
</table>

**Grade Requirements**

- **Knots**  
  - ≥ 90% surface clear, with well-spaced knots or knot indicators permitted on the upper 10% of two sides of the log or upper 20% of one side of the log only.
- **Rot**  
  - No conk permitted.
  - Rot permitted, provided 75% lumber attained.
### F GRADE

<table>
<thead>
<tr>
<th></th>
<th>Fir/Pine/Larch</th>
</tr>
</thead>
<tbody>
<tr>
<td>Min. top diameter inside bark</td>
<td>60 cm</td>
</tr>
<tr>
<td>Min. log length</td>
<td>5 m</td>
</tr>
<tr>
<td>Min. percentage lumber</td>
<td>75%</td>
</tr>
<tr>
<td>Min. percentage clear lumber</td>
<td>25%</td>
</tr>
<tr>
<td>Max. twist over 30 cm of length</td>
<td>4% of top diameter, Max. deviation 6 cm</td>
</tr>
</tbody>
</table>

#### Grade Requirements

**Knots**
- Logs 60-74 cm must have $\geq 75\%$ surface clear, with well-spaced knots or knot indicators permitted on the upper 25% of two sides of the log or upper 50% of one side of the log only.
- Logs 76 cm or greater must have $\geq 50\%$ surface clear, with well-spaced knots or knot indicators permitted on the upper 25% of two sides of the log or upper 75% of one side of the log only.

**Rot**
- No conk permitted.
- Rot permitted, provided 75% lumber attained.

### B GRADE (Fir only)

<table>
<thead>
<tr>
<th></th>
<th>Fir/Pine/Larch</th>
</tr>
</thead>
<tbody>
<tr>
<td>Min. top diameter inside bark</td>
<td>60 cm</td>
</tr>
<tr>
<td>Min. log length</td>
<td>5 m</td>
</tr>
<tr>
<td>Min. percentage veneer</td>
<td>80%</td>
</tr>
<tr>
<td>Maximum twist over 30 cm of length</td>
<td>7% of top diameter, Max. deviation 8 cm</td>
</tr>
</tbody>
</table>

#### Grade Requirements

**Knots**
- No knots or bunch knots over 4 cm are permitted.
- Logs 60-74 cm top diameter must have the lower 2.6 m free of knots or knot indicators.
- Logs $\geq 76$ cm top diameter must have the lower 2.6 m free of knots. Knot indicators are permitted.

**Rot**
- No conk rot permitted.
- No butt rot permitted.
- Sap rot permitted to 4% of top diameter or 5 cm in depth.

**Misc.**
- No splits permitted.
- Sun checks or insect holes permitted to a depth of 4% of top diameter or to a maximum of 5 cm in depth.
- Sweep is not permitted.
- Crook is not permitted.
- Burls are permitted to 1 burl per 2.6 m of log length.
### C GRADE (Fir only)  |  Fir/Pine/Larch
---|---
Min. top diameter | 38 cm
Min. log length | 5 m
Min. percentage veneer | 80%
Max. twist over 30 cm of length | 7% of top diameter, Max. deviation 8 cm

#### Grade Requirements

##### Knots
- No knots or bunch knots over 4 cm are permitted.

##### Rot
- No conk permitted.
- No butt rot permitted.
- Sap rot:
  - For logs < 50 cm top diameter, none is permitted.
  - For logs ≥ 50 cm top diameter, permitted up to 4% of the top diameter, and a maximum of 5 cm actual depth.

##### Misc.
- No splits permitted.
- Sun checks or insect holes:
  - For logs < 50 cm top diameter, none is permitted.
  - For logs ≥ 50 cm top diameter, permitted up to 4% of the top diameter, and a maximum of 5 cm actual depth.
- Sweep is not permitted.
- Crook is not permitted.
- Burls are permitted (1 burl per 2.6 m of log length).
### H GRADE

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Min. top diameter</td>
<td>38 cm</td>
</tr>
<tr>
<td>Min. log length</td>
<td>5 m</td>
</tr>
<tr>
<td>Min. lumber percentage:</td>
<td></td>
</tr>
<tr>
<td>- Logs ≥ 38 cm top diameter</td>
<td>75%</td>
</tr>
<tr>
<td>- Logs ≥ 50 cm top diameter</td>
<td>50%</td>
</tr>
<tr>
<td>Min. merchantable percentage</td>
<td>65%</td>
</tr>
<tr>
<td>Max. twist over 30 cm of length</td>
<td>7% of top diameter, Max. deviation 8 cm</td>
</tr>
</tbody>
</table>

#### Grade Requirements

**Knots**

- 38 — 48 cm top diameter:
  - 4 cm knots over the entire log **OR**
  - 5 cm knots over the upper 50% of the log, with knots ≤ 2 cm in diameter permitted over the lower 50% of the log.
- ≥ 50 cm top diameter:
  - 4 cm knots over the entire log **OR**
  - 5 cm knots over the upper 66\(\frac{2}{3}\)% of the log **OR**
  - 8 cm knots over the upper 50% of the log*
    (* with knots ≤ 2 cm in diameter permitted over the lower portion of the log).
- Occasional larger knots (OLKs) are permitted, to 1 per 3 metres.

**Rot**

- Permitted provided percentage lumber is maintained.

**Misc.**

- No insect holes penetrating the sapwood permitted.

### I GRADE

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Min. top diameter</td>
<td>38 cm</td>
</tr>
<tr>
<td>Min. log length</td>
<td>4 m</td>
</tr>
<tr>
<td>Min. lumber percentage:</td>
<td></td>
</tr>
<tr>
<td>- Logs ≥ 38 cm top diameter</td>
<td>75%</td>
</tr>
<tr>
<td>- Logs ≥ 50 cm top diameter</td>
<td>50%</td>
</tr>
<tr>
<td>- Logs 38-48 cm top diameter (former H log quality)</td>
<td>50%</td>
</tr>
<tr>
<td>Min. merchantable percentage</td>
<td>50%</td>
</tr>
<tr>
<td><strong>OR</strong> former H log quality 38-48 cm top diameter</td>
<td>65%</td>
</tr>
<tr>
<td>Max. twist over 30 cm of length</td>
<td>10% of top diameter, Max. deviation 9 cm</td>
</tr>
</tbody>
</table>

#### Grade Requirements

**Knots**

- 38 — 48 cm top diameter 8 cm
- 50 — 74 cm top diameter 9 cm
- ≥ 76 cm top diameter 10 cm
- Occasional larger knots (OLKs) are permitted, to 1 per 3 metres.

**Rot**

- Permitted, provided 75% percentage lumber is attained.
### J Grade

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Top diameter</td>
<td>16 cm *</td>
<td>36 cm</td>
</tr>
<tr>
<td>Log length</td>
<td>5 m</td>
<td></td>
</tr>
<tr>
<td>Lumber percentage</td>
<td>75%</td>
<td></td>
</tr>
<tr>
<td>Merchantable percentage</td>
<td>50%</td>
<td></td>
</tr>
<tr>
<td>Twist over 30 cm of length</td>
<td>10%</td>
<td></td>
</tr>
</tbody>
</table>

*Refer to grading procedure, item 6, Section 6.1 for variance to this diameter limit.*

#### Knots

- 16 — 26 cm top diameter: 4 cm
- 28 — 36 cm top diameter: 6 cm
- Occasional larger knots (OLKs) are permitted, to 1 per 3 metres.

#### Rot

Permitted provided 75% lumber is attained.

### U Grade

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Top diameter</td>
<td>10 cm *</td>
<td></td>
</tr>
<tr>
<td>Log length</td>
<td>5 m</td>
<td></td>
</tr>
<tr>
<td>Lumber percentage:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10–14 cm top diameter</td>
<td>75%</td>
<td></td>
</tr>
<tr>
<td>16–36 cm top diameter</td>
<td>66(\frac{2}{3})%</td>
<td></td>
</tr>
<tr>
<td>≥ 38 cm top diameter</td>
<td>50%</td>
<td></td>
</tr>
<tr>
<td>Merchantable percentage</td>
<td>35%</td>
<td></td>
</tr>
<tr>
<td>Twist over 30 cm of length</td>
<td>13%, Max. deviation 13 cm</td>
<td></td>
</tr>
</tbody>
</table>

*Refer to grading procedure, item 6, Section 6.1 for variance to this diameter limit.*

#### Knots

- 10–14 cm top diameter: 4 cm
- 16–26 cm top diameter: 6 cm
- 28–36 cm top diameter: 8 cm
- 38–48 cm top diameter: 10 cm
- 50–74 cm top diameter: 12 cm
- ≥ 76 cm top diameter: 14 cm
- Occasional larger knots (OLKs) are permitted, to 1 per 3 metres

#### Rot

Permitted provided percentage lumber is attained.
X GRADE (same for all Coniferous species)  

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Minimum/Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Min. top diameter</td>
<td>10 cm *</td>
</tr>
<tr>
<td>Min. log length</td>
<td>3 m</td>
</tr>
<tr>
<td>Min. lumber percentage</td>
<td>33(\frac{1}{3})%</td>
</tr>
<tr>
<td>Min. merchantable percentage</td>
<td>35%</td>
</tr>
<tr>
<td>Max. twist over 30 cm of length</td>
<td>13% Max. deviation 13 cm</td>
</tr>
</tbody>
</table>

* Refer to grading procedure, item 6, Section 6.1 for variance to this diameter limit.

**Grade Requirements**

<table>
<thead>
<tr>
<th>Knots</th>
<th>Same as “U” Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>- 10–14 cm top diameter</td>
<td>4 cm</td>
</tr>
<tr>
<td>- 16–26 cm top diameter</td>
<td>6 cm</td>
</tr>
<tr>
<td>- 28–36 cm top diameter</td>
<td>8 cm</td>
</tr>
<tr>
<td>- 38–48 cm top diameter</td>
<td>10 cm</td>
</tr>
<tr>
<td>- 50–74 cm top diameter</td>
<td>12 cm</td>
</tr>
<tr>
<td>- ≥ 76 cm top diameter</td>
<td>14 cm</td>
</tr>
<tr>
<td>Occasional larger knots (OLKs) are permitted, to 1 per 3 metres for logs &lt; 50cm.</td>
<td></td>
</tr>
<tr>
<td>Logs ≥ 50 cm may have oversize knots up to a maximum of 2 per 3 m of log length</td>
<td></td>
</tr>
</tbody>
</table>

**Rot**  
Permitted provided 33\(\frac{1}{3}\)% lumber is attained.

Y GRADE (same for all Coniferous species)  

Lower than X grade.

Cedar Grades and Grade Requirements

Table 6.5 – Cedar Grades and Grade Requirements.

<table>
<thead>
<tr>
<th>D GRADE</th>
<th>Cedar</th>
</tr>
</thead>
<tbody>
<tr>
<td>Logs</td>
<td></td>
</tr>
<tr>
<td>Min. top diameter</td>
<td>60 cm</td>
</tr>
<tr>
<td>Min. length</td>
<td>5 m</td>
</tr>
<tr>
<td>Min. percentage lumber</td>
<td></td>
</tr>
<tr>
<td>- 60–118 cm top diameter</td>
<td>75%</td>
</tr>
<tr>
<td>- ≥ 120 cm top diameter</td>
<td>66(\frac{1}{2})%</td>
</tr>
<tr>
<td>Min. percentage clear lumber</td>
<td>50%</td>
</tr>
<tr>
<td>Max. twist over 30 cm of length</td>
<td>4%, Max. deviation 6 cm</td>
</tr>
<tr>
<td>Slabs</td>
<td></td>
</tr>
<tr>
<td>Min. top diameter</td>
<td>50 cm</td>
</tr>
<tr>
<td>Min. thickness</td>
<td>38 cm</td>
</tr>
<tr>
<td>Min. length</td>
<td>5 m</td>
</tr>
<tr>
<td>Min. percentage lumber</td>
<td>75%</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>----------------------</td>
<td>--</td>
</tr>
<tr>
<td>Min. percentage clear lumber</td>
<td>50%</td>
</tr>
<tr>
<td>Max. twist over 30 cm of length</td>
<td>4%, Max. deviation 6 cm</td>
</tr>
</tbody>
</table>

**Grade Requirements**

**Knots**
- 60 – 74 cm top diameter, ≥ 75% surface clear*, with well spaced knots or knot indicators permitted on the upper 25% of two sides or on the upper 50% of one side of the log length only.
- ≥ 76 cm top diameter, ≥ 66\(\frac{2}{3}\)% surface clear, with well spaced knots or knot indicators permitted on the upper 33\(\frac{1}{3}\)% of one side or on the upper 66\(\frac{2}{3}\)% of one side of the log length only.

**Rot**
- Rot permitted provided percentage lumber is met.

**Misc.**
- “D” quality logs with < 75% lumber OR if > 120 cm with less than 66\(\frac{2}{3}\)% lumber become “K” shingle

---

**F GRADE Cedar**

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Logs</td>
<td></td>
</tr>
<tr>
<td>Min. top diameter</td>
<td>50 cm</td>
</tr>
<tr>
<td>Min. length</td>
<td>5 m</td>
</tr>
<tr>
<td>Min. percentage lumber</td>
<td>75%</td>
</tr>
<tr>
<td>Min. percentage clear</td>
<td>25%</td>
</tr>
<tr>
<td>Max. twist over 30 cm of length</td>
<td>4%, Max. deviation 6 cm</td>
</tr>
<tr>
<td>Slabs</td>
<td></td>
</tr>
<tr>
<td>Min. top diameter</td>
<td>50 cm</td>
</tr>
<tr>
<td>Min. length</td>
<td>5 m</td>
</tr>
<tr>
<td>Min. thickness</td>
<td>38 cm</td>
</tr>
<tr>
<td>Min. percentage lumber</td>
<td>75%</td>
</tr>
<tr>
<td>Min. percentage clear</td>
<td>25%</td>
</tr>
<tr>
<td>Max. twist over 30 cm of length</td>
<td>4%, Max. deviation 6 cm</td>
</tr>
</tbody>
</table>

**Grade Requirements**

**Knots**
- 50–58 cm top diameter, must be surface clear of knots or knot indicators.
- 60–74 cm top diameter, 66\(\frac{2}{3}\)% surface clear with well spaced knots or knot indicators permitted on the upper 33\(\frac{1}{3}\)% of two sides or on the upper 66\(\frac{2}{3}\)% of one side of the log length only.
- ≥ 76 cm top diameter, ≥ 50% surface clear with well spaced knots or knot indicators permitted on the upper 50% of two sides or on the upper 75% of one side of the log length only.

**Rot**
- Permitted provided 75% lumber is attained.

**Misc.**
- “F” quality logs with < 75% lumber become “L” shingle
### H GRADE Cedar

<table>
<thead>
<tr>
<th>Min. top diameter</th>
<th>38 cm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Min. length</td>
<td>5 m</td>
</tr>
<tr>
<td>Min. percentage lumber</td>
<td>75%</td>
</tr>
<tr>
<td>Min. percentage clear</td>
<td>65%</td>
</tr>
<tr>
<td>Max. twist over 30 cm of length</td>
<td>7%, Max. deviation 8 cm</td>
</tr>
</tbody>
</table>

#### Grade Requirements

**Knots**
- 38–48 cm top diameter:
  - 4 cm knots over the entire log OR
  - 5 cm knots over the upper 50% of the log
    (with knots ≤ 2 cm in diameter permitted over the lower 50% of the log).
- ≥ 50 cm top diameter:
  - 4 cm knots over the entire log OR
  - 5 cm knots over the upper 66\% of the log OR
  - 8 cm knots over the upper 50% of the log
    (*knots ≤ 2 cm in diameter permitted over the lower portion of the log). OR
  - Occasional larger knots (OLKs) are permitted, to 1 per 3 metres.

**Rot**
- Rot permitted, provided 75% lumber is attained.

**Misc.**
- “H” quality logs with < 75% lumber become “M” shingle provided clear requirements can be met.

### I GRADE Cedar

<table>
<thead>
<tr>
<th>Min. top diameter</th>
<th>38 cm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Min. log length 4 m</td>
<td>38 cm</td>
</tr>
<tr>
<td>- top diameter ≥ 38 cm</td>
<td>75% L 50% M</td>
</tr>
<tr>
<td>OR</td>
<td>75% L 50% M</td>
</tr>
<tr>
<td>- Logs ≥ 10 m in length</td>
<td>50% L 50% M</td>
</tr>
<tr>
<td>OR</td>
<td>50% L 65% M</td>
</tr>
<tr>
<td>- Otherwise H Grade</td>
<td></td>
</tr>
<tr>
<td>Max. twist over 30 cm of length</td>
<td>10%, Max. deviation 9 cm</td>
</tr>
</tbody>
</table>

#### Grade Requirements

**Knots**
- 38–48 cm top diameter: 8 cm
- 50–74 cm top diameter: 9 cm
- ≥ 76 cm top diameter: 10 cm
- Occasional larger knots (OLKs) are permitted, to 1 per 3 metres.

**Rot**
- Permitted provided percentage lumber is attained.

**Misc.**
- “I” quality logs with < 75% lumber become “M” shingle provided clear requirements can be met.
### J Grade (same for all Coniferous species)  | Cedar
| Min. top diameter | 16 cm*  |
| Max. top diameter | 36 cm  |
| Min. log length | 5 m  |
| Min. lumber percentage | 75%  |
| Min. merchantable percentage | 50%  |
| Max. twist over 30 cm of length | 10% of top diameter  |

*Refer to grading procedure, item 6, Section 6.1 for variance to this diameter limit.

### Grade Requirements

#### Knots
- 16–26 cm top diameter: 4 cm
- 28–36 cm top diameter: 6 cm
- Occasional larger knots (OLKs) are permitted, to 1 per 3 metres.

#### Rot
Permitted provided 75% lumber is attained.

### K Grade  | Cedar
| Logs | Min. top diameter | 50 cm  |
| Min. log length | 4 m  |
| Min. percentage shingle or shakes | 50%  |
| Min. percentage clear shingle or shakes | 75%  |
| Max. twist over 30 cm of length | 4%, Max. deviation 6 cm  |
| Slabs | Min. top diameter | 50 cm  |
| Min. thickness | 38 cm  |
| Min. log length | 4 m  |
| Min. percentage shingle or shakes | 50%  |
| Min. percentage clear shingle or shakes | 75%  |
| Max. twist over 30 cm of length | 4%, Max. deviation 6 cm  |

### Grade Requirements

#### Knots
- 50–58 cm top diameter, must be surface clear of knots or knot indicators.
- 60–74 cm top diameter, ≥ 75% surface clear with knots or knot indicators permitted on the upper 25% of two sides or the upper 50% of one side of the log length only.
- ≥ 76 cm top diameter, ≥ 66\(\frac{2}{3}\)% surface clear with knots or knot indicators permitted on the upper 33\(\frac{1}{3}\)% of two sides or the upper 66\(\frac{2}{3}\)% of one side of the log length only.

#### Rot
Rot permitted provided 50% shingles or shake is attained.

**Note:** D quality logs with < 75% lumber (≥ 120 cm top diameter with < 66\(\frac{2}{3}\)% lumber) become K shingle.
### L Grade Cedar

<table>
<thead>
<tr>
<th>Logs</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Min. top diameter</td>
<td>38 cm</td>
</tr>
<tr>
<td>Min. log length</td>
<td>4 m</td>
</tr>
<tr>
<td>Min. percentage shingle or shakes</td>
<td>50%</td>
</tr>
<tr>
<td>Min. percentage clear shingle or shakes</td>
<td>50%</td>
</tr>
<tr>
<td>Max. twist over 30 cm of length</td>
<td>7%, Max. deviation 8 cm</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Slabs</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Min. top diameter</td>
<td>38 cm</td>
</tr>
<tr>
<td>Min. thickness</td>
<td>26 cm</td>
</tr>
<tr>
<td>Min. log length</td>
<td>4 m</td>
</tr>
<tr>
<td>Min. percentage shingle or shakes</td>
<td>50%</td>
</tr>
<tr>
<td>Min. percentage clear shingle or shakes</td>
<td>50%</td>
</tr>
<tr>
<td>Max. twist over 30 cm of length</td>
<td>7%, Max. deviation 8 cm</td>
</tr>
</tbody>
</table>

#### Grade Requirements

**Knots**

- ≥ 50% surface clear, with knots permitted on the upper 50% of two sides or all of one side of the log length only.

**Rot**

- Rot permitted provided 50% shingle or shakes is attained.

*Note: F quality logs with < 75% lumber become L shingle.*

### M Grade Cedar

<table>
<thead>
<tr>
<th>Logs</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Min. top diameter</td>
<td>38 cm</td>
</tr>
<tr>
<td>Min. log length</td>
<td>4 m</td>
</tr>
<tr>
<td>Min. percentage shingles</td>
<td>50%</td>
</tr>
<tr>
<td>Min. percentage clear shingles</td>
<td>25%</td>
</tr>
<tr>
<td>Max. twist over 30 cm of length</td>
<td>7%, Max. deviation 8 cm</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Slabs</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Min. top diameter</td>
<td>26 cm</td>
</tr>
<tr>
<td>Min. thickness</td>
<td>16 cm</td>
</tr>
<tr>
<td>Min. log length</td>
<td>4 m</td>
</tr>
<tr>
<td>Min. percentage shingles</td>
<td>50%</td>
</tr>
<tr>
<td>Min. percentage clear shingles</td>
<td>25%</td>
</tr>
<tr>
<td>Max. twist over 30 cm of length</td>
<td>7%, Max. deviation 8 cm</td>
</tr>
</tbody>
</table>

#### Grade Requirements

**Knots**

- ≥ 25% surface clear.

**Rot**

- Rot permitted provided 50% shingle or shakes is attained.
### Grade Requirements

#### U GRADE (same for all Coniferous species) - Cedar

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Min. top diameter</td>
<td>10 cm*</td>
</tr>
<tr>
<td>Min. log length</td>
<td>5 m</td>
</tr>
<tr>
<td>Min. lumber percentage:</td>
<td></td>
</tr>
<tr>
<td>- 10–14 cm top diameter</td>
<td>75%</td>
</tr>
<tr>
<td>- 16–36 cm top diameter</td>
<td>66(\frac{2}{3})%</td>
</tr>
<tr>
<td>- ≥ 38 cm top diameter</td>
<td>50%</td>
</tr>
<tr>
<td>Min. merchantable percentage</td>
<td>35%</td>
</tr>
<tr>
<td>Max. twist over 30 cm of length</td>
<td>13%, Max. deviation 13 cm</td>
</tr>
</tbody>
</table>

*Refer to grading procedure, item 6, Section 6.1 for variance to this diameter limit.

### Grade Requirements

#### X GRADE (same for all Coniferous species) - Cedar

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Min. top diameter</td>
<td>10 cm*</td>
</tr>
<tr>
<td>Min. log length</td>
<td>3 m</td>
</tr>
<tr>
<td>Min. lumber percentage</td>
<td>33(\frac{1}{3})%</td>
</tr>
<tr>
<td>Min. merchantable percentage</td>
<td>35%</td>
</tr>
<tr>
<td>Max. twist over 30 cm of length</td>
<td>13%, Max. deviation 13 cm</td>
</tr>
</tbody>
</table>

*Refer to grading procedure, item 6, Section 6.1 for variance to this diameter limit.

### Grade Requirements

#### Y GRADE (same for all Coniferous species) - Cedar

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Min. top diameter</td>
<td>10 cm*</td>
</tr>
<tr>
<td>Min. log length</td>
<td>3 m</td>
</tr>
<tr>
<td>Min. lumber percentage</td>
<td>33(\frac{1}{3})%</td>
</tr>
<tr>
<td>Min. merchantable percentage</td>
<td>35%</td>
</tr>
<tr>
<td>Max. twist over 30 cm of length</td>
<td>13%, Max. deviation 13 cm</td>
</tr>
</tbody>
</table>

*Refer to grading procedure, item 6, Section 6.1 for variance to this diameter limit.

### Grade Requirements

#### Knots

- 10–14 cm top diameter: 4 cm
- 16–26 cm top diameter: 6 cm
- 28–36 cm top diameter: 8 cm
- 38–48 cm top diameter: 10 cm
- 50–74 cm top diameter: 12 cm
- ≥ 76 cm top diameter: 14 cm
- Occasional larger knots (OLKs) are permitted, to 1 per 3 metres for logs < 50 cm.
- Logs ≥ 50 cm may have oversize knots up to a maximum of 2 per 3 m of log length

### Rot

Permitted provided 33\(\frac{1}{3}\)% lumber is attained.

---

106 March 31, 2003
Lower than X grade.

Hemlock/Balsam Grades and Grade Requirements
Table 6.6 – Hemlock/Balsam Grades and Grade Requirements.

<table>
<thead>
<tr>
<th>D GRADE</th>
<th>Hemlock/Balsam</th>
</tr>
</thead>
<tbody>
<tr>
<td>Min. top diameter</td>
<td>66 cm</td>
</tr>
<tr>
<td>Min. log length</td>
<td>5 m</td>
</tr>
<tr>
<td>Min. percentage lumber</td>
<td>75%</td>
</tr>
<tr>
<td>Min. percentage clear</td>
<td>50%</td>
</tr>
<tr>
<td>Max. twist over 30 cm of length</td>
<td>4%, Max. deviation 6 cm</td>
</tr>
</tbody>
</table>

**Grade Requirements**

**Knots**
- 66–74 cm top diameter, must be 90% surface clear with well spaced knots or knot indicators permitted on the upper 10% of two sides or on the upper 20% of one side of the log length only.
- ≥ 76 cm top diameter, must be 80% surface clear with well spaced knots or knot indicators permitted on the upper 20% of two sides or on the upper 40% of one side of the log length only.

**Rot**
- No conk permitted.
- Rot permitted, provided 75% lumber is attained. Rot in balsam must be confined to centre 10% of log.

<table>
<thead>
<tr>
<th>F GRADE</th>
<th>Hemlock/Balsam</th>
</tr>
</thead>
<tbody>
<tr>
<td>Min. top diameter</td>
<td>50 cm</td>
</tr>
<tr>
<td>Min. log length</td>
<td>5 m</td>
</tr>
<tr>
<td>Min. percentage lumber</td>
<td>75%</td>
</tr>
<tr>
<td>Min. percentage clear lumber</td>
<td>25%</td>
</tr>
<tr>
<td>Max. twist over 30 cm of length</td>
<td>4%, Max. deviation 6 cm</td>
</tr>
</tbody>
</table>

**Grade Requirements**

**Knots**
- 50–64 cm top diameter, must be 75% surface clear with knots or knot indicators permitted on the upper 25% of two sides or on the upper 50% of one side of the log length only.
- Logs ≥ 66 cm top diameter, must be 50% surface clear with knots or knot indicators permitted on the upper 50% of two sides or on the upper 75% of one side of the log length only.

**Rot**
- No conk or blind conk permitted.
- Rot permitted, provided 75% lumber is attained.
### H GRADE

<table>
<thead>
<tr>
<th>Min. top diameter</th>
<th>38 cm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Min. log length</td>
<td>5 m</td>
</tr>
<tr>
<td>Logs ≥ 38 cm top diameter</td>
<td>75% lumber</td>
</tr>
<tr>
<td></td>
<td>65% merchantable</td>
</tr>
<tr>
<td>Logs ≥ 50 cm top diameter</td>
<td>50% lumber</td>
</tr>
<tr>
<td>Former “D” or “F” grade</td>
<td>25% clear</td>
</tr>
<tr>
<td>Max. twist over 30 cm of length</td>
<td>7%, Max. deviation 8 cm</td>
</tr>
</tbody>
</table>

#### Grade Requirements

**Knots**

- 38–48 cm top diameter:
  - 4 cm knots over the entire log **OR**
  - 5 cm knots over the upper 50% of the log
    (with knots ≤ 2 cm in diameter permitted over the lower 50% of the log).
- ≥ 50 cm top diameter:
  - 4 cm knots over the entire log OR
  - 5 cm knots over the upper 66.67% of the log** OR
  - 8 cm knots over the upper 50% of the log*
    (*knots ≤ 2 cm in diameter permitted over the lower portion of the log).
- Occasional larger knots (OLKs) are permitted, to 1 per 3 metres.

**Rot**

- Permitted, provided 75% lumber is attained.

### I GRADE

<table>
<thead>
<tr>
<th>Min. top diameter</th>
<th>38 cm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Min. log length</td>
<td>4 m</td>
</tr>
<tr>
<td>Logs ≥ 38 cm top diameter</td>
<td>75% lumber</td>
</tr>
<tr>
<td></td>
<td>50% merchantable</td>
</tr>
<tr>
<td>Logs ≥ 38 cm top diameter (former H grade)</td>
<td>≥ 50% lumber</td>
</tr>
<tr>
<td></td>
<td>≥ 65% merchantable</td>
</tr>
<tr>
<td>Max. twist over 30 cm of length</td>
<td>10%, Max. deviation 9 cm</td>
</tr>
</tbody>
</table>

#### Grade Requirements

**Knots**

- 38–48 cm top diameter 8 cm
- 50- 74 cm top diameter 9 cm
- ≥ 76 cm top diameter 10 cm
- Occasional larger knots (OLKs) are permitted, to 1 per 3 metres.

**Rot**

- Permitted, provided percentage lumber is attained.
### J GRADE (same for all Coniferous species)

<table>
<thead>
<tr>
<th>Metric</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Min. top diameter</td>
<td>16 cm*</td>
</tr>
<tr>
<td>Max. top diameter</td>
<td>36 cm</td>
</tr>
<tr>
<td>Min. log length</td>
<td>5 m</td>
</tr>
<tr>
<td>Min. lumber percentage</td>
<td>75%</td>
</tr>
<tr>
<td>Min. merchantable percentage</td>
<td>50%</td>
</tr>
<tr>
<td>Max. twist over 30 cm of length</td>
<td>10% of top diameter</td>
</tr>
</tbody>
</table>

*Refer to grading procedure, item 6, Section 6.1 for variance to this diameter limit.

### Grade Requirements

**Knots**
- 16–26 cm top diameter: 4 cm
- 28–36 cm top diameter: 6 cm
- Occasional larger knots (OLKs) are permitted, to 1 per 3 metres.

**Rot**
- Permitted, provided 75% lumber is attained.

### U GRADE (same for all Coniferous species)

<table>
<thead>
<tr>
<th>Metric</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Min. top diameter</td>
<td>10 cm*</td>
</tr>
<tr>
<td>Min. log length</td>
<td>5 m</td>
</tr>
<tr>
<td>Min. lumber percentage</td>
<td></td>
</tr>
<tr>
<td>10–14 cm top diameter</td>
<td>75%</td>
</tr>
<tr>
<td>16–36 cm top diameter</td>
<td>66.66%</td>
</tr>
<tr>
<td>≥ 38 cm top diameter</td>
<td>50%</td>
</tr>
<tr>
<td>Min. merchantable percentage</td>
<td>35%</td>
</tr>
<tr>
<td>Max. twist over 30 cm of length</td>
<td>13%, Max. deviation 13 cm</td>
</tr>
</tbody>
</table>

*Refer to grading procedure, item 6, Section 6.1 for variance to this diameter limit.

### Grade Requirements

**Knots**
- 10–14 cm top diameter: 4 cm
- 16–26 cm top diameter: 6 cm
- 28–36 cm top diameter: 8 cm
- 38–48 cm top diameter: 10 cm
- 50–74 cm top diameter: 12 cm
- ≥ 76 cm top diameter: 14 cm
- Occasional larger knots (OLKs) are permitted, to 1 per 3 metres

**Rot**
- Permitted, provided percentage lumber is attained.
**X GRADE** (same for all Coniferous species)  

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Hemlock/Balsam</th>
</tr>
</thead>
<tbody>
<tr>
<td>Min. top diameter</td>
<td>10 cm*</td>
</tr>
<tr>
<td>Min. log length</td>
<td>3 m</td>
</tr>
<tr>
<td>Min. lumber percentage</td>
<td>33(\frac{1}{3})%</td>
</tr>
<tr>
<td>Min. merchantable percentage</td>
<td>35%</td>
</tr>
<tr>
<td>Max. twist over 30 cm of length</td>
<td>13%, Max. deviation 13 cm</td>
</tr>
</tbody>
</table>

*Refer to grading procedure, item 6, Section 6.1 for variance to this diameter limit.

**Grade Requirements**

- **Knots**
  - 10–14 cm top diameter: 4 cm
  - 16–26 cm top diameter: 6 cm
  - 28–36 cm top diameter: 8 cm
  - 38–48 cm top diameter: 10 cm
  - 50–74 cm top diameter: 12 cm
  - ≥ 76 cm top diameter: 14 cm
- Occasional larger knots (OLKs) are permitted, to 1 per 3 metres for logs < 50cm.
- Logs ≥ 50 cm may have oversize knots up to a maximum of 2 per 3 m of log length

- **Rot**
  - Permitted, provided 33\(\frac{1}{3}\)% lumber is attained.

---

**Y GRADE** (same for all Coniferous species)  

Lower than X grade.
Spruce Grades and Grade Requirements

Table 6.7 – Spruce Grades and Grade Requirements.

<table>
<thead>
<tr>
<th>F GRADE</th>
<th>Spruce</th>
</tr>
</thead>
<tbody>
<tr>
<td>Min. top diameter</td>
<td>76 cm</td>
</tr>
<tr>
<td>Min. log length</td>
<td>4 m</td>
</tr>
<tr>
<td>Min. percentage lumber</td>
<td>75%</td>
</tr>
<tr>
<td>Min. percentage clear lumber</td>
<td>50%</td>
</tr>
<tr>
<td>Max. twist over 30 cm of length</td>
<td>4%, Max. deviation 6 cm</td>
</tr>
</tbody>
</table>

Grade Requirements

<table>
<thead>
<tr>
<th>Knots</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Must be 90% surface clear with well spaced knots or knot indicators permitted on the upper 10% of two sides or on the upper 20% of one side of that log length only.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Rot</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>No conk permitted.</td>
<td></td>
</tr>
<tr>
<td>Insect holes must not penetrate beyond the sapwood.</td>
<td></td>
</tr>
<tr>
<td>Permitted provided 75% lumber is attained.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>G GRADE</th>
<th>Spruce</th>
</tr>
</thead>
<tbody>
<tr>
<td>Min. top diameter</td>
<td>60 cm</td>
</tr>
<tr>
<td>Min. log length</td>
<td>4 m</td>
</tr>
<tr>
<td>Min. percentage lumber</td>
<td>75%</td>
</tr>
<tr>
<td>Min. percentage clear lumber</td>
<td>25%</td>
</tr>
<tr>
<td>Max. twist over 30 cm of length</td>
<td>4%, Max. deviation 6 cm</td>
</tr>
</tbody>
</table>

Grade Requirements

<table>
<thead>
<tr>
<th>Knots</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>60–74 cm top diameter, must be 75% surface clear with well spaced knots or knot indicators permitted on the upper 25% of two sides or on the upper 50% of one side of the log length only.</td>
<td></td>
</tr>
<tr>
<td>≥ 76 cm top diameter:</td>
<td></td>
</tr>
<tr>
<td>– must be 50% surface clear with well spaced knots or knot indicators permitted on the upper 50% of two sides or on the upper 75% of one side of the log length only OR</td>
<td></td>
</tr>
<tr>
<td>– with whorls of large knots spaced so that 75% of the log can be cut into clear 2.6 m lengths.</td>
<td></td>
</tr>
<tr>
<td>≥ 100 cm top diameter with whorls of large knots spaced so that 50% of the log can be cut into clear 2.6 m lengths.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Rot</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>No conk rot permitted.</td>
<td></td>
</tr>
<tr>
<td>Insect holes must not penetrate beyond the sapwood.</td>
<td></td>
</tr>
<tr>
<td>Rot permitted if 75% lumber is attained.</td>
<td></td>
</tr>
</tbody>
</table>
### H Grade Spruce

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Requirement Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Min. top diameter</td>
<td>38 cm</td>
</tr>
<tr>
<td>Min. log length</td>
<td>4 m</td>
</tr>
<tr>
<td>Logs ≥ 38 cm top diameter</td>
<td>≥ 75% Lumber</td>
</tr>
<tr>
<td></td>
<td>≥ 65% merchantable</td>
</tr>
<tr>
<td>Logs ≥ 60 cm top diameter</td>
<td>≥ 50% lumber</td>
</tr>
<tr>
<td>(former “F or G” grade)</td>
<td>≥ 25% clear</td>
</tr>
<tr>
<td>Max. twist over 30 cm of length</td>
<td>7%, Max. deviation 8 cm</td>
</tr>
</tbody>
</table>

#### Grade Requirements

<table>
<thead>
<tr>
<th>Knots</th>
<th>Requirement Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>38–48 cm top diameter</td>
<td>4 cm knots over the entire log <strong>OR</strong></td>
</tr>
<tr>
<td></td>
<td>5 cm knots over the upper 50% of the log (with knots ≤ 2 cm in diameter permitted over the lower 50% of the log).</td>
</tr>
<tr>
<td>≥ 50 cm top diameter</td>
<td>4 cm knots over the entire log <strong>OR</strong></td>
</tr>
<tr>
<td></td>
<td>5 cm knots over the upper 662/3% of the log <strong>OR</strong></td>
</tr>
<tr>
<td></td>
<td>8 cm knots over the upper 50% of the log *<em>(<em>knots ≤ 2 cm in diameter permitted over the lower portion of the log).</em></em></td>
</tr>
<tr>
<td>Occasional larger knots (OLKs)</td>
<td>permitted, to 1 per 3 metres.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Rot</th>
<th>Requirement Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Insect holes</td>
<td>must not penetrate beyond the sapwood.</td>
</tr>
<tr>
<td></td>
<td>Permitted, provided percentage lumber is attained.</td>
</tr>
</tbody>
</table>

### I Grade Spruce

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Requirement Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Min. top diameter</td>
<td>38 cm</td>
</tr>
<tr>
<td>Min. log length</td>
<td>4 m</td>
</tr>
<tr>
<td>Logs ≥ 38 cm top diameter</td>
<td>≥ 75% Lumber</td>
</tr>
<tr>
<td></td>
<td>≥ 50% merchantable</td>
</tr>
<tr>
<td>Logs ≥ 38 cm top diameter</td>
<td>≥ 50% lumber</td>
</tr>
<tr>
<td>(former “H” grade)</td>
<td>≥ 65% merchantable</td>
</tr>
<tr>
<td>Logs ≥ 50 cm top diameter</td>
<td>≥ 50% lumber</td>
</tr>
<tr>
<td></td>
<td>≥ 50% merchantable</td>
</tr>
<tr>
<td>Max. twist over 30 cm of length</td>
<td>10%, Max. deviation 9 cm</td>
</tr>
</tbody>
</table>

#### Grade Requirements

<table>
<thead>
<tr>
<th>Knots</th>
<th>Requirement Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>38–48 cm top diameter</td>
<td>8 cm</td>
</tr>
<tr>
<td>50–74 cm top diameter</td>
<td>9 cm</td>
</tr>
<tr>
<td>76–98 cm top diameter</td>
<td>10 cm</td>
</tr>
<tr>
<td>≥ 100 cm top diameter</td>
<td>13 cm</td>
</tr>
<tr>
<td>Occasional larger knots (OLKs)</td>
<td>permitted, to 1 per 3 metres.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Rot</th>
<th>Requirement Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Permitted, provided percentage lumber is attained.</td>
<td></td>
</tr>
</tbody>
</table>
## J GRADE (same for all Coniferous species)

<table>
<thead>
<tr>
<th></th>
<th>Spruce</th>
</tr>
</thead>
<tbody>
<tr>
<td>Min. top diameter</td>
<td>16 cm*</td>
</tr>
<tr>
<td>Max. top diameter</td>
<td>36 cm</td>
</tr>
<tr>
<td>Min. log length</td>
<td>4 m</td>
</tr>
<tr>
<td>Min. percentage lumber</td>
<td>75%</td>
</tr>
<tr>
<td>Min. percentage merchantable</td>
<td>50%</td>
</tr>
<tr>
<td>Max. twist over 30 cm of length</td>
<td>10%</td>
</tr>
</tbody>
</table>

*Refer to grading procedure, item 6, Section 6.1 for variance to this diameter limit.

### Grade Requirements

**Knots**
- 16–26 cm top diameter 4 cm
- 28–36 cm top diameter 6 cm
- Occasional larger knots (OLKs) are permitted, to 1 per 3 metres.

**Rot**
- Permitted, provided 75% lumber is attained.

## U GRADE (same for all Coniferous species)

<table>
<thead>
<tr>
<th></th>
<th>Spruce</th>
</tr>
</thead>
<tbody>
<tr>
<td>Min. top diameter</td>
<td>10 cm*</td>
</tr>
<tr>
<td>Min. log length</td>
<td>5 m</td>
</tr>
<tr>
<td>Min. lumber percentage:</td>
<td></td>
</tr>
<tr>
<td>- 10–14 cm top diameter</td>
<td>75%</td>
</tr>
<tr>
<td>- 16–36 cm top diameter</td>
<td>66(\frac{2}{3})%</td>
</tr>
<tr>
<td>- ≥ 38 cm top diameter</td>
<td>50%</td>
</tr>
<tr>
<td>Min. merchantable percentage</td>
<td>35%</td>
</tr>
<tr>
<td>Max. twist over 30 cm of length</td>
<td>13%, Max. deviation 13 cm</td>
</tr>
</tbody>
</table>

*Refer to grading procedure, item 6, Section 6.1 for variance to this diameter limit.

### Grade Requirements

**Knots**
- 10–14 cm top diameter 4 cm
- 16–26 cm top diameter 6 cm
- 28–36 cm top diameter 8 cm
- 38–48 cm top diameter 10 cm
- 50–74 cm top diameter 12 cm
- ≥ 76 cm top diameter 14 cm
- Occasional larger knots (OLKs) are permitted, to 1 per 3 metres

**Rot**
- Permitted, provided percentage lumber is attained.
**X GRADE** (same for all Coniferous species)  

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Min. top diameter</td>
<td>10 cm*</td>
</tr>
<tr>
<td>Min. log length</td>
<td>3 m</td>
</tr>
<tr>
<td>Min. lumber percentage</td>
<td>33(\frac{1}{3})%</td>
</tr>
<tr>
<td>Min. merchantable percentage</td>
<td>35%</td>
</tr>
<tr>
<td>Max. twist over 30 cm of length</td>
<td>13%, Max. deviation 13 cm</td>
</tr>
</tbody>
</table>

*Refer to grading procedure, item 6, Section 6.1 for variance to this diameter limit.

**Grade Requirements**

**Knots**

- 10–14 cm top diameter: 4 cm
- 16–26 cm top diameter: 6 cm
- 28–36 cm top diameter: 8 cm
- 38–48 cm top diameter: 10 cm
- 50–74 cm top diameter: 12 cm
- 76–98 cm top diameter: 14 cm
- ≥ 100 cm top diameter: 16 cm
  
- Occasional larger knots (OLKs) are permitted, to 1 per 3 metres for logs < 50cm.
- Logs ≥ 50 cm may have oversize knots up to a maximum of 2 per 3 m of log length

**Rot**

- Permitted, provided 33\(\frac{1}{3}\)% lumber is attained.

---

**Y GRADE** (same for all Coniferous species)  

Lower than X grade.
Cypress/Yew Grades and Grade Requirements

Table 6.8 – Cypress/Yew Grades and Grade Requirements.

<table>
<thead>
<tr>
<th>D GRADE</th>
<th>Cypress/Yew</th>
</tr>
</thead>
<tbody>
<tr>
<td>Min. top diameter</td>
<td>60 cm</td>
</tr>
<tr>
<td>Min. log length</td>
<td>4 m</td>
</tr>
<tr>
<td>Min. percentage lumber</td>
<td>75%</td>
</tr>
<tr>
<td>Min. percentage clear lumber</td>
<td>50%</td>
</tr>
<tr>
<td>Max. twist over 30 cm of length</td>
<td>4%, Max. deviation 6 cm</td>
</tr>
</tbody>
</table>

Grade Requirements

**Knots**
- 60–74 cm top diameter, ≥ 75% surface clear with knots or knot indicators permitted on the upper 25% of two sides or the upper 50% of one side of the log length only.
- ≥ 76 cm top diameter, ≥ \( \frac{662}{3} \)% surface clear with knots or knot indicators permitted on the upper 33\( \frac{1}{3} \)% of two sides or the upper 66\( \frac{2}{3} \)% of one side of the log length only.

**Rot**
- Permitted, provided 75% lumber is attained.

<table>
<thead>
<tr>
<th>F GRADE</th>
<th>Cypress/Yew</th>
</tr>
</thead>
<tbody>
<tr>
<td>Min. top diameter</td>
<td>50 cm</td>
</tr>
<tr>
<td>Logs ≥ 50 cm top diameter</td>
<td></td>
</tr>
<tr>
<td>– Min. Log Length</td>
<td>4 m</td>
</tr>
<tr>
<td>– Min. percentage lumber</td>
<td>75%</td>
</tr>
<tr>
<td>– Min. percentage clear lumber</td>
<td>25%</td>
</tr>
<tr>
<td>Logs ≥ 60 m top diameter</td>
<td>(former “D” grade)</td>
</tr>
<tr>
<td>– Min. Log Length</td>
<td>6 m</td>
</tr>
<tr>
<td>– Min. percentage lumber</td>
<td>50%</td>
</tr>
<tr>
<td>– Min. percentage clear lumber</td>
<td>50%</td>
</tr>
<tr>
<td>Max. twist over 30 cm of length</td>
<td>4%, Max. deviation 6 cm</td>
</tr>
</tbody>
</table>

Grade Requirements

**Knots**
- 50–58 cm top diameter, ≥ 75% surface clear with knots or knot indicators permitted on the upper 25% of two sides or the upper 50% of one side of the log length only.
- ≥ 60 cm top diameter, ≥ 50% surface clear with knots or knot indicators permitted on the upper 50% of two sides or the upper 75% of one side of the log length only.

**Rot**
- Permitted, provided percentage lumber is attained.
### H GRADE

<table>
<thead>
<tr>
<th>Min. top diameter</th>
<th>38 cm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Min. length</td>
<td>4 m</td>
</tr>
<tr>
<td>Min. percentage lumber</td>
<td>50%</td>
</tr>
<tr>
<td>Min. percentage merchantable</td>
<td>65%</td>
</tr>
<tr>
<td>Max. twist over 30 cm of length</td>
<td>7%, Max. deviation 8 cm</td>
</tr>
</tbody>
</table>

**Grade Requirements**

**Knots**

- 38–48 cm top diameter:
  - 4 cm knots over the entire log **OR**
  - 5 cm knots over the upper 50% of the log, with knots ≤ 2 cm in diameter permitted over the lower 50% of the log.
- ≥ 50 cm top diameter:
  - 4 cm knots over the entire log **OR**
  - 5 cm knots over the upper 66⅔% of the log** OR**
  - 8 cm knots over the upper 50% of the log** (*knots ≤ 2 cm in diameter permitted over the lower portion of the log).

- Occasional larger knots (OLKs) are permitted, to 1 per 3 metres.

**Rot**

- Permitted, provided 50% lumber is attained.

### I GRADE

<table>
<thead>
<tr>
<th>Min. top diameter</th>
<th>38 cm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Min. log length</td>
<td>4 m</td>
</tr>
<tr>
<td>Min. percentage lumber</td>
<td>50%</td>
</tr>
<tr>
<td>Min. percentage merchantable</td>
<td>50%</td>
</tr>
<tr>
<td>Max. twist over 30 cm of length</td>
<td>10%, Max. deviation 9 cm</td>
</tr>
</tbody>
</table>

**Grade Requirements**

**Knots**

- 38–48 cm top diameter 8 cm
- 50–74 cm top diameter 9 cm
- ≥ 76 cm top diameter 10 cm

- Occasional larger knots (OLKs) are permitted, to 1 per 3 metres.

**Rot**

- Permitted provided 50% lumber is attained.
### J GRADE (same for all Coniferous species)  
**Cypress/Yew**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Min. top diameter</td>
<td>16 cm*</td>
</tr>
<tr>
<td>Max. top diameter</td>
<td>36 cm</td>
</tr>
<tr>
<td>Min. log length</td>
<td>4 m</td>
</tr>
<tr>
<td>Min. percentage lumber</td>
<td>75%</td>
</tr>
<tr>
<td>Min. percentage merchantable</td>
<td>50%</td>
</tr>
<tr>
<td>Max. twist over 30 cm of length</td>
<td>10%</td>
</tr>
</tbody>
</table>

*Refer to grading procedure, item 6, Section 6.1 for variance to this diameter limit.

#### Grade Requirements

<table>
<thead>
<tr>
<th>Knots</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>16–26 cm top diameter</td>
<td>4 cm</td>
</tr>
<tr>
<td>28–36 cm top diameter</td>
<td>6 cm</td>
</tr>
<tr>
<td>Occasional larger knots (OLKs)</td>
<td>1 per 3 metres</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Rot</th>
<th>Requirement</th>
</tr>
</thead>
</table>

### U GRADE (same for all Coniferous species)  
**Cypress/Yew**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Min. top diameter</td>
<td>10 cm*</td>
</tr>
<tr>
<td>Min. log length</td>
<td>5 m</td>
</tr>
<tr>
<td>Min. lumber percentage:</td>
<td></td>
</tr>
<tr>
<td>– 10–14 cm top diameter</td>
<td>75%</td>
</tr>
<tr>
<td>– 16–36 cm top diameter</td>
<td>66 2/3%</td>
</tr>
<tr>
<td>– ≥ 38 cm top diameter</td>
<td>50%</td>
</tr>
<tr>
<td>Min. merchantable percentage</td>
<td>35%</td>
</tr>
<tr>
<td>Max. twist over 30 cm of length</td>
<td>13%, Max. deviation 13 cm</td>
</tr>
</tbody>
</table>

*Refer to grading procedure, item 6, Section 6.1 for variance to this diameter limit.

#### Grade Requirements

<table>
<thead>
<tr>
<th>Knots</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>10–14 cm top diameter</td>
<td>4 cm</td>
</tr>
<tr>
<td>16–26 cm top diameter</td>
<td>6 cm</td>
</tr>
<tr>
<td>28–36 cm top diameter</td>
<td>8 cm</td>
</tr>
<tr>
<td>38–48 cm top diameter</td>
<td>10 cm</td>
</tr>
<tr>
<td>50–74 cm top diameter</td>
<td>12 cm</td>
</tr>
<tr>
<td>≥ 76 cm top diameter</td>
<td>14 cm</td>
</tr>
<tr>
<td>Occasional larger knots (OLKs)</td>
<td>1 per 3 metres</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Rot</th>
<th>Requirement</th>
</tr>
</thead>
</table>
### X GRADE (same for all Coniferous species)

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Min. top diameter</td>
<td>10 cm*</td>
</tr>
<tr>
<td>Min. log length</td>
<td>3 m</td>
</tr>
<tr>
<td>Min. lumber percentage</td>
<td>33(\frac{1}{3})%</td>
</tr>
<tr>
<td>Min. merchantable percentage</td>
<td>35%</td>
</tr>
<tr>
<td>Max. twist over 30 cm of length</td>
<td>13%, Max. deviation 13 cm</td>
</tr>
</tbody>
</table>

*Refer to grading procedure, item 6, Section 6.1 for variance to this diameter limit.

#### Grade Requirements

<table>
<thead>
<tr>
<th>Knots</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>10–14 cm top diameter</td>
<td>4 cm</td>
</tr>
<tr>
<td>16–26 cm top diameter</td>
<td>6 cm</td>
</tr>
<tr>
<td>28–36 cm top diameter</td>
<td>8 cm</td>
</tr>
<tr>
<td>38–48 cm top diameter</td>
<td>10 cm</td>
</tr>
<tr>
<td>50–74 cm top diameter</td>
<td>12 cm</td>
</tr>
<tr>
<td>(\geq) 76 cm top diameter</td>
<td>14 cm</td>
</tr>
</tbody>
</table>

- Logs \(\geq\) 50 cm may have oversize knots up to a maximum of 2 per 3 m of log length.
- Occasional larger knots (OLKs) are permitted, to 1 per 3 metres for logs < 50cm.
- Logs \(\geq\) 50 cm may have oversize knots up to a maximum of 2 per 3 m of log length

| Rot                            | Permitted, provided percentage lumber is attained. |

### Y GRADE (same for all Coniferous species)

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lower than X grade.</td>
<td></td>
</tr>
</tbody>
</table>
Deciduous Grades and Grade Requirements

Table 6.9 – Deciduous Grades and Grade Requirements.

<table>
<thead>
<tr>
<th>C GRADE (Cottonwood only)</th>
<th>Deciduous</th>
</tr>
</thead>
<tbody>
<tr>
<td>Min. top diameter</td>
<td>25 cm</td>
</tr>
<tr>
<td>Min. log length</td>
<td>5 m</td>
</tr>
<tr>
<td>Min. percentage veneer</td>
<td>80%</td>
</tr>
<tr>
<td>Max. twist over 30 cm of length</td>
<td>7%, Max. deviation 8 cm</td>
</tr>
</tbody>
</table>

**Grade Requirements**

- **Knots**
  - No knots over 4 cm in diameter are permitted.
  - Knots < 4 cm in diameter must be well spaced.

- **Rot**
  - No conk allowed.
  - No butt rot allowed.

- **Misc.**
  - No sweep permitted.
  - No crook permitted.

<table>
<thead>
<tr>
<th>I GRADE</th>
<th>Deciduous</th>
</tr>
</thead>
<tbody>
<tr>
<td>Min. top diameter</td>
<td>25 cm</td>
</tr>
<tr>
<td>Min. log length</td>
<td>5 m</td>
</tr>
<tr>
<td>Min. percentage lumber</td>
<td>50%</td>
</tr>
<tr>
<td>Min. percentage merchantable</td>
<td>50%</td>
</tr>
<tr>
<td>Max. twist over 30 cm of length</td>
<td>10%, Max. deviation 9 cm</td>
</tr>
</tbody>
</table>

**Grade Requirements**

- **Knots**
  - 25–36 cm top diameter 4 cm
  - 38–48 cm top diameter 8 cm
  - ≥ 50 cm top diameter 9 cm

- **Rot**
  - Permitted provided 50% lumber is attained.
**U GRADE**

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Deciduous</th>
</tr>
</thead>
<tbody>
<tr>
<td>Min. top diameter</td>
<td>10 cm*</td>
</tr>
<tr>
<td>Min. log length</td>
<td>5 m</td>
</tr>
<tr>
<td>Logs</td>
<td></td>
</tr>
<tr>
<td>10–14 cm top diameter</td>
<td>75% Lumber</td>
</tr>
<tr>
<td>16–24 cm top diameter</td>
<td>66% Lumber</td>
</tr>
<tr>
<td>≥ 25 cm top diameter</td>
<td>50% Lumber</td>
</tr>
<tr>
<td>Min. merchantable percentage</td>
<td>35%</td>
</tr>
<tr>
<td>Max. twist over 30 cm of length</td>
<td>13%, Max. deviation 13 cm</td>
</tr>
</tbody>
</table>

*Refer to grading procedure, item 6, Section 6.1 for variance to this diameter limit.

**Grade Requirements**

<table>
<thead>
<tr>
<th>Knots</th>
<th>Deciduous</th>
</tr>
</thead>
<tbody>
<tr>
<td>10–14 cm top diameter</td>
<td>4 cm</td>
</tr>
<tr>
<td>16–24 cm top diameter</td>
<td>6 cm</td>
</tr>
<tr>
<td>25–36 cm top diameter</td>
<td>8 cm</td>
</tr>
<tr>
<td>38–48 cm top diameter</td>
<td>10 cm</td>
</tr>
<tr>
<td>≥ 50 cm top diameter</td>
<td>12 cm</td>
</tr>
<tr>
<td>Rot</td>
<td></td>
</tr>
<tr>
<td>Permitted, provided percentage lumber is attained.</td>
<td></td>
</tr>
</tbody>
</table>

**Y GRADE**

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Deciduous</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lower than X grade.</td>
<td></td>
</tr>
</tbody>
</table>
## 6.4 Summary of Log Grades by Species

### Table 6.10 – Fir/Pine/Larch log grade summary.

<table>
<thead>
<tr>
<th>Grade</th>
<th>Min. Length (m)</th>
<th>Min. Top DIB (cm)</th>
<th>Min. Top DIB Knots</th>
<th>Knots max DIB</th>
<th>Min. Scale</th>
<th>Defects</th>
<th>Twist</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>D</strong></td>
<td>5 m</td>
<td>76</td>
<td>76+</td>
<td>90% surface clear</td>
<td>75% L</td>
<td>no conk, blind conk or rotten branches</td>
<td>4% (6 cm)</td>
</tr>
<tr>
<td>Lumber</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>50% CL</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>F</strong></td>
<td>5 m</td>
<td>60</td>
<td>60-74</td>
<td>75% surface clear</td>
<td>75% L</td>
<td>no conk, blind conk or rotten branches</td>
<td>4%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>25% CL</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>76+</td>
<td></td>
<td>50% surface clear</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>B</strong>*</td>
<td>5 m</td>
<td>60</td>
<td>60-74</td>
<td>2.6 m butt block is clear</td>
<td>80% V</td>
<td>no conk, blind conk or butt rot</td>
<td>7% (8 cm)</td>
</tr>
<tr>
<td>Peeler</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>76+</td>
<td></td>
<td>2.6 m butt block knot indicators allowed</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>C</strong>*</td>
<td>5 m</td>
<td>38</td>
<td>38+</td>
<td>4 cm Maximum</td>
<td>80% V</td>
<td>no conk, blind conk or butt rot</td>
<td>7% (8 cm)</td>
</tr>
<tr>
<td>Peeler</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>H</strong></td>
<td>5 m</td>
<td>38</td>
<td>38-48</td>
<td>4 cm or — 5 cm top half (rem. 2 cm max.)</td>
<td>75% L</td>
<td>no conk, blind conk or butt rot</td>
<td>7% (8 cm)</td>
</tr>
<tr>
<td>Sawlog</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>65% M</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>50+</td>
<td></td>
<td>4 cm or — 5 cm top 2/3 (rem. 2 cm max.)</td>
<td>50% L</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>65% M</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>or — 8 cm top half (rem. 2 cm max.)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>I</strong></td>
<td>4 m</td>
<td>38</td>
<td>38-48</td>
<td>8 cm</td>
<td>75% L</td>
<td>or former H</td>
<td>10% (9 cm)</td>
</tr>
<tr>
<td>Sawlog</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>50% M</td>
<td>50% L 65% M</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>50-74</td>
<td></td>
<td>9 cm</td>
<td>50% L</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>76+</td>
<td></td>
<td>10 cm</td>
<td>50% M</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Fir only   ** Occasional larger knots (OLKs) 1 per 3 m*

L = Lumber   CL = Clear   M = Merchantable   V = Veneer
### Table 6.11 – Cedar log grade summary.

<table>
<thead>
<tr>
<th>Grade</th>
<th>Min. Length (m)</th>
<th>Min. Top DIB (cm)</th>
<th>Min. Top DIB Knots</th>
<th>Knots max DIB</th>
<th>Min. Scale</th>
<th>Defects</th>
<th>Twist</th>
</tr>
</thead>
<tbody>
<tr>
<td>D</td>
<td>5 m</td>
<td>60</td>
<td>60-74</td>
<td>75% surface clear</td>
<td>75% L</td>
<td>5% L</td>
<td>4%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>76-118</td>
<td>66% surface clear</td>
<td>50% CL</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>120+</td>
<td>66% surface clear</td>
<td>66% L</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>50% CL</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>F</td>
<td>5 m</td>
<td>50</td>
<td>50-58</td>
<td>100% surface clear</td>
<td>75% L</td>
<td>4%</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>60-74</td>
<td>66% surface clear</td>
<td>25% CL</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>76+</td>
<td>50% surface clear</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>H ***</td>
<td>5 m</td>
<td>38</td>
<td>38-48</td>
<td>4 cm or — 5 cm top half (rem. 2 cm max.)</td>
<td>75% L</td>
<td>65% M</td>
<td>7%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I ***</td>
<td>4 m</td>
<td>38</td>
<td>38-48</td>
<td>8 cm or — 5 cm top half (rem. 2 cm max.)</td>
<td>75% L</td>
<td>5% L</td>
<td>10%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>50% M</td>
<td>50% M</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>or former H</td>
<td>50% L/65% M</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>K</td>
<td>4 m</td>
<td>50</td>
<td>50-58</td>
<td>100% surface clear</td>
<td>50% SS*</td>
<td>4%</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>slabs &gt;38 cm thick</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>75% CL</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>60-74</td>
<td>75% surface clear</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>76+</td>
<td>66% surface clear</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>L</td>
<td>4 m</td>
<td>38</td>
<td>38+</td>
<td>50% surface clear</td>
<td>50% SS**</td>
<td>7%</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>50% S**</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>25% CL</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>slabs &gt;26 cm thick</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M</td>
<td>4 m</td>
<td>38</td>
<td>38+</td>
<td>25% surface clear</td>
<td>50% S**</td>
<td>7%</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>25% CL</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>slabs &gt;16 cm thick</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*SS = shingles or shakes  
**S = shingles only  
*** OLK = 1 per 3 m
### Table 6.12 – Hemlock/Balsam log grade summary.

<table>
<thead>
<tr>
<th>Grade</th>
<th>Min. Length (m)</th>
<th>Min. Top DIB (cm)</th>
<th>Min. Top DIB Knots</th>
<th>Knots max DIB</th>
<th>Min. Scale</th>
<th>Defects</th>
<th>Twist</th>
</tr>
</thead>
<tbody>
<tr>
<td>D</td>
<td>5 m</td>
<td>66</td>
<td>66-74</td>
<td>90% surface clear</td>
<td>75% L</td>
<td>no conk, blind conk or rotten branches</td>
<td>4% (6 cm)</td>
</tr>
<tr>
<td>lumber</td>
<td></td>
<td></td>
<td>76+</td>
<td>80% surface clear</td>
<td>50% CL</td>
<td></td>
<td></td>
</tr>
<tr>
<td>F</td>
<td>5 m</td>
<td>50</td>
<td>50-64</td>
<td>75% surface clear</td>
<td>75% L</td>
<td>no conk, blind conk or rotten branches</td>
<td>4% (6 cm)</td>
</tr>
<tr>
<td>lumber</td>
<td></td>
<td></td>
<td>66+</td>
<td>50% surface clear</td>
<td>25% CL</td>
<td></td>
<td></td>
</tr>
<tr>
<td>H</td>
<td>5 m</td>
<td>38</td>
<td>38-48</td>
<td>4 cm or — 5 cm top half (rem. 2 cm max.)</td>
<td>75% L 65% M</td>
<td>or former D,F 50% M 25% CL</td>
<td>7% (8 cm)</td>
</tr>
<tr>
<td>sawlog*</td>
<td></td>
<td></td>
<td>50+</td>
<td>4 cm or — 5 cm top 2/3 (rem. 2 cm max.) or — 8 cm top half (rem. 2 cm max.)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I</td>
<td>4 m</td>
<td>38</td>
<td>38-48</td>
<td>8 cm</td>
<td>75% L</td>
<td>or former H 50% L 65% M</td>
<td>10% (9 cm)</td>
</tr>
<tr>
<td>sawlog*</td>
<td></td>
<td></td>
<td>50-74</td>
<td>9 cm</td>
<td>50% M</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>76+</td>
<td>10 cm</td>
<td>50% M</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* OLK = 1 per 3 m
Table 6.13 – Spruce log grade summary.

<table>
<thead>
<tr>
<th>Grade</th>
<th>Min. Length (m)</th>
<th>Min. Top DIB Grade</th>
<th>Min. Top DIB Knots</th>
<th>Knots max DIB</th>
<th>Min. Scale</th>
<th>Defects</th>
<th>Twist</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>F lumber</td>
<td>4 m</td>
<td>76</td>
<td>76+</td>
<td>90% surface clear</td>
<td>75% L 50% CL</td>
<td>no conk</td>
<td>4% (6 cm)</td>
</tr>
<tr>
<td>G lumber</td>
<td>4 m</td>
<td>60</td>
<td>60-74</td>
<td>75% surface clear</td>
<td>75% L 25% CL</td>
<td>no conk</td>
<td>4% (6 cm)</td>
</tr>
<tr>
<td></td>
<td>76-98</td>
<td></td>
<td>50% surface clear or 2.6 m clear sections over 75% of the log</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>100+</td>
<td></td>
<td>50% surface clear or 2.6 m clear sections over 50% of the log</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>H sawlog</td>
<td>4 m</td>
<td>38</td>
<td>38-48</td>
<td>4 cm or — 5 cm top half (rem. 2 cm max.)</td>
<td>75% L 65% M</td>
<td></td>
<td>7% (8 cm)</td>
</tr>
<tr>
<td></td>
<td>50+</td>
<td></td>
<td>4 cm or — 5 cm top 2/3 (rem. 2 cm max.) or — 8 cm top half (rem. 2 cm max.)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>60+</td>
<td></td>
<td>or former F, G 50% L 25% CL</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I sawlog</td>
<td>4 m</td>
<td>38</td>
<td>38-48</td>
<td>8 cm</td>
<td>75% L 50% M or former H 50% L 65% M</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>50-74</td>
<td></td>
<td>9 cm</td>
<td>50% L</td>
<td>50% M</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>76-98</td>
<td></td>
<td>10 cm</td>
<td>50% L</td>
<td>50% M</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>100+</td>
<td></td>
<td>13 cm</td>
<td>50% L</td>
<td>50% M</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* OLK = 1 per 3 m
### Table 6.14 – Cypress/Yew log grade summary.

<table>
<thead>
<tr>
<th>Grade</th>
<th>Min. Length (m)</th>
<th>Min. Top DIB (cm)</th>
<th>Min. Top DIB Knots</th>
<th>Knots max DIB</th>
<th>Min. Scale</th>
<th>Defects</th>
<th>Twist</th>
</tr>
</thead>
<tbody>
<tr>
<td>D lumber</td>
<td>4 m</td>
<td>60</td>
<td>60-74</td>
<td>75% surface clear</td>
<td>75% L</td>
<td>4% (6 cm)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>76+</td>
<td>66% surface clear</td>
<td>50% CL</td>
<td></td>
<td></td>
</tr>
<tr>
<td>F lumber</td>
<td>4 m</td>
<td>50</td>
<td>50-58</td>
<td>75% surface clear</td>
<td>75% L</td>
<td>4% (6 cm)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>60+</td>
<td>50% surface clear</td>
<td>25% CL</td>
<td></td>
<td></td>
</tr>
<tr>
<td>H sawlog</td>
<td>4 m</td>
<td>38</td>
<td>38-48</td>
<td>4 cm</td>
<td>50% L</td>
<td>7% (8 cm)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>or 5 cm top half (rem. 2 cm max.)</td>
<td>65% M</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>50+</td>
<td>4 cm</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>or 5 cm top 2/3 (rem. 2 cm max.)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>or 8 cm top half (rem. 2 cm max.)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I sawlog</td>
<td>4 m</td>
<td>38</td>
<td>38-48</td>
<td>8 cm</td>
<td>50% L</td>
<td>10% (9 cm)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>50-74</td>
<td>9 cm</td>
<td>50% M</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>76+</td>
<td>10 cm</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* OLK = 1 per 3 m
Table 6.15 – Coniferous Common Grades log grade summary.

<table>
<thead>
<tr>
<th>Grade</th>
<th>Min. Length (m)</th>
<th>Min. Top DIB Grade (cm)</th>
<th>Min. Top DIB Knots</th>
<th>Knots max DIB</th>
<th>Min. Scale</th>
<th>Defects</th>
<th>Twist</th>
</tr>
</thead>
<tbody>
<tr>
<td>J† sawlog</td>
<td>5 m*</td>
<td>16-36**</td>
<td>16-26, 28-36</td>
<td>4 cm, 6 cm</td>
<td>75% L, 50% M</td>
<td>10%</td>
<td></td>
</tr>
<tr>
<td>U utility ****</td>
<td>5 m</td>
<td>10</td>
<td>10-14</td>
<td>4 cm</td>
<td>75% L, 35% M</td>
<td>13% (13 cm)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>16-26</td>
<td>6 cm</td>
<td>66% L</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>28-36</td>
<td>8 cm</td>
<td>35% M</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>38-48</td>
<td>10 cm</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>50-74</td>
<td>12 cm</td>
<td>50% L, 35% M</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>76+</td>
<td>14 cm</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>X utility ****</td>
<td>3 m</td>
<td>10</td>
<td>10-14</td>
<td>4 cm</td>
<td>33% L, 35% M</td>
<td>13% (13 cm)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>16-26</td>
<td>6 cm</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>28-36</td>
<td>8 cm</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>38-48</td>
<td>10 cm</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>50-74</td>
<td>12 cm</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>76+</td>
<td>14 cm</td>
<td>2 oversized per 3 m</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Y chipper</td>
<td>1 m</td>
<td>***</td>
<td>Logs lower in grade than “X”</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>N Missing</td>
<td>***</td>
<td>On Broken Top tree missing portion graded as N-99-00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Note Spruce & Cypress 4 m  ** Maximum top diameter 36 cm  *** No minimum diameter  ****OLK 1 per 3m
Table 6.16 – Deciduous Species log grade summary.

<table>
<thead>
<tr>
<th>Grade</th>
<th>Min. Length (m)</th>
<th>Min. Top DIB Grade (cm)</th>
<th>Min. Top DIB Knots</th>
<th>Knots max DIB</th>
<th>Min. Scale</th>
<th>Defects</th>
<th>Twist</th>
</tr>
</thead>
<tbody>
<tr>
<td>C* peeler</td>
<td>5 m</td>
<td>25</td>
<td>25+</td>
<td>4 cm</td>
<td>80% V</td>
<td>no conk or butt rot</td>
<td>7%</td>
</tr>
<tr>
<td>I sawlog</td>
<td>5 m</td>
<td>25</td>
<td>25-36</td>
<td>4 cm</td>
<td></td>
<td></td>
<td>10%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>38-48</td>
<td>8 cm</td>
<td>50% L</td>
<td></td>
<td>(9 cm)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>50+</td>
<td>9 cm</td>
<td>50% M</td>
<td></td>
<td></td>
</tr>
<tr>
<td>U utility</td>
<td>5 m</td>
<td>10+</td>
<td>10-14</td>
<td>4 cm</td>
<td>75% L</td>
<td></td>
<td>13%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>16-24</td>
<td>6 cm</td>
<td>66% L 35% M</td>
<td></td>
<td>(13 cm)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>25-36</td>
<td>8 cm</td>
<td>50% M</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>38-48</td>
<td>10 cm</td>
<td>50% L</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>50+</td>
<td>12 cm</td>
<td>35% M</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Y chipper</td>
<td>1 m</td>
<td>Logs lower in grade than “U”</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>N Missing</td>
<td>***</td>
<td>On Broken Top tree missing portion graded as N-99-00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Cottonwood only  *** No minimum diameter
7. Plants, Soils, and Old Growth

Introduction
The data collected in this section of the inventory will be used in a variety of ways:

- To provide data for management and research applications, such as enhancement of the provincial ecological classification system, particularly in previously undescribed ecosystems and managed successionaly younger ecosystems.
- To generate vegetation lists, including species codes and percentage cover values, and to assist in wildlife management and resource planning.
- To build a database that will permit different users to track floristic changes over time, in different regions, and in a variety of biogeoclimatic zones or subzones.

Objectives
- To establish a network of sample plots that can be located and resampled in the future.
- To collect accurate information about plant species composition in Change Monitoring Inventory sample plots.
- To identify, estimate, and measure selected soil and site features to provide a record of conditions at Change Monitoring Inventory sample plot locations.
- To determine the successional characteristics of the stand.
- To classify Change Monitoring Inventory sample plots using the biogeoclimatic ecosystem classification system, the British Columbia Land Cover Classification Scheme, and to identify the site series.
- To describe forested as well as non-forested ecosystems.
General Procedures
The following is a recommended sequence of steps in collecting the ecological measurements (steps 3 and 4 may be interchanged):

1. Establish the 10 m fixed-radius plot and the 5.64 m sub-plot.
2. Describe vegetation in the 5.64 m and 10 m fixed-radius plots before the soil pit is dug and the site is trampled too much.
3. Record the site and soil description.
4. Sample the coarse woody debris transects (Cards EW and EC) discussed in Section 8. CWD sampling can provide insights into successional processes and recent stand history on sampled sites.
5. Interpret the successional characteristics of the stand. Refer to other data collected to make successional interpretations.

Field Cards for this Section

Ecological Description 1 (EP) (Appendix A, Figures A.17 & A. 18)
Site classification, site features, soil features, soil description for pin location and summary information

Ecological Description 2 (ED) (Appendix A, Figures A.19 & A. 20)
As above, for when plot centre not in dominant site

Tree and Shrub Layers (ET) (Appendix A, Figures A.21 and A.22)
Species, and cover by species and for seedlings

Herb and Moss Layers (EH) (Appendix A, Figures A.23 and A.24)
Species, and cover by species and substratum

Succession Interpretations (EO) (Appendix A, Figures A.25 and A.26)
Factors influencing vegetation establishment, tree species succession, stand structure features, structural stages, old growth assessment
Detailed Procedures

7.1 Establishing Plots

The main ecological plot is 10 m radius (314 m²), centred on the Integrated Plot Centre. It is used to collect vegetation data from the tree and shrub layers, and for site description, soil, and site classification.

The nested subplot is 5.64 m radius (100 m²), also centred on the Integrated Plot Centre. It is used to sample vegetation in the herb and moss layers, and tree seedlings.

In order to evaluate slope gradient, aspect, meso slope position, succession interpretations, and a number of other attributes it is necessary to look beyond the 10 m main ecological plot to an approximate radius of 25 m around the Integrated Plot Centre, depending on the attribute, site variability, and topographic breaks.

The inventory sampling method does not allow movement of the ecological plot to more “typical” or homogeneous portions of the area as this would introduce sampling bias. Some plots may therefore contain more than one site series. This may lead to difficulties with secondary applications of the data such as ecological classification.

To address this concern, field crews will assess the ecological variability (uniformity) of the plot and estimate the relative proportions of component site series and/or land cover classes comprising a plot. If the Integrated Plot Centre does not fall in the dominant site series (within the 10 m plot), then additional soil and site data are needed for the dominant site series.

Procedure

Measure the 10 m and 5.64 m plots and flag at appropriate intervals around the circumferences of the plots to demarcate plot boundaries. For detailed procedures, see Section 3: Plot Establishment.

7.2 Assessing Ecological Variability

1. Assess the ecological variability within the integrated plot. If more than one site series occurs, identify the dominant site series (occupying the greatest proportion of the plot) and determine whether the plot centre falls within this site series. The dominant site can occur as discontinuous patches or as one contiguous area in the plot.

2. If the plot centre falls within the dominant site series, record only one site series and soil description (Field Card EP).

3. If the plot centre is not in the dominant site series, record the site features of the plot centre on Field Card EP, and a second set of soil and site features for the dominant site on Field Card ED.

4. Record the percentage cover of site series and land cover class, or land cover alone if site series does not apply.
5. Figure 7.1 illustrates some situations that may be encountered. Note that only one plant list is done for the entire plot, in all cases.

- **Example 1:** plot centre is in dominant site series (A)
  - complete one site and soil description at plot centre
  - complete EP card for A only.

- **Example 2:** plot centre is in dominant site series (A); subdominant (B) is discontinuous
  - complete one site and soil description at plot centre
  - complete the EP card for A only.

- **Example 3:** plot centre is subdominant site series (B)
  - complete one site and soil description at plot centre
  - complete another site/soil description within dominant site (A)
  - complete ED card for A and EP card for B.

- **Example 4:** plot centre is in subdominant (B), but site series is discontinuous
  - complete one site and soil description at plot centre
  - complete another site/soil description at dominant site (A)
  - complete ED card for A and EP card for B.

*Figure 7.1 — Assessing uniformity and attributes in areas with ecological variability within the 10 m fixed-radius plot.*
7.3 Identifying and Recording Site and Soil Features

The following classifications are based on all the observations taken in this section. Record your observations on the field cards in the numbered areas indicated for each observation.

A. Site Classification

1. Uniformity

Record the uniformity of the plot using the five-class scale shown in Table 7.1.

**Table 7.1 – Plot uniformity codes.**

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 — (uniform)</td>
<td>&gt; 98% of plot in one homogeneous* ecosystem or site series</td>
</tr>
<tr>
<td>2</td>
<td>&gt; 90%–98% of plot in one homogeneous* ecosystem or site series; the remainder in other ecosystems**</td>
</tr>
<tr>
<td>3</td>
<td>&gt; 70%–90% of plot in one homogeneous* ecosystem or site series; the remainder in other ecosystems**</td>
</tr>
<tr>
<td>4</td>
<td>&gt; 50%–70% of plot in one homogeneous* ecosystem or site series; the remainder in other ecosystems**</td>
</tr>
<tr>
<td>5 — (variable)</td>
<td>50% or less of plot is the largest homogeneous* ecosystem or site series</td>
</tr>
</tbody>
</table>

* Homogeneous means the same site series and structural stage.

** Other ecosystems include different successional and structural stages (for example, major structural differences beyond that of understory vegetation associated with smaller canopy gaps due to mortality of 1-3 trees) as well as different sites (different site series, or inclusions of avalanche tracks, streams, gullies, rock outcrops, roads).

2. Biogeoclimatic Unit

Record the biogeoclimatic unit as determined on the ground. This includes zone, subzone, variant, and phases (if applicable).

**Note:** Biogeoclimatic phases have not been defined for all variants. An example of a phase is the ICH mc1a (ICH Zone, Moist Cold Subzone, Nass Variant, Amabilis Fir Phase) as described in Chapter 5 page 116 of the Field Guide to Site Identification for the Prince Rupert Forest Region.

For a concise introduction to biogeoclimatic and site unit terminology see Ecosystems of British Columbia (Meidinger and Pobar 1991).

A digital copy of valid codes for "Biogeoclimatic Unit" and "Site Series and Coverage" is available (boxes 2 and 3 on the EP12 card). This complete list of BEC Zones, Subzones, Variants, Phases and matching Site Series is available from the MoF Research Branch.
website. It is called BECdb.mdb. Currently it is only available as a relational database file (MS Access 97). To obtain a copy, go to the following website:

http://www.for.gov.bc.ca/research/software/becdb.htm

These are the official provincial codes from Research Branch. MoF Research Branch is the data custodian of the BEC and Site Series information.

3. SITE SERIES AND COVERAGE

As clarified by Klinka et al. (1989), Indicator Plants of Coastal British Columbia, site series identification is aided by indicator plants, even when their cover and vigour are low and their presence is sporadic. Although, the CMI ecological methodology does suggest you do not need to record genera or species with less than 1% coverage, this does not imply that such plants should be ignored when doing site series identification.

1. Identify the site series at the plot centre and up to 2 other sites within the 10 m radius plot.
2. Enter the three-character site series/phase code from the appropriate MOF regional field guide to site identification and interpretation.
3. If the plot occurs on an ecosystem not recognized in the ecological classification, record the soil moisture regime (SMR) and soil nutrient regime (SNR). If these values cannot be estimated (for example, roads, gravel pits, boulder fields), record “site series #” as 99_ and in the SMR and SNR columns record a dash (–).
4. Estimate the coverage of each site series as a percentage of the 10 m plot, to a maximum of 100% if there is only one site series.

Note: Second and third site series or land cover classes covering less than 5% (16 m²) are considered too small to recognize.

4. SOIL MOISTURE REGIME

Relative Soil Moisture Regime (SMR) refers to the average annual amount of soil water available to plants, relative to a given biogeoclimatic subzone variant. This attribute is particularly valuable when the site series is not defined.

1. Record SMR for the plot centre and up to two other sites.
2. The SMR classes, given in Table 7.2, are inferred from the physiographic and soil features described. (A more complete description and keys are in the relevant regional field guide and in Describing Ecosystems In The Field, Luttmerding et al. 1990.)

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>very xeric (very dry)</td>
</tr>
<tr>
<td>1</td>
<td>xeric</td>
</tr>
</tbody>
</table>

Table 7.2 – Relative Soil Moisture Regime codes.
5. **SOIL NUTRIENT REGIME**

Soil Nutrient Regime (SNR) refers to the amount of essential soil nutrients, particularly nitrogen, available to plants. This attribute is particularly useful when the site series cannot be determined in other ways.

1. Record SNR for the plot centre and up to two other sites.

2. The SNR classes, given in Table 7.3, are inferred from the physiographic and soil features described. (A more complete description and keys are in the relevant regional field guide and in *Describing Ecosystems In The Field*, Luttmerding et al. 1990.)

![Table 7.3 – Soil Nutrient Regime codes.](image)

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>very poor</td>
</tr>
<tr>
<td>B</td>
<td>poor</td>
</tr>
<tr>
<td>C</td>
<td>medium</td>
</tr>
<tr>
<td>D</td>
<td>rich</td>
</tr>
<tr>
<td>E</td>
<td>very rich</td>
</tr>
<tr>
<td>F</td>
<td>ultra rich or saline (rarely used, but may be encountered)</td>
</tr>
</tbody>
</table>

6. **LAND COVER CLASSIFICATION**

Please refer to Appendix G for a description of the land cover levels and simplified flow charts.

1. Record the land cover class to the appropriate level.

2. Record up to three separate land cover designations if necessary, corresponding on a one-to-one basis with up to three site series designations (in a highly variable 10 m radius plot).

3. If “99” is recorded for site series, then the land cover classification still provides a description for that area of the plot.

4. Map the land cover classes encountered on to the CL field card in the section for "Integrated Plot Details (top view)".
Note: Second and third site series or land cover classes covering less than 5% (16 m²) are considered too small to recognize.

See Table 7.4 for a condensed version of the B.C. Land Cover codes. A more detailed description can be found in Appendix G. For full definitions and tables, please refer to the current Vegetation Resources Inventory B.C. Land Cover Classification Scheme Manual.
### Table 7.4 – B.C. Land Cover Classification codes in condensed form.

<table>
<thead>
<tr>
<th>Level I</th>
</tr>
</thead>
<tbody>
<tr>
<td>Codes</td>
</tr>
<tr>
<td><strong>V</strong></td>
</tr>
<tr>
<td><strong>N</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Level II</th>
</tr>
</thead>
<tbody>
<tr>
<td>Codes</td>
</tr>
<tr>
<td><strong>V</strong></td>
</tr>
<tr>
<td><strong>N</strong></td>
</tr>
<tr>
<td><strong>L</strong></td>
</tr>
<tr>
<td><strong>W</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Level III</th>
</tr>
</thead>
<tbody>
<tr>
<td>Codes</td>
</tr>
<tr>
<td><strong>N</strong></td>
</tr>
<tr>
<td><strong>U</strong></td>
</tr>
<tr>
<td><strong>A</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Level IV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Codes</td>
</tr>
<tr>
<td><strong>V</strong></td>
</tr>
<tr>
<td><strong>T</strong></td>
</tr>
<tr>
<td><strong>M</strong></td>
</tr>
<tr>
<td><strong>S</strong></td>
</tr>
<tr>
<td><strong>L</strong></td>
</tr>
<tr>
<td><strong>H</strong></td>
</tr>
<tr>
<td><strong>F</strong></td>
</tr>
<tr>
<td><strong>G</strong></td>
</tr>
<tr>
<td><strong>B</strong></td>
</tr>
<tr>
<td><strong>M</strong></td>
</tr>
<tr>
<td><strong>L</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Level V</th>
</tr>
</thead>
<tbody>
<tr>
<td>Codes</td>
</tr>
<tr>
<td><strong>V</strong></td>
</tr>
<tr>
<td><strong>O</strong></td>
</tr>
<tr>
<td><strong>S</strong></td>
</tr>
<tr>
<td><strong>C</strong></td>
</tr>
<tr>
<td><strong>G</strong></td>
</tr>
<tr>
<td><strong>P</strong></td>
</tr>
<tr>
<td><strong>B</strong></td>
</tr>
<tr>
<td><strong>T</strong></td>
</tr>
<tr>
<td><strong>L</strong></td>
</tr>
<tr>
<td><strong>R</strong></td>
</tr>
<tr>
<td><strong>E</strong></td>
</tr>
<tr>
<td><strong>L</strong></td>
</tr>
<tr>
<td><strong>R</strong></td>
</tr>
<tr>
<td><strong>B</strong></td>
</tr>
</tbody>
</table>

| Codes  | Description |
| **N**  | Landing |
| **V**  | Burned Area |
| **L**  | Road Surface |
| **M**  | Mudflat Sediment |
| **G**  | Cutbank |
| **P**  | Moraine |
| **B**  | Gravel Pit |
| **T**  | Tailings |
| **R**  | Railway |
| **U**  | Urban |
| **R**  | Other |
| **L**  | Lake |
| **E**  | Reservoir |
| **R**  | River / Stream |
| **O**  | Ocean |
Comments

Record on the field cards any items of ecological interest that have been otherwise missed. Preface your remarks with card and attribute identification.

B. Site Features

Site features such as slope, aspect, surface shape, meso slope, microtopography, rocky substrates, flood hazard, and open water should be assessed only for the particular site being described. For example, in the event of a site A and a site B (see Figure 7.1; examples 3 and 4 requiring EP and ED cards), do not average any of the above attributes (7, 8, 10, 11, 12, 13, 16, and 17) across the two site series. Record separate values on the EP and ED field cards.

7. SLOPE (%)

Record the slope gradient to the nearest percent. On uniform conditions, assess slope by averaging over a 100 m distance (50 m above and below the plot centre). On the EP card give more weight to the slope conditions at the IPC, particularly when the IPC falls within a topographically different site series, compared with the remainder of the 10 metre radius plot. If there is a major topographic break in the slope, measure only to the break point. If required, record separate values on the EP and ED cards.

8. ASPECT (°)

Record the orientation of the downward slope (in degrees) using a compass bearing. On the EP card give more weight to the slope orientation at the IPC, particularly when the IPC falls within a topographically different site series, compared with the remainder of the 10 metre radius plot. Level ground (less than 2% slope) has no aspect; code as 999. If the aspect is “due north” the value is recorded as “0” degrees. If required, record separate values on the EP and ED cards.

9. ELEVATION (M)

Record the elevation of the plot centre in metres.

10. SURFACE SHAPE

Describe the general shape of the slope the site is situated on (convex, straight, concave). If required, record separate values on the EP and ED cards.

11. MESO SLOPE

Meso slope describes the relative position of the site within a local catchment area, which affects surface and subsurface water flow to the plot. Slope position relates to the segment of slope between prominent topographic irregularities (for example, major slope breaks). If required, record separate values on the EP and ED cards.
1. Describe the meso slope of the site. Refer to Figure 7.2 for descriptive terms.
2. Record using the codes described in Table 7.5.

![Diagram of Meso and Macro Slopes](image)

**Figure 7.2 — Side view showing meso slope descriptive terms**

**Table 7.5 — Meso slope codes.**

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>crest</td>
</tr>
<tr>
<td></td>
<td>the generally convex upper portion of a hill.</td>
</tr>
<tr>
<td>U</td>
<td>upper slope</td>
</tr>
<tr>
<td></td>
<td>the generally convex upper portion of the slope immediately below the crest.</td>
</tr>
<tr>
<td>M</td>
<td>middle slope</td>
</tr>
<tr>
<td></td>
<td>the area of the slope between the upper slope and the lower slope where the slope is generally neither distinctly convex or concave.</td>
</tr>
<tr>
<td>L</td>
<td>lower slope</td>
</tr>
<tr>
<td></td>
<td>the area towards the base of a slope, generally concave.</td>
</tr>
<tr>
<td>T</td>
<td>toe</td>
</tr>
<tr>
<td></td>
<td>the area demarcated from the lower slope by an abrupt decrease in slope gradient.</td>
</tr>
<tr>
<td>D</td>
<td>depression</td>
</tr>
<tr>
<td></td>
<td>any area that is concave in all directions.</td>
</tr>
<tr>
<td>F</td>
<td>flat</td>
</tr>
<tr>
<td></td>
<td>any level area not directly adjacent to a slope (for example, toe). The surface profile is generally horizontal.</td>
</tr>
</tbody>
</table>
12. Microtopography

1. Microtopography describes the variability (or mounding) of the surface of the site being described. If required, record separate values on the EP and ED cards.

2. Record one of the classes of microtopography shown in Table 7.6.

Table 7.6 – Microtopography codes.

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>SM</td>
<td>smooth</td>
</tr>
<tr>
<td></td>
<td>few or no mounds; if present, less than 0.3 m high and more than 7 m apart</td>
</tr>
<tr>
<td>MO</td>
<td>moderately mounded</td>
</tr>
<tr>
<td></td>
<td>mounds 0.3 to 1 m high and 3 to 7 m apart</td>
</tr>
<tr>
<td>ST</td>
<td>strongly mounded</td>
</tr>
<tr>
<td></td>
<td>mounds 0.3 to 1 m high and less than 3 m apart</td>
</tr>
<tr>
<td>EX</td>
<td>extremely mounded</td>
</tr>
<tr>
<td></td>
<td>mounds more than 1 m high</td>
</tr>
</tbody>
</table>

13. Rocky Substrates

1. Estimate the percentage of the within-site ground surface covered by rocky substrates within the 10 m radius plot. If required, record separate values on the EP and ED cards.

2. Record percentage for codes listed in Table 7.7.

Table 7.7 – Rocky substrate codes.

<table>
<thead>
<tr>
<th>Codes</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CS</td>
<td>cobbles/stones</td>
</tr>
<tr>
<td></td>
<td>exposed rock fragments larger than 7.5 cm* diameter; may be covered by mosses or lichens, for example, with a forest floor less than 1 cm thick.</td>
</tr>
<tr>
<td>BR</td>
<td>bedrock</td>
</tr>
<tr>
<td></td>
<td>exposed bedrock that may be covered by mosses or lichens, for example, with a forest floor less than 1 cm thick.</td>
</tr>
</tbody>
</table>

*Coarse fragment size or diameter is measured along the b axis, where a = length, b = width, and c = height (a > b > c).

14. Slope Failure

1. Note any evidence of recent or past slope failure greater than 100 m² surface area in the plot or intercepted by a portion of the 11.28 m plot. Evidence of failure includes landslides, slumps, debris flows, debris torrents, and bedrock failures. For further information about slope failure refer to Chatwin (Chatwin et al. 1994).

2. Record if present in the plot (Y or N).

3. Features that would indicate slope instability are shown in Table 7.8.
Table 7.8 – Indicators of slope instability.

- obvious recent failures (tracks of exposed soil oriented downslope)
- headwall or sidewall scarps that are rectangular or horseshoe shaped
- deposits of slide materials at the base of the failure which are fan-shaped and often hummocky
- a significant difference in vegetation (species and age) from the surrounding area, which may indicate older failure tracks
- generally on steeper slopes, and often in association with wet sites (seepage zones, draws, and so on)

15. GULLIES

Gullies are long, linear depressions incised into the landscape by active erosion processes, mainly running water in places accompanied by mass movement and/or snow avalanching. Where the stream channel is confined in a narrow ravine with banks usually higher than 3 m. The longitudinal profile may range from gentle to steep, and uniform to irregular (benched). The cross-section profile may be V-shaped to U-shaped with moderate to steep sidewalls (50% or greater slope). Dry draws (gully shaped features without a stream) with long established vegetation and soils, and stream channels with none of the above active or potentially active sidewall erosion features are not included.

1. Note the presence of gullies in the main plot or intercepted by a portion of the 11.28 m plot.
2. Record if present in the plot (Y or N).

16. FLOOD HAZARD

Estimate the relative frequency of flooding of rivers, creeks, and streams using the biophysical features shown in Table 7.9. If required, record separate values on the EP and ED cards.
Table 7.9 – Indicators of flood hazard.

<table>
<thead>
<tr>
<th>Flood hazard</th>
<th>Flood frequency</th>
<th>Overbank deposits</th>
<th>Vegetation</th>
<th>Topography</th>
<th>Litter cover</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Frequent</strong></td>
<td>subject to annual flooding</td>
<td>recent organic or inorganic deposits may be present</td>
<td>none, or species of primary colonization</td>
<td>low lying areas adjacent to the potential flood waters</td>
<td>none or very thin layer of fresh litter</td>
</tr>
<tr>
<td><strong>Occasional</strong></td>
<td>occasionally flooded</td>
<td>recent organic or inorganic deposits may be present</td>
<td>mature vegetation, typically deciduous species; conifers restricted to elevated sites</td>
<td>areas of moderate elevation relative to the potential flood waters</td>
<td>thin forest floor ranging from fresh to partially decomposed material</td>
</tr>
<tr>
<td><strong>Rare</strong></td>
<td>subject to flooding at high stage</td>
<td>no evidence of recent organic or inorganic overbank deposits</td>
<td>mature vegetation, includes coniferous species</td>
<td>areas of high elevation relative to the potential flood waters</td>
<td>thicker forest floor with developed profile</td>
</tr>
<tr>
<td><strong>Not Applicable</strong></td>
<td>not subject to flooding</td>
<td></td>
<td></td>
<td>well above or away from potential flood waters</td>
<td></td>
</tr>
</tbody>
</table>

(adapted from *Describing Ecosystems in the Field* Luttmerding et al. 1990).

17. OPEN WATER

1. Estimate the within-site area covered by either flowing (F) or standing water (S). If required, record separate values on the EP and ED cards.

2. Record as a percentage.

C. Soil Features

1. Dig a soil pit to represent the centre point of the Integrated Plot and representative of conditions at the plot centre, regardless of which point is the most representative of the dominant site of the 10 m radius plot.

2. Dig a second soil pit if necessary to represent the most dominant site. Complete a second soil pit only where the dominant site (versus the IPC site) is clearly one of contrasting site quality due to obviously different site and soil conditions.

3. The soil pit should be a minimum of 60 cm deep unless you encounter impenetrable material. If a soil pit cannot be excavated on the plot, draw a line through the soil features section on the field card and note the reason in the comments.

4. Upon completion of the sample, refill the soil pit.
18. SURFICIAL MATERIAL

Surficial material refers to the soil parent materials. They are classified according to their mode of formation. The following description is based on the *Terrain Classification System for British Columbia* (Version 2), Howes and Kenk 1997.

1. Record the surficial materials seen in the soil pit using the appropriate code shown in Table 7.10.

2. If two types of material are observed, record both (for example, C_/M_ [colluvial over morainal]).

**Table 7.10 – Surficial material codes.**

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
</table>
| A __ | Anthropogenic  
  | • landfill, mine spoils, roadfill |
| C __ | Colluvium  
  | • deposits a direct result of gravity (talus, landslide deposits)  
  | • on steep terrain; below rock bluffs  
  | • coarse fragments, angular, same rock type as bedrock  
  | • coarse fragment >35%, loosely packed, porous.  
  | • landslide and slope failure deposits |
| E __ | Eolian  
  | • wind action (loess, dunes)  
  | • well-sorted silt or fine sand, loose and fluffy  
  | • a capping over other material |
| F __ | Fluvial  
  | • transported & deposited by streams or rivers (floodplain, fluvial terrace, fan, delta)  
  | • deposits gravels, sands, and/or silts, depending on stream velocity  
  | • rounded gravels  
  | • well sorted, stratified  
  | • topography flat, or steep erosional scarp  
  | • along valley bottoms near a river or stream |
| FG | Glaciofluvial  
  | • deposited by glacial meltwater streams in front of, within, or along margins of glacial ice (eskers, kame terraces, outwash)  
  | • coarse-textured, non-sorted to well-sorted, gravels and sands, with layers of finer textured materials  
  | • topography flat, sometimes steep erosional scarp  
  | • along valley bottoms, up valley sides, or extensive plain outside valley systems  
  | • gravel pits are often present |
| L __ | Lacustrine  
  | • old lake bottoms or old lake beaches  
  | • stratified silts and clays, often with varves  
  | • glaciolacustrine sediments may contain ice-rafted stones and lenses of morainal or glaciofluvial material  
  | • topography flat, sometimes with a steep erosional scarp, along valley bottoms  
  | • slumps and landslides are often present |
Code | Description
--- | ---
**M** | Morainal “Till”
- (till) deposited directly by glacial ice
- highly variable, compacted to non-compacted sediments, unsorted mixture of coarse and fines
- looks like “cement”
- stones of different rock types may have striations (grinding marks from the ice). The most widespread and variable parent material in B.C.

**O** | Organic
- wetland (peat, muck in bogs, fens, swamps) and forest floor overlying bedrock (LFH >10 cm thick; noted as O/R)

**R** | Bedrock
- exposed bedrock, organic layer (<10 cm)

**V** | Volcanic
- unconsolidated ash, cinders
- cappings over other parent materials (for example, V / M)

**W** | Marine
- salt water deposits old mud flats old beaches
- fine textured (sилts and clays) often dense
- old beaches are well-sorted sands and/or gravels with rounded coarse fragments
- shells, marine concretions
- flat or very gently sloping
- lower elevations near the ocean (as high as 200 m above present sea level in the Georgia Strait area)
- glaciomarine sediments similar to marine except may contain stones and lenses of morainal or glaciofluvial materials

19. DEPTH TO: (IN CM)

Record the observed depth from the “0 depth” (mineral soil surface for mineral soils, ground surface for organic soils) to each of the features shown in Table 7.11, if present within the soil profile.

**Table 7.11 – Soil features codes.**

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
</table>
| **W** | **water table or seepage**
Measure to the free water surface in the soil, or to the line along which water emerges. Free water may collect as the result of a high groundwater table or it may be due to a temporary accumulation of water above a relatively impermeable layer. Depth to water table and depth to seepage are closely related concepts which are combined here to avoid unnecessary difficulties in the field. |
| **M** | **mottles (not applicable in organic soils)**
Measure to the surface of orange to red (oxidized) spots or blotches within a predominantly dull yellow, grey, blue, or olive-coloured (reduced) mineral soil horizon. Mottles are characteristic of soils with periodic intense reduction (absence of free oxygen from the atmosphere). The mottled zone often overlies a permanently reduced, or strongly gleyed horizon of dull bluish to grey colour (often indicated by presence of a water table or seepage). Mineral soils with more intensely reduced conditions have relatively greater volumes of bluish-grey colours. Soils become reduced when they are anaerobic, or deficient in oxygen – which happens when microorganisms and plant roots
Use oxygen faster than it can be replaced from the atmosphere, or when oxygen entry is blocked, as in compact basal till. The colours associated with mottles and gleying are due to the effects of oxidation and reduction on iron, aluminum, manganese, and other metals.

**R** root-restricting pan
Measure to layers that impede root penetration (pans, cemented horizons, compact parent materials).

**B** bedrock
Measure to consolidated bedrock. Weathered bedrock that can be removed with a shovel should be considered soil.

**F** frozen layer
Measure to the top of a frozen layer.

**C** carbonates
Measure to the top of a layer containing carbonate accumulations.

**N** not observable (glacier, paved surface, lake)

**20. HUMUS FORM**
Humus refers to the forest floor and organic-enriched surface mineral horizons.

Describe the humus form as one of the types shown in Table 7.12.

**Table 7.12 – Humus form codes.**

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>MO</td>
<td>Mor</td>
</tr>
<tr>
<td></td>
<td>LFH horizons prominent, F horizon is matted, with abundant fungal mycelia, mushroom smell common, usually abrupt transition to mineral soil.</td>
</tr>
<tr>
<td>MM</td>
<td>Mormoder</td>
</tr>
<tr>
<td></td>
<td>intergrade between Mor and Moder, F horizon not strongly matted and often variable with clumps of matted material and pockets of friable material, fungal mycelia and insect droppings may both occur, but neither clearly predominates over the other.</td>
</tr>
<tr>
<td>MD</td>
<td>Moder</td>
</tr>
<tr>
<td></td>
<td>LFH horizons prominent, F horizon loose and friable, fungal mycelia less common, insects and droppings common, rich “potting-soil” smell, may have thin Ah horizons</td>
</tr>
<tr>
<td>MR</td>
<td>Mullmoder</td>
</tr>
<tr>
<td></td>
<td>intergrade between Moder and Mull, features well developed F and H (F+H horizons &gt;2 cm thick) but Ah present which is thicker than the F+H horizons.</td>
</tr>
<tr>
<td>MU</td>
<td>Mull</td>
</tr>
<tr>
<td></td>
<td>Ah horizon prominent, F + H horizons &lt;2 cm thick, F horizon very friable, Ah granular, earthworms often present.</td>
</tr>
<tr>
<td>NA</td>
<td>Not applicable</td>
</tr>
<tr>
<td></td>
<td>use this option when none of the above humus forms apply. For example, in situations where there is very little or no surface organic matter, such as on bare bedrock, on fresh mineral deposits (floodplain sands, active talus slopes), and on road surfaces. The L, F, H horizons are freely drained, upland organic horizons which are found on most mineral soils, and occasionally on some organic soils. You may need to use this category when describing wetland ecosystems.</td>
</tr>
</tbody>
</table>
21. SOIL COLOUR

1. Describe the general colour of the rooting-zone mineral soil.
2. Record one of the categories shown in Table 7.13.

Table 7.13 – Soil colour codes.

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>D</td>
<td>dark</td>
</tr>
<tr>
<td>chocolate brown or black (Munsell colour value &lt;4 when moist)</td>
<td></td>
</tr>
<tr>
<td>M</td>
<td>medium</td>
</tr>
<tr>
<td>intermediate colour (most commonly encountered)</td>
<td></td>
</tr>
<tr>
<td>L</td>
<td>light</td>
</tr>
<tr>
<td>very pale soil (Munsell colour value &gt;6 when moist)</td>
<td></td>
</tr>
<tr>
<td>N</td>
<td>not applicable (bedrock, no soil)</td>
</tr>
</tbody>
</table>

D. Soil Description

22. HORIZON

1. Record the main types of organic and mineral horizons.
2. Enter the appropriate code left justified, using Table 7.14, beginning with the uppermost horizon, followed by subsequent horizons proceeding down through the profile.
3. Horizons include L __, F __ & H __, Ah __, Ae __, B __, and C __.
4. Differentiate subdivisions of the B or C horizons (for example, B1 __, B2 __) if they differ substantially in colour, texture, coarse fragments, or structure.
5. Subordinate horizons of B and C (for example, Bf __, Bf1, Bf2, Bfg, Bt __, and Bm __) may be recorded if you can confidently identify them. The soil classification system follows the Canadian System of Soil Classification (1998) with additional combinations specific to British Columbia. The additional combinations are documented in the "Field Manual for Describing Terrestrial Ecosystems". A list of allowable codes can be found on the Inventory Branch website for reference.

Table 7.14 – Examples of important soil horizons.

<table>
<thead>
<tr>
<th>Horizon</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>L __ __</td>
<td>an upland organic horizon consisting of relatively fresh, undecomposed plant residues.</td>
</tr>
<tr>
<td>F __ __</td>
<td>an upland organic horizon consisting of partly decomposed plant residues in which fragmented plant residues are generally recognizable as to origin.</td>
</tr>
<tr>
<td>H __ __</td>
<td>an upland organic horizon comprised of well-decomposed plant residues in which plant structures are generally not recognizable.</td>
</tr>
<tr>
<td>Note: F __ and H __ can be combined and recorded as an FH __ horizon if they are difficult to distinguish</td>
<td></td>
</tr>
<tr>
<td>Ah __</td>
<td>surface mineral horizons enriched with organic matter (darker coloured than underlying horizon)</td>
</tr>
</tbody>
</table>
Horizon Description

Ae __ surface mineral horizons leached (eluviated) of organic matter, Fe, Al, and other elements (lighter [usually light greyish] coloured than underlying horizon).

B __ __ mineral horizons affected by pedogenic processes and characterized by enrichment in organic matter, Fe and Al, clay, or by the development of soil structure, or by a change in colour indicating gleying or oxidation.

C __ __ mineral horizons relatively unaffected by pedogenic processes except gleying, and accumulation of carbonates and salts. It represents the unweathered parent material.

Of __ a wetland organic horizon consisting of poorly decomposed plant residues that are readily identifiable as to origin (“peat”).

Horizon Description

Om __ a wetland organic horizon consisting of partly decomposed plant residues which are at a stage of decomposition intermediate between Of and Oh horizons (“peat”).

Oh __ a wetland organic horizon consisting of well decomposed plant residues (“black muck”).

R __ __ bedrock

23. DEPTH (CM)

1. Record the average distance from 'zero' depth for each horizon in the profile (Figure 7.3).
   • For forest floor horizons (L, F, H) zero depth is the boundary between organic and mineral horizons. Depths are measured from the ground surface to 0 depth (for example, in the diagram, L: 6, F: 4, H: 2).
   • For mineral horizons, zero depth is the top of the uppermost mineral horizon, and lower boundary depths are measured in descending order (for example, in the diagram A: 3, B: 10, C: 60).
   • For organic soils, zero depth is the top of the organic material. Organic soils are soils with greater than 60 cm of organic material (if surface horizons are Of _), or greater than 40 cm of organic material (if surface horizons are Om _ and Oh _), or greater than 10 cm thick if they overlie rock, as described on pp. 97-99 in the *Canadian System of Soil Classification* (1998).

2. Record the total depth of the soil pit (DOP).
Figure 7.3- Example of recording horizon depth in organic soils and mineral soils.

24. TEXTURE
1. Estimate the texture of the mineral soil (grains 2 mm or less in diameter) using field estimation methods as described in MOF Regional Ecology Field Guides to Site Identification and Interpretation.
2. Estimate texture of each mineral soil horizon, not just the main horizon.
3. Enter the appropriate codes.

25. COARSE FRAGMENTS
1. For each mineral soil horizon, estimate the proportion of the total volume of soil material occupied by mineral particles larger than 2 mm in diameter.
2. Record the total coarse fragment percentage. Coarse fragment size or diameter is measured along the b axis, where a = length, b = width, and c = height (a > b > c).
3. Break this total down into two categories:
   • gravel (greater than 2 mm and less than 7.5 cm)
   • cobbles and stones (greater than or equal to 7.5 cm)

E. Surface Substrate and Soil bulk Density Measurements

Introduction
In support of National Forest Inventory (NFI) requirements for the measurement of total ecosystem carbon stocks (TECS), a need was identified for the collection of data related to:

• Surface substrates (decaying wood, bedrock, cobbles and stones, mineral soil)
• Organic matter and water
• Forest floor organics
• Soil bulk density and carbon content

The data from these measurements will be applied in reports on climate change, criteria and indicators of sustainable forest management, biodiversity and forest health.
Surface Substrate Sampling

Objectives

To determine percent surface substrate for NFI sample plots. This will be determined by measuring 10 sample points taken at every meter along each of the woody debris transects (total of 20 sample points) to the edge of the large tree plot boundary.

Definitions

Percent surface substrate, for the purposes of this inventory, is defined as the proportion of the ground surface covered by each class of substrate with the corresponding depth. Surface substrate descriptions are listed in Table 7.15.

The total for all six classes should sum to 100%.

General Procedures

1. Set out two, randomly oriented, 30-meter woody debris transects

2. Measure and record information for surface substrate type and depth (where applicable) to the edge of the large tree plot boundary.

Detailed Procedures

Surface substrate is measured every meter for 10 meters, along the two, 30-meter line transects extending from the Integrated Plot Center. Detailed field forms are shown in Appendix M.

1. Establish the woody debris line transects as per woody debris protocol.

2. For every meter along the woody debris transect, check the box applicable to the surface substrate type.

3. For organic substrate and buried wood, measure and record the depth in centimetres.

4. Total the number of surface substrate occurrences in each category.

5. Note: in plots where the organic layer throughout the transect is > 40 cm thick, depth measurements need only be recorded every 2nd meter of transect. If only a portion of the line falls in deep organics (for example, a swamp) where the actual measurements would be difficult, an estimate should be made of the interim locations. The maximum depth that would be measured in thick organic layers would be to 40 cm. (record the depth as >40).

6. Anomalous conditions: if the sample point along the transect lands in an anomalous site, such as a cone pile, squirrel cache, debris pile, or large ant hill, the surface substrate would be classified as organic and a depth to mineral soil would still be measured. A note should be made in the comments section for this location. If the sample point lands on a sound log, the sample point should be moved to just beside the log.
Table 7.15 - Surface substrate classes and definitions.

<table>
<thead>
<tr>
<th>Surface Substrate</th>
<th>Definition</th>
</tr>
</thead>
</table>
| Organic matter             | Surficial accumulations of organic materials include the following:  
  - organic layers ≥ 1 cm thick overlying mineral soil, cobbles, stones or bedrock;  
  - layers of decaying wood < 10 cm thick;  
  - large animal droppings; and  
  - areas covered by dead mats of graminoids or other vegetation (mats include L and F horizon materials),                                                                                                              |
| Buried wood                | The proportion of the ground surface covered by buried wood:  
  - class 5 woody debris with > 50% below the surrounding surface;  
  - does not include freshly fallen material that has yet to decompose;  
  - may be covered by mosses, lichens, liverworts, or other living plants;  
  - if an organic layer has developed over the wood, buried wood must be > 10 cm thick otherwise it is classed as “organic matter”.                                                                                       |
| Decaying wood              | Fallen trees, large branches on the ground surface, and partially buried stumps with an exposed edge:  
  - does not include freshly fallen material that has not yet begun to decompose (e.g. decay class 1 and 2 logs). Note that if there is a recently fallen class 1 or class 2 log blocking measurement, move the sample point to just beside the log (see anomalous conditions);  
  - may be covered with mosses, lichens, liverworts, or other living plants;  
  - if an organic layer has developed over the wood, decaying wood must have > 50% of its thickness above the surrounding surface, otherwise it is classed as “buried wood”. |
| Bedrock                    | Bedrock includes exposed consolidated mineral material:  
  - may have a partial covering of mosses, lichens, liverworts, or other epilithic plants;  
  - does not qualify as bedrock if covered by unconsolidated mineral or organic material ≥ 1 cm in thickness.                                                                                                           |
| Rock or cobbles and stones | Rock (cobbles and stones) includes exposed unconsolidated rock fragments > 7.5 cm in diameter:  
  - may be covered by mosses, lichens, liverworts; or an organic residue layer < 1 cm in thickness  
  - does not include gravels < 7.5 cm in diameter.                                                                                                                                                                      |
| Mineral Soil               | Unconsolidated mineral material of variable texture not covered by organic materials:  
  - may have a partial cover of mosses, lichens, and liverworts;  
  - often associated with cultivation, tree tip-ups, active erosion or deposition, severe fires, trails, or late snow retention areas;  
  - includes small cobbles and gravel < 7.5 cm in diameter;  
  - areas of living grass or forb cover where mineral soil is visible between stems are classed as mineral soil, as are exposed Ah or Ap horizons.                                                                 |
| Water                      | Streams or areas of open water in bogs or fens. Note: this does not include “casual” or non-permanent water. The sample point should be recorded to reflect the conditions at the time of sampling, e.g. a gravel or sandbar below the high water mark for a stream would be recorded as mineral soil. |
Forest Floor Sampling

Objectives
To collect four samples of the forest floor/litter layer which will be analyzed for total carbon and mineral content.

General Procedures
1. Establish the forage sampling micro-plots along the woody debris transects.

2. Excavate and sample the forest floor organic layer(s) from each of the four plots or at an equivalent, representative area nearby that is in or near the micro-plot.

Detailed Procedures
1. Establish the woody debris transects as per woody debris protocol.

2. Establish the four forage micro-plots at pre-assigned distances along the woody debris transects.

3. Select a suitable (level if possible and free of large organic debris) representative site within each of the four micro-plots. In very few instances, the sample may need to be located outside of the micro-plot if the location is physically obstructed.

4. At the selected site in an area approximately 30 centimetres by 30 centimetres remove all live vegetation (including bryophytes and lichens) and woody debris from the sampling area.

5. Using the 20 cm x 20 cm (inside dimensions), square aluminium template, cut out the forest floor layer (combined litter and humus) to the top of the mineral soil from each of the four micro-plots (see Appendix M for a complete list of field equipment). Use the hand saw or knife to accomplish this and be careful not to compress the soil sample underneath as this will affect its bulk density.

6. With a hand trowel, use inward scooping motions to remove the forest floor organic matter (L, F and H layers) taking care to remove all organic material above the mineral soil. Discard any rocks or pebbles collected with the forest floor material. It is beneficial to have a tarp or piece of thick plastic on which the sample materials can be placed as the sample is collected. This may avoid loss of parts of the sample.

7. Bag and label each forest floor sample separately in a 10-mm weight, plastic bag. Place a label in each bag identifying the sample number and micro-plot number and whether there is more than 1 bag for a sample [identify as 1 of 1, or 2 of 3, etc.].

8. Measure the average depth of the excavated surface organic matter or residue to the nearest 0.5 cm. In order to capture the average depth, make sure the depth is measured in several places in the excavated hole. Record the average depth of the forest floor layer on the tally card.
9. Note: the forest floor sample may be offset 0.5 m to 1.0 m from the transect to avoid trampling and disturbance of the plot for other measurements, e.g. shrub and herb clipping and measurements, as long as the site chosen is representative of the site. The forest floor sample will also be offset if anomalous site conditions are encountered, e.g. a large ant hill, fallen sound wood. If the forest floor site is offset, clip and remove the fine wood and plants as per the normal micro-plot procedure.

**Forest floor organics > 20 cm in depth**

10. Collect the top 20 cm of surface organics on all four clip plots.

11. Collect and measure the total surface organics, in 20 cm thick intervals, to mineral soil / rock surface on one of the clip plots. This sample is necessary in order to get at least one bulk density measurement and sample for all depths of the surface organics.

12. Sampling of these sites should be conducted in the driest portion of the field season. The volume measurement of the organics will be obtained using the dimensions of the cut-out forest floor sample. No further excavations beyond the mineral/organic interface are necessary in instances where the organic layer extends beyond 60 cm in depth.

13. Note: there will be a large bulk of sample to bring back to the lab on these types of sites, e.g. the West Coast of Vancouver Island and North-Eastern parts of B.C.

**Soil Bulk Density and Carbon Sampling**

*Objective*

To collect seven, 1.0 to 1.5-Litre samples of mineral soil at approximate depths of 0 to 15 cm, 15 to 35 cm and 35 to 55 cm for each plot.

To measure the volume of each of the mineral soil samples extracted for the determination of soil bulk density. The samples will also be analyzed in the laboratory for carbon content, various mineral components, cation exchange capacity, pH and other soil properties.

*Definition*

*General Procedures*

Establish the forage sampling micro-plots along the woody debris transects.

Excavate the bulk density soil samples from the soil pit and three additional sites at three of the four micro-plots or at an equivalent, representative area nearby that is in or near the micro-plot. The following samples are to be taken:

- At the soil pit take 3 samples
  - 1 sample from 0 to 15 cm
  - 1 sample from 15 to 35 cm
  - 1 sample from 35 to 55 cm
- At one of the micro-plots take 2 samples
  - 1 sample from 0 to 15 cm
Change Monitoring Procedures for Provincial and National Reporting

- 1 sample from 15 to 35 cm
- At two of the other micro-plots take 1 sample
  - 1 sample from 0 to 15 cm

**Detailed procedures**

1. Upon cutting out the square forest floor layer at the soil pit, clear an area of the remaining organic material that is larger than the template (e.g. 50 x 50 cm) to begin excavation of the soil pit and samples.

2. Level an area about 20 x 20 cm and excavate a round hole inside the square for extracting the first soil sample. The hole should be approximately 12 to 15 cm in diameter (for a 15 cm deep sample) to allow for the extraction of at least 1.0 to 1.5 Litres of mineral soil. The minimum depth of the initial excavation should be 15 cm but could be adjusted to allow for sampling an entire layer.

3. During the excavation, extreme care must be taken not to compact the sides of the hole as this will affect the bulk density of the sample. A good way to avoid soil compaction during excavation is to always keep the handle of the trowel pointed in towards the centre of the hole, with the blade of the trowel pointing outwards.

**Mineral soil sampling on sloped terrain**

4. Note: as much as is possible, the soil bulk density sample should be taken on as level a surface as possible. In terrain located on a slope, the excavated hole should be located in the flattest location possible. This may mean clearing away a few centimetres of the Ae or Ah on one side to ensure a flat surface for sampling.

5. For the first excavation, measure the average depth of the hole after the few centimetres of Ae or Ah on one side have been cleared away.

6. Use glass beads or water for the volume measurement.

7. Note in the comments section that the depth measurement was taken on a slope and the percent of the slope.

**Mineral soil sampling in sites abundant with coarse fragments**

8. Note: if rocks (> 7.5 cm diameter, cobbles and stones) are encountered that take up more than ½ of the volume of the excavated hole, abandon the site and proceed with a new excavation in a different location. On sites where there are a lot of coarse fragments, this means that the initial excavation may take 2 or 3 tries before it is successful. An alternative to this method would be to excavate a larger diameter hole that captures the boundary of the coarse fragment(s).

9. Optional: to avoid having to carry the larger rocks removed from the hole, any adhering soil could be cleaned off the rocks and placed into the sample bag. The rock would then be weighed to the nearest gram. The volume of the rocks could then be estimated assuming rock to have a density of 2.65 g/cm³.
Mineral soil sample excavation and extraction

10. Extract the loose soil from the hole using the long-handled soup spoon and place in the 10-mm, heavy-duty bag.

11. Clean off the face of the hole using the hand-clippers or knife. All roots extending into the hole must be clipped and included in the sample.

12. Using your fingers or knife, smooth the surface of the hole and make sure there are no voids, e.g. where coarse fragments may have been extruding. If there are voids, the dimensions of the hole must be extended to accommodate a reasonably smooth surface.

13. Using the 5-mm weight plastic bag, line the hole and fill the bag with the glass beads (or water). Make certain the surface of the beads is flush with the top of the excavated hole.

14. Pour the beads (or water) into the 1.0-L graduated cylinder, measure the volume to the nearest 10.0 mL and record the information on the tallycard. The volume of beads exceeding 1.0 L can be measured using the 100 mL cylinder for greater accuracy.

15. Mark the sample number, volume and depth on the tallycard, label inside the sample bag and on the outside of the sample bag. If large rocks were removed from the sample, make note of their volume on the bag and the tallycard also.

Mineral soil excavations for second and third samples

16. Pick a feature in the excavated hole that marks the depth of the excavation. A golf tee or aluminium nail may also be used to mark the depth. It is important to excavate samples at depths that are continuous with one another.

17. Clear an area (to the same depth) that is larger than the already excavated area (e.g. 50 x 50 cm) to allow for sampling at the next depth. This larger area can serve as the soil pit on one site that needs to be dug for pedogenic layer description and coarse fragment content estimation.

18. Perform the second excavation using the same method as the first excavation. The second excavation should be between 15 cm to 35 cm in depth and should be approximately 1.0 L to 1.5 L of mineral soil. Record the sample number (sample 278), depth (15 cm to 35 cm) and volume (1.6 Litres) of the second excavation on the tally card, place a label inside the sample bag, and on the outside of the sample bag.

19. Perform the third excavation also using the same method. The third excavation should be between 35 to 55 cm in depth and should equal 1.0 to 1.5 L of mineral soil. Record the sample number, depth and volume of the third excavation on the tally card, place a label inside the sample bag, and on the outside of the sample bag.

20. Note: the second and third excavations will require extra care and effort to obtain. The top layer of the initial excavation surface should be cleared to a broad and level surface (an area larger than the size of the 40 cm square) before successive deeper holes are excavated.
Importance of obtaining continuous mineral samples

21. The highest amount of carbon is located in the first and second excavations of mineral soil. For analysis purposes, it is important to obtain samples that are continuous with one another.

22. Due to site-specific reasons, excavating at the specified depth increments may not always be possible. If excavating at the specified depths is not possible still attempt to take three continuous samples at successive depths.

23. Make note of why taking the samples at the targeted depths was not possible on the tally card in the comments section. Ensure the depth that the sample was taken at is noted on the tally card, the label inside the sample bag and on the outside of the sample bag.

Distinguishing organic/mineral interfaces

24. Distinguishing the organic/mineral interface can be more difficult on sites with humus forms that are well-mixed, e.g. a Moder humus over an Ah layer.

25. Technically, a soil horizon is classed as mineral soil when it contains an organic carbon content ≤ 17% by weight. For field purposes, the determination is usually made by hand-feeling for the presence of mineral materials in order to judge the organic/mineral interface.

26. Where the determination is unclear, make a best judgement call in the field and then note it on the tally card in the comments section. Appropriate measures will be taken in the lab processing of the samples.

Unobtainable samples

27. If a sample was not obtained due to site-specific reasons, e.g. ‘hit bedrock or site filled with large coarse fragments’, label an empty bag and send this back with the samples that were successfully obtained.

28. Make sure to note why the sample was not obtained on the tally card in the comments section and the label inside the empty sample bag.
29. Sending an empty sample bag, with the reason the sample was not obtained in the field, ensures the lab staff are better able to keep track of the samples, e.g. the lab staff do not think that one of the samples was lost or is missing.

Quality Assurance of Bulk Density Samples

The bulk density procedures will involve destructive sampling. Extreme care must be taken in the sampling of mineral soils for bulk density measurements, as quality assurance for these procedures will not be possible.

It is suggested that the field crew member performing the bulk density sampling procedures perform a dozen practice excavations before the actual data collection to ensure that consistency of methods is achieved.

Bulk Density Sampling in Organic Sites/Soils

Bulk density sampling in organic soils will not be conducted this field season.

7.4 Describing Vegetation

Species Coding System

There are a number of taxonomically difficult plants which need only be identified to the level of genus. In the interests of saving time, you are not required to identify these plants to the species level. However, if you know the species and/or time permits, you are encouraged to record these genera to the species level.

In general, species codes consist of the first 4 letters of the genus and the first 3 letters of the species. The most current plant species codes and descriptive information is available at the following website:

http://www.for.gov.bc.ca/research/becweb/standards-species.htm

However, there are a number of instances which would result in the same code for two different species. For example Vaccinium myrtilloides and Vaccinium myrtillus. The species that comes first alphabetically is assigned the standard code, and the last letter of the code for the second species defaults to the fourth letter in that species’ name. Thus V. myrtilloides = VACCMYR_ and V. myrtillus = VACCMYT_. This is a potentially serious error, which may be impossible to detect or correct. You must refer to master lists provided for the biogeoclimatic units in your project area, to ensure the code you use is correct.

If the genus is known but not the species, record all the characters (up to 7) in the genus. For example, if an unknown lichen of the Cladonia genus is collected, it is coded as CLADONI_. A grass of the Poa genus would be coded as POA_ _ _ __. If the grass is known to be Poa alpina, it would be coded as POA_ALP_.

If you are uncertain of genus but know the plant family, record the first 6 letters of the family name, and collect a specimen for determination. As an example, several species from the sunflower family could be recorded as ASTERA1 and ASTERA2, rather than as HERB1 and HERB2.
Assuming the species is unknown, use the following coding priority for vascular plants:

- genus > family > non-Latin code such as “FERN.”

Since family names are not as widely documented for lichens, liverworts, and mosses, the coding priority for these non-vascular unknown species is:

- genus > non-Latin code such as “MOSS” (see Table 7.15).

As a general rule, the non-Latin unknown code uses 4 letters (MOSS), the family code uses 6 (ASTERA), and the genus code uses 7 (VACCINI) or fewer if there are not 7 available (POA, CAREX, SALIX).

Although not encouraged, an 8-character code, may be used for special purposes to distinguish a variety or subspecies. For example, PINUCON1 versus PINUCON2, to differentiate *Pinus contorta* var. *contorta* (shore pine) from *Pinus contorta* var. *latifolia* (lodgepole pine).

**Table 7.16 – Suggested coding conventions for collected unknown species.**

<table>
<thead>
<tr>
<th>Code*</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>“genus”</td>
<td>code first 7 letters of genus</td>
</tr>
<tr>
<td>“family”</td>
<td>code first 6 letters of family</td>
</tr>
<tr>
<td>TREE</td>
<td>coniferous or deciduous tree</td>
</tr>
<tr>
<td>SHRU</td>
<td>coniferous or deciduous shrub</td>
</tr>
<tr>
<td>SEED</td>
<td>coniferous or deciduous seedling</td>
</tr>
<tr>
<td>HERB</td>
<td>herb (catch-all for herb-layer species)</td>
</tr>
<tr>
<td>Lycop or CLUB</td>
<td>clubmosses belong to one family “Lycopodiaceae”</td>
</tr>
<tr>
<td>SELAGIN</td>
<td>lesser-clubmosses belong to one genus “Selaginella”</td>
</tr>
<tr>
<td>Equiset or HORS</td>
<td>horsetails belong to one genus “Equisetum”</td>
</tr>
<tr>
<td>FERN</td>
<td>fern</td>
</tr>
<tr>
<td>GRAM</td>
<td>graminoid (grass, rush or sedge)</td>
</tr>
<tr>
<td>POACEA or GRAS</td>
<td>grasses belong to one family “Poaceae”</td>
</tr>
<tr>
<td>Juncac or RUSH</td>
<td>rushes belong to one family “Juncaceae”</td>
</tr>
<tr>
<td>CYPERA or SEDG</td>
<td>sedges belong to one family “Cyperaceae”</td>
</tr>
<tr>
<td>SAPR</td>
<td>saprophyte or parasite</td>
</tr>
<tr>
<td>LICH</td>
<td>lichen</td>
</tr>
<tr>
<td>LIVR</td>
<td>liverwort</td>
</tr>
<tr>
<td>MOSS</td>
<td>moss</td>
</tr>
</tbody>
</table>
Collecting Unknown Species and Voucher Specimens

1. Collect a sample for any species you cannot identify in the field for which you should record a percentage.

   Depending on the project, Voucher Specimens may be required. *Voucher Specimens* are samples collected, preserved, and stored to later verify identifications made in the field.

   - For trees, low shrubs, and tall shrubs, collect representative samples of flowers, fruits/cones, bark, a branch with leaves (needles) showing branching patterns. Record the height of plants when they are not collected as an intact specimen; this would obviously apply to trees and most shrubs.
   - For herb-layer species collect the entire plant or as much of the plant as feasible, including roots and, in particular, any flowering structures.
   - For mosses and lichens, collect a “palm-of-the-hand” size sample. Try to include moss capsules, lichen apothecia.

2. The following points will ensure good-quality specimens:

   - Use appropriate containers: paper bag, envelopes, plastic bags (allow air in occasionally).
   - Press or process as soon as possible.
   - Keep different genera separated.
   - Keep mosses/lichen samples separated and unpressed to maintain their three-dimensional form.
   - Cross-reference to item number on field card.
   - Collect specimens from outside the plot area, if possible.

3. Complete a waterproof plant label: for each plant sample being forwarded for identification (Fig. 7.4). Concentrate on microsite conditions directly associated with the plant, rather than duplicating general habitat or site information for the larger sample plot.

   Typical plant microsite habitat information:

   - soil or substrate conditions (humus, decaying wood, fibric organic soil, coarse- or fine-textured mineral soil, disturbed or recently mixed soil, SMR and SNR conditions, salinity)
   - drainage (seepage track, stream or pond margin, depressional hollow or shedding mound)
   - exposure and other physical factors (growing in open exposed or in relatively protected/shaded conditions, in an avalanche or a slide track, exposure to periodic or frequent flooding from standing or moving water).

Record only the most applicable microsite conditions, such as in these examples: “associated with an exposed seepage draw in saturated nutrient-poor organic soil; growing in steep well-drained mor humus beneath a large canopy gap; on disturbed sandy mineral soil associated with overturned tree roots; in a rocky south-aspect grassy patch with coarse well-drained dark soil.”
In the descriptive notes, include diagnostic characteristics which may not be obvious from a casual look at the dried and/or pressed specimen. Here are some examples of useful additional descriptive information:

- distribution and abundance (solitary individuals in a scattered pattern; common and growing in small clumps; several large clumps within the plot; continuous coverage)
- leaves (leaves feel slightly sticky; fresh leaves have a cucumber scent when crushed; blades have an undulating margin)
- associated species (with skunk cabbage and lady fern; within clumps of *Cladonia spp.*, in patches with *Veratrum, Fauria* and *Sphagnum*)

Keep documentation on the labels as concise and applicable as possible. Do not allow labels to become separated from their relevant plant samples.

**Figure 7.5- CMI Unknown plant label.**

**Plant Identification**

As a guideline, you should not need to spend more than 10 minutes per plot checking your plant identification references. If you cannot quickly identify the plant, collect it.

**Identify Vascular Plants to the Species Level**

Identification of vascular plants (tree-, shrub-, and herb-layer) should be carried to the species level.

**Identify Non-vascular Plants to Genus Level**

Identification of bryophytes and lichens need only go to the genus level. Alternatively, if the species is known or if there is enough time to sample, you are encouraged to carry on to the species level. If you are uncertain about the genus, you should sample anyway.

**Recommended Procedure for Identification of Collected Plants**

1. Time permitting, identify collected plants in the evening if this can be done efficiently. Otherwise, deliver unknown plants to the project leader as soon as possible for help with identification.
2. The project leader should press or package remaining unknown samples considered sufficiently intact, and forward them to the MOF Project Ecologist. Plant samples should be organized and packaged as separate “life form” groups, for example, shrubs, ferns, graminoids, herbs, bryophytes (mosses and liverworts) and lichens. Bryophytes and lichens should not be pressed. Rather, they should be stored in loose packaging such as envelopes, so they can air-dry while retaining their general shape.

3. If the Project Ecologist is unable to identify some of the samples, intact specimens should be forwarded to the MOF Regional Ecologist.

If the Regional Ecologist is unable to identify the remaining samples within a designated time, the identifications should default to genus or possibly a higher taxonomic level, such as family. Specimen quality or developmental stage may also limit identification to a higher taxonomic level. In any case, the final database entry must be the correct code for the particular taxonomic level.

**Unknown Species Coding**

Please use the unknown species coding conventions listed in Table 7.15, as this will help simplify interpretation of the unknown coding on the forms. You are encouraged to continue recording your descriptive notes for unknown species in the comments section on the ET and EH forms, as this will help you remember the species when you determine its cover value, and later when you key the plant or store it for identification.

These codes are normally temporary if the plant has been collected for identification, and they should be replaced on the forms and in the database with the correct Latin codes upon receiving results.

**26. Species Codes**

1. Record all shrub and tree species growing in the 10 m radius plot, and all herbs and bryoids growing on the dominant substrate within the nested 5.64 m radius plot, using codes based on the scientific names. A list of scientific names with codes will be provided by a local ecologist for an inventory project. Collect samples of any unknown species, bag and label them for later identification by specialists. Record the item number from the field card on the tagged plant sample as a cross-reference.

2. Maintain a systematic method of recording the species in the plot. The results are much easier to read and compile. One common method is to record species by strata, starting with the uppermost stratum, and within strata by abundance.

3. In some circumstances it may be necessary to collect the plant list at another time of the year to take advantage of peak floristic conditions.

4. Certain ecosystems are more difficult to sample (for example, alpine, subalpine meadows, wetlands, riparian edge communities, grasslands, rock outcrops, and disturbed sites with introduced weedy and non-native species). It may be necessary to have these plots sampled by specialists.

**Estimating Percent Coverage by Layer**
Percent canopy cover is the percent of the ground area covered by a vertical projection of the crown of the plant onto the ground surface. When estimating percent cover, care must be taken not to bias estimates because of crown density. Except for distinct holes in the crown, the area within the perimeter of the crown is assumed to be fully covered. It is required that percent cover be recorded for each species in each plot. To aid in assessing percent cover, a set of comparison charts are provided in Figure 7.5. Table 7.17 also provides examples of the area coverage and the percent cover for the plot. Figure 7.6 illustrates some relative amounts of percent canopy coverage and shows the “drip line” of the plant.
Figure 7.7 - An example of percent coverages in a plot, viewed from above.

Percent cover is estimated as the percentage of the ground surface covered when the ‘crowns’ of the plants are projected vertically. The values are estimates that will vary somewhat between individuals, however, the relative cover values are required to provide information on species abundance.

With regards to species of very low coverage, you are not expected to produce an exhaustive list. It is easy to overlook a few species given the seasonal variation in flowering and vegetative production. Species of very low coverage, less than 0.1 percent can easily be missed by anyone. Save time and energy by focusing on the main substrate, which in most forested ecosystems is the forest floor, as discussed in item 4 below.

1. Initially, record an estimate of overall coverage (in percent) in each layer (all species), excluding any overlapping. Use this figure to help calibrate cover estimates for individual species.

2. Estimate the coverage for each species in the tree and shrub layers within the 10 m radius plot.

   Estimate the coverage within the nested subplot (5.64 m radius)
   • for seedlings (ET card)
   • for herbs and mosses (EH card)

   For calibration, Table 7.17 (conversion factors) shows the equivalent area for percent cover when applied to the 10 m radius main plot and 5.64 m radius nested plots.

3. If the total of individual species percentages in a layer is less than the overall total, adjust cover estimates for individual species or totals.
If the cover of a species overlaps within a strata, then the total percentage may be considerably less than the sum of individual layer coverages, but never more. **Do not sum the individual cover values to compute the overall coverage.**

Vegetation layers are listed in Table 7.16 and in Figure 7.5.

4. The D layer consists of mosses, lichens, liverworts, and seedlings. Three main substrates are recognized in Layer D:
   - Dh (on forest floor and mineral soil)
   - Dw (on decaying wood)
   - Dr (on rock)

In Layer D emphasize species growing on the main substrate, which in most cases will be Dh (forest floor or mineral soil). Describe the species on atypical substrates (for example, Dw – decaying wood, and Dr – rock) only when these substrates individually represent 40% or more of the 5.64 m vertically projected plot surface. If present, forest floor (Dh) species should always be described, because they are often important indicators of soil conditions.
### Table 7.17 – Vegetation layer codes.

<table>
<thead>
<tr>
<th>Layer</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td><strong>Tree layer:</strong> includes all woody plants greater than 10 metres tall. Estimate cover values for individual tree or shrub species for the entire A layer. Overlapping crown is not additive for the same species, consequently a given tree or shrub species cannot have coverage greater than 100%.</td>
</tr>
<tr>
<td>B1</td>
<td><strong>Tall shrubs:</strong> includes all shrubs and advanced tree regeneration between 2-10 m tall. In some low productivity and young ecosystems the canopy of mature trees may be less than 10 m tall and should be recorded in the B1 layer.</td>
</tr>
<tr>
<td>B2</td>
<td><strong>Low shrubs:</strong> consist, with minor exceptions, of shrubs and established tree regeneration less than 2 m tall and at least 2 years old.</td>
</tr>
<tr>
<td>C</td>
<td><strong>Herbs:</strong> refers to herb-layer plants such as ferns, graminoids, forbs, saprophytes, and some woody species. Appendix H provides a list of low woody species and species of doubtful lifeform assigned to the herb (C) layer.</td>
</tr>
<tr>
<td>D</td>
<td><strong>Mosses, lichens, liverworts and seedlings:</strong> includes tree seedlings less than 2 years old.</td>
</tr>
</tbody>
</table>

### Table 7.18 – Conversion factors from percent coverage to horizontal area.

<table>
<thead>
<tr>
<th>Percent coverage</th>
<th>10 m radius plot</th>
<th>5.64 m radius plot</th>
</tr>
</thead>
<tbody>
<tr>
<td>Horizontal surface area</td>
<td>314 m²</td>
<td>100 m²</td>
</tr>
<tr>
<td>25% coverage</td>
<td>¼ of the plot pie or 78.5 m²</td>
<td>¼ of the plot pie or 25 m²</td>
</tr>
<tr>
<td>1% coverage</td>
<td>1.8 m × 1.8 m or 3.14 m²</td>
<td>1 m²</td>
</tr>
</tbody>
</table>

**Note:** You are not required to record genera or species with less than 1% coverage.

| 0.1% coverage | ~ 55 cm × 55 cm or 0.31 m² | ~ 32 cm × 32 cm or 0.1 m² |
| 0.01% (1H* – hundredth of a percent) | ~ 18 cm × 18 cm or 314 cm² | ~ 10 cm × 10 cm or 100 cm² |
| 0.001% (1T* – thousandth of a percent) | ~ 6 cm × 6 cm or 31.4 cm² | ~ 3 cm × 3 cm or 10 cm² |

*1H and 1T, or multiples (3H, 5H, 2T, 9T, . . .), allow for better estimates for species with very small coverage. Note that 9H or 9T is the maximum since 10H = 0.1% and 10T = 1H. “~” means approximately
Estimating Average Shrub Height

27. AVERAGE SHRUB HEIGHT B1 (M) AND B2 (M)

The height and the percent cover estimates will be used to calculate shrub volume by species.

1. Record the mean height, weighted by percent cover, for each species in shrub layers. Include all woody shrubs as well as trees in the shrub layers.
The following calculation provides the weighted average for a stand of Douglas maple 3 m tall covering 30%, with one 8 m tall shrub covering 10%.

\[
\text{Cover-weighted average height} = \frac{\sum (\text{height} \times \text{cover})}{\sum \text{cover}}
\]

\[
= \frac{(3 \text{ m} \times 0.3) + (8 \text{ m} \times 0.1)}{(0.3 + 0.1)}
\]

\[
= \frac{(0.9 \text{ m} + 0.8 \text{ m})}{0.4}
\]

\[
= \frac{1.7 \text{ m}}{0.4}
\]

\[
= 4.2 \text{ m (round down to nearest 0.1 m)}
\]

2. There is not enough time to calculate the weighted average in the field, and you are not expected to do it. Develop a quick visual estimate of average species height, weighted by coverage.

### 7.5 Interpreting Succession

Successional interpretations are based on an area within approximately 25 m of the Integrated Plot Centre, and within the 11.28 m plot. As the sample may cover more than one land cover type the succession interpretation which best describes the IPC location is to be recorded.

1. Record data on the EO Field Card using appropriate codes.
2. Identify factors influencing vegetation, including previous and current tree species, and structural class of the area surrounding the Integrated Plot Centre.
3. Assess the factors used to determine old growth characteristics of the stand, and estimate the percent of old trees remaining.
4. Decide whether the stand is old growth or not.
5. If not old growth, decide whether the stand has some old-growth characteristics.

### 28. Factors Influencing Vegetation Establishment

Record the major observable factors that are relevant to development of the current vegetation and soil characteristics. The time frame is (approximately) the past 500 years. Use from one to a maximum of four of the categories shown in Table 7.18. Only record factors for which direct evidence can be observed.

Use a 2-character description (such as Aw), or a 1-character description (such as A __) if the specific factor is unknown.

Enter a slash if no evidence can be observed.
Table 7.18 is adapted from the *Field Manual for Describing Terrestrial Ecosystems* draft, 1996. Table 7.19 provides a more detailed description of certain factors – marked *.

**Table 7.19 – Site disturbance codes.**

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>A</strong></td>
<td>Atmosphere-related effects</td>
</tr>
<tr>
<td>e</td>
<td>climatic extremes (extreme cold and/or heat; glaze ice, hail, heavy snow)</td>
</tr>
<tr>
<td>p</td>
<td>atmospheric pollution (toxic gases, acid rain)</td>
</tr>
<tr>
<td>w</td>
<td>windthrow*</td>
</tr>
<tr>
<td><strong>B</strong></td>
<td>Biotic effects (specify animal or plant in comments)</td>
</tr>
<tr>
<td>b</td>
<td>beaver tree-cutting*</td>
</tr>
<tr>
<td>d</td>
<td>domestic grazing/browsing</td>
</tr>
<tr>
<td>e</td>
<td>excrement accumulation (other than that normally associated with grazing/browsing)</td>
</tr>
<tr>
<td>i</td>
<td>insects (infestation, kill)*</td>
</tr>
<tr>
<td>p</td>
<td>disease (excluding insects)*</td>
</tr>
<tr>
<td>v</td>
<td>aggressive vegetation</td>
</tr>
<tr>
<td>w</td>
<td>wildlife grazing/browsing (specify animals)</td>
</tr>
<tr>
<td><strong>D</strong></td>
<td>Disposals</td>
</tr>
<tr>
<td>c</td>
<td>chemical spill or disposal</td>
</tr>
<tr>
<td>e</td>
<td>effluent disposal</td>
</tr>
<tr>
<td>g</td>
<td>domestic garbage disposal</td>
</tr>
<tr>
<td>m</td>
<td>mine spoils</td>
</tr>
<tr>
<td>o</td>
<td>oil spill or disposal</td>
</tr>
<tr>
<td>r</td>
<td>radioactive waste disposal or exposure</td>
</tr>
<tr>
<td><strong>F</strong></td>
<td>Fires</td>
</tr>
<tr>
<td>c</td>
<td>overstorey crown fire*</td>
</tr>
<tr>
<td>g</td>
<td>light surface (ground) fire</td>
</tr>
<tr>
<td>i</td>
<td>repeated severe surface fires (intense)</td>
</tr>
<tr>
<td>l</td>
<td>burning of logging slash (broadcast burn, piled and burned, burned windrows)</td>
</tr>
<tr>
<td>r</td>
<td>repeated light surface fires</td>
</tr>
<tr>
<td>s</td>
<td>severe surface fire*</td>
</tr>
<tr>
<td><strong>L</strong></td>
<td>Forest harvesting</td>
</tr>
<tr>
<td>a</td>
<td>patch cut system</td>
</tr>
<tr>
<td>c</td>
<td>clearcut system (if slash burned, see also Fires)</td>
</tr>
<tr>
<td>d</td>
<td>seed tree system (uniform, grouped)</td>
</tr>
<tr>
<td>e</td>
<td>selection system (group selection, strip, single tree)</td>
</tr>
<tr>
<td>l</td>
<td>land clearing (includes abandoned agriculture)</td>
</tr>
<tr>
<td>o</td>
<td>coppice</td>
</tr>
<tr>
<td>s</td>
<td>shelterwood system (uniform, group, strip, irregular, natural, nurse tree)</td>
</tr>
<tr>
<td><strong>M</strong></td>
<td>Plant or site modification effects</td>
</tr>
<tr>
<td>c</td>
<td>herbicide (chemical) use</td>
</tr>
</tbody>
</table>
## Code | Description
---|---
f | fertilization
g | seeded or planted to grasses
h | seeded or planted to herbs
i | irrigation
s | planted or seeded to shrubs
t | planted or seeded to trees

### P Gathering or removal of plant products

| Code | Description |
---|---|
f | firewood gathering
m | mushrooms
o | moss
s | salal
x | other (specify in comments)

### S Soil disturbance

| Code | Description |
---|---|
a | cultivation (agricultural)
c | compaction
e | excavation
f | sidecast/fill
g | gouging (> 5 cm into mineral soil)
m | mining effects (placer tailings, rock quarrying, open pit mines, tailings)
p | mechanical site preparation (brush blading, scarification, trenching, mounding)
r | road bed, abandoned
s | scalping (forest floor removed)
t | railway, abandoned

### T Terrain-related effects

| Code | Description |
---|---|
a | avalanche
d | recent deglaciation
e | eolian (active soil removal or deposition by the wind)
s | terrain failures (active/recent slumps, slides, solifluction – soil creeping)
v | volcanic activity

### W Water-related effects

| Code | Description |
---|---|
d | water table control (diking, damming)
e | water table depression (associated with extensive water extraction from wells)
i | inundation (including temporary inundation resulting from beaver activity)
s | temporary seepage (usually man-induced; excludes intermittent seepage resulting from climatic conditions)

### X Miscellaneous (for further disturbance types, enter “X” and describe in comments)

*Indicates additional information in Table 7.19

For certain factors shown in Table 7.18, further details are provided in Table 7.19.
Table 7.20 – Indications of site disturbances.

<table>
<thead>
<tr>
<th>Signs of windthrow</th>
</tr>
</thead>
<tbody>
<tr>
<td>• trees may be uprooted or snapped along the bole</td>
</tr>
<tr>
<td>• may lie parallel to each other if in patches</td>
</tr>
<tr>
<td>• stands arising after extensive windthrow will have mounded terrain</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Signs of clearcut logging</th>
</tr>
</thead>
<tbody>
<tr>
<td>• scattered, large stumps of similar species, size condition</td>
</tr>
<tr>
<td>• evidence of saw cut or felling machine cut on stumps</td>
</tr>
<tr>
<td>• CWD may be of a few large logs from previous stand and smaller material from mortality in new stand</td>
</tr>
<tr>
<td>• new growth will contain trees of fairly uniform DBH/height</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Signs of selective logging</th>
</tr>
</thead>
<tbody>
<tr>
<td>• scattered larger stumps, possibly of the same species</td>
</tr>
<tr>
<td>• skid trails will be visible</td>
</tr>
<tr>
<td>• larger trees of the logged species should still be present</td>
</tr>
<tr>
<td>• do not confuse with small clearcut</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Signs of surface fire</th>
</tr>
</thead>
<tbody>
<tr>
<td>• larger CWD will be charred or partially burned</td>
</tr>
<tr>
<td>• standing trees will have charred lower boles, and crowns raised (crown scorch)</td>
</tr>
<tr>
<td>• lower crown foliage discoloured (recent fire)</td>
</tr>
<tr>
<td>• dead or dying smaller trees in the understory (recent fire)</td>
</tr>
<tr>
<td>• fire scars on larger trees (basal wound with a burned catface) if surface fires common in area</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Signs of overstorey crown fire</th>
</tr>
</thead>
<tbody>
<tr>
<td>• most trees dead; most of their foliage gone and some small twigs</td>
</tr>
<tr>
<td>• bark charred (recent); bark shed, leaving silvery snag (older)</td>
</tr>
<tr>
<td>• soil organic layer consumed to various degrees</td>
</tr>
<tr>
<td>• tree roots exposed near boles</td>
</tr>
<tr>
<td>• charred debris present</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Signs of beaver tree-cutting</th>
</tr>
</thead>
<tbody>
<tr>
<td>• stumps show chipping and conical tops</td>
</tr>
<tr>
<td>• bark may be removed from larger branches</td>
</tr>
<tr>
<td>• primarily hardwood trees and willowy shrubs</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Signs of disease</th>
</tr>
</thead>
<tbody>
<tr>
<td>• symptoms specific to each agent (cankers, rusts, mistletoes, blights, root diseases)</td>
</tr>
<tr>
<td>• swellings on branches or boles</td>
</tr>
<tr>
<td>• dead leaves, needles, bark, tops</td>
</tr>
<tr>
<td>• resin flows, galls, brooms</td>
</tr>
</tbody>
</table>
• distress cone crops and fruiting bodies on various parts

**Signs of Insects**
• symptoms specific to each type (defoliators, sucking insects, woody tissue feeders)
• foliage discoloration to foliage loss
• curled twigs, branch galls, crown distortion
• stunted or deformed leaders

**Signs of snow avalanching**
• tracks (if fairly frequent); shrub and herb species instead of trees (in tracks)
• broken branches, snapped boles, piles of debris
• windthrow or pushed over trees
• forests affected may be on slope beside or between tracks or in valley floor below runout zone

**Signs of slope failures**
• sharp boundaries with remaining forest (severe)
• upper portion consists mostly of exposed mineral soil
• lower portion composed of soil, rock and forest debris
• debris forms mounded or lobed pattern
• trees dead, displaced or leaning
• older failures show decreasing mineral soil and increased organic matter
• slow regeneration of trees

29. **TREE SPECIES SUCCESSION**
1. In forested ecosystems look for signs of the earlier predominant tree species. The primary species has the greatest basal area.
2. Record previous and current predominant tree species with the appropriate code. For example, in a red alder stand with western hemlock and western redcedar stumps, record “previous species” as Hw _ Cw _, and “current species” as Dr _. Alternatively, if the stand is, and appears to have always been Bl _ Se _, simply record as Bl _ Se _ in both previous and current species boxes.
3. If stumps are present but they are unidentifiable, record the appropriate code for: Unknown (X _ _ ), Unknown hardwood (Xh _ ), Other hardwood species (Zh _ ).

**Stand Structure Features**
Evidence for the decision as to whether or not the stand has some old growth characteristics will be based on the following set of observations.

30. **TREE HARVESTING**
Record if the forest has experienced some form of harvest:

<table>
<thead>
<tr>
<th>Clearcut</th>
<th>C</th>
<th>Partial</th>
<th>P</th>
<th>None</th>
<th>N</th>
</tr>
</thead>
</table>
31. SNAGS > 25 CM DBH

*Count* the standing dead trees within the 25 m radius that meet the minimum size criteria: >25 cm DBH and >10 m tall or shorter due to advanced stage of decay (for example, wildlife tree classes 7 to 9).

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>N</td>
</tr>
<tr>
<td>Some</td>
<td>S</td>
</tr>
<tr>
<td>Common</td>
<td>C</td>
</tr>
</tbody>
</table>

32. SNAGS/CWD IN ALL SIZES AND STAGES OF DECAY

Assess the range of size and decay stage of the snags and CWD and record using codes in Table 7.20. This observation is meant to identify those sites where snag and coarse woody debris recruitment is an ongoing process.

**Table 7.21 – Snags/CWD codes.**

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td><em>No</em> no snags that meet the minimum size criteria, or all snags are within a narrow range (1 or 2) of decay classes; CWD absent or limited to a narrow range of decay classes.</td>
</tr>
<tr>
<td>S</td>
<td><em>Some</em> snags meet the minimum size criteria but are limited to 3 consecutive decay classes; CWD limited to 3 consecutive decay classes.</td>
</tr>
<tr>
<td>Y</td>
<td><em>Yes</em> snags meet the minimum size criteria and represent most decay stages; CWD in most decay classes.</td>
</tr>
</tbody>
</table>

33. CANOPY GAPS DUE TO TREE MORTALITY

Gaps are openings, caused by natural tree mortality, which are not yet occupied by A3 layer (>10 m tall) or equivalent trees. Mortality refers to natural causes of death; for instance trees have blown over, snapped off, or died standing.

1. Record gaps in the canopy that are due to natural tree mortality using codes in Table 7.21.
2. Do not count gaps if the cause of death appears to be related to harvesting or other human activities. It may be hard to decide, for example, where death is due to fire or other damage that could be related to human activities.
3. Do not include openings due to climatically drier or otherwise harsh regimes where trees are widely spaced. This also does not include natural stocking irregularities which may be caused by edaphic factors such as shallow soils, bluffs or rock outcrops, seepage or stream channels, wet depressional sites, colluvium, slide or avalanche tracks, snow accumulation patches, landings, trails, and roads.
4. Do not include successionaly young sites where trees have not yet grown into the A3 layer.
Table 7.22 – Canopy gap codes.

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>None</td>
</tr>
<tr>
<td>S</td>
<td>Smaller gaps amounting to &lt;10% of crown closure in 25 m area.</td>
</tr>
<tr>
<td>C</td>
<td>One or more larger gaps occupying 10% or more of the potential canopy area.</td>
</tr>
</tbody>
</table>

34. VERTICAL STRUCTURE

Describe the distribution of shrub and tree layer strata using Figure 7.6 and Table 7.22.

Table 7.23 – Vertical structure codes.

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>S</td>
<td>Simple Tends to be even-height, with limited coverage in up to two other strata (B2, B1, A3, A2, or A1).</td>
</tr>
<tr>
<td>M</td>
<td>Moderate Tends to be uneven height with &gt;10% of total coverage in each of three strata (B2, B1, A3, A2, or A1).</td>
</tr>
<tr>
<td>C</td>
<td>Complex Stand is uneven-height with &gt;10% of total coverage in each of four or five strata (B2, B1, A3, A2, and A1).</td>
</tr>
</tbody>
</table>

Figure 7.9 – Stratification of forest stands, shrubs, and trees.
35. SUCCESSIONAL STABILITY
Assess whether the dominant species composition is relatively stable and record the appropriate code from Table 7.23. We need to know if there is likely to be change in species composition of the dominant vegetation. It is important to consider the potential of a given species in a particular site.

For example, in a MH__ wh__ subzone plot there may be frequent Hw__ and Cw__ in the understory, but observations on the way to the plot suggest that in spite of their shade tolerance, few, if any, Hw__ and Cw__ survive into the main canopy, which is occupied by Hm__, Yc__ and some Ba__.

Table 7.24 – Successional stability codes.

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>U</td>
<td>Unstable</td>
</tr>
<tr>
<td></td>
<td>Change in dominant species composition is imminent. Clues are recently disturbed sites, early structural stages, or presence of shade-intolerant (pioneer) species for the given site. With no apparent sign of a short cyclic major disturbance regime (floods, slides, windthrow, fire, disease) the vegetation will likely progress unimpeded to more advanced structural stages, with changes in dominant species composition along the way. Unstable means that the relative rate of change is rapid (on the order of less than 40 years).</td>
</tr>
<tr>
<td>I</td>
<td>Intermediate</td>
</tr>
<tr>
<td></td>
<td>Change in species composition has and will continue to take place in the dominant vegetation. The longevity of the species involved is such that the relative rate of change in composition is gradual, but directional (on the order of 40 — 80 years).</td>
</tr>
<tr>
<td>S</td>
<td>Stable</td>
</tr>
<tr>
<td></td>
<td>Persistence in dominant species composition is apparent from factors such as advanced structural stage, occupation by shade-tolerant species, or when the rate of change in the dominant species composition is relatively very slow (stable for more than 80 years). Even relatively young dominant vegetation may qualify as stable if there is little sign of change in species composition. For example, an avalanche track dominated by slide alder would be considered stable if disturbance appears to be frequent enough to maintain the alder. Likewise a young shade-tolerant Hw__ stand that is unlikely to undergo much change in dominant species composition as its canopy gains height and structural complexity, would also be considered stable.</td>
</tr>
</tbody>
</table>

36. TREE AGE FOR SPECIES AND SITE SERIES
Assess whether the trees appear old for their species and the site conditions, and record one of the codes shown in Table 7.24.

Because few tree ages are being collected, this will be difficult to determine. Even-aged stands will tend to be the easiest to evaluate. In a stand with differing tree ages, assigning an approximate age for the trees dominating the site will be difficult. Concentrate on the trees that dominate the canopy.
Table 7.25 – Stand age codes.

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
</table>
| Y    | Young  
     | Characteristic of even-height forests in the young forest or earlier structural stages.                                                                 |
| I    | Intermediate  
     | Species may have attained near-maximum height, but there is little mortality in the main to upper canopy as the species are only in a mature forest stage. |
| O    | Old  
     | Trees in the upper canopy have been established for a relatively long time. Some upper canopy trees appear to have reached their physiological maximum age. Others may already have died. |

37. TREE SIZE FOR SPECIES AND SITE

Evaluate the size of the trees on the plot, relative to the potential size expected for the site quality, amount of disturbance, and growing time. Relatively larger trees will obviously tend to be found in the less disturbed, older stands. Even-aged stands will be easier to evaluate.

<table>
<thead>
<tr>
<th>Small</th>
<th>S</th>
<th>Intermediate</th>
<th>I</th>
<th>Large</th>
<th>L</th>
</tr>
</thead>
</table>

38. STRUCTURAL STAGES

Evaluate the stand and record one of the codes shown in Table 7.25. Note that, depending on the climatic conditions and the site properties, the length of time required to reach mature and/or old forest stages varies considerably.

Table 7.26 – Structural stage codes.

<table>
<thead>
<tr>
<th>Code</th>
<th>Structural Stage</th>
<th>Definition</th>
<th>Time since major disturbance</th>
</tr>
</thead>
<tbody>
<tr>
<td>NV</td>
<td>Non-vegetated</td>
<td>&lt; 5% vegetation cover</td>
<td>&lt;20 years for normal forest succession. Up to 100+ years for rocky or bouldery substrates and other severe sites.</td>
</tr>
<tr>
<td>SP</td>
<td>Non-vegetated or Sparse</td>
<td>Initial stages of primary and secondary succession. Little or no residual vegetation except up to 100% cover of bryophytes and lichens. &lt;10% cover of vascular plants. This stage may be prolonged (50 — 100+ years) where there is little or no soil development (bedrock, boulder fields).</td>
<td></td>
</tr>
<tr>
<td>H</td>
<td>Herb</td>
<td>Early successional stage or restricted development due to environmental conditions or disturbance (snow fields, avalanche tracks, wetlands, flooding, grasslands, intensive grazing, intense fire damage) dominated by herb-layer (forb, graminoid, fern) vegetation; some</td>
<td>&lt;20 years for normal forest succession. Up to 100+ years under conditions of soil, climate, or disturbance which limit succession.</td>
</tr>
<tr>
<td>Code</td>
<td>Structural Stage</td>
<td>Definition</td>
<td>Time since major disturbance$^1$</td>
</tr>
<tr>
<td>------</td>
<td>------------------</td>
<td>------------</td>
<td>----------------------------------</td>
</tr>
<tr>
<td></td>
<td></td>
<td>invading or residual shrubs and trees may be present. Tree cover &lt;10%, shrub cover &lt;20% or &lt;33% of total cover, herb-layer cover ≥20%, or ≥33% of total cover.</td>
<td></td>
</tr>
<tr>
<td>LS</td>
<td>Low Shrub</td>
<td>Early successional stage or restricted development due to environmental limitations and conditions, dominated by shrubby vegetation &lt;2 m tall. Seedlings and advance regeneration may be abundant. Tree cover &lt;10%, shrub cover ≥20% or ≥33% of total cover.</td>
<td>&lt;40 years for normal forest succession. Up to 100+ years under conditions of soil, climate, or disturbance which limit succession.</td>
</tr>
<tr>
<td>TS</td>
<td>Tall Shrub</td>
<td>Early successional stage or restricted development due to environmental limitations and conditions dominated by shrubby vegetation &gt; 2 m and &lt; 10 m tall. Seedlings and advance regeneration may be abundant. Tree cover &lt;10%, shrub cover ≥20% or ≥50% of total cover.</td>
<td></td>
</tr>
<tr>
<td>PS</td>
<td>Pole/ Sapling</td>
<td>Trees &gt;10 m tall, have overtopped shrub and herb layers and stands are typically densely stocked; younger stands are vigorous and usually &gt; 10–15 years old. Older pole-sapling stages composed of stagnated stands (up to 100 yrs. old) are also included. This stage persists until self-thinning and vertical structure becomes evident in the canopy (often by the age of 30 yrs. in vigorous deciduous stands). Deciduous stands are generally younger than coniferous stands belonging to the same structural stage.</td>
<td>&lt; 40 years for normal forest succession. Up to 100+ years for dense (&gt; 2,000 stems/ha.) stagnant stands.</td>
</tr>
<tr>
<td>YF</td>
<td>Young Forest</td>
<td>Self-thinning has become evident and the forest canopy has begun differentiation into distinct layers (dominant, main canopy, and overtopped); vigorous growth and a more open stand than in the pole-sapling stage; begins as early as age 30 and extends to 50 — 80 years depending on tree species and ecological conditions.</td>
<td>40 — 80 years</td>
</tr>
<tr>
<td>MF</td>
<td>Mature Forest</td>
<td>Trees established after the last disturbance have matured and a second cycle of shade tolerant trees may have become established; understories become well developed as the canopy opens up.</td>
<td>80 — 140 yrs. for Biogeoclimatic group A$^2$ 80 — 240 yrs. for Biogeoclimatic group B$^3$</td>
</tr>
<tr>
<td>OF</td>
<td>Old Forest</td>
<td>Old, structurally complex stands comprised mainly of shade tolerant and regenerating tree species, although older seral and long-lived trees from a disturbance such as fire may still dominate the upper canopy; snags and coarse woody debris in all stages of decomposition are typical and understories are patchy. In some ecosystems, such as high elevation, or otherwise stressed, the understorey may have a number of tree species which are uncommon in the canopy,</td>
<td>&gt;140 yrs. for Biogeoclimatic group A$^2$ &gt;240 yrs. for Biogeoclimatic group B$^3$</td>
</tr>
</tbody>
</table>
39. PERCENTAGE OF LIVE OLD TREES REMAINING

Assess the proportion of live old-growth trees by examining the numbers of dead and living old forest or old-growth trees (see table 7.25 Old Forest structural stage ages for your biogeoclimatic unit: for example, in the MS zone trees > 140 years are old growth trees, or their remains, in the form of snags, fallen trees, or stumps to support your estimate. This is not an estimate of the number of live old trees versus an imaginary potential number of old-growth trees. For example, if the 25 m radius area has evidence of 10 old trees and only 3 are still alive and standing, the value would be 30%.

Examples:

\[
\frac{2 \text{ old trees}}{2 \text{ old trees} + 0 \text{ old tree snags} + 0 \text{ fallen old trees} + 0 \text{ stumps}} \times 100\% = 100\%
\]

\[
\frac{0 \text{ old trees}}{0 \text{ old trees} + 2 \text{ old tree snags} + 1 \text{ fallen old trees} + 3 \text{ stumps}} \times 100\% = 0\%
\]

\[
\frac{3 \text{ live old trees}}{3 \text{ live old trees} + 2 \text{ dead old trees} + 5 \text{ stumps of old trees}} \times 100\% = 30\%
\]

If the percentage of live old trees remaining is less than 40%, the site is probably too disturbed for the old growth forest designation.

40. OLD-GROWTH FOREST

Base your choice on your opinion using all the succession attributes discussed above. “No (some)” suggests the stand has some old growth forest attributes, but it is not old growth.

Record one of the following:

<table>
<thead>
<tr>
<th></th>
<th>No</th>
<th>No (some)</th>
<th>Yes</th>
</tr>
</thead>
</table>

1 Structural characteristics have priority over time guidelines.

2 BGCU Group A includes the following: BWBSdk, BWBSmw, BWBSvk, BWBSwk, ESSFdc, ESSFdk, ESSFdv, ESSFxc, ICHdk, ICHdw, ICHmk1, ICHmk2, ICHmw1, ICHmw3, MS, SBPS, SBSdh, SBSdk, SBSdw, SBSmc, SBSmh, SBSmk, SBSmm, SBSmw, SBSwk1 (on plateau), and SBSwk3.

3 BGCU Group B: All other biogeoclimatic units.
Literature Cited


8. Woody Debris

Introduction

Woody debris is a major contributor to structural diversity in forests and provides habitat for plants, mammals, amphibians, insects, and micro-organisms. It influences hillslope and stream geomorphology, affects the microtopography and microclimate of the forest floor, is an important nutrient and moisture pool, and in some ecosystems, may be a nitrogen fixation site.

This section outlines the procedures for establishing the sampling transects, for deciding which woody debris to measure, and for recording the measurements.

Objectives

1. To accurately determine the gross volume of Fine (FWD), Small (SWD) and Coarse woody debris (CWD) by decay class.
2. To identify merchantable material and potential removals.

Definitions

Coarse woody debris (CWD), for the purpose of this inventory, is dead woody material located above the soil, in various stages of decomposition. CWD must be larger than 7.5 cm in diameter (or equivalent cross section) at the crossing point, and not self-supporting. Trees and stumps (intact in ground) are considered self supporting.

CWD can also be in the form of felled and bucked logs or log decks.

Small woody debris (SWD), for the purposes of this inventory, is defined as dead woody material located above the litter layer, in various stages of decomposition. Small woody debris must be 1.1 centimetres or larger and less than 7.6 centimetres in diameter (or equivalent cross section) at transect crossing point, and not self supporting. Trees and stumps intact in the ground are considered self supporting.

Fine woody debris (FWD), for the purposes of this inventory, is defined as dead woody material located above the litter layer, in various stages of decomposition. Fine woody debris must be less than 1.1 centimetres in diameter (or equivalent cross section) at the crossing point, and not self supporting. Trees and stumps intact in the ground are considered self supporting.

General Procedures

1. Set out the 30 m sampling transects.
2. Assess the transect conditions.
3. Measure and record information for the CWD pieces.

**Field Cards for this Section**

**Coarse Woody Debris (EW) (Appendix A, Figure A.9)**
Field card for the random transect 1, species, diameter, % class 1, other decay class, tilt angle, accumulations.

**Coarse Woody Debris (EC) (Appendix A, Figure A.10)**
Field card for transect 2 — species, diameter, % class 1, other decay class, tilt angle, accumulations.

**National Forest Inventory – Small Woody Debris**  (Appendix N)
Field card for recording small and fine woody debris in classes by average decay class.

**Detailed Procedures**

**8.1 Establishing the Sampling Transects**

Coarse woody debris is sampled along two horizontal 30 m line transects extending from the Integrated Plot Centre.

1. Establish the first line at a pre-assigned random azimuth from the plot centre.
2. Measure out along the random azimuth with a tape to 30.0 m, correcting the distance to horizontal.
3. Mark the 10.0 meters, 20.0 meters and the end of the transect, for example, with a small stick stuck in the ground, flagged with ribbon (temporary marking for quality control), or a small paint mark on the ground.
4. Mark along the line with logging paint the intersection of the line transect with potential small and coarse woody debris.
5. Number a few of the large CWD with log marking paint to aid remeasurement and quality control.
6. Establish the second line at plus 90° from the first transect commencing at the Integrated Plot Centre.
7. Record the azimuth of each line on the Coarse Woody Debris (EW) and (EC) Field Cards.
8. Measure the following pieces of coarse and small woody debris along the transect:
   a. From the IPC to 10.0 metres measure all CWD greater than 30.0 cm.
   b. From 10.0 metres to 20.0 metres measure all CWD equal to or greater than 7.6 cm.
   c. From 20.0 metres to the end of the transect measure all SWD and CWD equal to or greater than 1.1 cm.
9. Record the following measurements for the coarse and small woody debris:
   a. For the CWD record the standard measurements
b. For the SWD record the following attributes
   (i) Number of pieces by diameter class [the equivalent area for odd shaped pieces is also displayed] as follows:
   - Class 1 = 1.1 cm to 3.0 cm (0.8 cm² to 7.1 cm²)
   - Class 2 = 3.1 cm to 5.0 cm (7.1 cm² to 19.6 cm²)
   - Class 3 = 5.1 cm to 7.5 cm (19.6 cm² to 44.1 cm²)

   c. For all pieces of SWD assign one decay class for all pieces

   **Note:** The following conditions should be noted when measuring SWD:
   a. Small woody debris may include wood chunks, bark and cones
   b. Small woody debris should only be measured if it is above the litter (L layer)
   c. Odd shaped pieces will be estimated as an equivalent round diameter class
   d. Branches, roots etc (less than 7.6 cm) that intersect each transect (these may be attached to CWD) are to be measured as SWD or FWD as appropriate.
   e. If a crown from a fallen tree is encountered, estimate the number of line intersects and record the average diameter for the group rather than individually measuring each intersection.
   f. If aerial pieces are encountered only measure the piece if it is located in the B2 shrub layer (0.0 metres to less than 2.0 metres above the ground)

### 8.2 Assessing the Transect Conditions

Normally, the full length of the transect will be sampled. However, because the transects are based on a random bearing, unsafe or difficult conditions may be encountered and you may be unable to sample the full length.

If the full length of the line cannot be sampled, record the distance you actually sampled, and explain in the Comments section why the remainder was not measured.

Possible situations are:

1. **Normal conditions** — Sample both 30 m transects using the procedures outlined in Section 8.3.
2. **Anomalous conditions** — If the sample line intercepts an anomaly along the transect such as a stream, pond, avalanche chute, on a rock outcrop (Figure 8.1) continue to sample the line as long as it is safe to do so. If the debris is floating, the pieces are measured in their location at the time of sampling (make a note of this in the comments).
3. **Unsafe conditions** — If the sample line intercepts unsafe conditions, record the length of the line actually sampled in the field. (For example if you encounter a cliff at metre 19 record “horizontal length observed 19 out of 30” Note in the Comments section why a portion was not sampled.

5. Transect encounters a heavy accumulation of CWD

   - The Provincial Change monitoring Inventory will be measuring the full length of all CWD transects as long as conditions are safe for the crew.

### 8.3 Sampling CWD Along the Transects

**Which CWD to measure**

**Measure** the following along the transects:

- All pieces of CWD greater than 7.5 cm in diameter (or an equivalent area at the crossing of 44.2 square centimeters measured perpendicular to their length for odd shaped pieces) where the centreline is crossed by the vertically projected transect.

- Fallen or suspended (not self-supporting) dead tree boles, with or without roots attached, that intercepts the vertically projected sample line whether the transect passes above or below the CWD (Figure 8.2). CWD may be suspended on nearby live or dead trees, other coarse woody debris, stumps, or other terrain features. Visually estimate unmeasureable suspended CWD at the intercept point.
Figure 8.2 — Measuring suspended CWD.

- Fallen trees with green foliage if they are no longer rooted to the ground.
- Large fallen branches and fallen broken tree tops, horizontal or leaning.
- Pieces that are physically attached (lengthwise) are considered to be one piece.
- Recently cut logs.
- Uprooted (not self-supporting) stumps greater than 7.5 cm in diameter and less than 1.3 metres in length, and any exposed dead roots greater than 7.5 cm.
- CWD that lies above the soil (Figure 8.3). CWD is considered no longer above the soil when it is entirely buried beneath a layer of surface organic matter (forest floor) or mineral soil.

Figure 8.3 — Side view of partially buried coarse woody debris.

Do not measure the following:

- live or dead trees (still rooted) which are self-supporting
- dead branches still connected to standing trees
- exposed roots of self supporting trees
- self-supporting stumps or their exposed roots
• a piece is no longer considered CWD when the wood is decomposed to the point where it could be described as forest floor humus.

**Determining “in” or “out” CWD**

To be measured the CWD piece must be greater than 7.5 cm in diameter (or equivalent) at the point where the line transect crosses the centreline. The *centreline* is the midline of any section of wood (Figure 8.4 and 8.5.), and may not correspond to the pith.

**Figure 8.4 — Centreline of a CWD piece (top view).**

If the sample line appears to follow the centreline of the CWD, decide whether it is “measured” (transect line crosses centreline of CWD) or “not measured” (transect line does not cross centreline).

**Figure 8.5 — Measuring CWD near the centreline of the piece.**

**Measuring CWD in the Standard Transect Section**

For each CWD record the following:
### SPECIES

1. Record the tree species using the approved tree species code (see Appendix C).

2. If the species or genus cannot be determined, record the best available information as follows:

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zc</td>
<td>other conifer not on the list (record species name in Comments section)</td>
</tr>
<tr>
<td>Xc</td>
<td>unknown conifer</td>
</tr>
<tr>
<td>Zh</td>
<td>other hardwood not on the list (record species name in Comments section)</td>
</tr>
<tr>
<td>Xh</td>
<td>unknown hardwood</td>
</tr>
<tr>
<td>X</td>
<td>unknown (you cannot determine if it was conifer or deciduous)</td>
</tr>
</tbody>
</table>

### DIAMETER

1. Record (to nearest 0.1 cm) the diameter (or equivalent) of the CWD perpendicular to the bole at the point where the transect crosses the CWD (Figure 8.6).
Transect Measure diameter perpendicular to bole Centreline of piece

Figure 8.6 — Measuring diameter of circular CWD cross sections.

2. If the sample line intersects a curved or angular CWD more than once, measure each intersection as a separate observation, as shown in Figure 8.7.

Top View

Figure 8.7 — The sample line intersects the CWD more than once.

3. If the diameter cannot be measured, estimate it.

4. If the cross section is oval rather than circular estimate an “equivalent diameter” that will more accurately suggest the cross-section area. If the cross section is hard to express as a circle (or equivalent to a circle), refer to the procedures for measuring odd-shaped CWD.

5. Estimate an “equivalent” diameter for the remaining portion of CWD where part of the wood has decayed and become part of the soil layer.

6. If a log has split open but is still partially held together, record the equivalent diameter as if the piece were whole. If a stem has shattered into a number of distinct unconnected pieces, record each piece that is larger than 7.5 cm in diameter at the point of sampling.

7. If the CWD is hollow, estimate the diameter equivalent to the remaining wood.

LENGTH

For the Provincial CMI, the measurement of piece length is not required. A field has been left on the field card in case specific projects require length measurements for other purposes.

% Decay Class 1 (at the Transect Crossing)

All CWD cross sections will be assessed a percentage decay class 1. The decay classes are shown in Table 8.1.
• Determine the percentage decay class 1 by probing the CWD close to the point of intersection with an axe (do not destroy the CWD at the line intercept)
• Record the percentage of decay class 1
• If decay class 1 equals 100%, record as “___ ___”
• If decay class 1 equals 0%, record as “00”

Note: Percentage decay class 1 is an estimate across the cross section, not for the CWD as a whole. Decay class 1 is equivalent to wood commonly referred to as “sound” which is suitable for lumber or chips (regardless of the length or diameter).

CLASS OTHER (AT THE TRANSECT CROSSING)

Record the decay class of the remaining percentage of the CWD piece cross section using the classification scheme shown in Table 8.1.

• The emphasis is on the wood texture. Other criteria, such as portion on the ground, twigs, bark, shape, and invading roots, are guidelines to the wood texture.

Table 8.1 — Coarse woody debris decay classes

<table>
<thead>
<tr>
<th>WOOD TEXTURE</th>
<th>CLASS 1</th>
<th>CLASS 2</th>
<th>CLASS 3</th>
<th>CLASS 4</th>
<th>CLASS 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Other associated characteristics</td>
<td>intact, hard</td>
<td>intact, hard to partly decaying</td>
<td>hard, large pieces, partly decaying</td>
<td>small, blocky pieces</td>
<td>many small pieces, soft portions</td>
</tr>
<tr>
<td>PORTION ON GROUND</td>
<td>elevated on support points</td>
<td>elevated but sagging slightly</td>
<td>sagging near ground, or broken</td>
<td>all of log on ground, sinking</td>
<td>all of log on ground, partly sunken</td>
</tr>
<tr>
<td>TWIGS &lt; 3 cm (if originally present)</td>
<td>twigs present</td>
<td>no twigs</td>
<td>no twigs</td>
<td>no twigs</td>
<td>no twigs</td>
</tr>
<tr>
<td>BARK</td>
<td>bark intact</td>
<td>intact or partly missing</td>
<td>trace bark</td>
<td>no bark</td>
<td>no bark</td>
</tr>
<tr>
<td>SHAPE</td>
<td>round</td>
<td>round</td>
<td>round</td>
<td>round to oval</td>
<td>oval</td>
</tr>
<tr>
<td>INVADING ROOTS</td>
<td>none</td>
<td>none</td>
<td>in sapwood</td>
<td>in heartwood</td>
<td>in heartwood</td>
</tr>
</tbody>
</table>

TILT ANGLE

The tilt angle is the angle, measured in degrees, between the central axis of the CWD and the horizontal plane at the crossing point (Figure 8.8).
Figure 8.8 — Measuring the tilt angle of CWD pieces.

Measure the angle the CWD makes from the horizontal, regardless of the slope of the ground. Normally you can place a clinometer on the top surface of the CWD at the point of the intercept and record the angle in degrees.

**MERCHANTABILITY**

If the CWD is an X grade or better, record it appropriately. An X grade or better may potentially be harvested.

**PRODUCT TO REMOVE P/R**

This procedure is designed to accommodate wood that might be removed from the site. If the piece is expected to be removed as product (for example, blowdown which is scheduled for harvest, shakeblocks or felled and bucked material), record an “X” in the P/R Column. This does not include a merchantable piece that is expected to be left on site.

**DECAY CLASS FOR PIECE**

Record the class for the entire CWD piece using the classification scheme shown in Table 8.1.

- Decay Class is based on the wood texture. Assess the conditions along the entire piece length to determine Class on the basis of volume. Other criteria, such as the portion on the ground, twigs, bark, shape, and invading roots, are guidelines to the wood texture.
Measuring Odd-Shaped CWD

Record any odd-shaped CWD encountered in the appropriate section of the field card.

Note: It is important that any CWD that is not round or oval in cross section be recorded in this category. A different volume compilation formula is used because the measurement is made along the transect line, not at right angles to the centreline of the CWD.

1. Record the species of the CWD.
2. Measure the full horizontal length and average vertical depth of the CWD along the transect (this gives a rectangular area equivalent to the cross section along the transect).
   - the length is the full distance along the line intersect (shown as “L” in Figure 8.9).
   - the depth of the cross section is the average depth along the line intersect (shown as “D” in Figure 8.9).

Note: It is incorrect to measure the length and width, average the values, and record it as a circular cross section.

Example: An odd-shaped CWD is 25 cm x 40 cm.
- Consider the cross section as a rectangle and record the 25 and 40 in the accumulations section.
- Record the other information in the same way as in the “standard transect” section for round pieces.

![Figure 8.9 — Measuring the horizontal length and vertical depth of odd-shaped CWD.](image)

Measuring Accumulations

In heavy accumulations that cannot be safely or accurately measured, record an estimate of the depth and length of the accumulation.

1. Record the full horizontal length of the line intercept through the accumulation, and the **average** vertical depth of the accumulation. Visually compress the pile to measure the actual cross sectional area of wood, not the space between the pieces, as shown in Figure 8.10.
2. Identify and record species, as possible.
If the mixture of species is complex or too difficult to identify, record the following:

<table>
<thead>
<tr>
<th>Ze _</th>
<th>other conifer not on the list (record species name in Comments section)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Xc _</td>
<td>unknown conifer</td>
</tr>
<tr>
<td>Zh _</td>
<td>other hardwood not on the list (record species name in Comments section)</td>
</tr>
<tr>
<td>Xh _</td>
<td>unknown hardwood</td>
</tr>
<tr>
<td>X _ _</td>
<td>unknown (you cannot determine if it was conifer or deciduous)</td>
</tr>
</tbody>
</table>

3. If species can be determined, estimate the proportion of each, and record length and depth for each species separately.

Note: This horizontal and vertical cross section is the part which is along the transect line, not the average of the entire pile, and CWD described in this way is treated as rectangular in cross section.

4. For each species, record the other information in the same way as in the standard transect section.

![Figure 8.10 — Measuring an accumulation of coarse woody debris.](image)

**8.4 Sampling FWD on the Micro-plots**

1. Establish the range micro plots at 6.0 metres and 12.0 metres along the line transects.
2. Collect all fine woody debris less than 1.1 centimetres in diameter within each of the micro plots which is above the litter layer.
   (a) Clip pieces less than 1.1 centimetres at the plot edge. Collect all pieces less than 1.0 centimetres in diameter within the micro plot.
   (b) If a piece within the micro plot is less than 1.1 centimetres at one end of the piece and greater than 1.1 centimetres at the other end clip the piece at 1.1 cm diameter and collect the portion less than 1.1 centimeters. For example, if a large woody
debris piece located in the micro plot has fine branches less than 1.0 centimetres
these would be clipped at the tree bole or at 1.1 centimetres and collected.
(c) Pieces which extend into the litter layer will be clipped at the surface of the litter
layer.
(d) Collect all pieces within one bag for all 4 micro plots for subsequent removal from
the site and further measurement. Pieces may be cut into convenient sized portions
to facilitate bagging the material.
(e) Cones, bark, wood chunks and other debris less than 1.1 centimetres will also be
collected
(f) If aerial pieces are encountered only collect pieces located in the B2 shrub layer
(0.0 metres to less than 2.0 metres above ground level)
(g) Store the collected material in a cool dry place in a well ventilated bag to inhibit
development of mould or fungal growth
(h) Place a label in each bag identifying the sample number and whether there is more
than 1 bag for a sample (identify as 1 of 1, or 2 of 3, etc.]
(i) The fine woody debris will, if necessary, be air dried to remove excessive moisture.
The sample will then be oven dried (55 degrees for 24 hours) and weighed with the
information recorded on the CFS field card.

Note: a detailed field sheet to collect the fine and small woody debris data has been
developed by the CFS and is attached in Appendix N.
9. Range Resources

Introduction
Livestock and wildlife species use shrub and herbaceous biomass at various times of the year, and depend on the availability of these plants for their health and survival.

Resource stewards need to know the species and abundance of shrubs and other plant communities in an area. To manage livestock, range managers also need estimates of forage production, utilization of graminoids and forbs, and a measure of shrub abundance. This information may be used to allocate forage to livestock and wildlife in selected areas, to create short- and long-term plans, to make decisions on range improvements, to determine seral stages of plant communities, and to measure changes in plant community composition over time. Species composition and identification of site series is described in Section 7.

Forage production estimates may be correlated with other vegetation (such as forest or terrestrial) cover attributes and then projected across the growing season for site series or other vegetation classes.

Forage utilization information is used to adjust production estimates to reflect total forage abundance prior to grazing by wildlife or livestock. These estimates may also be used to determine use zones and may also contribute towards range-use planning (along with other range samples). Forage measurements in the Change Monitoring Inventory (CMI) procedures can be made at any time during the growing season, therefore range managers may choose to use these estimates only as an indication of total production or utilization for that location.

Range managers require information on the species composition of livestock forage and identification of site series. The method for generating a comprehensive vegetation list for identifying site series is described in Section 7: Plants, Soils and Old Growth.
Objectives

1. To provide estimates of forage production of graminoids and forbs by clipping plots.
2. To provide estimates of forage utilization of graminoids and forbs using forage utilization classes.

Definitions


**Foliar Cover** is defined as the percentage of ground covered by the vertical projection of the aerial portion of plants. Small openings in the canopy and intraspecific overlap are excluded. Foliar cover is always less than canopy cover; either may exceed 100% (S.R.M.).

**Forage Production** is the weight of forage that is produced within a designated period of time on a given area. The weight may be expressed as either green, air-dry, or oven-dry. The term may also be modified as to time of production such as annual, current year’s, or seasonal forage production (S.R.M.). Production can also be expressed as animal unit months (AUMs), which is the amount of dry forage required by one animal unit for one month based on a forage allowance of 26 pounds (11.7 kg) per day.

**Forbs** are any broad-leaved herbaceous plants except Gramineae (or Poaceae), Cyperaceae and Juncaceae families (S.R.M.) and, for forage measurement purposes, include ferns and fern allies, club mosses, and horsetails.

**Graminoids** are grass or grass-like plants (sedges and rushes) such as *Poa*, *Carex*, and *Juncus* species (S.R.M.).

**Phenology** is the study of periodic biological phenomena which are recurrent, such as flowering or seeding, especially as related to climate (S.R.M.).

**A shrub** is defined as a plant that has persistent woody stems and a relatively low growth habit and that generally produces several basal shoots instead of a bole. It differs from a tree by its low stature (generally less than 10 m) and non-treelike form (*Glossary of Range Terms*, Ministry of Forests 1994). Appendix K Low woody species and intermediate life forms lists doubtful lifeform species that are, for the purpose of this inventory, to be considered forbs and not shrubs. Therefore they are to be included in the clipped plot and not in the line intercept.

**Stolon** is a horizontal stem which grows along the surface of the soil and roots at the nodes (S.R.M.). A stoloniferous plant is a plant that has stolons.

**Utilization** is the proportion of current year’s forage production that is consumed or destroyed by grazing animals. May refer either to a single species or to the vegetation as a whole (S.R.M.).

Utilization refers to the percentage of plant weight removed, not the percentage of plant height removed.
General Procedures
Forage production measurements are discussed in this section. The recommended sequence of procedures is shown below:

1. On the transect line established for the measurement of coarse woody debris, establish the forage sampling micro-plots.
2. Estimate and record forage use.
3. Clip the forbs and graminoids to measure forage abundance.

Field Cards for this Section
Range Sampling (RS) (Appendix A, Figure A.7) forage production section only (it should be noted that the existing field cards indicate the collection of information that is additional to the data collection requirements for this program.)

Detailed Procedures
9.1 Establishing Forage Sampling Micro-Plots
Forage production measurements are usually made immediately after the Integrated Plot Centre is established to avoid trampling of the forbs and graminoids.

Figure 9.2 — Range resources sampling transects and micro-plots.
**Procedure**

1. Using the coarse woody debris transects, establish four micro-plots at points 6 m and 12 m (horizontally corrected distance) from the Integrated Plot Centre. Each micro-plot has a radius of 0.399 m and an area of 0.5 m$^2$.

2. The design of the transects and micro-plots is shown in Figure 9.1.

### 9.2 Estimating Forage Utilization

**Procedure**

1. Examine the herbaceous plant use within each of the four micro-plots and the area immediately adjacent (1 — 2 m around) and estimate forage use. Refer to Table 9.1 for a description of utilization classes and codes. You may find the utilization gauge developed by the USFS Rocky Mountain Forest and Range Station useful for some British Columbia species.

2. Record the utilization code on the field card before clipping herbaceous plants as described in Section 9.3.
Table 9.1 — Herbaceous forage utilization classes and codes

<table>
<thead>
<tr>
<th>Code</th>
<th>Class</th>
<th>Range (% utilized)</th>
<th>Utilization</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Nil</td>
<td>(0%)</td>
<td>The plants show no evidence of use.</td>
</tr>
<tr>
<td>1</td>
<td>Slight</td>
<td>(1 to 15%)</td>
<td>The plants show very little evidence of use and have the appearance of very slight grazing. Key forage plants may be topped or slightly used. Current seed stalks and young plants of key species show little disturbance.</td>
</tr>
<tr>
<td>2</td>
<td>Light</td>
<td>(16 to 35%)</td>
<td>The plants may be topped, skimmed, or grazed in patches. Low-value plants are ungrazed and 60 to 80% of current leafage of key plants remain intact.</td>
</tr>
<tr>
<td>3</td>
<td>Moderate</td>
<td>(36 to 65%)</td>
<td>The plants appear rather uniformly grazed. Fifteen to 25% of the number of current leafage of key species remain intact. No more than 10% of the number of low-value forage plants are used. (Moderate use does not imply proper use). Applied to a use zone, the area is entirely covered as uniformly as natural features or livestock facilities will allow.</td>
</tr>
<tr>
<td>4</td>
<td>Heavy</td>
<td>(66 to 80%)</td>
<td>Key species are almost entirely used, with &lt;10% of the current leafage remaining. More than 30% of the number of low-value plants have been utilized. Applied to a use zone, the area has the appearance of complete search. Some trampling damage may be evident.</td>
</tr>
<tr>
<td>5</td>
<td>Extreme</td>
<td>(&gt;80%)</td>
<td>Key species that are carrying the grazing load and are closely cropped. There is no evidence of reproduction or current seed stalks of key species. Applied to a use zone, the area has a mown appearance, and there are indications of repeated coverage. Trampling and trailing is evident.</td>
</tr>
</tbody>
</table>

From Procedures for Environmental Monitoring in Range and Wildlife Habitat Management, Habitat Monitoring Committee 1990

9.3 Clipping the Plot

Procedure

1. All plots will be fully clipped. Record an “X” in the “full” box on the field card.

2. Collect and label the current year’s growth of herbaceous material. Clip all the live material (at a height of 2 cm) of the forbs and graminoids in each of the four micro-plots. The material will be oven-dried in a drying oven at 55°C for 24 hours, and weighed in the field office. This measurement is used as an indicator of forage production.

3. Clip all forb and graminoid species as listed in the B.C. Ministry of Forests Vegetation Coding List.
   - Clip a forb or graminoid if the germination point is within the plot.
   - A plant is considered “in” or “out” of the plot depending on the germination point where the plant enters the soil.
• A stolon from a stoloniferous plant (such as wild strawberry) rooted within the plot is considered part of the plot. (Clip the stolon at the plot boundary if the stolon is rooted outside the plot perimeter.)
• A non-rooted stolon connected to a stolon rooted within the plot is considered part of the plot.
• If a plot splits a large clump of grass (where the germination point is not easily determined) then clip the portion within the plot.
• If the base of the forage is in standing water, clip the material below water line at the 2 cm height if practical. If not practical, clip the material at the water line and record an estimate of the portion clipped in the comments.
• Clip doubtful forb species listed in Appendix K — Low woody species and intermediate life forms.
• Do not spend excessive time separating live current year’s growth from dead vegetation. If a small amount of dead forbs or graminoids are present, simply remove a corresponding amount of live material. This will save time and still give a reasonable estimate of forage production.

4. Record (Y/N) on the RS Field Card (Appendix A, Figure A.7) if the forbs or graminoids have been collected.

5. Place the clipped samples in collection bags. Keep the forbs and graminoids in separate bags. Group all the forbs for a sample (4 micro-plots) in one bag and all graminoids for a sample in a separate bag.

6. Complete the sample labels (Figure 9.2) and return the bags to the field office where they will be oven dried (55°C for 24 hours) and weighed, and the information recorded on the RS field card. It is appropriate to air dry the sample before oven-drying. To air-dry, leave the forage in paper bags open in a warm dry room for several days as necessary to remove excess moisture. Rotate the forage in the bags to ensure even drying and to prevent decomposition.

Appendix K provides a list of low woody species and species of doubtful lifeform assigned to the herb (C) layer. These plants are collected as forbs in the forage production plots. A complete species list is available for downloading in Access97 database format or as an Excel file from the following locations via the RISC or Ministry of Forests websites at: http://www.for.gov.bc.ca/research/becweb/standards-species.htm

The species of doubtful lifeform are listed as “lifeform 12” on these files.
Literature Cited


Habitat Monitoring Committee. 1990. Procedures for environmental monitoring in range and wildlife habitat management. B.C. Min. For. and B.C. Min. Env., Lands and Parks, Victoria, BC.


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