

# **Hazardous Tree Management Guideline**



**NCDENR  
Division of Parks and Recreation  
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## 1.0 INTRODUCTION

Park visitors seek a pristine, wooded recreational facility, but recreation activities themselves can induce or intensify detrimental changes in forest and shade trees. Intensive recreation activities, such as camping, can cause tree damage by altering the tree's natural environment, or by directly damaging roots, stems and branches. These changes can lead to the development of hazardous trees, which pose a safety risk for park visitors to recreation sites.

The park staff is in the unenviable position of trying to preserve a recreation site's natural setting while trying to provide reasonable public safety by identifying and then correcting hazardous trees. Some tree failures can be predicted on the basis of identifiable defects; some failures cannot be predicted. There will be failures during severe storms that have nothing to do with tree defects. There are significant unknown or undetectable interactions occurring within forest and shade tree communities that may result in hazard trees.

All hazardous trees cannot be detected, corrected or eliminated. However, the park staff implementing a hazard tree management program can help make a recreation site reasonably safe while preserving its natural setting. This guideline will provide the framework for a hazard tree management program, which consists of regular and systematic inspections based on readily identifiable tree defects.

**What is a hazard tree?** A hazard tree is defined as any defective tree, or tree part, that poses a high risk upon failure to cause injury to people or damage to property. A hazard tree has one or more defects, which decreases its structural integrity and gives it an increased potential for failure. Defects that are visible or detectable include cracks, decayed wood, weak branch unions, cankers, poor tree architecture, root problems and dead trees or branches.

A defective tree is not considered hazardous unless there is a nearby target that it could hit. A target could be a person, vehicle, tent, building, picnic table, campfire ring, recreation equipment and etc. The term **target area** is used to describe an area where people or their equipment, are likely to stop and congregate. An individual campsite is an example of a target area. By definition, **a hazard tree = a defective tree plus a target.**

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## 2.0 **GUIDELINE RESPONSIBILITIES**

### **Division Director**

The division director is responsible to ensure the overall development and administration of the Hazardous Tree Guideline.

### **Superintendent of State Parks**

The superintendent of state parks is responsible for the management and supervision of the Hazardous Tree Guideline and to ensure compliance throughout the division.

### **Division Safety Officer**

The division safety officer is responsible for the administration of the Hazardous Tree Guideline. Perform an annual review of the Hazardous Tree Guideline and program.

### **District Superintendent**

The district superintendent is responsible for the management and supervision of the Hazardous Tree Guideline program in his/her district, to ensure training and equipment needs.

### **Park Superintendent**

The park superintendent is responsible for the management and supervision of the Hazardous Tree Guideline program in his/her park. To ensure training of the park staff and equipment needs.

### **Park Staff Employees**

The park employees are responsible for attending required training and performing work duties in compliance with this guideline and all other safety practices.

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### 3.0 **DIVISION POLICY**

It is the division's policy to provide reasonable public and employee safety on intensively used recreation areas and administrative sites by detecting and correcting situations involving hazard trees within the constraints, of the divisions resources. Inspections, maintenance and corrective action will accomplish this goal.

On an annual basis trees in the following areas will be inspected: drive-in campsites, hike-in campsites, group camps, picnic areas, around buildings and facilities in developed campgrounds, hiking trails/bridal trails, public water accesses, administrative sites, roadways and parking lot peripheries.

Not covered by this policy are trees along trout streams, abandoned forest roads, and natural forest areas not generally used by park visitors.

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#### 4.0 **INSPECTIONS**

An inspection is a systematic method of examining and rating trees. The purpose of a hazard tree inspection is to detect defective trees in target areas, assesses the severity of the defects and recommend corrective action before tree failure occurs.

The first step of an inspection is to decide which areas should be inspected. In general inspection priorities are based upon human mobility within the target area, the duration of site occupancy and the level of site maintenance.

The second step is to choose appropriate personnel to perform the inspections. Park personnel (inspector = Ranger/Maintenance) assigned to this task should be familiar with tree species found on site, tree defects and their potential for failure.

At the discretion of the park superintendent, one of the following inspection methods should be used:

##### 4.1 **Individual Tree Inspection**

Each tree in the specified area or any tree that could reach the target area will receive a 360-degree visual inspection for flaws and viewed from bottom to top. The designated inspector can make the final decision for corrective action. On occasion the inspector will have to confer with the park superintendent for guidance on how to handle a sensitive or technically difficult situation. This type of inspection will be standard for high-risk areas. (See table 4.1 for high and low risk areas)

##### 4.2 **Walk Through Inspection**

Walk through the area visually scanning for potential flaws. This includes inspections of individual trees suspected of being hazardous, as above. Walk through inspections are standard for low risk areas.

Use of binoculars, wood chisels, hammers, coring devices, and other tools enhance the quality of the inspection process. Areas are best inspected prior to peak visitation times. Inspections should be conducted to allow sufficient time to schedule necessary work. Areas should remain closed until hazardous tree conditions are eliminated.

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Inspections can be done any time of the year. The best time to see structural defects is during the leaf-off season. Early spring and late autumn when visitor are few would work well. Inspections done during leaf-on seasons, give a better sense of tree condition and location of dead branches.

If construction or severe storm occurred since the last inspection, then additional inspection should be done. As soon as possible after a severe storm a thorough inspection of high-risk areas and intensively used areas should be done to find trees and branches that failed, fractured or developed a lean during the storm. Strong winds can take a minor defect and change into a major one that may require corrective action.

When the inspector (s) arrive at the site they must determine which trees to inspect. Not all trees need to be inspected. Only trees that could fall onto a target or into the target area need to be inspected. The target area will vary according to facility type, see table 4.2.

The next step is to inspect each individual tree for defects. During the inspection the severity of each tree's defects are judged with respect to defect levels established in section 5.0 (Assessment). The final step of the inspection is to provide documentation. Use the inspection form located in the appendix along with a PR-63. A separate inspection form should be used for each facility type.

**See table 4.2 for target area.**

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Table 4.1 High and Low Risk Areas

Facility Type	High Risk	Low Risk
Drive-in campsite	X	
Hike-in campsite	X	
Group camps	X	
Picnic areas	X	
Restroom facilities	X	
Hiking trails		X
Horse bridle trails		X
Public water accesses		X
Roadways		X
Parking lot peripheries		X
Administrative office sites		X

Table 4.2 Target Areas

Facility Type	Target Area
Drive-in campsite	Target area will vary from park to park based on campground layout. Each site should have designated boundaries either by landscape timbers, by natural vegetation or the entire campground can be designated as target area. A 25-foot safety buffer shall be in effect around the target <b>area</b> boundary.
Hike-in campsite	25-foot safety buffer around target area.
Group camps	25-foot safety buffer around target area.
Picnic areas	25-foot safety buffer around target area.
Restroom facilities	25-foot safety buffer around target area.
Hiking trails	15-foot safety buffer parallel to target area.
Horse bridle trails	15-foot safety buffer parallel to target area.
Public water accesses	10-foot safety buffer parallel to target area.
Roadways	10-foot safety buffer parallel to road right-a-way
Parking lot peripheries	10-foot safety buffer around target area.
Administrative office sites	10-foot safety buffer around target area.



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#### 4.3 **Scheduling Inspections**

The basic guideline for inspection scheduling is listed below. Special trips or visits for the sole purpose of hazard tree inspections do not have to be made for administrative sites, parking lot peripheries, roadways and public water accesses. Inspections can be made on a regular basis with regularly scheduled maintenance activities. Inspections can be made more frequent and/or more intense than the minimums identified in the table below.

Table 4.3

Facility	Inspection	Type of Inspection
Drive-in campsite	Annual	Individual Tree Inspection
Hike-in campsite	Annual	Individual Tree Inspection
Group camps	Annual	Individual Tree Inspection
Picnic areas	Annual	Individual Tree Inspection
Restroom facilities	Annual	Individual Tree Inspection
Hiking trails	Annual	Walk Through Inspection
Horse bridle trails	Annual	Walk Through Inspection
Public water accesses	Annual or with regular maintenance operations	Walk Through Inspection
Roadways	Annual or with regular maintenance operations	Walk/Drive Through Inspection
Parking lot peripheries	Annual or with regular maintenance operations	Walk Through Inspection
Administrative office sites	Annual or with regular maintenance operations	Walk Through Inspection

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#### 4.4 **Site Conditions**

Individual tree inspections are enhanced if inspectors have an understanding of the factors that create or accelerate the development of defective trees. An awareness of the environment and human-related factors influencing the site can aid in detecting and assessing tree defects.

##### **Environmental Factors**

The following table outlines a few common environmental problems, the respective initial damage or changes they cause, and the type of defects that commonly result.

Table 4.4

Cause	Initial Damage or Change	Defects Observed
Fire	Wounds to stem	Stem decay, cavities, fire scars
Pest Infestation	Crown dieback, stem wounds, reduced vigor	Topkill, cankers, decay, tree mortality, root rot
Drought	Wilting, crown dieback	Topkill, tree mortality
Flooding	Root and rootlet mortality, crown dieback	Topkill, tree mortality
Shallow soils or hardpan layer soils	Shallow root system	Windthrow

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### Human-related factors

If you find trees that are experiencing problems you will usually find some human-made alterations that are to blame. The following table outlines some of the commonly observed defects resulting from a variety of human causes.

Table 4.5

Cause	Initial damage or change	Defects observed
Past logging	Stem wounds, stump sprouts, change in species composition	Stem decay, cracks, cankers
Past grazing	Soil compaction causes rootlet mortality, injury to exposed roots	Root rot, windthrow, decay, cracks
Compaction due to foot or vehicle traffic	Soil compaction causes rootlet mortality, limited root development	Root rot, crown dieback, tree mortality
Construction	Stem and root wounds	Decay, cracks, cankers, root rot, crown dieback, tree mortality
Trenching	Roots wounded and severed	Windthrow, root rot, crown dieback
Raising the soil grade	Rootlet mortality	Root death, root rot, crown dieback
Lowering the soil grade	Roots wounded and severed	Windthrow, root rot, crown dieback
Surfacing and paving	Rootlet mortality, lack of water and oxygen	Rootlet dieback, crown dieback, tree mortality
Removing nearby trees	Root and branch growth	Poor tree architecture, windthrow
Transplanting trees	Root loss during process	Slow growth, dieback
Inappropriate species planted	Poor vigor and decline	Topkill, branch breakage, tree mortality
Mowing, weedwhip injuries	Stem and root wounds	Decay, cracks, root rot, cankers, kills small trees
Herbicides	Defoliation, wilting or browning of foliage	Crown dieback, tree mortality
Poor pruning practices	Wounds caused by flush cuts, tipping, topping, long branch stubs	Decay, cankers, cracks, poor architecture
Nails, lanterns, hatchet marks, bark peeling	Wounds to stem	Cankers, decay, cracks, tree mortality

By being aware of site history and management practices, inspectors can anticipate some of the defects, which might occur and can be better prepared to evaluate the severity of those defects.

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#### 4.5 **Individual Tree Evaluations**

The most important part of an inspection is evaluating individual trees for their potential as hazards trees. The field examinations must be conducted in a careful and systematic manner. The search for defects in individual trees is a time consuming and repetitive process, so allow plenty of time for inspections. Individual tree evaluations must include a close inspection of the rooting zone, root flares, main stem, branches and branch unions. Use a pair of binoculars to visually inspect the higher branches.

Several factors should be considered while evaluating individual trees. These factors include but are not limited to; potential targets, target area, the presence of cracks and other defects, tree species, tree age and size, and tree condition.

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### **Potential Target and Target Area**

Defective trees are not hazard trees unless there is a target. If the defective tree in question would fail at the groundline, fall and not reach the target/target area, it is not considered a hazard tree since it poses no serious threat. Targets may be campsites, parking lots, picnic areas, buildings, public water accesses, or anywhere people are likely to congregate and/or stop.

### **Cracks**

Cracks are a principle factor in hazard tree evaluation. A crack is a fissure or deep split in the wood. Cracks are the visible sign that tree failure has begun and that corrective action is necessary.

### **Defects(s) Present**

Defects are visible signals that a tree is failing or has the potential to fail. There are seven main categories of defects: cracks, weak branch unions, stem or branch decay, cankers, dead trees and branches, root problems and poor tree architecture. Defects affect the structural integrity of the tree. Each type of defect has a range of severity; from no action required to requiring more immediate action. Often trees will have more than one defect.

### **Tree Species**

The type of defect a tree has is often influenced by the species of the tree. Some species are more prone to failure from certain kinds of defects. Silver Maples tend to form codominant stems and thus form weak branch unions. Learn the common defects known to trouble the tree species in your area and actively search for those defects.

### **Tree Age and Size**

The majority of serious defects are found in old and/or large trees. This is because old trees have had time to accumulate injuries and infections and more time for the problems to develop into structural defects. Large trees have greater structural stresses due to their size and weight. Defects identified and corrected in younger trees may reduce future hazards as they grow in age and size.

### **Tree Condition**

Determining tree condition involves evaluating the overall health and vigor of the tree. Trees in good condition will have live full crowns, few dead branches and full-sized foliage on actively growing branches. Trees in poor condition or declining trees will have branches dying back as well as many dead branches, with smaller and off-colored foliage. Declining trees have a higher probability of branch failures and premature death.

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## 5.0 **ASSESSMENT**

A sound tree becomes potentially hazardous when the trees woody structure is weakened by defects. Most defects can be linked to past wounding, pest infestations or severe storms that fracture, destroyed or decayed the wood. Defects are visible signs that a tree has failed, is failing or has the potential to fail. These are the seven main categories of defects:

**Cracks**

**Weak branch unions**

**Stem or branch decay**

**Cankers**

**Dead trees, tops or branches**

**Root problems**

**Poor tree architecture**

Cracks are the most serious defect because they indicate that the tree is in the process of failing.

Each type of defect has a distinctive range of symptoms that indicates its severity and potential to fail. At the lowest end of the spectrum, the defect does not appear to be currently affecting the structural integrity of the tree. A tree that has a moderate potential to fail is likely to fail in the near future. At the highest level, defects are causing tree failure and are therefore of present concern.

The location of the defect can be a critical factor when determining the hazard level of an individual tree. Tree stems have a zone called the “hot spot” which is presumed to be mechanically weaker than wood above and below it. The hot spot zone occurs about 4 feet above the groundline up to the lowest branch.

Hypothetically this is where the stem would snap off if enough force were applied to bend the tree over. If an additional defect occurs in the hot spot assume the severity of the defect is worse than it appears because of its location on the stem.

Trees are living organisms under constant change and the introduction of recreational activities can induce or intensify detrimental changes in them. No two trees will respond to these changes in the same way. There is a natural variability in the trees’ response, so defect severity will also be variable in each tree. Remember that these are guidelines and no absolute rules can be made because of the natural variability of trees and their defects. Inspectors need to use their judgment and experience when evaluating and assessing tree defects.

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Tree picture

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## 5.1 **Cracks**

**Cracks = a separation of wood, a fissure or deep split in the bark and wood.** Cracks can occur in stems and branches; they may even extend up from the roots into the lower stem.

**Cracks are the number one hazardous defect because they indicate the tree is already failing.**

Cracks can be generated in two ways, (1) from short-term injuries such as storm damage or the impact from heavy equipment, or (2) from improper wound closure over a period of years. Most cracks develop from improper closure of wounds. The wounds behind a crack may be sound or decayed.

If the wound does not close, the layers of bark and wood forming the margins of the wound meet but do not grow together and do not seal over the wound. These layers curl inward on each side of the wound and form inrolled bark and wood. As more layers of bark and wood are added, the crack becomes more pronounced. The crack will continue to grow as new wood is added to the inrolled bark, increasing the separating force between the two sides. Rams-horning is another term for inrolled bark and wood. Rams-horned cracks become more hazardous as they enlarge and generate secondary cracks in the stem.

If there is another defect in the same stem segment that has a crack like a canker or a weak branch union failure may be imminent and corrective action should be taken as soon as possible.

Picture insert.....



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### **High Failure Potential**

- A crack goes completely through the stem or branch. You may be able to detect movement of each section of wood.
- Stem has 2 cracks on the same segment with a cavity or extensive decay on the inside.
- Stem has a crack in contact with another defect (canker, decay, weak branch union, leaning, etc.)
- 4 inch or larger branch has any crack. Remove only the cracked branch.
- Conifer stem has 1 crack that has inrolled bark and internal cylinder of wood is gone or extensively decayed.

### **Moderate Failure Potential**

- Hardwood stem has 1 crack that has inrolled bark and the internal cylinder of the wood is gone or extensively decayed.

## **5.2 Weak Branch Unions**

**Branch union = fork in the stem or union of two or more main branches. A weak branch union is structurally unsound because bark layers are ingrown; bark has formed inside the wood in the union.**

The term for this is included bark. Unlike wood, bark has no power to hold the branches together. As more and more bark is included inside the tree the remaining woody connections between branches can't support the weight of the branch and the weak union fails. The branch breaks off or the tree splits open.

Weak unions are characterized by a sharp angle between the stem (V-shaped connection), and the presence of included bark in the union and by the presence of inrolled bark on the branch bark ridge.

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### **High Failure Potential**

- A weak branch union that is cracked, cankered or decayed.
- A weak union in the tree's "hot spot".

### **Moderate Failure Potential**

- A weak union with inrolled bark at the branch bark ridge.

Strong branch unions are characterized by a U-shaped connection, branch angles approaching 90 degrees and upturned branch bark ridges at branch junctions. When the branch bark ridge is upturned, there is no included bark. Wood from the branch grows together with wood from the stem creating a sound union.

Insert picture.....

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### 5.3 Stem or Branch Decay

**Decayed wood = Wood that has rotted or is missing. Decay always results in less structural strength and stability.**

Decay is caused by fungi, which infect wounds in the bark and wood. Over a period of years the fungi consumes and degrades the wood making it structurally unsound. When a tree is wounded it compartmentalizes the infected or injured wood so new wood laid down after the wound is free from decay. The diameter of the tree at the time of wounding is generally the only part invaded by decay fungi from the wound. If this decay process goes on long enough a hollow the same size diameter as the tree at the time of the wounding can result. This process may take many years. Wounds occurring later may result in new decay columns outside the older ones, sometimes enlarging the diameter of the hollow.

The most dangerous decay-causing fungi are the canker-rot fungi. They can overcome the tree's efforts at compartmentalization and spread outward into wood formed after the year it was wounded. Infection by canker-rot fungi usually results in more extensive decay, the entire cylinder of wood can be structurally weakened. Trees are easily fractured at the site of canker-rot infections. Some common canker-rot fungi and their host are: *Inonotus obliquus* on birch, *Phellinus pini* on conifers, *Phellinus everhartii* on oak, and *Inonotus glomeratus* on maple.

The health and vigor of a tree's crown does not indicate whether there is internal decay or not. Trees require only a thin layer of bark and sapwood to transport water and nutrients to the crown. The crown will be visibly healthy even if internal decay is present.

Fungal fruiting bodies on the tree or roots and growing on the ground adjacent to the tree are reliable indicators of decay.

#### **High Failure Potential**

- Canker-rot infection (fruiting body) present in tree's "hot spot."
- Cavity or decay present (fruiting body) associated with a weak branch union or an open crack.
- Any branch with decay.

#### **Moderate Failure Potential**

- Canker-rot infection.

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#### 5.4 **Cankers**

A canker is an area of dead bark and cambium anywhere on the tree, often affecting the wood beneath. Fungi, insects, weather or mechanical damage such as lantern burn wounds can cause cankers. Stems and branches often fracture on or near cankers.

There are two types of cankers, annual and perennial. Annual cankers are short-lived infections, which do not affect the tree's structural integrity. Perennial cankers are long-term tree/fungus associations, which can alter the tree form and structure and take on a target or diffused appearance. Cankers increase the likelihood of stem breakage or kill the tree above the canker location. Cankers are more hazardous if they affect more than half of the circumference of the tree.

##### **High Failure Potential**

- Canker is in the tree's "hot spot" and affects more than half of the tree circumference.
- Canker and decay in the tree's "hot spot."
- Canker is physically connected to a crack or another defect.

##### **Moderate Failure Potential**

- Canker affects more than half the stem's circumference.
- Large old wound or canker at base of leaning tree.

#### 5.5 **Dead Trees, Tops or Branches**

A dead tree, branch or treetop is structurally unsound. Dead tops or branches may remain attached to live trees for several years or may fall off suddenly. Dead branches commonly break off near or at the main stem. Dead treetops frequently break off just above the live stem. Dead trees can fracture anywhere, at the ground level, in the tree's "hot spot" or anywhere there was a defect.

##### **High Failure Potential**

- Any dead tree.
- Any dead branch or dead top.
- Any lodged branch.

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### **Moderate Failure Potential**

- Any branch more than two-thirds dead, remove entire branch.

## **5.6 Root Problems**

Root problems serious enough to warrant corrective action are trees with partial windthrow, root severing, missing root systems, or extensive root rot. Root problems are difficult to find and assess since tree roots are under ground. Tree root systems extend two-four times the height of the tree and most of the water and nutrient absorbing roots are within 12 inches of the soil surface.

Root problems are often a combination of mechanical disruption of the root system and reduced vigor. The mechanical support of a root system can be disrupted by soil erosion, severing the roots or extensive root rot. Construction activities, soil compaction, paving, lowering the soil grade, etc. reduce rooting area. Soil compaction is caused by heavy equipment, auto traffic or prolonged foot traffic. Flooding, raising the soil grade, and application of salts and herbicides can reduce root vigor.

Root problems only become apparent when tree crowns begin to show symptoms or when signs of root failure become obvious. Root lifting, partial windthrow, soil mounding, or recently leaning tree is an obvious sign that the root system is failing.

Tree picture...

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If construction has taken place under the crown, or excavation has occurred within ten feet of the stem, assess the impact this may have had on the mechanical support of the tree. Correlate this with signs of dieback or decline in the crown.

### **High Failure Potential**

- Freshly leaning trees with evidence of recent root lifting, soil movement or mounding near base of tree.
- Inadequate root support, tree has more than half the root system severed within the crown radius.

### **Moderate Failure Potential**

- Root problem physically connected to stem decay, crack or canker.

## **5.7 Poor Tree Architecture**

A growth pattern that indicates weakness or structural imbalance in the affected branch or stem is an example of a tree with poor architecture. In most cases poor tree architecture is the tree's response to past changes. It may take many years for the tree's response to fully develop to those changes. Examples listed in table 5.1

Table 5.1

<b>Cause</b>	<b>Watch for...</b>
Tree clearing or branch pruning in nearby trees	Change in growth habit or branch losses
Branch out of proportion with rest of tree, growing into a new hole in the canopy	Branch failure
Branch with sharp twist or bend	Branch failure
Multiple branches or co-dominant stems arising in one area of the stem	Branch failure
Tree was topped in the past	Branch or stem failure in upper crown
Tree growing at a sharp angle from the ground and one of the following: crack, root rot, stem decay, or after a severe storm	Tree failure

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### **High Failure Potential**

- Tree leaning over target with an angle greater than 45 degrees to the lean.
- Tree leaning over target and it has another defect in the “hot spot.”

### **Moderate Failure Potential**

- Branches with a twist, sharp angle or bend in them.
- Branches lopsided or unbalanced with respect to rest of the crown, especially if nearby trees were pruned or removed within the last ten years.

## **5.8 Hazard Tree Assessment Guide**

There are several factors that must be considered while inspecting individual trees. These factors are the defect(s) present, tree species, tree age and size, tree condition and potential targets. This guide is a synopsis of the seven defects and hazard levels. Trees with high hazard potential warrant corrective action as soon as possible. Moderate hazard defects are discretionary: the park superintendent or designee may elect to correct them before the next inspection.

Defect location can be a critical factor when determining the hazard potential of an individual tree. The “hot spot” zone is from about 4 feet above the ground line up to the lowest branch. If an additional defect occurs in the hot spot, assume the defect is worse than it appears.

The number of defects a tree has is also critical when assessing for hazard potential. Some trees have more than one defect and if two or more defects are connected, the tree can be very weak in that area.

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## Hazard Potential Guide

Table 5.2

Defect	Moderate	High
Crack	Hardwood stem has single crack with cavity or decay inside	Crack goes completely through stem. May be able to detect movement of the two sections.  Stem has 2 cracks on the same segment with cavity or extensive decay inside.  Stem has crack in contact with another defect or at the base of leaning tree.  Branch (4" or larger) has any crack.  Conifer has a single crack with inrolled bark and cavity or decay inside.
Weak unions	A weak union with inrolled bark	A weak union that is also cracked, cankered, or decayed.  A weak union in the tree's hot spot.
Decay	Canker-rot infection	Canker-rot infection in tree's hot spot  Cavity or decay associated with an open crack or a weak branch union.
Canker	Canker affects > ½ of tree's circumference.  Canker at base of leaning tree.	Canker in tree's hot spot and affects > ½ of tree's circumference.  Canker-rot infection in tree's hot spot  Canker physically connected to crack, decay or weak union.
Dead	Branch more than 2/3rds dead (remove branch)	Any dead tree.  Any dead branch or top.  Any lodged branch
Poor Tree Architecture	Branch unbalanced with respect to rest of crown.  Branch with sharp bend or twist.	Tree leaning over a target with > 45° angle to the lean.  Tree leaning over the target with another defect in the hot spot.
Root Problems	Root problems associated with stem decay, crack or canker.	Freshly leaning tree with recent root-lifting, soil movement or mounding near base of tree.  Inadequate root support, > ½ of roots severed inside the drip line.



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## 6.0 **CORRECTIVE ACTIONS**

Recommending corrective action is one of the most difficult parts of the inspection since the inspectors should take into account a number of factors including, the severity of the tree's defects, site conditions that limit options, the impact of tree removals on the aesthetics of the site and physical effects on the surrounding trees. An additional goal in corrective action is avoiding damage to existing trees and saplings in order to prevent defects from happening. If a hazardous situation exists there are three basic options for corrective action.

- Move the target.
- Remove the hazardous part of the tree by pruning, or
- Remove the tree.

It may be necessary to temporarily close the site until final corrective actions are taken on hazard trees. Where people/park visitors may go back to site or simply use it by mistake, the use of warning signs and flagging is recommended to keep people away.

### 6.1 **Move the Target**

One way of correcting a hazardous situation is to direct people away from the defective tree by moving the targeted picnic table, fire ring, tent spot, etc. In other cases it may be necessary to permanently close an area to public access and relocate the campsite or building when the tree cannot be removed due to its historical value, stature or position in the canopy.

### 6.2 **Pruning**

A hazardous situation may be caused by a defective branch, while the rest of the tree is still sound. In this case pruning the branch would solve the problem. Hazardous situations requiring branch pruning are:

- Branch over 3" in diameter with a crack, decay, or dead.
- Weak branch union that doesn't affect the entire tree.
- Large branch showing signs of decay.
- Large dead branch.
- Branch that forms a sharp angle or bend, or that twist.
- Branch that is lopsided or unbalanced with crown mass.
- Broken branches lodged in the crown should be removed.

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Pruning can be good and bad. If done improperly the immediate problem is corrected but cracks, decay, cankers or poor architecture are promoted and remain with the tree. If done properly pruning does not create defects. It is recommended that “natural target pruning” be used.

Illustration.....

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The removal of the terminal portions of the crown, “topping”, is a serious injury and has negative, long-term effects. It is a temporary measure and the tree will again be hazardous due to decay in the topped stem, poor architecture and weak unions in the newly developed top. It is not normally an accepted practice. However, topping can be acceptable when dead or broken tops need to be removed. Never cut into live wood when topping or you run the risk of promoting rapid decay in the entire stem.

Illustration...

### 6.3 **Tree Removal**

Removal of a tree is considered a last resort since tree growth is a long-term process and removal may lead to increased windthrow on the remaining trees, and may reduce the aesthetic values of the recreation area. Corrective actions should be avoided after March 1<sup>st</sup> in trees that are candidates for denning mammals or cavity nesting birds. The **Migratory Bird Treaty Act** prohibits the taking of any protected birds or eggs or conducting an activity that threatens or disturbs nest, eggs, birds and their young. This includes both cavity and cup nesting species. Assessments can be done any time of the year, however timing of corrective action needs to consider probable use of the trees by birds and mammals. Contact the natural resource section of our division prior to the removal of any tree containing endangered or threatened species.

When tree removal is prescribed the goal should be to minimize the damage to adjacent trees. Wounding of surrounding trees is the major cause of future defects. Damage can be reduced by, limbing or topping a tree before felling. When removing felled trees care must be taken not to wound the trunks or roots of surrounding trees. The best season for tree pruning and felling is in the winter when the ground is frozen and when trees and their respective pest are dormant.

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#### 6.4 **Preventing Future Hazards**

When recreation facilities are being constructed, trees are often wounded by, trenching, blacktopping, changing the grade, and heavy machinery. During site maintenance, wounds are caused by, mowers, weed trimmers, falling trees and limbs, and improper pruning techniques. Trees can also be damaged by careless use of herbicides. Park visitors inflict many wounds with such activities as, pounding nails into trees, burning trees with lanterns, gathering and chopping firewood, and damaging trees with vehicles.

Any activity that scrapes, removes or kills the bark and cambium cause a wound. Roots as well as stems and branches can be wounded. The prevention of wounds can not be stressed enough, because wounds initiate the formation of cracks and other defects.

While planning and developing a recreation site, use ideas such as; minimize human intervention (paving, trenching, changing the grade, etc.), use corridors for equipment travel, use fencing to limit vehicle movement and save islands of trees not individual trees. Teach workers and employees not to wound trees when mowing, trimming, felling trees or pruning trees. Park visitors can also be taught to respect trees and preserve the site's natural beauty.

Wounds serve as the entrances for fungi, which cause the decay process. By preventing wounding and promoting rapid wound closure, decay problems will be kept to a minimum. Rapid wound closure occurs when the tree is in good condition and the wound is small. Use natural target pruning as the method of choice when pruning is recommended.

Roots damaged by construction or maintenance activities can develop root and butt rot, which often leads to stem cracks and tree failure. In addition, root damage may cause top dieback, increasing the amount of dead wood in the crown.

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## 6.5 **Program Follow-up**

The effectiveness of a hazard tree program needs to be evaluated. Evaluations provide the park employee who has been assigned the responsibility of inspecting for hazardous trees the feed back they need to increase their proficiency. Inspectors should be on site when trees they have judged to be hazards are removed or pruned. This will allow the inspectors to compare their assessment of external indicators and potential hazard to the real evidence of internal defects. It is also recommended that inspectors be on site during storm damage clean up to gain experience in rating important defects and their respective actions to environmental conditions.

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## 7.0 **TRAINING**

Employees shall be trained in and familiar with the safety related work practices, safety procedures, and other safety requirements in this section that pertain to the use of chain saws and felling trees.

Employees shall be familiar with the Employee and Workplace Safety Guideline and trained in accordance with any special requirements of that guideline or sections as necessary for their safety.

### 7.1 **Training Requirements**

Division employees (rangers and maintenance) felling hazardous trees will be trained at a minimum to the following requirements:

- Staff Directive 89-9 Power Tool/Equipment Checklist.
- NC State Parks S-212 Chain Saw Training.
- Review Safe Operating Practices (SOP) on all associated equipment, chain saws, brush chipper, etc.
- First Responder Training.
- CPR/AED.

Training may be classroom and on-the-job practical exercises. Training shall establish employee proficiency in the work practices required.

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## 8.0 **SAFETY**

### 8.1 **Safety Compliance**

Regular supervision and job task safety audits, conducted on at least an annual basis will determine that each employee is complying with the safety related work practices required.

An employee shall receive additional training (or retraining) under any of the following conditions:

- If supervision and annual inspections indicate that the employee is not complying with safety related work practices.
- If new technology, new procedures or changes in procedures cause new safety related work practices to be introduced.
- If the employee must use safety related work practices that they do not normally use (used less than once a year).

### 8.2 **Tailgate Safety Meeting**

The employee in charge shall conduct a tailgate safety meeting with the employees involved before the start of each job. The safety meeting will at least cover the following subjects: hazards associated with the job, work procedures involved, special precautions and personal protective equipment.

If the work or operations to be performed during the workday are repetitive and similar, at least one safety meeting shall be conducted before the start of the first job of each day. Additional safety meeting shall be held if significant changes, which might affect the safety of the employees, occur during the course of the work.

A brief discussion is satisfactory if the work involved is routine and if the employee, by virtue of training and experience can reasonably be expected to recognize and avoid the hazards involved in the job. A more extensive discussion shall be conducted if the work is complicated or extremely hazardous, or the employee cannot be expected to recognize and avoid the hazards involved in the job.

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### 8.3 **Safety Preparedness**

An employee shall not work alone in the operation of felling or pruning trees. **At a minimum two employees will work together in this operation.** The employees will have appropriate radio communication devices and first aid equipment on site. Employees shall advise their supervisor of work location and expected duration of operation. It is highly recommended that all chain saw related work be done in pairs for safety precautions.



**Hazard Tree Inspection Form**

Park \_\_\_\_\_

Park Section \_\_\_\_\_

Inspector(s) \_\_\_\_\_ Date \_\_\_\_\_

Remarks \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Tree Location	Tree Species	Defect(s)	Hazard Potential H or M	Recommended Action	Action Taken/Date

