Wildlife / Dangerous Tree Assessor's Course Workbook

Wildland Fire Safety Module

WorkSafeBC
WORKING TO MAKE A DIFFERENCE

Revised Edition – **March 2020**

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Foreword

This training course provides information and technical procedures for assessing tree hazards and establishing appropriate safe work practices in situations where there is potential exposure from dangerous trees to workers involved in wildland fire fighting. Information on habitat quality is intended to be used to retain some high-value wildlife trees where opportunities exist to assess both tree hazards and wildlife tree habitat value, on fires where there is enough time to assess wildlife tree habitat components.

Fire crews involved in wildland fire fighting have competing time constraints impacting detailed tree assessment to determine if trees that appear dangerous, that might be assessed as safe. This course focuses on worker safety assessment of tree defects which can be visually inspected as having “high defect failure potential” and the decisions that support hazard reduction.

Persons who wish to learn more about wildlife/Dangerous Tree assessments applicable to post-fire forestry activities (e.g., tree planting burned areas), should take this training module in conjunction with the Wildlife/Dangerous Tree Assessor’s Course for “Harvesting and Silviculture.”

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COURSE BACKGROUND

This module is intended for those who work around potentially Dangerous Trees in wildland fire operations.

Those participants wishing to become qualified assessors must have the following course prerequisites:

- Three or more years of practical field experience in the area of forestry, resource management, parks management, wildland fire protection, arboriculture, or a related field; and
- Grade 10 equivalency in reading, writing and arithmetic skills (including the ability to calculate percentages); and
- Ability to identify tree species native to BC; and
- Proven forestry measurement skills to determine tree diameter, height, lean, stem cross-section, and distance measuring; and
- Persons must demonstrate that they have recent fire-line experience (at least 10 days over the previous 3 years); OR
- Persons have a minimum of 5 days of documented Dangerous Tree assessment experience (harvesting/silviculture, parks) in the previous calendar year.

In order to receive a qualifying certificate, students must pass a certifying exam (written and field practical with combined 75% average including minimum 85% on field practical exam).

Certified assessors will be recognized by WorkSafe BC, Ministry of FLNRORD and the Ministry of Environment & Climate Action Strategy.

COURSE GOALS AND OBJECTIVES

Goals

The goals of the Wildlife/Dangerous Tree Assessor's course it to present information, practical field experiences and methods for:

- Dangerous Tree and wildlife identification;
- maintaining a safe work environment;
- retaining selected wildlife trees and habitat that do not compromise safety.

Objectives

Participants on successful completion of the 2-day Wildlife/Dangerous Tree Assessor's Course will be trained to:

- identify important attributes of wildlife and Dangerous Trees;
- assess trees for their failure potential;
- make appropriate safety decisions regarding assessed trees and work activities;
- determine tree hazards and related safe work and communication procedures for dealing with Dangerous Trees in wildland fire operations;
- recognize existing and potential wildlife trees, identifying wildlife tree use and understand the importance of wildlife trees.

WHAT IS A WILDLIFE TREE?

Trees have various stages of life, death and decay that are important components of the structure and function of natural forest ecosystems. They are constantly being formed by biotic and abiotic factors such as insects, fungi, fire and weather. Wildlife trees are part of this cycle of that create habitat for birds and mammals to survive.

> *A wildlife tree is any standing dead or live tree with special characteristics that provide valuable habitat for the conservation or enhancement of wildlife.*

In British Columbia, 80 species of birds, mammals and amphibians depend on wildlife trees for nesting, feeding and shelter. Some wildlife trees are protected under Section 34 of the provincial *Wildlife Act*, which reads as follows:

> *"A person who, except as provided by regulation, possesses, takes, injures, molests or destroys*
>
> *(a) a bird or its egg,*
>
> *(b) the nest of an eagle, peregrine falcon, gyrfalcon, osprey, heron or burrowing owl, or*
>
> *(c) the nest of a bird not referred to in paragraph (b) when the nest is occupied by a bird or its egg commits an offence."*

Depending on their cause of death, specific tree defects and condition, and the type of work activity, some wildlife trees can be dangerous. A discussion of tree danger rating is found in the upcoming sections. More information on wildlife tree habitat value is found in Appendix 1.

Bat roost in cedar snag
Photo courtesy of Province of British Columbia

WILDLIFE TREES AND THE PROCESS OF TREE DEATH AND DECAY

Decay, deterioration and death of trees are natural processes that regularly occur within forested ecosystems and are partly responsible for the ever-changing nature of forests. It may appear that individual trees die randomly, however, tree death is a complex process that can occur slowly or relatively quickly. Plants can die either in whole or in part, as it is common to see trees with dead tops, branches, or roots.

Different mortality processes produce different types of wildlife trees and change the forest in different ways. The timing and rate of death depend on several factors, including but not limited to:

A. The tree species: Some trees, such as hardwoods, die from pathogens at a relatively early age (i.e., 50–60 years).

B Tree growing site and regional conditions: Trees growing outside their normal niche are less resistant to pest attacks. Trees located on harsh sites (e.g., flooded sites or on rock outcrops) are more easily stressed and susceptible to attacks by various pests

C. The age and health of the tree: Trees are most susceptible to injury and attack when they are very young, very old, or a tree has become unhealthy or stressed.

D. The pest and pathogen attack: Trees naturally have a defense system against attacks by pests. Most pests favor certain host tree species and have minor or no effect on other species. If the pests are numerous and/or aggressive, they can overcome the tree's natural defense.

Canker on pine. An obligate pathogen, the canker fungus derives its nutrition by killing host tissue.

White Mottled Rot (Ganoderma applanatum), a heart rot fungus common on hardwoods.

Simultaneous and Cumulative Pest Attacks

Often several agents simultaneously attack, weaken and ultimately kill a single tree, a small group of trees, or even an entire stand of trees. At other times the death-causing pests occur sequentially and act in an additive manner.

An example of this sequential process could be:

I. Low intensity forest fire creates a large basal scar on a western larch tree.
II. The scar is subsequently attacked and infected by a decay organism that causes heart rot.
III. After several years the decay has traveled up the trunk of the tree.
IV. A heavy snowfall and high winds cause the trunk of the tree to break off halfway up the tree. If there are no live limbs below the breakage, the tree is killed.

In this example, fire, followed by decay, followed by adverse weather conditions, combined to kill the tree.

Significance of Disease and Decay in our Forests

Generally, natural tree mortality can be attributed to three broad categories: fire, insects and disease (including losses due to adverse climatic conditions and pollution). The estimated percentages attributable to each of these categories in B.C. are:

Fire	15%
Insects	20%
Disease	65%

Note: Recent Mountain Pine Beetle Outbreak and Severe Wildfire seasons do not contribute to these statistics

WILDLIFE TREE CLASSIFICATION SYSTEM FOR B.C.

The Wildlife Dangerous Tree classification system used in B.C. describes each class of wildlife tree in several ways. This includes a simple, general description of each class, a list of the wildlife uses associated with that class, and a summary of the decay characteristics. Although this classification system is based on the decay pattern of thick-barked conifers, such as Douglas-fir and ponderosa pine, it is broadly applicable to all British Columbia native trees (conifers and broad-leaved deciduous).

The deterioration and decay processes occur in various stages, corresponding to the tree classes described below. Conifers can have up to 9 tree classes; whereas deciduous trees have 6 classes, reflecting their accelerated decay and fall-down rates as compared to conifers.

Class I: These are live, healthy trees with NO structural defects or injuries that have associated decay, and which could compromise the structural strength of the tree. Some live trees may show signs of deterioration or slight damage, such as dead branches, sound live forked or secondary tops, or minor physical injuries (e.g., healed-over stem scrapes). In most cases, these DO NOT have associated decay that might compromise the tree's structural strength.

Class 2: These are live trees but have some VISIBLE EXTERNAL DEFECT that can affect the tree's structural strength or introduce decay. The fast stages of deterioration often begin while the tree is still alive. Fungi or wood-boring beetles lead the invasion.
Wildlife trees that are alive or in the early stages of decay, attract birds that can build large open nests, such as Ospreys, Bald Eagles and Great Blue Herons, or cavity excavators such as woodpeckers and sapsuckers.

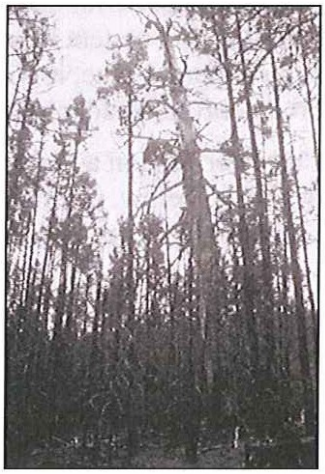
Class 2: showing large hung-up dead limb

The presence of the following **defects on LIVE** trees can be used to distinguish Class 2 trees from Class 1 trees:

- Fungal conks and/or internal decay
- Large external stem scars and/or canker face
- Visible tree cavities
- Stem cracks/splits (such as frost cracks)
- Dead tops (including secondary tops and forks) or broken tops
- Hung-up Large dead limbs (>10cm diameter) – note: natural self-pruning is not a defect
- Damaged roots (from disease, fire or mechanical damage).
- Excessive lean (>30%) AND damaged/diseased roots or a poor anchoring soil substrate - note that "sweep" is not a hazard defect.
- Unusual stem swellings (may indicate hidden decay)
- Insect or fire damage that is likely to kill the tree relatively soon (i.e., become a Class 3 tree)

Class 3, 4, and class 5 conifers: These are dead trees which usually have solid to spongy (punky) wood. Once a tree has died, decay begins or continues.

- Class 3 trees are RECENTLY dead, still bearing their fine branches and twigs, and the bark remains tight on the tree.
- Class 4 trees have lost their fine twigs and only have larger, coarse limbs left, and bark has begun to loosen or shed.
- Class 5 trees are spongy, and as a result, have signs of advancing decay in the stem and roots. Class 5 trees have shed most of their limbs but have not yet shed their tops, and the bark will be missing on parts of the stem. Woodpeckers often chisel out nesting cavities and/or feeding excavations, as the tree continues to deteriorate, and the wood softens.



Class 4: dead tree, with only larger coarse limbs

Class 5 broad-leaved deciduous: This is the tree class for deciduous trees before they fall to the ground as coarse woody debris. By this stage, the sapwood and heartwood are soft, portions of the stem have broken away, and most of the limbs are gone. Class 5 for deciduous trees is roughly equivalent to classes 6-7 for coniferous trees.

Classes 6 and 7 conifers:

When the tree reaches these stages of decay the tree is rotting from the top down, weaker excavators, such as nuthatches and chickadees, can make their nest holes in the soft wood.

- Branches are often broken off, creating knot holes and natural cavities which can be converted into homes by a variety of animals.
- Chunks of bark and sapwood are sloughing as the stem of the tree is disintegrating which creates habitat for bats.
- Decay is advanced in the upper portions of the trunk. Over the years, the tree becomes shorter as portions of the decayed top fall. Generally, up to ½ of the original top height of the tree has disintegrated away. Once the softer heartwood is exposed, wildlife trees are used less by woodpeckers and more by other animal species.

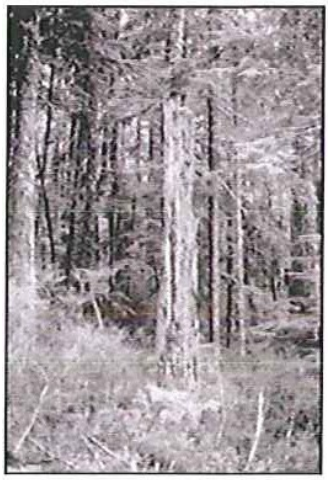
Class 7: soft heartwood, showing numerous nest cavities

Class 6 for deciduous trees represents a dead fallen tree.

Classes 8 and 9

In the final phases of tree decay, these trees are characterized and being extremely decayed.

- Class 8, only about 1/3 or less of the original tree height remains- the heartwood is highly decayed and is often visible as brown-cubical sloughing fragments.
- Class 9, the stump and the mound of woody debris that surrounds it become an ideal site for new plants to grow (nurse log/stump) because of the available moisture and nutrients. It has now become suitable habitat for amphibians, such as the clouded salamander, that require moist, thermally buffered environments.



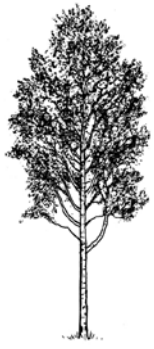
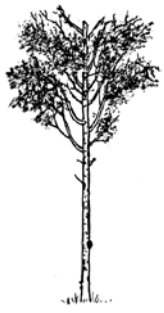
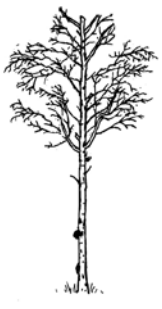
Class 8

TREE CLASS COMPARISON FOR CONIFERS AND HARDWOOD TREES

The following tree decay class diagrams illustrate the general breakage and decay patterns seen in coniferous and deciduous trees. The hardwood classification system (broad-leaved deciduous trees) is parallel to the coniferous scheme but is more accelerated in the middle and latter classes. Both systems are used in this workbook to provide information for rating trees for defect failure potential and ecological habitat value. A detailed description of common tree pathogens is found in Appendix 1 (p. 1-6).

	Live				Dead				Dead Fallen
Conifers	1	2	3	4	5	6	7	8	9
Hardwoods	1	2	3	4		5			6

	LIVE		DEAD						DEAD FALLEN
			Hard →		Spongy		→ Soft		
Tree Class	1	2	3	4	5	6	7	8	9
						approx. 2/3 original height 	approx. 1/2 original height 	approx. 1/3 original height 	
Description	**Live/healthy:** No decay or structural damage	**Live/unhealthy:** Internal decay or growth deformities or other structural damage (including stem damage, dead or broken tops); dying tree	**Dead:** Recently dead, needles or fine twigs present	**Dead:** No needles/twigs; 50% of branches lost; only larger limbs remain; often bark loose	**Dead:** Most branches/bark absent; some internal decay	**Dead:** Very little branches or bark; sapwood/ heart-wood may be sloughing from upper bowl; decay more advance; lateral roots of later trees usually softening	**Dead:** Extensive internal decay; outer shell may be hard; lateral roots usually completely decomposed; hollow or nearly hollow shells		**Debris:** Downed trees or stumps

Tree class	LIVE		DEAD			DEAD FALLEN
	1	2	3	4	5	6
						

WHAT IS A DANGEROUS TREE?

In the past, the term "snag" has been synonymous with "Dangerous Tree" and was historically defined in forestry operations as:

"a standing dead or dying tree over 3 metres in height"

However, live trees may have features that could be hazardous to workers.

The following interpretation of "Dangerous Tree" now applies and is quoted from WorkSafe BC Regulation Section 26.11:

A DANGEROUS TREE...

...is any tree (regardless of its size) that is a hazard to a worker due to:

- location or lean
- physical damage
- overhead hazards
- deterioration of limbs, stem or root system
- a combination of the above.

With reference to Dangerous Trees and the workplace,
WorkSafe BC's Occupational Health and Safety Regulation 26.11 (1) states:

26.11 (1) If it is known or reasonably foreseeable that work will expose a worker to a Dangerous Tree,

(a) the tree must be felled, or
(b) a risk assessment of the tree must be undertaken by a person who has completed a training program acceptable to the Board.

Consider the following risk equation, illustrating the relationship hazard and exposure.
Risk can be minimized by either eliminating the hazard associated with tree defect or condition or eliminating exposure of workers to the tree.

RISK = HAZARD x EXPOSURE

Exposure is not limited to the active work area where workers currently are, but also includes the perimeter of the work (within 1 tree length or greater depending on site factors such as slope), as well as other locations such as rest areas and staging areas. (See Glossary for definition of work area.)

DANGEROUS TREE ASSESSMENT PROCESS

There are five steps required to making dangerous tree management decisions:

Step 1 **Conduct site assessment overview.** Look for site factors which suggest tree decline or potential tree failure. Refer to Table 1.

Step 2 **Determine level of ground or tree disturbance** [VLR, Low, Medium or High] and type of work activity. See Table 2.

Step 3 **Conduct visual tree inspection.** Assess the tree(s) for visual hazard indicators (see tables 3, 3A and 3B). If the root condition is suspect (i.e., the roots have been burned into, severed or uplifted), a shallow root excavation with a hand tool may be necessary.

Step 4 **Make the appropriate safety decision** (either Safe or Dangerous) and implement necessary actions.

Step 5 **Provide Documentation** of assessed trees and assessed areas (includes date, location, level of disturbance, marking procedures and how Dangerous Trees have been managed).

The 5-step process is described in the sections that follow. Persons developing Dangerous Tree Assessment skills and knowledge should understand that the process described herein will be learned over time with field training, coaching and diligent practice.

Step 1: Conduct Site Assessment Overview

Table 1. Site Assessment Overview (for all tree species)

The following site/stand factors should be reviewed during a walkthrough of the site, prior to individual tree inspections. The site overview provides a context for the inspection of individual trees (i.e., it will identify overall site problems and trends such as damaged roots and soil condition, or windthrow hazard). Specific tree defect failure ratings are summarized in Table 3A. **For wildfire sites the most important site hazard indicators are bolded below.** Information and stand/site indicators found in the site overview can provide useful clues as to the condition and the potential danger of individual trees.

Site/Stand Factors	Hazard Indicators/Influences
Stand history and condition	• evidence of mass tree death (e.g., insects, disease, fire) • evidence of species-specific tree failure • **natural disturbance history** (e.g., old burn, old root rot area) • stand age and structure • tree species composition • evidence of root and/or stem diseases • **soil or slope instability, steep slopes** • sites where air tanker or water scooper aerial drops have recently occurred • sites where blasting has recently occurred
Flooding	• high water table • evidence of water damaged/decayed roots • saturated soils • area prone to flooding
Windthrow potential	• topography (e.g., ridge crests) • prevailing winds (e.g., valley bottom outflows) • evidence of significant windthrow • **area of high or recent exposure** • tall trees with small live crowns & low stem taper (which increases blowdown potential.) • **shallow soils** with restricted rooting depth (clays, bedrock)
Crown condition	• stress cone crop • thinning foliage • chlorosis • rounded crown • crown imbalance (majority of branch weight on one side)
Resinosis	• higher than normal stem or basal pitch flow (indicating internal decay, splits, or root disease)
Tree lean	• **trees recently leaning due to windstorm, root damage, shifting root mat or other causes**.
Severity of fire/burn and BUI thresholds	• **depth and severity of burn** • **amount of root burn** • **damage to anchoring soil layer** • **deep basal stem burn**
Time since fire	• If BUI Values are above the established thresholds and there is potential for **continuous active burning within the area of work** • If more than three days with continuous burning have passed since the last assessment • Consider the depth and degree of root damage from burning in the area to be assessed.

Canadian Forest Fire Danger Rating System

Fuel Type	BUI Threshold Value
C–1	>40
C–2, C–3, C–4, C–5, C–6	>60
C–7	>80
D–1	>30
M–1, M–2, M–3, M–4	>40

Build-up Index (BUI)

The Build-up Index (BUI) represents a numerical rating for forest fuels available for combustion in the sub-surface layer located between forest litter (non-decomposed vegetation) and mineral soil (parent material, hardpan, rock). This fuel layer is more commonly known as organic soil and is where the roots of trees are located, seeking nutrients and moisture. The lack of moisture entering this layer over time causes drying. This drying is represented by the BUI value where the higher the numerical rating, the drier the soil is.

A high BUI forest floor means more organic matter becomes available as fuel to wildfire and long-term smoldering. When more soil is consumed during a fire, the risk to tree instability increases, caused by the burning of the root system itself or the undermining of the anchoring soil layer which supports the roots. BUI threshold values for various fuel types are used as an indicator of potential tree instability and hazard that can compromise worker safety. (Table 1).

Different fuel types have different BUI threshold values. This is due to the relationship between soil condition (amount, depth, structure and moisture of organic layers), climate and tree species. Consequently, different forest soils have different fuel consumption rates (e.g., fires in spruce stands often burn away live roots as well as undermine the anchoring soil layer surrounding the near-surface “plate-root” system of spruces).

FBP System
Fuel types

Group	Identifier	Description
Coniferous	C-1	Spruce-lichen woodland
	C-2	Boreal spruce
	C-3	Mature jack or lodgepole pine
	C-4	Immature jack lodgepole pine
	C-5	Red & white pine
	C-6	Conifer plantation
	C-7	Ponderosa pine - Douglas fir
Deciduous	D-1	Leafless aspen
Mixed wood	M-1	Boreal mixedwood- leafless
	M-2	Boreal mixedwood- green
	M-3	Dead balsam fir mixedwood- leafless
	M-4	Dead balsam fir mixedwood- green
Slash	S-1	Jack or lodgepole pine slash
	S-2	White spruce/balsam slash
	S-3	Coastal cedar/hemlock/Douglas fir slash
Open	O-1a	Matted grass
	O-1b	Standing grass

* M-1 & M-2 are transitional between C-2 and D-1

Step 2: Determine Level of Disturbance (LOD)

Various work activities are associated with differing levels of disturbance. Activities rated as very low risk (VLR) or low disturbance (1) create negligible ground or tree disturbance and as a result, reducing worker exposure to tree failures. However, as the level of disturbance increases, so does the potential danger. As a result, fewer activities are appropriate around potentially Dangerous Trees under situations of higher ground or tree disturbance. Where exposure to people and facilities is of long or constant duration (e.g., fire camps, staging areas) are another factor assess.

Table 2 relates level of disturbance with various work activities.

Table 2 Level of Disturbance

Level of Disturbance (LOD)	Type of Work Activity
Very Low Risk (VLR) **	• surveys • stand reconnaissance • patrolling ** • tree marking, boundary marking • fire guard/control line layout • establishing hose lays in green (unburned) areas • burning off and holding patrols • road or trail travel with light vehicles (ATV, pickups <5500 kg GVWR) in green (unburned) areas
Low (Table 3)	• fire control and mop-up with hand tools and/or water hoses (manual activities only) • unmanned pump sites • establishing hose lays and unmanned pump sites in black (burned) areas • road or trail travel with light vehicles (ATV, pickups <5500 kg GVWR) in black (burned) areas and trails • road travel with heavy vehicles (>5500 kg GVWR) on maintained resource roads • tree bucking and slashing • Light vehicle parking area (independent of other higher disturbance work activities)
Medium (Table 3a)	• manned pump sites • tree falling *** • use of heavy mechanized equipment • use of light and intermediate helicopters where workers are exposed to rotor wash • road travel with heavy vehicles (>5500 kg GVWR) on a trail or overgrown road
High (Table 3b)	• use of medium and heavy helicopters where workers are exposed to rotor wash • fire camp (designated areas) and command posts • designated heavy equipment and helicopter staging and marshalling areas

* NOTE Risk can be considered as a combination of tree hazard (condition) AND exposure to that hazard (i.e. work activity and location). RISK = HAZARD x EXPOSURE

** NOTE Very Low Risk (VLR) activities usually result in negligible amounts of ground or tree disturbance and have very low exposure time to potential tree hazards. Consequently, the risk of injury or damage due to tree hazards is very low under these circumstances. **Workers should keep a "heads-up" and stay away from any obvious Dangerous Trees and overhead tree hazards (e.g., insecurely lodged trees, hanging tops or limbs). A pre-work inspection is not required for VLR activities except for foot patrolling (see page 17 for further explanation).**

*** NOTE Does not include falling Dangerous Trees identified for removal

Wind Influence

- Workers must be aware of wind conditions and the influence of wind on tree stability. Stronger winds than the conditions of assessment will increase the potential of tree defects failing.
- Dangerous Trees assessed by a certified Dangerous Tree assessor can be determined trees as safe for the current conditions of the worksite, HOWEVER may not be rated for significant increases in wind that cause full tree movement.
- If winds become significantly stronger than planned due to weather events such as thunder cells, wind gusts and advancing frontal passages, workers should be advised to consider leaving the work area and moving to a safe refuge at their own discretion when tree failures are observed.

Describing wind speeds that will affect tree stability during safety briefings is important to ensure workers are alert to changing wind conditions and the possible effect to tree stability from wind gusts. Use of safety messages in safety briefings to highlight observed wind-induced tree failure is important for workers to assess their own safety. Describe the observed tree species, topography, wind speed and your recommended conditions to change work plans.

The Beaufort Scale is a good way to communicate wind speed information.

Beaufort Scale

Beaufort number	Wind Speed (km/h)	Seaman's term		Effects on Land
0	0	Calm		Calm; smoke rises vertically.
1	1 -6	Light Air		Smoke drift indicates wind direction; vanes do not move.
2	7 - 11	Light Breeze		Wind felt on face; leaves rustle; vanes begin to move.
3	12 - 19	Gentle Breeze		Leaves, small twigs in constant motion; light flags extended.
4	20 -29	Moderate Breeze		Dust, leaves and loose paper raised up; small branches move.
5	30 - 39	Fresh Breeze		Small trees begin to sway.
6	40 - 50	Strong Breeze		Large branches of trees in motion; whistling heard in wires.
7	51 - 62	Moderate Gale		Whole trees in motion; resistance felt in walking against the wind.
8	63 - 75	Fresh Gale		Twigs and small branches broken off trees.
9	76 - 87	Strong Gale		Slight structural damage occurs; slate blown from roofs.
10	88 - 102	Whole Gale		Seldom experienced on land; trees broken; structural damage occurs.
11	103 - 117	Storm		Very rarely experienced on land; usually with widespread damage.
12	> 118	Hurricane Force		Violence and destruction.

Patrolling in Burned Stands

Foot patrols in burned areas to locate "hot spots" is considered a **Very Low Risk** work activity.

Detailed pre-work assessment for Dangerous Trees are NOT required, however assessors must implement the following **procedures for VLR activities:**

- A supervisor or certified assessor must have conducted a current site assessment overview of the work area or a similar area on that same fire that typifies conditions found on the work area (i.e., similar terrain, fuel type and fire intensity) in order to determine the general stand condition and level of fire damage **PRIOR** to the foot patrol;
- Any specific information gathered by the above site assessment (i.e. amount and type of burn damage, site factors such as steep slopes, hung-up trees, etc.) must be communicated to the foot patrol crew **PRIOR** to their work commencing;
- When foot patrolling in a burned stand is conducted as a multi-person parallel walk through, each crew person should be spaced apart and enabled to communicate hazards identified by the site assessment overview and observed hazards to co-workers.
- While patrolling, crews must be careful not to disturb or dislodge damaged trees (i.e. do not strike or push trees), which might be unstable or hazardous, while paying attention to the influence of wind disturbance on potentially unstable trees.
- If patrol crew members observe locations which require mop-up or other work procedures, these sites must be assessed by a supervisor or certified assessor for the intended LOD **PRIOR** to mop-up work activities commencing.

Step 3: Conduct Tree Assessments

Visual Tree Inspection

The determination of tree safety/danger is generally a visual process. Only trees which are considered by a certified assessor to be “suspect” or potentially dangerous after conducting the **site assessment overview** need a visual tree inspection. Careful observation of potential tree defects and hazards can generally result in determination of an individual tree’s failure potential and resultant safety decision within several minutes.

Tree Hazards

A tree can be potentially dangerous if it has defects in its top, branches, stem or root system. The degree of hazard will vary with the size of the tree, type and location of the defect, the severity of any damage, the tree species, and nature of the work activity or target.

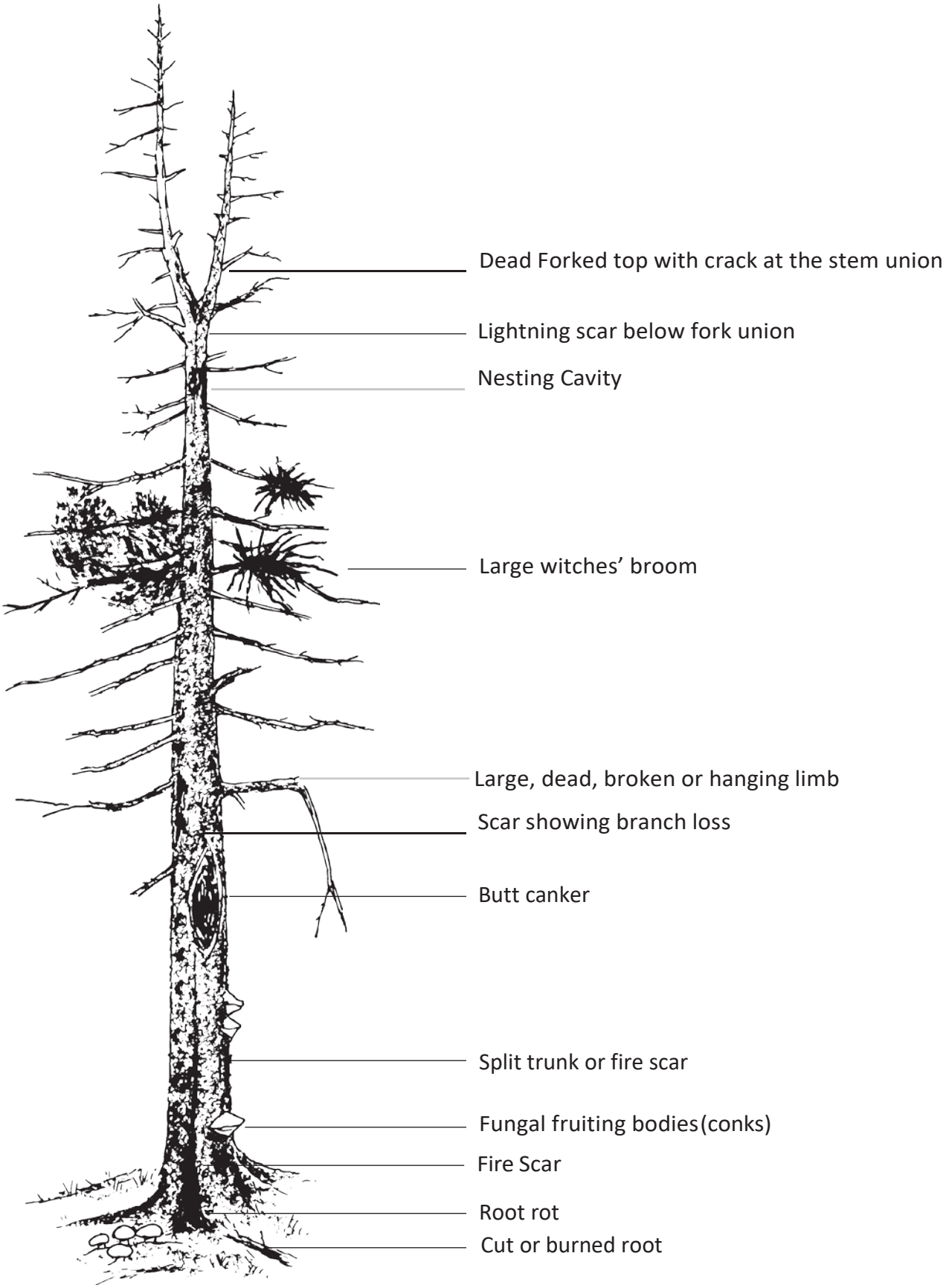
The Dangerous Tree assessment process requires that assessors identify tree hazards and know how to recognize, evaluate and manage for all types of hazards.

Live or Dead Tree Defects

Tree defects can be separated into three categories: top and branch defects, stem defects, and root and butt defects.

- Tables 3A and 3B provide a summary of High Failure Potential tree defects associated with live or dead trees.
- Trees with **NO** defects or only defects which fall below the High Failure threshold description are often rated safe.
- However, see Step 4 for further safety procedure information.

Generalized Tree Defects or Indicators Which Influence Tree Failure



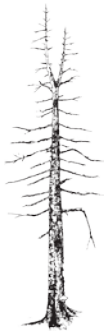
Eight Common Dangerous Tree Defects (for further description see Table 3A)

Hazardous tops (HT)

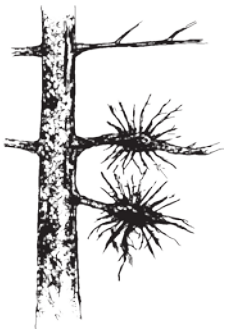
proportion of tree height

single leader secondary top that resulted from an old top breakage

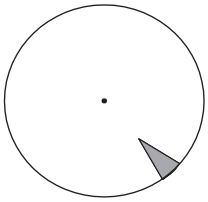
Large dead and broken limbs **(DL)**



Witches' broom **(WB)**



Split trunk **(ST)**



>2 cm width
> 25% into stem
evidence of
internal decay

Stem damage (scarring, fire damage, or butt rot) **(SD)**

Butt and stem cankers **(CA)**

Fungal fruiting bodies (conks and mushrooms) **(CM)***

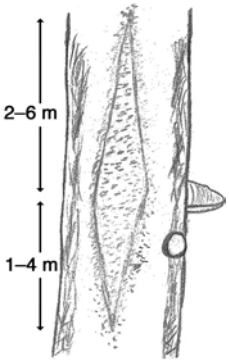
Columns of heart rot decay extending above and below fungal fruiting body (conk).

General rule of thumb for fungal decay columns

Extend the extent of advanced decay 3m below and 4 m above the lowest conk

Circular cavity nests holes CN) are a good indicator of heart rot and structural defect

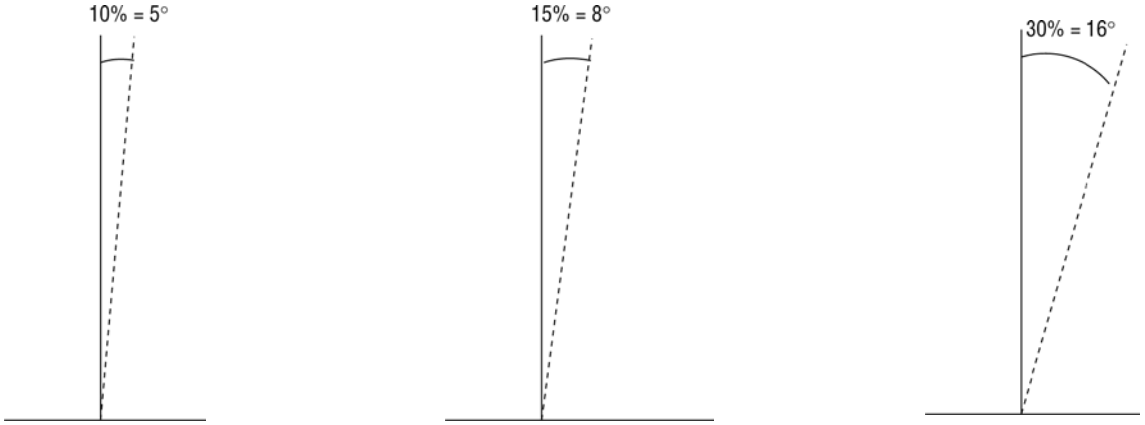
Thick sloughing bark (SB)



Tree lean and **Roots** must also be evaluated as part of the "Visual Inspection Process" (Step 3). Specific failure potential criteria for tree lean and root inspection are described in Table 3A.

Tree Lean - recent and long-standing.

Long-standing lean trees have often subsequently grown a vertical top in the time since the lean occurred. Live lean trees develop tension and compression wood at stress points, to aid in support. Where disturbed tree also develops a reinforced root system, to compensate for prior damage. Unless the roots are disturbed further, or decay is present, **the potential for failure of long-standing leaning trees is low, and such trees need not be considered a hazard.**



Recently-leaning trees are tilted over their entire length. Since there is no evidence of subsequent reinforcement of the root system or bole wood, assessors must assume hazard potential.


Lean

Assessors should also identify other rooting problems which can compound the effects of high tree lean. These include shallow roots or thin soils, burned, damaged or decayed roots and/or lifted roots, burned or disturbed anchoring soil layers, or adjacent history of windthrow.

Leaning trees which are **securely lodged** in a large sound tree with no chance of breaking free, have negligible lean hazard. Leaning trees in this condition must be evaluated on an individual basis.


Sweep

Sweep is defined as the curvature or distortion of the stem and is often associated with competition for sunlight, response to snowpack and steep slope conditions. Sweep should not be confused with lean.

Slope is an important determinant of the direction of falling, and how far and with what force a tree will roll or slide after falling. Dangerous Trees falling on slopes may travel farther than the length of the tree.

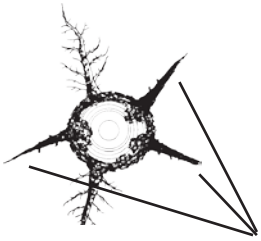

Steep slope

ROOT CONDITION (BASED ON VISUAL INSPECTION)

Root condition should be assessed at the root collar (area where the tree and ground meet) and surrounding root mat (area under the tree canopy).

If visual inspection indicates questionable root stability**,** then a shallow root excavation and probing into the roots with a suitable hand tool should be done to expose the condition of the roots and to determine whether the tree should be considered dangerous for the particular work activity.

Example 1:



dead or decaying roots

This tree has 5 major later roots. Exploration with a hand tool showed that 3 roots had decay and were unstable. The tree was assessed as dangerous.

Example 2:

Heavy equipment used during fire guard construction has severed the root system of this tree, resulting in more than 50% lateral roots damaged. This is a high failure potential defect

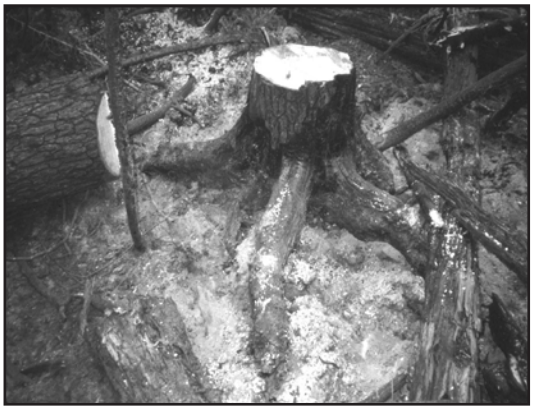
Trees with >50% of lateral roots damaged, burned or decayed have a **HIGH failure potential** (see Table 3A).

Watch for root systems which have been **severely burned along with the supporting/anchoring soil layer**. These "propped" roots can be very unstable.

- Trees on **shallow soils over bedrock or hardpan**, or with high water tables, will have shallow root systems. Also look for **root pull and cracked or lifting soil mats**. They will become more hazardous over time and should be examined carefully before work commences.

Root Disease

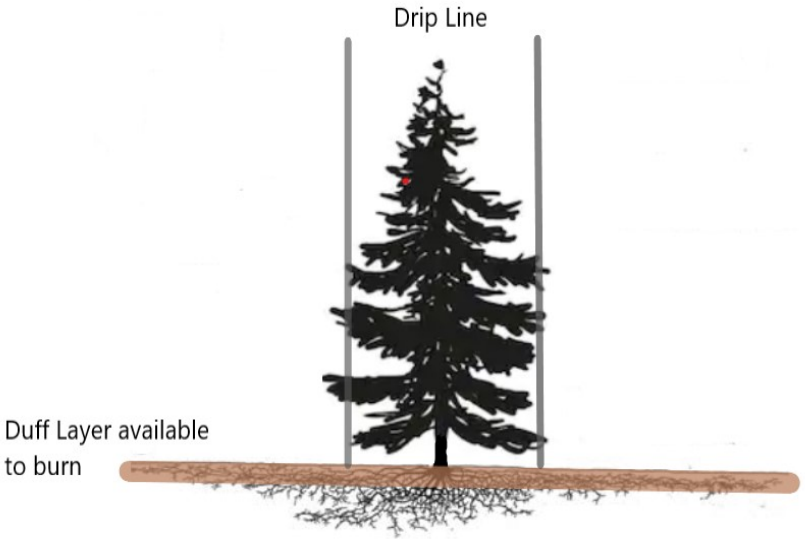
- **Trees growing in or near areas where root disease is seen to be present** are likely to be diseased as well. Watch for stand openings associated with uprooted trees, or trees with suspect crown conditions (Table 1)



Burned and severed roots – high failure potential. Tree felled.

Tree Species Rooting Types

Trees in BC basically root in 2 main methods: deep rooted and shallow rooted.



Shallow rooted or duff anchored tree species (Spruce, Cedar and Hemlock) establish most of their rooting structure in the duff layer to compensate for poor soil or root restrictions. Beware when >50% of the rooting zone (area beneath the drip-line of the tree's branches) has been burned away – these trees are at high risk of failing under light winds.

When assessing shallow rooted species trees under high BUI conditions consider the impact of continuous burning and loss of rooting layers on tree stability.

Deep rooted trees species (Douglas Fir, Larch and Pine) where the soil duff layer has been scraped or burned away, merely exposing the roots may not damage them due to deeper rooting structure. Rooting inspections may require review of other tree indicators such as smoldering in the base of the tree, crown condition, root restricting layers and machine damage to indicate hidden defects.

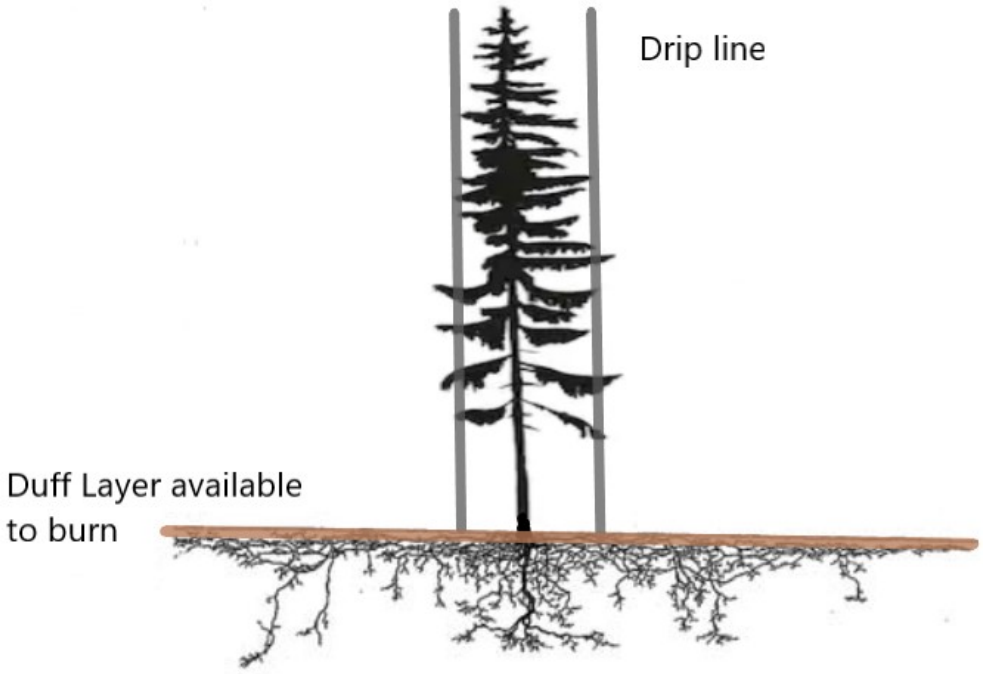


Table 3 describes the 3 **significant tree hazards which indicate a high failure potential for low disturbance/work activities**—lesser hazards (as described in Table 3a) can be rated Safe for low disturbance activities.

Table 3. Dangerous Tree Assessment Process for Low Disturbance Activities — 3 Significant Hazard Indicators

D = Dangerous	**D** if tree has one or more of the following **significant tree hazards indicators** that are **at risk of IMMINENT failure:** • **Insecurely lodged trees or Insecure hang-up** 1. Insecurely lodged trees (a hung-up tree that is likely to shake free of the support trees and fall to the ground with little or no wind); or 2. Dislodged but hung-up limbs or tops (consider size and height above ground) at risk of shifting free during light winds or tree motion • **Highly unstable tree**: Examples 1. >50% of tree cross-sectional area significantly damaged or decayed 2. Spongy snags with heart rot conks along most of the length of the stem (e.g. class 5-6 conifers or class 4 deciduous) or soft snags (e.g. class 7-8 conifers or class 5 deciduous); or 3. Significantly >50% lateral roots damaged or with advanced decay • **Recent lean** towards the work area **AND** decayed root system (>50% of roots have advanced decay) or damaged and lifting anchoring soil layer (consider soil conditions and anchoring)
S = Safe	All other trees

The certified assessor must be sufficiently experienced and/or trained to be able to recognize and ensure workers avoid exposure to the above significant hazards. Crews should be instructed to keep a “heads-up” for any of the 3 significant hazards and to stay away (generally greater than 1.5 defect lengths) from any trees showing these hazards. However, any trees that the assessor determines or suspects to be dangerous must be dealt with as follows **BEFORE** any workers enter that area:

- have tree(s) or hazardous parts removed
- flag a no-work zone of appropriate size and shape around tree(s) and instruct workers to stay out of this area (generally 1.5 defect lengths in size).

NOTE: *Work crews should be provided instructions how to observe wind effects on tree conditions. If winds become strong enough to cause trees defects to uproot and/or break and fall, workers should leave the work area and go to a safe refuge.*

Table 3a. **Dangerous Tree Criteria for Medium Disturbance Activities**
NOTE: Any tree defects as described in the boxes below will be rated as DANGEROUS for medium disturbances.
Trees with lesser defects can be rated SAFE for medium LOD - take care to not brush trees if failing adjacent trees.

Defect Category	**Species Group**	
	Douglas-fir, larch, pines, spruces	**Western redcedar, yellow cedar**
Hazardous top (HT)	Class 2-5 trees: Defective top (any size: e.g., secondary top) where **structural weakness is evident; OR** **Class 4 and 5 trees: Defective** top (e.g., secondary top) which have **> 30% of tree height**	Class 2-5 trees: Defective top (any size) as a fork, co-dominant or multiple stem where **structural weakness is evident**
Dead limbs (DL)	▮ Dead limbs >10 cm diameter **with structural weakness** ▮ Cracked, decayed, broken or hung-up limbs	▮ Dead limbs >15 cm diameter **with structural weakness** ▮ Cracked, decayed, broken or hung-up limbs
Witches' broom (WB)	Brooms >1 m diameter on live or dead branches **AND** evidence of decay, cracking or failure	n/a
Split trunk (ST) (includes frost, lightning, wind and impact-induced cracks)	Crack or split >2 cm wide extending >25% of tree diameter into stem AND evidence of decay in surrounding stem wood	Class 2 and 3 trees: Crack or split >2 cm wide extending > 50% of tree diameter into stem **AND** evidence of decay in surrounding stem wood. Class 4-8 trees: Crack or split > 2cm wide **AND** evidence of decay in surrounding stem wood
Stem damage (SD) includes scarring, fire, machine and animal damage or butt rot)	>50% of tree cross-sectional area damaged, burned, scarred or fractured	>50% of tree cross-sectional area damaged, burned, scarred or fractured
Thick sloughing bark or sloughing sapwood (SB) bark applicable to Douglas-fir, larch, ponderosa pine and cottonwood >50cm dbh)	Large pieces of bark or sapwood separated and sloughing from bole of tree	Bark n/a Long slabs of sapwood hanging from bole of tree
Butt and stem cankers (CA)	> 50% of butt or stem circumference as a perennial canker face*	n/a
Fungal fruiting bodies CM) (conks and mushrooms)**	**Any heart rot fungus present** Exception: For veteran and dominant trees, if Porodaedalea pini conks present **BUT** NO other visible defects/damage to stem that allow oxygen exchange (e.g., broken top,, scarring, nest cavity, etc.) = SAFE; • Sap-rotting fungi present on any tree < 30 cm dbh where sap rot depth is > 5 cm	n/a
Tree lean (TL) (for class 1-3 trees)	**Lean >15%** toward target/work area **AND** tree has rooting problems (e.g., damaged roots; shallow, compacted or wet soils; cracked or lifting root mat; steep slope)	Lean >15% toward target/work area AND tree has rooting problems (e.g., damaged roots; shallow, compacted or wet soils; cracked or lifting root mat; steep slope) - For candelabra-branched trees, where candelabras are predominantly on lean side of tree — lean >10% toward target/work area and tree has rooting problems
Tree lean (TL) (for class 4-8 trees)	**Lean >10%** toward target/work area **AND** tree has rooting problems (e.g., damaged roots; shallow, compacted or wet soils; cracked or lifting root mat; steep slope)	Lean >10% toward target/work area AND tree has rooting problems (e.g., damaged roots; shallow, compacted or wet soils; cracked or lifting root mat; steep slope)
Root inspection (RI)	Occurrence of any of the following: root pull or lifting root mat; visible damage or decay to roots affects >50% of lateral roots	Occurrence of any of the following: root pull or lifting root mat; visible damage or decay to roots affects >50% of lateral roots

1 - A secondary top is a growth leader which forms after the breakage or die-back of the original tree's top

Table 3a. **Dangerous Tree Criteria for Medium Disturbance Activities (concluded)**

NOTE: Any tree defects as described in the boxes below will be rated as DANGEROUS for medium disturbances. Trees with lesser defects can be rated SAFE for medium LOD - take care to not brush these trees if falling adjacent trees.

Defect Category	Species Group	
	Hemlock, true firs	Broad-Leaved deciduous
Hazardous top (HT)	**Class 2-5 trees:** Defective top (any size e.g., secondary top) where **structural weakness is evident; OR** **Class 4 and 5 trees**; Defective top (e.g., secondary top) **>20% of tree height**	**Class 2-5 trees**: Defective top (any size) in the form of a fork, co-dominant or multiple stems where **structural weakness is evident; OR** Where dead top **> 20% of tree height**
Dead limbs (DL)	▮ Dead limbs >10 cm diameter with structural weakness ▮ Cracked, decayed, broken or hung-up limbs	▮ Dead limbs >10 cm diameter with structural weakness ▮ Cracked, decayed, broken or hung-up limbs
Witches' broom (WB)	Brooms >1 m diameter on live or dead branches AND evidence of decay, cracking or failure	n/a
Split trunk (ST) (includes frost, lightning, wind-and impact-induced cracks)	Crack or split >2 cm wide extending >25% of tree diameter into stem AND evidence of decay in surrounding stem wood	Crack or split >2 cm wide extending > 25% of tree diameter into stem AND evidence of decay in surrounding stem wood
Stem damage (SD) includes scarring fire, machine, and animal damage or butt rot)	50% of tree cross-sectional area damaged, burned, scarred or fractured	> 25% of tree cross - sectional area damaged, burned, scarred or fractured
Thick sloughing bark or sloughing sapwood (SB) (bark applicable to Douglas- fir, larch, ponderosa pine and cottonwood >50cm dbh)	n/a	Large pieces of bark separated and sloughing from bole of tree
Butt and stem cankers (CA)	n/a	• >20% of butt or stem circumference as a perennial canker face* • > 50% of butt or stem circumference as a canker face on a dead tree
Fungal fruiting bodies (CM) ** (conks and mushrooms)	Any heart rot fungi present; **OR** Sap-rotting fungi present on trees <60 cm dbh where sap rot depth is > 5 cm	Any heart rot fungi present*** Sap-rotting fungi present on trees <60cm dbh where sap rot depth is > 5 cm
Tree lean (TL) (for class 1-3)	Lean >15% toward target/work area AND tree has rooting problems (i.e., damaged roots; shallow, compacted or wet soils; cracked or lifting root mat; steep slope)	Lean >15% toward target/work area AND tree has rooting problems (e.g., damaged roots; shallow, compacted or wet soils; cracked or lifting root mat; steep slope)
Tree lean (TL) (for class 4-8 trees)	Lean >10% toward target/work area AND tree has rooting problems (e.g., damaged roots; shallow, compacted or wet soils; cracked or lifting root mat; steep slope)	Lean >10% toward target/work area AND tree has rooting problems (e.g., damaged roots; shallow, compacted or wet soils; cracked or lifting root mat; steep slope)
Root Inspection (RI)	Occurrence of any of the following: root pull or lifting root mat; visible damage or decay to roots affects >50% of lateral roots	Occurrence of any of the following: root pull or lifting root mat; visible damage or decay to roots affects >50% of lateral roots.

NOTE: Structural weakness includes decay, cracking, breakage, embedded bark or cracking at single leaders, forks or multiple stem unions, presence of conks, stem scars, and woodpecker cavities (CN).

Additional Relevant Notes to Table 3a

A secondary top is a growth leader **(live or dead)** on a tree which formed after the breakage or die-back of the original tree's top (can be singular or multiple new tops). Assessors must look for signs of structural weakness at the base of the secondary tops.

Perennial cankers are generally circular to lens-shaped cankers that can persist for years, and slowly expand at about the same rate as the radial growth of the affected live tree. They gradually take on a sunken appearance because the tissues under the dead cambium do not grow along with the surrounding wood. They are sometimes called ''exploding cankers."

Conks: If identity of wood decay fungus cannot be determined (e.g., sap rot or heart rot), then default to Dangerous rating.

OR if there are conks distributed along the entire bole length, then default to Dangerous rating.

Aspen Conk: An alternate safe work procedure for dealing with fungal conks on live trembling aspen is described in **Appendix 6**.

Tree Species: A list of common tree species names and their species codes is found in **Appendix 7**.

Cavity Nests (CN)
Cavity nests (which are usually circular in shape) should be considered as **stem damage** and are an indication of **internal decay.** However, some trees with cavity nests will have sufficient sound shell in this section of the tree, but this will vary with tree species and size, type of decay pathogen present, and other factors (e.g., other tree damage, site moisture, species of excavating bird, etc.). Assessors must therefore practice due diligence when evaluating trees containing cavity nests - these valuable wildlife trees warrant thorough assessment before concluding with the tree assessment. If you suspect the stem to be weak, as a general rule, extend the weakness an extra 1m below the lowest cavity nest.

Use of Cab-Guarded Machinery
As a rule, workers must stay a minimum of 2 tree lengths or 300 feet (91m) whichever is greater away from the heavy equipment and the surrounding trees where heavy mechanized machinery is operating (e.g., for guard construction). It is required that only machines with manufacturer-installed cabs and associated protective cab structures be used and there should be no workers on the ground outside of these machines while they are working. The use of unguarded equipment is not allowed.

TABLE 3B. DANGEROUS TREE ASSESSMENT PROCESS FOR HIGH DISTURBANCE ACTIVITIES

When conducting High disturbance assessments, only **the following four types of trees are rated safe.** All other trees will be rated Dangerous for high disturbance activities.

ALL TREE SPECIES EXCEPT CEDAR

Level 4 disturbance

S = Safe
if tree is one of the following:

- class 1 tree (all species)
- class 2 trees with NO structural defects (all species) (usually wind- or snow-snapped green trees, very light fire scorching).
- class 2 **cedars** with LOW failure potential defects (refer to table at right)
- class 3 **conifers** with NO structural defects (tree recently killed by insects, climate or light intensity fire— these will have no structural damage or decay)

D = Dangerous all other trees
(fall tree; create a no-work zone;
or remove hazardous parts)

Any leave tree that is damaged during the work activity must be reassessed if work is to continue within reach of the tree.

CLASS 2 CEDAR TREES ARE SAFE FOR HIGH LOD IF THEY FIT THE FOLLOWING CRITERIA:

	Western Redcedar, Yellow cedar
Defect Category	**LOW FAILURE POTENTI**
Hazardous top (HT)	**S**econdary top (live or dead) as single leader, V-shaped fork or multiple stems <30% of tree height, with **no evidence** of decay, cracking, failure or other structural weakness
Dead limbs (DL)	Dead limbs (no size limit) with **no evidence** of decay, cracking or failure
Split trunk (ST) (includes frost, lightning and wind-induced cracks; does not include dry checking)	Crack or split >2 cm wide extending <50% of tree diameter into stem; **no evidence** of decay in surrounding stem wood
Stem damage (SD) (includes scarring, fire damage, machine damage, animal damage or butt rot)	<50% of tree cross-sectional area damaged, scarred or fractured with **no evidence** of decay in remaining stem wood
Tree lean (TL)	Lean <30% (16°) toward target/work area **and** tree has no rooting problems
Lean — candelabra branched trees (for class 1 and 2 trees) (where candelabras are predominantly on lean side of tree)	Lean <10% (5°) toward target/work area **and** tree has no rooting problems
Root inspection	**No visible problems:** no root pull or lifting root mat. Any visible structural damage to roots only affects **<25% of lateral roots** (remaining roots undamaged)

Step 4: Determine Safety Ratings and Appropriate Procedures

Once a tree(s) has been determined to have a dangerous defect, the appropriate safety procedures must be undertaken. These are described below.

Safety Procedures (for "suspect" trees that have been assessed)

Safe – suspect tree is safe to work around with no removal or modification necessary

- mark tree as Safe (**if required**)
- reassess tree later; used as an "indicator" tree of site-specific changes to tree hazard due to changes in fire condition

Dangerous - mark tree as Dangerous (**if required**) and;

- remove tree
- remove dangerous part of tree (e.g., hazardous limb)
- install flagged no-work zone (NWZ)
- inform workers of location of flagged NWZ's

SUMMARY OF ASSESSMENT REQUIREMENTS

All work activities EXCEPT those defined as **"Very Low Risk**" require a pre-work inspection by a certified Dangerous Tree Assessor to determine if there are any trees that might endanger workers. A summary of activity level assessment requirements is shown below. For a discussion of liability and Dangerous Tree assessments, see Appendix 3.

- **Very Low Risk (VLR)** – No pre-work site inspection is required.

** **EXCEPTION Foot Patrolling in Burned Stands****
Still requires a pre-work inspection

- **Low Disturbance Activities** – A pre-work inspection by a Qualified Person or certified Dangerous Tree assessor is required. If trees with significant tree hazards (see table 3) are observed, then the appropriate safety procedures must be taken BEFORE work activities begin.

- **Medium or High Disturbance Activities** – A pre-work inspection by a certified Dangerous Tree assessor is required. If suspect trees (see tables 3A, 3B) are identified, then further assessment by the certified Dangerous Tree assessor is required, and the appropriate safety procedures must be taken BEFORE work activities begin.

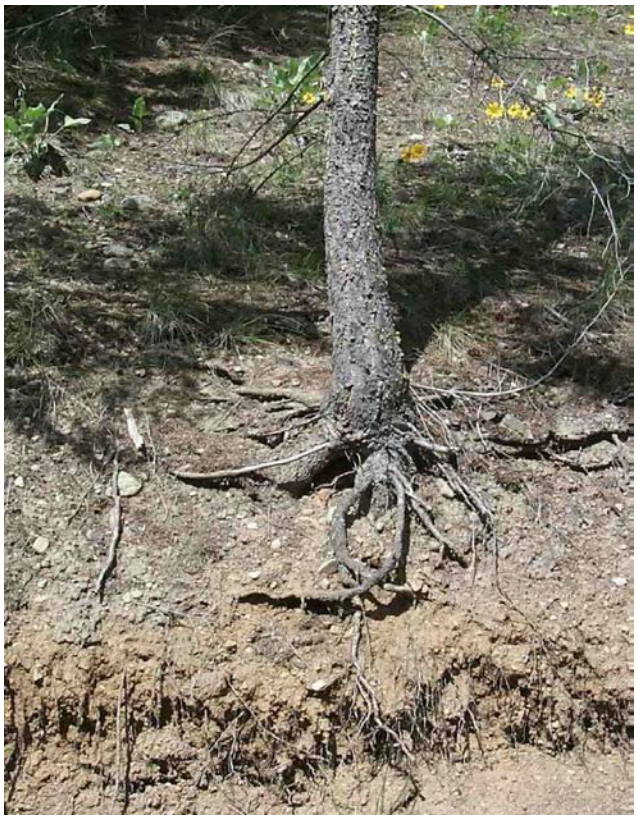
- After the Dangerous Tree Assessor has completed their assessment, they should brief their crew about the hazards they encountered in the work area, and site and tree hazards identified during their Site Assessment Overview. This is also a good time to review windspeed concerns.

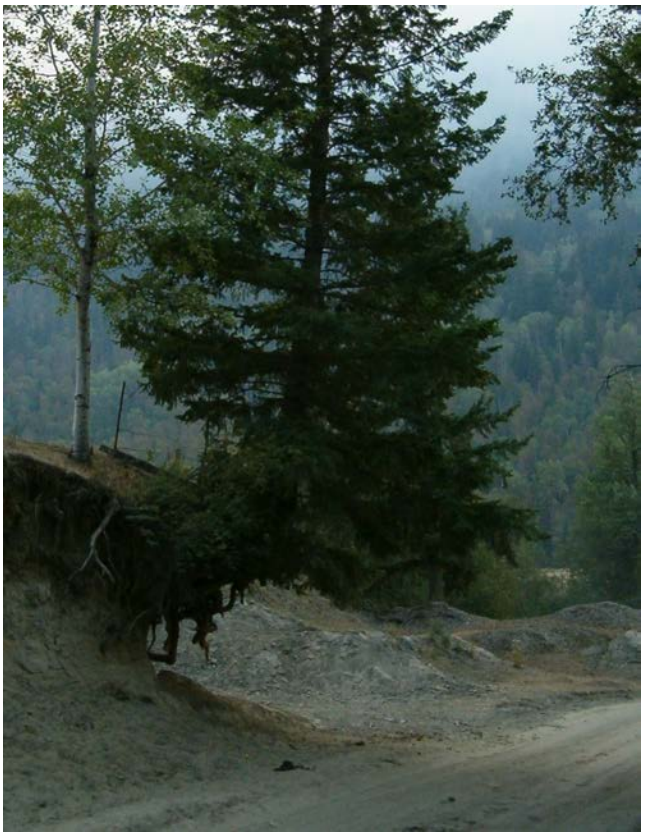
ASSESSMENTS ALLONG ROADWAYS

Roadways are a common part of a wildfire that need to be assessed. Roadway assessments are generally completed from the onsite incident command post or staging areas to the fire for safe travel along areas impacted by wildfires. The prioritization of safe roadways for travel within a fire are important access and egress.

Secondary roadways that are not required for travel within the incident should be marked with orange flagging to identify that the area is not assessed.

Roadways not part of the incident do not need to be formally assessed; however, if there are obvious trees at risk of impacting the travel route they should be identified for the incident commander to discuss with the local road permit holder.





Parking areas along roadways are to be assessed to the LOD of the work activity associated with the parking areas. Generally low disturbance activities conducted by crews is a sufficient assessment, however if there is a helicopter landing area adjacent to the parking location then the area must be assessed to the LOD appropriate to the helicopter landing area.

Note: If there is sufficient buffering beyond 1/2 of a tree length, by trees of sufficient size and number to break the fall of suspect trees, these suspect trees need not be deemed dangerous to the road users. If there is a helicopter landing along a road, extend the area of assessment to the extent of rotor wash (the downdraft from the helicopter) disturbance for approach and departure.

NO-WORK ZONES (NWZ)

The purpose of NWZs is to keep workers out of a hazardous area. Only the perimeter of the NWZ, if it is adjacent to an active work area, needs to be assessed for additional tree hazards.

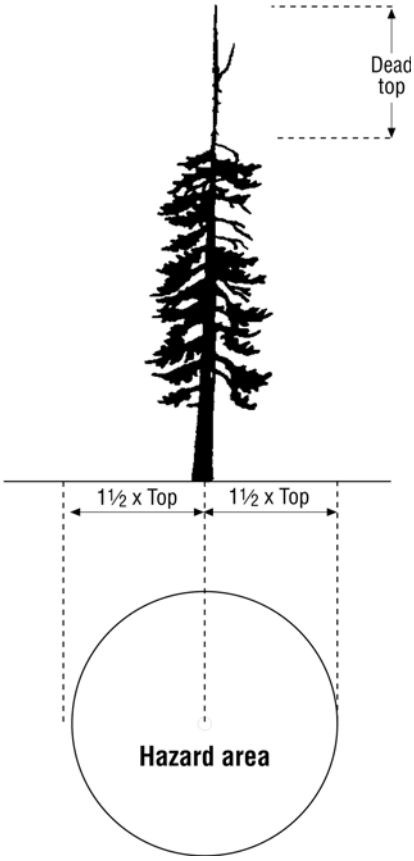
NWZ length is generally 1.5 times the defect length. This length can be modified (larger or smaller) depending on the site-specific conditions such as slope or size of surrounding green timber.

- When the decision has been made to retain a tree that has been assessed as dangerous to workers, a no-work zone must be clearly identified and marked on site. This includes high value wildlife trees that have been assessed as dangerous. The no-work zone must include all the area on the ground that could be reached by any dislodged portion of the tree.
- The shape of the no-work zone must accommodate the nature of the hazard and the lean of the tree.
- On steep ground, the no-work zone will be extended downhill to protect workers.
- No-work zones can be adjusted in size depending on the size of the surrounding live timber (e.g., a small Dangerous Tree surrounded by much larger trees that “shield” the adjacent area have a NWZ radius less than 1.5 defect lengths).
- A kick-back area should be included for semicircular no-work zones. The size and shape of this area is determined by tree lean, condition and form (branching).

The most common types of Dangerous Tree no-work zones are illustrated on the following pages.

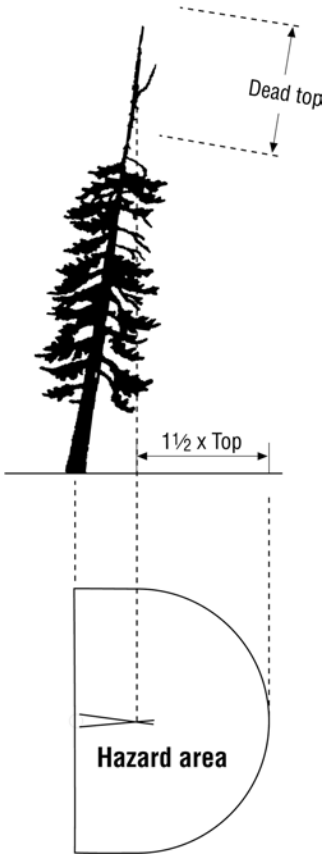
A. Sound tree, no lean, hazardous top, flat ground

1. Determine the length of top that might dislodge.
2. Add ½ of this length, to get a 1½ top length distance. This distance is the radius of the no-work zone.



B. Sound tree with lean, hazardous top, flat ground

1. Determine the length of top that might dislodge.
2. Add ½ of this length, to get a 1½top length distance.
3. Determine from the lean how far from the base of the tree the top might land.

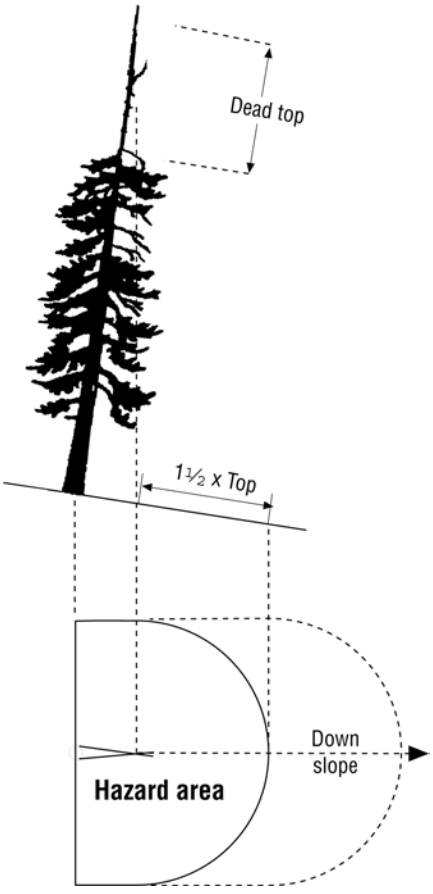


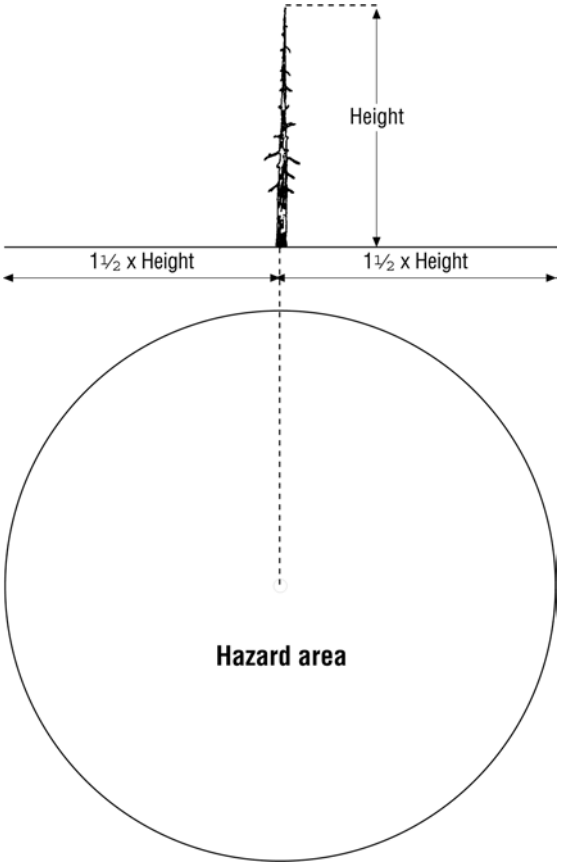
C. Sound tree with lean, hazardous top, on slope

1. Determine the length of top that might dislodge.
2. Add ½ of this length, to get a 1½ top length distance (horizontal distance from tree).
3. From the lean, determine how far from the base of the tree the top might land.
4. On slopes >30%, extend the no-work zone downslope. This distance must be determined on a site-specific basis.

D. Unsound or hazardous tree, no lean, flat ground

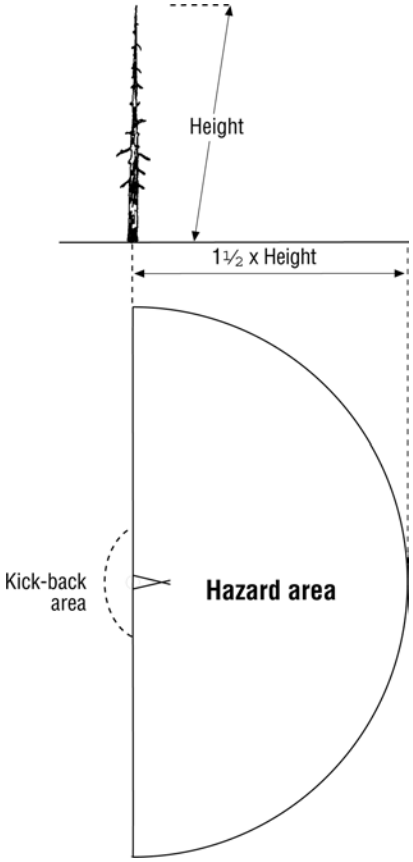
1. Measure the height of the tree.
2. The no-work zone is a circle around the tree, with a radius of up to 1½ times the height.





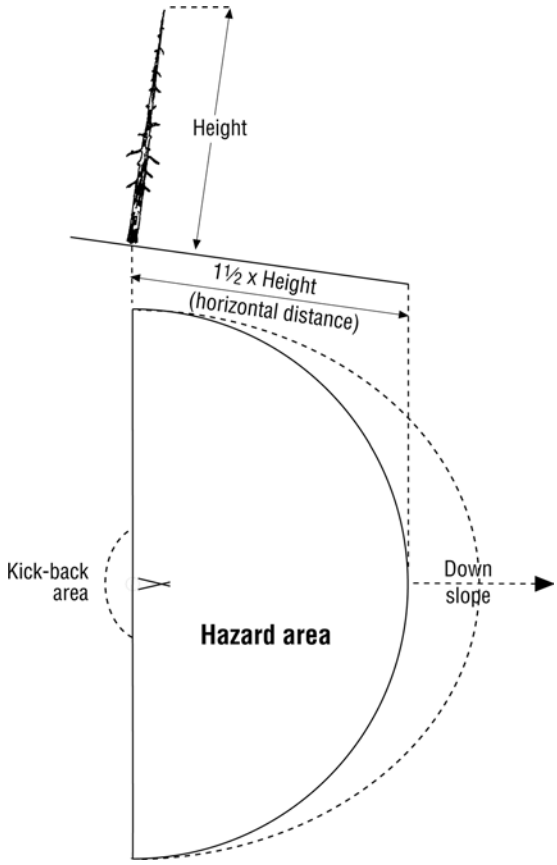
E. Unsound or hazardous tree, with lean, flat ground

1. Measure the height of the tree.
2. Add ½ of this length to get a 1½ tree length no-work zone.

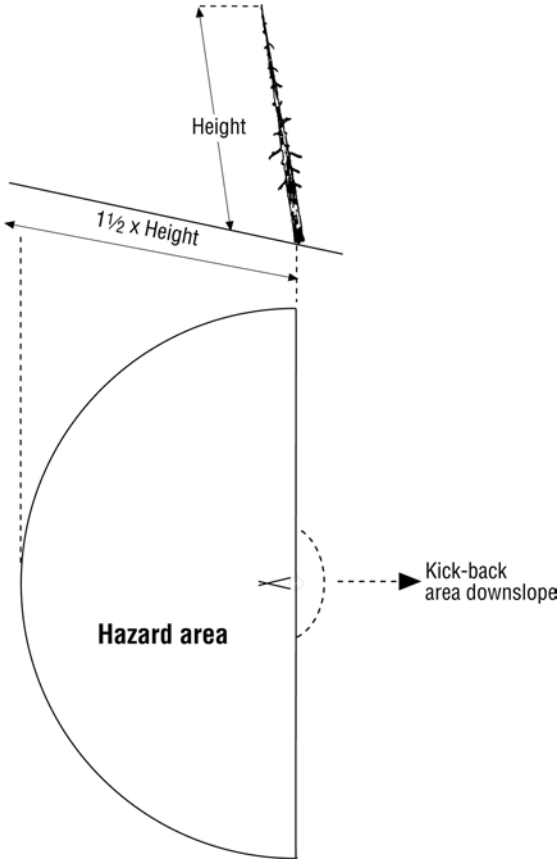


F. Unsound or hazardous tree, with lean, on slope

1. Measure the height of the tree.
2. The no-work zone is a half-circle extending 90° on each side of the lean, with a radius of 1½ times the height of the tree.
3. On slopes >30%, extend the no-work zone downslope. This distance must be determined on a site-specific basis.
4. Trees on a >30% slope need to be carefully assessed for their wildlife tree value, as the no-work zone will take up a large part of the treatment area.



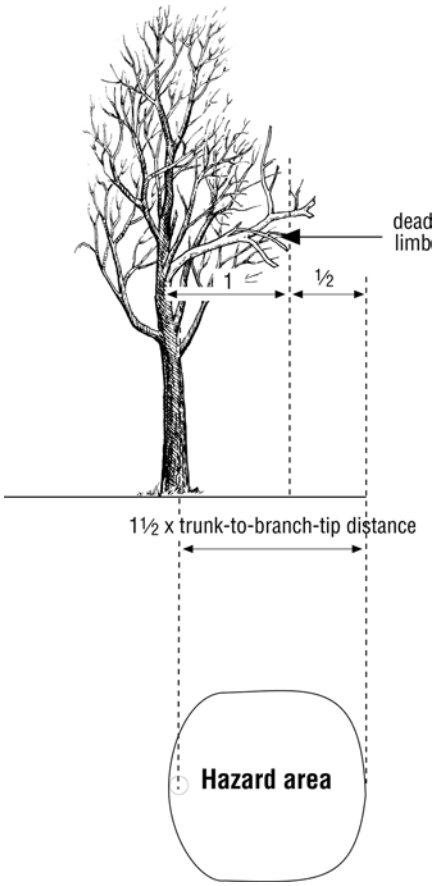
5. Where the tree slopes uphill, the no-work zone should be 1½ times the tree height going upslope.
6. Where the tree slopes uphill, depending on the slope of the hill, a kick-back area will be added on a site-specific basis.



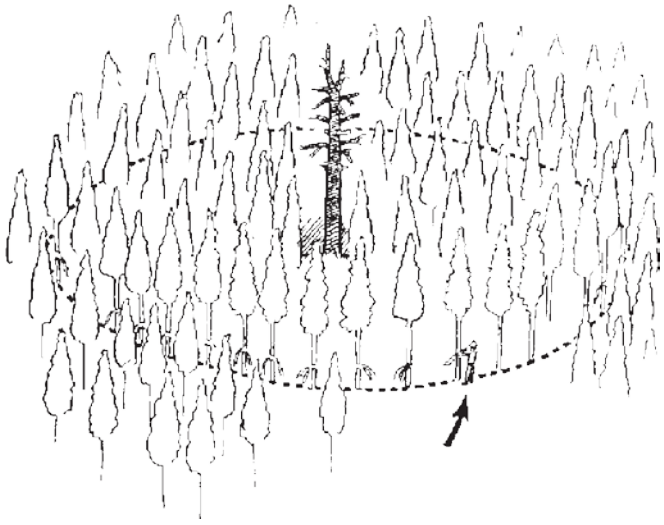
G. Deciduous, sound tree, no lean, defective branches

1. Determine the length of defective limbs that might dislodge.
2. Add ½ of this length to get a 1½ limb length distance.

The 1½ limb length distance must be estimated for all defective limbs on the tree.

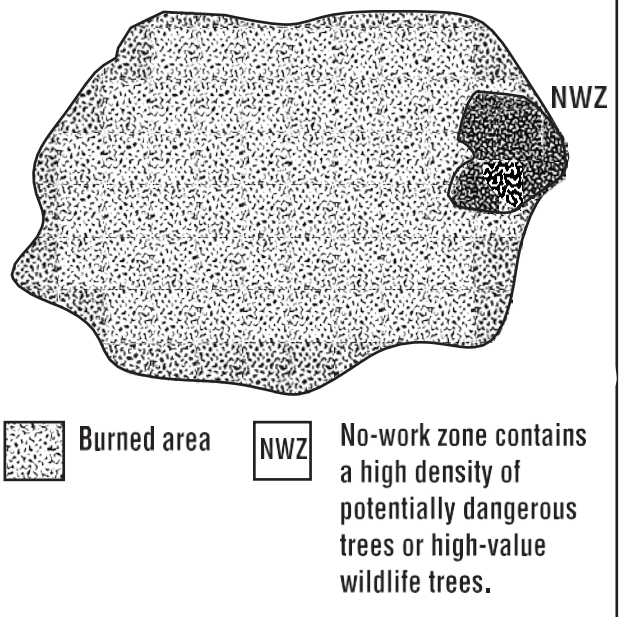


FLAGGING NO-WORK ZONES AROUND SINGLE TREES



- No-work zones will generally only be installed around dangerous but high-value wildlife trees, or around trees too dangerous to fell. The assessor should ensure that all no-work zones are easily identifiable in the field, and their locations communicated to workers who may subsequently be in the area.
- Once the no-work zone has been calculated by the assessor, the area should be flagged.
- Flagging should be tied with the tails facing out at intervals that workers will always be able to see the NWZ boundary from any position along its perimeter.
- **No forest worker is allowed to enter the no-work zone except to remove a specific tree hazard to the work area** (e.g., Dangerous Tree faller or guarded mechanical equipment enters zone to remove a Dangerous Tree along NWZ edge).
- For short duration and exposure fire situations (e.g. Initial Attack) flagging of NWZ may not be necessary. HOWEVER, NWZ boundaries must still be clearly identified, communicated to the crew in the area, and be documented.

DELINEATING LARGER NO-WORK ZONE AREAS



- In wildfire burns with a high density of stems, where potentially hundreds of standing dead trees remain, it is not possible to assess each tree for potential safety hazards. In this circumstance, some areas may not be treated (e.g., mop-up activities) or will be treated later or may contain numerous high-value wildlife trees. These Area Nor Work Zones should be delineated with "no-work zone" flagging or other physically identifiable boundary. These are generally flagged along guard edges and include banner flagging at the start and end.
- Along the edges of these No-Work Zones should be clear of dangerous trees which can reach the work area.
- No forest worker is allowed to enter the no-work zone except to remove a specific tree hazard to the work area (e.g., Dangerous Tree faller or guarded mechanical equipment enters zone to remove a Dangerous Tree along NWZ edge).
- The locations of no-work zones and no-work zone boundaries which have been flagged on the ground MUST be communicated to any workers who may subsequently be in the area.
- See documentation requirements in Step 5.

MARKING OF TREES ASSESSED AS SAFE OR DANGEROUS

- Trees which have **NO VISUAL HAZARD INDICATORS** (e.g., trees with no structural damage or disease and no indication of other problems based on the site assessment overview) **DO NOT** have to be assessed nor marked. Only mark trees assessed as "Dangerous" or assessed as "Safe" suspect trees.
- Trees which have "suspected hazards" and are then determined to be either "Dangerous" or "Safe" based on the site assessment overview and visual tree inspection **may** be marked in the field as follows:
  - mark trees determined to be Dangerous with colour flagging, or by painting a large "D" on it or other suitable marking which must be documented and communicated to workers on site. The tree must then be removed, or a **flagged** no-work zone established around it before workers enter this area.
  - suspect trees determined to be Safe **MAY** be marked by painting a large "dot" on it or other suitable marking which must be documented and communicated to workers on site. These "SAFE" trees will include a tree that upon initial observation appears dangerous, but **after assessment** is found to be safe, and/or which may warrant follow-up reassessment.
  - safe tree flagging should only be used on individual trees, NOT AREAS!
- If trees are spray marked, this will be with hi-vis spray paint - blue is recommended - at eye level on the tree with the markings large enough to be seen from 1½ tree lengths away from all directions.
- **Whatever flagging or paint colour is used, the marking scheme must be documented.**
- Refer to Appendix 5 for suggested Dangerous Tree marking procedures.

AREA MARKING

It is essential to visibly mark any areas which have been assessed in the field so that workers will know if that area has been assessed and the appropriate safety procedures implemented. It is recommended that assessed areas be marked with the following flagging colour scheme:

Orange: Indicates area has been assessed. Assessors initials, date and time of assessment LOD, and if necessary, a brief description of the area assessed (e.g., 35m from edge of guard only) should be written on the flagging. Orange flagging will be **hung in plain view at the assessment start point and finish banners each day** (assessors should record the GPS coordinates for these points on their paperwork). This information must be recorded on the appropriate site/planning map.

Yellow: No Work Zone flagging indicates presence of a No Work Zone. All No work zones must be clearly identified and marked on site and when appropriate will be marked in yellow on the site/planning map.

Plain Lime Green: Indicates the assessed area trees have been felled out. Green flagging must be written on by the faller, including their name and date. Green flagging will be hung on top of the orange flagging and the site/planning map will be coloured green for areas declared/made safe at the end of each day.

Seeing orange and green flagging indicates the area has been assessed and felled, and it is safe for work entry. If you do not see any flagging in an area, do not assume the area has been assessed!

These colours are only a guideline. It is critical that whatever field marking system is in place that it is communicated to all workers on site.

GUIDELINES FOR KEEPING OR REMOVING DANGEROUS TREES

- Fell all Dangerous Trees in main part of work area along access and evacuation trails. This includes trees marked "D" and any other trees which the faller (or machine operator) finds unsafe to the work area as a result of the falling process.
- Use qualified fallers.
- Use explosives or appropriate machinery, where necessary, to fell Dangerous Trees too dangerous for hand felling.
- If Dangerous Trees are too dangerous to fell safely, install an appropriately sized No-Work Zone around them.
- If felling Dangerous Trees will create excessive fuel loading and create fire control difficulties, assess if the area can be left and declared a No-Work Zone. This procedure must be discussed and approved with supervisor.
- Leave Dangerous Trees around perimeter IF they lean sufficiently away from the present work area and not into the work area, or trees with sufficient buffering that will prevent the tree from reaching the work areas
- Remove Dangerous Trees above and below roads if they pose a potential hazard to road activity.
- Where possible, Dangerous Trees should be removed with adequately guarded machinery.

Step 5: Provide Documentation

DOCUMENTATION

The Qualified Person and certified Dangerous Tree Assessor must document the following information on the FS 502c field card, or other retrievable format. Also refer to Appendix 4 for examples of assessment documentation.

- assessor's full name and crew name
- date and time of assessment
- location of assessed area or trees (where appropriate this should be mapped to scale)
- marking protocol for individual trees assessed as "Safe" or "Dangerous" (i.e., paint or flagging colour) (see Appendix 5)
- location and method of identifying no-work zones (i.e., location mapped or described, and type of boundary flagging used)
- locations of areas assessed as safe (map or describe location and include relevant boundary flagging or tree marking procedures). Include GPS coordinates (Lat/Long) if available
- level of disturbance/work activity the area was assessed for (i.e., road travel; workers in area using heavy equipment; tree falling; etc.)
- describe how the above information was communicated to appropriate personnel (i.e., develop a safety plan). The assessor must give a brief explanation/orientation to crews on site concerning the safety procedures associated with Dangerous Tree
  assessments (i.e., tree marking protocol, location of no-work zones, locations of areas assessed as safe).
- documentation must be available and retrievable (i.e., copied to fire file)
- documentation (data forms, maps of assessed area) must be handed in to Plans or forwarded to the Dangerous Tree Specialist once the assessment work has been completed for a given area (i.e. on a daily basis).

See Appendix 4 for examples of documentation.

Remember: *Documentation is part of the due diligence to safe operations of personnel on the fire. Through the chain of command process, documentation ensures new workers can be properly briefed about relevant and current site and tree hazards. Complete documents support safety audit processes, and indicate how workplace hazards are appropriately managed. Documentation is the 5th step to a diligent assessment and is a sign of professional due diligence!*

WORK PROCEDURES FOR ASSESSED AREAS

Once an area has been assessed, there is still work required before crews can be allowed to enter:

- Assuming that the assessor has found all Dangerous Trees, a qualified faller must now cover the area to remove all trees marked as dangerous, except those that are retained within No Work Zones.
- The **faller must be supplied with a map** showing the relative location and numbers of trees to be felled. This map and numbers will ensure the faller does not miss any trees.
- The areas that are completed (assessed/felled/NWZs) must be included in the ongoing documentation for both large and small fires.
- The procedures for reassessment of areas/trees must also be followed depending on site conditions.

REASSESSMENT OF TREES

Reassessment of previously assessed trees should occur before workers enter the area. This reassessment will be required **ONLY IF**: **ONE OR MORE OF THE FOLLOWING CONDITIONS APPLY**

– BUI values are above established thresholds **AND** there is continuous burning within the area of work

– more than **3 days with continuous burning** have passed since the last assessment

– work activity in the area creates more disturbance than what the area was originally assessed for (Level of Disturbance has increased)

– There has been recent/new tree altering disturbance (e.g., green area is now burnt, area of widespread tree failures, etc).

NOTE: **Continuous burning means** - there is smoldering or active flame within the internal decay column of a tree or the duff where the tree's rooting stability is becoming compromised. This condition must be assessed for the work area appropriate to where worker exposure is planned.

- If an area is reassessed, any tree previously marked as safe, but which after sometime is now determined to be dangerous (e.g., because of a smoldering fire burning the roots), shall then be marked with a "D." It should then be removed or a no-work zone established around it.
- Assessments in green (unburned) areas outside of the active fire area need only be done once for the appropriate level of disturbance (work activity)

LARGE FIRE OPERATIONS

- Because of the size and relative logistics of fighting large fires, Dangerous Tree assessments in these scenarios require careful planning, coordination and communication.
- In order to do the most effective job of tree assessment it is important to work with other assessors in a coordinated effort and mark work areas so people unfamiliar with the area can make sense of the flagging and risk assessment performed.
- Planning can require several assessors and fallers in the field each day to ensure enough area is assessed and Dangerous Trees removed ahead of the fire crews.

DANGEROUS TREE SPECIALIST

- The “Dangerous Tree Specialist” will be responsible for ensuring that all assessors working on the project are completing assessments to the required standard. If able, he/she should spend time with assessors to ensure continuity and consistency of field assessments, documentation and implementation of appropriate safety procedures.
- The “Dangerous Trees Specialist” will work in conjunction with the Planning Section to coordinate and ensure that the completion, documentation, mapping and communication of ongoing assessments are produced in a timely manner.
- On a daily basis, the “Dangerous Tree Specialist” must produce a summary of all areas assessed and pass this information on to the Planning Section.
- Your assessment of Dangerous Trees must be part of the project safety plan, feeding into the planning meetings and mapping process.

GLOSSARY

bio geoclimatic subzone A representative class of ecosystem under the influence of the same regional climate. It is associated with a distinct climax (or near-climax) group of plants. For example, the Sub-Boreal Spruce Moist Cool (SBSmk) subzone is characterized by a hybrid spruce-huckle berry-highbush cranberry plant association.

blind conk Sometimes called swollen knots; are significant indicators of decay. They typically appear as pronounced swellings around knots and are the result of the tree attempting to heal over an old conk. Often the affected knot and new conk is partially covered by sound wood, which is implied by the term "blind" conk.

build up index (BUI) A numerical rating of the total amount of fuel available for combustion that combines duff moisture code (DMC) and drought code (DC).

canker Dead portion of the cambium and bark on a branch or the main stem. Cankers can be raised or sunken and are sometimes surrounded by a raised lip of tissue.

certified Dangerous Tree Assessor A person who has successfully passed one or more of the "Wildlife/Dangerous Tree Assessor's Course" modules sponsored by the Wildlife Dangerous Tree Committee of British Columbia since November 1998, and who holds a valid certificate which signifies this designation.

chlorotic Yellowing of normally green foliage tissue due to lack of chlorophyll. Usually indicates poor growing conditions or some sort of tree stress (e.g., root disease).

Cheeko or Stubby A standing tree or stubb which is burning from inside; the fire often started from an ember landing on a broken top or burned through a dry knot and can sit idle with little or no obvious visual sign of fire.

coarse woody debris Fallen trees and parts of trees on the forest floor.

conk The fruiting body of a wood decay fungus; bracket-like or reclined or flat on the host or ground, but not a mushroom. Usually woody or leathery in texture.

Dangerous Tree A live or dead tree whose trunk, root system or branches have deteriorated or have been damaged so as to be a potential danger to workers in the vicinity.

drought code (DC) A numerical rating of the average moisture content of deep, compact, organic layers. This code indicates seasonal drought effects on forest fuels, and the amount of smoldering in deep duff layers and large logs.

duff moisture code (DMC)	Numerical rating of the average moisture content of loosely compacted organic layers of moderate depth. This code indi cates fuel consumption in moderate duff layers and medium-sized woody material.
embedded (included) -	Bark that is pushed inside a developing branch or stem crotch, bark causing visible cracking and a weakened structure.
fire intensity	The rate of heat energy release per unit time per unit length of fire front. Frontal fire intensity is a major determinant of certain fire effects and difficulty of control.
fire perimeter	The entire outer edge or boundary of a fire.
forest activity	Any activity that requires workers to be in the field where they may be in the vicinity of living or dead trees.
hazardous top	A suspect or defective top section (live or dead) of a tree that may be hazardous because of visible structural weakness, especially if there is evidence of decay or cracking. The defect length is defined by the point of visible stem deformation (stem swelling or goiter, spike, multi-tops or candelabra, fork, kink or other such deformity) or stem damage that makes the top prone to failure.
Imminent failure	A tree which has deteriorated or been damaged to a state where failure is most likely to occur in the very near future, or where failure may already have started. This term is used to describe trees deemed dangerous trees for Low disturbance work activities.
live cull	A live tree with some visible external defect such as a broken, dead, or forked top, split or scarred trunk, or fungal conks.
live class 1 tree	A living, growing tree with good vigor, no structural problems, and no visible signs of disease or decay.
no-work zone (NWZ)	A flagged area on the ground (must be indicated on site map) where no worker shall enter except to remove hazards. Workers will be informed about no-work zones prior to commencement of work on site. No-work zones are usually 1½ times the length of the tree defect, but can be modified larger or smaller depending on site-specific conditions such as slope or size of adjacent standing timber.
pathogen	A living organism that incites disease in a host.

resinosis	An abnormal flow of resin or pitch from conifers, often from the base or lower stem. Resinosis can indicate the presence of tree pathogens or damage.
rust	A disease caused by infection with one of the rust fungi, often producing brown to red spores at some point during the infection.
Sap rot fungi	A general group of fungal organisms which decay in the outer sapwood layer of trees. Sap rots tend to be more commonly found on dead trees. Because of their shallow depth of penetration (2 cm – 5 cm is usual), they generally only contribute to tree structural failure on small diameter dead trees (e.g., <30 cm dbh).
scaffold branching	Multiple stem and branch attachments characteristic of some deciduous trees. They consist of a system of co-dominant branches and lack a central leader.
secondary top	A growth leader on a tree which usually forms after the breakage or die-back of the original tree's top. Secondary tops (live or dead) can occur as single leaders, forks or multiple tops. They may be hazardous, especially if there is **evidence of decay or cracking at the point of the original top breakage or stem deformity.**
sloughing	Starting to separate and eventually falling or breaking away from the tree trunk.
spike top	The pointed **dead top of a living tree** from which most of the needles and branches have fallen off. The length of this "spike-shaped" dead top is variable, and can sometimes be up to 1/3 or more of the tree height for species such as cedars. This top dieback may be caused by insects, disease, or climatic factors.
suspect tree	Suspect trees are any live or dead tree with a visible defect which could cause failure of the tree, either whole or in part, for the applicable level of disturbance. Suspect trees require a visual inspection as well as a site assessment by a qualified person or a certified Dangerous Tree assessor, in order to determine whether they are dangerous for a particular level of disturbance/ type of work activity.
veteran tree	A tree which is significantly older than the trees of the main canopy (usually 150 years of age or greater). The tree may have survived one or more fires as evidenced by fire scars. Veteran trees are usually isolated in distribution and often extend well above the main tree canopy. Because of their large size, they usually provide valuable wildlife tree habitat.

wildlife tree A standing dead or live tree with special characteristics that provide valuable habitat for the conservation or enhancement of wildlife.

Wildlife Dangerous Tree Committee
A committee organized in 1985 to find ways of maintaining wildlife tree habitat in forestry activities without endangering the safety of forest workers.

wind speed A measure of the force of air moving overland measured at 10m above ground. Ground level wind speed measurements need to be multiplied by 1.5 in order to achieve 10m open wind speed equivalence

work area Includes area of actual fire fighting within the fire perimeter and adjacent areas by 1½ or more tree lengths, as well as access roads, evacuation routes, helicopter landing areas, rest areas, staging areas, marshalling points, and incident facilities.

work place Includes all locations where a worker is or is likely to be engaged in work activities. In the case of forest workers, this includes locations where they are exposed to trees.

Appendix 1 – Habitat Ecology

What Constitutes Good Wildlife tree habitat?

When considering the needs of wildlife, it is important to recognize that all trees are not equal in value. Given the large number of wildlife tree-dependent species and wide range of wildlife uses of these trees, there can be no simple system for determining which trees provide the best habitat for wildlife. The most significant indicators of wildlife tree quality are height and diameter, decay stage, location, distribution and cause of death.

Ideal Wildlife Tree Characteristics:

- greater than 15 m in height preferable
- greater than 30 cm dbh preferable (interior)
- greater than 70 cm dbh preferable (coastal)
- decay classes 2–6 conifers and 2–4 hardwoods most valuable
- windfirm, sound root system
- broken top
- some large branches
- some intact bark with space behind loose bark
- nest cavities, feeding excavations
- some evidence of decay (visible fungal conks or cankers)

Height and diameter

Generally, the larger the diameter of a wildlife tree, the greater the variety of species that benefit from it. Most wildlife tree-dependent species prefer tall, larger diameter trees because they offer greater security. A tree with a large trunk provides the potential for a spacious cavity with strong walls. Thick-walled cavities protect their occupants against predators and inclement weather. Large dead trees usually remain standing for many years, providing wildlife habitat for a much longer time than small trees, which fall soon after they die. Large trees are also important for open nesters such as Bald Eagles, Ospreys, and some hawks and owls.

Decay stage

Each stage in the decay process has particular value to certain wildlife species. The earlier the stage of decay, the harder the wood will be. Strong excavators (woodpeckers) usually nest and roost in “hard” trees, while weak excavators (nuthatches, chickadees) prefer “soft” trees. Soft trees also provide the substrate for the numerous species of invertebrates that comprise the food supply of many wildlife species. “Hard” trees which still have branches provide good hunting perches for predatory birds. They also have great future value since most of them, except for those that are fire hardened, will eventually become soft. Fire hardened wildlife trees are not usually suitable for excavating nest holes, but they are often good feeding sites, especially in the first 1–2 years after the fire.

Location

Animals that require dead trees for nesting, denning or feeding usually need live trees nearby for protective cover and foraging habitat. Nest trees of primary cavity excavators (PCEs) are often found at the edge of cutblocks, roads or natural forest gaps. The species composition and structure of the surrounding plant community also influence wildlife use of trees. Some wildlife species such as kestrels, flycatchers and bluebirds require trees surrounded by low or early-seral vegetation (grass-forb, shrub-seedling, pole-sapling) which can function as hunting perches and harbour prey species. Woodpeckers, owls, Vaux’s Swifts and others are dependent on the taller tree communities that develop later (young, mature or old-growth). Wildlife trees adjacent to water bodies are important for cavitynesting ducks, Great Blue Herons, Ospreys, Bald Eagles and Belted Kingfishers. The preferred topographic location of roost trees may vary from season to season.

Determining wildlife tree value

Generally, the following characteristics indicate the relative habitat value of a wildlife tree.

Wildlife Tree Value	Characteristics
HIGH a high value tree has at least two of the characteristics listed in the adjacent column and, where possible, is within the upper 10–15% of the diameter range distribution.	• internal decay (heartrot or natural/ excavated cavities present) • crevices present (loose bark or cracks suitable for bats) • large brooms present • active or recent wildlife use (feeding, nesting, denning) • tree structure suitable for wildlife use (suitable for large nest, hunting perch sites, bear den, etc.) • largest trees for site (height and/or diameter) and veteran trees • locally important wildlife tree species
MEDIUM	• large, stable trees that will likely develop two or more of the above attributes
LOW	• trees not covered by high or medium categories

NOTE: Any tree with an active nest is automatically deemed High Value, regardless of the size of the tree.

notes

Class 2 Trees

Definition

Class 2 trees are live trees with **a visible defect which directly compromises the structural strength of the tree**. This will (or has the potential to) cause whole or partial breakage or uprooting of the tree, or a portion thereof. Consequently, these will be defects which are almost always associated with internal decay or some form of stem or root system damage. The **presence of the following defects on LIVE trees** can be used to differentiate Class 2 trees from Class 1 trees:

- Fungal conks
- Tree cavities (natural or created by wildlife)
- External stem scars (usually will be caused by mechanical or fire damage, or the breakage of large limbs)
- Stem cracks/splits (must have associated decay; not a simple dry check):
    * This condition will include “included bark” (cracking/splitting) at live stem fork unions, and is most common in large deciduous trees.
    * **NOTE**: if you cannot clearly see the crack and therefore are uncertain whether there is associated decay, then categorize this as a defect
- Dead tops (any size — either as a dead spike, dead fork, or dead multiple top)
- Broken tops
- Large dead limbs (> 10 cm diameter)
- Damaged roots (mechanical, fire or disease)
- Excessive lean (>30 %) AND damaged/diseased roots or a poor anchoring soil substrate. “Sweep is not a lean defect
- Large canker face (>50 % of tree circumference)
- Unusual stem swellings (may indicate hidden decay)

Class 1 trees are live, healthy trees and are free of the above defects. Minor defects such as stem scrapes, bark scorching, small dead limbs, live forks and live multiple tops, will usually have no associated decay or loss of columnar shell thickness, and will therefore NOT reduce the tree’s structural strength NOR present a worker safety hazard.

The ability to distinguish between Class 1 and Class 2 trees is most important when working under Level 4 disturbance. At this level (as per the WDTAC guidelines), all Class 1 trees, Class 2 cedars with low failure potential defects, and class 2 trees with no structural defects are rated as safe.

Appendix 2 – Common Pathogens Of Trees In British Columbia

Common Pathogens of trees in British Columbia

REGION: North Coast—Bella Coola is the approximate southern limit

Diseases	***Common/Scientific name***	***Hosts***	***Notes***
Stem diseases	Brown Stringy Trunk Rot *Echinodontium tinctorium*	Mountain and western hemlock; amabilis, grand and subalpine fir; white and Sitka spruce Douglas-fir and western redcedar	High elevations only on coast, Not found on Queen Charlottes
	Red Ring Rot *Porodaedalea pini*	Mountain and western hemlock; amabilis, grand and subalpine fir; black, white, Engelmann and Sitka spruce; jack, lodgepole, ponderosa and western white pine; Douglas-fir, yellow-cedar, larch and western redcedar	Throughout the host range
	Brown Crumbly Rot *Fomitopsis pinicola*	Occurs on a wide range of hosts, including most conifers. It has not been reported on yellow-cedar, black spruce or maple in B.C. Red alder, paper birch, aspen and cottonwood	Is one of the most frequently occurring decay fungi in B.C. Is very common on dead trees but can cause considerable damage to live trees
	Hemlock Dwarf Mistletoe *Arceuthobium tsugense*	Hemlock	Throughout the host range
Root diseases	Annosus Root Rot *Heterobasidion occidentale*	Occurs on a wide variety of coniferous and broad-leaved species: western hemlock, amabilis and grand fir, white and Sitka spruce, lodgepole pine, Douglas-fir, western redcedar, bigleaf maple, and alder	Affects trees west of the Coast Mountains
	Tomentosus Root Rot	Sitka and white spruce *Inonotus tomentosus*	Mainly in ICH (Interior Cedar Hemlock) zone
Insects			
Bark beetles	Western Balsam Bark Beetle *Dryocoetes confusus*	Subalpine fir	Throughout the host range.
Defoliators	Tent Caterpillar *Malacosoma disstria*	Trembling aspen	Throughout the host range
	Western Blackheaded Budworm *Acleris gloverana*	Western hemlock, amabilis fir, Sitka spruce	Throughout the host range
	Green Striped Forest Looper *Melanolophia imithea*	Western hemlock	Throughout host range

REGION: South Coast—Bella Coola is the approximate northern limit

Diseases	*Common/Scientific name*	*Hosts*	*Notes*
Stem diseases	Brown Stringy Trunk Rot *Echinodontium tinctorium*	Mountain and western hemlock; amabilis, grand and subalpine fir; white and Sitka spruce Douglas-fir and western redcedar	High elevations only on coast
	Red Ring Rot *Porodaedalea pini*	Mountain and western hemlock; amabilis, grand and subalpine fir; black, white, Engelmann and Sitka spruce; jack, lodgepole, ponderosa and western white pine; Douglas-fir, yellow-cedar, larch and western redcedar	Throughout the host range
	Aspen Trunk Rot *Phellinus tremulae*	Only on trembling aspen	Found where trembling aspen occurs on the south coast
	Brown Crumbly Rot *Fomitopsis pinicola*	Occurs on a wide range of hosts, including most conifers; has not been reported on yellow-cedar, black spruce or maple in B.C. Red alder, paper birch, aspen and cottonwood	Is one of the most frequently occurring decay fungi in B.C. Is very common on dead trees but can cause considerable damage to live trees
	Hemlock dwarf mistletoe *Arceuthobium tsugense*	Hemlock	Throughout the host range
Root diseases	Armillaria Root Rot *Armillaria solidipes*	All native conifer species are susceptible except mountain hemlock	Throughout the host range south of 57° latitude
	Annosus Root Rot *Heterobasidion occidentale*	Occurs on a wide variety of coniferous and broad-leaved species: western hemlock, amabilis and grand fir, white and Sitka spruce, lodgepole pine, Douglas-fir, western redcedar, bigleaf maple, and alder	Affects trees west of the Coast Mountains
	Laminated Root Rot *Phellinus sulphurascens*	Douglas-fir; grand, Pacific silver and white firs; mountain hemlock	Throughout the host range, but most damaging to Douglas-fir in coastal stands
	Blackstain root disease *Leptographium wageneri*	Douglas-fir	Throughout the host range
Insects			
Bark beetles	Douglas-fir Beetle *Dendroctonus pseudotsugae*	Douglas-fir	Mainly eastern Vancouver Island and lower mainland north to host range
Defoliators	Western Hemlock Looper *Lambdina fiscellaria lugubrosa*	Western hemlock	Occurs primarily south of latitude 56° along the coast
	Western Blackheaded Budworm *Acleris gloverana*	Western hemlock; amablis fir; Sitka spruce	Throughout the host range along the south coast
	Western Spruce Budworm *Choristoneura occidentalis*	Douglas-fir; true firs; spruce	Throughout the host range along the south coast

REGION: North and Central Interior—from approximately Williams Lake and north

Diseases	*Common/Scientific name*	*Hosts*	*Notes*
Stem diseases	Brown Stringy Trunk Rot *Echinodontium tinctorium*	Mountain and western hemlock; amabilis, grand and subalpine fir; white and Sitka spruce; Douglas-fir and western redcedar	Main cause of heart rot in mature hemlock and true firs
	Red Ring Rot *Porodaedalea pini*	Mountain and western hemlock; amablis, grand and subalpine fir; black, white, Engelmann and Sitka spruce; jack, lodgepole, ponderosa and western white pine; Douglas-fir, yellow-cedar, larch and western redcedar	Throughout the host range
	Aspen Trunk Rot *Phellinus tremulae*	Only on trembling aspen	Found where trembling aspen occurs
	White Spongy Trunk Rot *Fomes fomentarius*	White birch	Throughout host range
	Lodgepole Pine Dwarf Mistletoe *Arceuthobium americanum*	Lodgepole pine	Throughout host range
Root diseases	Tomentosus Root Rot *Inonotus tomentosus*	Amablis and subalpine fir; Engelmann, black and white spruce; lodgepole, ponderosa and white bark pine; Douglas-fir; western hemlock; larch	Found in spruce-pine forests, particularly spruce stands in northern interior
Insects			
Bark beetles	Mountain Pine Beetle *Dendroctonus ponderosae*	All pines, especially lodgepole	Throughout the host range
	Spruce Beetle *Dendroctonus rufipennis*	Engelmann, white and Sitka spruce	Throughout the host range
	Western Balsam Bark Beetle *Dryocoetes confusus*	Subalpine fir	Throughout the host range, on the east of the Coast Mountains
Defoliators	Forest Tent Caterpillar	Trembling aspen *Malacosoma disstria*	Throughout the host range
	Large Aspen Tortrix *Choristoneura conflictana*	Trembling aspen	Throughout host range
	2-year Cycle Budworm *Choristoneura biennis*	White spruce; subalpine fir	Sub-Boreal Spruce zone McBride, Hazelton and north
	Western Blackheaded Budworm *Acleris gloverana*	Subalpine fir; white spruce	Throughout the host range
	Eastern Spruce Budworm *Choristoneura fumiferana*	Subalpine fir; white spruce	Fort Nelson area

REGION: South Interior—from approximately Williams Lake and south

Diseases	*Common/Scientific name*	*Hosts*	*Notes*
Stem diseases	Brown Stringy Trunk Rot *Echinodontium tinctorium*	Mountain and western hemlock; grand and subalpine fir; white spruce; Douglas-fir; western redcedar	Interior wet belt. Main cause of heart rot in mature hemlock and true firs
	Red Ring Rot *Porodaedalea pini*	Mountain and western hemlock; grand and subalpine fir; black, white, Engelmann and Sitka spruce; jack, lodgepole, ponderosa and western white pine; Douglas-fir; larch; western redcedar	Throughout the host range
	Lodgepole Pine Dwarf Mistletoe *Arceuthobium americanum*	Lodgepole pine	Throughout host range
Phellinus tremulae	Aspen Trunk Rot	Only on trembling aspen occurs	Found where trembling aspen
	Brown Crumbly Rot *Fomitopsis pinicola*	Occurs on a wide range of hosts, including most conifers; has not been reported on yellow-cedar, black spruce or maple in B.C. Red alder; paper birch; aspen; cottonwood	One of the most frequently occurring decay fungi in B.C. Very common on dead trees but can cause considerable damage to live trees occurs
	White Spongy Trunk Rot *Fomes fomentarius*	White birch	Throughout host range
Root diseases	Armillaria Root Rot *Armillaria solidipes*	All native conifer species are susceptible except mountain hemlock	Most prevalent in south interior
	Tomentosus Root Rot *Inonotus tomentosus*	Amablis and subalpine fir; Engelmann, black and white spruce; lodgepole, ponderosa and white bark pine; Douglas-fir, western hemlock; larch	Less common than in north interior. Usually in moist spruce stands at high elevations
	Laminated Root Rot *Phellinus sulphurascens*	Douglas-fir; grand fir; western hemlock	Rare, east of Purcell Mountains
	Blackstain root disease *Leptographium wageneri*	Douglas-fir	Primarily West Kootenays
Insects			
Bark beetles	Mountain Pine Beetle *Dendroctonus ponderosae*	All pines, especially lodgepole	Throughout the host range.
	Spruce Beetle *Dendroctonus rufipennis*	Engelmann and white spruce	Throughout the host range
	Western Balsam Bark Beetle *Dryocoetes confusus*	Subalpine fir	Throughout the host range
Defoliators	2-year Cycle Budworm *Christoneura biennis*	Engelmann spruce; subalpine fir	High elevation in southeastern B.C.
	Forest Tent Caterpillar *Malacosoma disstria*	Trembling aspen	Throughout the host range.
	Western Hemlock Looper *Lambdina fiscellaria lugubrosa*	Western hemlock	Primarily in the interior wet belt
	Western Spruce Budworm *Choristoneura occidentalis*	Douglas-fir; true firs; spruce	Okanagan and West Kootenays
	Douglas-fir Tussock Moth *Orgyia pseudotsugata*	Douglas-fir	Throughout Okanagan and drier areas of West Kootenays

Appendix 3 – A Discussion of Liability and Dangerous Tree Assessment

A DISCUSSION OF LIABILITY AND DANGEROUS TREE ASSESSMENT

"Duty of care" is the legal responsibility of the landowner or someone acting on their behalf (i.e., forest manager, park manager) to reasonably ensure the safety of persons working on or using that property. The duty of care is often established by various Acts or policies such as the Occupiers Liability Act. The Duty of Care invokes a certain standard of conduct called the "standard of care." Standard of care is defined as the best available guidelines and practices used to fulfill a particular "duty of care." Standard of care is recognized according to established procedures at an accepted level of standards. The Wildlife/Dangerous Tree Assessment process and associated course (WDTAC) is recognized in B.C. as the current "standard of care" relative to the determination of tree danger and hazards.

A person performing Dangerous Tree assessment need not worry about being liable if they are qualified (i.e., they have successfully completed standardized training in Dangerous Tree assessment ofor wildland fire fighting operations), applied the standard of care for assessing and managing Dangerous Trees (i.e., the WDTAC process), and have performed their duties with due diligence (i.e., they were not negligent in following the accepted procedures or techniques). The assessment would be viewed as consistent with "what a reasonable and prudent person (i.e., trained with similar qualifications) would have concluded under similar circumstances." Therefore, there would be no case for liability since liability has to be proven, usually by showing that some sort of negligence was involved.

"Due diligence" is the process of performing a task to the best of one's knowledge, ability and, as far as reasonably possible, according to the prescribed procedures.

When determining whether "due diligence" was taken, the following will be considered:

- Who was involved? A combination of the following determines one's capability for completing the particular task:
  - ~ knowledge
  - ~ training
  - ~ experience
  - ~ skills
- What was done?
  - ~ was the work done as well as others would do it? Done according to accepted procedures?
  - ~ what is required by regulation for the work done?

Appendix 4 – Sample Dangerous Tree Assessment documentation

Wildfire Dangerous Tree - Daily Assessment Form

Assessment Date:	Incident #:
Assessor(s) Name(s):	Location:

DT Task Force? Yes☐ No☐

					FBP			
1	Work activity		LOD		Fuel Type		BUI	
2	Work activity		LOD		Fuel Type		BUI	
3	Work activity		LOD		Fuel Type		BUI	

GPS		Lat		Long			Lat.		Long.	
1	Start	°	.	°	.	Stop	°	.	°	.
2	Start	°	.	°	.	Stop	°	.	°	.
3	Start	°	.	°	.	Stop	°	.	°	.

Coordinate Line: Linear? Yes☐ No☐… or Encompass spot(s)? Yes☐ No☐

Map submitted: Yes☐ No☐. Sketch map (over): Yes☐ No☐. Scaled map: Yes☐ No☐

Site assessment Overview:

The assessment of the area above was completed as per the standards set out in the Wildfire Dangerous Tree Assessors Course and conducted to the following criteria:

☐ Assessments were conducted to a min. of 1½ tree lengths of all work areas
Assessments were conducted to a max. of_____metres from the : ☐ Established Fireline (or)
☐ Fire edge (or) ☐ Other:
All areas assessed this date [☐ have] or [☐ have not] been managed
☐ All areas assessed this date are considered safe *
☐ All areas assessed this date are considered safe to the following point:

The following marking protocol was used:

Dangerous Trees:		No work zones:	
Safe trees:		Assessed boundary:	
Begin/end:			

# trees assessed:		# trees felled:		# NWZ established:	

Additional Comments:

Information passed on to:

Signature:	Title:
Date:	Time submitted:

Appendix 5 – Dangerous Tree Marking/Flagging Protocol

Example Dangerous Tree Marking/Flagging Protocol in Wildland Fire Operations

To ensure work areas on fire situations can be easily identified on the ground relative to their status concerning wildlife/Dangerous Tree assessment and hence worker safety, the following procedures are **SUGGESTED**. **However, it is most important that whatever flagging or paint colours are used, that these be communicated to all workers on site.**

Flagging Colours
No Flagging or paint present: Only applicable to areas open for Very Low Risk (VLR) activities with appropriate safety/work procedures implemented. Heads-up, be aware of Dangerous Tree defects.

Orange: Indicates area has been assessed, but Dangerous Trees have NOT yet been removed.
Assessors initials, date and time of assessment, and next assessment date should be on an appropriate number of ribbons and maps with updates undertaken as appropriate. The LOD level should also be indicated on flagging and accompanying maps.

Yellow: Indicates no-work-zone (NWZ) around dangerous areas or individual trees/defects that have been assessed as dangerous.

Lime green (Safe Tree/Area): To be used as an indicator that the area has been felled out (i.e., Dangerous Trees have been removed or NWZs in place around some individual trees) by a qualified person. Therefore, this area is now safe for workers. Can also be used on high value individual wildlife trees that have been assessed as Safe and which are to be retained.

Paint
Where possible, use same paint colour as the flagging colours described above.
Use paint for marking Dangerous Trees with 'D' on three sides (Hi-Vis blue is recommended). When paint is in short supply, 3 dots can be painted on 3 angles of view to the Dangerous Trees.

Paint can also be used to place an arrow on the tree to identify hung-up limbs and tops and install a **no work zone** to accommodate the hazard. This will help to minimize fuel loading, as the tree can remain standing. Paint is also useful for making traffic signs such as 'warning', 'no-entry' and 'Dangerous Tree removal'.

Please note that paint should only be used in situations where flagging is not available. Flagging is easily removed, changed and/or updated; paint is not so easy to change.

Communication

Ideally, the assessors will be working in conjunction with the fallers and will provide a detailed map of the areas assessed and felled.

Each assessor and/or faller will hand in the maps, field cards and assessment forms to Plans of the Dangerous Tree Specialist at the end of every day.

The Dangerous Tree removal process and all records must be accessible and retrievable. This will give all personnel an accurate and up-to-date record of what has been assessed and felled, when and where it was done, and when it needs to be reassessed.

If workers are scheduled to work in an area subsequent to that area being assessed, and the appropriate safety procedures have been implemented (i.e., Dangerous Trees felled or placed in NWZs), then all assessment information (i.e., marking procedures, locations of NWZs, locations of assessed areas) **must be clearly communicated to all workers in the field PRIOR to them beginning their proposed work.**

Appendix 6 – Alternate Safe Work Procedure For Decay Defects On Trembling Aspen

Alternate Safe Work Procedures for Decay Defects on Trembling Aspen

Rationale

Trembling aspen (Populus tremuloides) is one of the most common deciduous trees which occurs throughout most of interior British Columbia. Where it occurs, it is perhaps the most valuable wildlife tree for cavity excavating birds because of its propensity to develop heart rot decay as a live tree, relatively soon in its life span. In most cases this heart rot is caused by the fungi Phellinus tremulae, which is restricted to the heartwood of the tree and is often successfully compartmentalized by the tree. Consequently, depending on the diameter and vigour of the tree, the internal decay is restricted to the heartwood, with the tree developing a sound outer shell of later heartwood and sapwood. The result is a live tree which can often exhibit numerous fruiting bodies of P. tremulae (brownish-gray conks are usually visible just below branch stubs), yet have enough sound outer wood in the stem cross-section to provide columnar strength to the bole of the tree (i.e., the minimum required shell thickness is $\geq$ 30% of the tree radius). Trees in this condition make excellent nest sites for cavity excavating birds, and while they are still alive, often do not suffer stem breakage.

Related Dangerous Tree Assessment Guidelines

According to the tree failure criteria described in the Wildland Fire Safety Module, the presence of "…any heart rot fungi" found on broad-leaved deciduous trees results in a "Dangerous" rating for those trees, under M - H work activities. Most mature aspen have P. tremulae conks or blind conks --- this means that these trees would automatically get a "D" rating if there is exposure to workers (except for Level 1 work activities). In some areas of the province where aspen is abundant, this may mean that an undue number of live and/or minimally damaged aspen would be rated "D" for Level M - H work activities --- this would result in an unnecessary amount of tree felling and subsequent fuel loading in these situations, as well as a loss of wildlife habitat. An alternate job safety procedure is recommended for aspen, as follows.

Alternate Job Safety Procedure for Trembling Aspen (Medium & High work activities)

1. Conduct a site assessment overview in order to determine the general size and condition of aspen in the work area.
2. Look for visible conks and blind conks on tree trunks (usually seen as rough textured, blackish swellings at the base of branch stubs)
3. Look for aspen trees which have broken or snapped. If trees have enough decay to be a safety hazard (i.e., they have insufficient sound shell), then it is very likely that you will observe some broken and snapped trees, and trees with extensive woodpecker nest holes along the trunk.
4. If you do not see many broken or snapped aspen (with or without fire damage), then conclude that live standing aspen with NO OTHER DAMAGE other than visible conks, can be declared "Safe" to work around during the period of the work activity (subject to 72 hour reassessment period as per all trees).
5. Document your observations of aspen based on the site assessment overview
6. Determine and document marking procedures for aspen. If live aspen with conks are generally not breaking in the stand, then you will likely NOT have to mark aspen which have visible conks, but no other damage.
7 The above 6 steps ONLY apply to LIVE aspen with visible conks or blind conks, AND which do NOT have other damage. Trees with other damage (e.g., fire scarring, dead tops, damaged roots, etc.) must be assessed according to Table 3, 3A or 4 from the Wildland Fire Safety Module course manual and dealt with accordingly.

Appendix 7 – Common Tree Species Codes

Common Tree Species Name and Codes

Tree Species	Code Symbol
Douglas -fir	Fd
Western larch	Lw
Lodgepole pine	Pl
Ponderosa pine (Yellow pine)	Py
Western white pine	Pw
White spruce	Sw
Hybrid spruce	Sx
Sitka spruce	Ss
Subalpine fir	Bl
Amabilis fir	Ba
Grand fir	Bg
Western hemlock	Hw
Western redcedar	Cw
Yellow cedar	Cy
Black cottonwood Trembling	Ac
Aspen	At
Paper birch	Ep
Red alder	Dr
Bigleaf Maple	Mb

Appendix 8 – Where To Get Resource Materials

Where to Get Resource Materials

The following resource materials and contacts can be obtained as follows:

- FS502b, FS502c and FS502c cards - contact MFLNR, BC Wildfire Service Victoria BC (250) 387-5965

- *Tree Book - Learning to Recognize Trees of British Columbia* - contact Crown Publications, Victoria, BC (250) 386-4636

- *Common Tree Diseases of British Columbia* - contact Natural Resources Canada, Pacific Forestry Centre, Victoria, BC (250) 363-0600

- To enroll in a *Wildlife/Dangerous Tree Assessor's Course* Module - contact University of Northern British Columbia, Dept. of Continuing Education, Prince George, BC (250) 960-5982. http://www.unbc.ca/continuingstudies

- To find out about the *Wildlife Tree* Program in British Columbia, see the Wildlife Tree Committee of BC website at http://www.for.gov.bc.ca/hfp/values/wildlife/WLT/