

City of Surrey

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Parks, Recreation and Culture



**Natural**

# **Tree Hazard Management Strategy**

Shawn Gurney  
Technician, Park Urban Forestry and Environmental Services

Greg Ward  
Manager, Park Urban Forestry and Environmental Services

Edited by: Diana Wegner  
Professional Writer

# Table of Contents

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<i>Introduction</i> .....	3
Risk Control of Hazard Trees .....	3
Purpose and Scope .....	4
Past Tree Hazard Management Programs .....	4
Current Tree Hazard Management Programs .....	4
Duty of Care for Managing Tree Hazards.....	5
Standard of Care for Managing Tree Hazards .....	5
<i>Tree Hazard Management Strategy</i> .....	7
Goals and Objectives .....	7
Park Planning and Design .....	9
Land Development and Construction .....	10
Park Operation and Maintenance .....	10
Tree Inspection and Assessment .....	11
Tree Hazard Inspection Procedures .....	13
Other Recommended Practices .....	16
<i>References</i> .....	19

# **Introduction**

## **Risk Control of Hazard Trees**

An important aspect of a city's overall risk management program is the management of tree hazards. Trees by their very nature will decay, die and present potential danger to person and property. In densely populated urban areas the frequency and severity of City liability and financial losses can be significant when trees fail. In Surrey, natural areas are host to many recreational pursuits and are also bordered by busy roads—these factors can therefore result in conditions whereby trees fail, potentially causing property loss and physical injury to people. The Risk Management Division of the City reports that tree failures are the third highest cause of incidents and claims, after roads and drainage claims.

The City of Surrey has an unusually high percentage of forested natural areas, with well over 550 hectares of forested parkland and over 200 kilometers of trails and pathways. The forests are adjacent to private property, urban and rural roadways, and other similar 'targets' that could be damaged in the event of a tree failure.

The City is growing at a rapid rate—between 1989 and 1999 its population grew from approximately 220,000 to 325,000. A 1997 park survey found that 52% of the respondents cited trails in forests as their most used outdoor facility. The combination of the above factors creates an environment where the risk of damage from tree failure is a concern. Both the number of targets and risk of injury are fairly high in Surrey.

Other causative factors that have increased the risk of tree failure and potential for injury include changes to the water table which result in increased mortality of forest trees, construction damage to root zones during land development, and the clearing of land for development in and around forests which results in increased windthrow due to exposure to winds. The result is serious destabilization of some trees.

Tree failure incidents and claims have increased steadily in the last five years, from 31 reported in 1995, to 112 reported in 1999. This total includes only those reported to the Risk Management Division of the City and is not representative of the total tree failures throughout the City. The numbers are made available only to show the relative increase in five years, which is approximately 400%.

In July 1998 the Risk Management Division provided the Parks Division with an Executive Summary of a Risk Assessment Report, which reported on the expected frequency, and severity of the risks identified in the Division's area of responsibility. The consultant wrote "in the absence of funding for regular tree inspection programs, the potential risk of injury or property damage resulting from diseased/damaged trees is significant." The Risk Map provided by the consultant indicated that, of the key risks in the Parks Division area, the lack of a tree inspection program created the greatest liability exposure for the Division's operation.

## **Purpose and Scope**

The purpose of this strategy is to provide direction and guidance for the management of tree hazards in natural area ecosystems within Surrey. The Parks, Recreation and Culture Commission and Department would be responsible for such management of the land under their auspices. The goal of this strategy is to develop and implement a comprehensive tree hazard management program that controls tree hazard risks and establishes a reasonable standard of care in managing tree hazard risks in natural areas.

A comprehensive Tree Hazard Management Strategy will provide the following benefits:

- Risk management and reduced liability
- Safe environments for park patrons
- Protection of assets
- Management of conflict
- Improved customer service and public image
- Reduced insurance costs
- Enhanced forest ecology
- Improved tree health

## **Past Tree Hazard Management Programs**

The Parks Division has been conducting a forest management program since approximately 1979. This program was implemented to focus on the removal and abatement of tree hazards in natural areas and Parks grounds maintenance staff conducted the work. Parks and forests would typically be inspected and assessed for tree hazards on a scheduled basis, and the work would be conducted during the fall and winter months following seasonal mowing programs and when staff were available.

Over the years, as tree hazards in the forests were progressively removed and abated, the forest management program focused on other issues such as reforestation and trail maintenance. Funding for forest management did not keep pace with growth and demand and the effect has been that inspection for tree hazards is conducted primarily on a request-basis from residents or park users, rather than on a schedule.

## **Current Tree Hazard Management Programs**

Currently, the Parks Division has no comprehensive tree hazard management program in place, so that planned, scheduled inspections do not occur.

Inspections for tree hazards are conducted as a result of the following:

- Resident requests or notification to inspect a tree
- Incidental observation by staff when conducting trail maintenance, mowing activities, etc.

- Occasional inspections when new parkland is purchased either for park development or greenbelt forest
- Following significant storms, inspection for “hot spots” where previous tree failures have occurred
- Follow-up inspections for specific trees, or in specific areas where deemed necessary

## **Duty of Care for Managing Tree Hazards**

Generally, cities will honour the duty of care that requires them to implement a comprehensive tree hazard management program.

The Occupier’s Liability Act imposes a common affirmative duty on occupiers of land and premises to take reasonable care that people and their property will be reasonably safe. An occupier is defined as a person who has physical possession of premises. The goal of the Act is to promote, and indeed require where circumstances warrant, positive action on the part of occupiers to make their premises reasonably safe.

As the City of Surrey has been rapidly urbanizing, it has become the occupier and manager of considerable amounts of public forest land that have many recreational uses. Because the City invites public access and recreation in its natural areas, it has a duty to provide for reasonably safe use of the natural areas. That duty includes managing the risks associated with tree hazards.

## **Standard of Care for Managing Tree Hazards**

The standard of care stipulates those actions required to fulfill the duty of care of a landowner. A number of factors are considered:

- Industry standards—based on studies of standards for tree hazard management in cities of similar size and type.
- Available resources—finances, staff and equipment
- Professional opinion, recommended standards, and court rulings
- Types of vegetation to be managed

Should a tree fail and cause property loss or physical injury, failure to comply with a reasonable standard of care may result in negligence and liability on the part of the City.

### **1. Industry Standards**

Interviews with local municipalities and other cities indicate that the standard of care is highly variable in the region. Some of the more developed communities such as Vancouver and Burnaby, have implemented some form of scheduled hazard tree inspections. Most communities report they will conduct hazard tree abatement work if a hazard tree is noted by staff, or if a request for tree hazard assessment is received from

the public. They also report they are planning to develop a more comprehensive approach to tree hazard management.

## **2. Available Resources**

- **Finances**—The Parks Division currently allocates approximately \$800,000 of operating funds to natural area maintenance management programs. Another \$250,000 of capital funds is also allocated to the development of natural areas that include initial hazard tree abatement work.
- **Staff**—Within the staff compliment of the Parks Division there are highly trained certified arborists and urban forest technicians capable of conducting tree hazard evaluations.
- **Equipment**—Although the necessary equipment is not on hand for City staff to conduct all of the various types of hazard tree abatement work, the private sector contractors do possess the necessary equipment.

Within the scope of the available funding and other resources such as equipment and staff expertise, many of the activities associated with a tree hazard management program could be undertaken.

## **3. Professional Opinion, Recommended Standards, and Court Rulings**

A review of literature on the issue of ‘standard of care’ for managing tree hazards clearly indicates that a tree hazard management program is an integral part of a comprehensive natural area management program, particularly in the case of urban areas.

“Case law and common law have delineated a difference between duty principles in rural versus urban settings. Traditionally in rural settings, an owner/manager had a duty to correct or remove known hazards. Duty principles continue to evolve but generally suggest a greater level of duty in urban/suburban areas. In urban areas duty has included removal of known hazards and, in addition, inspection for hazards. Inspection for hazards is a burden that must be met to prevent a failure in duty and charges of negligence. (Dr. Kim Coder, *Tree Risk Management and Hazard Assessment: A General Overview*, 1966, pp 4)

## **4. Vegetation**

The natural area trees and forests managed by the City are in a variety of locations, sizes and condition. Many of the forests are comprised of even age, single species that are near or at maturity, or even in decline. Many of the forests are comprised of trees that are large in size, second growth with poor live crown ratios, sometimes over 100 feet in height, and located in narrow greenbelt corridors. Therefore, the forests in City parks, in many cases, pose potential hazards by the nature of their location, size and condition.

# **Tree Hazard Management Strategy**

A tree hazard management strategy controls risk associated with tree failure by implementing standards, procedures and practices that prevent, eliminate, avoid, reduce, and transfer the risk:

- Prevent ~ through careful park design
- Eliminate ~ through removal of hazard trees
- Avoid ~ through policies on level of service
- Reduce ~ through tree hazard inspections
- Transfer ~ through installation of appropriate signage

The following measures are recommended as standards, procedures and practices that form a tree hazard management strategy and program for natural areas.

## **Goals and Objectives**

- 1. Implement a comprehensive tree hazard management program that will provide benefits to the City, and the natural areas and park patrons who use natural areas.**

The implementation of a tree hazard management program serves to meet a duty of care to provide reasonable safety for those who use natural areas, or those who may have property adjacent to the natural area. The purpose is to manage City risk and liability exposure, and maximize public safety. The program also considers the need to provide wildlife trees, coarse woody debris, and protection of existing habitat and other vegetation in the natural area.

- 2. Reduce risk of tree hazards by implementing preventative measures, in park planning, development, construction, operation and maintenance processes.**

A wide range of preventative measures can be implemented:

- Reduce the windthrow potential of the forest stand by increasing the interior area of a forest in relation to the total length of the forest edge, effectively providing for forest stand widths and sizes that reduce windthrow.
- Implement clearing guidelines and specifications that prevent unnecessary damage to trees during development of natural area parkland or private land adjacent to forested parks.
- Assess and abate of tree hazards during development or acquisition of natural area parkland prior to receiving the land for operations management.

- Adopt practices that prevent damage to trees, particularly tree root zones and trunks, during construction and installation of park recreation amenities and structures.
- Develop comprehensive site drainage to ensure appropriate forest hydrology.
- Eliminate park operation and maintenance practices that cause unnecessary damage to tree roots and trunks, and adopt more constructive practices.

**3. Create awareness of tree hazards and inform park users that there are inherent risks in using urban forests.**

Comprehensive risk management programs would include creating awareness and providing direct information to park users as to the potential hazards and dangers associated with particular activities or uses of certain facilities. This information will help users make decisions about the degree of responsibility they are willing to assume for risks involved in certain “dangerous” activities in natural areas. Appropriate park signage, information brochures, and newspaper notices should be utilized as vehicles for providing this information.

**4. Schedule inspection of natural areas to assess for trees hazards.**

Comprehensive scheduling of inspections for tree hazards is needed because particular types of vegetation are vulnerable to becoming hazardous by their nature (condition, location, and forest/species type). Achieving the goal of a full schedule will depend on funding and target prioritization.

**5. Respond to internal and external demand requests for tree inspections in a timely manner.**

In addition to scheduled inspections for tree hazards, timely response to demands/requests from internal or external sources is also necessary to meet ‘a duty of care’. Reducing delay will reduce risk and danger.

**6. Stipulate consistent inspection guidelines and tree assessment procedures to guide qualified staff or consultants in conducting tree hazard inspections and assessment work.**

Tree assessment procedures should be developed according to recommended current industry techniques and standards, and will utilize an objective hazard methodology.

**7. Prevent unnecessary damage to the ecology of the natural area, including all significant vegetation or habitat, when carrying out hazard tree abatement work.**

Pruning, cabling, removing or other hazard tree abatement must be done according to recommended industry standards and sound arboricultural practices. Potential benefits to local flora and fauna must be maximized, and negative disturbances minimized. This entails, wherever possible, the creation and retention of wildlife trees and coarse woody debris, the consideration of the time of year (seasonal nesting and rearing of the young), and the obvious presence of wildlife.

**8. Create a reliable natural area inventory database and work history recording system.**

An inventory database needs to be created for natural areas that include descriptors for targets, forest stand and other necessary tree management information. Tree hazard inspections and abatement work needs to be recorded for future reference, modeling, and scheduling.

## **Park Planning and Design**

**Windthrow**—Because single, even-aged tree species typify much of the forested lands within the City, narrow forests and treed greenbelts often create significant tree windthrow, impacting private property and roads. This is often the case where poorly planned forested parks are adjacent to residential properties. In the past, the City has sometimes needed to remove complete forest stands at considerable expense. It is therefore recommended that:

- Planning for provision of forests needs to fully consider the character and type of forest stand and its windthrow potential. This planning includes providing for appropriate forest stand widths and sizes and requiring developers to reduce windthrow through tree pruning or removal prior to the City receiving the land for management.

**Tree failure and invasive roots**—Planning should consider the potential risks associated with trees, such as whole or part tree failure and trip hazards associated with surface root zones. Two examples of this are firstly, that in some City parks there are many paved paths near trees with aggressive root systems, this often results in pavement lifts and trip hazards. Secondly, playgrounds have been sited directly beneath tree species known for unpredictable branch drop, posing hazards for children. It is therefore recommended that:

- Planning and siting of recreation facilities, park amenities and park structures must consider the inherent risks associated with adjacent trees, this includes whole and part tree failure and invasive roots.

**Drainage**—Effective forest hydrology—the natural flow patterns and amounts of water available in a forest—is critical to the health of an urban forest. However, it can become seriously compromised by development in a number of ways: when development adjacent to park forests deprives the forest of needed water, or when excess water is deposited into the forest from the adjacent development site, or when development within park sites is undertaken without properly engineered drainage. These practices result in tree mortality from drought, stress, or saturated root zones. Therefore it is recommended that:

- Planning for park and open space development must provide comprehensive drainage to ensure the forest hydrology is maintained at appropriate, natural levels to avoid tree mortality.

**Expertise**—Stakeholder and expert opinion should be solicited and included in planning processes. With the recent creation of the Urban Forestry and Environmental Services

Section, there is a good opportunity to include Park’s Division input during the planning and design stages of development. Therefore it is recommended that:

- Planning and design processes that affect natural areas will solicit the concerns and expertise of the Urban Forestry and Environmental Services Section of the Parks Division and other stakeholders when necessary.

## **Land Development and Construction**

During land development, the Parks Division does not provide a set of comprehensive tree protection guidelines for land developers, land clearing companies or construction companies. Nor does it consistently monitor development activities when work is being conducted in and around park trees or forests. Tree trunks and roots of park trees are often significantly damaged by machinery, and the excess construction side castings, spoil and unwanted building materials are often left on-site. The result is compacted root zones, altered hydrology in the forest and premature tree death. By-law enforcement and litigation have not proven to be an effective method for eliminating these practices. Therefore it is recommended that:

- The Development and Construction Services Section of the Parks Division should create comprehensive “Tree Protection and Preservation Guidelines and Standards” to be used when development and construction occurs in the vicinity of park trees.
- Appropriate professionals should strictly monitor and enforce the guidelines to ensure compliance.

## **Park Operation and Maintenance**

Natural area operating practices can contribute to reducing tree hazards. For example, closing forests or trails during particular climatic conditions when tree loss can be expected is an option that has yet to be explored.

**Park Maintenance Practices**—Inappropriate maintenance practices have contributed to the creation of tree hazards, some of these practices are as follows:

- Damage to tree roots and trunks during mowing of forest trails, edges and verges.
- Foreign materials from park renovation activities are sometimes deposited on tree root zones in forests as a mistakenly accepted and inconsequential practice.
- Topping, improper branch, sucker and root pruning. Although topping has now been discontinued as an abatement practice, the best arboricultural methods and techniques are still not used consistently. This is due, in part, to the insufficient number of qualified staff available for hazard assessment and abatement work.

It is therefore recommended that:

- All park operation and maintenance practices be designed and implemented to prevent unnecessary damage to trees.

**Informing the Public**—Effective tree hazard management will reduce but not entirely eliminate the inherent dangers in natural areas. In addition to these measures, users and adjacent land owners need to be informed of any risks or dangers so that they can make informed decisions about entering and using the natural area. Therefore it is recommended that:

- park users and adjacent landowners need to be informed of the inherent dangers within the natural area. Information should be provided on park signage and through a wide range of media information sources such as general distribution brochures and newspaper advertisements.

## **Tree Inspection and Assessment**

Sound and clear guidelines are necessary for inspection and assessment of tree hazards, especially given the inevitable difficulties involved in making judgments about potential tree hazard:

“Identifying and managing the risks associated with trees is a subjective process. Since the nature of tree failures remain largely unknown, our ability to predict which trees will fail and in what fashion is limited. As currently practiced, tree evaluation involves examining a tree for structural defects, associating those defects with a known pattern of failure and rating the degree of risk.” (N. P. Matheny and J.R. Clark, *Evaluation of Hazard Trees in Urban Areas*, 1994. pp 2).

The following definitions apply to inspection and assessment guidelines:

1. A **hazard tree** is a tree which is likely to fail due to major structural weaknesses, adverse site conditions or other external factors, under average conditions, and has the potential to strike a target.
2. A **wildlife tree** is a tree which possesses high habitat values for wildlife due to its physical attributes, location and relative uniqueness. High value wildlife trees will have some of the following characteristics:

Native species	Greater than 20m tall
Large diameter	Loose bark
Cavities or decay pockets	Many large branches

3. A **target** is a person, property or other asset that has the potential to be struck and injured or damaged by a falling tree or part thereof.
4. A **tree hazard inspection** is conducted on a regular, scheduled basis to identify trees that require individual tree hazard assessment in park areas and forest/treed sites.
5. A **tree hazard assessment** is conducted to evaluate and rate the extent and degree of defects in a tree and the risk that it may pose to a potential target.

6. A **tree hazard rating system** is used to rate the degree of tree hazard. It is based on the risk factor of the tree, the failure probability of the tree, size of part that could potentially fail and the value of the potential target. A numerical value is often rendered that assists in decisions to undertake tree hazard abatement work.

### **Tree Hazard Inspection and Abatement Work**

1. Inspections and abatement work should be conducted:
  - In a timely manner, on a priority basis, and in order from high to low risk.
  - According to industry standards with recommendations that consider the need to retain and preserve trees, provide for wildlife habitats, and provide for safety of life and property.
2. Tree Hazard abatement work should consider the option of “wildlifing” the tree or leaving coarse woody debris whenever possible.
3. Inspections and assessments for hazards:
  - will utilize a variety of procedures including site assessment;, visual tree assessment; detailed, written tree assessments.
  - will detail tree assessments for scheduled and demand inspections.
  - will consider the option to monitor a tree’s condition through future scheduled inspections.
  - will be documented and filed for future reference in all cases.
4. A numerical rating system will be used to determine the hazard rating of trees according to the following criteria:
  - structural integrity of the tree.
  - failure potential of the tree or its parts.
  - potential target should the tree or parts of the tree fail.
  - endemic climatic conditions for the site.
5. Qualified persons will assess tree hazards and conduct abatement work..

### **Qualifications for Tree Hazard Inspectors and Assessors**

Tree hazard inspectors and assessors should be familiar with the City’s overall tree hazard management program, the natural area management issues, and the City policies and procedures as they relate to tree hazard management. Their professional qualifications should include a combination of the following:

- A demonstrated ability to undertake inspections and assessments of trees for hazards.
- Graduation from an accredited forestry or arboricultural program.
- Arborist certification from an approved and accredited organization such as the International Society of Arboriculture.

- Successful completion of the “Wildlife / Hazard Tree Evaluators Course for Parks and Recreation Sites”.
- Training specific to hazard tree evaluation and assessment.
- Familiarity with industry standards and procedures in hazard tree inspections and assessment.
- Basic training in the ecology of coastal forest ecosystems.

## **Tree Hazard Inspection Procedures**

### **Assessment Methods**

**Site Assessment**—A site assessment is appropriate for determining overall tree and forest health, and involves visually scanning for obvious and general conditions that indicate tree or forest health problems. The site assessment is a visual scan of the area to determine if there is a need to schedule further visual or detailed tree assessments (described below). Site assessments could address the following:

- General site conditions
- Overall tree canopy health
- Overall forest composition and health

**Visual Tree Assessment**—A visual tree assessment is appropriate when assessing for obvious tree defects, emerging problems, site conditions and other visually apparent factors that could contribute to tree failure. Trees should be circumnavigated to assess for defects, and then hazard management strategies or further assessment could be recommended (see below).

Possible defects and site conditions are as follows:

#### **Tree Defects**

- splits or cracks in the trunk or branches
- necrotic or chlorotic appearance
- unnatural lean (>10%)
- visible decay pocket
- fungal fruiting bodies
- seeping sap (resinosis) or bark stains
- insect frass or bore holes
- canker faces
  
- scars or sunscald
- thick, sloughing bark
- hanging or weakly attached limbs or tops
- evidence of recent mechanical damage
- codominant stems, included bark

#### **Site Conditions and Other Factors**

- newly exposed trees
- site or tree exposure to winds
- saturated or compacted soils
- recently altered grades/drainage patterns
- poor rooting substrate
- evidence of other failures nearby
- undermined or heaving roots
- topography
- depleted or contaminated soils

**Detailed Tree Assessment**—The purpose of a detailed tree assessment is to follow up on a visual assessment in order to determine the extent of tree defects. Tests and procedures such as the following are often required:

- core sampling
- strength loss calculations
- sounding
- water table/hardpan location (soil pit)
- sample collection and analysis (fungi, foliage, wood, roots, soil, insects)
- drilling or resistographing roots or trunk
- root crown excavation and inspection
- soil compaction tests (penetrometer)
- aerial inspections (upper trunk and crown)

Tree hazard inspectors will make judgments as to which natural areas should be inspected, and then employ the following recommended methods of inspection.

### **1.0 Scheduled Tree Inspections**

Inspections for hazard trees in parks and forests should be scheduled on a recurring basis and as funding permits. Experts agree that regular scheduling is necessary:

“Parks and recreation sites should be inspected for tree hazards on a regular basis,” “the frequency of inspection will depend on the level of use/exposure, proximity and type of target and the level of disturbance,” and “assessment frequency will be determined on a site by site basis” (Dunster 1-8).

Tree hazard inspections should be prioritized by risk rating for the following:

- General failure probability of trees within a stand or forest
- History of tree failure at the site
- Target values

Scheduled assessments should proceed as follows:

1. Delineate the site and area that will be the subject of the tree inspection, and review the site and tree history.
2. Identify and value the potential targets at the site.
3. Conduct a visual tree assessment to determine tree hazards that can impact the potential targets and cause significant damage.
4. If the visual tree assessment, site history information and other factors warrant, conduct a detailed tree assessment to determine the extent of the tree defects.
5. Record all trees that require hazard abatement work using the industry standards hazard tree rating system.
6. Conduct hazard tree abatement work in a timely, cost effective manner.
7. If necessary, schedule further inspections to monitor the site.

## **2.0 Demand Tree Inspections**

Tree hazard inspections requested by internal and external clients will be conducted in a timely manner, and then prioritized according to the reported immediacy of the hazard. Procedures will vary depending on the specific type of request.

### **2.1 Hazard Assessment for Specific Trees Identified by the Requestor**

1. Review site and tree history.
2. Discuss request with service requester.
3. Identify and value the potential targets at the site.
4. Conduct a visual tree assessment for the specific trees.
5. If the visual tree assessment, site history and other factors warrant, conduct a detailed tree assessment to determine the extent of the tree defects.
6. Record all trees that require hazard abatement work using an industry standard hazard tree rating system.
7. Conduct hazard tree abatement work in a timely, cost effective manner.
8. From the vicinity of the tree assessment site, conduct a site assessment of the remaining trees or forest area. If necessary, schedule a tree inspection for the future and prioritize with other planned scheduled tree inspections.
9. If necessary, schedule further inspections to monitor the site.

### **2.2 Hazard Assessment for Trees in a General Area as Identified by the Requestor**

1. Determine the specific area of concern to the requester.
2. Review site and tree history.
3. Conduct a visual tree assessment to determine tree hazards that can impact the potential targets and cause significant damage.
4. If the visual tree assessment, site history information and other factors warrant, conduct a detailed tree assessment to determine the extent of the tree defects.
5. Record all trees that require hazard abatement work utilizing an industry standard hazard tree rating system.
6. Conduct hazard tree abatement work in a timely, cost effective manner.
7. If necessary, schedule further inspections to monitor the site.

## **3.0 Tree Inspections Following Tree Failure**

Following tree failure, an inspection should occur and a decision should be made as to the need for any future scheduled inspections. The following procedure should be followed:

1. Review site history, particularly the history, amount, and reasons for previous tree failure.

2. Determine the inspection area, based on site history and significant targets at the site.
3. Conduct a site assessment to determine general tree health and site condition.
4. If necessary, based on the results of the site scan, conduct a visual tree assessment to determine tree hazards that can impact the potential targets and cause significant damage.
5. If the visual tree assessment, site history information and other factors warrant, conduct a detailed tree assessment to determine the extent of the tree defects.
6. Record all trees that require hazard abatement work utilizing an industry standard hazard tree rating system.
7. Conduct hazard tree abatement work in a timely, cost effective manner.
8. If necessary, schedule further inspections to monitor the site.

## **Other Recommended Practices**

### **Failure Pattern Recording, Mapping, and Prediction**

To better understand the causes of tree failures, and to identify specific tree-type vulnerabilities, it is essential to assess failed trees and record the findings in a centralized database. Through the long-term collection of data, a set of trends or patterns should emerge that will enable better prediction of the failure potential of the City's trees.

Notes should be recorded on a formal data collection sheet and should contain the following information.

- date and time of event
- species
- dbh
- height
- direction of fall
- weather and soil conditions at the time of failure
- condition of tree and individual parts of tree
- any other factors that, in the trained assessors opinion, may have contributed to the failure of the subject tree.

### **Damage Assessment**

If a tree managed by the Parks Division has failed and has caused damage to persons or property, notes should include explicit details describing the damage that occurred and possible causes. Photographs must be taken as described below.

### **Photographs**

Photographs should be taken of all trees that:

- Have failed and caused damages.
- Have failed and not caused damages.
- Are to be retained after a detailed inspection.

When taking photographs of trees, standing or fallen, the following procedures should be employed:

1. Take photos from more than one perspective.

2. Include objects to aid in determining scale.
3. Take detailed photos of the point of failure and any damaged items.
4. Record the following:
  - Date and time of inspection
  - Date and time of incident (if any)
  - Weather during inspection and during incident
  - Site location and/or tree location
  - Observers name
  - Direction the photographer was facing

### **Resource Identification and Assessment**

Resource information is necessary to schedule tree hazard inspections on a priority basis.

- **Inventory and map all subject areas.** Identify all subject lands where the Parks Division is responsible for tree management, and generate hardcopy base maps for each of these areas. These maps should be kept in a dedicated book.
- **Assess and classify areas according to forest type and characteristics.** Overview assessments of each subject area should be performed to determine tree/target interfaces, forest types, ages, relative health, and exposure to elements, target types and past histories regarding hazardous trees. These items should be digitally entered into the City's GIS system.
- **Priority rating for tree hazard inspections.** Table 1, below, depicts a sample risk rating system.

The risk rating is the value placed on the risk posed by a forest stand, tree or portion thereof, and considers tree age, condition, forest composition, site conditions, topography, history of the failure at the site, etc.

The target rating is the value placed on the target. A person would have a high target value, a fence a low target value. Target rating also considers the frequency of use of the target: well used trails may be rated as a high target rating whereas low use trails may be rated as medium target rating.

Priority hazard ratings exist on a scale of 1 to 5, with 1 the highest and 5 the lowest. Priority 1 areas would be inspected and assessed first, then priority 2, etc.

Priority Rating	Risk Rating	Target Rating
1	high	High
2	high	Medium
3	high	Low
2	medium	High
3	medium	Medium
4	medium	Low
3	low	High
4	low	Medium
5	low	Low

Table 1. Sample Risk-Rating System

### **Formal Tracking System**

A computer based tracking system should be designed and implemented to coincide with the field data sheets to accurately record and manage hazard tree work. Customized database for Maximo™, MS Access™, Tree Keeper™, or Quantitree™ are the recommended choices.

## **References**

Risk Management Division, Executive Summary of the Risk Assessment Report, City of Surrey, 1998

Coder, K. Tree Risk Management and Hazard Assessment: A General Overview. Website, <[www.forestry.uga.edu/warnell/html/service/library](http://www.forestry.uga.edu/warnell/html/service/library)>. 1996.

Matheny, N.P. and Clark, J.R. Evaluation of Hazard Trees in Urban Areas; Published by the International Society of Arboriculture, 1994.