



Parks

New Forester Orientation

Tree Risk Assessment Training

NYC Parks Urban Forestry Principles

1. Ensure public safety
2. Promote tree health
3. Increase tree canopy benefits
4. Preserve urban canopy



NYC Parks Urban Forestry Principles

Why must we consider public safety when managing trees?

???Risk???



<https://me.me/i/the-thinking-tree77e3775112b6416a81864ba6a34f14dd>

What is Risk?

The combination of the likelihood of an event and the severity of the potential consequences. In the context of trees, risk is the likelihood of a conflict or tree failure occurring and affecting a target, and the severity of the associated consequences.



What is Risk?

Risk – The combination of the likelihood of the event (tree or tree part failure) and the severity of the potential consequences (personal injury, property damage, disruption of activities).

Inherent Risk – The amount of risk before the application of mitigation efforts or controls.

Residual Risk – Risk remaining after mitigation.



How do we prevent risk?

How do we prevent risk?

- All trees have potential for failure, even without defects, therefore all trees pose risk.
- **Risk Management**: The application of policies, procedures, and practices used to identify, evaluate, mitigate, monitor, and communicate tree risk.

What is Tree Risk Management?

- A Best Management Practice.
 - USFS Urban Tree Risk Management Guide (2003)
 - ISA Tree Risk Assessment Best Management Practice (2011)
 - ANSI A300 Tree Risk Assessment Standard (2013)
- A management framework through prioritization.
 - Large scale management through strategic prioritization.
- A legally defensible strategy.
- A tool for tree preservation.
 - Enhances the longevity of trees by identifying and correcting structural defects.

What does tree risk look like?

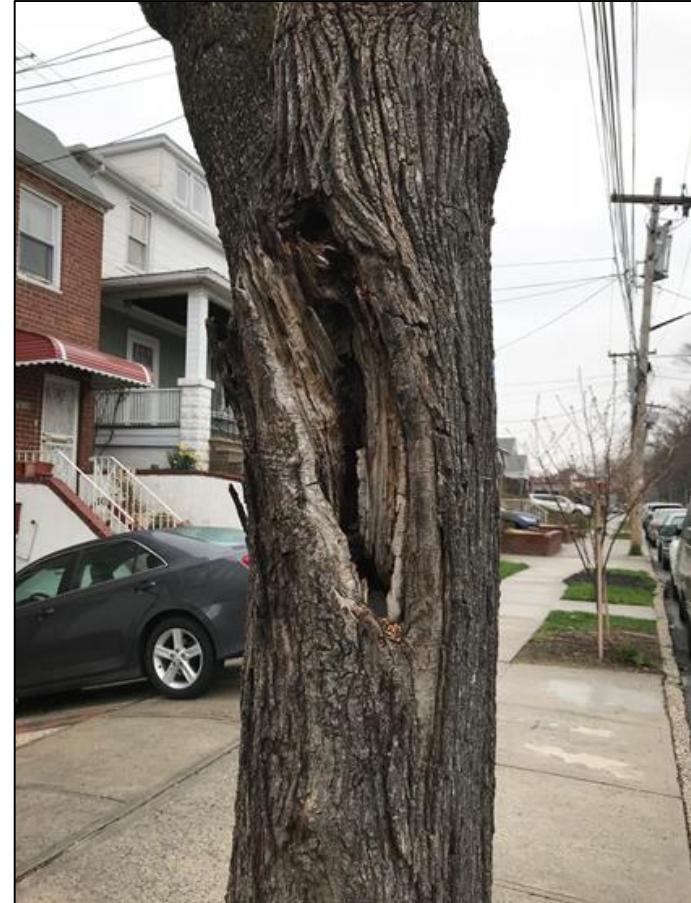


<https://www.bestfunnies.com/top-20-funny-trees/funny-tree-17/>

What to look for when assessing risk

Defect – An imperfection, weakness, or lack of something necessary. In trees, defects are injuries, growth patterns, decay, or other conditions that reduce the tree's structural strength.

An observable defect is a tree part greater than 2" in diameter.



Common Defects

1. Cankers
2. Cracks
3. Dead Wood



Common Defects

4. Decay
5. Poor Tree Architecture
6. Weak Branch Unions



Performing tree assessments

Tree risk assessment – the systematic process to identify, analyze, and evaluate tree risk

Tree risk evaluation – The process of comparing the assessed risk against given risk criteria to determine significance of the risk.

Likelihood of failure and impact – The chance of a tree or tree part failure occurring and impacting a target within a specified timeframe.



Performing tree assessments

Level 2 Inspections

Basic Assessment: Detailed visual inspection of a tree and surrounding site that may include the use of simple tools. It requires that a tree risk assessor walk completely around the tree trunk looking at the site, aboveground roots, trunk, and branches.

Performing tree assessments

Level 2 Inspections

- Full 360 degree inspection
- Use of basic inspection tools
- Inspect all visible parts of the tree
- Assess general tree health
- Review site factors, history, conditions, and species failure profile
- Identify defects and assess general loads on tree and tree parts
- Identify targets and occupancy rates
- Establish timeframe of inspection (One Year for NYC Parks Level 2)
- Determine if mitigation work and/or re-inspection is necessary

Performing tree assessments

Why 360 degrees?



Performing tree assessments

Basic Inspection Tools

- Sounding Mallet
- Probe
- Binoculars
- Trowel/Shovel



Performing tree assessments

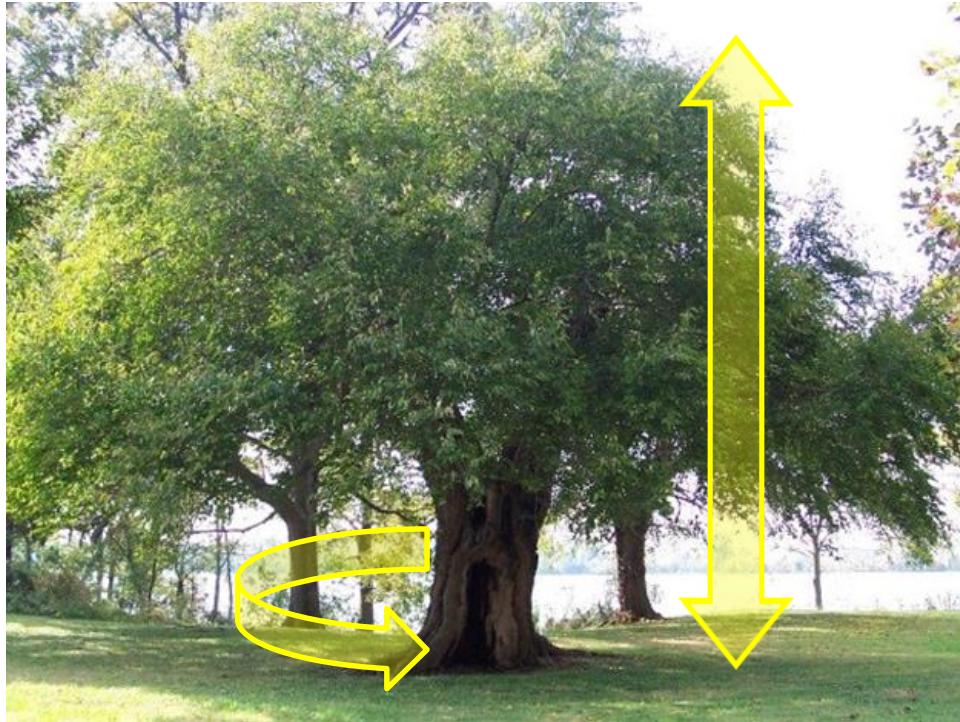
Inspect entire tree and assess general health

Examine all sides of the tree (360 degree walk around)

- From a distance
- Close up

Visible parts of tree to inspect

- Root zone
- Root flare
- Trunk
- Branches Unions
- Branches
- Crown (twigs and foliage/buds)



Performing tree assessments

Inspect entire tree and assess general health:
Roots and Root Flare Defects

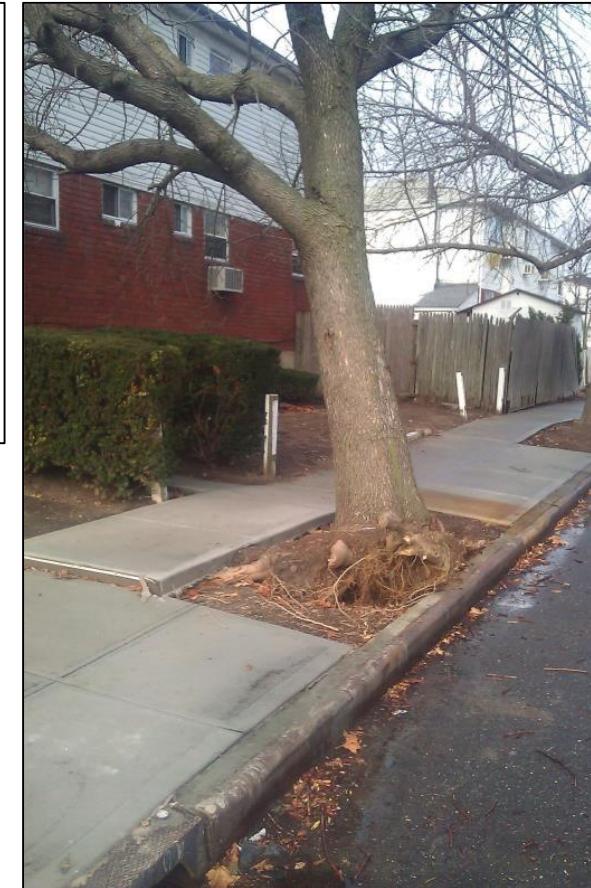
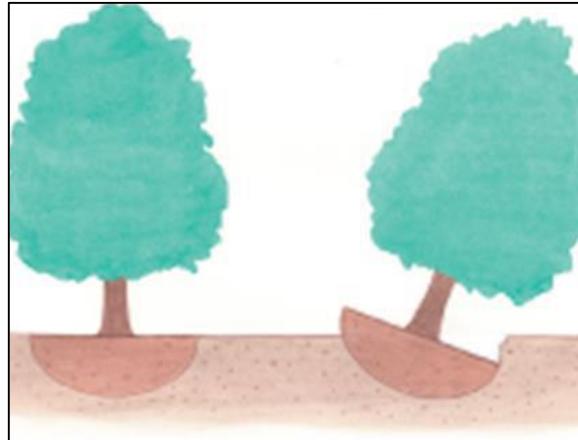
- Stem girdling
- Conks/Mushrooms
- Ooze
- Cavities
- Cracks
- Cut/Damaged root
- Root plate lifting/shifting
- Soil weakness
- Decay
- Response growth
- Buried root collar



Performing tree assessments

Inspect entire tree and assess general health:
Roots and Root Flare Defects

- Soil mounds associated with leaning trees.
- Cracks or similar disturbances at base of trunk.
- Broken/exposed roots.



Tree drawing from Figure 3.78 from Urban Tree Risk Management: A Community Guide to Program Design and Implementation (Pokorny, J., 2003. NA-TP-03-03).

Performing tree assessments

Inspect entire tree and assess general health:
Roots and Root Flare Defects

- Frass/ sawdust accumulation at base of tree indicates insect damage or decay.
 - Carpenter ants
 - Borers (ALB/ EAB)
 - Termites (only eat dead wood)
- Conks or mushrooms at base of tree are indicators of decay.



Identifying and Prioritizing risk

Inspect entire tree and assess general health:
Roots and Root Flare Defects

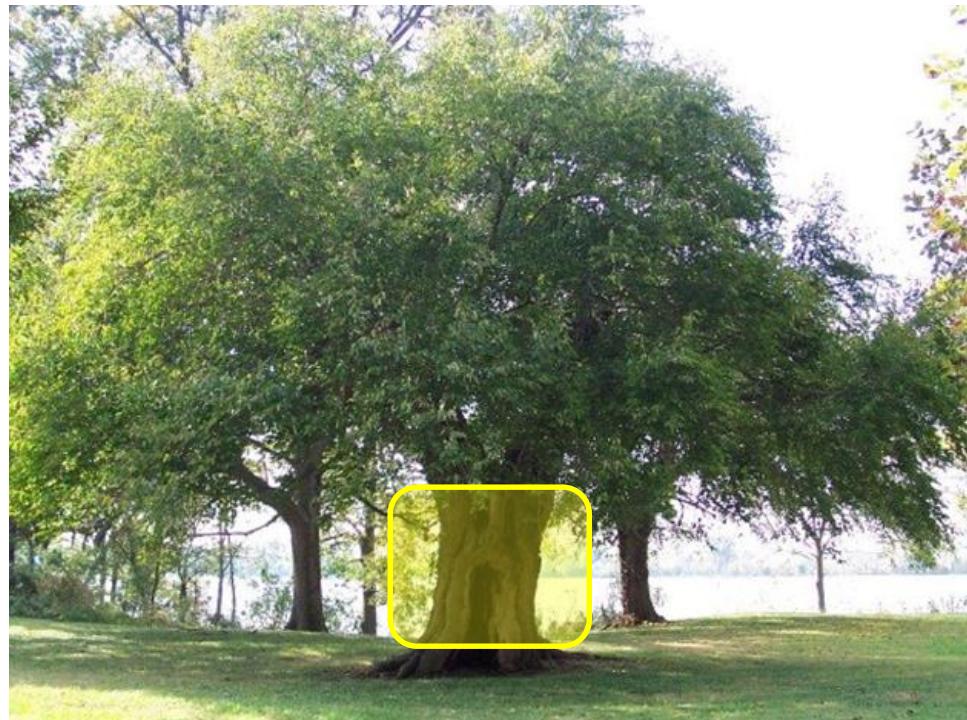
- Lack of root flare indicates fill soil was placed over root flare or tree was planted too deeply, which can affect tree health over time.
- Root flare development can be restricted by surrounding pavement, creating an area of structural weakness.



Performing tree assessments

Inspect entire tree and assess general health: Trunk Defects

- Dead/missing bark
- Abnormal bark texture/color
- Codominant stems
- Included bark
- Cracks
- Sapwood damage/decay
- Cankers/galls/burls
- Sap ooze
- Lightning damage
- Heartwood decay
- Conks/mushrooms
- Cavity/nest hole
- Lean
- Trunk taper
- Response growth



Performing tree assessments

Inspect entire tree and assess general health:
Trunk Defects

- In-rolled cracks or “Rams Horn” form when a wound does not heal or close properly. Serious advanced decay is always associated with in-rolled cracks over time as the in-rolled wood continues to grow.



Figure 3.59 from *Urban Tree Risk Management: A Community Guide to Program Design and Implementation* (Pokorny, J., 2003. NA-TP-03- 03)

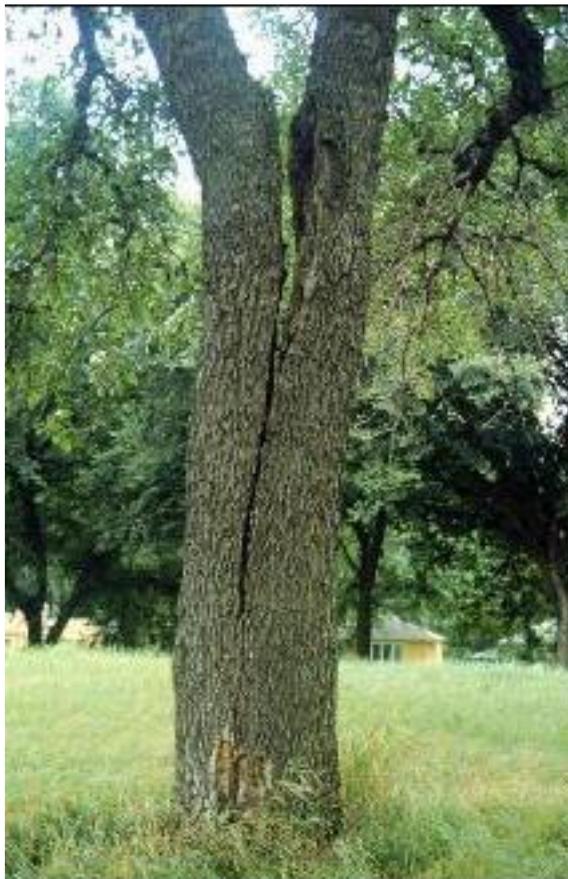


Performing tree assessments

Inspect entire tree and assess general health:

Trunk Defects

- Horizontal cracks indicate imminent failure.
- Normally develop just before failure.
- Vertical cracks indicate a high failure risk.



Performing tree assessments

Inspect entire tree and assess general health:
Trunk Defects

- Abnormally shaped stems indicate potential decay within the stem.
- Asymmetry
- Ribs
- Bulges along trunk
- “Bottle butt”



Performing tree assessments

Inspect entire tree and assess general health:
Trunk Defects

- Bark with abnormal colors or patterns also indicates potential decay.
- Color of bark in cracks.
- Change in bark texture.
- Loose or cracking bark.



Performing tree assessments

Inspect entire tree and assess general health:

Trunk Defects

- Oozing is an indicator of potential decay.
 - Many possible causes – cankers, borers, other beetles.
- Sap exuding from almost-closed wounds indicates decay behind wound.



Performing tree assessments

Inspect entire tree and assess general health:
Trunk Defects

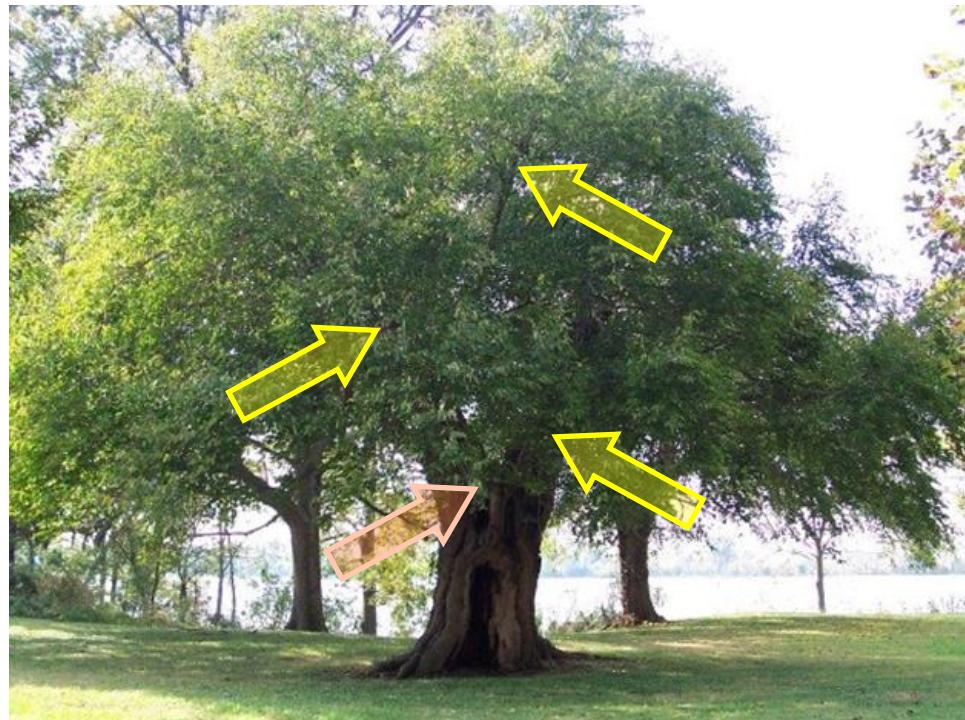
- Fungal activity is a positive indicator of advanced decay.
- Mushrooms
- Conks
- Brackets



Performing tree assessments

Inspect entire tree and assess general health:
Branch Unions and Branches

- Dead/missing bark
- Abnormal bark texture/color
- Included bark
- Cracks
- Sapwood damage/decay
- Cankers/galls/burls
- Sap ooze
- Conks/mushrooms
- Cavity/nest hole
- Branch taper
- Response growth
- Flush cuts
- Over-extended branches
- Poor taper
- Hanging limbs



Performing tree assessments

Inspect entire tree and assess general health:
Branch Unions and Branches

- **Strong branch union**

- Branch bark ridge



- **Weak branch union**

- Included bark, acute angle



Performing tree assessments

Inspect entire tree and assess general health:
Branch Unions and Branched

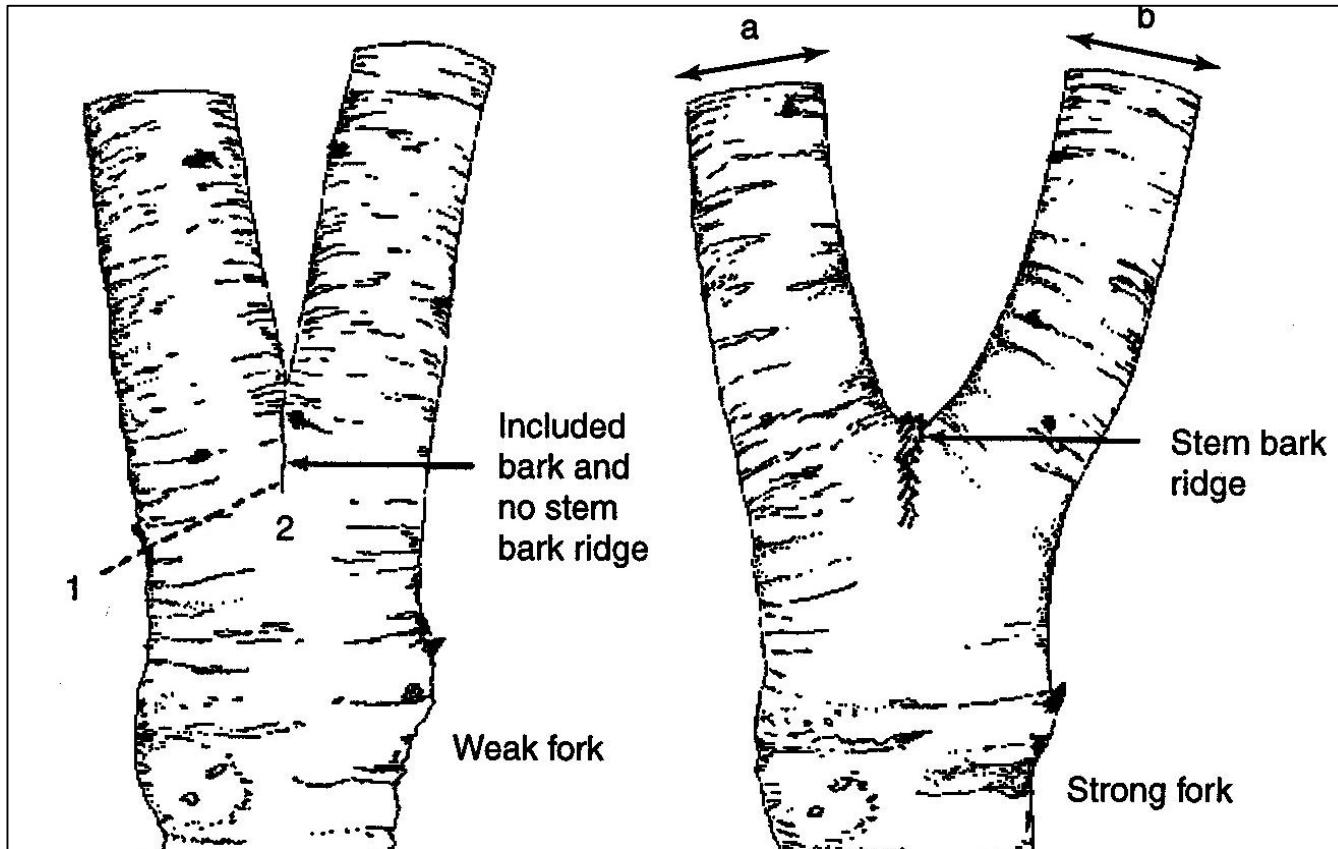


Figure from University of Florida Landscape Plants website: <http://hort.ifas.ufl.edu/woody/junction.shtml>

Performing tree assessments

Inspect entire tree and assess general health:
Branch Unions and Branches

- Weak branch unions
 - Weak branch unions can lead to the failure of an entire limb with severe consequences.



Performing tree assessments

Inspect entire tree and assess general health:
Branch Unions and Branches

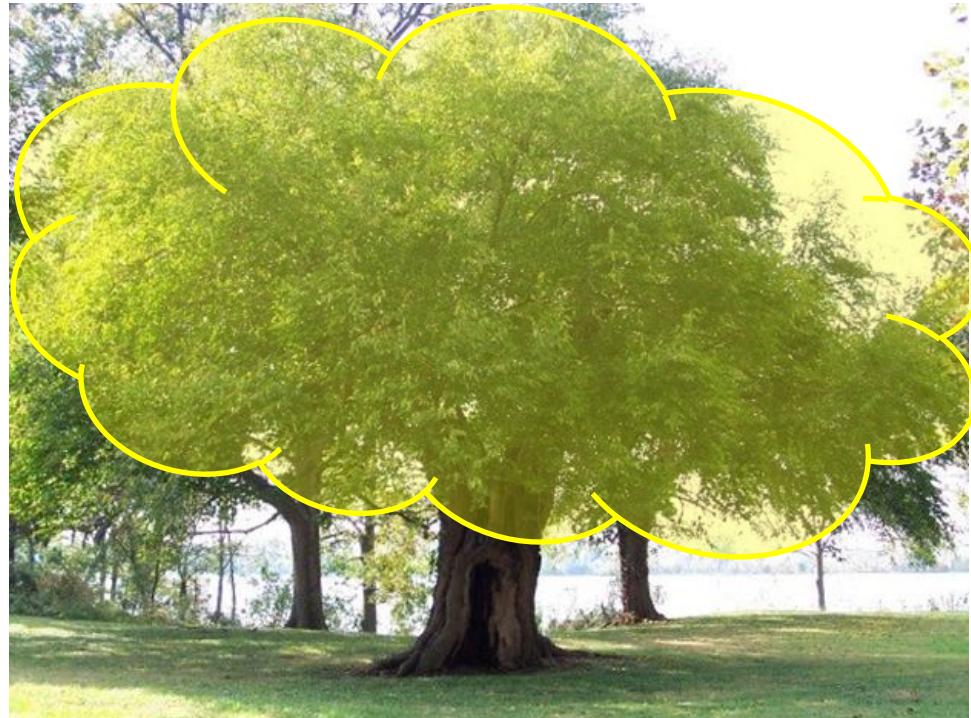
- Look for the presence of all other defects
 - Wounds
 - Cavities/ hollows
 - Cracks
 - Hangers
 - Splits
 - Dead limbs



Performing tree assessments

Inspect entire tree and assess general health:
Crown (Leave and Buds)

- Unseasonal change in foliage (leaves) color and density
- Progressively shorter annual growth
- Dead twigs/branches
- Lack of and/or dead buds (winter)
- Broken branches/hangers
- Unbalanced
- Pruning history



Performing tree assessments

Inspect entire tree and assess general health:
Crown (Leave and Buds)

- **Chlorosis**
- **Bacterial/Fungal**
- **Presence of insects**



Performing tree assessments

Review site factors, history, conditions, and species failure profile

- Site History
 - Planting environment
 - History of Failures
 - Site Changes
 - Construction
 - Major weather events
- Topography
 - Aspect
- Soil Conditions
- Local Climate



Performing tree assessments

Review site factors, history, conditions, and species failure profile

Site History: Planting environment

- Root and buttress development restricted by surrounding pavement
- Trees located close to heavy pedestrian and vehicle traffic are subject to higher levels of stress:
 - Compaction
 - Pollution
 - Wounding/damage
 - Vandalism
- Overhead utilities require regular tree maintenance

Performing tree assessments

Review site factors, history, conditions, and species failure profile

Site History: History of Failures

- Stand/community/tree history.
- History of failure within the tree.
- History of failures in adjacent trees.
 - Similar species?
- History of root disease in adjacent trees.
 - *Armillaria, Phytophthora, Phellinus*



Performing tree assessments

Review site factors, history, conditions, and species failure profile

Site History: Site Changes and Construction

- Sidewalk Repair
- Construction
 - New Building Construction
 - Capital Park Reconstruction
 - Road Work
 - Utility repair/replacement
- Grade Change
- Aboveground Utility Work
- Hydrologic change
- Tree work

Performing tree assessments

Review site factors, history, conditions, and species failure profile

Site History: Site Changes and Construction

A tree's development may be altered if the environment around a tree changes due to:

- Thinning/clearing
- Construction
- Other disturbance

For example: Increased wind speed as result of exposure will induce taper development. Failure rates increase during the transition period.

Performing tree assessments

Review site factors, history, conditions, and species failure profile

Site History: Site Changes and Construction

Increased winds along a new edge may result in:

- Greater root uplift potential
- Branch failure

Altered drainage patterns may result in:

- Root rot and/or uplift
- Erosion/undermining of root system

Performing tree assessments

Review site factors, history, conditions, and species failure profile

Site History: Site Changes and Construction

- Root crown development restricted by surrounding pavement creates an area of weakness
- Trees close to traffic are subject to repeated wounding that increase failure potential
- Overhead wires require regular tree maintenance
- Recent construction
- Vandalism

Performing tree assessments

Review site factors, history, conditions, and species failure profile

Site History: Major weather Events

- Tornadoes
- Hurricanes
- Drought
- Flooding
- Blizzard



Performing tree assessments

Review site factors, history, conditions, and species failure profile

Topography: Land and water features of an area, including changes in elevation.

Consider the following:

- Aspect
- Slope%
- Drainage
- Natural barriers
- Elevation
- Degree of exposure



Performing tree assessments

Review site factors, history, conditions, and species failure profile

Soil Conditions

- Structure: Water, Air, Clay, Silt, Sand, Organic matter
- pH
- Depth/Volume
- Saturation/Drainage
- Erosion
- Compaction
- Pavement/Pavers



Performing tree assessments

Review site factors, history, conditions, and species failure profile

Soil Conditions

- Sandy sub-soils provide less support than clay
- Gravel soils are very unstable
- Summer flooding and shallow, compacted soil are often related to past failures

Performing tree assessments

Review site factors, history, conditions, and species failure profile

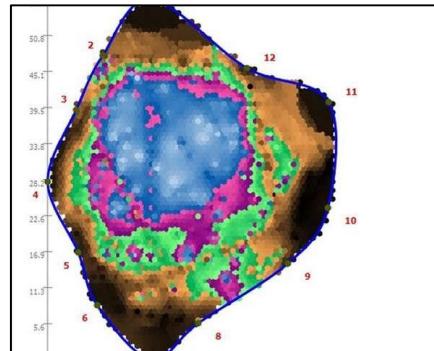
Local Climate

- Tree failures can be associated with:
 - Winds greater than 35 mph
 - Snow and ice loads
 - Extreme precipitation, flooding, or storm surge that saturates the soil
 - Other extremes of climate

Performing tree assessments

Level 3 Inspections

- Require specialized equipment
- Assess defects not otherwise visible during level 2 Inspection
- Examples:
 - Resistograph
 - Aerial Inspection
 - Sidewalk Lift
 - Tomograph



Deriving A Tree Risk Rating

1. Identify Tree Parts With Potential For Failure
2. Assess Likelihood for Failure for Each Part
3. Identify Strike Zones Of Potential Part Failures
4. Identify Potential Targets In Strike Zones
5. Identify Protection Features In Strike Zones
6. Assess Likelihood of Part Impacting Target
6. Rate Consequences of Failure
7. Derive Final Risk Rating

1. Identify Tree Parts With Potential For Failure

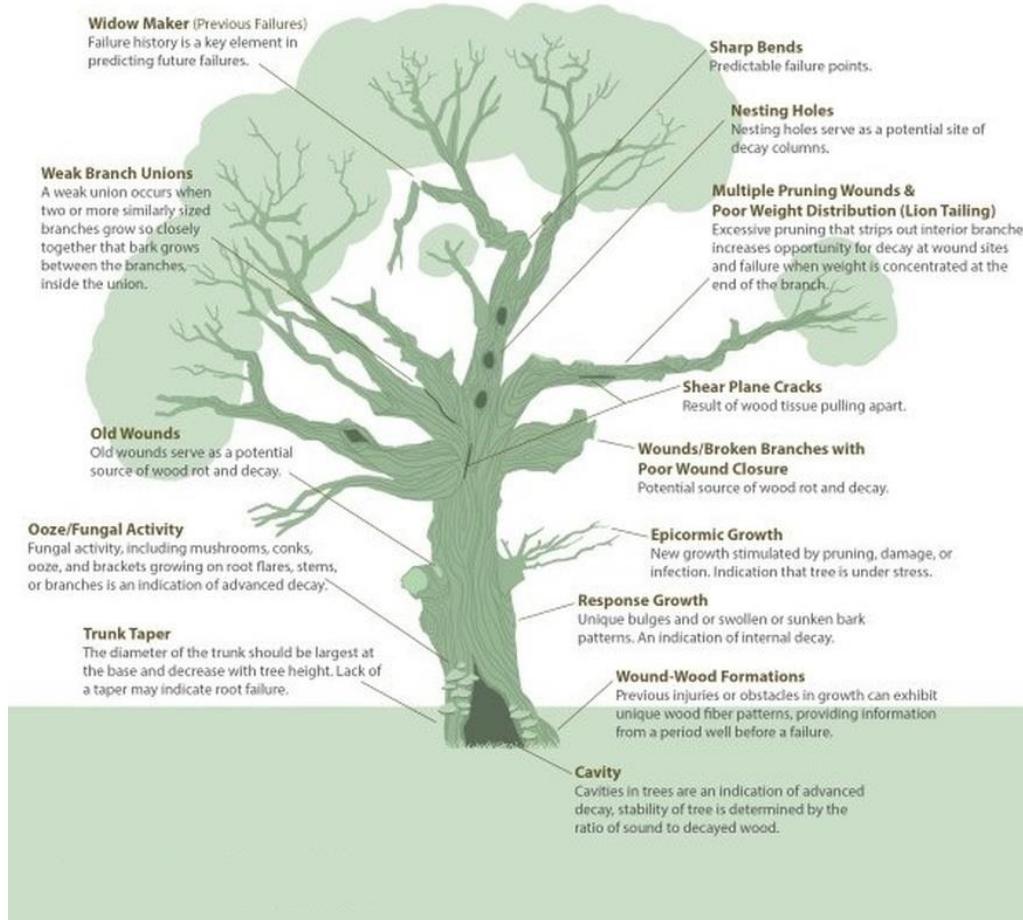
- Perform systematic Level 2 assessment of the tree
 - Visually scan all parts
 - Investigate extent of obvious defects
 - Investigate indicators/symptoms of advanced defects
 - **Assess failure potential**
- Identify if Level 3 assessment is required

1. Identify Tree Parts With Potential For Failure

Consider the following:

- Tree species profile
- Overall tree health and age
- Tree vigor
- Tree and/or tree part structure
- Response growth
- Extent of defect(s)
- Local weather patterns

1. Identify Tree Parts With Potential For Failure



<https://www.bauermeistertree.com/hazardous-tree-assesment.html>

2. Assess Likelihood for Failure for Each Part

- **Imminent** – failure is active, or is likely to occur within 7 days (very rare)
- **Probable** – failure may be expected within 1 year
- **Possible** – failure could occur, but it is unlikely, within 1 year
- **Improbable** – failure is not likely to occur within 1 year

All assessments performed must consider normal annual weather patterns (pre-storm assessment may be performed at Directors discretion).



Likelihood of Failure = IMPROBABLE



Likelihood of Failure = POSSIBLE



Likelihood of Failure = PROBABLE



Likelihood of Failure = IMMINENT

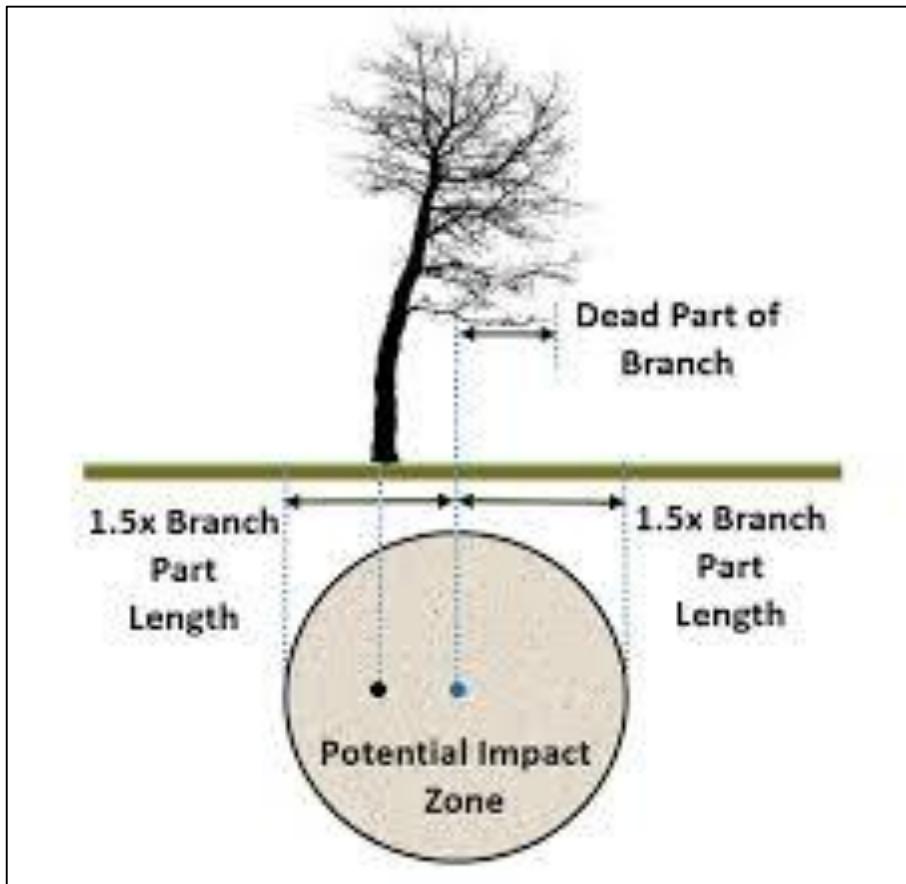


3. Identify Strike Zones Of Potential Part Failures



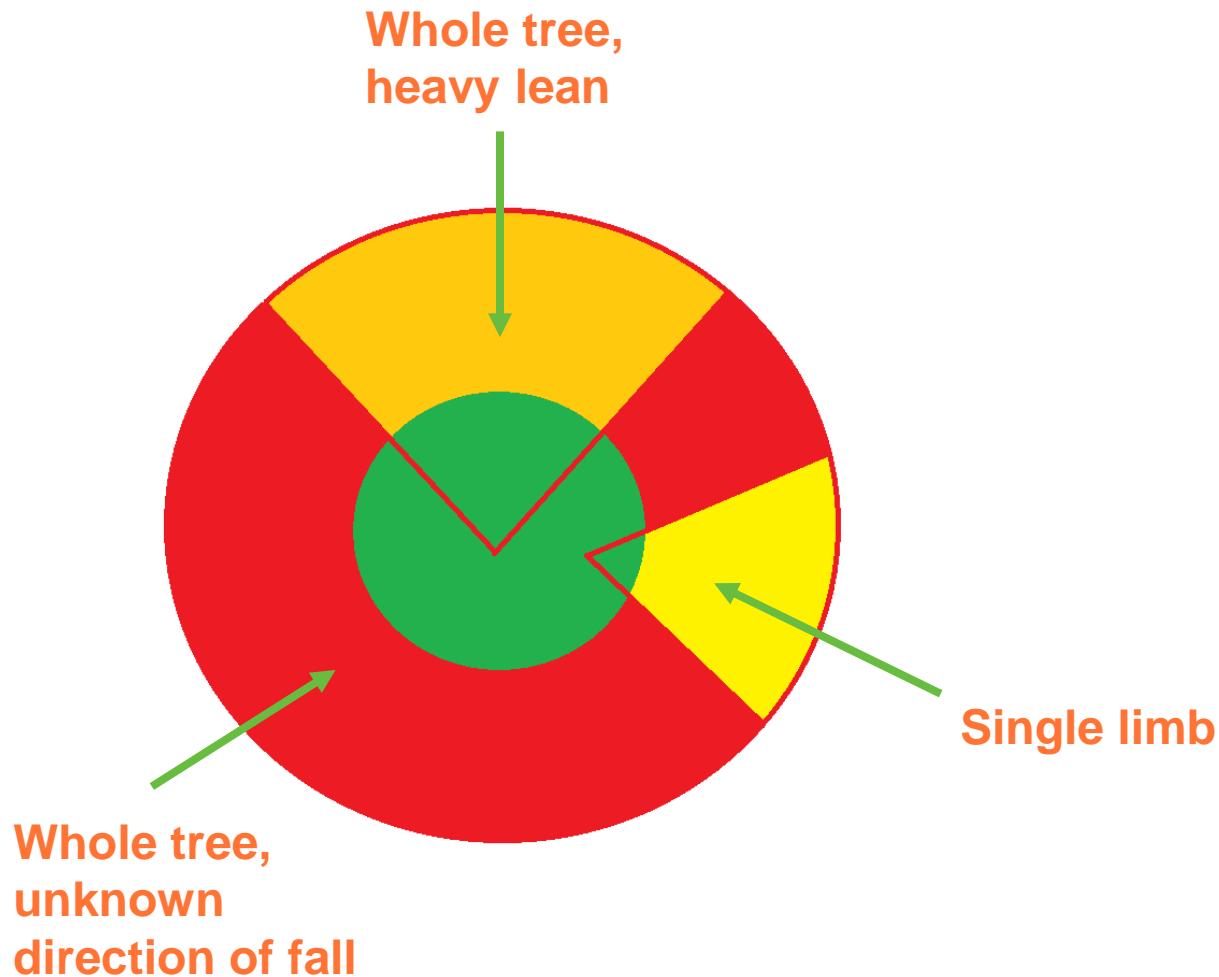
2013 International Society of Arboriculture

3. Identify Strike Zones Of Potential Part Failures



https://www.fs.usda.gov/Internet/FSE_DOCUMENTS/fseprd571021.pdf

3. Identify Strike Zones Of Potential Part Failures



3. Identify Strike Zones Of Potential Part Failures



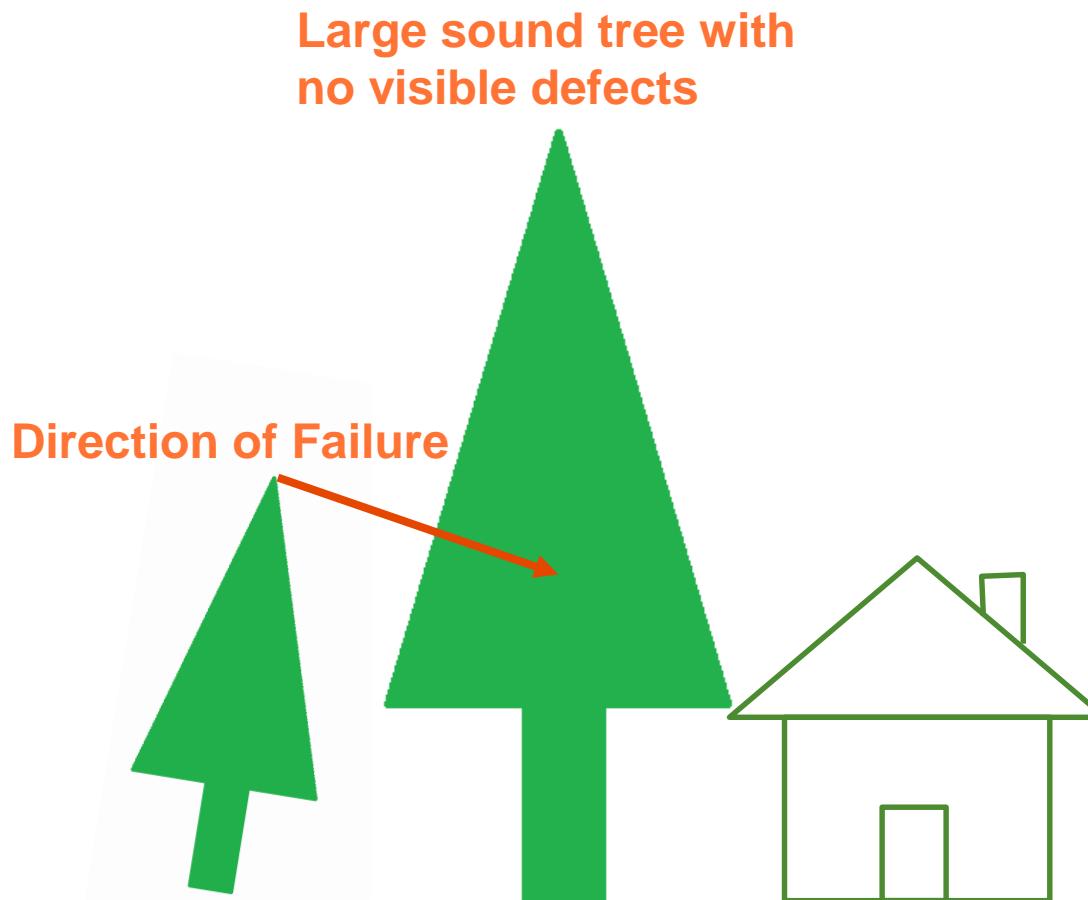
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4. Identify Potential Targets In Strike Zones

Determine which targets exist, or could exist within the next year, within the strike zones:

- Humans
- Property
 - Emergency services (EMS, PD, FDNY, hospitals)
 - Non-emergency (vehicles, buildings, fences)
- Access routes
 - Highways and major arteries
 - Side-streets

5. Identify Protection Features In Strike Zones



6. Assess Likelihood of Part Impacting Target

For each potential target, determine **whole-day (24 hour) occupancy rate averaged across 1-year timeframe:**

- **Very Low** – 0 to 2 hours per day (0-10%)
- **Low** – 2 to 6 hours per day (10-25%)
- **Medium** – 6 to 12 hours per day (25-50%)
- **High** – target is present 12 hours per day, up to constant 24-hour occupancy (50-100%)

Exception: if Likelihood of Failure is Imminent, determine occupancy rate for the 7-day period

Likelihood of Impact = VERY LOW



Likelihood of Impact = LOW



Likelihood of Impact = MEDIUM



Likelihood of Impact = HIGH



7. Rate Consequences of Failure

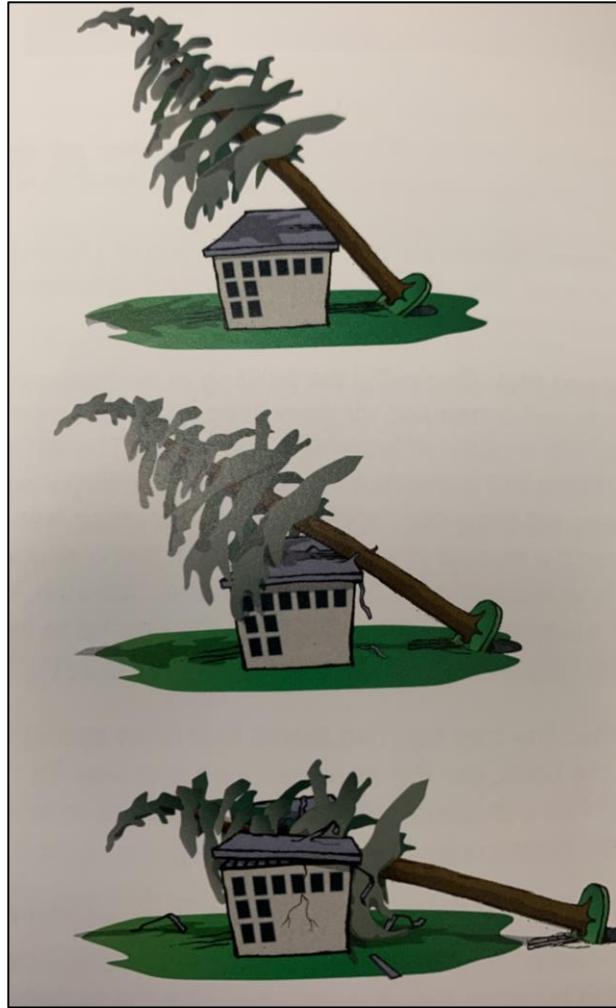
Negligible – Low value property (bench, fence, street furniture, sidewalk, secondary electrical or communications lines) or disruption that can be repaired.

Minor – Moderate-value property damage (such as buildings, vehicles, play equipment, and electrical utility lines) or small disruptions to traffic or utilities.

Significant – High-value property damage, considerable disruption of emergency access route(s), or personal injury that is not serious or life threatening.

Severe – Serious personal injury or death or major disruption of critical emergency access route(s).

7. Rate Consequences of Failure



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Consequence = Negligible



Consequence = Minor



Consequence = Significant



Consequence = Severe



9. Derive Final Risk Rating – Step 1 & 2

Likelihood of Tree Failure	Likelihood of Impacting Target			
	Very Low (1)	Low (2)	Medium (3)	High (4)
Imminent (4)	Unlikely (5)	Somewhat Likely (6)	Likely (7)	Very Likely (8)
Probable (3)	Unlikely (4)	Unlikely (5)	Somewhat Likely (6)	Likely (7)
Possible (2)	Unlikely (3)	Unlikely (4)	Unlikely (5)	Somewhat Likely (6)
Improbable (1)	Unlikely (2)	Unlikely (3)	Unlikely (4)	Unlikely (5)

9. Derive Final Risk Rating – Step 3

Likelihood (Failure/Impact)	Consequences			
	Negligible (1)	Minor (2)	Significant (3)	Severe (4)
Very Likely (8)	Moderate (9)	High (10)	High (11)	Extreme (12)
Likely (7)	Moderate (9)	Moderate (9)	High (10)	High (11)
Somewhat Likely (6)	Low (7)	Moderate (8)	Moderate (9)	Moderate (9)
Unlikely (5)	Low (6)	Low (7)	Moderate (8)	Moderate (9)
Unlikely (4)	Low (5)	Low (6)	Low (7)	Moderate (8)
Unlikely (2-3)	Low (3-4)	Low (4-5)	Low (5-6)	Low (6-7)

Combined Work Prioritization and SLA

Risk 8 and greater: Generation of Work Order to mitigate risk required.

ALWAYS IDENTIFY MULTIPLE DEFECTS!!!!



What Risk Looks Like--**EXTREME**



Failure: Imminent

Likelihood: High

Consequences: Severe

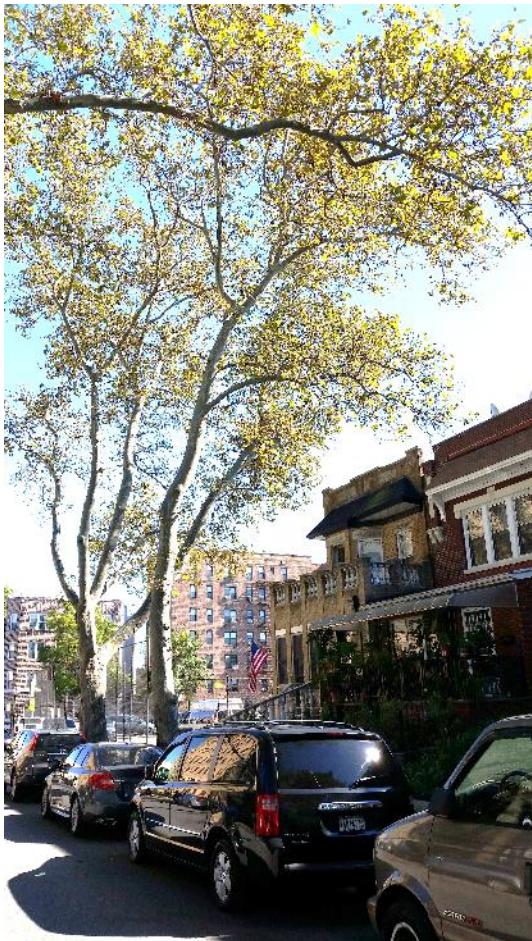
Risk Rating: Extreme

What Risk Looks Like--**HIGH**



Failure: Probable
Impact: High
Consequence:
Significant
Risk Rating: High

What Risk Looks Like--MODERATE



Likelihood: Possible
Impact: High
Consequence:
Significant
Risk Rating:
Moderate

What Risk Looks Like--LOW



Left

Likelihood: Possible

Impact: Very Low

Consequences: Negligible

Risk Rating: Low

Right

Likelihood: Imminent

Impact: Medium

Consequences:

Negligible

Risk Rating: Low