Tree Assessor's Course Workbook

Parks, Recreation Sites & Trails Course Module

An initiative of the:

Wildlife Tree Committee of British Columbia

in cooperation with:

WorkSafeBC
WORKING TO MAKE A DIFFERENCE

BRITISH COLUMBIA | BC Parks

BRITISH COLUMBIA | Recreation Sites and Trails BC

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PREFACE

Forests, and in particular stands of impressive mature trees, are important parts of the recreational and inspirational experience offered by BC Parks and Recreation Sites & Trails BC. In a desire to enable visitors to appreciate this experience, park facilities such as interpretive areas, picnic areas and campgrounds have often been placed close to, or even within, mature forests, in at-risk ecological communities, in critical habitat for at-risk species or other sensitive areas. However, as trees age or get injured they become subject to potential for failure. Additionally, as climate changes, trees are exposed to stresses associated with extremes. These situations create immediate conflicts between mandates to preserve nature or conserve wildlife habitats and responsibilities to provide a safe setting for the visitors invited into parks and recreation areas.

In response to a recognition that policies and procedures regarding wildlife hazard tree assessment were not applied equally across the province this course was developed by the Wildlife Tree Committee in 2000. The hazard criteria and tree assessment procedures taught in the course can be reliably and defensibly used to inform land managers where to implement mitigation strategies that will promote visitor safety while preserving trees of significance. The majority of assessment procedures recommended in this training are applicable to BC Parks and Recreation Sites & Trails BC. They can also be applied to native tree species found in municipal parks or other wooded areas, such as golf courses and ski hills.

This training program retains the same technical tree assessment procedures recognized as the provincial tree assessment standards developed by the Wildlife Tree Committee and used in the other provincial dangerous tree assessment modules developed to protect workers engaged in Forest Activities and Forest Fire fighting. These worker safety modules are applied to tree assessments in worksites in recognition of employer responsibilities to manage tree hazards under Part 26 of the Occupational Health and Safety Regulation, as administered by WorkSafeBC.

Lindsay Vandesteeg
Provincial Land and Resource Section Head, BC Parks
Ministry of Environment & Climate Change Strategy

Persons taking this course are NOT certified to assess dangerous trees in industrial forestry activities or wildland fire operations.

ACKNOWLEDGEMENTS

Many individuals and organizations have contributed time and expertise to the initial development of this course and to its subsequent revisions and updates over the years. The Wildlife Tree Committee (WTC) would like to thank the many people who contributed to the revisions of this workbook.

The following people are responsible for this edition of the course workbook: Lindsay Vandesteeg (BC Parks), Mikel Leclerc (Rec'n Sites & Trails BC); Mike Nielsen and Budd Phillips (WorkSafe BC); and Dean McGeough (WTC Coordinator). Final technical edits were conducted by Dean McGeough. Graphic and formatting assistance by Martina Blanchard.

The following course instructors have made invaluable contributions to the delivery of this course since its inception: Doug Ellis, Bill Golding, Mikel Leclerc, Todd Manning, Fred Marshall, Dean McGeough and Michael Shepard.

Illustrations are by Mark Nyhof, Soren Henrich, Andrew Macdonald and Bill Adams. Photographs were provided by Bill Beese, Brinkman and Associates, Doug Ellis, Tom Hedekar, Jared Hobbs, Todd Manning, Duncan Morrison, Bruce Morrow, Dean McGeough, BC Ministry of Environment and Climate Change Strategy, Ministry of Forests, and Natural Resources Canada (Pacific Forestry Centre).

CONTENTS

WHAT IS THE WILDLIFE TREE COMMITTEE OF BRITISH COLUMBIA

The Wildlife Tree Committee (WTC) was formed in 1985 and is a multi-agency committee composed of representatives from the provincial Ministry of Forests, the Ministry of Environment & Climate Change Strategy, and WorkSafe BC. The WTC operates under a memorandum of understanding between the three signatory agencies to liaise with industry and labour, and public interest groups, and to serve as the advisory body acting and representing all wildlife tree matters in British Columbia.

The Wildlife Tree Committee mandate is:

To promote the conservation of wildlife trees and associated stand-level biodiversity in a safe and operationally efficient manner, in forest, park and urban environments.

Two major objectives of the WTC are:

- to ensure the maintenance and enhancement of wildlife trees in order to sustain the species and processes dependent on them (about 80 species, or 15% of the province's birds, mammals, and amphibians); and
- to foster cooperation and understanding between the various interest groups.

The WTC believes that managed forests, high standards of worker safety, and maintenance of valuable habitat for wildlife tree-dependent species are mutually compatible if cooperative action is taken to integrate these goals.

COURSE BACKGROUND

This module is intended for those who must assess potentially hazardous trees in parks, recreation sites, interpretive forest sites, recreation trails and park-like settings. The Wildlife Hazardous Tree Assessors Course (WHTAC) was developed for non-urban environments based on native conifer species and selected native hardwoods. In these types of environments, where both public and maintenance worker safety, as well as various public values such as aesthetics are an issue, there is a greater expectation to ensure diligent tree assessment and risk management efforts are taken to provide a reasonably safe environment for people recreating. **Consequently, Wildlife Hazardous Tree (WHT) Assessors are cautioned to apply the WHTAC process only to the circumstances and tree species for which they are trained and familiar.**

Those participants wishing to become qualified WHT Assessors require:

- *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 (including ability to determine tree diameter, height, lean, stem cross-section, and skill in distance measuring).*

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).

The course will be offered on an ongoing basis throughout British Columbia to persons who qualify to take this course and who need to perform tree assessments in park-like settings. Certified WHT Assessors will be recognized by the WorkSafe BC, Ministry of Forests and the Ministry of Environment & Climate Change Strategy.

On successful completion of the 2-day course, the certified WHT Assessor should be competent in the following:

- identifying important attributes of wildlife/hazardous trees;
- assessing trees for their potential as wildlife habitat;
- assessing trees for their failure potential;
- recommending appropriate management actions regarding assessed trees.

The Wildlife/Hazardous Tree Assessor's Certification is valid for a period of 4 years.

COURSE GOALS AND OBJECTIVES

Goals

The goal of the **Wildlife/Hazardous Tree Assessor's Course** is to present information, practical field experiences and methods for:

- developing wildlife tree and hazardous tree identification procedures;
- retaining selected wildlife tree habitat; and
- maintaining a reasonably safe worker and visitor environment.

Objectives

Participants in the ***Wildlife/Hazardous Tree Assessor's Course*** will be trained to:

- recognize existing and potential wildlife trees, identify wildlife tree use, and understand the importance of wildlife trees and how to integrate them into the management of parks, recreation sites or trails; and
- distinguish between safe and hazardous trees, thereby enabling them to determine tree hazards and related safe work procedures appropriate for dealing with wildlife and hazardous trees in parks, recreation sites or trails or park-like settings, as well as along forested roadsides and within the riparian areas protected under the Riparian Area Protection Regulation.

NOTES:

AGENDA
WILDLIFE/HAZARDOUS TREE ASSESSOR'S COURSE

(Schedule may vary depending on audience and location of field sites, and instructor needs)

DAY 1

8:00 a.m.	Welcome participants Introduce instructor and participants
8:20 a.m.	Introduction to Significant Trees • CMT, Recreational Attraction tree & Wildlife tree • wildlife tree habitat • pathology of wildlife trees • wildlife tree classification • importance of wildlife trees • ecological significance of wildlife trees
9:45 a.m.	Coffee break
10:00 a.m.	Tree assessment • what is a hazardous/dangerous tree • level of exposure • site overview and temporary worksite perimeters • visual tree inspection • detailed tree assessment • overall tree hazard rating • safety procedures
12:00 noon	Lunch break
1:00 p.m.	Wildlife/hazardous tree field assessment—individual trees • participants will assess trees for hazards and significant tree value. Participants will carry out practical field identification and determine tree hazard ratings and safety procedures for various trees
4:30 p.m.	Adjourn Day 1

DAY 2	
8:00 a.m.	Discuss hazard zones; tree marking procedures; management of wildlife/hazardous trees under various scenarios (along roads, trails, campgrounds); alternate safety procedures for trembling aspen
9:30 a.m.	Written exam
12:00 p.m.	Lunch break
12:30 p.m.	Field session. Additional practice and field exam
4:30 p.m.	Course concludes

Materials Required

All necessary classroom course materials will be supplied by the instructor. The participant is responsible for providing the following essential items for field exercises:

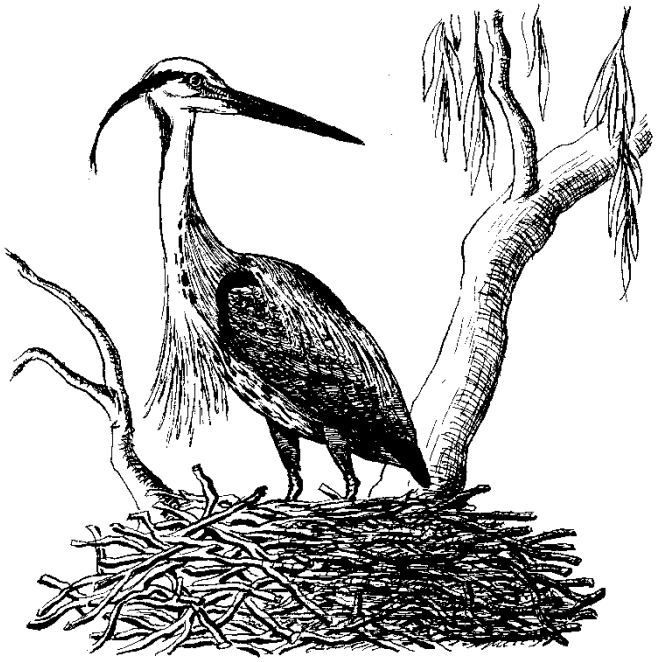
- hardhat (mandatory)
- personal gear, including rain gear (mandatory)
- boots with ankle support (mandatory; caulk boots recommended for coastal locations)
- probing instrument (mandatory) (e.g., ice or rock pick, screwdriver, hammer)
- 6-ring field notebook and pencils (mandatory)
- binoculars (recommended)
- clinometer and/or compass (recommended)
- increment borer (recommended)
- diameter tape or carpenter tape (recommended)
- bag lunch and refreshments (recommended)

Section One

INTRODUCTION TO SIGNIFICANT TREES

Learning Objectives

- What is a Culturally Modified Tree
- What is a Recreational Attraction Tree
- What is a Wildlife Tree?
- What Constitutes Good Wildlife Tree Habitat and Significant Tree Value?
- Wildlife Trees and the Process of Tree Death and Decay
- Wildlife Tree Classification System
- The Importance of Wildlife Trees
- The Ecological and Economic Significance of Wildlife Tree Users
- Coarse Woody Debris



INTRODUCTION TO SIGNIFICANT TREES

Forests provide a wide range of benefits to people and the environment. The value placed upon trees in recreation areas is not solely for monetary or ecological value but also for intrinsic values related to, but not limited to, aesthetics, spiritual renewal, indigenous use, and cultural significance. This section of the course will focus the attention of participants to the wildlife habitat values tree provide. However, WHT Assessors will still need to account for the myriad of societal values when making recommendations about trees that were assessed for hazards.

WHAT IS A CULTURALLY MODIFIED TREE?

A culturally modified tree (CMT) is one which Indigenous people have used for traditional and cultural purposes. Regardless of whether the CMT is protected under the Heritage Conservation Act, it is very important to protect CMT's in BC during the tree assessment process. The WHT Assessor will need to take special care when assessing such trees to ensure they are preserved in their natural state (e.g., not marked with paint or damaged) during hazard tree assessments. The WHT Assessor will note in their documentation if the tree being assessed is suspected to be a CMT so that the Designated Land Manager can account for this cultural value if there is a recommendation from the WHT Assessor for hazard mitigation.

Example of a cultural modified tree (note the test hole) assessed and protected at a recreation site.

There are numerous resources and field guides one can reference to help with the identification and appreciation of CMTs, such as the field guide "Culturally Modified Trees of BC. A Handbook for the Identification and Recording of Culturally Modified Trees" (see appended reference).

WHAT IS A RECREATIONAL ATTRACTION TREE?

A tree can be called a recreational attraction if the tree or grove of trees are of public significance. It may be that a community has promoted this tree as a tourist attraction, or the tree has been inventoried because it is a significantly large tree that has been registered in the provincial Big Tree Registry. Additionally, the tree may have unique architecture (stem or canopy features) that is being promoted to visitors through information pamphlets or interpretive signage. In these situations, the WHT Assessor will note in their documentation if the tree being assessed should be regarded as a recreational attraction so that the Designated Land Manager can account for this intrinsic value if there is a recommendation from the WHT Assessor for hazard mitigation.

This gnarly western redcedar at Avatar Grove on Vancouver Island is an example of a tree considered to be a recreational attraction.

WHAT IS A WILDLIFE TREE?

Trees in various stages of life, death and decay are important components of the structure and function of all natural forest ecosystems. Wildlife trees are part of this cycle of life and death. They are constantly being formed by biotic and abiotic factors such as insects, fungi, fire and weather.

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

It can take decades, even centuries, for a tree to complete the cycle of germination, maturation and decay. Careful assessment and conservation of wildlife trees during site management efforts can help to ensure continued existence of wildlife trees in a recreational setting. The assessment and monitoring of trees can help managers maintain important elements of the natural setting while keeping workers and visitors safe.

The value of any tree as wildlife habitat depends on a variety of attributes, including structure, age, condition, abundance, species, geographic location and surrounding habitat features. Rapid death by fire produces a different kind of wildlife tree than gradual death by insects or disease. Forest health agents such as these create most of the wildlife trees in the forest. Local climate and tree species also influence the way a tree deteriorates and decays.

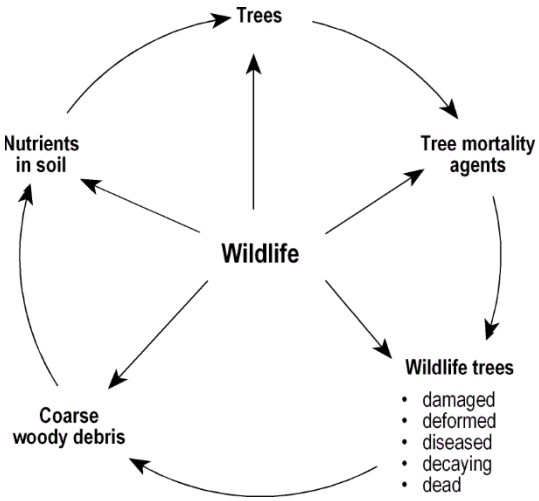
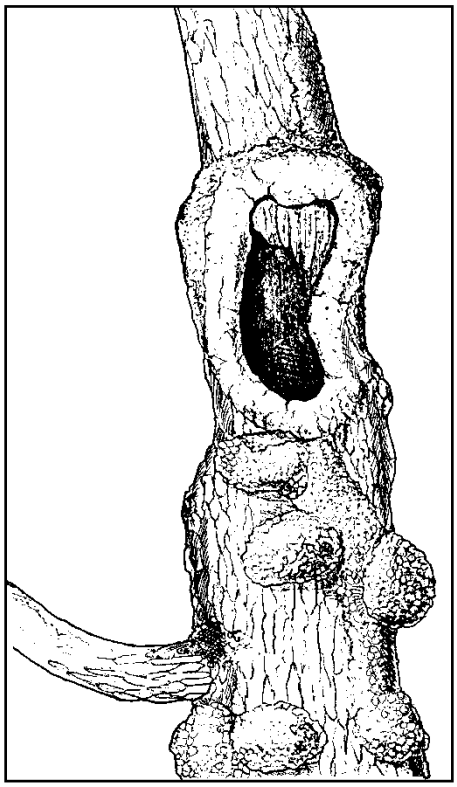


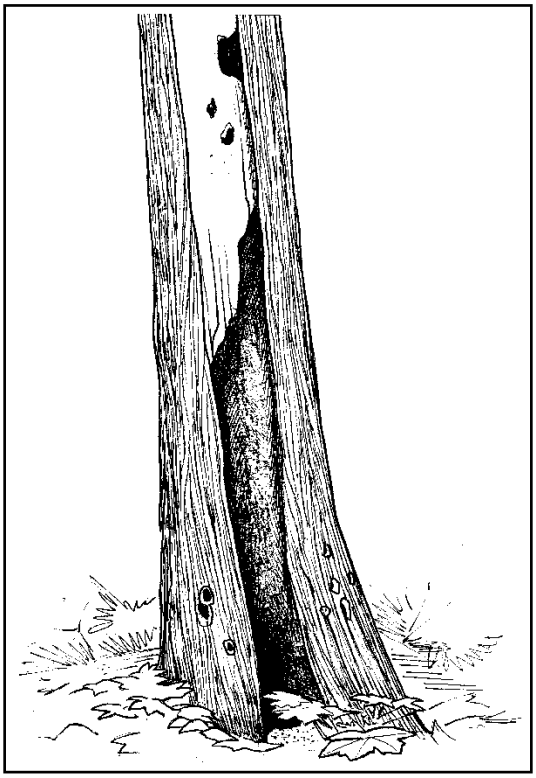
Figure 1. Interaction between wildlife and trees.

There are many habitat features associated with wildlife trees. They are created or caused by influences such as animal excavations, disease, insect attacks, wind, snow and lightning. More than 80 species of vertebrates and countless invertebrates, plants, fungi and bacteria depend on these habitat features for part of their livelihood. Twelve common examples of habitat features found in wildlife trees are shown on the following pages.

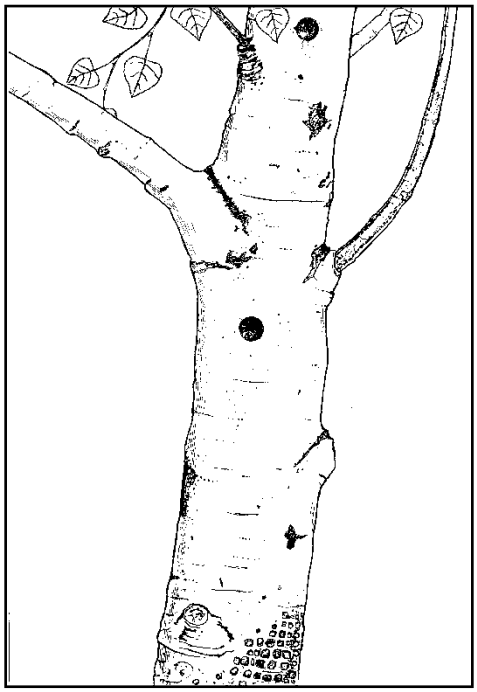
Habitat Features in Wildlife Trees



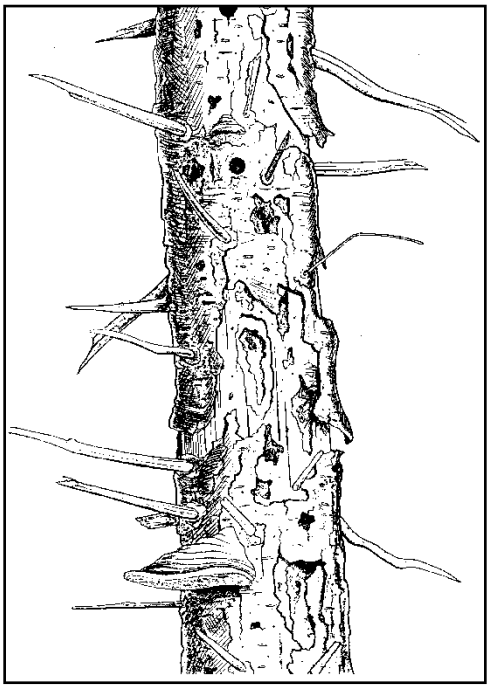
Natural cavity in bigleaf maple.



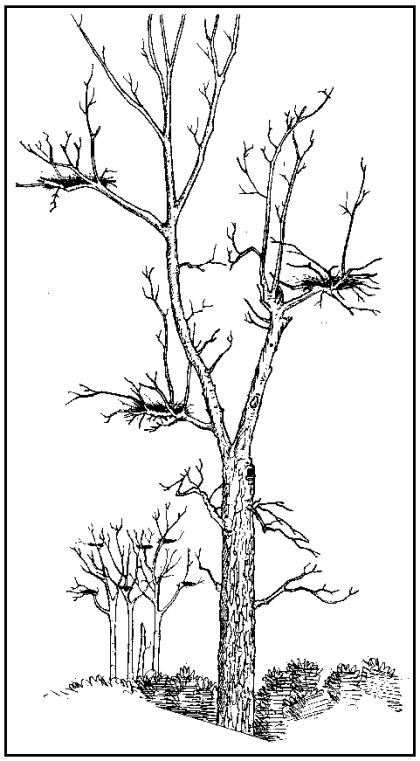
"Chimney effect" in western redcedar (a bat tree).



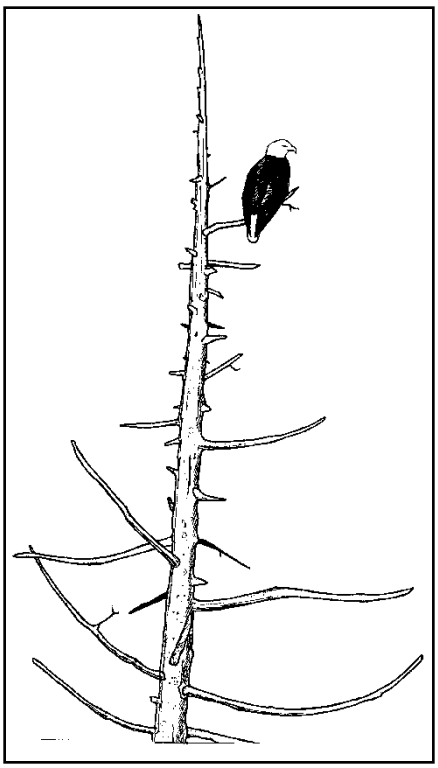
Live hardwood with primary cavity excavation and feeding holes.



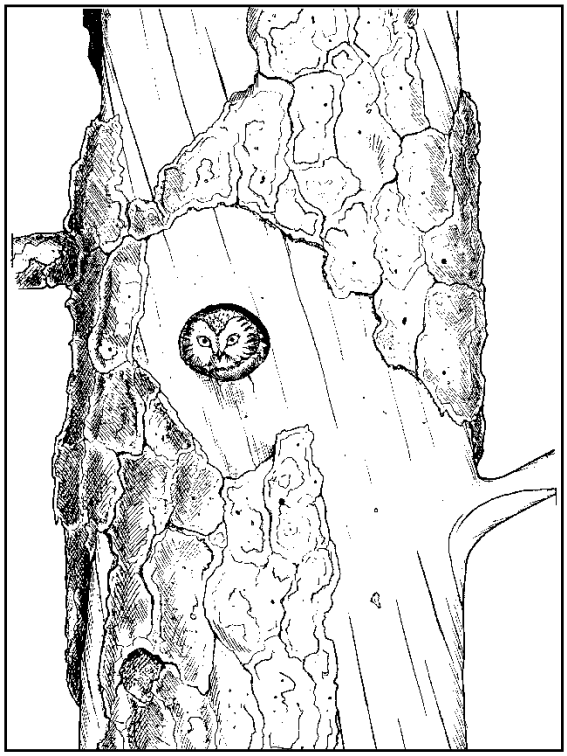
Heart rot and loose bark in grand fir, (used by birds such as Brown Creepers and nuthatches).



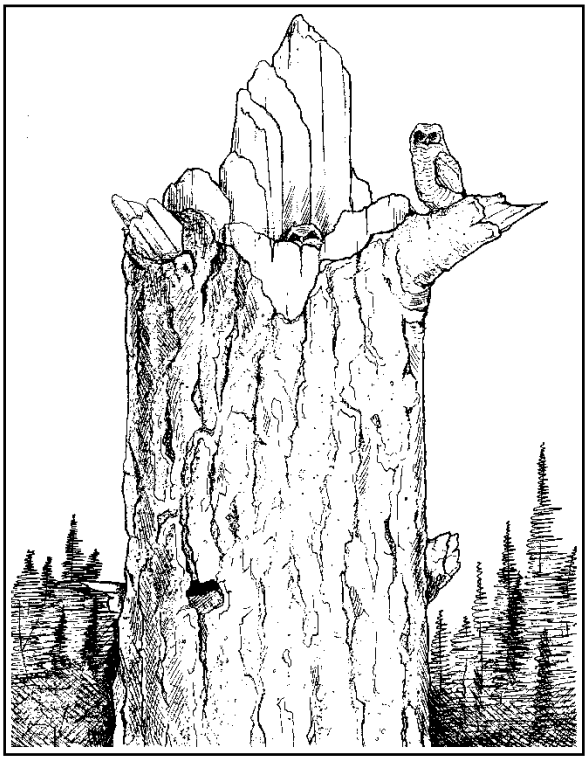
Branching in black cottonwood (nesting for Great Blue Heron).



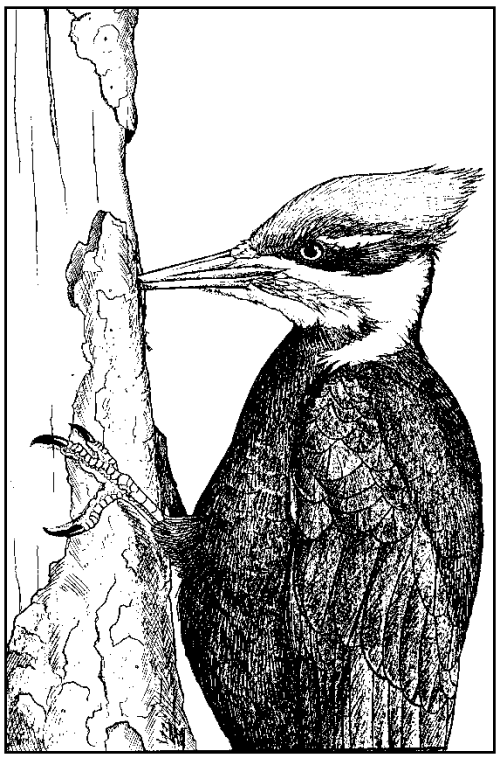
Spike top snag (for perching birds such as Bald Eagle).



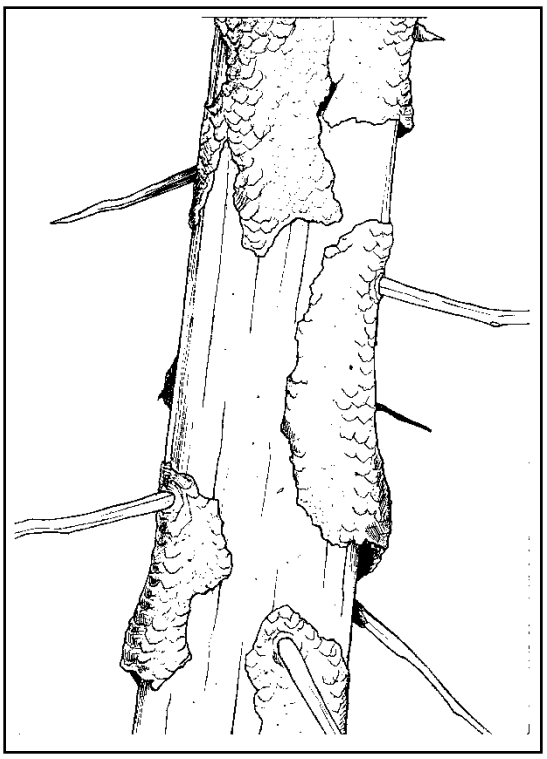
Secondary cavity in ponderosa pine (Saw-whet Owl using old Northern Flicker cavity).



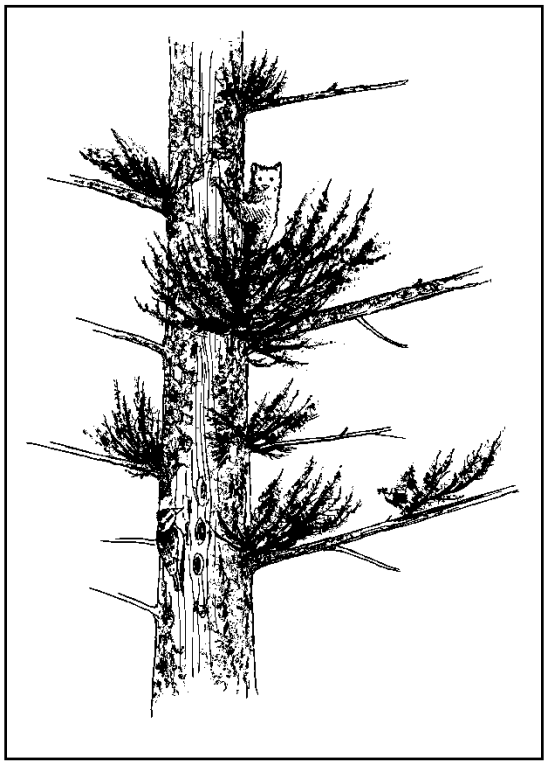
Douglas-fir snag (nesting and perching for owls).



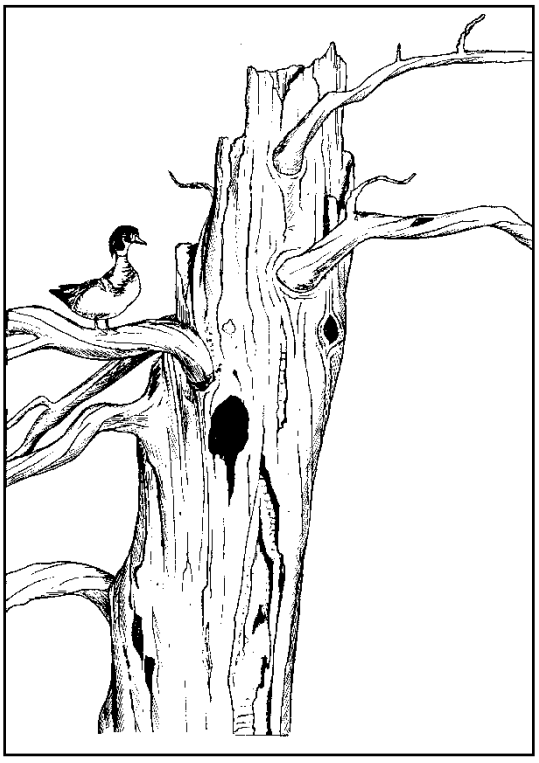
Pileated Woodpecker excavating for insects.



Loose bark suitable for a bat roost.



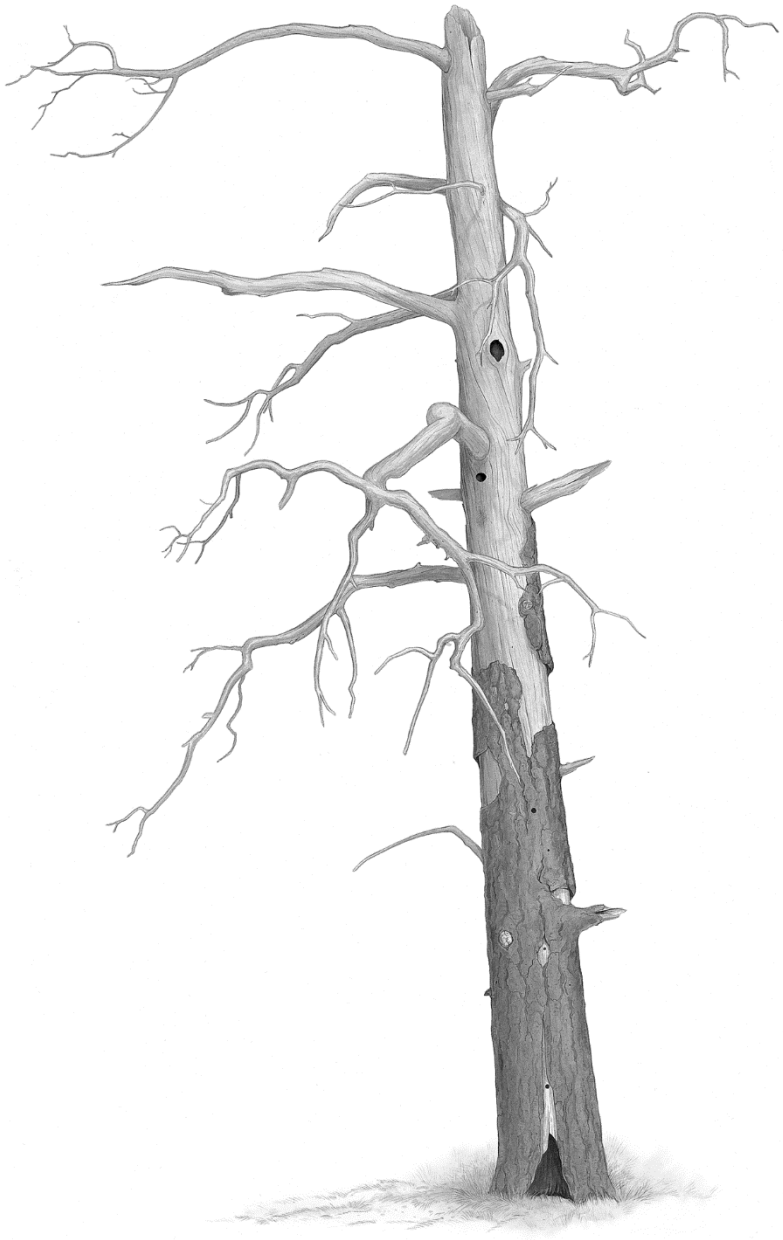
Witches' broom, habitat for marten and other wildlife tree users.



Wood Duck at enlarged cavity in dead ponderosa pine.

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.



Valuable Wildlife Tree Characteristics:

- Greater than 15 m in height preferable
- Greater than 30 cm DBH preferable (interior)
- Greater than 70 cm DBH preferable (coastal)
- Tree classes 2–6 most valuable
- Wind firm, 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, cavity)

These are GENERALIZED parameters.

NOTE: DBH = diameter at breast height (1.3m above root collar)

Wildlife tree habitat value should also consider the context within which a tree is found, particularly where wildlife trees provide habitat features for species at risk within critical habitat (e.g., residence) and/or at-risk plant communities (those either red- or blue-listed in BC by the Conservation Data Centre). Wildlife trees may provide critical habitat structure for rare species. Special provisions, considerations and legal requirements may apply to protect wildlife tree habitat in these cases.

Most valuable tree species

Because of natural variations in size, growth form and habit, and decay characteristics, some native tree species are inherently more valuable as wildlife trees than others. The following is a **generalized ranking** (i.e., 1 = most valuable) for some common native tree species. However, this order will vary depending on site, tree and habitat specific conditions. The localized ranking would reflect the presence and type of pathogens, relative abundance of tree species, condition of trees in the local area, critical habitat needs for species at risk, and the location or proximity to other habitats (e.g., riparian areas along lakes, streams and wetlands).

1. Douglas-fir and western larch,
2. ponderosa pine,
3. trembling aspen and cottonwood,
4. cedars (which have large hollow cavities), and
5. hemlocks and true firs (these species have better short-term habitat value).

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 that 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 and perching sites, especially in the first 1–2 years after the fire.

Ecosystem Context

A tree's landscape position influences its importance for different species. Wildlife 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) can often be found at the edge of roads or natural forest openings. The species composition and structure of the surrounding plant community also influence wildlife use of trees. Habitat patch size, distance from high use areas, and adjacency of other specific habitat needs can affect species use. Even small natural areas surrounded by human development can provide important habitat for some species.

Some wildlife species such as kestrels, flycatchers and bluebirds require trees surrounded by low or early-seral vegetation (grass-forb, shrub-seedling, pole-sapling) that can function as hunting perches and harbor prey species. Woodpeckers, owls, Vaux's Swifts, and others are dependent on the taller tree communities that develop later (young, mature or old-growth forest).

Wildlife trees adjacent to water bodies are important for cavity-nesting ducks, Great Blue Herons, Ospreys, Bald Eagles and Belted Kingfishers. The preferred topographic location of roost trees may vary from season to season.

Distribution and Tree Mortality Agents

Wildlife trees are not evenly distributed throughout the forest. They are usually found in patches corresponding to the unpredictable nature of tree mortality agents such as insects, disease or wildfire. These forest health factors are often interrelated and play important roles in the ecology of wildlife trees. Root diseases, for example, may predispose trees to infestations by insects and/or heart rots, thereby creating suitable nesting and feeding habitat for many wildlife species. Similarly, wood-boring beetles or flying insects often attack stem-damaged or fire-killed trees that subsequently become a source of food for woodpeckers, bats and other wildlife tree users.

Determining Tree Significance Value

Generally, the following table can be used by the WHT Assessor to indicate the significance value of a tree to a park, recreation site or trail. It is important to remember that the tree significance value assigned to a tree is site specific and based upon observations made by the WHT Assessor during the site assessment review and in context of the current state of the tree in question.

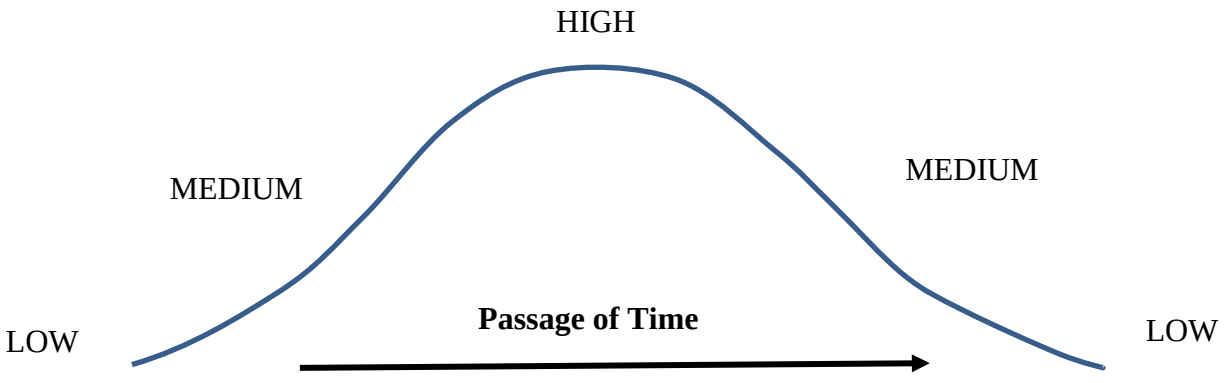
A tree with habitat features that are common or abundant could be rated lower than if the habitat features are rare or scarce. Regardless of the features and tree size, if wildlife is actively using the tree, then it's value should be regarded as high. Likewise, a former wildlife tree which has now deteriorated to such an extent that it is expected to fall apart very soon should be downgraded to a lower value.

The tree significance value assigned to a tree by the WHT Assessor can subsequently be used by the Designated Land Manager when deciding whether to expend time and resources to protecting the tree.

Guide to Tree Significance Value

Tree Significance Value	Characteristics
HIGH	• A tree with rare or uncommon habitat characteristics for the site. (e.g., large brooms, cavities, loose bark, dead tops, broken tops, perch site) • A culturally modified tree (CMT) • A tree protected by policy or special management practices (e.g., Special Tree, monumental trees, veteran trees, etc) • Tree with active or recent wildlife use (feeding, nesting, denning, perching, roosting, etc) • Tree structure suitable for wildlife use (suitable for large stick nest, hunting perch sites, bear den, fisher den, etc.) • Largest tree for site (height and/or diameter) or rare tree species • Habitat characteristics suited for locally important wildlife tree user species
MEDIUM	• Large, stable trees that will likely develop into a wildlife tree (e.g., recent split, broken top, death from insects) • A wildlife tree that has deteriorated and has diminishing viability for continued use
LOW	• Trees not covered by high or medium categories • Trees which are highly unstable and unlikely to remain standing beyond an operational period (e.g., advanced root disease, leaners, soft wood decay class)

The following graphic helps to illustrate how the relative wildlife value of a tree may change over time, starting as a young, healthy tree (Low value). Over time, as the tree becomes larger and the impacts by tree mortality agents affect the tree, the tree develops a broader range of habitat features which attract more wildlife (Medium to High value). Then, as deterioration advances, the suitability of the tree and wildlife use diminishes until the tree reaches an advanced state of deterioration (Low value) and is about to become coarse woody debris when it falls to the ground.



WILDLIFE TREES AND THE PROCESS OF TREE DEATH AND DECAY

Decay and the associated deterioration and death of trees are normal processes that regularly occur within forested ecosystems and are partly responsible for the ever-changing nature of forests. Casual observation may suggest that, aside from obvious factors such as fires and insect attacks, trees die randomly. However, a closer look reveals that tree death is a complex process, involving a vast number of tree mortality agents (see figure 2). The timing and rate of death depend on several factors, including but not limited to:

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

B. **The location of the tree relative to site and biogeoclimatic zone:** Trees located near the edge of their normal range are less resistant to pest attacks than those situated well within their normal range. Trees located on harsh sites are more easily stressed and hence more susceptible to attacks by various pests.

C. **The age, health and vigor of the host tree**: Trees are most susceptible to injury and attack when they are very young, very old, or otherwise unhealthy or stressed.

D. **The pest species**: Most pests favour certain host tree species and have little or no effect on other species.

E. **The amount or numbers of the pest present and its virulence**: Successful attack resulting in significant injury or death almost always requires that the attacking agent be quite strong and/or numerous in order to overcome the natural defenses of the host tree.

Plants can die either in whole or in part. It is common to see trees with dead tops or branches or roots. Tree death can occur slowly or relatively quickly, as with insect attacks. Different mortality processes produce different types of wildlife trees and change the forest in different ways.

Canker (Atropellis spp) 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.*

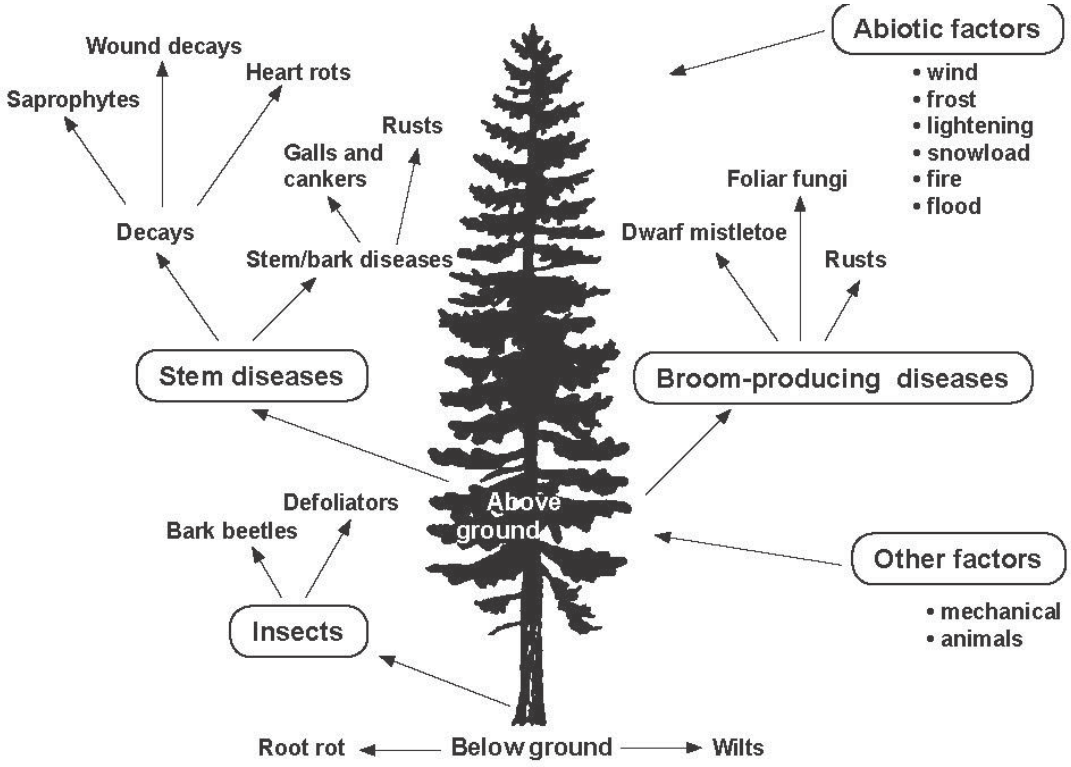


Figure 2. Tree mortality agents.

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 mortality agents occur sequentially and act in an additive manner.

One possible scenario of mortality agents acting sequentially begins with a small hatchet wound cut into the base of a western larch tree. This scar is subsequently attacked and infected by a decay organism that causes heart rot. After several years the decay has traveled up the trunk of the tree. A heavy snowfall accompanied by high winds causes the trunk of the tree to break off at the 12-meter point. If there are no live limbs below the breakage, the tree is killed. In this example, mechanical damage, followed by decay, followed by adverse weather conditions, combined to kill the tree.

Significance of Disease and Decay

Virtually all the natural tree mortality can be attributed to three broad categories: fire, insects and disease (the latter includes losses due to adverse climatic conditions and pollution). We can add the human dimension to these natural processes. Persons working or visiting our parks, recreation sites or trails injure trees, either accidentally or intentionally. Trees can be wounded during the construction of the site (e.g., excavator damage to a tree's roots or scars the stem), or by a vehicle backing into a camping site, or from persons throwing a hatchet into a tree. Each wound on a tree initiates the process of tree death and decay.

These losses are not necessarily negative. What constitutes a healthy forest depends upon one's viewpoint, and definitions of healthy and unhealthy are human perspectives.

Some negative aspects of losses due to decay

1. Weak or unhealthy trees are often knocked over or are broken off by wind or heavy snow. Such events sometimes cause damage to park facilities, homes or power lines, and may result in human injury or death.

2. Dead or dying trees are susceptible to insect attacks and may act as brood trees for small insect populations, allowing them to build up to epidemic levels that subsequently cause widespread forest damage.

Some positive aspects of fungi in our forests

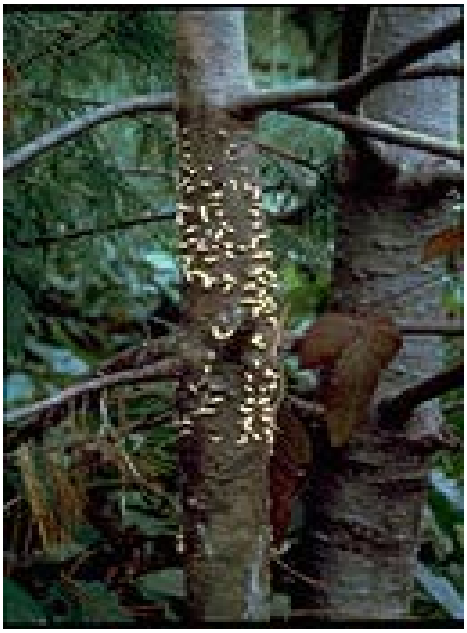
1. Fungi are decomposers. They breakdown organic matter and thereby serve as important agents in nutrient cycling. They also reduce fire hazard by breaking down woody debris.

2. Decay fungi also soften wood, thereby rendering otherwise inhospitable trees more 'user friendly' to many species of birds and animals. Fungi are therefore an important agent in producing and developing what we now refer to as wildlife trees. Host trees with softened heartwood are more vulnerable and accessible to primary excavators, such as large woodpeckers, that create cavities for nesting. Once cavities are created, they are available over many years for other species of birds and animals to use.

3. As the boles of trees continue to decay and break apart over time, woody material falls to the forest floor. This coarse woody debris provides habitat for numerous animals, as well as contributing nutrients to the forest floor.

4. Many fungi, often referred to as ectomycorrhizae or mycorrhizal fungi, live on the outer surface of tree roots and assist trees in absorbing nutrients form the surrounding soil.

Additional information on the distribution, hosts, and identifying characteristics of some of the major tree pathogens in B.C. (fungi, cankers, mistletoe and insects) can be found in Appendix 1.



Blister rust fungus (Cronartium spp) on White pine.

Cinder conk butt rot (Kretzschmaria deusta) on Bigleaf maple

WILDLIFE TREE CLASSIFICATION SYSTEM FOR B.C.

The wildlife tree classification system adapted for use in B.C. from Maser et al (1979) 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 1: 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 which might compromise the tree's structural strength.

Class 2: These are live trees but have some VISIBLE EXTERNAL DEFECT which can affect the tree's structural strength or introduce decay. The first stages of deterioration often begin while the tree is still alive. The invasion is led by fungi or wood-boring beetles.

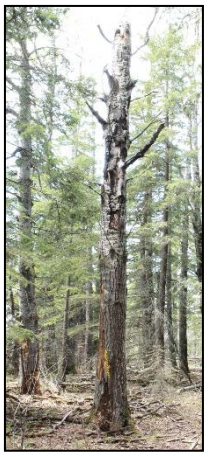
Wildlife trees that are alive or in the early stages of decay attract birds that build large open nests, such as Ospreys, Bald Eagles and Great Blue Herons, or cavity excavators such as woodpeckers.

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 evidence of decay
- Tree cavities (natural or excavations)
- External stem scars into the stem wood
- Stem cracks/splits (e.g. wind shake or frost cracks)
- Dead or dying tops (including secondary tops and forks)
- Broken or missing tops
- Large, broken dead limbs (>10cm diameter) pulled out at branch collar
- Damaged roots (from disease, fire or mechanical damage)
- Excessive lean (>30%) **AND** damaged/diseased roots
- Large witches' broom (>1m in diameter)
- Stem canker
- Unusual stem swellings (may indicate hidden decay)
- Insect, animal or fire damage such that tree is likely to die relatively soon (i.e., become a Class 3 tree)

Class 2: showing missing top & dying limbs

Class 3, 4, and class 5 conifers: The tree has died, and decay begins or continues. Class 3 trees are RECENTLY dead, still bearing their fine branches and twigs, and the bark is "tight". Class 4 trees have lost their fine twigs and only have larger, coarse limbs left, and bark has begun to loosen or shed from parts of the stem. Class 5 trees have usually lost many of their limbs but have not yet broken their tops, although their tops may be weakening. Woodpeckers will chisel out nesting cavities, taking advantage of the outer shell of sapwood that protects eggs and nestlings. As time passes, the tree continues to rot and soften.



Class 4: dead deciduous tree, with only larger coarse limbs remaining

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 from advanced decay, portions of the stem have broken away, and most of the limbs are gone. Class 5 for deciduous trees is roughly equivalent to classes 6–8 for coniferous trees.

Classes 6 and 7 conifers

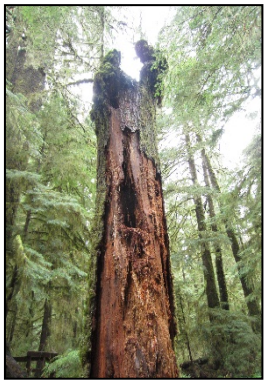
When the tree reaches these stages, weaker excavators, such as nuthatches and chickadees, can make their nest holes in the soft wood. Branches are often broken off, and slabs of bark loosen from the trunk. Decay is advanced in the upper portions of the trunk. The loss of tree limbs creates knot holes and natural cavities, many of which are soon converted into homes by a variety of animals. Over the years, the tree becomes shorter as portions of the top break because of advancing decay. Throughout stages 6 and 7, chunks of bark and sapwood are sloughed off and the upper bole of the tree has broken away. Generally, up to 1/2 of the original top height of the tree has broken away. Once the softer heartwood is exposed, wildlife trees are used less by woodpeckers and more by other animal species. Class 6 for deciduous trees represents a dead fallen tree.

Class 7: soft class with extensive decay

Classes 8, 9 conifers

In the final phases of tree decay, all the sapwood is highly decayed and sloughing and the heartwood is completely rotted through. By 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. At class 9, the stump and the mound of woody debris that surrounds it become an ideal site for new plant growth, providing a ready supply of moisture and nutrients. It has now become suitable habitat for amphibians, such as the clouded salamander, that require moist, thermally buffered environments.

British Columbia's wildlife tree classification system (conifers)



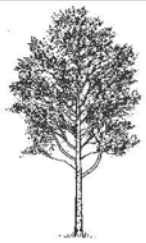
Class 8: extremely decayed stem

WILDLIFE TREE CLASSIFICATION SYSTEM FOR B.C. — Conifers

	LIVE TREES		DEAD TREES					DEAD FALLEN	
			Hard →	Spongy →			Soft		
Tree class	CLASS 1	CLASS 2	CLASS 3	CLASS 4	CLASS 5	CLASS 6	CLASS 7	CLASS 8	CLASS 9
SOFTWOOD									
Description	**Live / healthy:** no decay; tree has valuable habitat characteristics such as large, clustered or gnarled branches, or horizon-tal, thickly moss-covered branches*.	**Live / un-healthy:** internal decay or growth deformities (including insect damage, broken tops); dying tree.*	**Recently dead:** needles or fine twigs are present; bark is tight.	**Dead:** no needles or fine twigs — only coarse limbs present; 50% of branches lost; loose bark.	**Dead:** most branches absent; some internal decay; sapwood decay present; bark shedding; weak top.	**Dead:** no branches or bark; sapwood / heartwood sloughing from upper bole; decay more advanced.	**Dead:** extensive internal decay; outer shell may be hard; lateral roots usually completely decomposed; hollow or nearly hollow shells.		**Debris:** downed trees or stumps.
Uses and users	Nesting (e.g., Bald Eagle, Great Blue Heron colonies; Marbled Murrelet); feeding; roosting; perching.	Nesting / roosting[1] — strong PCEs[2] (woodpeckers); SCUs[3]; large-limb and platform nests (Ospreys); insect feeders.	Nesting / roosting — strong PCEs SCUs; bats.	Nesting / roosting — strong PCEs SCUs; insect feeders.	Nesting / roosting — weak PCEs (nuthatches, chickadees); SCUs; bats; insect feeders.	Weaker PCEs SCUs; insect feeders; salamanders; small mammals; hunting perches.	Insect feeders; salamanders; small mammals; hunting perches; occasionally used by weak cavity excavators such as chickadees.		Insect feeders; salamanders; small mammals; drumming logs for grouse; flicker foraging; nutrient source.

[1] Large witches' brooms provide nesting / denning habitat for some species (e.g.; fisher, squirrels).
[2] PCE = primary cavity excavator.
[3] SCU = secondary cavity user.
* This classification system does not recognize root disease specifically. Such trees become unstable at or before death.

WILDLIFE TREE CLASSIFICATION SYSTEM FOR B.C. — Broad-leaved deciduous

	LIVE TREES		DEAD TREES			DEAD FALLEN
Tree class	CLASS 1	CLASS 2	CLASS 3 (Hard)	CLASS 4 (Spongy)	CLASS 5 (Soft)	CLASS 6
HARDWOOD						

British Columbia's wildlife tree classification system (native broad-leaved deciduous)

NOTES:

Class 1 and 2 trees are LIVING trees. A class 1 tree is healthy, but a class 2 tree is unhealthy (it may be damaged, dying, diseased, injured, decaying). A broken top or a dead top are NOT a pre-requisite to being labelled as a Class 2 tree (these are simply two image examples of 'unhealthy' trees). The WHT Assessor must consider the mechanism of damage and the mortality agents when concluding on a tree class. For example, a healthy tree that recently died because its topped snapped during a windstorm would be called class 3 because decay has not yet begun, even though the stem is of reduced height. For dead trees, the progression of decay in the outer shell of the stem and roots is more important in designating a tree's class than its form or stature.

THE IMPORTANCE OF WILDLIFE TREES

Wildlife trees at all stages provide a portion of the life support system for many species of plants, invertebrates, birds, amphibians, reptiles and mammals. Altogether, 25% of all forest dwelling terrestrial vertebrates in British Columbia depend on dead or deteriorating trees. Some of their uses include nesting, feeding, communication (drumming, marking), roosting, shelter and overwintering.

Some highlights include:

- The largest group of wildlife tree users are cavity-nesting birds, such as owls, woodpeckers, and some ducks. Many of these, such as the Flammulated owl, Lewis' woodpecker, Western screech owl, Williamson's sapsucker, Spotted owl, and other cavity nesters are listed as species at risk.
  - ~ There are about 19 species of primary cavity-nesting birds in British Columbia.
  - ~ There are about 31 species of secondary cavity-nesting birds in British Columbia.
  - ~ Approximately 18% of the bird species known to breed in British Columbia are cavity nesters.
- More than 30 species of mammals in British Columbia use wildlife trees.
  - ~ Marten and Fisher often raise their young in tree cavities.
  - ~ Black bears often hibernate in hollow trees.
  - ~ Several kinds of bats roost in tree cavities or behind the loose bark of dead trees.
- Birds of prey, including Bald Eagles, Ospreys and some hawks, use the branches of these trees as perches, and often build their nests in dead or broken-topped trees.
- Woodpeckers, nuthatches and Brown Creepers forage on bark for a variety of insect pests.
- The long list of wildlife tree users includes some rare and endangered birds and mammals.
- In all, there are more than 80 wildlife tree-dependent species in British Columbia; a list of wildlife tree-dependent vertebrates and their dependency levels can be found in Appendix 2.

Vertebrate wildlife tree users can be divided into five general groups:

1. Primary Cavity Excavators;
2. Secondary Cavity Users;
3. Open Nesters;
4. Mammals; and
5. Amphibians.

NOTE: The listing of species at risk or protected species changes frequently, and for this reason any details contained in this document cannot be relied upon. Please consult with the BC Conservation Data Centre and the Federal Species at Risk listing for current information.

Primary Cavity Excavators

- Primary cavity excavators (PCE) are adapted to chisel out holes in the decaying wood of trees. They usually make new nest holes each year, leaving the old ones to be used by other wildlife. Woodpeckers and sapsuckers are primary cavity excavators, as are some species of chickadees and nuthatches.
- PCE's depend on the availability of dead or defective trees for nesting sites, and often for roosting and foraging sites as well. Cavity excavation and drumming are a part of their communication system, and also play a role in mating. Many of B.C.'s woodpeckers are year-round residents, so trees in which they can excavate thick-walled roosting cavities are an essential part of their winter roosting habitat. B.C.'s four species of chickadees and three species of nuthatches are also year-round residents that use cavities for both nesting sites and winter roosts. Pygmy Nuthatches often roost communally in winter for heat conservation, with up to 150 birds sharing a single roost.

Northern flicker – a primary cavity excavator.

Secondary Cavity Users

- Secondary cavity users (SCU) are birds and mammals that cannot excavate their own holes. They raise their young in holes abandoned by primary cavity nesters, or in natural cavities created by decay, loose bark, lost branches and lightning strikes. This group may also use wildlife trees for food storage and temporary shelter. They include small owls, swallows, bluebirds, some ducks, marten, raccoons, flying squirrels, deer mice and bats.
- Purple martin (aerial feeding bird) are a SCU that uses abandoned woodpecker nests and nest boxes. Their recovery in BC has been a result of the volunteer artificial nest box program that started in 1986. Today, these nest boxes account for almost all B.C. Purple Martin nests, with over 1200 nesting pairs and 120 active colonies on B.C.'s lower mainland and eastern coast of Vancouver Island.

Fisher, which are secondary cavity users, often use wildlife trees to raise their young and for year-round shelter.

Open Nesters

- Cavity-nesting birds are not the only birds that require wildlife trees. Birds that build large, heavy nests in the tops of big trees are called open nesters. Great Blue Herons, Bald Eagles, Ospreys, and the largest hawks and owls depend on large trees that can support their bulky, heavy nests. They do not necessarily require dead or decaying trees, but broken-top, split-top, or flat-crown trees are favored because of their open, flat structure. Some open nesters depend on wildlife trees for hunting perches. Several open nesters are named as protected species in BC under Section 34 of the *Wildlife Act*.

Great Blue Heron – an open nester. Nest site is protected year-round.

Other Mammals

- Black bears are known to hibernate in hollow trees with entrance openings <50cm. The mountain caribou's main winter food is arboreal lichens, which grow on the branches of old and/or dead trees. Marten and fisher den in tree cavities and hollow logs. Bats roost and nurse their young behind loose bark or inside dead, hollow trees. Of all mammals, bats are perhaps the most dependent on wildlife trees.

Black bear den entrance to a yellow cedar.

NOTE: Tree damage and internal decay resulting from prominent stem wounds (catface) and frost cracks (particularly on balsam poplar, lodgepole pine, trembling aspen and cottonwood), and which have a relatively narrow external opening/entrance, can be used as den sites for furbearers such as marten and fisher. These species require specific cavity entrance dimensions in the range of 5-12 cm wide.

Amphibians

- Amphibians, including the wandering and western red-backed salamanders, use the soft, moist wood found in highly decayed wildlife trees and fallen logs as shelter, and for laying their eggs.

Wandering salamander.

British Columbia's forested landscape offers a rich diversity of flora and fauna, making our parks a strong attraction to visitors from all over the world. We have over 80 different wildlife tree dependent users. When properly managed, wildlife trees can be safely maintained to provide many years of continued use by wildlife tree users, and at the same time, provide viewing pleasure for the many recreational visitors.

Wildlife/hazardous Tree Assessors have an important opportunity to manage wildlife trees for the species dependent upon these trees, both in the immediate and long term. WHT Assessors have the privilege of balancing public safety (discussed in chapter 2) with the conservation of wildlife habitat.

Additional Tree Protection Mandates

In addition to habitat provisions, WHT Assessors play a role in retaining trees in accordance with numerous tree protection requirements. **Special trees** as defined by the *Special Tree Protection Regulation*, provide an opportunity to promote the protection of legacy big trees for their ecological, cultural, biological and historical values. Some local and Indigenous governments have special bylaws to protect rare and endangered tree species (e.g., Gary oak, Arbutus), requiring a tree assessment by certified WHT Assessors and the development of a mitigation plan that strives to retain these trees.

Tree Species	Location	DBH (cm)
Arbutus	Anywhere	164
Cedar, yellow	Anywhere	265
Cottonwood, black	In coastal Biogeoclimatic zones	268
Cottonwood, black	Outside coastal Biogeoclimatic zones	176
Douglas-fir, coastal	Anywhere	270
Douglas-fir, interior	Anywhere	160
Fir, grand	Anywhere	146
Maple, bigleaf	Anywhere	198
Oak, Gary	Anywhere	136
Pine, ponderosa	Anywhere	119
Redcedar, western	In coastal Biogeoclimatic zones	385
Redcedar, western	Outside coastal Biogeoclimatic zones	290
Spruce, Sitka	Anywhere	283
Yew, pacific	Anywhere	63

Examples of the Special Tree listings as defined by DBH ranges by species (Special Tree Protection Regulation 2022)

LEGISLATION AND POLICY

The management and protection of certain wildlife species, and the trees they rely upon for survival, are mandated at both the provincial and federal levels of government. In some instances, protection is further guided under municipal bylaws. It can be very easy to contravene the legislations below and harm protected birds or their nests. Remember that some nests are protected all year, while others are protected while in use. You may need to remind the Designated Land Manager to consult with a registered professional biologist for advice before removing or modifying a nest tree.

Migratory Birds Convention Act/Migratory Birds Regulations

In Canada, some wildlife trees are protected under the Migratory Birds Convention Act and the associated Migratory Birds Regulations (MBR). The objective of the MBR is the conservation of migratory birds, including their eggs and nests, in Canada. It is important to note that the nests of all migratory bird species are protected when they contain a live bird or a viable egg (so generally during the nesting period). However, the nests of 18 species (listed in Schedule 1 of the regulations), whose nests are reused by migratory birds, continue to have year-round nest protection, unless they have been shown to be abandoned. To be considered abandoned:

(a) Environment and Climate Change Canada must be notified, via an online registration system (the Abandoned Nest Registry), that the nest does not contain a live bird or viable egg; and

(b) the nest is to remain unused by migratory birds during the designated wait time for that species.

In BC, the Great Blue Heron and the Pileated Woodpecker are migratory wildlife tree users whose nests are federally protected year-round under the MBR. The Pileated Woodpecker is a primary cavity excavator that excavates a large cavity into a tree for its nest and will also excavate cavities in hollow trees for roosting. These nest and roost cavities are relied upon by many other cavity dwelling birds and mammals for nesting and overwintering survival for several years once vacated by this woodpecker, hence the nest site is protected.

Wildlife Act

In British Columbia, some wildlife trees are protected indirectly under Section 34 of the *Wildlife Act*. It 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."

Species at Risk Act (SARA)

In Canada, the Federal Government proclaimed the Species at Risk Act (SARA) to legally protect wildlife species at risk, as well as their habitats, on federal lands. SARA makes it an offence under sections 32 and 33 of SARA to disturb or possess individuals, or to alter the residence of the SARA listed species. The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) is an independent body of experts that identifies and assesses species at risk. When establishing the legal list of species at risk the Federal Government considers COSEWIC's designations on the status of wildlife.

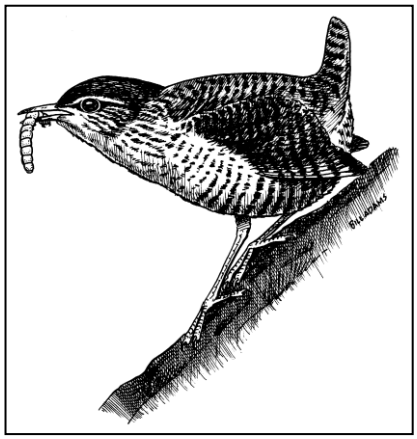
For further information on federal listings, refer to the *Species at Risk Act Public Registry* at: http://www.registrelep-sararegistry.gc.ca and to query and search COSEWIC species lists, visit: http://www.cosewic.gc.ca

Identified Wildlife Management Strategy (IWMS)

Identified wildlife is a term given to the species at risk and regionally important wildlife that our provincial government has designated as requiring special management provision under the Forest and Range Practices Act (FRPA). The IWMS (version 2004) provides direction for managing the identified wildlife, with a goal to minimize the effects of forest and range practices on Crown land. For further information on identified wildlife provisions, refer to the IWMS at http://www.env.gov.bc.ca/wld/frpa/iwms/accounts.html.

NOTE:
If a hazardous but high-value wildlife tree poses an unmanageable risk to the safety of persons or facilities (ie, the tree hazard cannot be successfully mitigated by topping, the target cannot be removed or closed), then the protection of life and property supersedes protection of the tree. In this case, the tree may be removed, and artificial wildlife habitat modification techniques could be used to create a safer substitute wildlife tree nearby (see Section Three). However, for trees used by **identified wildlife**, application for permission to alter or remove the hazard must first be sought from the designated authorities before taking action.

Winter Wren feeding on insect pest.



Wildlife Tree Users Under Pressure

Wildlife tree users include more than two-dozen species considered to be red- or blue-listed according to the BC Conservation Data Centre and species listed by COSEWIC. Red-listed species are those being considered for legal designation as endangered or threatened under the *B.C. Wildlife Act*. Blue-listed species are considered vulnerable and/or sensitive and at risk because of low or possibly declining populations. Species may also be placed on the blue list because of inadequate understanding of their status. All other wildlife tree-dependent species are considered of general management concern. Appendix 3 shows the uses and level of dependency of indigenous wildlife tree users in B.C.

THE ECOLOGICAL AND ECONOMIC SIGNIFICANCE OF WILDLIFE TREE USERS

Wildlife tree-dependent species have a number of ecological roles in B.C. forests. One of the most important and well-documented roles of wildlife tree users is their impact on forest invertebrates and small mammal populations. Each year, B.C. forests are subject to disturbance from a variety of insects and small mammals. Bark beetles (e.g., mountain pine beetle), spruce budworm and Douglas-fir tussock moth are examples of some of the insects most damaging to the forest industry in B.C. Although the relative impact of vertebrate pests on our forests is considered small, some species (e.g., voles, squirrels, rabbits, snowshoe hares and porcupines) can cause significant economic losses under certain conditions.

To identify the prey groups of wildlife tree-dependent species, wildlife tree users can be grouped into "feeding guilds" (Tables 2 and 3) for birds and mammals, respectively. Birds of prey and carnivores feed on a variety of small mammals, some of which eat conifer seeds or damage seedlings and saplings. Bark-foraging birds, foliage-gleaning birds, and aerial-foraging birds feed largely on insects. Differences in bill structure and feeding location result in the partitioning of insect prey types (e.g., defoliators, sucking insects, woody tissue feeders) and life stages (e.g., larvae, pupae, adults) among group members. All 13-wildlife tree dependent bats are insectivorous.

Visitors to B.C.'s parks, recreation sites or trails are attracted by the many opportunities to observe wildlife, especially wildlife tree users. Wildlife viewing is a growing activity, not only in parks but across the forested landscapes of B.C. The economic and social benefits generated by these opportunities are significant and wildlife tree management should continue to be promoted within the context of parks wherever safety permits.

Defoliators: Western spruce budworms.

Woodpecker bark scaling for mountain pine beetle larvae.

Avian wildlife tree user feeding guilds that consume forest insects and small mammals *(adapted from Machmer and Steeger 1995)*

Wildlife Tree User Guild	Guild Members	Predator Example	Prey Example	General Remarks
Birds of prey	eagles[1], hawks[2], falcons[3], owls[4]	Golden Eagle	rabbits, hares, rodents	• rodents, pikas, rabbits and hares are the most common food item of 13 of the 17 species in this group
Bark-foraging birds	sapsuckers[5], woodpeckers[6], Northern Flicker, nuthatches[7], Brown Creeper	White-headed Woodpecker	bark beetles (e.g., mountain pine beetle)	• forest insects make up ≥75% of the diet volume in 11 of the 15 species in this group • 13 of the 15 species are known to eat a variety of *pest* insects
Foliage-gleaning brids	chickadees[8]	Black-capped Chickadee	moths, budworms, loopers, beetles, weevils	• forest insects are the most common food item of the 4 species in this group • all 4 species are known to eat a variety of *pest* insects
Aerial-foraging birds	flycatchers[9], swallows[10], bluebirds[11], Flammulated Owl, Lewis' Woodpecker Vaux's Swift Purple Martin	Violet-green Swallow	beetles (e.g., western pine beetle)	• insects make up ≥75% of the diet volume in 9 of the 10 species in this group • 5 of the 10 species are known to prey on *pest* insects

1 eagles = Bald Eagle, Golden Eagle

2 hawks = Northern Goshawk, Red-tailed Hawk, Swainson's Hawk, Cooper's Hawk

3 falcons = American Kestrel, Merlin

4 owls = Barn Owl, Western Screech-Owl, Great Horned Owl, Northern Hawk Owl, Northern Pygmy-Owl, Spotted Owl, Barred Owl, Boreal Owl, Northern Saw-whet Owl

5 sapsuckers = Yellow-bellied Sapsucker, Red-naped Sapsucker, Red-breasted Sapsucker, Williamson's Sapsucker

6 woodpeckers = Downy Woodpecker, Hairy Woodpecker, White-headed Woodpecker, Three-toed Woodpecker, Black-backed Woodpecker, Pileated Woodpecker

7 nuthatches = Red-breasted Nuthatch, White-breasted Nuthatch, Pygmy Nuthatch

8 chickadees = Black-capped Chickadee, Mountain Chickadee, Boreal Chickadee, Chestnut-backed Chickadee

9 flycatchers = Pacific-slope Flycatcher, Ash-throated Flycatcher

10 swallows = Tree Swallow, Violet-green Swallow

11 bluebirds = Western Bluebird, Mountain Bluebird

Mammalian wildlife tree user guilds that consume forest pests (adapted from Machmer and Steeger 1995)

Wildlife Tree User Guild	Guild Members	Predator Example	Prey Example	General Remarks
Aerial-foraging bats	Myotis spp.[1], Big Brown Bat, Silver-haired Bat, Pallid Bat, Hoary Bat	Big Brown Bat	beetles, moths	• all 13 species in this group are insectivorous • investigations of specific pest species consumed are under way
Terrestrial and arboreal rodents	mice[2], squirrels[3], chipmunks[4], Southern Red-backed Vole, Bushy-tailed Wood Rat	Red Squirrel	moths (e.g., spruce budworm)	• insects comprise part of the diet of at least 6 of 12 species in this group; 4 species are known to consume *pest* insects • fungi is the predominant food for several species
Carnivores	Weasels[5], Marten, Fisher, Ermine, Spotted Skunk, Black Bear, Racoon	Marten	rodents, rabbits, hares	• small to medium-sized mammals (many of which are considered pests) are the first-ranked foods for 5 of 8 species in this group

1 Myotis spp. = California Myotis, Western Small-footed Myotis, Western Long-eared Myotis, Keen's Long-eared Myotis, Little Brown Myotis, Northern Long-eared Myotis, Long-legged Myotis, Yuma Myotis

2 mice = Deer Mouse, Columbia Mouse, Sitka Mouse

3 squirrels = Flying Squirrel, Douglas Squirrel, Red Squirrel

4 chipmunks = Yellow-pine Chipmunk, Least Chipmunk, Red-tailed Chipmunk, Townsend's Chipmunk

5 weasels = Long-tailed Weasel, Least Weasel

Wildlife tree users eat many forest invertebrates and small mammals and affect the level of change incurred by these species. However, this does not tell us whether wildlife tree users can in fact control the abundance of certain pests. Some of the best evidence for this type of control comes from the bark-foraging guild.

Three-toed, Black-backed, and Hairy Woodpeckers eat mainly insects, and in winter they specialize on wood-boring beetle larvae. They use their chisel-shaped bills to drill beneath the bark and then extract the larvae with their unique tongues (Figure 3). Three-toed Woodpeckers show impressive rates of consumption using this feeding technique. During a spruce beetle outbreak, their stomachs contained an average of 915 beetles per bird, with each bird filling its stomach to capacity several times a day. Many studies show that woodpeckers can impact beetle populations; they respond *directly* to beetle outbreaks by including more beetles in their diet and by aggregating in outbreak areas, especially in winter.

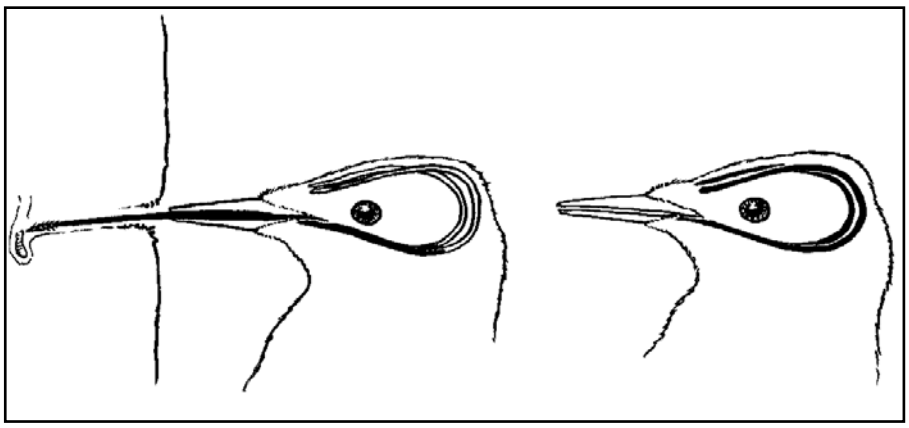


Figure 3. Specialization of woodpecker tongues (adapted from Ehrlich et al. 1988). Most woodpeckers have very long tongues that wrap around the skull when retracted (right). When extended (left), they can probe deep into holes drilled into trees. The tip of the tongue is barbed and coated with sticky saliva to help extract prey.

Woodpeckers also increase beetle mortality *indirectly* through their feeding activities. The process of excavating beneath the bark alters the microhabitat of the beetle larvae, making them more susceptible to temperature extremes, desiccation, and attack by parasitic or predaceous insects. Other predators (e.g., Brown Creeper, Red-breasted Nuthatch) are also drawn to "woodpeckered" bark where they can access beetle larvae. Both the direct and indirect effects of woodpecker feeding activity contribute to the biological control of bark- and wood-boring beetles.

In general, cavity-nesting birds play an important role in maintaining some insect species at low levels by delaying the onset of an insect outbreak and accelerating its decline. Their main benefit lies in preventing outbreaks rather than in controlling established outbreaks. The feeding habits of aerial-foraging bats suggest that they too could play a significant role in controlling insects. Maintaining healthy populations of these predators makes good biological and economic sense.

Some wildlife tree-dependent rodents (figure 4) (e.g., flying squirrel, southern red-backed vole) rely on fungi for food, especially in winter. In turn, those mycorrhizal fungi that produce their fruiting bodies underground rely on small mammals for spore dispersal. Small mammals smell and dig up nutritious fungal fruiting bodies. Once eaten, fungal spores pass through the rodent digestive tract and are excreted into pellets. Spores within these pellets can establish a new fungal colony on a tree root system. By dispersing spores, small mammals act as a critical link in a cycle that promotes the growth and survival of our forests.

Wildlife tree users play a significant role in the transport of other materials within forest ecosystems. Small mammals collect and eat several kilograms of seeds annually. Many seeds are adapted to passage through the digestive tract, and substances contained in rodent pellets (e.g., yeast, nitrogen-fixing bacteria) encourage seedling establishment and growth. In the process of digging, small mammals mix soil layers and improve the properties of the soil for seedling establishment. Ground-foraging birds (e.g., House Finch, Common Grackle) also disperse seeds. Birds and bats are important transporters of nutrients because of their mobility. Bat feces are very rich in nitrogen and contribute to the nutrient content of roost trees and entire forest ecosystems.

Through their excavations, primary cavity excavators provide other wildlife with nesting, roosting and feeding opportunities. Ultimately, they accelerate the rate of tree decomposition and nutrient cycling in forest ecosystems.

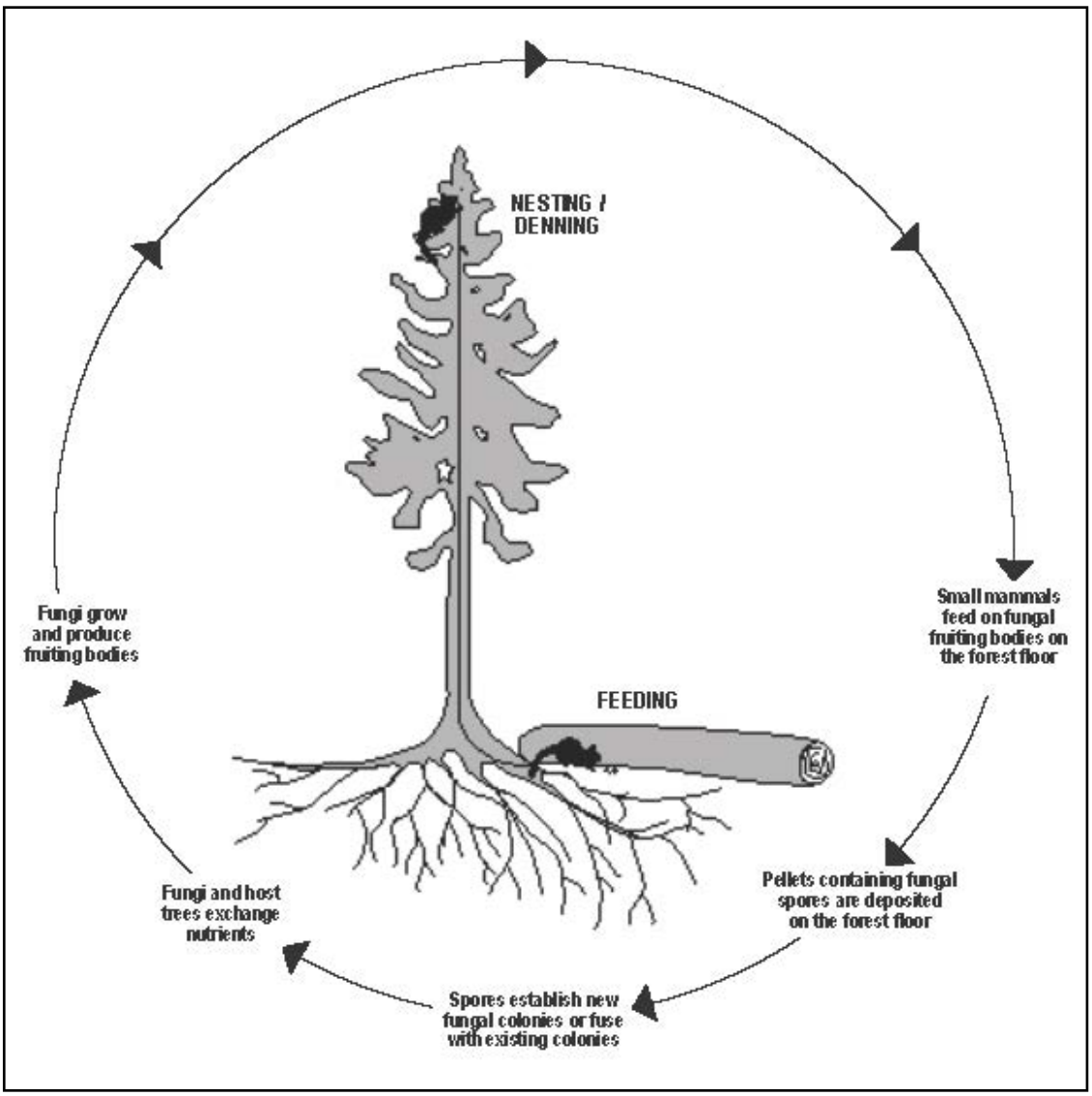


Figure 4. Root-fungus–small mammal interrelationships (adapted from C. Maser 1988).

NOTES:

COARSE WOODY DEBRIS

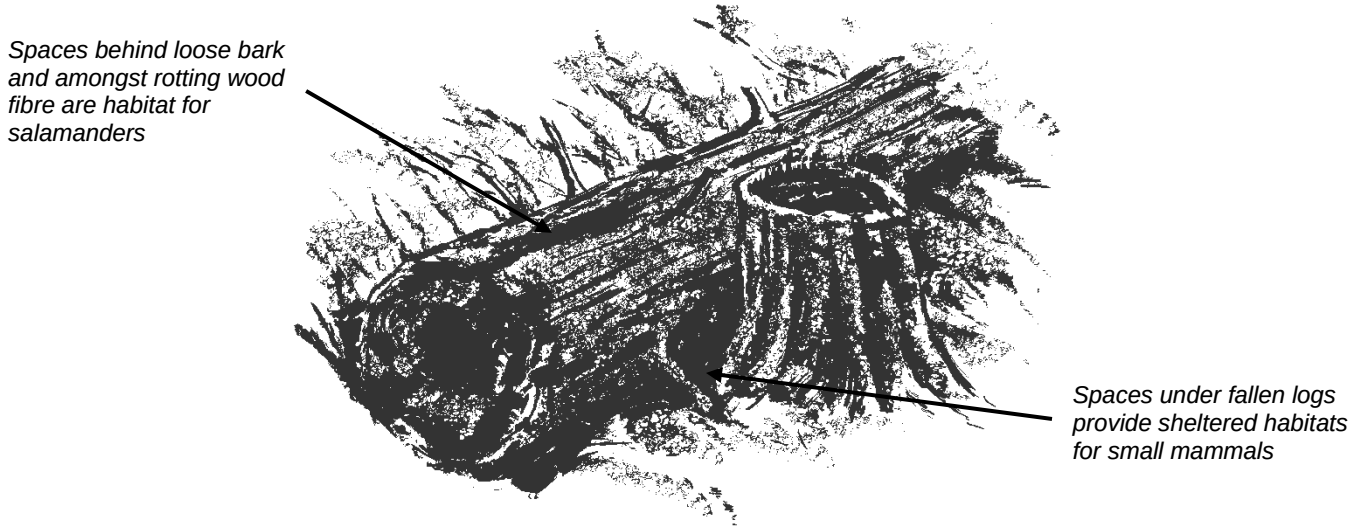
Scientific studies show that coarse woody debris (CWD) can be a significant contributor to biological carbon sequestration. Trees store atmospheric carbon in their wood using photosynthesis. Once the trees die, fungi and other saprotrophs transfer some of that carbon from CWD into the soil.

The list of organisms dependent on CWD for habitat or as a food source includes bacteria, fungi, lichens, mosses and other plants, and in the animal kingdom, invertebrates such as termites, ants, beetles, and snails, amphibians such as salamanders, reptiles such as the slow-worm, as well as birds and small mammals.

Fallen trees, or other course woody debris (CWD), continue to serve an important role in the forest. Some of the many benefits CWD provides include:

- feeding, breeding, and shelter substrate for many organisms (invertebrates, small mammals, amphibians),
- nutrient source and growing substrates for various bacteria and fungi (including the mycorrhizal fungi that benefit most woody plants), as well as saprophytic plants, lichens and mosses that function in decay, nitrogen production, and other nutrient and moisture cycling,
- erosion control,
- buffered microclimates suitable for seedling establishment,
- escape cover from predators, shelter and access routes for small mammals in periods of heavy snow cover.

CWD also shapes and stabilizes stream banks, and in aquatic habitats it increases channel complexity and habitat quality by creating pools and riffles (dispersing stream energy and creating fish habitats). In streams, CWD increases litterfall retention (up to 70%), which is then decomposed by stream organisms.



Recommendations for Managing Coarse Woody Debris

When felling trees or clearing trails, leave some large logs and limbs as wildlife habitat and as a source of forest floor nutrients. Try to leave large logs with heart rot or hollow cavities because these pieces will provide refuge cover for wildlife. Hollow logs are rare and cannot be created once a tree has fallen.

General guidelines for managing CWD include:

- Leave a range of piece lengths and diameters.
- Leave a range of decay classes (hard, spongy and soft stages of decayed CWD).
- Move CWD away from the trails so that it can decay naturally and with minimal disturbance from public visitors.
- In cleared areas, leave some small debris piles (<1 m high) as habitat for small mammals.
- If woody debris must be chipped, spread the chips thinly (<10 cm deep) on the forest floor to maintain biomass levels on site.
- In traveled or high use areas, slash CWD to the ground (this helps prevent potential injury from suspended logs).
- Balance objectives for coarse woody debris with other management objectives (e.g., fire hazard, back country versus front country).
- Manage forest fire fuel loading (e.g., bucking small debris to the ground for accelerated decomposition) and bore into larger logs to hasten their water absorption and rate of decay.

NOTES:

Section Two

WILDLIFE/HAZARDOUS TREE ASSESSMENT

Learning Objectives

- Hazardous and Dangerous
- Level of Disturbance & Exposure
- Site Assessment Overview
- Visual Tree Inspection
- Detailed Tree Assessment
- Overall Hazardous Tree Rating
- Safety Procedures
- Hazard Zones
- Documentation and Communication

HAZARDOUS TREES

Trees are an integral component of most parks, recreation sites and trails. Often the very trees that attract visitors also pose risk of failure, especially where there are examples of legacy trees (large and often over-mature trees). Section two covers hazardous tree management – a systematic process for identifying tree hazards, assessing these trees using tree hazard tables, and making recommendations about how to manage hazardous trees. The guiding principles and goals for managing tree hazards in parks, recreation sites or trails are:

- To ensure workers and the public are reasonably safe,
- To conserve forest and wildlife tree values, and
- To promote tree health and sustainability.

Reasonable care must therefore be exercised to reduce the risk of failure to acceptable levels. The hazardous trees must be identified and managed to reduce the risk of tree failures causing harm to workers and the visiting public, as well as preventing damage to property. Mitigation planning will therefore strive to protect worker and public safety, and where opportunities exist, select appropriate treatments (e.g., closures, tree modification) that can promote conservation values.

WHAT IS A DANGEROUS TREE?

The Occupational Health and Safety Regulation (OHS) provides a definition for a Dangerous Tree under section 26.1:

> **A DANGEROUS TREE**...
>
> *… means a tree (live or dead, regardless of size) that is a hazard to a worker due to:*
>
> *(a) its location or lean,*
>
> *(b) its physical damage,*
>
> *(c) overhead conditions,*
>
> *(d) deterioration of its limbs, stem or root system, or*
>
> *(e) any combination of the conditions in paragraphs (a) to (d).*

For the purposes of parks, recreation sites or trails, the hazardous conditions will depend upon specific levels of disturbance and exposure (LODE) categories and their associated tree hazard tables (tables 3, 4, 4A, or 5). A hazardous tree will be labelled as a "Dangerous Tree" if it is located within reach of workers, developed areas or located adjacent to site infrastructure or buildings where there is a high risk of failure, whole or in part, that may cause injury or harm to persons or damage to property.

Tree Assessment Process

All trees, whether they are alive or dead, have the potential to be a hazard to people, property, or facilities. With reference to dangerous trees and the workplace, OHS Regulation 26.11 (1) states: *If it is known or reasonably foreseeable that work will expose a worker to a dangerous tree,*

(a) the tree must be removed or

(b) a risk assessment of the tree must be undertaken.

Fundamentally, to be declared a dangerous tree means the tree is in a hazardous condition according to the LODE tree hazard tables, and that the hazardous defects are within reach of a target. For the purposes of parks, recreation sites or trails, targets are those established areas and buildings that are specifically provided (i.e., can include constructed trails, camping sites, picnic sites, playgrounds, roads, bridges, facilities, etc) to the visiting public to help them safely enjoy the park, recreation site or trail. Workers responsible for the development and upkeep of the park, recreation site or trail are also targets.

Therefore, people trained in this wildlife/hazardous tree (WHT) assessment process will systematically search for trees within reach of identified targets that have visual hazard indicators and a potential for failure. They will then consider the degree of risk that a failure could cause harm or damage. For example, the degree of hazard will depend on factors such as type, size and weight of the hazardous part, location of the tree, tree species, shielding by other trees, disturbance by worker activities, duration of public exposure and season of occupancy. It is noteworthy to caution that this tree assessment process is limited because not all defects can be detected prior to a tree failing. Additionally, there are unpredictable circumstances (e.g., storm events, vandalism, climate change, fire, flooding, landslides) which may create new hazards to what were healthy trees.

Therefore, successful hazardous tree management will require a routine and systematic inspection and assessment of trees growing within 1½ tree lengths of worksites and identified targets within the developed areas within the park, recreation site and trails. The procedures for determining whether a hazardous tree is dangerous to workers, to the public, to facilities, to property and the appropriate steps and safety procedures for mitigating the hazard, are described in the following sections.

The determination of a tree's hazard rating requires an understanding of the hazards inherent in a tree and the level of target exposure to the hazards of the tree. If either the tree hazard or exposure of the target is eliminated, then there is low risk associated with the tree.

RISK = HAZARD X EXPOSURE

In application, a tree located beyond reasonable reach of persons or property would be considered to have no exposure and thus very low risk. Similarly, a tree within reach of persons or property but which has no visual hazards would be of very low risk. Trees which have a very low risk of causing harm or damage would not require intervention.

Worker Safety

The ***Workers Compensation Act*** in BC requires employers to ensure the safety of their workers while performing duties at the workplace and to make workers aware of every known or foreseeable safety hazard. Furthermore, employers are to ensure supervisors or managers are adequately trained and informed in such health and safety responsibilities. These responsibilities will ensure that a prescribed program for the prevention of those work site hazards is developed, implemented, and monitored as part of an employer's due diligence. Where workers are engaged in site maintenance/construction activities at a park, recreation site or trail, then a pre-work hazardous tree assessment must be conducted at the worksite, and the appropriate safety measures implemented before work starts.

In British Columbia, the standard assessment practices for identifying and assessing hazardous trees that are located within parks, recreation sites or trails is this Wildlife/Hazardous Tree Assessors Course (WHTAC) module.

Additionally, the WHTAC process can be used when Qualified Environmental Professionals (QEP) are reviewing urban developments under the Riparian Area Protection Regulation in BC. Often there are trees to review from within the Streamside Protection and Enhancement Area (SPEA). Within the SPEA, trees play an important role that support a healthy and functioning riparian area, such as:

1. Contributing Large Woody Debris (LWD) for fish habitat and maintaining channel morphology.
2. Anchorage for localized bank stability.
3. Stabilizing floodplains during channel movements.
4. Provide shade (especially important for temperature sensitive streams).
5. Provide litter fall and insect drop for fish and nutrient supply.

Typically, the QEP who has successfully completed this module and is a current WHT Assessor will review trees within the SPEA area that could impact the property developments and buildings and make recommendations that will support stewardship of the trees within the riparian area while protecting workers and property.

For more guidance on managing public safety, refer to Appendix 4.

DETERMINING TREE HAZARD RATING

The primary goals of tree hazard rating are to ensure the reasonable safety of people (workers and visitors), property (vehicles, buildings), and to protect facilities at the park, recreation sites or trails. WHT Assessors must be able to recognize tree hazards, know how to evaluate them, and recommend appropriate safety procedures that will reasonably ensure the safety of workers and the public while balancing the conservation values associated with these trees.

Hazardous tree rating is a systematic process that begins by collecting relevant information about the site, identifies worker activities and public use patterns, and then identifies tree hazards in relation to targets (people, property, or facilities) within the park, recreation site or along a trail. Individual tree assessment is only undertaken when there is a risk of failure, whole or part, of a tree that is within reach of an identified target.

The hazardous tree assessment process is described in 5 main steps:

1. **Determine the level of worker disturbance and visitor exposure** (refer to Table 1)
2. **Conduct a site assessment overview** (refer to Table 2)
3. **Conduct tree assessments** (refer to Tables 3, 4, 4A and 5)
4. **Make the appropriate safety recommendation** (Safe or Dangerous)
5. **Provide documentation and communicate safety procedures.**

This 5-step process is described in the sections that follow. Steps 1 and 2 guide the planning process so that WHT Assessors will have the context for all known or foreseeable tree and site hazards prior to evaluating individual trees. Persons interested in hazardous tree assessment must understand that the processes described herein must be combined with field training and diligent practice.

STEP 1: Determine the level of disturbance and exposure (LODE)

Not all defects pose an immediate and serious threat to the health and safety of workers and the visiting public. However, various human activities can result in differing levels of disturbance that may eventually be of adequate force (either by striking the tree or causing ground vibration) to dislodge defective trees. Likewise, the longer the duration of exposure to a defective tree, the higher probability that a tree failure could impact the visiting public.

Thresholds for tree defect failure potential have been developed on the basis of disturbance and exposure. The WHT Assessor will refer to Table 1 to select the level of disturbance and visitor exposure (LODE) within the park, recreation site and trail. This step can start in the office by looking at maps of the site, reviewing previous assessments and discussing the assignment of LODE with the Designated Land Manager. In some cases, the Designated Land Manager may decide to increase the LODE when planning tree care management to address specific site or visitor use factors, budgetary priorities, or to anticipate planned upgrades (e.g., assess trails to LODE-2 instead of LODE-1).

Worker Disturbance

Occasionally, there can be various work activities within parks, recreation sites or trails and these may have differing levels of ground vibration and tree disturbance than visitor exposure. The WHT Assessor will determine the Level of Disturbance of these work activities using Table 1 and reference the associated tree hazard tables (tables 3, 4, 4A or 5) to complete their workplace tree hazard assessment. These tree hazard tables are based upon the principle that work activities create differing levels of disturbance. With increasing levels of disturbance there is a corresponding increased risk of defects failing under disturbance.

Table 1. Levels of work disturbance and exposure (LODE)

Level of Disturbance & Exposure Risk*	Example Types of Work Activities
Very Low Risk (No Pre-work WHT Assessment)	• Field surveys and reconnaissance, trail layout, foot travel (heads up work) • General light vehicle travel on roads (pickups, ATV/UTV, snow sleds)
1 - Low (Table 3) <40km/hour Windspeed	• Maintenance of developed areas: repairing, replacing, installing infrastructure with hand tools; cleaning, painting, firewood bucking, landscaping, brushing/pruning, lawn mowing • Brushing & Weeding (e.g., removing invasive plants, trimming overgrown areas) • Trail construction with hand tools • Use of light-duty machinery (e.g., weed whips, brush saws, lawnmowers) • Road travel with heavy vehicles (>5500 kg GVWR) on a constructed and maintained road • Fire control with hand tools and/or water hoses
2 - Moderate (Table 4) <40km/hour Windspeed	• Road travel with heavy vehicles (>5500 kg GVWR) on a trail or overgrown road • Maintenance or construction activities without heavy equipment (e.g., small machines such as "bobcats") • Tree pruning (stems >20 cm dbh) • Juvenile spacing or slashing (stems <15 cm dbh) • Tree bucking (e.g., bucking windfalls, felled trees)
3 - High (Table 4a) 40-65 km/hour Windspeed	• Maintenance or construction activities with heavy equipment (including rubber tire backhoe where digging could affect tree root systems/stability) • Use of light & intermediate lift helicopters where persons are exposed to rotor wash • Tree falling (does not include hazard tree removal) and log removal (any tree >15 cm dbh)
4 – Very High (Table 5) >65km/hour Windspeed	• Land clearing operations in structurally damaged stands (e.g., wildfire burns, extensive windthrow) • Use of medium & heavy lift helicopters where persons are exposed to rotor wash (e.g., slinging bridges and materials, landing sites)

NOTE: A hazardous tree assessment is only valid for the lowest LODE at which the assessment has been done.

Very low risk activities

Some worker activities result in negligible levels of ground or tree disturbance and have very low exposure time to potential tree hazards. Consequently, the risk of injury due to tree hazards is very low. Very low risk (VLR) activities include:

- Foot travel and non-motorized travel (walking, hiking, cycling, horseback riding)
- Road travel with light vehicles (passenger vehicles, ATV/UTV, snow sled)
- Forest surveys, stand reconnaissance (recce)

For these VLR work activities, workers should keep a "heads-up" awareness of their surroundings and stay away from any obvious tree hazards (e.g., extremely rotten trees; insecurely lodged trees; hanging tops or limbs; recently leaning trees). Workers should avoid disturbing suspect trees (i.e., do not attempt to push them over) and to not walk beneath the lean or over-head hang-up. Workers will also observe standard operating procedures for windspeed work shutdown (see Table 1A).

NO pre-work site inspection or WHT assessment is required for workers performing VLR work activities.

Site Stratification

Areas within a park, recreation site or trail need to be stratified to reflect differences in worker disturbance activities and visitor exposure. Workers engaged in very low risk activities or areas which are infrequently used by the public will expose people to very little danger and require less aggressive hazardous tree management effort. Where exposure to people and facilities is of long or constant duration (e.g., picnic sites and campgrounds) there is an increased need to perform a hazard tree assessment and the level of care must increase accordingly. Similarly, some work activities such as those involving the use of heavy equipment for clearing and constructing parking lots and campgrounds can cause significant ground disturbance and require a more detailed assessment of trees.

The WHT Assessor will therefore identify targets having differing levels of disturbance and exposure. This stratification exercise can be hand drawn onto the site map. Each area of differing LODE will be called a stratum and the WHT Assessor will assess trees within each stratum using the highest LODE rating. For example, if there is a worker doing maintenance work (raking leaves and collecting garbage) this is regarded as a LODE 1 work activity. If this work is being done in a campground, the campground is regarded as a LODE 3. Suspect trees in this stratum would be assessed using the LODE 3 tree hazard table 4A (trees are assessed using the higher LODE). Another example might be where a trail (LODE 1) requires upgrading works using small machines (e.g., bobcat) to install drainage structures (LODE 2). In this situation, the suspect trees in the worksite areas of the trail would be assessed using the LODE 2 tree hazard table 4.

WHT Assessors must also perform a risk assessment in relation to the season of work and consider the relationship of critical site factors. If treatments will be performed during a time where otherwise healthy, defect-free trees are prone to wind-induced failure (i.e., when shallow soils are wet) then consideration must be given to restricting work during high-risk weather patterns (e.g., saturated soils and strong winds) or by creating wind speed shutdown criteria for the high-risk work stratum. The WHT Assessors must communicate these work site hazards to the Designated Land Manager so that controls of work site hazards (both known and foreseeable) will be added to the pre-work safety plan.

Assessing Temporary Worksites

Occasionally, there may be work activities undertaken within the undeveloped areas (e.g., clearing for new site developments, post-wildfire salvage, pipeline or hydro line construction). Or there may be heavy equipment construction efforts along a trail (e.g., construction of stream crossings, installing pit toilets). Under temporary work situations, the worksite and their perimeters must be assessed for hazards BEFORE work starts, and the assessment process documented and communicated to

subsequent workers. It is preferred that the Designated Land Manager work with the experienced WHT assessor during the planning and development phases of such developments to ensure both short and long-term goals of protecting wildlife habitat are considered. Using the perimeter worksite process helps avoid unsafe and unnecessary sanitization of the perimeter areas which could otherwise have resulted in the unfortunate loss of valuable wildlife tree habitat.

NOTE: This worksite perimeter process is NOT to be used to assess the forested areas surrounding public targets during routine tree assessments. For example, at a Campground (LODE-3), the entire 1.5 tree length forest surrounding the campground (the perimeter) is assessed for hazardous trees according to the LODE-3 criteria (using hazard table 4a) because public use target areas are long-term compared to a relatively short duration work project.

During the WHT assessment process, the WHT Assessor must be apprised of any special work projects. Work projects are usually short-term compared to public exposure targets which are managed long-term (e.g., campground or day-use picnic site). However, worker safety is paramount, and trees in proximity to the worksite must be assessed according to the highest LODE of the work being undertaken, regardless of the LODE selected for public exposure. For example, if a pipeline or hydro line construction project occurs within the park or recreation site this disturbance is typically LODE 3 (use of heavy equipment to clear the land) even though the visitor exposure may be of lower LODE (e.g., undeveloped areas with no public exposure would be considered VLR).

The WHT Assessor needs to determine whether trees beyond the work site perimeters pose a risk (exposure) to the workers within the work site. If workers stop performing tasks at the work site boundary and all workers are directed to use a 'work away' from the boundary strategy, then there is a diminishing risk of disturbance to trees the farther one looks beyond the immediate perimeter of the worksite. However, workers can still be exposed to trees beyond the immediate perimeter which can fail and land into the work site. Therefore, work site perimeters must be assessed for hazards, and the assessment process documented and communicated to subsequent workers.

Suspect trees immediately along the boundary should be assessed to the corresponding LODE of the activities within the work site. Moving into the forest and away from the work site perimeter, the WHT Assessors must continue to look for trees that could collapse and fall into the work site. However, the criteria used to assess suspect trees beyond the perimeter are those found in Hazard Table 3 (used for LODE 1), namely, looking for trees which are at risk of imminent failure.

Within the active work site, all suspect trees must be regarded as dangerous until proven safe if they are to be retained. If significant trees (e.g., culturally significant trees, rare and endangered trees, high value wildlife habitat trees) are required to be retained within or alongside a work site, then these trees must also be assessed for hazards according to the LODE of the work site activity, and workers instructed not to disturb these trees.

WHT Assessors must stratify their work site into two assessment zones (figure 5), the treatment zone (the active work site) and the worksite perimeter zone (the area surrounding the treatment area). WHT Assessors need to make their assessment of both the treatment zone and the worksite perimeter zone, and then communicate the results from their WHT Assessment so that safe work procedures can be implemented to ensure trees are not disturbed during work activities.

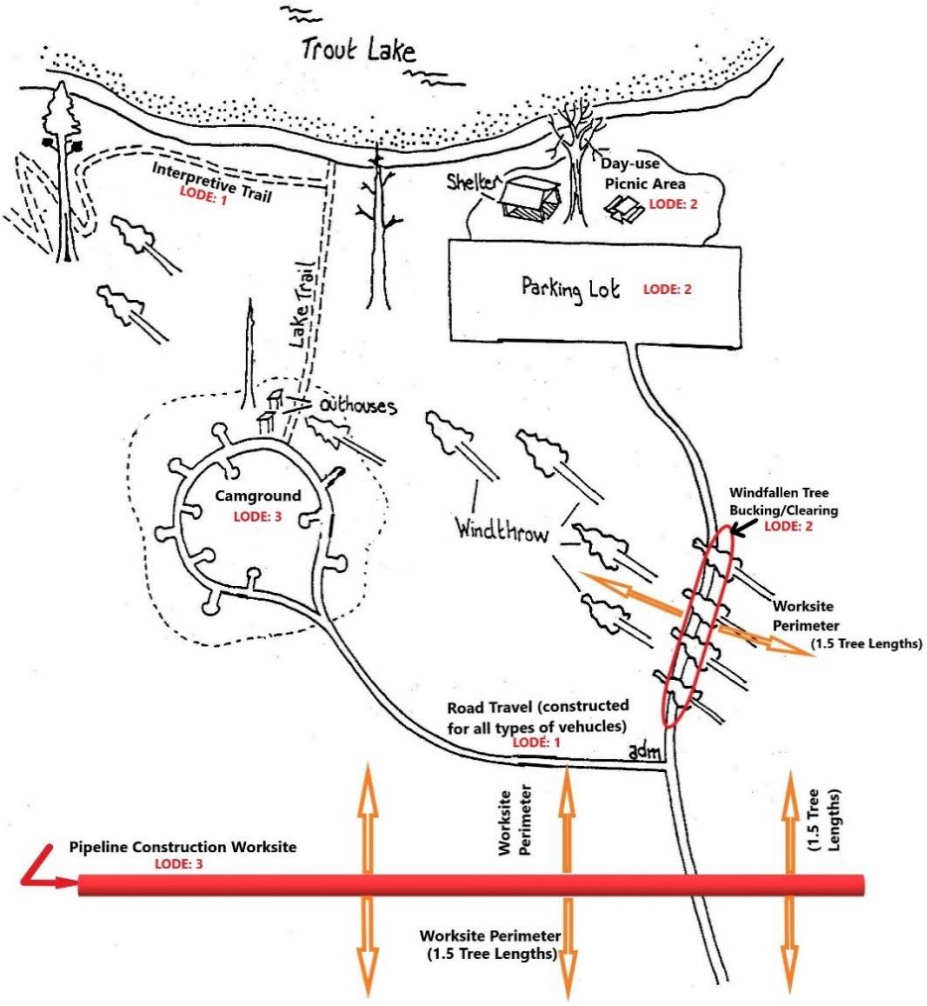


Figure 5: Example of 2 temporary worksites at a recreation site. 1. Construction of a pipeline is LODE=3, and 2. Bucking and clearing windfallen trees is LODE=2. The tree assessment zones of these worksites include the Treatment Zone and the Worksite Perimeter Zone (1.5 x Tree Length).

The **Treatment Zone** consists of the active work site and the first 5 meters of the treatment area's immediate boundary. The WHT Assessor will assess suspect trees located within the active work site and within 5m of the work site perimeter according to the hazardous tree criteria for the LODE of the activity being undertaken.

The **Worksite Perimeter Zone** consists of the 1.5 tree lengths of area surrounding the active treatment zone. The WHT Assessor must apply their knowledge, skills and experience when determining how to assess work site perimeters. The criteria for defining a dangerous tree within the perimeter zone of a work site (but out of reach from direct disturbance by the activity), will be based upon Hazard Table 3 (notably those trees at risk of imminent collapse). The exception would be if workers are entering the forested perimeters to perform other work activities.

Trees within the Worksite Perimeter Zone need to be viewed from the perspectives of:

1) Is the tree (or its part) within reach of the work site, and
2) Is it likely the tree could collapse without any disturbance during the project period?

If the answer to BOTH of these two conditions is YES, then the tree is a dangerous tree, and it needs to be managed accordingly.

If the WHT Assessor identifies a suspect tree that is within the Worksite Perimeter Zone, the WHT Assessor must review the tree amidst its surroundings and determine whether the tree poses an imminent hazard and whether the tree can reach the work site. The WHT Assessor must consider whether a tree having significant hazards has a sufficient buffer of trees to prevent the tree from reaching the work site. If there is sufficient screening to prevent the fall of a tree or its part from reaching the work site, then the tree is not a risk to workers.

Where there are steep slopes above the worksite (e.g., >30%) the assessment of the perimeter area must be extended upslope of the treatment zone. The distance extended would depend upon site factors (e.g., slope, terrain complexity, tree size, stocking, crown structure, lean, etc) to detect trees with an imminent risk of failure that could fail and slide downslope into the treatment zone.

Windspeed thresholds

Table 1A should be used to determine the level of windspeed equivalency for workers. This is most useful when there is a need to "bump-up" the LODE rating to a higher value to allow work to continue under increasing wind conditions. For example, if an assessment has been conducted for LODE 1 or 2 and constant winds or frequent gusts (as opposed to infrequent gusts) that exceed 40 km/h during the work activity then there is an elevated risk of tree failures. The initial assessment must be regarded as invalid, and the workers need to cease work until the winds subside to below 40km/hour. If there is a need to continue working, then the worksite needs to be reassessed to the higher windspeed equivalency and LODE (e.g., LODE 3 has a windspeed threshold of 40-65km/hour) before work resumes.

Trees at a worksite can initially be assessed at a higher LODE category to compensate for expected higher winds during the work project to avoid having to perform a reassessment. Additionally, if there is a likelihood that the work activity might change (e.g., light-duty construction LODE 2 becomes heavy-equipment construction LODE 3), then assessing to a higher LODE may be prudent and efficient.

Table 1A. Influence of wind speed on level of disturbance

Wind Speed (km/h)	Description	LODE Equivalency
0–40	light breeze (0 - 20) (dust and loose paper raised; small branches move) to fresh breeze (20 – 40) (small trees sway; tops of large trees sway)	1 – 2
40–65	strong breeze (small branches fly in the air; whole tree in motion)	3
65+	gale (branches broken off trees)	4

Posting signs about wind and other weather-related risks

Posting caution signs that aim to warn visitors about tree hazards associated with wind-prone stand types (e.g., Mountain Pine Beetle killed stands) and other weather-related conditions may be considered prudent by some, but signs are not an effective alternative for tree assessment and hazard mitigation for several reasons. It is unlikely that all visitors have training, knowledge and skills for interpreting wind speeds and making an association to the inherent tree hazards; not everyone will look at or read and comprehend the message on signs; hazards are variable with season and weather patterns; and with changing tree species and forest canopy structure. Furthermore, not all visitors will comply with the mere placement of a good-intentioned sign. However, supervisors must control the actions of workers and ensure weather-related stop-work measures (e.g., risk of high wind, snow/ice storms, fog, heavy rainfall, flooding, avalanche, landslide, etc) are implemented to protect workers.

Helicopter types

Table 1B is a useful guide to the types of helicopters and their lift capacity ratings. Prior to selecting the LODE for a work project that will use a helicopter the WHT Assessor will need to know the type of aircraft that will be used in the project.

Table 1B. Helicopter types

Helicopter Category	***Passenger Capacity***	***Lift Capacity***
Type 1 (Heavy)	*15+*	*Exceeds 2720kg (6000 lbs)*
Type 2 (Medium)	*9 – 14*	*1135 – 2720kg (2500-6000 lbs)*
Type 3 (intermediate)	*5 - 8*	*680 – 1134kg (1500 – 2500 lbs)*
Type 4 (Light)	*1 - 4*	*Not exceeding 680kg (1500 lbs)*

The following listing provides examples of common aircraft by helicopter type and is a useful guide when determining the appropriate level of disturbance for the type of aircraft being used when ground crews will be exposed to rotor downdrafts (rotor wash).

Light Category: Jet Ranger (Bell 206), Hughes 500, Hiller 12, EC 120, R22 & R44
Intermediate Category: Long Ranger, A-Star (AS350), Bell 407, EC 130
Medium Category: K-Max, Bell 204, 212, 205
Heavy Category: Bell 214, Kamov, Sikorsky 61 & 64, BV 107 & 234

STEP 2: Conduct a Site Assessment Overview

The site conditions at the park, recreation site or trail can have a significant impact on the prevalence of tree hazards and likelihood of tree failure. In this step the WHT Assessor looks to identify site factors that influence tree failure, and which may also influence tree mitigation practices. It is important for WHT Assessors to remember that individual trees and stands of trees are adaptive to their environment. Therefore, knowing the development history of the public use areas, historic weather patterns, prevalence of wildlife habitat and culturally significant trees, and history of tree failures can help us identify important risk factors affecting trees.

Prior to going out to the field, review all available information relevant to the site (e.g., safety policy, operating procedures, orthographic imagery, forest cover maps, past tree assessment reports, history of tree failures, development plans for the site, visitor use patterns, land use development, etc.). Divide the site into areas (strata) having differing management needs. For example, this could be based upon the LODE, known locations having cultural interests, root disease centres, and areas where temporary work projects are planned.

Once on site, confirm your stratification. Review the site/stand factors from Table 2 during a walkthrough of each stratum prior to undertaking individual tree inspections. The site overview provides a context for what constitutes a suspect tree that requires inspection. The objective of this step is to identify overall site and tree risk factors which may contribute to tree failures. Information and site/stand indicators found in the site overview can provide clues about the condition and potential hazard of individual trees, especially if you see patterns of failure since the last assessment.

Stand history and condition

Feature trees within the forest will also guide the WHT Assessor to finding other suspect (candidate) trees. If culturally significant trees are found, then consultation with local Indigenous Peoples will be required if any of the trees are hazardous and mitigation actions are planned. Ask the Designated Land Manager about any special protocols for identifying and assessing culturally significant trees.

One may notice site-specific wildlife trees. For example, primary cavity nesters are foraging heavily on a specific tree species which under closer inspection, might reveal an underlying disease or insect pest, or that a particular tree species is targeted for foraging once it has reached a particular decay class. Additionally, one may find that cavity nests are prevalent in a particular tree species and decay class. If this is noted, then looking for similar tree conditions may help the WHT Assessor identify additional nest trees. For example, one might notice several live trembling aspen trees with cavity nests. Upon closer inspection, one might discover that these nest trees commonly have heart rot conks of *Phellinus tremulae*, are of a certain diameter range and the live candidate trees have a rust-coloured stem flux (rusty stain 'flowing' down the stem). If one notices this pattern of visual clues, then the WHT Assessor can more readily find other candidate trees to assess by watching for these visual clues.

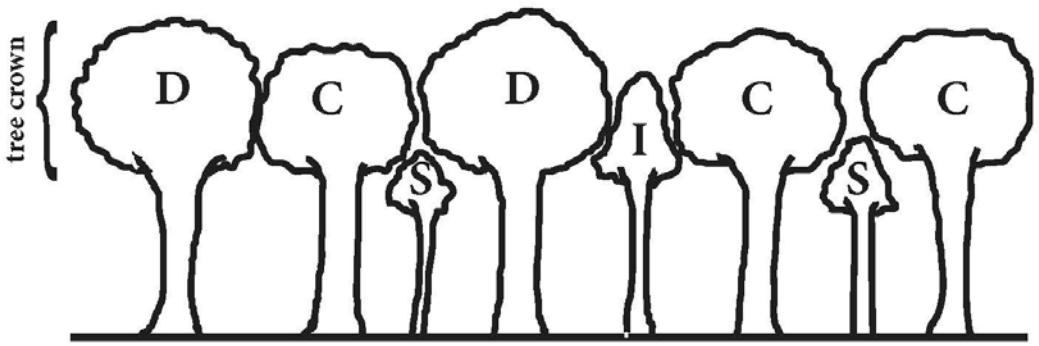
It is helpful to review the developmental stage of the treed areas. Observing the stand processes should help provide insights into the types of trees most likely to be hazardous. For example, if the forest is a young thrifty stand undergoing self-thinning one may observe mortality of suppressed and intermediate trees (figure 6). The self-thinning mortality stems of young stands can become surprisingly unstable after only a couple of years following death. The WHT Assessor would need to carefully review the suppression mortality for signs of pending collapse. Perhaps you observe a mixed species stand where deciduous trees have reached old age and are being replaced/over-topped by longer-lived conifers. In this scenario, the WHT Assessor will need to be vigilant to inspect these deciduous trees for signs of

pending collapse. There may be a history of periodic insect outbreaks from defoliators (e.g., looper or budworm) or bark beetles that have impacted the species mix or the stem form of individual trees (e.g., created multiple tops or stunted growth). There may be evidence of historic fire damage whereby surviving trees have been subsequently infected with stem/root decay, but the trees may have concealed these wounds and require the WHT Assessor to use a mallet, probe or increment borer to check for extensive decay.

Similarly, knowing the history of land developments in and adjacent to the area you are assessing can provide context to tree health and decline. The newer the disturbance the higher the risk that trees have not yet adapted to new land-use development disturbances. For example, trees may not have had time to adapt to the impacts from new wind patterns and changes to drainage patterns caused by the local disturbances.

Trees growing in the suppressed or intermediate canopy layer of a forest are protected from wind and snow loading compared to dominant and co-dominant trees. Consequently, these protected trees are not well adapted to wind and snow loading. Therefore, when assessing trees along newly cleared areas the WHT Assessor will need to consider the exposure and co-dependency of trees along the edge and focus attention to trees that suffered rooting damage, or trees growing on raised organic mounds or on flat depressions immediately adjacent to the new clearing.

Figure 6: *Tree crown position of trees in a forest.*



Tree crown position as it relates to dominance in a forest stand.
D = Dominant, C = Co-dominant, I = Intermediate, S = Suppressed (adapted from Smith 1986)

Weather patterns

Knowledge of seasonal and historic weather patterns can be used to reflect upon the adaptive response (or lack) of trees to normal wind, snow, ice, flooding, and drought events. It is important for the WHT Assessor to remember that tree assessments are presuming 'normal' or endemic conditions for the area. Normal weather is the meteorological term used (recommended by the World Meteorological Organization) to describe the weather experienced at a location over the preceding 30 years. It is nearly impossible to predict and prevent tree failure from dramatic storm events, such as gale force and hurricane force weather events. Once winds exceed strong gale force windspeeds (e.g., >75km/hour) then even defect-free trees are increasingly prone to failure. Trees with defects or site conditions affecting a tree's stability (e.g., micro-topography, new exposure, ponding water) should be presumed to be susceptible of failure (whole or part) below strong gale force winds.

Regardless, documenting episodes of dramatic weather events and unseasonal weather changes can help the WHT Assessor evaluate tree decline and tree resilience. For example, extreme heat and prolonged drought can kill trees or put the trees under severe stress that enables secondary insects or diseases to take advantage of a tree's weakened condition. If you observe widespread dieback or "flair-out" (browning or dieback of the tops and branch foliage) one can generally attribute this to weather-related stress. If the dieback is weather-related then the risk of whole tree failure is generally not as imminent as if the die-back were a symptom of a root disease or mechanical stem/root damage. However, sometimes the die-back is confounded by pests and diseases.

An important consideration is the compounding challenges when trees are exposed to wind under precipitation conditions. One must cautiously consider the potential for windthrow risks when the soils are saturated, the stand of trees are primarily shallow rooted species (e.g., hemlock, cedar, aspen, alder), and the soil is shallow or fine-textured (e.g., clay and silt). In these conditions, trees can fail at lower-than-expected windspeeds, especially when the crowns are heavily laden with rain or snow. Consequently, the WHT Assessor might recommend wind/weather condition shutdowns to work activities. In stands susceptible to failure under these weather conditions (e.g., newly developed sites, subdued topography, evidence of of root disease or stem deterioration) it may also be prudent to recommend the site be managed by closing access to the park, recreation site or trail prior to the normal storm season because of the elevated risk of tree failures that would not normally pose a risk during the drier seasons and conditions.

Tree failure history

The presence of tree failures should be investigated by the WHT Assessor. These failures provide an opportunity to learn about the causal factors that precipitated the tree failure, whole or part. Monitoring trees with hazard symptoms can be a useful process to better understand the rate of deterioration from point of discovery to when the tree or part fails. This can be done by tagging and mapping a sample of trees in the outer reaches of the assessment area (away from public targets) and visiting the trees during subsequent assessments. Additionally, after hazard trees are felled the WHT Assessor should inspect the felled trees and stump to better correlate their observations of external symptoms to the extensiveness of inner deterioration. This knowledge will help in scheduling trees for mitigation before they reach a state of being too hazardous to treat.

There may be tree species related trends to tree death and/or failures. For example, one might encounter a species that is succumbing to micro-topographical differences in growing sites during fluctuating weather extremes and/or climate shift. Trees growing on nurse logs or in wet depressional areas may

be at increased risk of failure during periods of gusting winds or heavy, wet snowfall. If there is a species related pattern, then the WHT Assessor will regard this species as a suspect tree that requires close inspection, especially when the tree is growing in a problematic micro-topographical site.

Looking for evidence of root and/or stem diseases will also help the WHT Assessor find failure prone trees. Start by looking at failed trees. Groups of trees failing in a random orientation are generally related to a root disease more than from endemic 'normal' winds. Inspecting the roots of the failed tree(s) may reveal a decayed root system from a root disease pathogen. Use a tree pathology reference book or take photos of the decayed roots and ask a more experienced WHT Assessor to help you identify the organism. Once the pathogen is identified one can research the virulence of the pathogen, its mode of infection and learn about its preferential host species. Return to the site where trees failed and look for nearby host trees which may exhibit visual clues of infection. For example, with Armillaria root disease, one often sees crown thinning symptoms combined with other visual clues: resinosis on the infected live stems, abundant sap wells from sapsucker feeding, and honey-coloured mushrooms growing on the stem. If you explore beneath the bark and find a white mycelial fan, you have confirmed the infection to be Armillaria and nearby trees with any of these external visual symptoms should be carefully inspected for this pathogen and the roots probed to determine the extent of root deterioration.

Fleshy armillaria mushrooms growing on an infected tree.

White mycelium fan beneath the bark of an infected tree.

An emerging pathogen of concern in some broadleaved deciduous trees on the southern coast of BC (Vancouver Island and Lower Mainland) is the brittle cinder butt rot fungus (*Kretzschmaria deusta*). This pathogen is a soft rot that destroys both the cellulose and lignin of the lower bole and roots of living trees through injuries or by root contact with infected trees. This fungus primarily attacks maple, oak and horse chestnut and can cause catastrophic failure of the whole stem – with or without wind. Once the infection is identified on a host tree, then other trees in the local area showing signs of crown dieback should be suspected of infection and inspected carefully.

Fruiting bodies of brittle cinder conk on a bigleaf maple – black fruiting body resembles creosote and is very brittle when handled.

If there have been recent hazard tree mitigation treatments, the WHT Assessor should review the successes of these treatments and adapt management recommendations to apply the successes and avoid the treatments that have created issues. For example, if tree modification treatments have been done to create wildlife habitat but the trees are collapsing before being used by wildlife then abandon or modify the treatment.

In high use areas, watch for tree damage (roots or stem) inflicted by visitors and assess any wounds for signs of decay. A common hazard at campgrounds is strangulation from ropes tied to trees. The growth bulges from embedded ropes will create a structural stem weakness. Ideally, ropes should be removed at the end of a camping season as a preventative measure.

Example of stem deformation caused by rope strangulation.

Table 2. Site Assessment Overview (for all tree species)

Site/Stand Factors	Hazard Indicators/Influences
Stand history and condition	• evidence & patterns of past tree failure; history of tree mitigation • disturbance history (natural or human-caused, including wildfire damage; year of site construction) • general tree species age, condition and density • evidence and type of wildlife tree use, presence of culturally significant trees or trees of special recreational attraction • evidence of root and/or stem diseases
Common rain, snow and ice conditions	• high snow or ice loading • high rain fall periods
Flooding	• high water table • evidence of water damaged/decayed roots • area prone to flooding
Windthrow potential	• topography & prevailing wind directions • evidence of significant windthrow • area of high or recent exposure • stems with height/diameter ratio >100 or small live crown (<20% tree height) (i.e., very tall, slender stems) • saturated soils • shallow soils & restricted rooting depth • fine textured soils
Crown condition (i.e., common root disease indicators)	• stress cone crop • thinning foliage and/or chlorosis • rounded crown or top dieback
Resinosis	• higher than normal stem or basal pitch flow (e.g., from butt rot, mechanical stem damage, root disease)
Tree lean	• trees recently leaning due to windstorm, root damage, shifting root mat or other causes
Additional site-specific factors	• based on local knowledge (e.g., soil or slope instability)

STEP 3: Conduct Tree Assessments

A tree is potentially hazardous if it has defects in its top, branches, stem wood or root system. The degree of hazard will vary with the size of the tree, type and location of the defect, tree species, and nature of the target or work activity. All trees within 1½ tree lengths of targets (work areas, facilities, and public use areas) are therefore candidates requiring tree assessment. Tree assessment is divided into visual inspection and detailed assessment, in order of increasing rigour of testing and examinations. In most cases, tree assessments can be completed with a visual evaluation of tree defects/hazards with the aid of binoculars for upper tree locations. For basal (lower stem) defects, probing of the stem/roots can be performed to investigate the extent of damage and deterioration.

Tree Hazards

Tree hazards can be separated into three categories: top/branch defects, stem wood defects, and root/butt defects. The hazardous tree assessment process requires that the WHT Assessors identify tree hazards and know how to recognize and evaluate all types of hazards.

Tree defect descriptors that indicate a Hazardous Tree rating are summarized in Tables 3, 4 and 4A. Use these tables to determine which trees are rated dangerous for LODE 1, 2 and 3 activities respectively. The defects described in these tables are those that have a high failure potential and would likely cause injury if they were to fail. Table 5 describes the only types of trees that are safe in LODE 4 activities. During WHT assessments consider the size of the defect and its height above ground.

Visual Tree Inspection

The determination of tree safety/hazard is generally a visual process. Careful observation of hazards can usually result in the determination of an individual tree's failure potential and resultant safety decision within several minutes. However, where visual inspection identifies questionable root stability or shell thickness and where the results of the visual inspection are inconclusive, a detailed assessment involving root probing and/or stem sampling will be necessary.

Identify and describe any visible defects on trees where there is target exposure. Use the Hazardous Tree Assessment Field Data card to record the tree defects and hazards, wildlife habitat value information, soundness, and other details that will guide the management decisions for the tree. For each tree, refer to the defect descriptions in tables 3-5, and record whether the observed defect is safe (**S**) or a dangerous hazard (**D**), or questionable and requires a detailed assessment (**?**). It is important to record the presence and condition of each observed defect when recommending that a safe tree be monitored for decline and development of hazardous indicators.

WHT Assessors must review trees from different vantages to reduce the possibility of missing defects obscured by poor lighting, vegetation, or other obstacles. To properly evaluate defects high in the canopy of trees, WHT Assessors are advised to use binoculars. Remember that weather conditions may also impair one's ability to detect and evaluate defects.

A tree defect can be declared as hazardous after the visual inspection. The presence of one or more hazardous tree defects will result in the tree receiving an overall rating of Dangerous and thus be identified as a Dangerous Tree in need of mitigation actions.

Figure 7: Common Tree Hazard Indicators

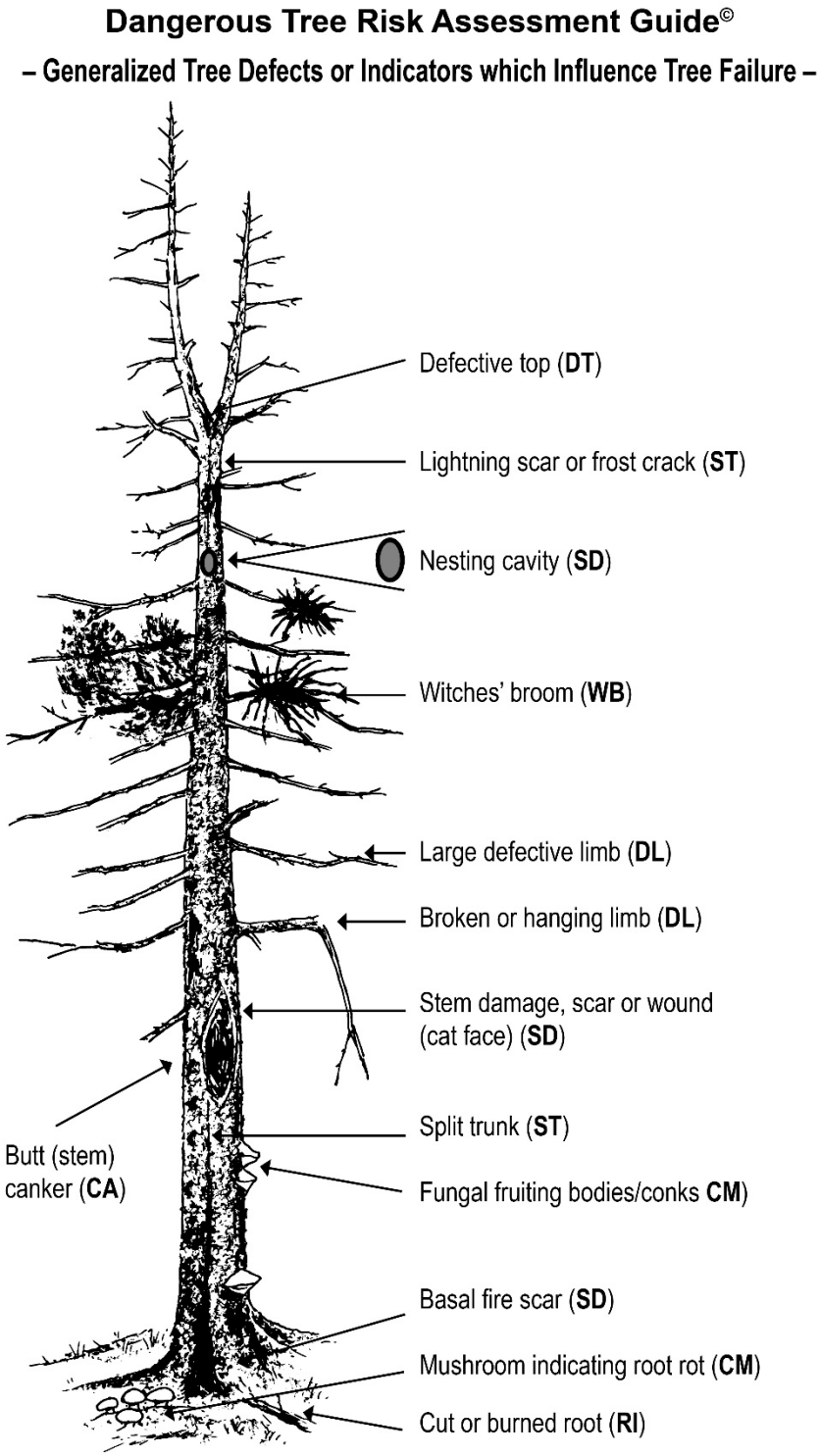
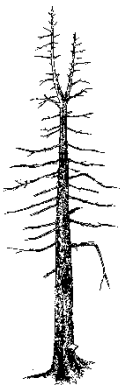


Figure 8: Eight Generalized Tree Hazards That Influence Tree Failure

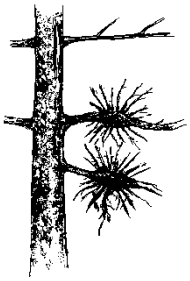
(for further description, see Tables 3–5)

Defective limbs (DL)

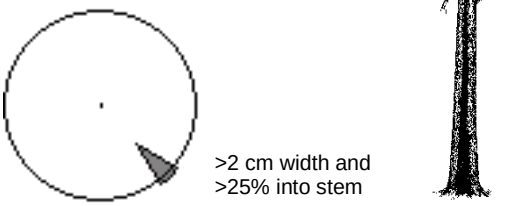


Defective tops (DT)

Witches' broom (WB)



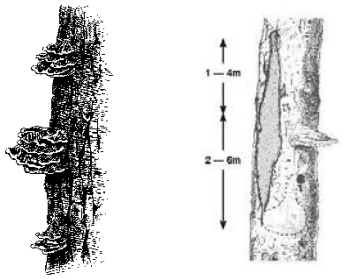
Split trunk (ST)



Stem damage (scarring or butt rot) (SD)

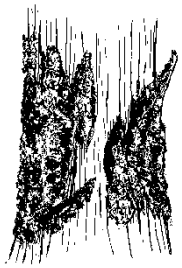
Butt and stem cankers (CA)

Fungal fruiting bodies (conks and mushrooms) (CM)



Heart rot decay column extending above and below conk. Distances indicated are a general rule of thumb. Note the circular woodpecker nest cavity below the conk (drawing not to scale).

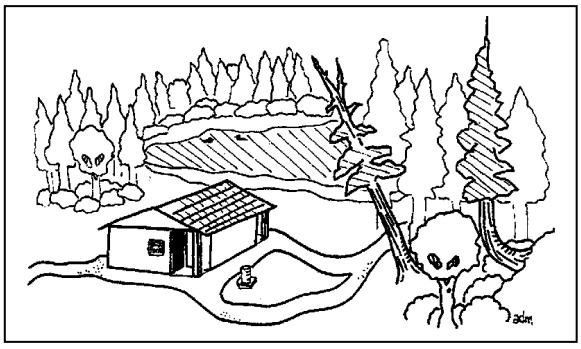
Thick sloughing bark (SB)



Tree Lean and **Root Inspection** must also be evaluated as part of the Visual Inspection Process. Specific failure potential criteria for Tree Lean and Root Inspection are described in Tables 3–5.

Tree Lean

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

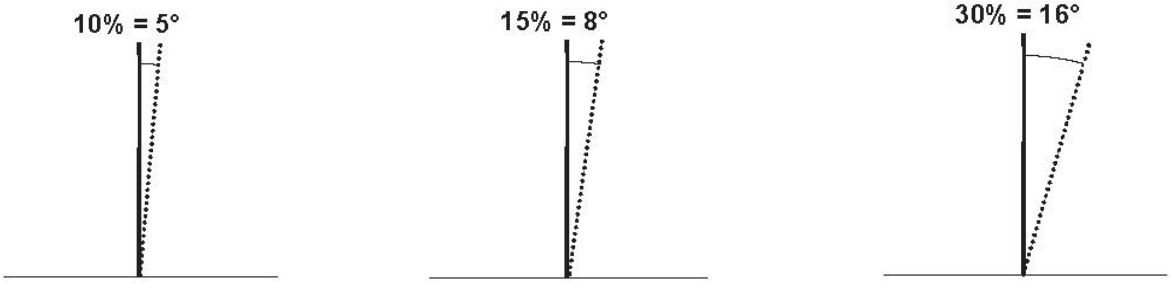


Hazard rating for leaning trees

For Class 1-3 trees, a lean >15% toward targets with compromised rooting or instability problems will be declared hazardous. However, to make the assessment complete, the WHT Assessor must look for evidence of tree instability (i.e., shallow soils and lifting or damaged roots, root disease indicators, and time since lean). The amount of acceptable lean will therefore be a site-specific decision.

For Class 4-8 trees, however, the lean threshold is reduced. A lean >10% toward targets with rooting and stability problems would be rated as hazardous.

The hazard rating for lean is recorded as either S (safe) or D (dangerous hazard). If you wish to monitor tree lean, record the amount of lean and the direction of lean relative to targets. For example, a tree with a safe lean of 10% towards a target can be recorded as –10% (the negative sign reflects the lean is towards the target and the S that the lean is safe; use a positive sign when the lean is away from the target).



Recently leaning trees are tilted over their entire length. Since there is no evidence of reinforcement of the root system or bole wood, WHT Assessors must assume potential hazard. WHT Assessors should also identify other rooting problems such as shallow roots or substrate, damaged or decayed roots, lifted roots, root disease indicators, or adjacent history of windthrow.

Sweep is defined as the curvature or distortion of the stem, and is often associated with competition for sunlight, snowpack and steep slope conditions. Live tree sweep should not be confused with lean. Sweep without decay or rooting compromise is not a hazard indicator for live trees because of compensating adaptive geotropic or phototropic growth. Beware of situations where a tree has had to grow up and around a fallen log. In this case the WHT Assessor must evaluate the stem to determine if there is damage and internal decay that may be obscured by the remnant log. Also note that once a tree dies the once sweeping tree will now be regarded by the WHT Assessor to be a leaning tree because root deterioration processes are underway.

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. Wildlife/hazardous trees falling on steep slopes may travel farther than the length of the tree. Slope angle must be evaluated site-specifically, but in general steep slopes are slopes of >30%.

Detailed Tree Assessment

The detailed tree assessment is more rigorous than the visual inspection and uses diagnostic tests to explore the extent of observed weakness or decay associated with a tree defect. Stem increment boring, drilling or sounding and root probing/drilling techniques will be employed. The detailed assessment may involve:

1. Stem sampling to measure the average stemwood shell thickness, and/or
2. Root probing to determine root condition.

It is important to note that the results of the detailed tree assessment (e.g., actual sound stemwood shell thickness) can, in some cases, override the hazardous tree criteria for visual inspections of a particular tree defect. For example, the WHT Assessor could determine the extent of decay due to an isolated conk on a live tree by increment-boring the affected area rather than simply defaulting to a dangerous rating.

In circumstances where visual inspection identifies questionable root stability or shell thickness and where the WHT Assessor wishes to retain the tree, a detailed assessment is required. The mandate to protect the conservation values in parks, recreation site and trails may warrant the extra time required to conduct detailed assessments. This is especially true when visually obscure defects are encountered on trees having high significance value for the park, recreation site or trails (e.g., wildlife tree, culturally significant, veteran, or legacy trees).

Remember: A detailed assessment is required when:

- the visual inspection is inconclusive as to the safety of a tree; and
- the tree is planned for retention where there is target exposure.

Stemwood Condition

The relative thickness of either the outer shell or inner core of the tree in proportion to the tree's diameter provides an indication of the "columnar" strength. When the thickness of the shell or core of sound wood is insufficient for a tree's diameter, the failure potential can be said to be high. At least three cores should be taken from stems >40 cm diameter at the sample height (DSH) to ensure that the required stem thickness is present. Look for signs of decay or weakness and bore the stem adjacent to those areas.

Trees that have both heartwood decay and external scars that suggest an incomplete cylinder of sound stem wood will usually be rated as unsound. **If the stem is determined to be unsound, the tree is rated as hazardous, and there is no need to proceed with a test of root condition.**

The WHT Assessor should consider stem condition and canopy exposure factors when applying the detailed stem testing threshold for Required Stemwood Thickness (RST) and the results from the Average "actually drilled" Stem Thickness (AST). For example, the RST threshold presumes the tree is full height. If the tree has lost its top naturally or from previous interventions, then the WHT Assessor must rely on site assessment patterns of failure to build a site-specific failure potential rating. Similarly, a live healthy tree with a symmetrical crown and exhibiting strong wound wood growth around the margins of a stem damage can be at a lower risk of failure than a tree with signs and symptoms of crown decline, a poorly compartmentalized wound and a wound which is not centralized.

> Trees with an AST <30% of the tree's radius have a high failure potential and are rated as Dangerous (D) for stem condition.
>
> Trees with >50% circumference as an open wound and AST <30% of the tree radius have a high failure potential and should be rated as Dangerous (D).

NOTE: Sound wood is any wood that is firm, with no evidence of "punkiness." The wood is usually fairly light and uniform in colour, and growth rings are distinct. An increment core taken from the stem remains intact and has a smooth texture and usually snaps when broken and doesn't dent under fingernail pressure. An alternative to increment boring is to use a Resistograph^{R} (a specialized electronic micro-drilling device that measures the resistance to the drill which is translated to reflect changes in relative wood density) or other such specialized devices.

CAUTION: In certain dead coniferous trees in Classes 3–7 (especially ponderosa pine), the sapwood often deteriorates more quickly than the heartwood. The unsound sapwood must be discounted when measuring the stem's actual stem thickness.

Diameter at Sample Height (DSH): This is the position on the tree where a defect is being evaluated with a detailed stem test or probe. If there is no detailed testing, then the tree's diameter will be recorded as the diameter of the tree at breast height (1.3m above the root collar known by many as DBH or diameter at breast height).

The procedure for determining the RST compared to the AST is outlined below.

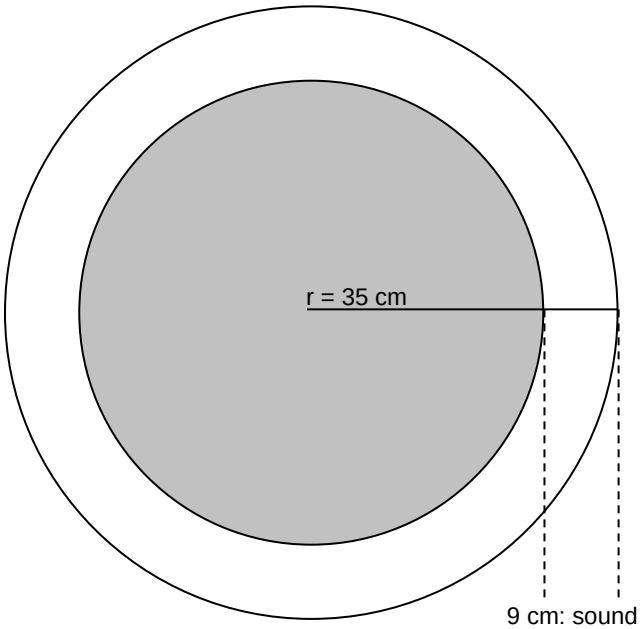
1. Measure diameter at a sample position (DSH) where there is weakness on the stem. This measurement is made outside the bark. For thick-barked Douglas-fir, ponderosa pine, western larch and cottonwood, a deduction for bark thickness should be made to determine the actual diameter of the stem. Most other tree species have relatively thin bark and do not need a deduction for bark thickness. A WHT Assessor, however, may make bark thickness deductions any time it is appropriate.
2. Divide diameter inside bark by 2 to determine the stem's radius.
3. Multiply the radius by 0.3 to determine required stemwood thickness (RST). The RST is 30% of the tree radius (RST = radius X 0.30).
4. Bore tree at sample height or where the stem was measured (average of two or more borings may be required) to determine the tree's actual solid stemwood thickness (AST).
5. Compare RST with AST. If the AST is equal to or greater than (≥) the RST, the stemwood condition is considered sound (S). If the AST is less than (<) the RST, the stemwood condition is dangerous (D).

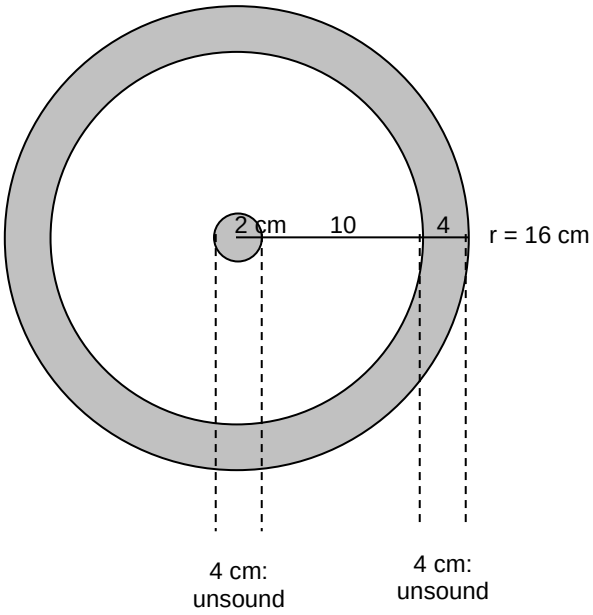
Example 1: tree with extensive heartrot

1. DSH = 70 cm
2. 70 cm ÷ 2 = 35 cm radius
3. 35 cm x 0.3 = 10.5 cm = RST. The required stem thickness (RST) of this tree is 10.5 cm.
4. A core from this tree shows that the outer shell of sound wood (actual stem thickness or AST) is only 9 cm.
5. 9 cm AST <10.5 cm RST, therefore the stemwood condition of this tree is rated as dangerous (D).

Example 2: tree with saprot decay and some inner heartrot

1. DSH = 32 cm
2. 32 cm ÷ 2 = 16 cm radius
3. 16 cm x 0.3 = 4.8 cm= RST. The required stem thickness (RST) of this tree is 4.8 cm.
4. A core from this tree shows an unsound outer shell of 4 cm, and an unsound central core of 4 cm, with 10 cm of sound wood in between. The actual stem thickness (AST) is 10 cm.
5. 10 cm AST > 4.8 cm RST, therefore the stemwood condition of this tree is rated as safe (S).



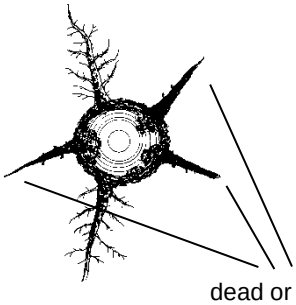


Root Condition (only if required for Detailed Root Assessment)

Root condition is assessed at the root collar (as close to the ground as possible) using an increment borer or appropriate sharp probing instrument.

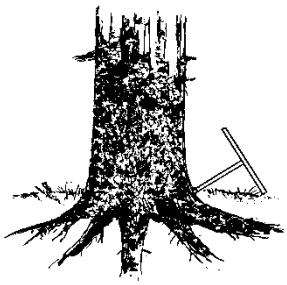
First, count the number of major lateral roots. Increment cores should then be taken until >50% of the major lateral roots are shown either to have advanced decay (>50% of the root's diameter is decayed) or be free from decay (Example 1). Borings or probing is made into the lateral roots at a downward angle of ≈45° (Example 2). Root excavation and chopping into the roots may cause unnecessary damage and destabilize the tree, thus this practice should be avoided.

Example 1:



This tree has 5 major lateral roots. Cores were taken until it was found that 3 roots had advanced decay. The tree receives a high failure potential rating for root condition.

Example 2:



Core probes should be made at a 45° angle into the major lateral roots to assess root soundness. If possible, check the underside of the roots for any decay.

NOTE:
In general, trees have a high failure potential when **>50% of lateral roots have decayed more than 50% through; or when >50% of the root system has been mechanically disturbed, damaged or burned through.** Damaged root condition should not be confused with roots having the soil duff layer scraped or burned away, merely exposing the roots but not actually damaging them. For visual root inspection criteria, refer to Tables 3 - 5 for the corresponding Level of Exposure (e.g., LOE 3 uses >25% root damage as the visual inspection criteria for danger rating).

- 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. These will become more hazardous over time and should be examined carefully before work activities begin.
- Trees growing in or near areas where root disease is present are likely to be infected as well. Watch for stand openings associated with uprooted trees, standing trees with thin or discoloured crown foliage, and fruiting bodies of root disease-causing fungi near the base of trees.

Critical Rooting Zone

It is important for WHT Assessors to inspect the critical rooting zone of trees (ground area beneath the canopy drip-line) within areas affected by site users, traffic and construction. Where tree root plates have been impacted >50% of the critical rooting zone, then tree health is likely to be impacted and death will ensue unless interventions are implemented (watering, fertilization, air-spade treatments) to reverse rooting impacts.

WHT Assessors and site managers need to communicate the need for protecting the critical rooting zone when treed areas are under construction. Suggestions could include:

- Flagging out the critical rooting zone with barricade flagging/snow-fencing prior to the start of site works,
- Avoid vehicle and heavy equipment parking and trafficking within the rooting zone,
- Avoid any grading or grubbing within the rooting zone,
- Minimize trenching for utility lines or irrigation systems within the rooting zone,
- Avoid stockpiling construction materials and soils within the rooting zone.

NOTE: The critical rooting zone is essentially the area beneath the dripline of the tree's longest branches.

Hazardous Tree Criteria

The failure potential thresholds for each defect have been summarized by levels of disturbance tables (see Tables 3, 4, 4a and 5). The WHT Assessor simply evaluates the tree defects observed against the criteria described within the applicable disturbance table.

Table 3 describes the 3 significant tree hazards that indicate a high failure potential **(if at risk of imminent failure)** and therefore a hazardous rating for LODE 1 — lesser hazards (as described in Tables 4–5) can be rated Safe for LODE 1 activities. In most cases a site assessment overview conducted by a qualified person (working under the mentoring of a certified WHT Assessor) may be sufficient to identify the significant tree hazards at LODE 1.

Structurally damaged sites

A structurally damaged site is one that contains trees that have been severely and extensively damaged to the extent that a certified hazardous tree WHT Assessor decides there is an undue risk of tree failure in the stand or site (e.g., site clean-up following extensive windthrow).

If work is required WITHIN 1.5 defect lengths of locations which are known or likely to contain defective, structurally damaged trees, then a certified WHT Assessor must assess the work area PRIOR to work commencing to identify any trees which are dangerous, and to implement the appropriate safety procedures. Because of the complex nature of structurally damaged sites, it is recommended that new and inexperienced WHT Assessors mentor under experienced and qualified hazard tree WHT Assessors.

Table 3. *Hazardous Tree Assessment Process for LODE 1 Activities: Significant Hazard Indicators*

D = dangerous hazard	D if tree has one or more of the following significant tree hazard indicators that are at risk of imminent failure: • Insecurely Lodged trees or insecure hang-ups: i) Insecurely Lodged trees (a tipped tree that is likely to shake free of the support trees and fall to the ground); or ii) Dislodged but hung-up limbs or tops (consider size and height above ground) at risk of shifting free during light winds or other tree motion • Highly decadent or unstable Examples: i) >50% tree cross-sectional area damaged or decayed; or ii) spongy snags with heartrot conks along the majority 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 iii) >50% lateral roots damaged or with advanced decay • Recent lean toward 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

*Imminent failure: there is a high likelihood of failure during the operational period while workers are exposed, or to fail within recurring WHT assessment intervals.

The qualified person must be sufficiently experienced and/or trained and mentored by a certified WHT Assessor 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 significant hazards and to stay away (generally greater than 1.5 defect lengths) from any trees showing these hazards. However, any trees that the qualified person 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 HAZARD 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 must also observe wind speed conditions. After winds exceed 40 km/h, crews cannot be near any trees which might be suspect unless they have first been rated as safe by a WHT Assessor for the equivalent wind speed rating (see Table 1A).

Table 4. *Hazardous Tree Criteria for LODE 2 Activities*

NOTE: Any tree defects as described in the boxes below will be rated as HAZARDOUS for level 2 exposure. Trees with lesser defects can be rated SAFE for level 2—care should be taken not to brush these trees and to fall and yard away if possible.

Defect Category	Species Group			
	Douglas-fir, larch, pines, spruces	**Western redcedar, yellow cedar**	**Hemlock, true firs**	**Broad-leaved deciduous**
Defective top (DT)	• **Class 2 to 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) **>30% of tree height**	**Class 2 to 5 trees:** Defective Top (any size; e.g., secondary top) **where structural weakness is evident**	• **Class 2 to 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 to 5 trees:** Defective Top (any size) as a fork, co-dominant or multiple stem **where structural weakness is evident; OR** ▪ Where a dead top is **>20% of the tree height**
Defective limb (DL)	• Limbs >10 cm diameter **with structural weakness** • Hung-up limbs	• Limbs >15 cm diameter with structural weakness • Hung-up limbs	• Llimbs >10 cm diameter **with structural weakness** • Hung-up limbs	• Llimbs >10 cm diameter (including "scaffold branching") **with structural weakness** • Hung-up limbs
Witches' broom (WB)	Brooms >1 m diameter on dead branches with evidence of decay, cracking or failure (dead branches and brooms may be on the ground)	n/a	Brooms >1 m diameter on dead branches with evidence of decay, cracking or failure (dead branches and brooms may be on the ground)	n/a
Split trunk (ST) (includes frost, lightning, wind-induced and impact-induced cracks)	Crack or split >2 cm wide extending >25% of tree diameter into stem **AND** evidence of advanced decay in surrounding stemwood	Crack or split >2 cm wide extending >50% of tree diameter into stem **AND** evidence of advanced decay in surrounding stemwood	Crack or split >2 cm wide extending >25% of tree diameter into stem **AND** evidence of advanced decay in surrounding stemwood	Crack or split >2 cm wide extending 25% of tree diameter into stem **AND** evidence of advanced decay in surrounding stemwood
Stem damage (SD) (includes scarring, fire damage, machine damage, animal damage or butt rot)	>25% of tree cross-sectional area damaged, burned, scarred, decayed, or fractured	>50% of tree cross-sectional area damaged, burned, scarred, decayed, or fractured	>25% of tree cross-sectional area damaged, burned, scarred, decayed. or fractured	>25% of tree cross-sectional area damaged, burned, scarred, decayed, or fractured
Thick sloughing bark or sloughing sapwood (SB) (bark applicable to Douglas-fir, larch, yellow pine and cottonwood >50 cm dbh)	**Class 6–8 trees:** Large pieces of bark or sapwood separated and sloughing from bole of tree*	• Bark n/a • Long slabs of sloughing sapwood hanging from bole of tree	n/a	**Class 5 trees**: Large pieces of bark separated and sloughing from bole of tree
Butt and stem cankers (CA)	>50% of butt or stem circumference as a perennial canker face	n/a	n/a	>50% of butt or stem circumference as a canker face on a dead tree
Fungal fruiting bodies (CM) ** (conks and mushrooms)	• **Any heartrot 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 saprot depth is >5 cm	n/a	• **Any heartrot fungus present** • Sap-rotting fungi present on any tree <30 cm dbh where saprot depth is >5 cm	• **Any heartrot fungus present;** **Exception:** P. tremulae on live trembling aspen; apply alternate safe work procedures. • Sap-rotting fungi present on any trees <30 cm dbh where saprot depth is >5 cm
Tree lean (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)	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)
Tree lean (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)	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; lifting root mat; visible decay or damage to roots affects >50% of lateral roots	Occurrence of any of the following; root pull; lifting root mat; visible decay or damage to roots affects >50% of lateral roots	Occurrence of any of the following: root pull; lifting root mat; visible decay or damage to roots affects >50% of lateral roots	Occurrence of any of the following: root pull, lifting root mat; visible decay or damage to roots affects >50% of lateral roots.
Detailed Tree Assessments	STEM TEST: Average sound stemwood shell thickness <30% of tree radius (i.e., AST < RST), or >50% circumference as an open wound and AST <30% of tree radius. ROOT TEST: More than half of the roots are >50% decayed or rotten			

* In Douglas-fir, larch and yellow (ponderosa) pine, treat thick sloughing sapwood according to the bark failure potential criteria

Table 4A. *Hazardous Tree Criteria for LODE 3 Activities*

NOTE: Any tree defects as described in the boxes below will be rated as HAZARDOUS for level 3 exposure. Trees with lesser defects can be rated SAFE for level 3—care should be taken not to brush these trees and to fall and yard away if possible.

Defect Category	Species Group			
	Douglas-fir, larch, pines, spruces	Western redcedar, yellow cedar	Hemlock, true firs	Broad-leaved deciduous
Defective top (DT)	• Class 2 to 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) >30% of tree height	• Class 2 to 5 trees: Defective Top (any size; e.g., secondary top) where structural weakness is evident	• Class 2 to 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 to 5 trees: Defective Top (any size) in the form of a fork, co-dominant or multiple stem where structural weakness is evident; OR ▪ Where dead top >20% of tree height
Defective limb (DL)	• Limbs >10 cm diameter with structural weakness • Cracked, decayed, broken or hung-up limbs	• Limbs >15 cm diameter with structural weakness • Cracked, decayed, broken or hung-up limbs	• Llimbs >10 cm diameter with structural weakness • Cracked, decayed, broken or hung-up limbs	• Liimbs >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	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-induced and impact-induced cracks)	Crack or split >2 cm wide extending >25% of tree diameter into stem AND evidence of decay in surrounding stemwood	Class 2 and 3 trees: Crack or split >2 cm wide extending >50% of tree diameter into stem AND evidence of decay in surrounding stemwood Class 4–8 trees: Crack or split >2 cm wide extending >25% of tree diameter into stem AND evidence of decay in surrounding stemwood	Crack or split >2 cm wide extending >25% of tree diameter into stem AND evidence of decay in surrounding stemwood	Crack or split >2 cm wide extending >25% of tree diameter into stem AND evidence of decay in surrounding stemwood
Stem damage (SD) (includes scarring, fire damage, machine damage, animal damage or butt rot)	• >25% of tree cross-sectional area damaged, burned, scarred, decayed, or fractured	Class 2 and 3 trees: >50% of tree cross-sectional area damaged, burned, scarred, decayed, or fractured Class 4–8 trees: >25% of tree cross-sectional area damaged, burned, scarred, decayed or fractured	• >25% of tree cross-sectional area damaged, burned, scarred, decayed, or fractured	• >25% of tree cross-sectional area damaged, burned, scarred, decayed, or fractured
Thick sloughing bark or sloughing sapwood (SB) (bark applicable to Douglas-fir, larch, yellow pine and cottonwood >50 cm 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	n/a	Large pieces of bark separated and sloughing from bole of tree
Butt and stem cankers (CA)	>50% of butt or stem circumference as a perennial canker face *	n/a	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 Exception: For veteran and dominant trees, if *Porodaedalea pini* conks present but no other defects or damage to stem that allow oxygen exchange (e.g., scars, broken top, nest cavity) = SAFE • Sap-rotting fungi on trees <30 cm dbh where saprot depth is >3 cm	n/a	• Any heartrot fungi present ; OR • Sap-rotting fungi present on trees <60 cm dbh where saprot depth is >6 cm	• Any heartrot fungi present; Exception: P. tremulae on live trembling aspen; apply alternate safe work procedures. OR • Sap-rotting fungi present on trees <60 cm dbh where saprot depth is >6 cm
Tree lean (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	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)
Tree lean (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)	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 >25% of lateral roots	Occurrence of any of the following: root pull or lifting root mat; visible damage or decay to roots affects >25% of lateral roots	Occurrence of any of the following: root pull or lifting root mat; visible damage or decay to roots affects >25% of lateral roots	Occurrence of any of the following: root pull or lifting root mat; visible damage or decay to roots affects >25% of lateral roots.
Detailed Tree Assessments	STEM TEST: Average sound stemwood shell thickness <30% of tree radius (i.e., AST < RST), or >50% circumference as an open wound and AST <30% of tree radius. ROOT TEST: More than half of the roots are >50% decayed or rotten			

* In Douglas-fir, larch and yellow (ponderosa) pine, treat thick sloughing sapwood according to the bark failure potential criteria

Additional Notes Relevant to Tables 4, 4a and 5

Structural Weakness

Structural weakness includes visual evidence of decay, cracking, breakage, embedded bark or cracking at forks or multiple stem unions, presence of conks, stem scars with decay, swollen stems from mistletoe (goiter), and woodpecker cavities.

Nest Cavities

Nest cavities themselves (which are usually circular in shape) should be considered as stem damage and is an **indication of internal decay**. Some trees with nest cavities 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.). WHT Assessors must therefore practice due diligence when evaluating trees containing cavity nests – these valuable wildlife trees warrant a thorough assessment before concluding with the tree assessment.

Perennial Cankers

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 as tissues under the dead cambium and do not grow along with the surrounding wood. They are sometimes called "exploding cankers."

Identity of Wood Decay Fungi

- If the identity of wood decay fungus cannot be determined (e.g., saprot or heartrot), then default to Dangerous rating.
- When ***Porodaedalea pini*** is present (see the exception note for the Douglas-fir, larch, pine, spruce conifer group) and the stem has structural damage such as a broken top or scarring that allow oxygen exchange or other stress indicators (e.g., resinosis, damaged roots), **OR** if there are conks distributed along the bole length, then default to Dangerous rating.
- With class 2 Aspen, when ***Phellinus tremulae*** is present, alternate safe work procedures can be used. This requires the WHT Assessor to peform a site review and to sample a selection of the trees in an attempt to determine what combination of defects results in failures at the site, and to use these criteria to define hazardous trees. If you do not see many broken or snapped aspen, 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.

If there is an isolated heart-rot conk on a live tree, the WHT Assessor can conduct a detailed assessment in vicinity of this conk to determine whether there is sufficient sound stemwood thickness to override the default dangerous rating. Such trees would then be monitored for decline and appearance of multiple conks (an indication that heart-rot has advanced and compromises stem wood strength). Refer to Appendix 1 for more detailed information about wood decay fungi or consult reference resources that aid in recognizing fungi.

Table 5. *Hazardous Tree Assessment Process for LODE 4 Activities*

When conducting LODE 4 assessments, only the following 4 types of trees are rated safe. All other trees will be rated Dangerous for level 4 activities.

Level 4 Exposure

S = Safe
if tree is one of the following:

- class 1 tree (all species)
- class 2 trees with NO structural weakness (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 weakness (tree recently killed by insects, climate or light intensity fire—these will have no structural damage or decay)

D = Dangerous hazard 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 IF THEY FIT THE FOLLOWING CRITERIA:

Defect Category	Western Redcedar, Yellow cedar Low Failure Potential
Defective top (DT)	Dead top with spike, V-shaped fork or multiple stems <30% of tree height, with no evidence of decay, cracking, failure or other structural weakness
Defective limb (DL)	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 stemwood
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 stemwood
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 (RI)	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)
Average stemwood shell thickness (for Detailed Tree Assessment if required)	Total sound stemwood shell thickness >30% of tree radius

NOTE: Structural weakness includes visual evidence of decay, cracking, breakage, embedded bark or cracking at forks or multiple stem unions, presence of conks, stem scars with decay, swollen stems from mistletoe (goiter), and woodpecker cavities.

STEP 4: Make the Appropriate Safety Recommendations

After the initial visual inspection (checking for hazards/defects and site conditions such as lifting root mats) and, if needed, after the more detailed tree assessment (checking stemwood and root soundness) the tree will be declared a "Dangerous Tree" for any hazard condition rated as "dangerous". Subsequently, the WHT Assessor will make safety recommendations about how to reduce the risks (e.g., fall or modify tree, install Safety Zone, site or area closure, modify access to the site, etc).

Generally, the trees having moderate to high tree significance value will affect the safety procedure decision (e.g., removal of the target versus the removal of the tree). Refer to Section 1 for information on tree significance value. Tree significance value should be factored into mitigation strategies for hazardous trees. On the field data card, record the values related to the tree. Where wildlife use is observed, record the type of current use by selecting from the following codes:

CN – Cavity Nest	**F** – Feeding	**P** – Perch tree	**ON** – Open nest
M – Mark tree	**D** – Den	**R –** Roost	**O -** Other

The distance to the nearest target should also be recorded on the field data card to guide safety decisions for trees or groups of trees. WHT Assessors should also take note of the magnitude of impact a hazardous tree will have to the recreation site (e.g., whether the tree affects one or multiple camping sites). This information can help the management team prioritize resources and consider the use of tree modification techniques to manage trees with high conservation values.

Safety Procedures

To demonstrate due diligence for the suspect trees that have been assessed, ensure your field data card is completed accurately. Record a hyphen where defects are absent or where assessments were not required (e.g., if the detailed assessment was not required). Use a "?" to indicate where the visual assessment of a hazard is being evaluated using a detailed assessment to make the final determination (e.g., increment drilling was needed to confirm solid shell thickness, or a root probe was needed to confirm the extent of root deterioration).

On the field data card, select the safety procedure that you recommend be applied to the tree(s). The following options are recommended. It is your duty to recommend the appropriate safety procedure based upon your tree and site assessment. Treatment or implementation is the responsibility of the management team.

For trees rated as Safe (S), consider the following management procedures:

- record tree as **Safe**: tree is safe for activities and exposure, retain tree - no removal or modification necessary (may affix a numbered tag, paint dot or numbered flagging)
- record tree as **M**: monitor the tree with low-risk defects (useful when there is concern about future tree failure and there is target exposure)
- record tree as **R**: recommendation that the tree with low-risk defects be treated now while the tree is safe to mitigate (because to delay until the tree reaches a dangerous state will be problematic, especially when there is exposure to a permanent target)

For trees rated as Dangerous (D), consider the following procedures:

- record tree as Dangerous (affix tag, paint or flagging)
- hazardous; tree risk is high, fall tree
- hazardous; remove the hazardous part(s) of the tree
- install temporary flagged hazard zone (referred to as a No Work Zone); usually a temporary work area, or awaiting opportunity to treat the tree and need to temporarily prevent exposure to workers and visitors
- modify target or facility; to prevent exposure to the tree, move the amenities that attract visitors, or modify access routes (gate or barricade), close the site, or move the facility
- map the location of NWZ's and trees recorded as Dangerous.

Overall Rating

Any tree that receives a Dangerous rating for a visible defect, lean, stemwood and/or root condition automatically receives an overall rating and must be labelled as a DANGEROUS tree. The WHT Assessor then recommends a mitigation strategy (and optional treatments) to the Designated Land Manager for managing the specific hazards.

Summary of Assessment Requirements

All work activities EXCEPT those defined as "very low risk" require a pre-work inspection by a qualified person to determine if there are any trees that might endanger workers. A summary of activity level assessment requirements is shown below.

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

- **Level 1 Work Activities**: A pre-work inspection by a qualified person is required. If trees with significant tree hazards (see Table 3) are observed, the appropriate safety procedures must be taken BEFORE work activities begin.

- **Level 2, 3 or 4 Work Activities**: A pre-work inspection by a qualified person is required. However, if "suspect" trees (see Table 4, 4A, 5) are identified by a qualified person, then **further assessment by a certified WHT Assessor** is required and the appropriate safety procedures must be taken BEFORE work activities begin.

Hazardous Trees Along Roadsides

Vehicle travel along established roads is considered a Very Low, Level 1 or Level 2 exposure (see Table 1). Consequently, inspection/assessment and subsequent recommendations for removal or modification of trees alongside roads must be determined on a site-specific basis by the WHT Assessor. The location of the tree relative to the roadway and its surroundings will affect whether a tree is hazardous to travelers. If trees are leaning towards the road, but because of the distance or presence of intervening large, live trees, the tree cannot reach the road, then there is no exposure and therefore no risk to road users. However, factors such as excessive lean (generally >15%), whether the tree is alive or dead, tree condition (tree class, stemwood soundness), rooting conditions (root health and soundness, soil depth and moisture), distance from the road, slope toward the road, and wind exposure all determine whether trees along roads should be declared dangerous and a recommendation made by the WHT Assessors to remove or modify the tree.

Alternate Safety Procedure for Decay Defects on Live Trembling Aspen

Rationale

Trembling aspen (*Populus tremuloides*) is one of the most common deciduous trees occurring 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 (stem) 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.

Related Hazardous Tree Assessment Guidelines

According to the tree failure criteria described in this course, the presence of "... any heart rot fungi" found on broad-leaved deciduous trees results in a "Dangerous" rating for those trees, under LODE 2-4 activities. Most mature aspen have *Phellinus tremulae* conks or blind conks - this means that these trees would automatically get a "D" rating if there is exposure to maintenance/construction workers and visitors (except for LODE 1). 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 LODE 2-4 exposure - this would result in an unnecessary amount of tree felling and subsequent loss of valuable wildlife habitat. An alternate job safety procedure is recommended for live aspen with these conks, but without structural defects, as follows.

Alternate Safety Procedures for live Trembling Aspen with heart rot (applicable to LODE 2-4)

1. **Conduct a site assessment overview** in order to determine the general size and condition of aspen in the stand;
2. **Look for visible conks and blind conks** on tree trunks (blind conks usually seen as rough textured, blackish swellings at the base of branch stubs);
3. **Look for aspen trees that have broken or snapped**. If trees have sufficient 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 damage), then conclude that **LIVE** standing aspen with NO OTHER DAMAGE other than visible conks, can be declared "Safe" during the operational period between assessments;
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 structural damage. Trees with other structural damage (e.g., cavity nest holes, internal fire scarring, broken tops, split trunks, etc.) must be assessed according to Tables 3-5 and dealt with accordingly.

Hazard Areas

The hazard area is the extent of area where a failing tree (whole or part) is most likely to impact. Hazard areas are flagged or barricaded to keep people safe. No worker can enter except to remove specific tree hazards or to re-assess whether the hazardous condition has changed. In most parks, recreation sites and trail applications, hazard areas will usually be areas flagged temporarily as a No Work Zone (NWZ) until work activities are completed. The NWZ may also be installed to protect workers and visitors in situations where the hazardous tree or parts thereof have not yet been removed. This flagged NWZ must include all the area on the ground that could be reached by any dislodged portion of the tree were it to fail. The following guidelines apply to the determination of the size and shape of hazard areas:

- Hazard areas will consider the nature of the hazard and the lean of the tree.
- On steep ground, the hazard area will be extended downhill to protect workers and visitors.
- Hazard areas can be adjusted in size depending on the size of surrounding live timber (e.g., a small hazardous tree surrounded by much larger trees that "shield" the adjacent area has a hazard area radius less than 1.5 defect lengths).
- A kick-back area should be included for semicircular hazard areas. The size and shape of this area is determined by tree lean, condition and form (branching).

> **NOTE:** HAZARD AREAS are generally 1.5 times the length of the defect which was rated as dangerous. This hazard area can be modified (larger or smaller) depending on site-specific conditions such as slope or size of surrounding trees.

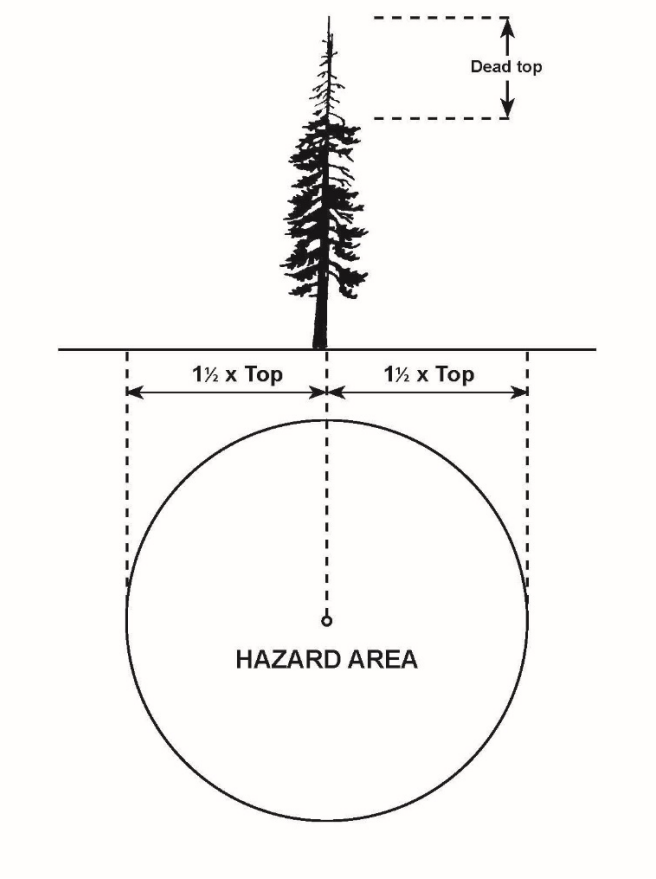
The most common types of hazard areas are illustrated on the following pages.

NOTES:

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

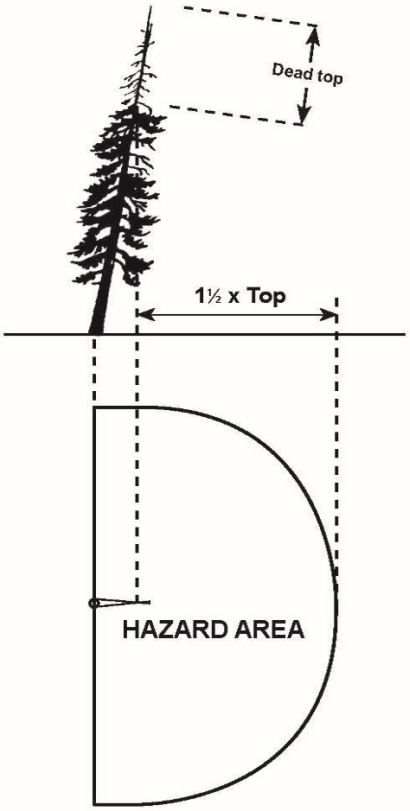
1. Determine the length of top that might dislodge.
2. Add ½ of this length, to get a 1½ top length distance.

This distance is the radius of the hazard area.



B. Sound tree with lean, defective 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.
3. Determine from the lean how far from the base of the tree the top might land.

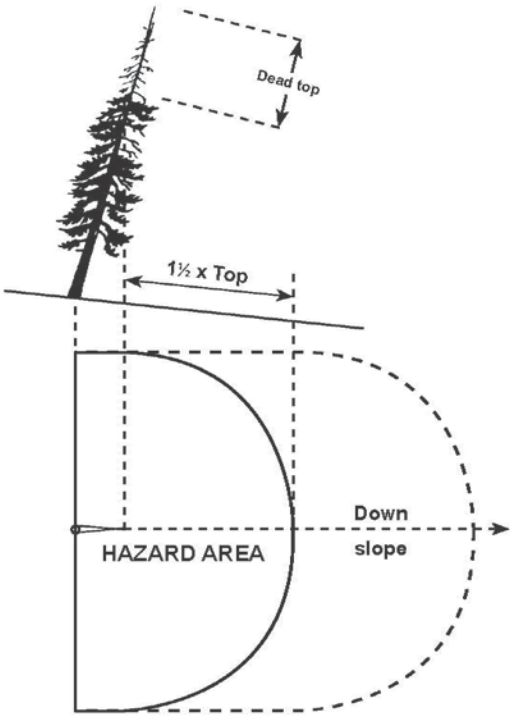


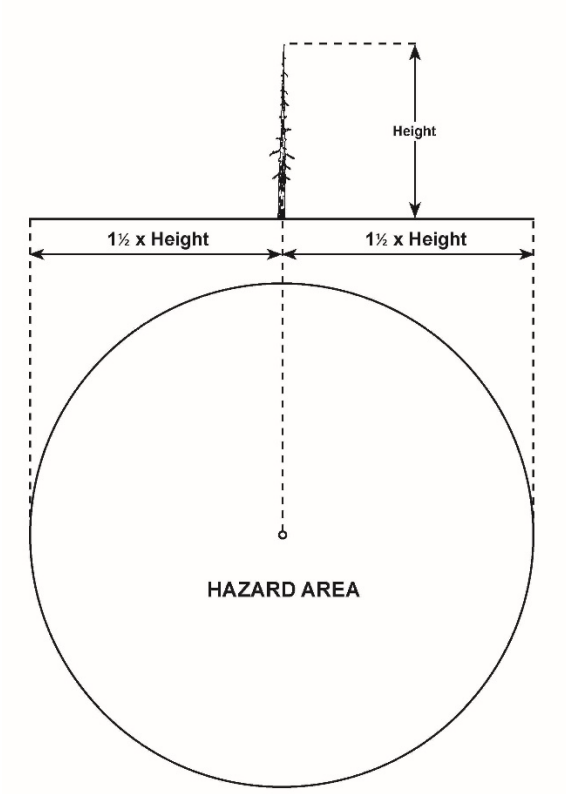
C. Sound tree with lean, defective top, on slope

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 hazard area 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 hazard area is a circle around the tree, with a radius of up to 1½ times the height.



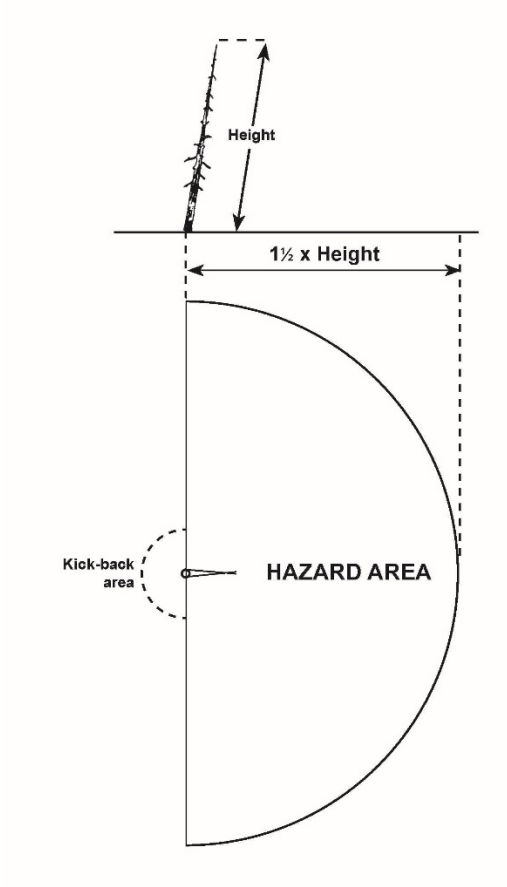


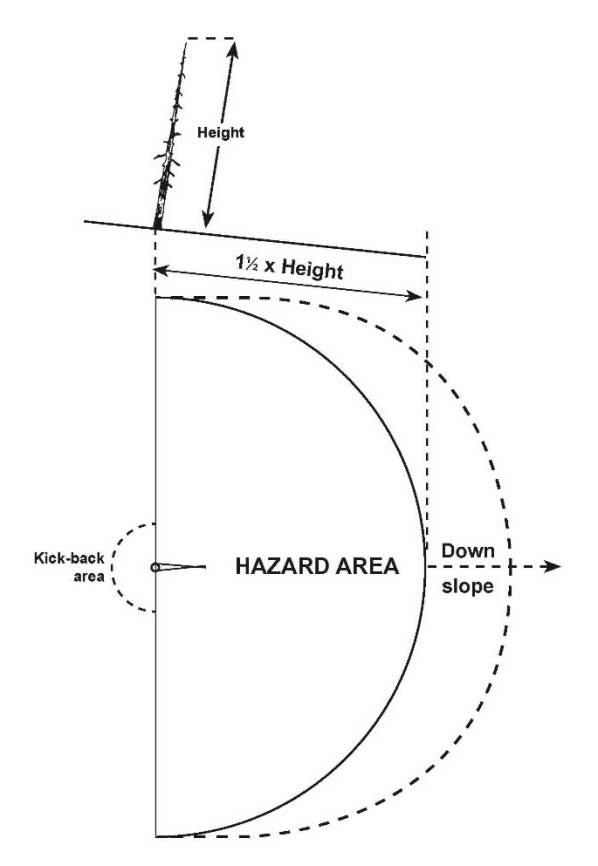
E. Unsound or hazardous tree, with lean, flat ground

1. Measure the height of the tree.
2. Add ½ of this length to get a 1½ tree length hazard area.

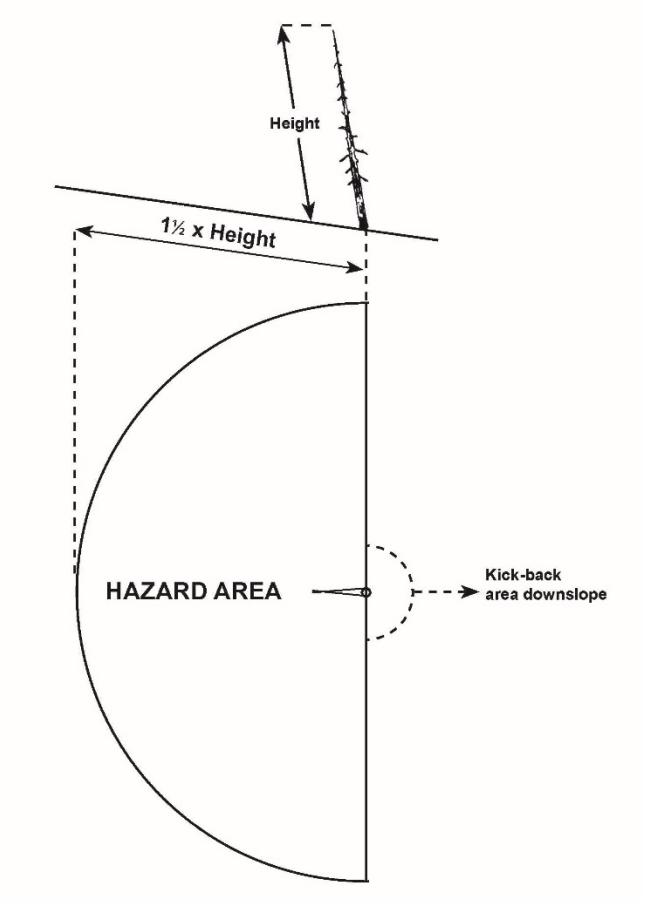
F. Unsound or hazardous tree, with lean, on slope

1. Measure the height of the tree.
2. The hazard area is a half-circle extending up to 90° on each side of the lean, with a radius of 1½ times the height of the tree.
3. On slopes >30%, extend the hazard area 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 hazard area will take up a large part of the treatment area.





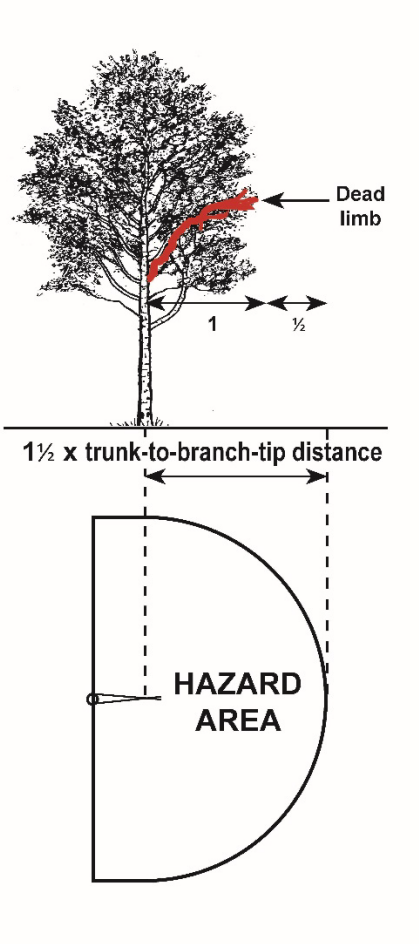
5. Where the tree slopes uphill, the hazard area should be 1½ times the tree height going upslope.
6. Where the tree slopes uphill, depending on the slope of the hill, a kick back area will be added on a site-specific basis.



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 calculated for all defective limbs on the tree.

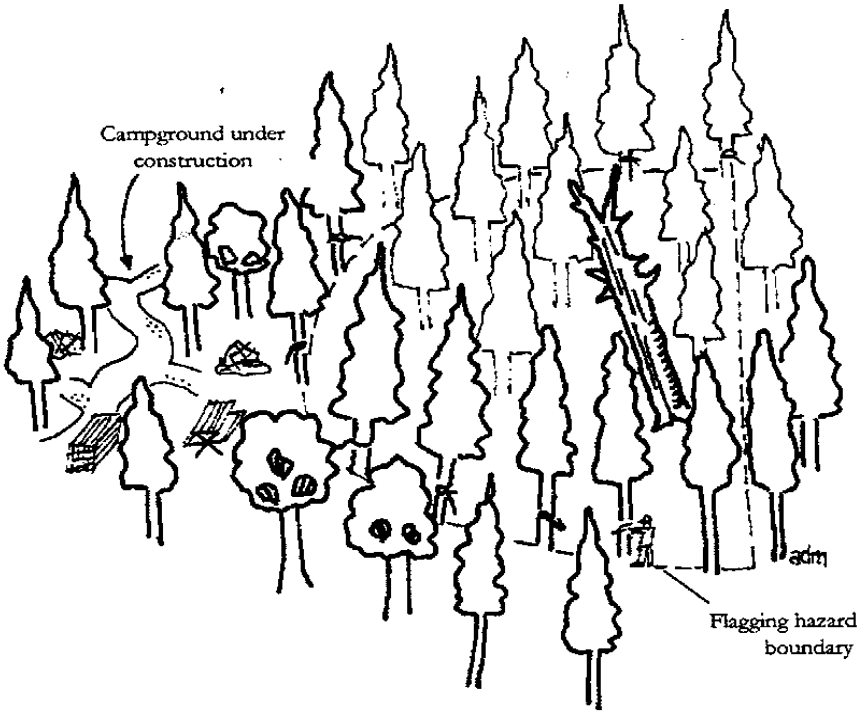


Establishing Hazard Areas

The WHT Assessor should use standardized coloured barricade tape with bold black letters reading "**No Work Zone"**, or "**Danger – No Entry**", or any other tape that is easily identifiable to indicate a hazard. Once the size of the hazard zone area has been determined by the WHT Assessor, the area should be flagged at sufficient intervals so that workers will always be able to see the hazard area boundary from any position along its perimeter. No person is allowed to enter this area EXCEPT to remove a specific tree hazard (e.g., faller) or a WHT Assessor to re-assess whether the hazardous condition has changed.

When needing to protect visitors, the hazard area needs to be both flagged and appropriate signage posted to communicate that the temporary closure is for the safety of the public. The Designated Land Manager can take further action to strengthen the closure.

NWZ flagging and barricades should be "dismantled" when there is no further exposure to a tree hazard because the hazard has been removed, or there is no target exposure (people or facilities are now out of reach of the hazard), or the original hazard has fallen on its own.



STEP 5: Provide documentation and communicate safety procedures

As part of applying these hazard tree assessment practices, it is extremely important that a well-documented, thought-out plan, process and decision are followed in the implementation of any dangerous tree management program. Operational activities must be documented in case of liability issues. Operationally, documented assessment and mitigation actions can be referenced to help WHT Assessors identify causal relationships. WHT Assessors can use the Hazardous Tree Assessment field data cards (FS502f) to record tree information.

Additionally, it is helpful for the Designated Land Manager to document the circumstances surrounding post-assessment tree failures so that possible site correlations can be communicated to the WHT Assessors and used in future assessments. It is helpful for the WHT Assessor(s) to receive this knowledge about the prevailing wind directions, the level of actual tree deterioration compared to the initial visual condition of the tree(s), compounding factors (e.g., soil saturation and windspeeds, flooding, snow/ice loading) the strength of the storm (maximum windspeed and gusting windspeeds) at the time of tree failures. This information can be used by the WHT Assessor to make informed decisions on how to interpret the visible hazards (which may be species specific) for the site.

All worksite documentation must be retained on file and be retrievable.

Minimum documentation from the WHT Assessor must include:

- WHT Assessor's name and certification
- Date and location of assessment
- Level of Disturbance and Exposure (LODE).
- Marking procedures (i.e., flagging, paint or tags) used for assessed trees, assessed areas and hazard areas.
- Locations of assessed trees and completed assessment areas.
- Locations of flagged hazard areas.
- Use field cards (FS502f) and photographs if necessary to provide documentation on individual tree assessments.
- A statement of limitations and recommendations for re-inspection timing.

Reassessment of Trees

Trees assessed and recorded as SAFE at a worksite must be reassessed if, prior to the work activity commencing, an intervening winter or major disturbance event has occurred, or if the LODE has changed from the original assessment (e.g., LODE 1 routine maintenance becomes LODE 3 heavy equipment use for construction).

It is important that the WHT Assessor specifically state any limitation of the assessment when providing their recommendations to the Designated Land Manager. Consider the following examples of limitations when communicating the results of the assessment:

- Tree damage may be hidden from sight or undetectable with the tools used to perform the assessment (state what tools were used when conducting tree assessment).
- Tree assessment was performed on trees with visible hazards and detectable tree conditions relative to the known/assigned targets (provide a listing of identified targets).
- The assessment represents the condition of the site and trees within the area assigned for assessment and at the time of the visit (provide a map showing the area assessed).
- Assessment procedures are broadly accepted as a diligence tool but cannot predict or prevent when a tree failure (whole of part) will occur.
- Trees are dynamic living organisms that may vary in their ability to response to physical damage, environmental pressures, tree pests and pathological factors.
- Any tree, with or without visible hazards, can fail when exposed to stresses that exceed their strength.

The WHT Assessor should also make recommendations about the timing for tree intervention and follow-up reassessment. For example, if a tree has a hazard that is at risk of imminent failure (e.g., cracked and has a partially dislodged stem) then call the Designated Land Manager as soon as is practicable that the intervention is needed without delay. Additionally, communicate the necessity for a reassessment if there are any site altering events or changes in use.

Section Three

HAZARD TREE MANAGEMENT

Learning Objectives:

- Habitat Modification Techniques

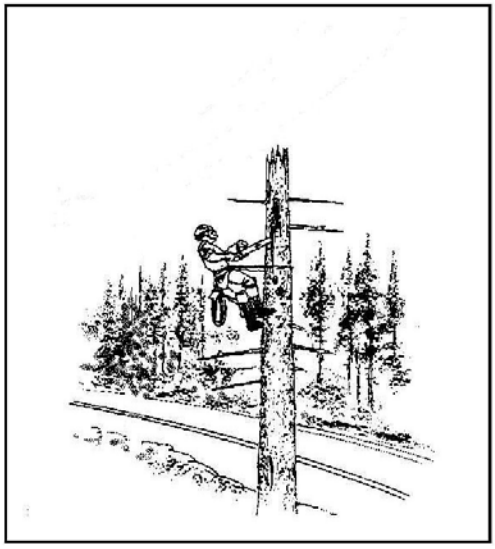
HABITAT MODIFICATION TECHNIQUES

In many situations it will be desirable to recommend removal of the hazardous portion of the tree, while still maintaining the rest of the tree intact for wildlife habitat. In this context, trees with wildlife tree-like attributes such as broken tops, decayed heartwood, and artificial cavities can be created using various techniques. These techniques have value under specific applications and can be viewed as methods for enhancing or restoring wildlife tree habitat.

Tree Topping

- Tree topping can be employed in situations where removal of the tree is not desirable, and where the installation of a hazard area around the tree to protect facilities or the work area from aerial hazards (e.g.; a large spiked top or large dead limbs on a class 2 tree) is not appropriate.
- Healthy class 1 trees (trees with no visible external defects) can also be topped to stimulate natural breakage and promote snag recruitment. This is especially important in even-aged stands with little or no structural diversity.
- Trees should be "jagged topped" to stimulate natural breakage, thereby facilitating weathering and decay processes that encourage heart rot for future cavity nesting.
- Only highly experienced and trained personnel should climb and top trees.
- Each tree must be assessed for safety concerns by personnel who are experienced and trained in hazardous tree assessment, tree climbing and topping.

Removing the hazardous portion of a tree along a road. Tree can be "jagged-topped" with a chainsaw.



Creating feeding cavity starts in a tree where a hazardous top was removed.

NOTE: *If tree mitigation strategies are within reach of the limits of approach to high voltage lines and equipment, these treatments MUST be planned and performed under the direct supervision of a* Certified Utility Arborist*. Contact your nearest Utility Company for guidance.*

Nest boxes and Cavity Construction

- Artificial nest boxes can provide suitable nesting structures for a variety of hole-nesting birds. This is especially true for areas with a shortage of natural cavities.
- When recommending installing nest boxes, it is essential to place the box in the appropriate habitat for the intended species. This includes nest height (e.g., for predator avoidance) and nest location (e.g., proximity to water for cavity-nesting ducks).
- Proper nest box construction is required to ensure use of the box by the intended species. Accurate species-specific hole size (diameter) and shape (e.g., circular, flattened oval) will usually limit use of the box to the intended species.
- "Cavity starts" for feeding, nesting and roosting can be constructed in trees, using a chainsaw. This requires knowledge of the habitat needs of the species in question (e.g., size, shape and location of the nest hole for secondary cavity users), and an experienced tree climber/chainsaw operator.

Creating an artificial nest hole with an accompanying faceplate for use by cavity nesting ducks or owls.

Fungal Inoculations

- Inoculation of live trees with native wood decay fungi to promote heart rot has excellent potential as a wildlife tree creation tool. Inoculated trees usually maintain good growth and form and pose few worker safety problems. Inoculation is potentially useful in restoring or enhancing habitats where there may be a lack of suitable wildlife trees and stand structure (e.g., riparian management areas, damaged ecosystems, and immature forest stands). Preliminary results from studies have shown development of internal decay and subsequent uses by wildlife within 5-10 years.
- However, fungal pathogens are tree species specific and area specific. Detailed knowledge of inoculation procedures is required for this technique to become broadly successful (including choice of fungal species and injection parameters and procedures). The Ministry of Forests regional pathologists should be consulted if this method of treatment is being considered.

Inoculation tubes placed in live trees for insertion of fungal inoculums (Photos courtesy of T. Manning)

Timing of Modifications

- If possible (i.e., within timeline to implement safety procedures), perform wildlife tree modifications outside of the breeding/nesting period (i.e., March - August) for most wildlife tree users. Consequently, the recommended periods for performing tree modifications are after winter storms or in autumn (September-December).

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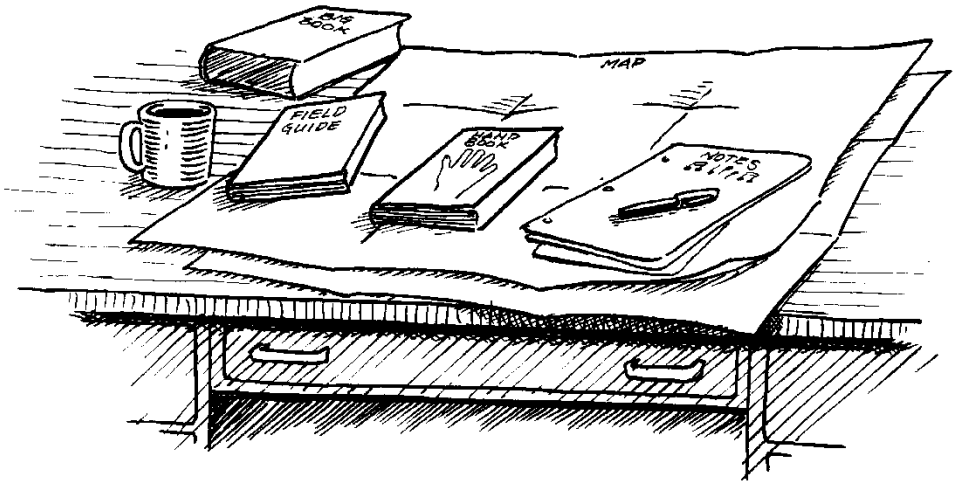

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GLOSSARY

For the purposes of this document, the following terms and definitions will be used:

actual stem thickness (AST)	The average "actually measured" (solid) stem thickness found during the detailed stem analysis; typically using an increment borer and averaging the solid wood samples taken from a minimum of 3 borings for trees >40cm in diameter.
biogeoclimatic 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-huckleberry-highbush cranberry plant association.
biological diversity	The diversity of plants, animals and other living organisms in all their forms and levels of organization, including genes, species, ecosystems, and the evolutionary and functional processes that link them.
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.
butt rot	The presence of decay in the lower trunk of the tree, including the root collar and buttressed roots.
butt swell	The abnormally swollen base of a tree, where the tree's taper is exaggerated; typically as a result of increased wood growth to overcome internal deterioration by butt rot or root disease.
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.
catface	A catface is a partially healed or grown-over wound on a tree stem inflicted by equipment, or when the stem was struck by a falling tree.
cavity	The opening into a tree's stem, either naturally from limb loss or created by primary cavity excavators for feeding or nesting; indicator of internal stem decay.
certified WHT Assessor	Someone who has passed one or more of the Wildlife/ Hazardous Tree Assessor's course modules sponsored by the Wildlife Dangerous Tree Committee of B.C., and who holds a valid certificate which signifies this designation. Certification is valid for four years.

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).
coarse woody debris (CWD)	Fallen trees or logs, and parts of trees on the forest floor at least 7.5 cm in diameter. CWD provides habitat for various small mammals, salamanders and numerous invertebrates. As it decays, it provides nutrients back to the forest soil.
compartmentalization	The natural processes of a tree's cellular defense mechanism to limiting the spread of disease and decay following wounding.
conk	The fruiting body of a wood decay fungus; bracket-like or reclined or flat growing on the host tree's stem or limb or root zone, but not a mushroom. Usually woody or leathery in texture.
critical root zone	The majority of a tree's vital and structural support roots are found within the critical root zone, which is approximated to be the crown's outer drip-line. Damage or compaction within this zone often harms the tree, and if excessively damaged will lead to its death.
culturally modified tree (CMT)	A CMT is a tree that has been altered by indigenous people as part of their traditional use of the forest.
dangerous tree	Means a hazardous tree that poses a risk to a person or facility due to its location or lean, its physical damage, overhead conditions, deterioration of its limbs, stem or root system, or any combination of these conditions (OHS regulation 26.1).
defect length	The length of the dangerous defect on a tree; this could be the dangerous dead limb, or hazard top (i.e., the segment above an observed weakness), or the entire tree (i.e., the whole tree is at risk of failure because of root problems, lean or insufficient stem thickness).
defective 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. Suspect tops are defined by visible stem deformations (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.
Designated Land Manager	The Area Supervisor or Recreation Officer that is the decision makers acting on behalf of the government, and they may assign a responsible agent to act on their behalf. In other jurisdictions, the person who is in the land manager role.

detailed tree assessment	The use of stem and root analysis techniques (probes and increment borers) to help determine whether the defect has deteriorated to a high failure potential.
dominant trees	The tallest trees within the main forest canopy layer and which are typically large in diameter and have a wide crown compared to the neighbouring trees.
diameter	The tree's width or girth and referred to as DBH (diameter at breast height) when measured at 1.3m up from the root collar, or as DSH (diameter at sample height) when measured at the location where a stem defect is being detail tested with a probe or increment borer.
embedded bark	Bark that is pushed inside a developing branch or stem crotch, usually evidenced by visible cracking and is a weakened structure.
environmentally sensitive area (ESA)	An area with potentially fragile or unstable soils that may deteriorate unacceptably after forest harvesting, or one of high value for non-timber resources such as fisheries, wildlife, water and recreation.
failure potential	The potential for a tree or tree part to fail during various exposure levels and wind speed equivalencies before the next inspection period.
forest activity	Any activity that requires workers to be in the field where they may be in the vicinity of living or dead trees.
geotropic growth	The compensation growth of a live tree in response to gravity; commonly seen as growth sweep in conifers.
habitat	A specific kind of living space or environment that provides at least minimal conditions for one organism to live, or for a group to appear together.
hazard area (HA)	A flagged No Work Zone area where no worker shall enter except to remove hazards. Workers will be informed about these hazard areas prior to commencement of work on site. The size of HA's are 1.5 times the defect length, but this area can be modified (larger or smaller) depending on site-specific conditions.
heart wood fungi	A general group of fungal organisms which extensively decay live or dead trees. Heartrots include wound invaders and heartwood invaders and are a significant vector for tree structural failure. Fruiting bodies are generally woody perennial conks, and can be found on stem wounds, branches and bole of the stem.
live Class 1 tree	A living, growing tree with good vigour, no structural problems, and no visible signs of disease or decay.
live Class 2 tree	A live tree with some visible external defect such as a broken, dead, or forked top, split or scarred trunk, cankers, root or stem damage, cavities or visible fungal conks.

mycorrhizal fungi	A symbiotic association between a tree and a fungus, where both enjoy improved existence. The tree provides the fungus with photosynthesis molecules (e.g. carbohydrates) while the fungus provides the host tree with water and mineral nutrients (e.g., phosphorus and nitrogen) taken from the soil.
nest	The location a bird has chosen to lay and incubate its eggs and raise its young. A cavity nest is a hollowed-out chamber in a tree (live or dead) that is used by primary cavity nesters (the builders of cavity nests) and/or by secondary cavity users (did not excavate the nest).
old growth forest	An old forest distinguished from younger stands by having large trees for species and site, wide variation in tree sizes and spacing, accumulations of large dead standing trees and CWD, multiple canopy layers, canopy gaps and understory patchiness, decadence in the form of broken or deformed tops or boles.
pathogen	A living organism that incites disease in a host.
pattern of failure	The analysis during a site assessment overview where the WHT Assessor detected common modes of failure since their last assessment and uses this information to identify similar candidate trees for inspection and possible intervention.
phototropic growth	The adaptive growth of a tree towards sunlight, and common among hardwood species of trees.
playground	A developed area intended for and equipped with facilities (e.g., slides, swings, climbing apparatus, etc) for recreation activities, especially by children.
pruning	The practice of removing limbs to reduce crown weight, remove a limb hazard, or to improve the tree's architecture to gain safety objectives or to promote habitat (e.g., provide roosting or nesting).
qualified person	A person experienced in the specified work activity and who, by reason of education, training, experience or a combination thereof, is able to recognize and evaluate hazards associated with trees under the mentoring of a WHT Assessor, with due regard for the anticipated work activity and possible disturbance of the tree(s).
raptor	A bird of prey such as an eagle, hawk, falcon, or owl.
reaction wood	The reinforcement wood formed in leaning and crooked stems, or on the upper or lower side of branches to counteract the force of gravity.
recruitment	Wildlife tree management strategy of retaining standing live or dead trees that will become future wildlife trees.

reserve	The retention of unharvested (reserved) trees, distributed either uniformly or in groups for purposes other than regeneration. Some of these purposes include wildlife habitat, biological diversity, and aesthetics. For purposes of wildlife tree management, a reserve can range in size from a single outstanding wildlife tree to a forested patch containing many wildlife trees on several hectares.
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 (e.g., root disease) or damage (e.g. wind shake or split).
retention	The decision to keep a suspect tree following an assessment but to recommend monitoring of the tree during returning assessment visits for signs of accelerated deterioration or death.
retrenchment	The natural growth pattern observed in mature to old trees to increase their longevity by reducing height growth and increasing girth growth; the practice of crown reduction pruning to mimic natural growth processes.
required stemwood thickness (RST)	RST is the theoretical amount of stemwood required to support the weight of a tree and is calculated to be 30% of the tree's radius. When performing a detailed stem analysis for trees with stem defects (visible or hidden), the WHT Assessor determines whether the tree has sufficient holding wood to support the weight of the tree.
riparian area	The land bordering a river, stream, lake, reservoir, pond, wetland or spring. Riparian areas typically exemplify a rich and diverse vegetative mosaic reflecting the influence of available surface water.
risk	The integrated likelihood that a tree failure (whole or part) would cause a severe impact to identified targets and incur injury, damage or disruption.
riparian management zone (RMZ)	That area located adjacent to a stream, wetland or lake of a width determined in accordance with the *Riparian Management Guidebook*.
root rot	The decay observed or discovered in roots from mechanical damage or from a disease pathogen (e.g., root disease fungus).
rust	A disease caused by infection with one of the rust fungi, often producing yellow to orange spores at some point during the infection.
saprot fungi	A general group of fungal organisms which decay in the outer sapwood layer of trees. Saprots tend to be more commonly found on dead trees or dead parts of the tree and 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 tree's original top. Secondary tops (live or dead) can occur as single leaders, forks or multiple tops.
seral stage	One of a chain of successional ecological stages leading to a climax plant community. For example, an early seral stage could be a new stand with fire origin, a mid-seral stage could be a mixed hardwood/conifer forest, and a late seral stage could be a mature or old-growth forest.
shielding	The protection afforded by other trees, branches, or other factors that would catch or prevent a tree or its parts from reaching the identified target.
sloughing bark	Bark that has started to separate and eventually falling or breaking away from the tree's stem. Sloughing bark can be a significant hazard from thick-barked tree species (e.g., Douglas-fir, western larch, yellow pine, cottonwood).
soil compaction	Soils which are compressed because of vehicular traffic or heavy equipment to the detriment of tree health because of the diminished soil volume and soil aeration, and impoverished water percolation.
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 age, drought flooding, insects, disease, or climatic factors.
stand level	The level of forest management at which a relatively homogeneous land unit can be managed under a single prescription, or a set of treatments, to meet well-defined objectives.
stand-level structural attributes	Components of a forest stand (including living and dead standing trees, canopy architecture and fallen dead trees) which together determine stand structure.
stratification	Dividing or organizing an area, such as a campground, into distinct units based on site-specific factors such as visitor use, vegetation type or physiographic relief.
structurally damaged stand	A stand of trees which has been severely and extensively damaged, to the extent that a qualified person decides there is an undue risk of tree failure in the whole stand or site.

structural weakness	Structural weakness refers to instability or compromised strength which may cause a failure; includes visual evidence of decay, cracking, breakage, embedded bark or cracking at forks or multiple stem unions, presence of conks, stem scars with decay, swollen stems from mistletoe (goiter), or woodpecker cavities.
stub	An artificially-created wildlife tree, usually cut from a class 1, 2 or 3 tree.
suppression	Reduced tree growth and vigor due to excessive competition for space, light, moisture and nutrients.
suspect tree	Any live or dead tree within reach of a target and has a visible defect which could cause failure of the tree, either whole or in part, and pose a risk to people or property.
sweep	Adaptive growth of a leaning, live tree which is self-correcting, and the top appears to be curled upwards to near vertical.
target	Workers, infrastructure (picnic table, kiosks, buildings) and developed areas (e.g., playground, constructed trail, parking lot, campsite, etc) provided for visitors at a recreational area; Identified areas where the protection of persons and property from damage or injury by a tree failure, whole or part, is managed.
veteran tree	An old tree, likely a survivor from a stand-initiating event and because of its great age, size or condition is regarded as having special conservation value.
visual inspection	The process of inspecting and assessing trees for the presence of visual tree hazard indicators, and reviewing the tree in context to its surroundings and target.
widow-maker	The presence of an overhead hazard that could shift free during tree disturbance (e.g., loose limb, weakened top).
wildlife tree	A standing dead or live tree with special characteristics that provide valuable habitat for wildlife.
Wildlife Dangerous Tree Committee	A committee organized in 1985 to find ways of maintaining wildlife tree habitat in timber harvesting and silviculture operations, without endangering the safety of forest workers, and expanded to parks, recreation sites or trails.
windthrow	The toppling or breakage of a tree as a result of windstorms.
workplace	Includes all locations where a worker is or is likely to be engaged in work activities.
Xylem	Vascular tissue throughout which most of the water and nutrients are conducted from the roots to other parts of the plant.

APPENDICES

APPENDIX 1. Examples of Important Tree Pathogens in B.C

Although there are thousands of different types of fungi present in the forest, only some cause decay. Of these, only a few are significant with respect to the development of wildlife trees. The most prevalent decay fungi relative to wildlife trees in British Columbia are listed below. NOTE: The names of fungi are subject to change and readers are advised to check the literature for the most recent names.

Mainly conifers

Disease name:	**Brown Crumbly Rot** (or Red Belted Conk)
Organism name:	*Fomitopsis pinicola*
Common name of organism:	Red Belt Fungus
Hosts:	Many coniferous and deciduous species.
Characteristics useful for identification:	Perennial fruiting bodies hoof-shaped or shelved, brown-black with a red-brown margin. Pore surface white-cream.

Disease name:	**Brown Cubical Butt and Pocket Rot**
Organism name:	*Postia sericeomollis*
Hosts:	Most conifers, most importantly western redcedar.
Characteristics useful for identification:	No reliable external indicators, fruiting bodies are thin and crust-like but very rare. Use an increment borer to check for decay.

Disease name:	**Brown Cubical Butt Rot**
Organism name:	*Phaeolus schweinitzii*
Common name of organism:	Velvet Top Fungus
Hosts:	Most conifers.
Characteristics useful for identification:	Stalked, annual fruiting bodies with brown, velvety tops that are up to 20 cm in diameter are found near the base of infected trees. In advanced decay the wood breaks into large red-brown cubes.

Disease name:	**Brown Cubical Rot**
Organism name:	*Laetiporus conifericola (formerly: L. sulphureus)*
Common name of organism:	Sulphur Fungus
Hosts:	Many coniferous and deciduous hosts.
Characteristics useful for identification:	Annual bracket-like fruiting bodies, bright yellow-orange in colour.

Disease name:	**White Trunk Rot of Conifers**
Organism name:	*Phellinus hartigii*
Common name of organism:	Velvet fungus
Hosts:	Western hemlock, amabilis and subalpine fir, Douglas-fir.
Characteristics useful for identification:	Perennial, velvet fruiting bodies; hoof-shaped on stems, commonly along the underside of branches.

Disease name:	**Brown Stringy Trunk Rot**
Organism name:	*Echinodontium tinctorium*
Common name of organism:	Paint fungus
Hosts:	Most importantly Hw and true firs, also other conifers.
Characteristics useful for identification:	Distinctive perennial fruiting bodies with tooth- like pore layer, usually associated with branch stubs, and is orange/rust coloured if broken off the tree.

Disease name:	**Brown Trunk Rot**
Organism name:	*Laricifomes officinalis* *(formerly Fomitopsis officinalis)*
Common name of organism:	Quinine Fungus
Hosts:	Most commonly Lw, also on most other conifers.
Characteristics useful for identification:	Hard, perennial fruiting bodies, hoof-shaped to long and pendulous. Thick, white mycelial felts often associated with advanced decay.

Disease name:	**Red Ring Rot**
Organism name:	*Porodaedalea pini* (formerly *Phellinus pini)*
Hosts:	Most conifers.
Characteristics useful for identification:	Hard, brown, perennial fruiting bodies, generally bracket-like, are associated with branch stubs. Decayed wood is red stained with distinctive white-pockets.

Mainly hardwoods

Disease name:	**Aspen Trunk Rot**
Organism name:	*Phellinus tremulae*
Hosts:	Only on aspen.
Characteristics useful for identification:	Perennial fruiting bodies are hard, woody and triangular-shaped. Upper surface is gray-black and rough. The lower surface is brown.

isease name:	**Hardwood Trunk Rot**
Organism name:	*Phellinus igniarius*
Hosts:	Many deciduous tree species.
Characteristics useful for identification:	Perennial fruiting bodies are hard, woody and hoof shaped. The upper surface is gray-black and rough. The lower surface is brown, generally at a 90° angle to the stem.

Disease name:	**Hypoxylon stem canker**
Organism name:	*Hypoxylon mammatum*
Hosts:	Mainly trembling aspen, possibly poplars.
Characteristics useful for identification:	Blistered stem with orange/yellow or reddish-brown discoloration at early infection, mottled and rough grey-black surface in later stages.
Disease name:	**White Mottled Rot**
Organism name:	*Ganoderma applanatum*
Common name of organism:	Artist's conk
Hosts:	Most hardwoods.
Characteristics useful for identification:	Perennial fruiting bodies are hard, leathery, flat and plate-like. The upper surface is brown. The lower surface is white, turning brown when bruised or marked.
Disease name:	**White Spongy Trunk Rot**
Organism name:	*Fomes fomentarius*
Hosts:	Mainly birch, also other hardwoods.
Characteristics useful for identification:	Perennial fruiting bodies are hard, grey-brown and hoof-shaped. The pore layer is generally at a 90° angle to the stem.
Disease name:	**Sterile Conk Trunk Rot**
Organism name:	*Inontus obliquus*
Common name of organism:	Chaga
Hosts:	Mainly birch, also other hardwoods.
Characteristics useful for identification:	Perennial mycelium mass is a hard, charcoal black growth exuded outward from the stem. The brown fertile fruiting body is hidden from sight beneath the bark, causing white rot in the heartwood.
Disease name:	**Brittle Cinder butt rot**
Organism name:	*Kretzschmaria deusta*
Hosts:	Maple, Oak and Beech.
Characteristics useful for identification:	It is a soft rot; breaking down both the cellulose & lignin as it decays the trunk and/or roots of living trees. The fruiting body is a white mat at the base of the infected tree, then turns black as it matures; resembles black tar or creosote (feels brittle).

Major Root Diseases

Disease name:	**Annosus Root and Butt Rot**
Organism name:	*Heterobasidion occidentale (*formerly *H. annosum)*
Hosts:	Many coniferous and deciduous species. In B.C., mainly Hw.
Characteristics useful for identification:	Fruiting bodies are rare, but will be found on the underside of stems and roots. Wood in advanced state of decay is white and stringy with black flecks running parallel to the grain.
Disease name:	**Black Stain Root Disease**
Organism name:	*Leptographium wageneri*
Hosts:	Mainly Fd, Pl, also Pw, Se, Sw, and Hw.
Characteristics useful for identification:	Reduced leader and branch growth, discoloured foliage. A purple-black stain is present in portions of annual rings in roots and up into the stem.
Disease name:	**Armillaria Root Disease**
Organism name:	*Armillaria solidipes (*formerly *A. ostoyae)*
Hosts:	Attacks all tree species; cedars and white pin tend to be more resistant.
Characteristics useful for identification:	Causes diagnostic crown symptoms (reduced leader grown, foliage discoloration and thinning). Rosin may exude from bark on lower bole. Whitish mycelial fans may be seen under the bark, showing resinosis. Fruiting bodies (mushrooms) occur around the base of infected trees and stumps. They are cream- to brown-coloured with a distinct ring on the stem. Dead and diseased trees usually occur in disease centres.
Disease name:	**Laminated Root Rot**
Organism name:	*Phellinus weirii (Cw host) P. sulphurascens (Fd host)*
Hosts:	Fd, Sx, hemlocks and true firs; a separate "form" occurs as a butt rot on Cw.
Characteristics useful for identification:	Infected trees often grouped in "disease centres." Standing infected trees have thinning, yellow foliage with reduced leader growth. Look for windthrown trees with "root balls" (lateral roots have characteristic laminated decay and broken close to stems).
Disease name:	**Tomentosus Root Rot**
Organism name:	*Inonotus tomentosus*
Hosts:	Mainly Sx, also other conifers.
Characteristics useful for identification:	Stalked fruiting bodies, ≈ 10 cm in diameter, with velvety upper surface on ground near infected trees. Small longitudinal pits in decayed wood give it a honeycombed appearance.

All of the above fungi have unique 'conks' or fruiting bodies which, with some practice, can be easily recognized and identified. However, fruiting bodies are not always present and visible. These conks occur on the bole or trunk of the tree and their presence, size, and frequency of occurrence can be good indicators of the amount of decay present in the host tree. Identifying the various types of conks and their associated fungi helps in identification and classification of both present and potential wildlife trees.

For example, a live tree infected with *Porodaedalea pini* with one conk present would likely be a very good wildlife tree and could be expected to persist for several years. On the other hand, a dead tree infected with one *Fomitopsis pinicola* conk could be a poor wildlife tree because it could have extensive decay and would not remain standing for long. Depending on its location, it could be a hazardous wildlife tree and warrant early intervention.

Ganoderma applanatum

Laetiporus conifericola

Root Disease

Root diseases are caused by fungi that kill the living parts and decay the woody parts of tree roots. Decay in the root system can advance several metres up the trunk. All root diseases produce similar symptoms—thin, yellowish (chlorotic) foliage, reduced growth, and distress cone crops (cones that are smaller than normal but perhaps more numerous). The severity of the symptoms depends on the disease organism, the species and size of the tree, and the proportion of the root system affected. Root disease fungi will eventually weaken the host tree, making it susceptible to bark beetles and saprophytic decay fungi. Root systems weakened by disease can make trees unstable.

Cankers and Rusts

Fungi that cause cankers (an area of dead tissue marked by a flattened surface on the trunk) and rusts are two types of pathogens that can eventually girdle trees. The mortality rate depends on the species of fungus and the size of the host: small diameter trees are killed more easily. If no root pathogens or decay are present, the roots are generally stable. Aspen, poplars, lodgepole pine and white pine are the species most susceptible to stem or bark diseases. Pines attacked by stem rusts attract squirrels which chew the margins of the infections, resulting in resin flow.

Heart Rots

True heart rot fungi may enter a live tree through branch stubs, branchlet scars, or other wounds. As heartwood decays it becomes more easily excavated by primary cavity excavators. The sapwood remains intact, leaving a hard outer shell that protects nest cavities. The most common heart rot fungi are *Porodaedalea pini* (red ring rot) because it affects many conifer species, *Echinodontium tinctorium* (Indian paint fungus) commonly affecting hemlock and true firs, and *Phellinus tremulae* which affects aspen. For the purposes of this course, *Fomitopsis pinicola* (brown crumbly rot or red belted conk) is called a heart rot fungus because it is such a common wound invading species on most live trees (conifers and hardwoods) and it rapidly invades and decomposes dead trees to creates high risk hazards.

Living trees with heart rot are not prone to windthrow because the fungus does not usually attack the roots. However, trees displaying several conks (fruiting bodies) are usually extensively decayed and are increasingly susceptible to wind-induced breakage. However, the proliferation of fruiting bodies varies within the fungus. A lack of visible conks does not indicate a lack of heart rot.

Echinodontium tinctorium

Phellinus tremulae

Porodaedalea pini

Wound Decays

Wound decay fungi are specialized fungi that invade freshly scarred trees where there is localized killing of tissue. Basal scars are often colonized by such fungi, sometimes resulting in a hollow at the tree base. Some wound decay fungi are able to progress beyond the wound site and cause heart or sap rot, but they usually do not kill the tree.

Scars, broken tops, frost cracks, forks and crooks are decay indicators because they mark exposed sapwood that can serve as an entry point for decay fungi. Decay indicators are generally more reliable in conifers than in hardwoods. Decayed trees are prone to breakage, particularly at the site of infection and colonization. The larger or older the wound, the more susceptible to breakage the tree is likely to be.

Saprophytes

Strict saprophytes, which can only colonize dead wood, cause decay in fallen logs and standing dead trees. Such fungi usually follow other organisms in the successional pathway and are effective competitors for woody substrates. Trees killed by repeated attacks by defoliators or bark beetles are susceptible to wood borers, secondary bark beetles (those that infest only severely stressed or dead trees), and saprophytic fungi. Decay by saprophytic fungi usually results in a soft outer shell, and decayed trees are prone to losing tops or large branches in wind or when subject to ground vibration. Whether there is more external decay (sap rot) or internal decay (heart rot) depends on what types of fungi become established and where the infection starts. For example, a tree that has a broken top before or shortly after death is more likely to be infected with heart rot than is a tree that remains intact. Dead trees continue to be decayed by saprophytes until they finally collapse.

Witches' Brooms

Dwarf mistletoes are parasitic plants that absorb mineral nutrients, water and carbohydrates from the host. Their presence is marked by witches' brooms and sometimes by swollen cankers on branches or the main stem. Western hemlock, larch, lodgepole pine and Douglas-fir mistletoe produce large, heavy brooms. Although dwarf mistletoes are not usually the primary cause of tree death, they often make host trees more vulnerable to other pathogens. Needle-cast fungi and some species of rust fungi also cause brooming symptoms. Witches' brooms may provide an entry point for decay fungi and may reduce the vigor of host trees. Large brooms and infected branches are prone to breakage.

Large brooms may provide habitat for some species of wildlife. The brooms provide excellent shelter, hiding cover from predators, and good nesting sites. Several research studies have shown that the numbers and varieties of bird species present in stands that were heavily infected by dwarf mistletoe were significantly higher than in uninfected stands.

Several species of mammals, including flying squirrels, marten and fisher, also use brooms. One research study showed that fisher often sleep in dead or live brooms caused by spruce broom rust. (For breeding, fisher prefer to nest in old centre-rotted Douglas-fir, spruce or cottonwood).

On the other hand, mistletoe is responsible for significant levels of mortality and growth reduction in managed forests. Live trees (Class 2) with mistletoe brooms within 20 metres of regenerating commercial forest trees should be carefully managed.

> Death and decay are dynamic processes, but they do not necessarily occur rapidly. Trees may take decades to die and even longer to become decayed enough to be useful to some species of wildlife. Pathogens and trees in various stages of death and decay are important natural components of forest ecosystems.

The Process of Tree Decay

Tree decay is a complex process, about which we still have a lot to learn. While there are several theories concerning decay and its various stages, the scenario outlined below is presented as a reasonable case for what the process could be like.

Stages of Tree Decay

1. The host tree is wounded, with the wound providing a weakened area and hence a suitable infection site for an invading pathogen. The wound might be a broken branch stub, a broken top, a frost crack, or other area on the butt or bole of the tree where the bark has been removed.
2. The exposed wood becomes infected through the successful attack and subsequent establishment of a pathogen. Once established, the pathogen develops microscopic hyphal threads that penetrate between the cell walls of the wood. These threads secrete enzymes that condition and weaken the wood for further hyphal development. As the wood and cell walls weaken and the hyphae continue to grow, they invade the cells and obtain even more nutrients from them.
3. After the pathogen has become well established, a brown, reddish-brown or black stain may appear in the wood. This stain further conditions the wood for subsequent growth and development of the pathogen; in advanced stages it is often a diagnostic tool in identifying the disease. In fact, the common names of some decay fungi are derived from the distinctive color and pattern of stain they impart to the wood.
4. After several years, some triggering mechanism occurs and fungal hyphae, which may now form felts, fans or strands within the wood of the tree, produce fruiting bodies or 'conks' which grow on the branch, branch stubs or on the bole of the tree. Most of the conks associated with the pathogens listed in Table 1 are perennial, persisting for many years and often growing very large. The more numerous the conks and the larger their size, the more decay one can expect to find in the tree. Each conk and associated decay are different. Conks of some decay fungi (e.g., *Fomitopsis cajanderi)* may mean only a little rot is present. The presence of others (e.g., *Fomitopsis pinicola)* means that the host tree is likely already dead.
6. In the advanced stages of decay, the pathogen that originally killed the host tree may fade out, while a secondary pathogen becomes established, overtaking and displacing the primary pathogen.

APPENDIX 2. Users of Wildlife Trees and Level of Dependency

Dependency	Use
1 High	R Reproduction
2 Common	F Feeding
3 Occasional	S Shelter
	^ Artificial

Key

SCU	Secondary cavity user
PCE	Primary cavity excavator
1R	Highly dependent on wildlife trees for reproduction
1R^	Highly dependent on wildlife trees for reproduction, but may use artificial structures when available
IF	Highly dependent on wildlife trees for feeding
1S	Highly dependent on wildlife trees for other needs, such as shelter
1S^	Highly dependent on wildlife trees for other needs, such as shelter, but may use artificial structures when available
2R	Commonly uses wildlife trees for reproduction, but also uses alternative natural sites and/or artificial structures (moderately dependent)
2F	Commonly uses wildlife trees for feeding (moderately dependent)
2S	Commonly uses wildlife trees for other needs, such as shelter (moderately dependent)
3R	Occasionally uses wildlife trees for reproduction (non-dependent)
3S	Occasionally uses wildlife trees for other needs, such as shelter (non-dependent)

Species (including subspecies, varieties and populations) and ecological communities are assigned to provincial lists depending on their Provincial Conservation Status (refer to the BC Conservation Data Centre). Species at Risk (SARA) are also noted where appropriate. Listings are based upon the status in 2022.

Red Listed: Includes any native species or ecological communities that have, or are candidates for, Extirpated, Endangered, or Threatened status in British Columbia. Extirpated species no longer exist in the wild in British Columbia but do occur elsewhere. Endangered species and ecological communities are facing imminent extirpation or extinction. Threatened species and ecological communities are likely to become endangered if limiting factors are not reversed. Not all Red-listed species or ecological communities will necessarily become formally designated. Placing species or ecological communities on these lists flags them as being at risk and requiring investigation.

Blue Listed: Includes any native species or ecological community considered to be of Special Concern (formerly Vulnerable) in British Columbia. Species or ecological communities of Special Concern have characteristics that make them particularly sensitive or vulnerable to human activities or natural events. Blue-listed species or ecological communities are at risk, but are not Extirpated, Endangered or Threatened.

Species	Wildlife Tree Users	Dependency Level	Species Status
Amphibians			
Wandering salamander	lays eggs in rotting wood; feeding site; shelter	2RFS	Blue, SARA
Aquatic Birds			
Great Blue Heron	open nest on large tree limbs	2R	Blue, SARA
Wood Duck	Secondary Cavity User (SCU)	1R^	
Barrow's Goldeneye	SCU	1R^	
Common Goldeneye	SCU	1R^	
Bufflehead	SCU	1R^	
Common Merganser	SCU	2R	
Hooded Merganser	SCU	1R^	
Marbled Murrelet	SCU (old growth/coniferous, if large live trees are wildlife trees)	2R	Blue, SARA
Birds of Prey			
Bald Eagle	open nest on large tree limbs; hunting perch; roost	2RS	
Cooper's Hawk	open nest in live trees, in crotch near main trunk	3R	
Northern Goshawk	hunting perch; nest in largest tree in the stand line	3R	Blue, SARA
Red-tailed Hawk	hunting perch; nest in large trees, often dead tops	2R	
Osprey	open nest on large tree stump and limbs; lookout & feeding perch	1R^2FS	
American Kestrel	SCU; hunting perch	1R^3F	
Great Horned Owl	SCU; nest in broken treetop; hunting perch	2RF	
Barred Owl	SCU; nest in broken treetop and large limbs; winter roost	1R2S	
Spotted Owl	SCU; winter roost (cavity)	1R	Red, SARA
Western Screech-Owl	SCU; winter roost (cavity)	1R^2S	Blue, SARA
Flammulated Owl	SCU	1RS	Blue, SARA
Northern Pygmy-Owl	SCU; winter roost	1R2S	Blue
Northern Saw-whet Owl	SCU; winter roost	1R2S	Blue, SARA
Northern Hawk Owl	SCU; nest in broken treetop; hunting perch; winter roost (cavity)	2RFS	
Boreal Owl	SCU; winter roost	1R2S	

Species	Wildlife Tree Users	Dependency Level	Species Status
Woodpeckers			
Lewis' Woodpecker	Primary Cavity Excavator (PCE) & roost – soft wood; hawking perch; foraging	1RS2F	Blue, SARA
Yellow-bellied Sapsucker	PCE & roost – live trees, sound and soft wood; foraging	1RS	
Red-naped Sapsucker	PCE & roost – live trees, sound and soft wood; foraging	1RS	
Red-breasted Sapsucker	PCE & roost – live trees, sound and soft wood; foraging	1RS	
Williamson's Sapsucker	PCE & roost – sound wood; foraging	1RS	Blue, SARA
Downy Woodpecker	PCE & roost – soft wood; foraging	1RS	
Hairy Woodpecker	PCE & roost – sound or soft wood; foraging	1RS2F	
White-headed Woodpecker	PCE & roost – sound or soft wood; foraging	1RS2F	Red, SARA
Three-toed Woodpecker	PCE & roost – sound or soft wood; foraging	1RFS	
Black-backed Woodpecker	PCE & roost – sound or soft wood; foraging	1RFS	
Northern Flicker	PCE & roost – soft wood; foraging	1RS	
Pileated Woodpecker	PCE & roost – sound wood; foraging	1RFS	
Insectivorous perching birds			
Vaux's Swift	SCU	1R1S	
Tree Swallow	SCU	1R^3S	
Violet-green Swallow	SCU	2R^3S	
Purple marten	SCU	1R^S	Blue
Black-capped Chickadee	PCE – soft wood; opportunistic SCU; foraging; winter roost (cavity)	1R^S	
Mountain Chickadee	PCE – soft wood; opportunistic SCU; foraging; winter roost (cavity)	1R^S	
Boreal Chickadee	PCE – soft wood; opportunistic SCU; foraging; winter roost (cavity)	1RS	
Chestnut-backed Chickadee	PCE – soft wood; opportunistic SCU; foraging; winter roost (cavity)	1R^S	
Red-breasted Nuthatch	PCE – soft wood; occasional SCU; foraging; winter roost (cavity)	1RS	
White-breasted Nuthatch	PCE – soft wood; opportunistic SCU; foraging; winter roost (cavity)	1R^S	
Pygmy Nuthatch	PCE – soft wood; opportunistic SCU; foraging; winter roost (cavity)	1R^S	
Brown Creeper	SCU (behind bark); foraging	1RS	
Western Bluebird	SCU; hawking perch	1R^	
Mountain Bluebird	SCU; hawking perch	1R^	

Species	Wildlife Tree Users	Dependency Level	Species Status
Bats			
California Myotis	nursery/day roost in cavities and behind bark	2RS	
Western Long-eared Myotis	nursery and day roost in cavities and behind bark	2RS	
Little Brown Myotis	nursery and day roost in cavities and behind bark	3RS	Blue
Northern Long-eared Myotis	nursery and day roost behind bark	2RS	
Long-legged Myotis	nursery and day roost in cavities and behind bark	2RS	Blue, SARA
Yuma Myotis	nursery and day roost in cavities and behind bark	2RS	Blue
Hoary Bat	day roost in cavities	3S	Blue
Silver-haired Bat	nursery, day roost, and hibernation site in cavities and behind bark	1RS	
Big Brown Bat	nursery and day roost in cavities	3R2S	
Townsend's Big-eared Bat	unknown	–	Blue
Pallid Bat	day roost in cavities	3S	Red, SARA
Rodents			
Bushy-tailed Woodrat	nest, summer and winter dens in cavities	3RS	
Keen's Mouse	nests in cavity or behind bark; summer and winter dens in cavities	2RS	
Northern Flying Squirrel	nest, summer and winter dens in cavities; cavities used as feeding stations	1RS3F	
Chipmunks	nest and summer den in cavities (Least and Red-tailed are listed)	3RS	Red, Blue
Douglas' Squirrel	nest, summer and winter dens in cavities; cavities used as feeding stations	2RS/3F	
Red Squirrel	nest, summer and winter dens in cavities; cavities used as feeding stations	2RS/3F	
Weasel Family			
Marten	nest, summer and winter dens in cavities	2RS	
Fisher	nest, summer and winter dens in cavities	1R 2S	Red, Blue, SARA
Ermine	nest and summer den in cavities	3RS	
Other Mammals			
Raccoon	nest, summer and winter dens in cavities	2RS	
Black Bear	hibernates in hollow trees and standing dead trees	2RS	
Caribou	feeds on arboreal lichens on old trees and standing dead trees	2F	Red, Blue, SARA

APPENDIX 3. Policy, Regulations and Additional Information

Guiding Regulations

Forest and Range Practices Act (FRPA)

(https://www2.gov.bc.ca/gov/content/environment/natural-resource-stewardship/laws-policies-standards-guidance/legislation-regulation/forest-range-practices-act)
Under FRPA's Government Actions Regulations (GAR), wildlife may be identified as species at risk if they are endangered, threatened or vulnerable. Species that have been identified to date include those whose habitats may be impacted by forest or range practices.

Habitat for identified species at risk may be managed through the establishment of Wildlife Habitat Areas (WHAs) and General Wildlife Measures (GWMs) under the GAR – establishment is guided by the Identified Wildlife Management Strategy. General practice requirements for licensees and tenure holders operating in WHAs are outlined in three planning and practices regulations under FRPA.

Under the Special Tree Protection Regulation, specified trees on Crown land and private land subject to the Forest Act, are protected with a designated supporting tree protection buffer. For more details, refer to the website link: https://www.bclaws.gov.bc.ca/civix/document/id/complete/statreg/229_2020

Park Act (https://www.bclaws.gov.bc.ca/civix/document/id/complete/statreg/96344_01)
Provides for the establishment, classification, and management of parks, conservancies, recreation areas, natural resources, and wildlife (and their habitats) in parks. The Park, Conservancy and Recreation Area Regulation addresses management and protection of park resources (general application).

Land Act (https://www.bclaws.gov.bc.ca/civix/document/id/complete/statreg/96245_01)
The Land Act can be used to establish map reserves to manage habitat or restrict activities that may be harmful to a species' habitat. Land use orders or permits can be included as part of land use planning and strategic agreements.

Wildlife Act (https://www.bclaws.gov.bc.ca/civix/document/id/complete/statreg/96488_01)
The Wildlife Act protects most all vertebrate animals from direct harm, except as allowed by regulation (e.g., hunting or trapping).
Under this legislation, vertebrate species, other than fish, can be legally designated as endangered or threatened – enabling the following additional protections:

- Anyone who kills or harms an endangered or threatened species will receive penalties – conviction could mean a fine of $500,000 and three years in jail
- Habitats for endangered or threatened species can be designated as Critical Wildlife Habitats in Wildlife Management Areas

The Wildlife Act also authorizes direct management of wildlife (e.g., translocation, predator control) or human activities (e.g., recreational vehicle closures) where it is necessary to achieve recovery objectives.

Workers' Compensation Board Occupational Health and Safety Regulation

(https://www.worksafebc.com/en/law-policy/occupational-health-safety/searchable-ohs-regulation/ohs-regulation/part-26-forestry-operations)

Part 26: Forestry Operations and Similar Activities, Section 11: Dangerous trees

(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.

(2) If a risk assessment under subsection (1) determines that a tree poses a risk to a worker, the recommendations made in the risk assessment for eliminating or minimizing the risk must be implemented before the work referred to in that subsection starts.

(3) Despite subsections (1) and (2), if work in a forestry operation is to be carried out in an area that has more than 500 hazardous trees per hectare, the Board may approve a request to work without felling or assessing all the hazardous trees, if before the work starts,

(a) a person who has completed a training program acceptable to the Board conducts a risk assessment of a representative sample of the hazardous trees, and

(b) any recommendations made in the risk assessment for eliminating or minimizing the risks are implemented.

Oil and Gas Activities Act (OGAA)

(https://www.bclaws.gov.bc.ca/civix/document/id/complete/statreg/08036_01)

Similar to FRPA, wildlife species may be identified as at risk under the Environmental Protection and Management Regulation. OGAA includes the same species listed as at risk under FRPA, as well as the WHAs established under that Act.

Government's environmental objectives and species at risk habitat protection are considered in decisions made by the Oil and Gas Commission related to permit applications where permit activities intersect WHAs. Permit conditions can be applied comparable to General Wildlife Measures established under FRPA.

Species at Risk Act (SARA) (https://laws-lois.justice.gc.ca/eng/acts/S-15.3/)

Protects federally listed species at risk from becoming extinct or lost from the wild. The Act covers all species that are listed as being at risk nationally and federally identified critical habitat). See the Species at Risk Public Registry for a list of species and documents.

SARA provides immediate protection to listed species, making it an offence in sections 32 and 33 to:

- kill, harm, harass, capture or take an individual of a listed species that is extirpated, endangered or threatened;
- possess, collect, buy, sell or trade an individual of a listed species that is extirpated, endangered or threatened, or its part or derivative;
- damage or destroy the residence of one or more individuals of a listed endangered or threatened species or of a listed extirpated species if a recovery strategy has recommended its reintroduction.

For a listing of species, visit the website: https://www.cosewic.ca/index.php/en-ca/

Species at Risk all related B.C. legislation.

https://www2.gov.bc.ca/gov/content/environment/plants-animals-ecosystems/species-ecosystems-at-risk/legislation#:~:text=The%20purpose%20of%20this%20act%20is%20to%20provide%20a%20framework,or%20destruction%20of%20fish%20habitat.

BC Species & Ecosystem Explorer

https://www2.gov.bc.ca/gov/content/environment/plants-animals-ecosystems/conservation-data-centre/explore-cdc-data/species-and-ecosystems-explorer

Species at Risk - Federal and Provincial

https://www2.gov.bc.ca/gov/content/transportation/transportation-infrastructure/engineering-standards-guidelines/environmental-management/reference-documents/environmental-regulatory-compliance/species-at-risk-federal-provincial#:~:text=Explanation%3A%20The%20Species%20at%20Risk,necessary%20actions%20for%20their%20recovery.

Accounts and Measures for Managing Identified Wildlife

https://www.env.gov.bc.ca/wld/frpa/iwms/accounts.html

Weblinks to pertinent Acts and Regulations

Special Tree protection regulation

https://www.bclaws.gov.bc.ca/civix/document/id/complete/statreg/229_2020

Heritage Conservation Act

https://www.bclaws.gov.bc.ca/civix/document/id/complete/statreg/96187_01#section1

Workers Compensation Act
https://www.bclaws.gov.bc.ca/civix/document/id/complete/statreg/19001_00

Occupational Health and Safety Regulation
https://www.worksafebc.com/en/law-policy/occupational-health-safety/searchable-ohs-regulation/ohs-regulation

BC Parks Act and Regulation
https://bcparks.ca/about/legislation.html

Migratory Bird and Convention Act and Migratory Birds Regulations
https://www.canada.ca/en/environment-climate-change/services/migratory-birds-legal-protection/convention-act-regulations.html

Forest and Range Practices Act
https://www.bclaws.gov.bc.ca/civix/document/id/complete/statreg/02069_01

Forest Planning and Practices Regulation
https://www.bclaws.gov.bc.ca/civix/document/id/complete/statreg/14_2004

Forest Recreation Regulation
https://www.bclaws.gov.bc.ca/civix/document/id/lc/statreg/16_2004#:~:text=18%20(1)%20A%20person%20using,on%20the%20site%20or%20trail.

Where to get Resource Materials & Additional Guidance

Course Field Cards (FS502e reference and FS502f data cards) can be purchased from the Distribution Centre: 1-800-282-7955

Tree Book: Learning to recognize Trees of British Columbia
https://www.for.gov.bc.ca/hfd/library/documents/treebook/

Common tree diseases of British Columbia. 1996. Allen, E.A.; Morrison, D.J.; Wallis, G. Natural Resources Canada, Canadian Forest Service, Pacific Forestry Centre, Victoria, BC. 178 p. https://cfs.nrcan.gc.ca/publications?id=4633

Forest Pest Identification handbook: Field Guide to Pests of Managed Forests in British Columbia (1983) https://www2.gov.bc.ca/gov/content/industry/forestry/managing-our-forest-resources/forest-health/forest-pests/pest-identification

Wildlife & Trees in British Columbia (2006) by Mike Fenger, Todd Manning, John Cooper, Stewart Guy and Peter Bradford. Lone Pine Publishing.

Tree Wounding and Decay Guidebook
https://www.for.gov.bc.ca/ftp/hfp/external/!publish/FPC%20archive/old%20web%20site%20contents/fpc/fpcguide/Decay/Tw-toc.htm

Tree Wounding and Partial-cut Harvesting
chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/forestry/stand-tending/treewounding.pdf

Guide to identifying Fisher Habitat structures:
https://www.bcfisherhabitat.ca/wp-content/uploads/2021/07/2021_Pictorial-Guide-of-Important-Fisher-Habitat-Structures-in-British-Columbia.pdf

APPENDIX 4. Protecting Public Safety

Policy and Regulations in Developed Areas

There are various policies and regulations pertinent to the management of hazards associated with trees in parks, recreation sites or trails. All of these provide some level of policy direction and/or technical guidance concerning the management of tree hazards to protect the visiting public. As such, they also imply a duty of care on behalf of the Designated Land Manager. It is important that the WHT Assessor ask about specific policies and regulations for the sites being visited and assessed.

NOTE: It is important for WHT Assessors to perform their assessments diligently, using these Wildlife Hazard Tree Assessment Practices and to document and communicate their findings. The Designated Land Manager is responsible to make and implement any risk management strategies in the context of risk reduction priorities, applicable legislation, existing policies and long-term objectives for protecting the public.

Visitor Safety

There is an increased need to manage the safety of people visiting and recreating in parks, recreation sites or trails. The development of a visitor safety policy that covers tree hazard assessment is a prudent step. A safety policy will support managers who must exercise a diligent effort to ensure that all persons and their property are reasonably safe while visiting and enjoying the developed portion of a park, recreation site or trail. Once a visitor safety policy is in place, the Designated Land Manager has a legal responsibility (duty of care) to exercise common prudence while using an established set of procedures (assessment practices) in operating the park, recreation site or trails.

Frequency of Site Assessments

It is mandatory according to the Workers Compensation Act and Occupational Health and Safety Regulations that workers be protected from dangerous trees at a worksite. Therefore, as a minimum, prior to the start-up of any work activity, a current WHT assessment has been conducted and the Designated Land Manager has implemented the hazard mitigation actions. Ideally, the assessment should be conducted relatively close to the timing of work to avoid the risk of weather disturbances creating new hazards, but with sufficient lead time to hire persons to implement the mitigation treatments.

Additionally, the responsibility for public safety should be considered during the management of parks, recreation sites and trails. The frequency of hazard tree inspection will depend on the level of use/exposure (e.g., high use or low use), proximity and type of target (e.g., trail, facility). Thus the frequency of site assessment for public safety will be determined on a site-by-site basis by the Designated Land Manager, and will likely vary seasonally (i.e., with changes in weather and visitor use patterns) and with changes in levels of site disturbance, facilities development, target exposure, and other factors (e.g., tree or stand damage resulting from forest pathogens, windthrow, fire, flooding, landslides/avalanches, or human-caused injury).

Infrequent Inspections

In general, public low-use/low target exposure areas such as low-use trails will require infrequent inspections (e.g., more than a year between assessments depending upon stand health factors and risk management priorities).

Periodic Inspections

Relatively low-use public facilities such as backcountry campsites will require periodic inspections, but if person or property is required to remain in a particular location (e.g., place their tent or cook in a defined space; stop at a viewing platform), then the level of target exposure increases. In these locations the frequency of inspection could be annual (e.g., in the spring, following the winter season and prior to peak summer season use; or more frequently given knowledge of local site conditions) or after major site altering events.

Frequent Inspections

Public areas such as campgrounds, visitor centers, public viewing sites, parking lots, and other buildings, facilities or locations which have high use and/or high target exposure, may require more frequent inspections and assessment for hazardous trees. Again, this will vary site-specifically but could be biannual (i.e., every 6 months, spring and autumn) or annual. The Designated Land Manager who is familiar with the site and local area, and informed by the WHT Assessor, will make the decision about the frequency of assessments.

Timing to Implement Operational Procedures

Timing of the assessments as determined by the Designated Land Manager, but informed by the WHT Assessor, must permit time for implementing mitigation actions with minimal conflict (e.g., avoid scheduling tree removals during active nesting seasons). Once a tree has been declared to be dangerous then a mitigation plan must be implemented as soon as possible with the appropriate action (e.g., fell tree, remove hazardous part(s), move the target, close the area).

Visitor Exposure

Various human activities can result in differing levels of exposure to potentially hazardous trees. Activities rated as very low risk, such as hiking along a trail, have low exposure time to potential hazards (i.e., people are present at a single location for only a brief period). As a result, the visitors are exposed to very little risk. With increases in visitor exposure there is a corresponding increased risk that a tree failure, whole or part, could impact the public. The WHT Assessor will refer to Table 1 to guide the selection of visitor exposure levels and confirm this with the Designated Land Manager.

The following table shows the levels of visitor exposure rankings that were initially developed by BC Parks and have been broadly adopted by many managers of parks, recreation sites and trails in BC. For each level of exposure there is a corresponding reference to the Tree Hazard tables (3, 4, 4A) that are similarly used for worksite tree assessments. In consultation with the Designated Land Manager, the WHT Assessor will confirm the appropriate level of exposure prior to undertaking the tree assessments. Deviations from the examples in Table 1 will occur when the Designated Land Manager is managing the risks and timing intervals between assessments. For example, a maintained road may be assessed to higher scrutiny using LOD2 when faced with uncertain funding for tree mitigation. Assessing to a higher standard would likely result in more tree removals but may provide a reprieve from tree mitigation over the next 1-2 years.

Table 1. Levels of exposure risk

Level of Exposure Risk*	Example Types of Visitor Exposure in Developed and Actively Used Areas
Very Low Risk (No annual WHT Assessment)	• Unmaintained hiking trails (e.g., Backcountry trails) and footpaths • Road travel by light vehicle (ATV/UTV), horseback and cycling
1 - Low (Tree Hazard Table 3)	• Maintained trails (front-country) & trails with designated lookouts and viewpoints • Hiking trails with interpretive signs • Motorized trail use (ATV/UTV, snowmobile) • Rest stops alongside hiking trails • Wheelchair trails & high-use trails (e.g., large tour bus groups)
2 - Moderate (Tree Hazard Table 4)	• Parking lots (paved or compacted roads) • Day use picnic sites • Public beach/swimming areas • Roadside viewpoints, rest stops • Portable/temporary toilet facilities • Portable/seasonal kiosks • RV sani-stations
3 - High (Tree Hazard Table 4a)	• Campgrounds and permanent amenities • Developed Playgrounds (e.g., swings, slides, etc) • Permanent buildings/facilities and engineered bridges

* A hazardous tree assessment is only valid for the lowest level of exposure at which the assessment has been done.

APPENDIX 5. TREE ASSESSMENT FIELD DATA FORMS (SAMPLE)

HAZARD TREE ASSESSMENT FIELD DATA – PARKS

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Assessor's Name: J Doneit | Date:

Park, Rec Site or Trail: Name of Place | Location: Somewhere, BC | Certificate # P0000 | Map Attached (Y or N): Yes

Type of Facility: Year-Round Campground | Target Description: Camping pads, amenities and dock

Type of Activity: Camping, Day-use picnic, Boating and Fishing | LODE: 3

						LODE = 1			LODE = 2, 3 or 4															Tree Comments				Hazard Tree Management Plan				
						From Table 3			From Table 4 or 4A or 5									Detailed Assessment														
Tree #	Species	Tree Class	Tree Height (m)	Diameter (cm)	Distance to Target (m)	Insecurely lodged or hung up limbs/tops = D	Highly unstable stem = D	Recent lean with unstable roots = D	Tree Defects (S = defects rated safe; D = defects rated dangerous; / = absent; ? = needs detailed assessment)									DSH (cm)	RST (radius x 0.3)	AST (cm)	Stem (S or D)	Roots (S or D)	Overall Rating (S or D)	Tree Significance Value (L, M, H)	Wildlife Uses (CN, F, P, ON, M, R; Other)	Recreational Attraction?	Culturally Significant?	Safe / No action	Dangerous - Fall Tree	Dangerous - Modify Tree	Dangerous - Move Target/ Install NWZ	Treatment Recommendations
									DT	DL	WB	ST	SD	SB	CA	CM	TL	RI													
1	Fd	2	35	80	5				S	D	-	-	?	-	-	?	-5	S	80	12	18	S	-	D	H	CN	No	No			X		Remove 8m
2	Pl	2	22	42	10				S	S	-	-	S	-	S	-	0	-						S	L	F	No	No	S				
3	At	3	18	34	12				-	S	-	-	?	-	S	D	0	S	34	5.1	5.3	S	-	D	H	CN	No	No			X		Remove 5m

Field Marking Method: Numbered tag

Notes: #1 - CN in dead top #3 - CN at dead secondary top

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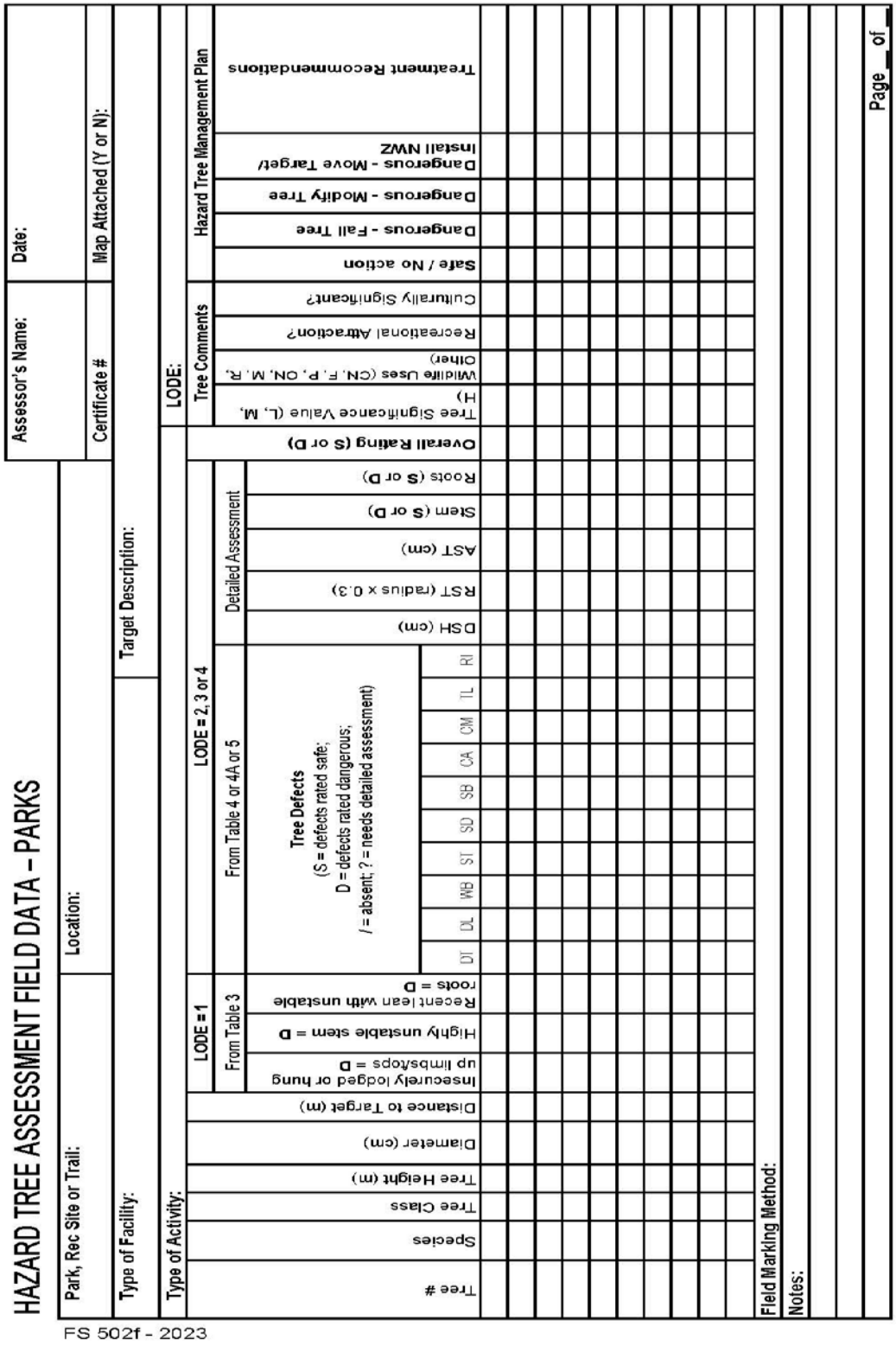
The sample field data card illustrates some basic conventions that can be used to consistently document observations and assessment results made during the assessment of wildlife or hazardous trees. In this example, trees were assessed for a campground. This activity is recorded as a LODE-3.

The visual tree assessment details are recorded according to the corresponding category of exposure. If needed, record each visible defect as either "S" (Safe), "D" (Dangerous hazard), or use a "?" to indicate that the visual hazard rating for the defect is inconclusive and a detailed assessment was used. For tree lean, consider recording the percentage of lean with a "+" to indicate the lean is away from the target, and a "-" to indicate the lean is towards the target. Alternatively, one could simply record whether the lean was safe or dangerous according to the hazard criteria associated with the respective LODE.

Detailed assessment results can be recorded for trees where visual assessment was inconclusive or for trees where a more thorough assessment was made to determine the extent of damage. Record the diameter at sample height (DSH) to correspond to the location where increment cores were taken.

The overall rating for a tree will be "S" if all defects rate as safe. If any defect is found to be hazardous, then the tree is recorded as Dangerous (D) for the LODE being assessed. The WHT Assessor must then document the management action proposed. Use the "Comments" section to record other pertinent details about the tree and its features that will enable the site manager to select the appropriate treatment methods.

Appendix 5. TREE ASSESSMENT FIELD DATA FORM (BLANK)



HAZARD TREE ASSESSMENT FIELD DATA – PARKS

Park, Rec Site or Trail:	Location:	Assessor's Name:	Date:
Type of Facility:	Target Description:	Certificate #	Map Attached (Y or N):

Type of Activity: LODE:

Tree #	Species	Tree Class	Tree Height (m)	Diameter (cm)	Distance to Target (m)	LODE = 1	LODE = 2, 3 or 4																Tree Comments	Hazard Tree Management Plan
						From Table 3	From Table 4 or 4A or 5								Detailed Assessment									
						Recent tear with unstable roots = D	Tree Defects (S = defects rated safe; D = defects rated dangerous; / = absent; ? = needs detailed assessment)								DSH (cm)	RST (radius x 0.3)	AST (cm)	Stem (S or D)	Roots (S or D)	Overall Rating (S or D)	Tree Significance Value (L, M, H)	Wildlife Uses (CN, F, P, ON, M, R, Other)	Recreational Attraction?	Culturally Significant?	Safe / No action	Dangerous - Fall Tree	Dangerous - Modify Tree	Dangerous - Move Target/ Install NWZ	Treatment Recommendations
						Highly unstable stem = D	Insecurely lodged or hung up limbs/tops = D	DT	DL	WB	ST	SD	SB	CA	CM	TL	RI											

Field Marking Method:

Notes:

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Appendix 5. TREE ASSESSMENT FIELD DATA FORM (SITE OVERVIEW)

SITE ASSESSMENT OVERVIEW – PARKS & NATURAL AREAS

NAME:	DATE:
LOCATION/PARK NAME:	LEVEL(S) OF DISTURBANCE:

SITE DESCRIPTION & HISTORY

Targets - infrastructure	
Targets – people/user patterns	
Describe adjacent lands/targets	
Topography & aspect	
Recreational attractions	
Cultural and heritage features	
Access (pickup, ATV, foot)	
Frequency / Timing of Assessments	
Construction history and future plans	

TREE & STAND FACTORS

Tree species mix by %	
Range of tree heights	
Range of tree diameters	
Estimated tree ages (range)	
Estimated crown closure by %	

SITE HAZARDS

Shallow/saturated soils	
Steep, unstable terrain	
Prevailing winds, windthrow risk	
Areas of high or recent exposure	
Other site hazards (explain)	

COMMON TREE PATHOGENS / CAUSE OF FAILURE

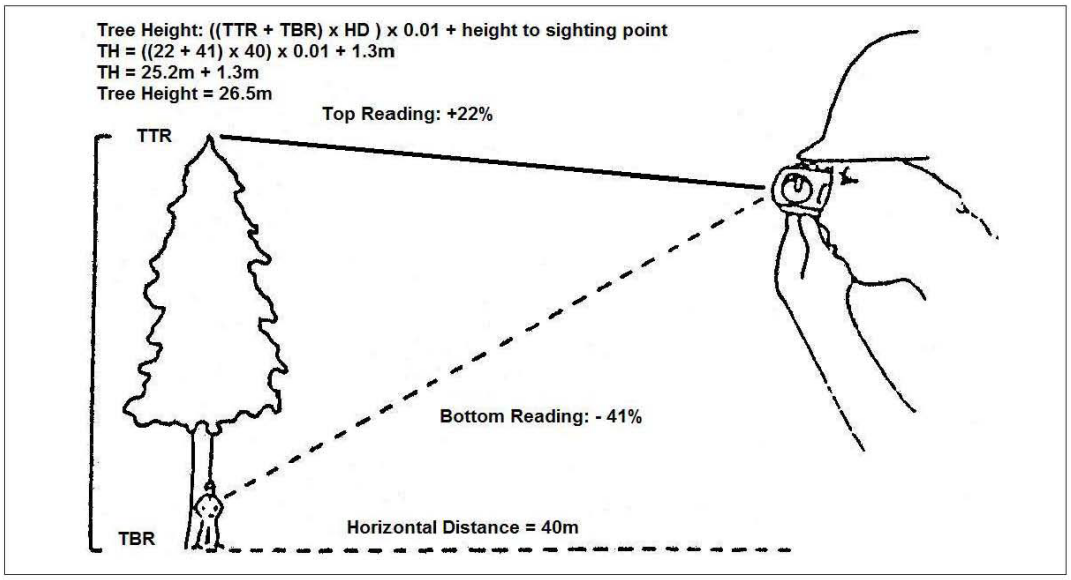
Recent/past tree failure(s)	
Roots: damage, defects or decay	
Stems: damage, defects or decay	
Crown: damage, defects or decay	
Recent wind damaged trees	
Other issues (describe)	

WILDLIFE TREES

Wildlife tree uses observed	
Wildlife tree attributes	
WT decay class distribution by %	
Coarse woody debris classes by %	
Long-term tree mgmt plan	
Other special features (describe)	

Appendix 6. FIELD PROCEDURE GUIDES

Measuring Tree Heights



The most common tool for measuring tree height is the Suunto clinometer. The 'clino' works on a pendulum principle and measures the angles to the top and to the base of the tree.

When these measurements are combined with a measured distance to the tree, the height of the tree can be calculated.

The Suunto makes it possible for you to estimate tree height based on two quick readings of the slope lines from your eye to the top and bottom of the tree.

To use the Suunto, hold it to your right eye and watch the internal movable scale, while looking at the target tree with your left eye. Tilt the instrument until you can see the top of the tree, and read the right hand side of the scale (in %). Make note of the reading, then tilt the instrument to the 'base' of the tree (actually, at dbh) and record the reading. Measure the horizontal distance you are from the tree, then calculate the tree height according to the following formula:

Tree height = (TTR + TBR) x HD x .01

where TTR = Tree top reading (%)

TBR = Tree bottom reading (%) *

HD = Horizontal distance from tree **

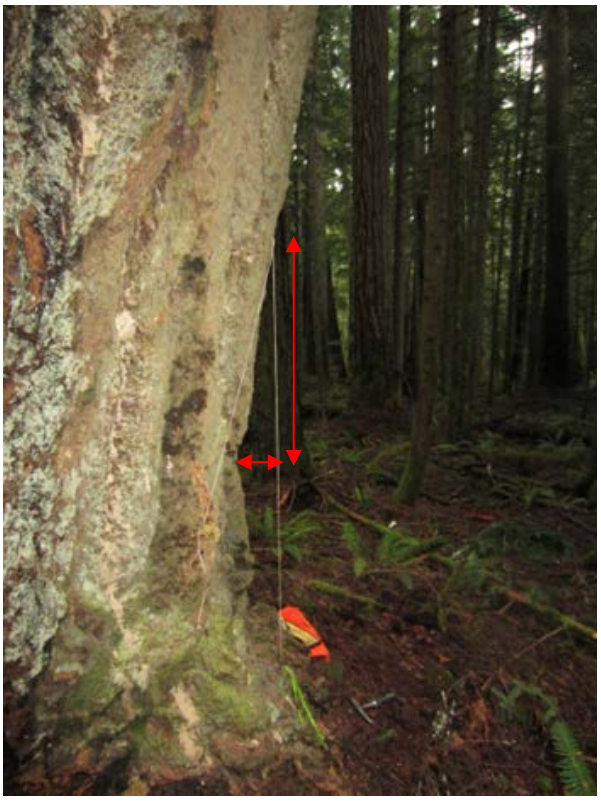
* Tree bottom readings are usually a negative %; ignore the negative sign and add the bottom % measurement to the top % measurement. In cases where you are looking uphill to sight both the top and bottom of the tree, and both % readings are positive, subtract the tree bottom % reading from the tree top % reading.

** Remember to derive the horizontal distance using slope tables.

Measuring Tree Lean

When the WHT Assessor finds a tree that is leaning, firstly, consider whether the lean is recent or long-standing. If the tree has recently shifted there should be evidence at the root collar. Look for separation between the tree's root collar and the forest floor (duff) and sign of root collar damage. If there is a noticeable change then look for signs of root plate lift. This is done by reviewing the forest floor on the tension side of the tree as far out as the canopy drip line. A tree that has recently shifted will have little to no evidence of adaptive growth (top curl, fluting of the bole, reinforcement growth beams (bulges) along the stem). Dead trees should always be considered for lean because their roots are undergoing deterioration since death (and maybe before death in the case of root damaged or diseased trees).

Use a carpenter tape or a plumb-bob and hold the tape or string against the stem of the tree beneath the lean. Measure the distance between the stem and the body of the carpenter tape or plumb-bob. This distance divided by the length of the tape/plumb line x 100 will give you the % lean of the tree. The WHT Assessor then uses this %lean value and root inspection details to determine the failure potential using the tree hazard tables.



Use a carpenter tape or a plumb-bob and hold the end of the tape or plumb-bob string against the stem of the tree beneath the lean. Measure the distance between the stem and the body of the carpenter tape or plumb line. This distance divided by the length of the tape/plumb line x 100 will give you the % lean of the tree. The WHT Assessor then uses this %lean value and root inspection details to determine the failure potential using the appropriate tree hazard tables.

In this example, the plumb line is 60cm long and the swing distance is 10cm. % Lean is (10/60)x100 = 16.7%

SLOPE CORRECTION TABLE

To get horizontal distance, multiply slope distance by this factor.

Percent Slope (%)	Factor	Percent Slope (%)	Factor	Percent Slope (%)	Factor	Percent Slope (%)	Factor
1	1	26	0.968	51	0.891	76	0.796
2	1	27	0.965	52	0.887	77	0.792
3	1	28	0.963	53	0.884	78	0.789
4	0.999	29	0.960	54	0.880	79	0.785
5	0.999	30	0.958	55	0.876	80	0.781
6	0.998	31	0.955	56	0.873	81	0.777
7	0.998	32	0.952	57	0.869	82	0.773
8	0.997	33	0.950	58	0.865	83	0.769
9	0.996	34	0.947	59	0.861	84	0.766
10	0.995	35	0.944	60	0.857	85	0.762
11	0.994	36	0.941	61	0.854	86	0.758
12	0.993	37	0.938	62	0.850	87	0.754
13	0.992	38	0.935	63	0.846	88	0.751
14	0.99	39	0.932	64	0.842	89	0.747
15	0.989	40	0.928	65	0.838	90	0.743
16	0.987	41	0.925	66	0.835	91	0.740
17	0.986	42	0.922	67	0.831	92	0.736
18	0.984	43	0.919	68	0.827	93	0.732
19	0.982	44	0.915	69	0.823	94	0.729
20	0.981	45	0.912	70	0.819	95	0.725
21	0.979	46	0.908	71	0.815	96	0.721
22	0.977	47	0.905	72	0.812	97	0.718
23	0.975	48	0.902	73	0.808	98	0.714
24	0.972	49	0.898	74	0.804	99	0.711
25	0.97	50	0.894	75	0.800	100	0.707

Source: BC Ministry of Forests and Range, Forest Practices Branch. Aug. 9, 2005. How to Determine Site Index in Silviculture.

Increment Boring: Field Methods

Increment boring is performed to:

- determine the age of standing trees;
- measure the tree growth rate;
- check for tree defects in stems and roots;
- check chemical penetration of treated wood products;
- test the condition of wooden structures

Your primary field tool will be the increment borer. They are manufactured by several companies (e.g., Haglof, Suunto, Timberline, Mattson), but all contain the same three components (from top to bottom): a handle, a bit, and a core retriever (extractor). They are sold in various bit lengths ranging from 4" to 28". The components nest together for easy packing. When in use, the bit is inserted into the handle and twisted into the tree (always keep the extractor out of the bit and in a safe place while coring).

The tip of the increment borer is threaded to help pull the hollow bit into the tree. Thread styles on the bit may vary from 2 to 3 thread types. The sharpened surface of the leading edge MUST be protected from damage at all times. The consequences of a dull bit are varied and can range from mild to extreme. A severely nicked or damaged bit cannot be re-sharpened and must be replaced. The diameter of the core of wood is determined by the inside diameter of the opening of the threaded end of the bit and may range from 5.0 mm to 12.0 mm.

Assemble the coring tool by inserting the bit into the handle and closing the locking mechanism. BE SURE TO REMOVE THE EXTRACTOR! To begin coring, hold the bit just behind the threads and lean into the borer to provide as much body pressure as possible. Slowly turn the bit until the threads have become fully engaged.

After the threads have engaged, you may step back from the increment borer and in a clockwise motion, turn the handle. The bit will proceed into the tree and should be held at a 90-degree angle. Hardwoods (e.g., oak) will require a considerable use of strength and energy. DO NOT EXTEND THE HANDLE TO GAIN LEVERAGE OR USE A POWER DRILL!

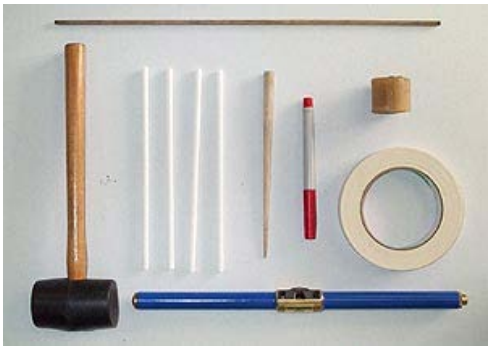
If you hit a rot pocket (you will know immediately because of the ease of turning), back out immediately or else your bit may be incredibly difficult to remove.

Your goal with WHT Assessing is to core the tree slightly past the RST calculated for the stem. On live trees, drilling too far may contribute to compromising the tree's natural process of compartmentalizing decay. To gauge your depth at any given time, you can hold the extractor up to the side of the tree (it is the same length as the bit and will inform you of your progress).

When the proper depth has been achieved, back the bit out one full turn, then insert the extractor with the edges turned upside down (∩) into the hollow increment corer bit, at a slight angle applying upward pressure. Insert the extractor to its full length (depending upon the species, this may require that you apply some pressure with the heel of your hand near the end). NEVER drive the extractor in with a hammer or other implement.

Then turn handle ½ turn backwards, causing the extractor edges to point up (∪). SLOWLY withdraw the extractor from the increment handle and you should retrieve an intact core with the serrated tip holding it in place. Remove your borer from the tree as soon as possible to prevent it from being "frozen" in the tree. Current wisdom suggests that the hole you left will scar over quickly and no attempt should be made to treat or plug the hole with any type of substance or object. Just leave it be. If you experience twisting or breaking of the cores, try cleaning and oiling the borer bit (inside and out). Some follow this practice every few cores to reduce core problems.

Immediately place the core into a paper drinking straw, seal the ends, and mark the straw with the sample ID number (this should code to your field data sheets that contain additional information about the tree and site). Be sure not to loose any pieces. If the core breaks, maintain the order of the pieces in the straw. Store the straws in a protective container while in the field (such as a map tube).



Shown here is a collection of basic field tools you will need. They include the INCREMENT BORER, PAPER STRAWS (for core storage), MARKER PEN, MASKING TAPE (for joining two or more straws together for long cores), BEESWAX (to rub on borer tip to facilitate boring), 2 WOODEN DOWEL RODS and a RUBBER MALLET to free pieces of wood that may become entrapped in borer bit (this is a common occurrence). A wooden golf tee works well for dislodging material at the tip of the borer bit.

You should always keep a cleaning kit within easy reach (field or office). Use a cleaning rod designed for .22 caliber rifles with a plastic tip insert that holds either some steel wool or a small cotton pad (both of which should be soaked in WD-40 or equivalent spray lubricant or rust inhibitor). All bits should be sprayed with WD-40 inside and out prior to storage and minimally after every day of use. Cleaning the bits after every few trees is a good idea. Store and transport the bit inside the handle with a plastic cap over its end.

Source: WHTAC – Ministry of Transportation and Highways. 2003.

British Columbia Tree Code List

NATIVE CONIFERS

Cedar	**Thuja**	**C**
western redcedar	*T. plicata*	Cw
Cypress	**Callitropsis**	**Y**
yellow-cedar	*C. nootkatensis*	Yc
Douglas-fir	**Pseudotsuga**	**F**
Douglas-fir	*P. menziesii*	Fd
coastal Douglas-fir	*P. menziesii* var. *menziesii*	Fdc
interior Douglas-fir	*P. menziesii* var. *glauca*	Fdi
Fir (Balsam)	**Abies**	**B**
amabilis fir	*A. amabilis*	Ba
grand fir	*A. grandis*	Bg
subalpine fir	*A. lasiocarpa*	Bl
Hemlock	**Tsuga**	**H**
mountain hemlock	*T. mertensiana*	Hm
western hemlock	*T. heterophylla*	Hw
mountain x western hemlock hybrid	*T. mertensiana x heterophylla*	Hxm
Juniper	**Juniperus**	**J**
Rocky Mtn. juniper	*J. scopulorum*	Jr
seaside juniper	*J. maritima*	Js
Larch	**Larix**	**L**
alpine larch	*L. lyallii*	La
tamarack	*L. laricina*	Lt
Western larch	L. occidentalis	Lw
Pine Pinus	**P**	
jack pine	*P. banksiana*	Pj
limber pine	*P. flexilis*	Pf
lodgepole pine	*P. contorta*	Pl
lodgepole pine	*P. contorta var. latifolia*	Pli
lodgepole x jack pine hybrid	*P. x murraybanksiana*	Pxj
ponderosa pine	*P. ponderosa*	Py
shore pine	*P. contorta var. contorta*	Plc
Western white pine	*P. monticola*	Pw
whitebark pine	*P. albicaulis*	Pa
Spruce	**Picea**	**S**
black spruce	*P. mariana*	Sb
Engelmann spruce	*P. engelmannii*	Se
Sitka spruce	*P. sitchensis*	Ss
white spruce	*P. glauca*	Sw
spruce hybrid	*Picea cross*	Sx
Engelmann x white	*P. engelmannii x glauca*	Sxw
Sitka x white	*P. x lutzii*	Sxl
Sitka x unknown hybrid	*P. sitchensis x ?*	Sxs
Yew Taxus	**T**	
Western yew	*T. brevifolia*	Tw

NATIVE HARDWOODS

Alder	**Alnus**	**D**
red alder	*A. rubra*	Dr
Apple	**Malus**	**U**
Pacific crab apple	*Malus fusca*	Up
Arbutus	**Arbutus**	**R**
Arbutus	*A. menziesii*	Ra
Aspen, Cottonwood or Poplar	**Populus**	**A**
poplar	*P. balsamifera* + trichocarpa	Ac
balsam poplar	*P. b.* ssp. *balsamifera*	Acb
black cottonwood	*P. b.* ssp. *trichocarpa*	Act
hybrid poplars	*P.* ssp. x *P.* ssp.	Ax
trembling aspen	*P. tremuloides*	At
Birch	**Betula**	**E**
Alaska paper birch	*B. neoalaskana*	Ea
Alaska x paper birch hybrid	*B.x winteri*	Exp
paper birch	*B. papyrifera*	Ep
water birch	*B. occidentalis*	Ew
Cascara	**Rhamnus**	**K**
cascara	*R. purshiana*	Kc
Cherry	**Prunus**	**V**
bitter cherry	*P. emarginata*	Vb
choke cherry	*P. virginiana*	Vv
pin cherry	*P. pensylvanica*	Vp
Dogwood	**Cornus**	**G**
Pacific dogwood	*C. nuttallii*	Gp
Maple	**Acer**	**M**
bigleaf maple	*A. macrophyllum*	Mb
vine maple	*A. circinatum*	Mv
Oak Quercus	**Q**	
Garry oak	*Q. garryana*	Qg
Willow	**Salix spp.**	**W**
Bebb's willow	*S. bebbiana*	Wb
Pacific willow	*S. lucida*	Wp
peachleaf willow	*S. amygdaloides*	Wa
pussy willow	*S. discolor*	Wd
Scouler's willow	*S. scouleriana*	Ws
Sitka willow	*S. sitchensis*	Wt
UNKNOWNS		
Unknown		X
Unknown conifer		Xc
Unknown hardwood		Xh
OTHERS		
Other tree, not on list		Z
Other conifer		Zc
Other hardwood		Zh

ADDITIONAL NOTES:

WHTAC – Parks, Recreation Sites & Trails

Table 1. Levels of Disturbance and Exposure (LODE)

Level of Disturbance & Exposure Risk	Example Types of Work Activities	Example Types of Visitor Exposure in Developed and Actively Used Areas
Very Low Risk (No Pre-work WHT Assessment)	• Forest surveys and reconnaissance, trail layout, foot travel (heads up work) • General light vehicle travel on roads (pickups, ATV/UTV, snow sleds)	• Unmaintained hiking trails (e.g., Backcountry trails) and footpaths • Road travel by light vehicle (ATV/UTV), horseback and cycling
1 – Low (Tree Hazard Table 3) <40km/hour Windspeed	• Maintenance of developed areas: repairing, replacing, installing infrastructure with hand tools; cleaning, painting, firewood bucking, landscaping, brushing/pruning, lawn mowing • Brushing & Weeding (e.g., removing invasive plants, trimming overgrown areas) • Trail construction with hand tools • Use of light-duty machinery (e.g., weed whips, brush saws, lawnmowers) • Road travel with heavy vehicles (>5500 kg GVWR) on a constructed and maintained road • Fire control with hand tools and/or water hoses	• Maintained trails (front-country) & trails with designated lookouts and viewpoints • Hiking trails with interpretive signs • Motorized trail use (ATV/UTV, snowmobile) • Rest stops alongside hiking trails • Wheelchair trails & high-use trails (e.g., large tour bus groups)
2 – Moderate (Tree Hazard Table 4) <40km/hour Windspeed	• Road travel with heavy vehicles (>5500kg GVWR) on a trail or overgrown road • Maintenance or construction activities without heavy equipment (e.g., small machines such as “bobcats”) • Tree pruning (stems >20 cm dbh) • Juvenile spacing or slashing (stems <15 cm dbh) • Tree bucking (e.g., bucking windfalls, felled trees)	• Parking lots (paved or compacted roads) • Day use picnic sites • Public beach/swimming areas • Roadside viewpoints, rest stops • Portable/temporary toilet facilities • Portable/seasonal kiosks • RV sani-stations
3 – High (Tree Hazard Table 4a) 40 - 65 km/hour Windspeed	• Maintenance or construction activities with heavy equipment (including rubber tire backhoe where digging could affect tree root systems/stability) • Use of light and intermediate lift helicopters where workers are exposed to rotor wash • Tree falling (does not include hazard tree removal) and log removal (any tree >15 cm dbh)	• Campgrounds and permanent amenities • Developed Playgrounds (e.g., swings, slides, etc) • Permanent buildings/facilities and engineered bridges
4 – Very High (Tree Hazard Table 5) >65km/hour Windspeed	• Land clearing operations in structurally damaged stands (e.g., wildfire burns, extensive windthrow) • Use of medium and heavy lift helicopters where workers are exposed to rotor wash (e.g., slinging bridges and materials, landing sites)	

* A wildlife hazard tree (WHT) assessment is only valid for the lowest LODE at which the assessment has been done.

** VLR activities are based upon the expectation that workers have been trained and mentored how to be situationally aware of the hazards expected in their workplace under a variety of forest and weather conditions.

*** If trees CANNOT be safely felled and yarded away from adjacent standing timber (i.e., there is a chance that felled or yarded timber will strike adjacent standing "leave timber"), then default to LODE 4.

**** Does not include dangerous tree falling for tree hazard mitigation. Falling of dangerous trees does not require reassessment to LODE 3; the falling process must be in accordance with the BC Faller Training Standard and adherence to safe falling practices.

Table 1A. Influence of Wind Speed on Level of Disturbance (worker safety)

Wind Speed (km/h)	Description	Level of Disturbance Equivalency
0 – 20	**light breeze** (dust and loose paper raised; small branches move)	1 – 2
20 – 40	**fresh breeze** (small trees sway; tops of large trees sway)	
40 – 65	**strong breeze** (small branches fly in the air; whole tree in motion; resistance felt when walking against wind)	3
65+	**gale** (branches broken off trees; walking impeded)	4

Table 1B. Helicopter Types

Helicopter Category	Passenger Capacity	Lift Capacity
Type 1 (Heavy)	15+	Exceeds 2720 kg (6000 lbs)
Type 2 (Medium)	9 – 14	1135 – 2720 kg (2500 – 6000 lbs)
Type 3 (Intermediate)	5 – 8	680 – 1134 kg (1500 – 2500 lbs)
Type 4 (Light)	1 – 4	Not exceeding 680 kg (1500 lbs)

The following listing provides examples of common aircraft by helicopter type, and is a useful guide when determining the appropriate level of disturbance for the type of aircraft being used.

Light Category: Jet Ranger (Bell 206), Hughes 500, Hiller 12, EC 120, R22 & R44

Intermediate Category: Long Ranger, A-Star (AS350), Bell 407, EC 130

Medium Category: K-Max, Bell 204, 212, 205

Heavy Category: Bell 214, Kamov, Sikorsky 61 & 64, BV 107 & 234

What is a Hazardous Tree?

A tree (live or dead) with structural defects that could fail (whole or part) and cause injury to people, or damage to facilities or property.

What is a Dangerous Tree? defined in the *Occupational Health and Safety Regulation* s. 26.1

A dangerous tree means a tree (live or dead, regardless of size) that is a hazard to a worker (including public and facilities) due to:

a) its location or lean,
b) its physical damage,
c) overhead hazards,
d) deterioration of limbs, stem or root system, or
e) any combination of the conditions in paragraphs a) to d) above.

Steps Required to Determine Tree Danger Rating:

1. **Determine the level of ground disturbance and visitor exposure** (refer to Tables 1, 1A, 1B)
2. **Conduct a site assessment overview** (refer to Table 2)
3. **Conduct tree assessments** (refer to Tables 3, 4, 4A and 5)
4. **Make the appropriate safety recommendation** (Safe or Dangerous)
5. **Provide documentation and communicate safety procedure**

Summary of Assessment Requirements

All work activities EXCEPT those defined as "very low risk" require a pre-work inspection by a qualified person to determine if there are any trees that might endanger workers. A summary of activity level assessment requirements is shown below.

- **Very Low Risk (VLR) Activities** – No pre-work site inspection or WHT assessment is required.
- **Level 1 Disturbance Activities** – A pre-work inspection by a qualified person is required. If trees with significant tree hazards (see Table 3) are observed, the appropriate safety procedures must be taken before work activities begin. A certified WHT assessor is required for structurally damaged stands or high stem density (>500sph) stands of suspect hazard trees.
- **Level 2, 3 or 4 Disturbance Activities** – A pre-work inspection by a qualified person is required. If "suspect" hazard trees (see Table 4, 4A, 5) are identified by a qualified person, then further assessment by a certified WHT assessor is required and the appropriate safety procedures must be taken BEFORE work activities begin.

Common Tree Species Name and Codes

Tree Species	Code Symbol	Tree Species	Code Symbol	Tree Species	Code Symbol
Douglas -fir	Fd	Sitka spruce	Ss	Western redcedar	Cw
Western larch	Lw	Spruce hybrid	Sx	Yellow cedar	Yc
Lodgepole pine	Pl	Black spruce	Sb	Black cottonwood	Act
Yellow pine (Ponderosa pine)	Py	Subalpine fir	Bl	Trembling aspen	At
Western white pine	Pw	Amabilis fir	Ba	Paper birch	Ep
White spruce	Sw	Grand fir	Bg	Red alder	Dr
Engelmann spruce	Se	Western hemlock	Hw	Bigleaf maple	Mb

Table 2. Site Assessment Overview (for all tree species)

Site/Stand Factors	Hazard Indicators / Influences
Stand history and condition	• evidence and patterns of past tree failure, history of tree mitigation • disturbance history (natural or human-caused, including wildfire damage, year of site construction) • general tree species age, condition and density • evidence and type of wildlife tree use, presence of culturally significant trees or trees of special recreation attraction • evidence of root and/or stem diseases
Common rain, snow and ice conditions	• high snow or ice loading • high rain fall periods
Flooding	• high water table • evidence of water damaged/decayed roots • area prone to flooding
Windthrow potential	• topography and prevailing wind directions • evidence of significant windthrow • area of high or recent exposure • stems with height/diameter ratio >100 or small live crown (<20% tree height) (i.e., very tall, slender stems) • saturated soils • fine textured soils • shallow soils and restricted rooting depth
Crown condition (i.e., common root disease indicators)	• stress cone crop • thinning foliage and/or chlorosis • rounded crown
Resinosis	• higher than normal stem or basal pitch flow (e.g., from butt rot, mechanical stem damage, root disease)
Tree lean	• trees recently leaning due to windstorm, root damage, shifting root mat or other causes
Additional site-specific factors	• based on local knowledge (e.g., soil or slope instability)

Table 3. Hazardous Tree Assessment Process for Level 1 Disturbance & Exposure – Significant Hazard Indicators

D = Dangerous Hazard	**D if tree has one or more of the following significant tree hazard indicators that are at risk of imminent failure*:** • **Insecurely lodged trees or insecure hang-ups:** i) Insecurely lodged trees (a tipped tree that is likely to shake free of the support trees and fall to the ground); **or** ii) Dislodged but hung-up limbs or tops (consider size and height above ground) at risk of shifting free during light winds or other tree motion • **Highly unstable tree:** Examples: i) >50% tree cross-sectional area damaged or decayed; **or** ii) Spongy snags with heart rot conks along the majority 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** iii) >50% lateral roots damaged or with advanced decay • **Recent lean** toward 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

* Imminent failure: there is a high likelihood of failure during the operational period while workers are exposed, or expected to fail within recurring WHT assessment intervals.

Guide to Tree Significance Value

Tree Significance Value	Characteristics
HIGH	• A tree with rare or uncommon habitat characteristics for the site. (e.g., large brooms, cavities, loose bark, dead tops, broken tops, perch site) • A culturally modified tree (CMT) • A tree protected by policy or special management practices (e.g. Special Tree, monumental trees, veteran trees, etc.) • Tree with active or recent wildlife use (feeding, nesting, denning, perching, roosting, etc.) • Tree structure suitable for wildlife use (suitable for large stick nest, hunting perch sites, bear den, fisher den, etc.) • Largest tree for site (height and/or diameter) or rare tree species • Habitat characteristics suited for locally important wildlife tree user species
MEDIUM	• Large, stable trees that will likely develop into a wildlife tree (e.g., recent split, broken top, death from insects) • A wildlife tree that has deteriorated and has diminishing viability for continued use
LOW	• Trees not covered by high or medium categories • Trees which are highly unstable and unlikely to remain standing beyond an operational period (e.g., advanced root disease, leaners, soft wood decay class)

Wildlife Tree Uses: The following codes can be used to document types of recent uses observed:
CN – Cavity Nest **ON** – Open nest **F** – Feeding **M** – Mark tree **D** – Denning **P** – Perching **R** – Roosting

Safety Procedures *for "suspect" hazard trees that have been assessed*

S = Safe	**tree safe to work around, retain tree — no removal or modification necessary:** • record tree as **Safe** (numbered tag, paint dot or numbered flagging if required) • monitor tree • recommend treatment with low-risk defects while tree is safe to mitigate
D = Dangerous	**manage tree:** • record tree as **Dangerous** (affix tag, paint or flagging if required) • fall tree • remove dangerous part(s) of tree • install flagged no-work zone (Hazard Area) • inform workers of location of no-work zones and trees marked as **Dangerous** • modify target or facility (prevent exposure)
Alternate Safety Procedures for Aspen	• If a stand of LIVE trembling aspen trees has visible *Phellinus tremulae* conks (heart rot fungi), but without structural defects, apply the alternate safe work procedures • Conduct a site assessment overview to determine the general health of the live aspen in the stand • Review failed stems (presumed to have been live trees) to determine the presence and number of conks • Document the conk distribution of each failed tree to develop a risk table for this stand; aspen in better condition will be regarded as SAFE • If there are no failed aspen with conks, then all LIVE aspen with these conks will be regarded as SAFE for all LODEs • These steps only apply to LIVE aspen with *Phellinus tremulae*. If an aspen tree has other structural damage, then assess the tree according to the applicable LODE hazard tables and manage accordingly

Table 4. Hazardous Tree Criteria for LODE 2 Activities

NOTE: Any tree defects as described in the boxes below will be rated as DANGEROUS for level 2 disturbance. Trees with lesser defects can be rated SAFE for level 2 – take care to not brush trees and to fall and yard away if possible.

Defect Category	Species Group	
	Douglas-fir, larch, pines, spruces	**Western redcedar, yellow cedar**
Defective top (DT)	• **Class 2 to 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) >30% of tree height	**Class 2 to 5 trees: Defective Top** (any size; e.g., secondary top) **where structural weakness is evident**
Defective limbs (DL)	• Limbs >10 cm diameter **with structural weakness** * Hung-up limbs	• Limbs >15 cm diameter **with structural weakness** * Hung-up limbs
Witches' broom (WB)	Brooms >1 m diameter on dead branches with evidence of decay, cracking or failure (dead branches and brooms may be on the ground)	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 advanced decay in surrounding stemwood	Crack or split >2 cm wide extending >50% of tree diameter into stem **AND** evidence of advanced decay in surrounding stemwood
Stem damage (SD) (includes scarring, fire damage, machine damage, and animal damage or butt rot)	>25% of tree cross-sectional area damaged, burned, scarred, decayed or fractured	>50% of tree cross-sectional area damaged, burned, scarred, decayed or fractured
Thick sloughing bark or sloughing sapwood (SB) (bark applicable to Douglas-fir, larch and yellow [ponderosa] pine)	**Class 6 – 8 trees:** Large pieces of bark or sapwood separated and sloughing from bole of tree*	• Bark n/a • Long slabs of sloughing 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 heartrot fungus present** **Exception:** For veteran and dominant live 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 saprot 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)
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; lifting root mat; visible decay or damage to roots affects >50% of lateral roots	Occurrence of any of the following; root pull; lifting root mat; visible decay or damage to roots affects >50% of lateral roots
Detailed Tree Assessments	STEM TEST: Average sound stemwood shell thickness <30% of tree radius (i.e., AST < RST), or >50% circumference as an open wound and AST <30% of tree radius ROOT TEST: More than half of the roots are >50% decayed or rotten	

NOTE: Structural weakness includes visual evidence of decay, cracking, breakage, embedded bark or cracking at forks or multiple stem unions, presence of conks, stem scars with decay, swollen stems from mistletoe (goiter) or woodpecker cavities.

* In Douglas-fir, larch and yellow [ponderosa] pine, treat sloughing sapwood according to the bark failure potential criteria.

** If identity of wood decay fungus cannot be determined (e.g., saprot or heartrot), then default to Dangerous rating. Where *Porodaedalea pini* is present, if the stem has structural damage such as a broken top or scarring which allow oxygen exchange or other stress indicators (e.g., resinosis, damaged roots), **OR** if there are conks distributed along the bole length, then default to Dangerous rating.

Table 4. Hazardous Tree Criteria for LODE 2 Activities (concluded)

NOTE: Any tree defects as described in the boxes below will be rated as DANGEROUS for level 2 disturbance. Trees with lesser defects can be rated SAFE for level 2 – take care to not brush trees and to fall and yard away if possible.

Defect Category	Species Group	
	Hemlock, true firs	**Broad-leaved deciduous**
Defective top (DT)	• **Class 2 to 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 to 5 trees: Defective Top** (any size) as a fork, co-dominant or multiple stem **where structural weakness is evident; OR** • Where a dead top is >20% of the tree height
Defective limbs (DL)	• Limbs >10 cm diameter **with structural weakness** • Hung-up limbs	• Limbs >10 cm diameter **with structural weakness** • Hung-up limbs
Witches' broom (WB)	Brooms >1 m diameter on dead branches with evidence of decay, cracking or failure (dead branches and brooms may be on the ground)	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 advanced decay in surrounding stemwood	Crack or split >2 cm wide extending >25% of tree diameter into stem **AND** evidence of advanced decay in surrounding stemwood
Stem damage (SD) (includes scarring, fire damage, machine damage, and animal damage or butt rot)	>25% of tree cross-sectional area damaged, burned, scarred, decayed or fractured	>25% of tree cross-sectional area damaged, burned, scarred, decayed or fractured
Thick sloughing bark or sloughing sapwood (SB) (bark applicable to cottonwood >50 cm dbh)	n/a	**Class 5 trees:** Large pieces of bark separated and sloughing from bole of tree
Butt and stem cankers (CA)	n/a	>50% of butt or stem circumference as a canker face on a dead tree
Fungal fruiting bodies (CM) ** (conks and mushrooms)	• **Any heartrot fungus present** • Sap-rotting fungi present on any tree <30 cm dbh where saprot depth is >5 cm	• **Any heartrot fungus present** **Exception:** *Phellinus tremulae* on live trembling aspen; apply alternate safe work procedures; • Sap-rotting fungi present on any trees <30 cm dbh where saprot depth is >5 cm
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)
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; lifting root mat; visible decay or damage to roots affects >50% of lateral roots	Occurrence of any of the following; root pull; lifting root mat; visible decay or damage to roots affects >50% of lateral roots
Detailed Tree Assessments	STEM TEST: Average sound stemwood shell thickness <30% of tree radius (i.e., AST < RST), or >50% circumference as an open wound and AST <30% of tree radius ROOT TEST: More than half of the roots are >50% decayed or rotten	

NOTE: Structural weakness includes visual evidence of decay, cracking, breakage, embedded bark or cracking at forks or multiple stem unions, presence of conks, stem scars with decay, swollen stems from mistletoe (goiter) or woodpecker cavities.

** If identity of wood decay fungus cannot be determined (e.g., saprot or heartrot), then default to Dangerous rating.

Table 4a. Hazardous Tree Criteria for LODE 3 Activities

NOTE: Any tree defects as described in the boxes below will be rated as DANGEROUS for level 3 disturbance. Trees with lesser defects can be rated SAFE for level 3 – take care to not brush trees and to fall and yard away if possible.

Defect Category	Species Group	
	Douglas-fir, larch, pines, spruces	**Western redcedar, yellow cedar**
Defective top (DT)	• **Class 2 to 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) >30% of tree height	**Class 2 to 5 trees: Defective Top** (any size; e.g., secondary top) **where structural weakness is evident**
Defective limbs (DL)	• Limbs >10 cm diameter **with structural weakness** • Hung-up limbs	• Limbs >15 cm diameter **with structural weakness** • Hung-up limbs
Witches' broom (WB)	Brooms >1 m diameter on live or dead branches AND with 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 advanced decay in surrounding stemwood	• **Class 2 and 3 trees:** Crack or split >2 cm wide extending >50% of tree diameter into stem **AND** evidence of decay in surrounding stemwood • **Class 4 – 8 trees:** Crack or split >2 cm wide extending >25% of tree diameter into stem **AND** evidence of decay in surrounding stemwood
Stem damage (SD) (includes scarring, fire damage, machine damage, and animal damage or butt rot)	>25% of tree cross-sectional area damaged, burned, scarred, decayed or fractured	• **Class 2 and 3 trees:** >50% of tree cross-sectional area damaged, burned, scarred, damaged or fractured • **Class 4 – 8 trees:** >25% of tree cross-sectional area damaged, burned, scarred, decayed or fractured
Thick sloughing bark or sloughing sapwood (SB) (bark applicable to Douglas-fir, larch and yellow [ponderosa] pine)	Large pieces of bark or sapwood separated and sloughing from bole of tree	• Bark n/a • Long slabs of sloughing 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 heartrot 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 saprot depth is >3 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; lifting root mat; visible decay or damage to roots affects >25% of lateral roots	Occurrence of any of the following; root pull; lifting root mat; visible decay or damage to roots affects >25% of lateral roots
Detailed Tree Assessments	STEM TEST: Average sound stemwood shell thickness <30% of tree radius (i.e., AST < RST), or >50% circumference as an open wound and AST <30% of tree radius ROOT TEST: More than half of the roots are >50% decayed or rotten	

NOTE: . all Footnotes can be found on Page 9 (on reverse)

Table 4a. Hazardous Tree Criteria for LODE 3 Activities (concluded)

NOTE: Any tree defects as described in the boxes below will be rated as DANGEROUS for level 3 disturbance. Trees with lesser defects can be rated SAFE for level 3 – take care to not brush trees and to fall and yard away if possible.

Defect Category	Species Group	
	Hemlock, true firs	**Broad-leaved deciduous**
Defective top (DT)	• **Class 2 to 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 to 5 trees: Defective Top** (any size as a fork, co-dominant or multiple stem **where structural weakness is evident; OR** • Where a dead top is >20% of the tree height
Defective limbs (DL)	• Limbs >10 cm diameter **with structural weakness** • Cracked, decayed, broken or hung-up limbs	• 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 advanced decay in surrounding stemwood	Crack or split >2 cm wide extending >25% of tree diameter into stem **AND** evidence of advanced decay in surrounding stemwood
Stem damage (SD) (includes scarring, fire damage, machine damage, and animal damage or butt rot)	>25% of tree cross-sectional area damaged, burned, scarred, decayed or fractured	>25% of tree cross-sectional area damaged, burned, scarred, decayed or fractured
Thick sloughing bark or sloughing sapwood (SB) (bark applicable to cottonwood >50 cm 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 heartrot fungus present** • Sap-rotting fungi present on any tree <60 cm dbh where saprot depth is >6 cm	• **Any heartrot fungus present** **Exception:** *Phellinus tremulae* on live trembling aspen; apply alternate safe work procedures; • Sap-rotting fungi present on any trees <60 cm dbh where saprot depth is >6 cm
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)
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; lifting root mat; visible decay or damage to roots affects >25% of lateral roots	Occurrence of any of the following; root pull; lifting root mat; visible decay or damage to roots affects >25% of lateral roots
Detailed Tree Assessments	STEM TEST: Average sound stemwood shell thickness <30% of tree radius (i.e., AST < RST), or >50% circumference as an open wound and AST <30% of tree radius ROOT TEST: More than half of the roots are >50% decayed or rotten	

NOTE: Structural weakness includes visual evidence of decay, cracking, breakage, embedded bark or cracking at forks or multiple stem unions, presence of conks, stem scars with decay, swollen stems from mistletoe (goiter) or woodpecker cavities.

* 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 as tissues under the dead cambium do not grow along with the surrounding wood. They are sometimes called "exploding cankers".

** If identity of wood decay fungus cannot be determined (e.g., saprot or heartrot), then default to Dangerous rating. Where *Porodaedalea pini* is present on Douglas-fir, larch, pines and spruces, if the stem has structural damage such as a broken top or scarring that allow oxygen exchange or other stress indicators (e.g., resinosis, damaged roots), OR if there are conks distributed along the bole length, then default to Dangerous rating.

Table 5. Danger Tree Assessment Process for LODE 4 Activities

When conducting Level 4 disturbance assessments, only the following four types of trees are rated safe. All other trees will be rated Dangerous for Level 4 activities

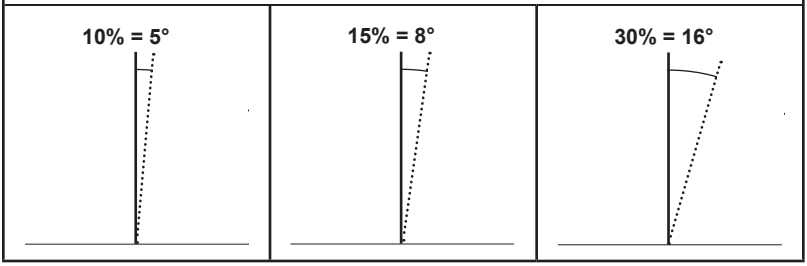
Level 4 disturbance	
S = Safe	**S if tree is of the following:** • class 1 tree (all species) • class 2 trees with NO structural defects (all species) (usually wind- or snow-snapped green trees, very light fire scorching) • class 2 **cedars** with LOW failure potential defects (**refer to table below**) • 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)

Structural Weakness includes visual evidence of decay, cracking, breakage, embedded (included) bark or cracking at forks or multiple stem unions, presence of conks, stem scars with decay, swollen stems from mistletoe (goiter), or woodpecker cavities

Class 2 Cedar Trees are SAFE for LODE 4 if they fit the Following Criteria

Defect Category	Western Redcedar, Yellow-cedar Low Failure Potential
Defective top (DT)	Defective Top (e.g. secondary top, spike) <30% of tree height with no evidence of decay, cracking, failure or other structural weakness
Defective limbs (DL)	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 stemwood
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 stemwood
Tree lean (TL)	Lean <30% (16°) toward target/work area and tree has no rooting problems
Tree lean (TL) — candelabra branched 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 (RI)	**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)
Average stemwood shell thickness (for Detailed Tree Assessment if required)	Total sound stemwood shell thickness >30% of tree radius

Tree Lean Comparisons



* Sweep is where a LIVE tree is curved because of competition for sunlight, snow pack or steep slope conditions (live tree sweep is NOT lean).

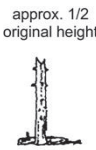
** Tree lean is documented as -% if towards target, and +% if away from target.

Special Considerations

Conks	Extend the dangerous decay level 3m below the location of the lowest conk.
Cavity nests	Extend the dangerous level of decay 1m below the lowest cavity hole.
No Work Zones (NWZ)	Must be flagged on the ground; generally, 1.5 times the length of the longest dangerous defect, adjusted (larger or smaller) based upon site specific conditions such as slope or size of surrounding trees.
Reassessment	Reassessment is needed: • if an intervening winter or site altering event occurs (e.g., extensive windthrow, fire, flood, ice storm, landslide, etc) since the assessment was completed, **OR** • the LODE has changed from the original assessment.
Mechanically cut stubs	If stub wildlife trees are mechanically created from Class 1 – 3 stems, these DO NOT require a WHT assessment for any forest activity.
Documentation	When documenting the assessment, enter: • **"–"** for defects/hazards that don't exist, • "**S**" for the defect seen and it is safe, • "**D**" for the defect seen and it is dangerous, • "**?**" for a defect seen but a detailed assessment was performed. • Remember to state limitations, field marking procedures and recommendations for re-inspection timing.
Structurally damaged stand	• Stands which have been severely and extensively damaged (e.g., wildfire, windthrow, advanced root disease) are complex and require an assessment by a Certified Wildlife Hazard Tree Assessor, even if performing LODE 1 activities, before work commences. • If there are >500 stems per hectare, then an application to WorkSafeBC will be required to develop a Points of Control safe work strategy in accordance with OHS Regulation 26.11(3) before work commences.

Decay Class Comparison for Conifers and broad-leaved Deciduous

SOFTWOOD

Decay class	LIVE TREES		DEAD TREES					DEAD FALLEN	
			Hard →			Spongy →		Soft	
	CLASS 1	CLASS 2	CLASS 3	CLASS 4	CLASS 5	CLASS 6	CLASS 7	CLASS 8	CLASS 9
									

HARDWOOD

Decay class	LIVE TREES		DEAD TREES			DEAD FALLEN
	CLASS 1	CLASS 2	CLASS 3 (Hard)	CLASS 4 (Spongy)	CLASS 5 (Soft)	CLASS 6