Superstorm Sandy Aftermath

Bruce R. Fraedrich Ph.D.
BARTLETT TREE RESEARCH LABORATORIES
SCIENTIFIC TREE CARE SINCE 1907

Lessons From Sandy

BREAKING NEWS

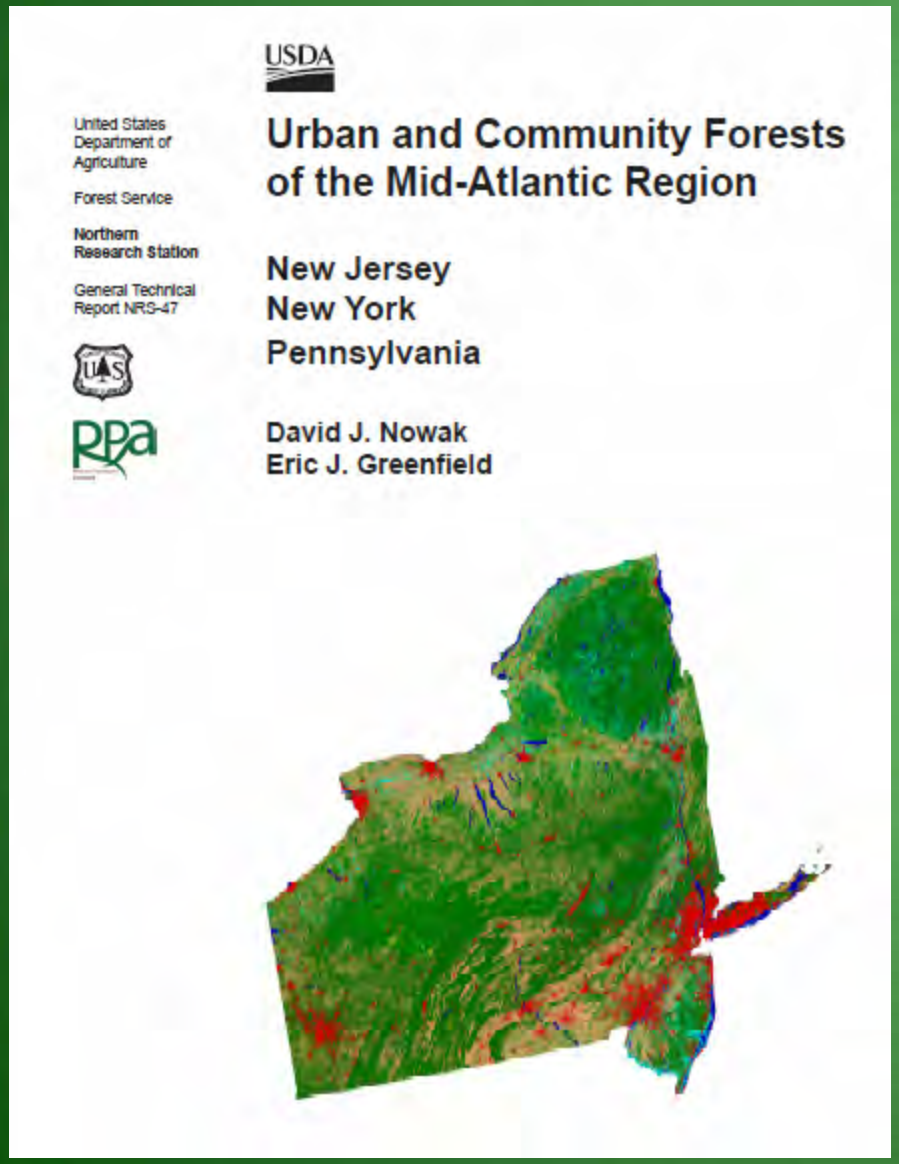
SANDY

Sandy set record for fallen trees in New York, New Jersey; 10,000 lost in New York City alone, 113,000 across New Jersey - @AP

Replanting New Jersey

An estimated 40,000 trees were lost during superstorm Sandy. Utility companies suggest replacing fallen trees near powerlines with varieties that grow slowly and don't reach heights that will interfer with powerlines. Some trees well suited to North Jersey:

Assessing the Urban Forest



USDA

United States Department of Agriculture

Forest Service

Northern Research Station

General Technical Report NRS-47

Urban and Community Forests of the Mid-Atlantic Region

New Jersey
New York
Pennsylvania

David J. Nowak
Eric J. Greenfield

- Characteristics
- Values/benefits

37% of urban land in NJ is covered in tree canopy

- **152,000,000 trees in urban areas**
- **43% of entire state with canopy cover**

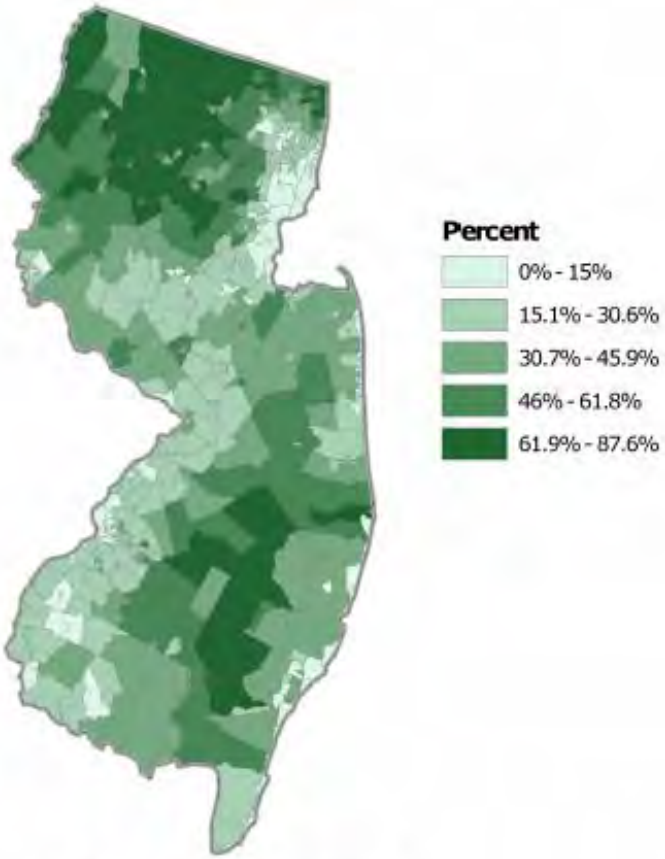


Figure NJ-5.—Percentage tree canopy cover within county subdivisions.

124 Fatalities in Sandy.
26 were tree related-8 during cleanup. The rest were caused by falling/fallen trees or tree limbs. Most of these occurred in vehicles.

What Factors Contribute to Tree Failure?

- **When you evaluate trees for likelihood of failure, what do you consider?**

- **Tree Species**
- **Tree Defects & Conditions**
- **Response Growth**
- **Site Conditions**
- **Loads**

University of California

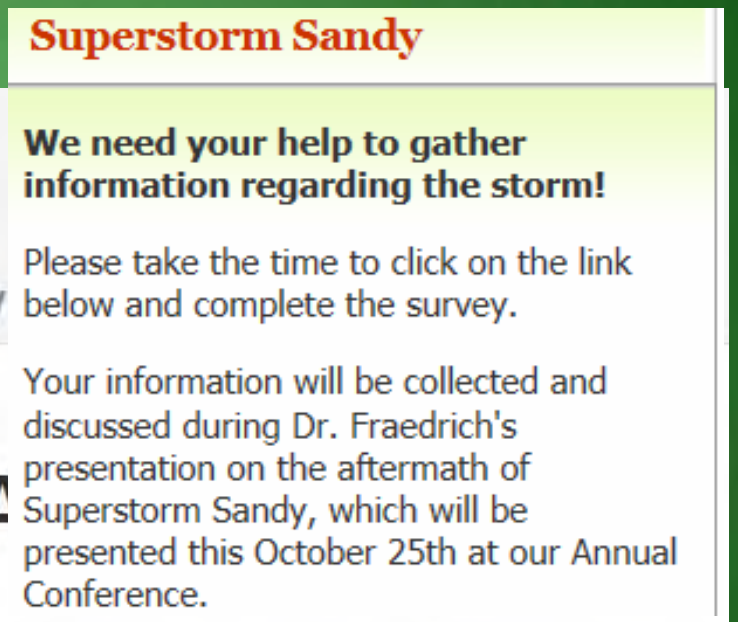
California Tree Failure Report Program

- Home
- News
- Become a Cooperator
- Contact Information
- CTFRP Statistics
- Species Profiles
- Failure Photos
- Stories
- Annual Meetings

Home

The California Tree Failure Report Program (CTFRP) was established in 1987 to collect quantitative information on the mechanical failure of urban trees (trunk breaks, branch breaks, and uprootings). This information is used to develop "failure profiles" for genera and species to more accurately assess failure probability in standing trees and thereby reduce failure potential in urban forests.

Tree Species Failure Profiles

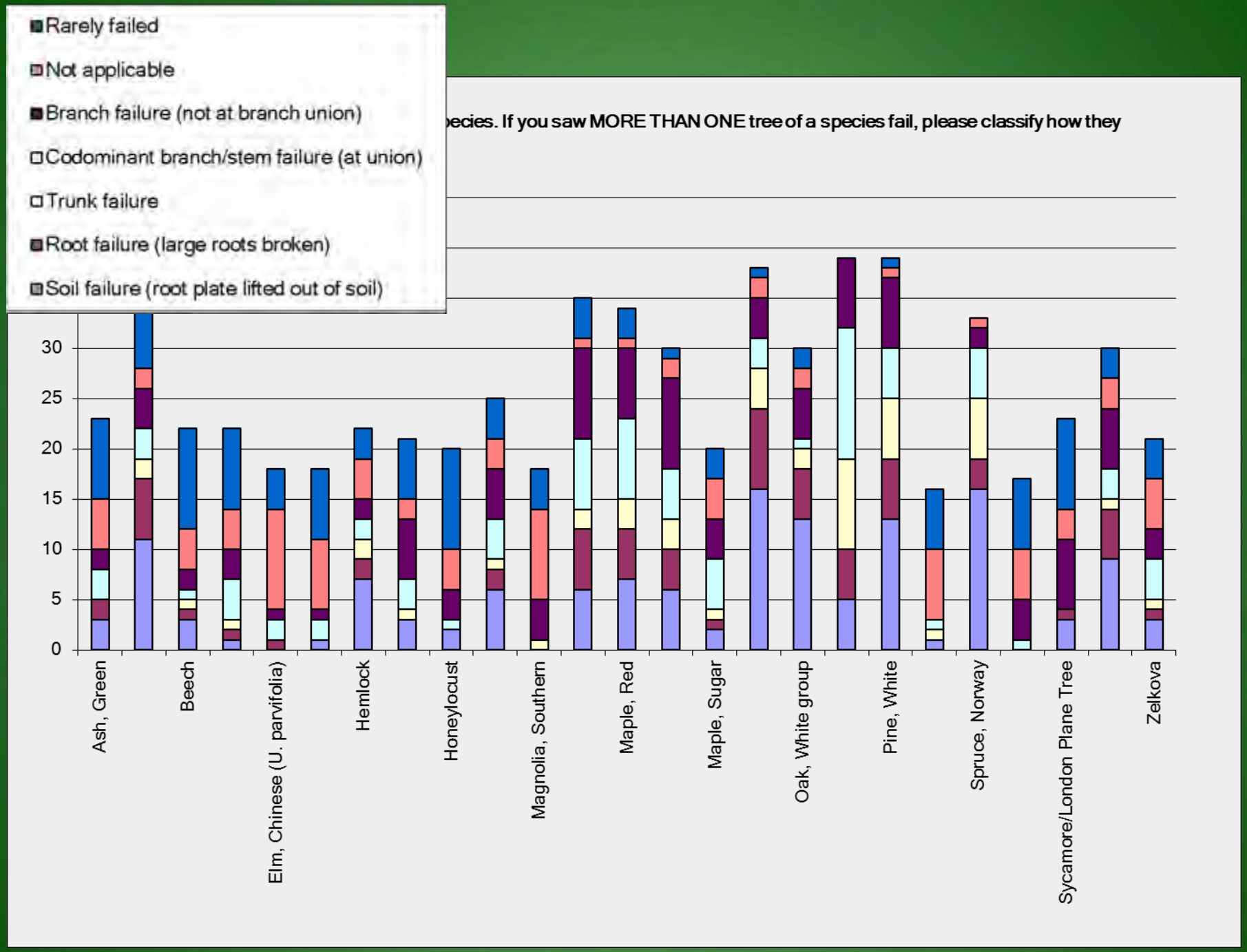


- **What types of failures occurred with various tree species?**
- **Failure Resistant Species?**

Failure Profile

- Rarely failed
- Not applicable
- Branch failure (not at branch union)
- Codominant branch/stem failure (at union)
- Trunk failure
- Root failure (large roots broken)
- Soil failure (root plate lifted out of soil)

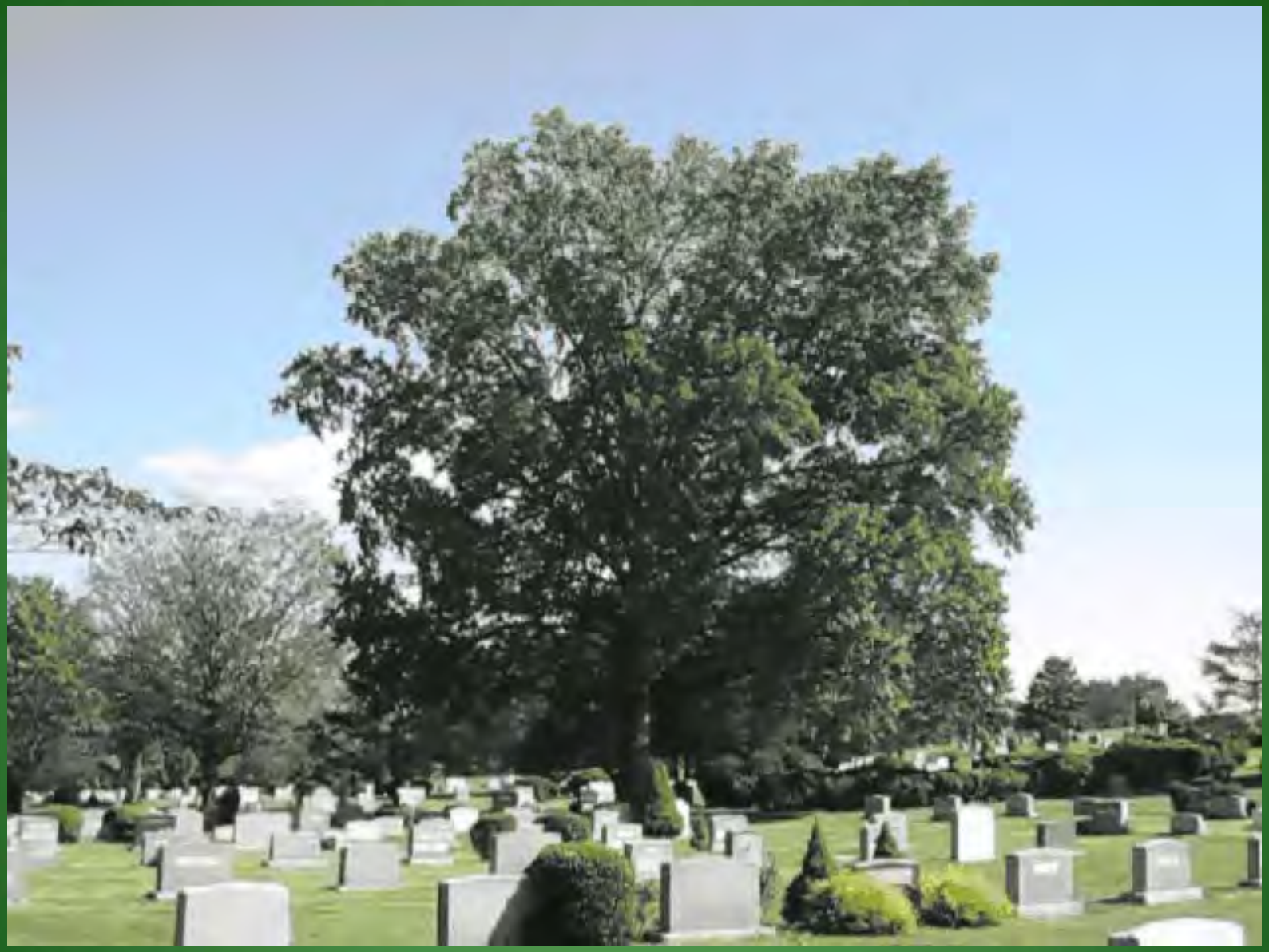
- **Oaks**
- **Maples**
- **Ash**
- **Pear**
- **Conifers**
- **Honeylocust**
- **Beech**


Rarely failed
Not applicable
Branch failure (not at branch union)
Codominant branch/stem failure (at union)
Trunk failure
Root failure (large roots broken)
Soil failure (root plate lifted out of soil)
pecies. If you saw MORE THAN ONE tree of a species fail, please classify how they
0
5
10
15
20
25
30
Ash, Green
Beech
Elm, Chinese (U. parvifolia)
Hemlock
Honeylocust
Magnolia, Southern
Maple, Red
Maple, Sugar
Oak, White group
Pine, White
Spruce, Norway
Sycamore/London Plane Tree
Zelkova

Failure Resistant Species

- London Plane/Sycamore
- Beech
- Honeylocust

Pine and Spruce were listed most often for soil/root failures



Silver maple and other shallow rooted trees and species on wet sites were prone to soil and root failures

Branch/Codom Failures

- Pear
- Maple
- Elm
- Ash was not cited

Trees with large crowns and limited soil volumes were prone to soil failures

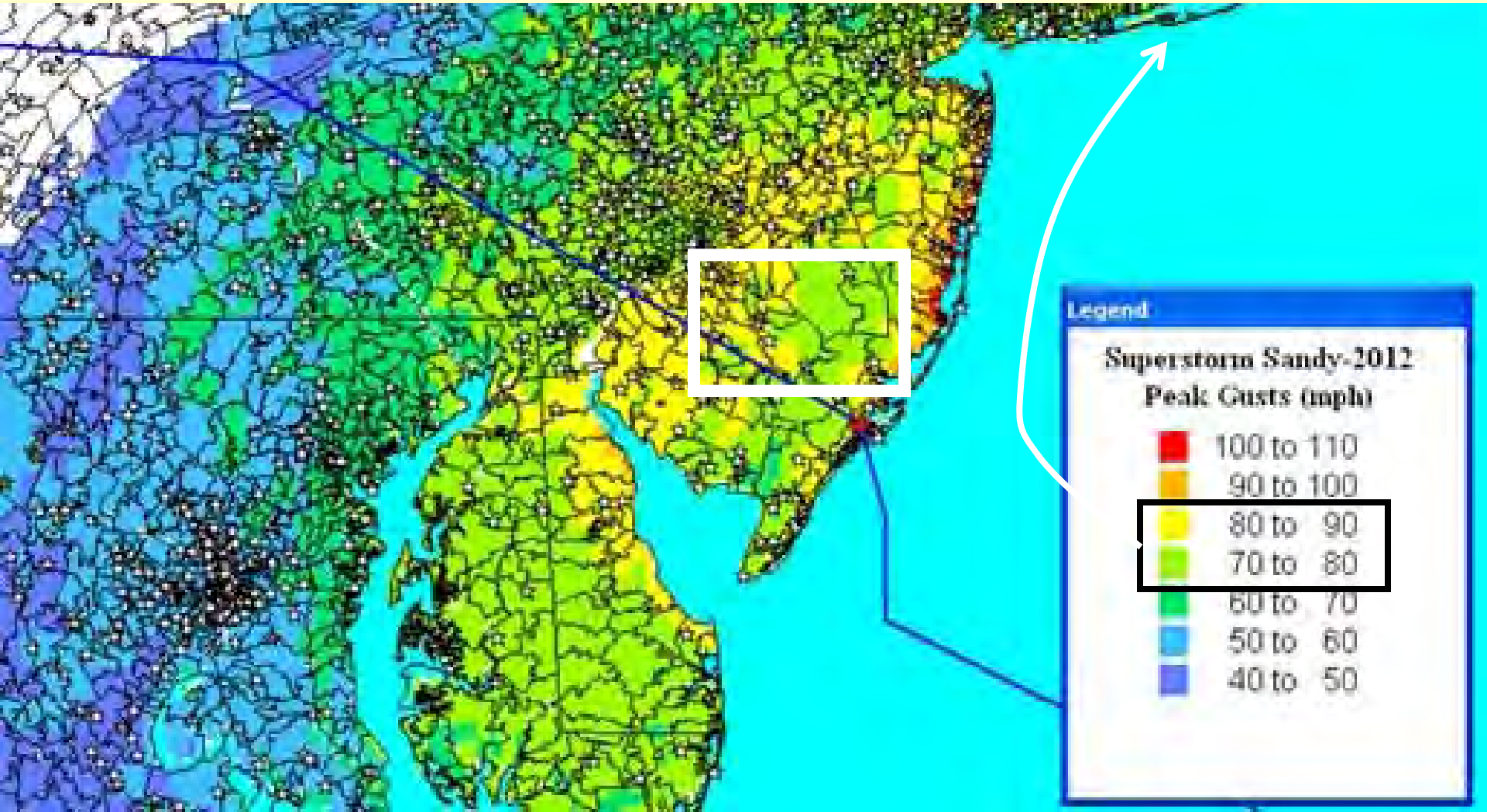
Trees with extensive defects failed

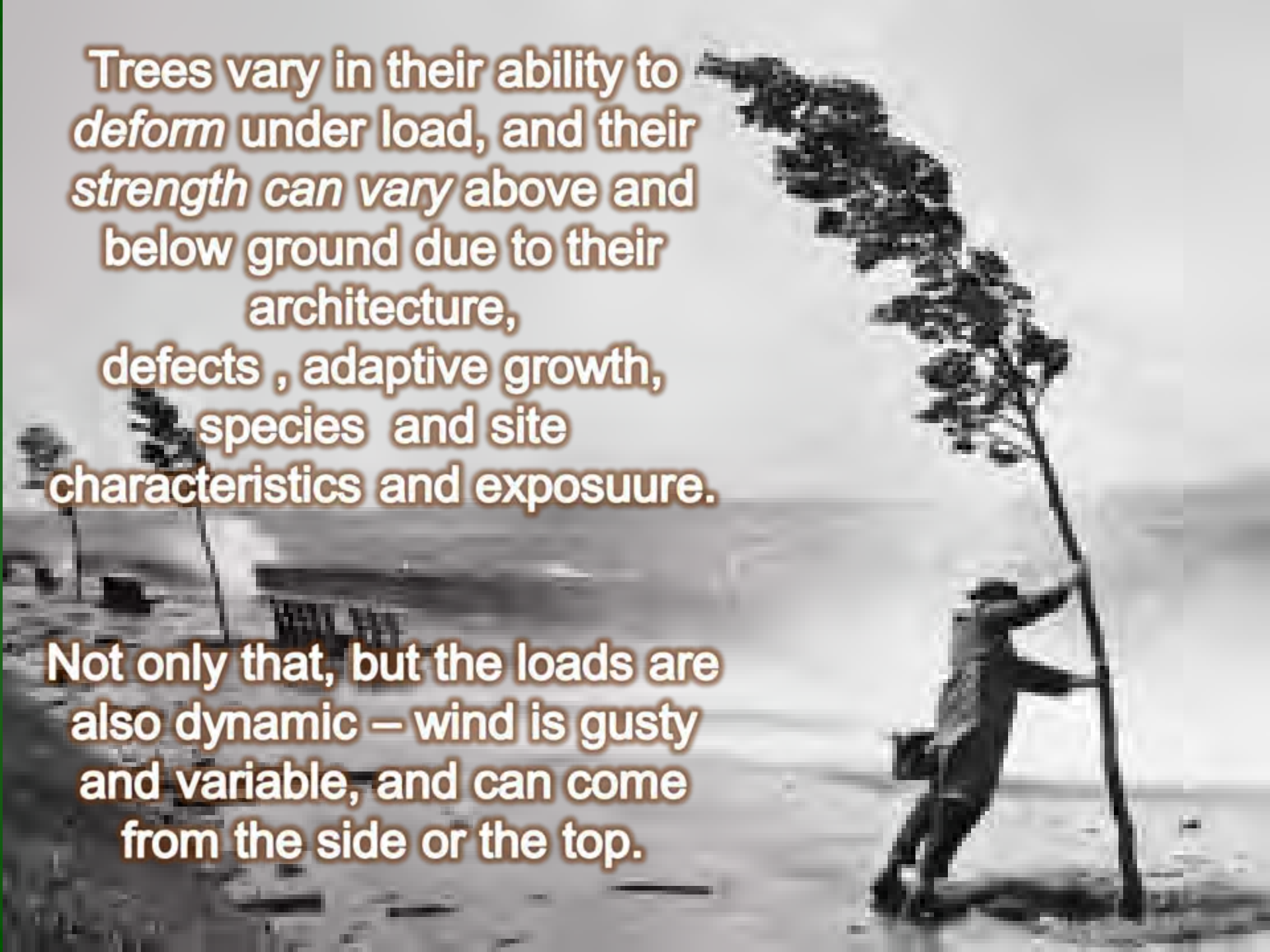
Many of the defects were hidden

The domino effect was quite common

Loads created by high winds was the biggest factor contributing to tree failure

Non-defective trees fail at wind gusts>50mph




Trees vary in their ability to *deform* under load, and their *strength can vary* above and below ground due to their architecture,
defects , adaptive growth, species and site characteristics and exposuure.
Not only that, but the loads are also dynamic – wind is gusty and variable, and can come from the side or the top.

Sandy Summary

-
-
-

Salt Spray
Foliage Desiccation

Salt Water Intrusion

- **Osmotic effects of salt on plants**
- **Long Term Effect of Sodium that is left behind**
- **Sodium an be toxic to plants and soil microorganisms.**

Salt Water Intrusion

London Plane and Sweetgum were severely damaged

Soil Analysis Report - Client Copy

Bartlett Tree Research Laboratories

Commodore

Commodore

Bartlett Arborist:
Plant Species: London Planetree
Location/ELM ID:
Fertilization Goal: Maintain Vitality

Sample ID: 184625
Date: 29-Nov-12
A&L: 12-339-9565

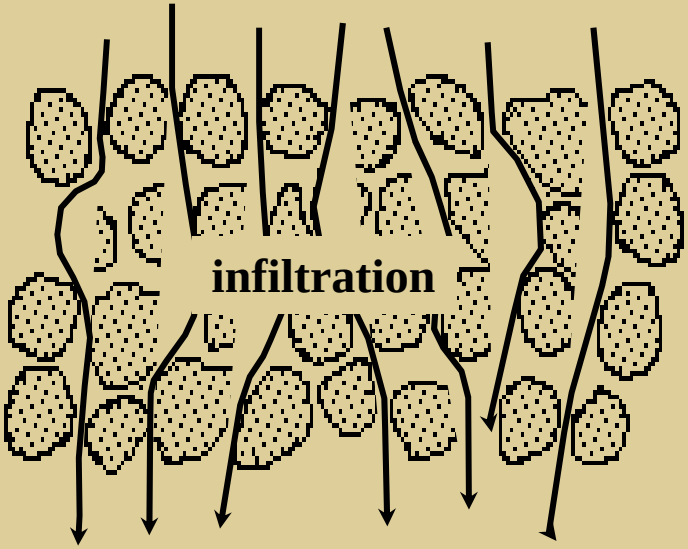
Results

Soil pH	7.3	
Nitrogen (ENR)	126.0	
Phosphorous (P)	592.0	Very High
Potassium (K)	168.0	* Low
Magnesium (Mg)	186.0	* Medium
Calcium (Ca)	946.0	* Very Low
Sodium (Na)	534.0	High
Soluble salt	0.6	Low
Soil Organic Matter (OM)	5.0	Medium

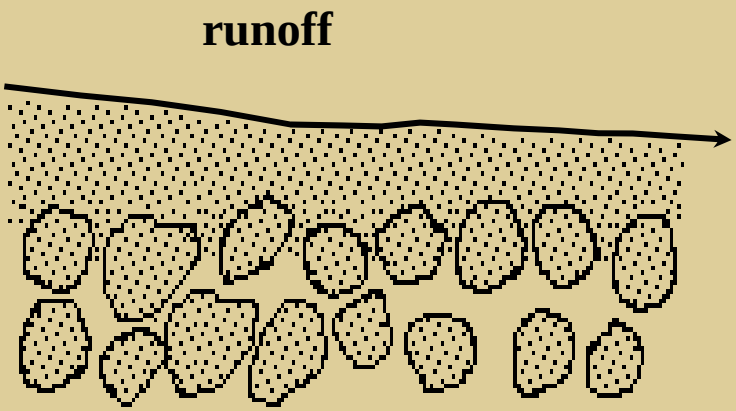
Ideal pH range for London Planetree: 6.0 to 8.0

Nutrient Retention Capacity 7.7 High

Soil Aggregation breakdown



a) **aggregated soil**



b) soil crusts over after aggregates break down

High levels of sodium causes loss of soil aggregation leading to reduced water infiltration, soil crusting and compaction.
Plant Root Growth is impeded.

Colorado State University
Extension

Managing Sodic Soils

Fact Sheet No. 0.504 Crop Series | Soil

by J.G. Davis, R.M. Waskom, and T.A. Bauder*

Soils with high levels of exchangeable sodium (Na) and low levels of total salts are called sodic soils. Sodic soils may impact plant growth by: 1.) Specific toxicity to sodium sensitive plants; 2.) Nutrient deficiencies or imbalances; 3.) High pH; and 4.) Dispersion of soil particles that causes poor physical condition of the soil.

Sodic soils tend to develop poor structure and drainage over time because sodium ions on clay particles cause the soil particles to deflocculate, or disperse. Sodic soils are hard and cloddy when dry and tend to crust. Water intake is usually poor with sodic soils, especially those high in silt and clay. Poor plant growth and germination are also common. The soil's pH is usually high, often above 9.0, and plant nutritional imbalances may occur. A soil pH above 8.4 typically

quality. Some labs report high sodium levels as ESP (exchangeable sodium percentage). An ESP of more than 15 percent is sometimes used to classify a soil as sodic. This means that sodium occupies more than 15 percent of the soil's cation exchange capacity (CEC). Be aware that sensitive plants may show injury or poor growth at even lower levels of sodium.

Sodium Hazard

Analyzing the soil for both soluble salts and sodium levels helps identify the specific soil problem and its severity. To find out if a problem exists, take a composite sample of several cores, 6 to 8 inches deep, from the affected area. In many cases, comparing soil samples from the affected area to

Quick Facts

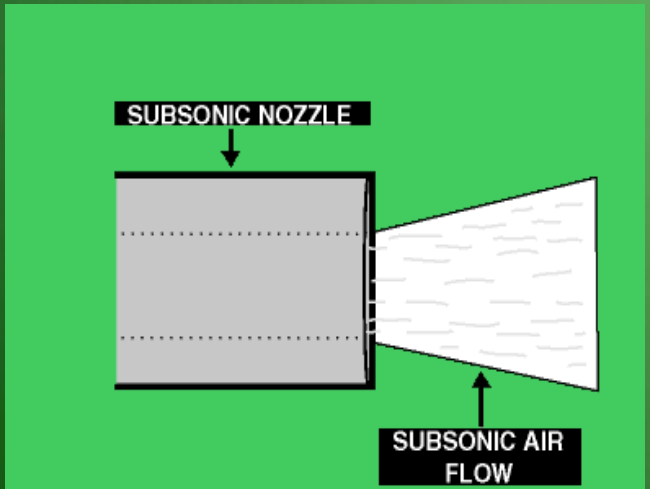
- Sodic soils are poorly drained and tend to crust.
- Sodic soils respond to continued use of good irrigation water, good irrigation methods, and good cropping practices.
- Sodic soils are often reclaimed by adding a calcium-based soil amendment.

Treatment of Sodic Soils

- Leach salts from soil with water-
- Soil wetting agents
- Apply gypsum/lime to displace sodium

Air tools

- Three tools are marketed to the arboriculture industry
- Compared for user ergonomics
- and speed of excavation
- Air spade, Air Pick and Air Knife



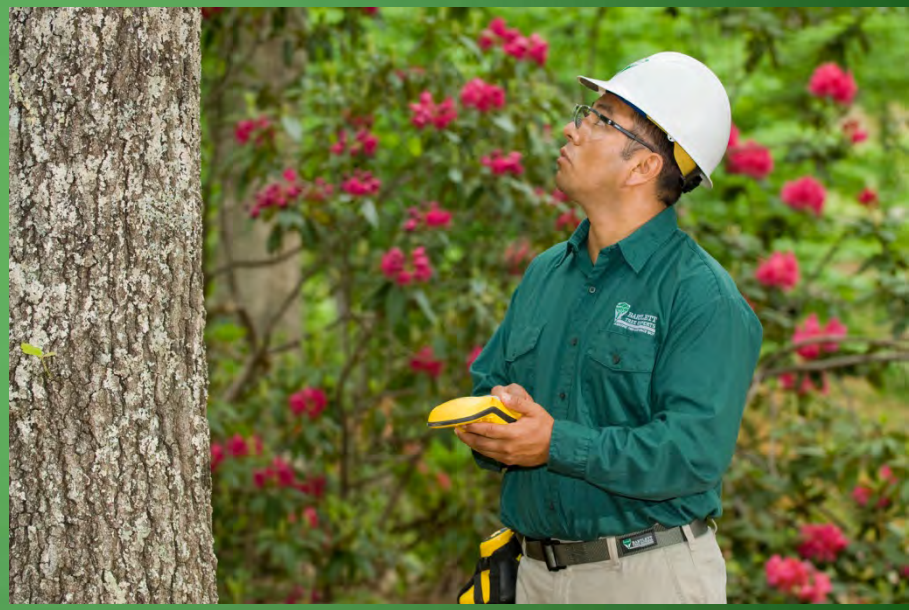
Mulching

Pests of Stressed Trees

- Borers
- Bark Beetles
- Canker Diseases

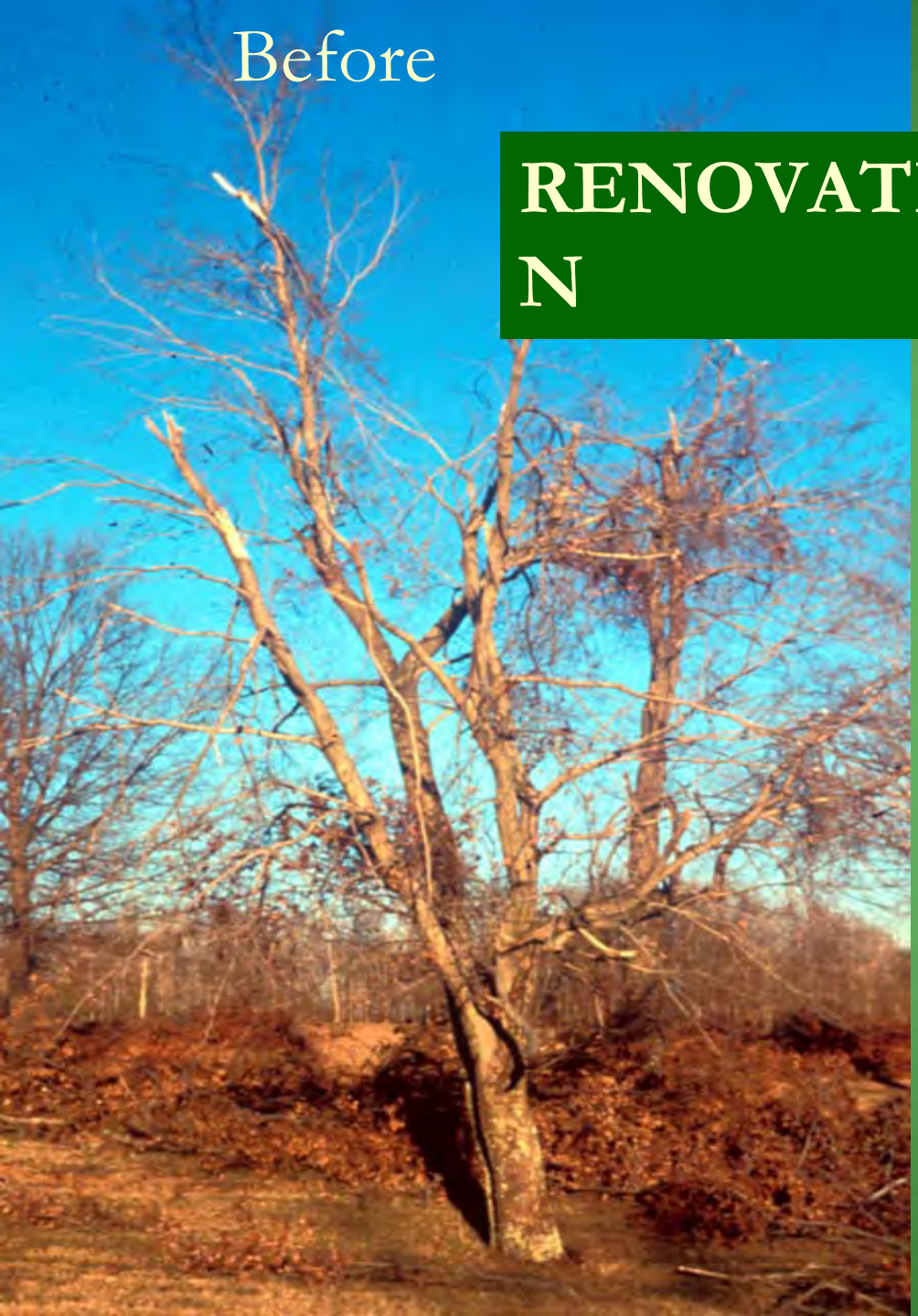
What to do now after Hurricane Sandy
-Inspections

- **Root Plate Heaving**
- **Leaning Stems**
- **Broken Hanging Branches**
- **Cracks**



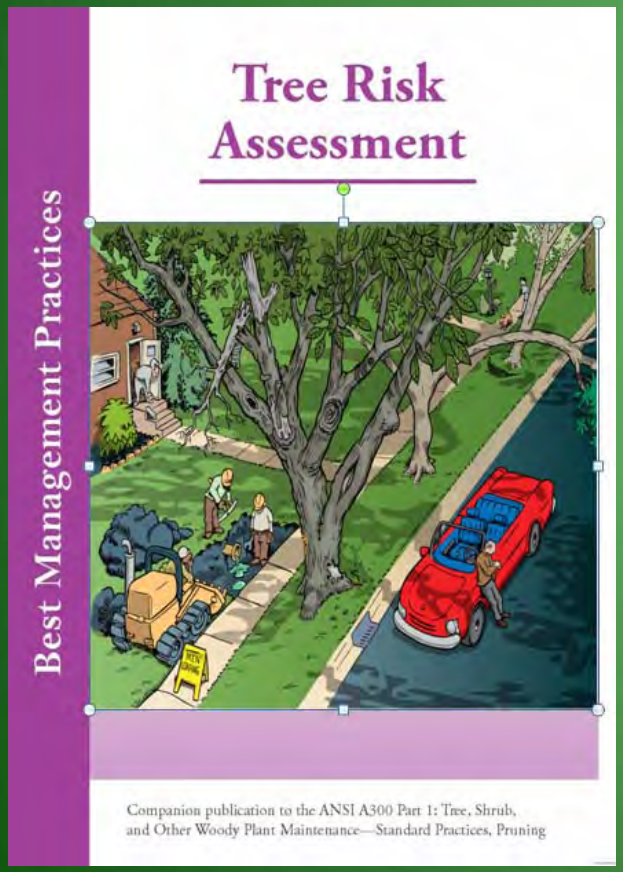
MACON STATE COLLEGE
RESERVED PARKING
VISITORS, STAFF
& FACULTY
7 A.M. to 5 P.M.

Where co-doms failed the other lead frequently within five years



RENOVATION

Risk is the Likelihood of a tree failure or conflict occurring and impacting a target and the severity of associated consequences.



Risk Methodology

Likelihood of Failure	Likelihood of Impact			
	Very Low	Low	Medium	High
Imminent	Unlikely	Somewhat likely	Likely	Very Likely
Probable	Unlikely	Unlikely	Somewhat likely	Likely
Possible	Unlikely	Unlikely	Unlikely	Somewhat likely
Improbable	Unlikely	Unlikely	Unlikely	Unlikely

Likelihood of Failure & Impact	Consequences of Failure			
	Negligible	Minor	Significant	Severe
Very Likely	Low	Moderate	High	Extreme
Likely	Low	Moderate	High	High
Somewhat likely	Low	Low	Moderate	Moderate
Unlikely	Low	Low	Low	Low

- Matrix-based, qualitative methodology from the *Best Management Practices: Tree Risk Assessment*
- Developed by tree risk assessment experts and risk scientists in accordance with International Standards Organization (ISO) standards

Likelihood of Failure

The chance of a tree or tree part failure occurring.

Likelihood of failure

- Imminent
- Probable
- Possible
- Improbable

is primarily determined by:

Tree Species

Defects & conditions

Load

Response growth

Site factors

Likelihood of Impact

The chance of a tree failure impacting a target during the specified time frame.

Likelihood of impact

- high
- medium
- low
- very low

is primarily determined by

Proximity to Tree

Occupancy rates

Protection factors

Direction of fall

Likelihood Matrix Introduction

- Determines the **likelihood of failure & impact**
- Determines the likelihood that a tree or tree part will fail and impact the target of concern
- First step toward determining the risk rating

Likelihood of Failure	Likelihood of Impact			
	Very Low	**Low**	**Medium**	**High**
Imminent	Unlikely	Somewhat likely	Likely	Very Likely
Probable	Unlikely	Unlikely	Somewhat likely	Likely
Possible	Unlikely	Unlikely	Unlikely	Somewhat likely
Improbable	Unlikely	Unlikely	Unlikely	Unlikely

Consequences of Failure Review

Consequences are based on the value of the damage and the amount of harm or disruption to the target.

Consequences of failure

- severe
- significant
- minor
- negligible

are affected by

Tree or tree part size

Distance of tree or tree part fall

Protection factors

Target value

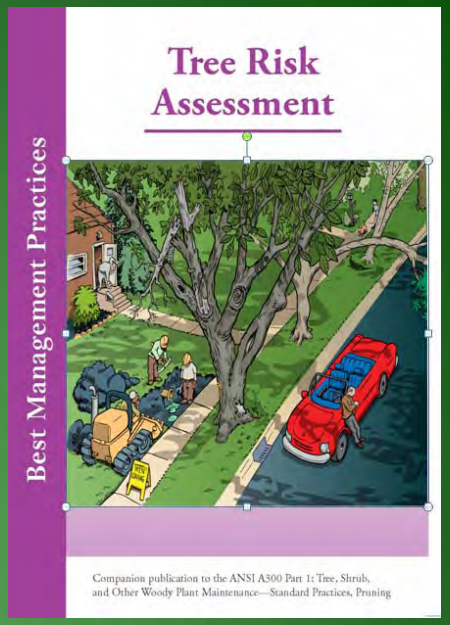
Risk Rating Matrix Introduction

- Determine risk rating by combining ratings from likelihood matrix with consequences of failure.
- Risk ratings communicate the level of risk for tree or tree part failure.

Likelihood of Failure & Impact	Consequences of Failure			
	Negligible	Minor	Significant	Severe
Very Likely	Low	Moderate	High	Extreme
Likely	Low	Moderate	High	High
Somewhat likely	Low	Low	Moderate	Moderate
Unlikely	Low	Low	Low	Low

Likelihood of Failure-Possible
Likelihood of Impact-Med
Consequences-Extreme
Risk: Low

Tree Risk Categorization



Risk → **Likelihood + Consequence**

↓

Pecan Risk Assessment: Low: this means that the tree is not likely to fail during normal weather conditions but could fail under severe events. If it fails, the tree may or may not strike people or the house with approximately equal likelihood. If it does strike a target, the consequences would be severe.

Thank You

HOW TO BUILD A FRANKENSTORM

Take one hurricane and mix it with the elements of a giant Nor'easter

Hurricane Sandy, moving north from the Caribbean, is expected to interact with a cold front just off the Virginia coast on Monday morning. The cold front could pull the storm westward to make landfall in New Jersey.

Sandy was a Category 2 hurricane last night, with sustained winds at more than 100 mph.

The hurricane is being penned in by weather disturbances to the north, east and west, slowing its movement to a crawl. It could affect New Jersey through Halloween.

Very heavy surf and extensive coastal flooding are possible from Cape May to the southern coast of Maine.

SOURCES: National Weather Service; MCT News Service

THE STAR-LEDGER

Frank Cecala/The Star-Ledger

Q:Are trees likely to fall due to the storm?

A: Winds of 50 to 70 mph with hurricane-force gusts are forecast to affect the state during the storm at this time, and could easily bring down trees and large limbs. Remaining leaves could be blown off trees and clog drains during the storms, but, the further north you go the fewer leaves remain, and the less problematic this becomes.