Storm Planning for the Urban Forest

May 2023

MODULE 1

Tree Risk Assessment

Green Infrastructure Center

GEORGIA FORESTRY COMMISSION

FOREST SERVICE U S DEPARTMENT OF AGRICULTURE

Green Infrastructure Center

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Cover photo credit: Virginia Department of Forestry

Credit to Rachel Barker, ArborMetric Solutions LLC for producing the original video content these modules are based. on.

Storm Planning for the Urban Forest

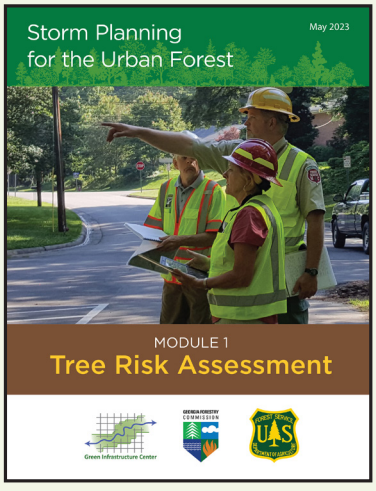
Effective storm planning for the urban forest entails three foundational activities: tree risk assessments, standing contracts, and debris management sites. These are discussed in detail in the following modules:

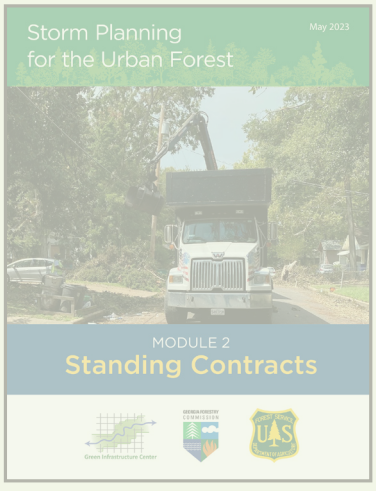
Module 1: Tree Risk Assessment

Module 2: Standing Contracts

Module 3: Debris Management Sites

Below, you can review the steps on how to set up and run a successful tree risk assessment program for your urban forest. For further modules on developing standing contracts or establishing debris management sites in your community, check the Community Forestry Academy's website at: https://communityforestry.academy/courses/community-planning-for-the-urban-forest-strike-team/





Introduction

What is a tree risk assessment program and why is it important?

Storms and severe weather events are mounting in frequency, duration and intensity, along with an increased occurrence of the strongest storms – those of Category 4 and 5 – in the Southeastern U.S. (Kossin 2007). Tornadoes and other severe thunderstorm phenomena frequently cause as much annual property damage in the U.S. as do hurricanes, and often cause more deaths (Mellilo 2014). New research suggests that favorable conditions for these types of storms will also increase under future climate scenarios (Diffenbaugh 2013). In addition, there has been a sizeable upward trend in the number of storms that cause substantial financial and other losses (Herring 2013). Furthermore, storms often damage city and town infrastructure, requiring significant repair or replacement. These new climate trends elevate the importance of emergency preparedness and community disaster plans.

Photo credit: Georgia Forestry Commission

As storms become more powerful and frequent, this exposes a community's infrastructure to greater risk. A tree risk management program can mitigate risk and save money in the long-term.

Photo credit: Georgia Forestry Commission

Roads blocked by down trees can delay emergency response times.

Another type of infrastructure that is often overlooked, and just as likely to be damaged by storms, is the urban forest. Most communities have experienced the challenges of blocked roads, downed power lines and flash floods caused by debris buildup and overflowing stream banks. But this problem can be drastically reduced, or even avoided through better care of our "green infrastructure." Collaborative storm planning between arborists and emergency management personnel reduces tree related damage, blockages, and debris that slow recovery time from storms while also improving the health and resilience of the urban forest.

Urban trees are a part of the community's green infrastructure and we need to manage those trees, just as we manage our grey infrastructure (roads, sidewalks, bridges, powerlines, pipes, etc).

Trees are "green infrastructure" that enhance livability by filtering storm water and reducing runoff, cleaning the air, providing oxygen, shading streets and offering natural beauty and enhanced property values. Routine tree risk assessments and regular corrective tree pruning can cultivate a healthy urban forest that is better able to withstand severe weather, ensuring that trees can continue to provide valuable services.

Unfortunately, many communities do not routinely assess tree safety or prune their public trees to reduce the risk of limbs breaking or falling. Too often, tree problems are addressed in crisis mode management, after a storm has already caused damage. And this approach comes at a high cost.

Costs for cities are twice as high on a per unit basis for tree maintenance performed during crisis mode management than when conducted as part of routine tree maintenance. (World Forestry Center 1993). And it's not only higher costs that are a concern. Cities need to be aware of the elevated liability associated with a lack of sound care and management of public trees. Investments in routine tree care and risk management can reduce property damage and personal injury caused by tree failure, thereby reducing the number of lawsuits, legal fees and settlement costs facing a community.

This module outlines the steps needed to establish a tree risk assessment program and integrate routine tree evaluations, tree removal and corrective pruning into the annual maintenance plan for your urban forest, in order to save money and to protect public health and safety.

Reducing Storm Risk Works

Case example: Tree Risk Management in Columbus, Georgia

A comprehensive and effective tree risk management program decreases the time and resources required for post-storm cleanup response and recovery efforts. Below are some statistical differences in storm response claims between 2001-2006 after the implementation of a successful tree risk management program in Columbus, Georgia (Rachel Barker, ArborMetric Solutions LLC). This tree risk management plan led to a measurable reduction in crisis mode management of the urban forest and the associated costs:

- Tree-related claims were reduced by 72%.
- Work order complaints and requests for service were reduced by over 55%.
- 911 emergency calls and overtime expenditures for tree cleanup were reduced by over 69%.

Step 1: Begin a Dialogue with the Emergency Management Department

Most communities create emergency response plans for natural and man-made disasters. Unfortunately, most local emergency management and hazard mitigation plans focus on the aftermath of disasters: pickup, processing and disposal of vegetative debris. Tree risk assessments should be integrated into existing maintenance plans, to ensure more effective storm preparation. City arborists or managers should meet with the local emergency management director on a regular basis to build a case for collaboration by explaining the benefits of strategic pre-emptive forest management, and to ensure such plans are implemented.

Photo credit: Darren Green

Establish a dialogue between emergency managers and urban foresters to reduce risks associated with natural disasters and the urban forest.

Step 2: Develop a Storm Team

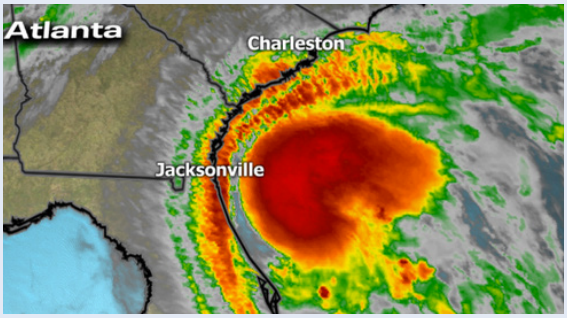
Once the emergency management department has agreed to add urban tree care and failure prevention to the plan, assemble a storm team comprised of professionals who can contribute, not only to storm preparation, but also to storm response and recovery. Consider such representatives as:

- Tree Care Manager, Municipal Arborist, Urban Forester
- Emergency Manager
- Municipal Administrator
- Public Works (Parks, Streets, Utilities) Manager(s)
- Municipal Planners
- Public Safety Officer
- Public Information Officer
- Procurement/Contract Specialist
- Utility Representatives
- Tree Service Contractors
- State Agency Representatives

Storm Definitions

Minor storm event –
A storm that can be cleaned up within 48 hours, using only local resources.

Major storm event –
A storm that requires a cleanup effort lasting much longer than 48 hours and access to non-local (usually state and federal) resources.



Step 3: Identify Priority Areas for Tree Risk Assessment

The newly formed storm team should map and prioritize the urban forest for targeted tree risk assessments. If possible, obtain an urban tree canopy map and a public tree inventory before beginning this process. If these are unavailable, utilize land cover data showing the extent of tree cover in the community. Consider focusing on areas that are more subject to damage (e.g. a coastal roadway) and facilities that, if blocked, could hamper community safety and responses, such as roads leading to fire and police stations, to service depots, to emergency evacuation routes or to hospitals. Assemble maps and tables of community data with the following information:

Critical Facilities:
- Hospitals and other critical health care facilities
- Fire stations
- Police stations
- Communications networks and facilities
- Electric utilities and other utility networks and facilities
- Water system
- Sanitary sewer system
- Local authority service depots

Transportation Network:
- Emergency evacuation routes
- Street network
- Major road corridors
- Congested intersections
- Priority streets to critical facilities

Population Density:
- Extensively used public areas and buildings
- Neighborhoods with high population density

Trees:
- All public trees
- Large canopy public trees
- Tree canopy density
- Trees at risk

Emergency Response Sites:
- Emergency shelters, such as schools and churches
- Emergency management centers
- Homeland Security offices
- Personnel and equipment staging areas *(see Module 3: Debris Management Sites for more info)*
- Debris staging areas *(see Module 3: Debris Management Sites for more info)*
- Debris storage areas *(see Module 3: Debris Management Sites for more info)*

Federal Highway Administration Road Classifications

The Federal Highway Administration classifies roads into a hierarchy useful for prioritizing tree risk assessments. Roads providing the highest levels of mobility will be the highest priority for risk assessment and mitigation.

Interstates: These are the highest classification of roadways in the United States. These arterial roads provide the highest level of mobility and the highest speeds over the longest uninterrupted distance.

Principal Arterials: These roadways serve major centers of metropolitan areas, provide a high degree of mobility, and can also provide mobility through rural areas. Unlike their access-controlled counterparts, abutting land uses can be served directly.

Minor Arterials: Provide service for trips of moderate length, minor arterials serve geographic areas that are smaller than their Principal Arterial counterparts and offer connectivity to the Principal Arterial system. In an urban context, they interconnect and augment the Principal Arterial system, provide intra-community continuity and may carry local bus routes.

Collectors: These are major and minor roads that connect local roads and streets with arterials. Collectors provide less mobility than arterials at lower speeds and for shorter distances. They balance mobility with land access.

Local roads: These provide limited mobility and are the primary access to residential areas, businesses, farms and other local areas.

The highest priority areas should include emergency routes and major corridors, where tree damage would cause the greatest disruption to emergency services, public services and mobility. Using these noted data and maps, the storm team should assign priority levels to all areas of the community, including public trees flanking critical road segments to parks or greenspaces, since they may be used to temporarily store debris.

The Urban Tree Risk Index (UTRI) model is an existing method for identifying these priority areas and routes, and was developed by The Central Alabama Regional Planning and Development Commission. This tool ranks priorities as very high, high, moderate, and low. For more information on this tool, see the text box below. Communities lacking the technology or resources to create digital (GIS) maps can use physical maps, data and local knowledge to identify critical infrastructure, major corridors and public trees, and can then assign priority levels for tree risk assessment and mitigation.

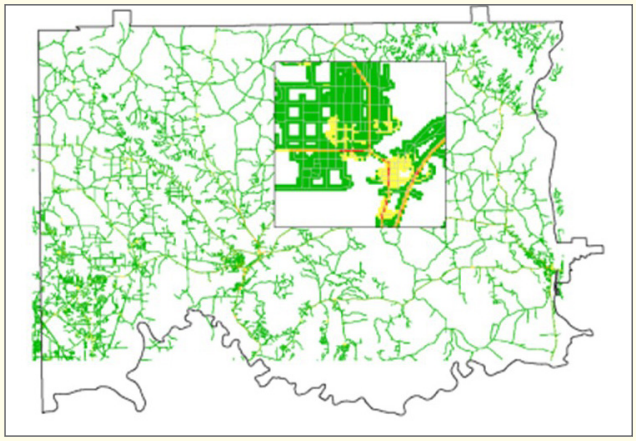
Photo credit: Virginia Department of Forestry

Use maps and GIS data to identify priority areas to assess tree risk.

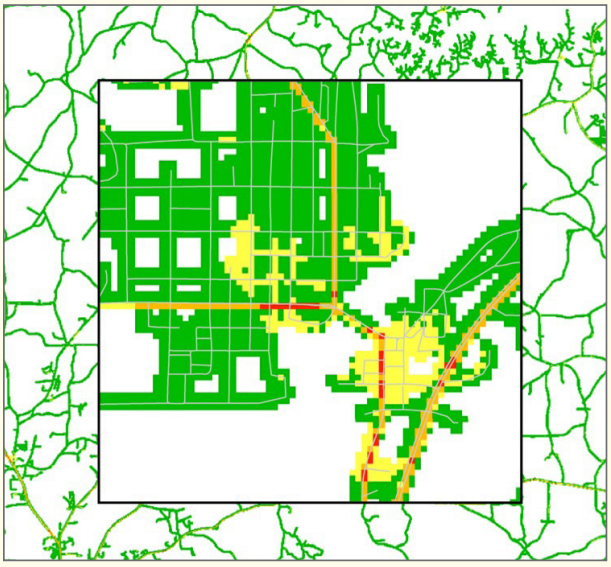
When completed, share the priority map or model with the storm team.

Urban Tree Risk Index (UTRI) Prioritization Tool

The Urban Tree Risk Index (UTRI) is a GIS tool that can help community arborists and emergency management personnel define, rank and map the areas of greatest need for tree risk assessment. For communities with GIS capabilities, it can rank areas of a community, from high to low priority, for tree risk assessment and can also establish routine inspection schedules. The tool analyzes such spatial data as roads, parcels, facilities and land cover data, in order to determine areas where the highest risk of tree failure overlaps with major corridors and prioritized routes. Field verification of the index values is conducted and the values are adjusted, based on field conditions. Instructions for building the model can be found here: https://urbanforestrysouth.org/resources/library/ttresources/urban-tree-risk-index-model



This map shows the summary of all layers to include in an Urban Tree Risk Index - canopy, transportation, critical facilities, and population for Elmore County, Alabama.



The inset map zooms into downtown Wetumpka to highlight high (red), moderate (yellow) and low (green) risk to the community.

Maps credit: Central Alabama Regional Planning and Development Commission

Step 4: Conduct a Risk Assessment

Once priority areas for tree risk assessments are identified, a risk assessment can begin. Employ or hire an International Society of Arboriculture (ISA) Certified Arborist who has gained a Tree Risk Assessment Qualification (TRAQ). This qualification ensures that the arborist can accurately identify and assess tree defects and associated risks. To find a qualified company with TRAQ/ISA certified staff in your area see: https://www.treesaregood.org/findanarborist

Tree Risk Assessment Levels

There are three levels of risk assessment, based on the scope of work. A level-1 assessment will quickly survey a population of trees, such as those along major streets or those in public parks and is intended to detect trees with problems that require a more thorough level-2 or level-3 assessment.

These are definitions of the different levels of risk assessment, Level 1 being the most basic:

Level 1 – Limited Visual assessment: This is also known as a "walking survey" or "windshield survey." It is an initial, rapid assessment performed by an arborist with a tree risk assessment qualification (TRAQ) who walks or drives by slowly to identify obvious defects to those trees he or she can see. Typically, the assessment only evaluates a portion of the trees – those visible from a right-of-way or an accessible spot (hence the name "limited visual"). This assessment is intended to quickly flag those trees with obvious defects (hanging limbs, severe lean, visible decay, etc.) for a follow-up and more thorough evaluation using Level-2 protocols.

Level 2 – Basic assessment: This involves a complete walk around every tree from all sides, including the immediately surrounding area in order to look for signs of potential or imminent failure. Other simple diagnostic tests may occur, such as using a rubber mallet to detect trunk decay, binoculars to more thoroughly examine the crown, or a probe to detect decay around the root collar.

Photo credit: Georgia Forestry Commission

A Level-1 Limited Visual Assessment, also known as a "walking survey" is an initial and rapid assessment by a trained and qualified arborist in tree risk assessments.

Level 3 – Advanced assessment: This is a comprehensive tree structure evaluation and is based on the information discovered during the Level 2 assessment. The tests for a Level 3 assessment are more advanced and may require specialized equipment to gain a clearer picture of the extent of the problem. Level 3 tree risk assessments are typically time intensive and require specialized diagnostic equipment, so are more expensive to conduct and should be used sparingly, and only for higher-value trees.

Tree Risk Assessment Process

An ISA/TRAQ arborist should perform a Level 1 Assessment on all trees located in areas with potential damage targets (people, infrastructure, facilities, etc). Trees in forested natural areas with no targets (fall zones where injury to people or property is unlikely) can be left out of such an assessment, which can be phased over time, especially for smaller communities with limited resources. Start with the highest priority areas and then work through to lower priority categories, based on the Urban Tree Risk Index (UTRI).

Ideally, your community has an existing tree inventory and can supplement it with it with risk assessment data.

Ideally, your community has an existing tree inventory and can supplement it with risk assessment data. Tree inventory data is composed of other necessary fields to aid arborists in identifying and tracking trees and their health over the long-term. If no tree inventory exists, collect data to start one with staff or volunteer assistance before the assessment, in order to reduce costs or direct the ISA/TRAQ arborist to simultaneously perform the assessment and collect the data to start a tree inventory.

Photo credit: Virginia Department of Forestry

If available, an existing public tree inventory is foundational to develop a tree risk assessment program.

Data required for a tree inventory include:

- Location data, such as a GPS point or address.
- Tree species (at least to the genus level).
- Diameter of the tree at Breast Height (DBH) – measured at 4.5 feet above the ground.
- Condition, site characteristics (tree lawn, park, etc.) and notes on obvious defects (dead, dying, broken branches, severe lean, decay, etc.).

After a Level 1 Assessment is complete, an arborist conducts a more thorough Level 2 Assessment for trees flagged for further investigation. The types of tests performed during Level 2 will depend on initial observations of the tree and the risk posed to property or public safety. A more in-depth Level 3 Advanced Assessment may be necessary for historic/heritage trees or trees that could cause severe damage AND require more diagnostic testing to determine their defects and level of risk.

In both a Level 1 and Level 2 Assessments, the arborist will make recommendations for mitigation, which could include tree removal or pruning.

Step 5: Mitigate Risk

Typical mitigation recommendations from Tree Risk Assessments are tree removal or corrective pruning. The type of mitigation needed is dependent on which part of the tree is likely to fail, the likelihood of possible targets in the area and the severity of the consequences if the target is hit by a failing limb or trunk. For example, a tree that has significant, widespread decay within the root collar and is within falling distance of the entrance to a public library should be removed. However, a tree with broken limbs stuck in the crown and dangling over a playground, while urgent to address, may only need reduction cuts and crown cleaning.

For more tips and information on proper arboriculture care, pruning and mitigation, watch this video from the Southern Group of State Foresters on street tree pruning. Link: https://youtu.be/2IYJ-vNeCvs

Prioritize and complete work first for highest risk trees. Next, create a mitigation schedule for work that should be completed over the next two-three years (informed by the health and risk level of each tree). A mitigation plan with a timetable can then be used to create a request for proposals (RFP) from contractors. Consider separate contracts for tree removals and pruning. Using a tree removal company that meets the municipal guidelines for insurance is acceptable. However, tree pruning requires you to employ an ISA Certified Arborist to do the work. Poor pruning techniques can exacerbate tree defects by destabilizing the crown or a damaged branch and causing the tree part to fail. The canopy should be pruned to correct poor structure and reduce crown weight, thus preventing further damage to the tree, while also reducing risk.

Photo credit: Virginia Department of Forestry

After a TRAQ arborist has assessed and recommended mitigation actions, contract with a separate certified arborist to perform the required maintenance.

PRO TIP

Create separate contracts for tree risk assessment and tree pruning and/or removal work to ensure there is no conflict of interest between mitigation recommendations and mitigation work.

Step 6: Establish Timelines for Re-evaluations

Re-evaluate risk annually for the highest risk trees and every 2-7 years for lower risk trees. Create a tree inspection schedule that includes data on inspection dates, types of inspection and mitigation work performed (if any).

PRO TIP

Preparation and regular inspections are just as vital to storm recovery and will save 50% of costs by performing them outside of the crisis timeframe. This is vital to a successful tree risk management program!

Best Practices for an inspection schedule:

- Planning for an annual Level 1 inspection on very high- or high-risk routes (red and orange).
- Planning for post-storm/disaster event Level 1 inspection on all routes (regardless of prior identified risks).
- Continuing to evaluate trees for defects, according to their inspection schedule.

Below is a sample tree inspection schedule generated from the Urban Tree Risk Index analysis to identify which assessment routes to prioritize. This spreadsheet helps with planning and annual budgeting for your urban forest program.

Urban Tree Risk Index Inspection Schedule

An example inspection schedule for evaluating tree risk along streets taken from the UTRI model. Streets coded in red (very high risk) would be evaluated annually, while orange (high), yellow (moderate) and green (low) would be evaluated on a schedule of 1-7 years. Inspection data, recommended actions and mitigation work should all be recorded in the schedule.

UTRI	Inspection Schedule
15–20 (or 4)	Very High— Red — annual
10–14 (or 3)	High— Orange — 1-2 years
5–9 (or 2)	Moderate — Yellow - 3-5 years
0–4 (or 1)	Low — Green — 5-7 years

Map ID	Street	Length (Feet)	UTRI (Raw Data)	UTRI (Adjusted Index 1-4)	Field Check and Verify Index	Mitigation Prune-Remove-None	Mitigation Complete Date (if applicable)	Inspection Schedule
563	Chapel Lakes Dr	118	20	4				Annual
410	Chapel Lakes Loop	1063	18	4				Annual
532	Chapel Rd	186	18	4				Annual
292	Chapel Rd	9	15	4				Annual
214	Chapel Rd	26	14	3				1-2Years
489	Chapel Rd	118	12	3				1-2Years
44	Chapel Rd	428	12	3				1-2Years
379	Coosa River Pkwy	186	9	2				3-5Years
204	Holtville Rd	71	9	2				3-5Years
246	Holtville Rd	71	8	2				3-5Years
354	Tallassee Hwy	348	6	2				3-5Years
45	Barnes Ct	1257	3	1				5-7Years
29	Tallassee Hwy	235	3	1				5-7Years

Graphics credit: Central Alabama Regional Planning and Development Commission

Step 7: Perform Routine Tree Evaluations

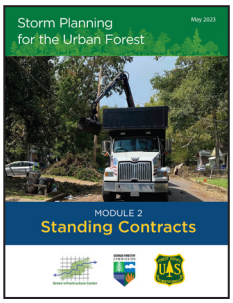
Routine tree evaluations are the foundation of a successful tree risk management program. High risk trees must be evaluated annually, results and recommendations recorded, and tree pruning and removal work completed. Lower risk trees should also be evaluated according to their designated schedule. While this work is less intensive than establishing and inventorying the tree baseline, annual budgets should allocate funding to complete both assessment and mitigation work. Tree defects and risk change over time, so without routine inspections, the ability to track defects and relative risks will be lost, increasing risk to public safety and property. To improve efficiency and reduce costs, integrate risk assessment with other types of routine maintenance work. For example, pruning crews working on a population of trees who notice additional defects should document that information and record it in the assessment system for follow-up, corrective action.

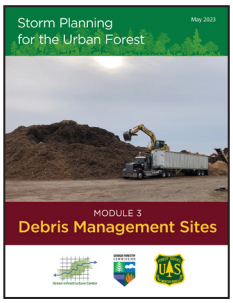
Photo credit: Georgia Forestry Commission

Annual evaluations based on tree risk inspection schedules is important to keep the data valid and up-to-date. Reassess all trees, not just high-risk trees after a natural disaster.

Conclusion

In summary, storm planning for the urban forest begins with establishing a tree risk assessment program. This module outlined the steps to create such a program. To learn more about how to prepare to respond effectively to storms and other disasters affecting the urban forest, see **Module 2. Standing Contracts** and **Module 3. Debris Management Sites**.





See the resource links on the next page to access additional tools to prepare for, respond and recover your urban forests from storm impacts and create a safer community.

Resources

ANSI A300 Tree Risk Assessment Standard
Link: https://wwv.isa-arbor.com/store/product/133/

Community Forestry Academy, Storm Planning Resources
Link: https://communityforestry.academy/courses/community-planning-for-the-urban-forest-strike-team/

Green Infrastructure Center, Resilient Communities, Storm Planning Resources Link: http://www.gicinc.org/

Qualified companies with ISA/TRAQ trained staff
Link: https://www.treesaregood.org/findanarborist

The Urban Tree Risk Index (UTRI) GIS Model
Link: https://urbanforestrysouth.org/resources/library/ttresources/urban-tree-risk-index-model

Urban Tree Risk Management: A Community Guide to Program Design and Implementation, 2003
Link: https://www.fs.usda.gov/research/treesearch/11070

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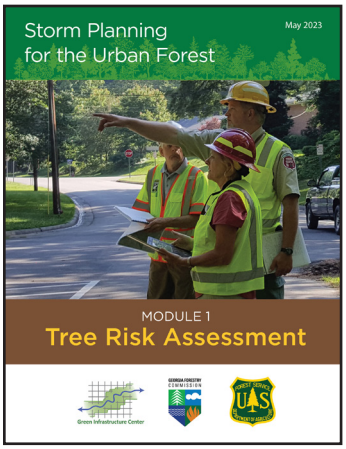
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