

Assessing Storm Damage in Urbanized Landscapes: Preparation, Response & Recovery



David Bloniarz, USDA Forest Service



Why Prepare?

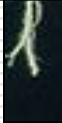




Tornados




Thunderstorms & Wind




Snow

Any Time, Any Place....




My Location
Springfield, MA





Tornado Watch

Expires: 06/02/2011 12:00 AM
Ma . Massachusetts
Counties Included Are

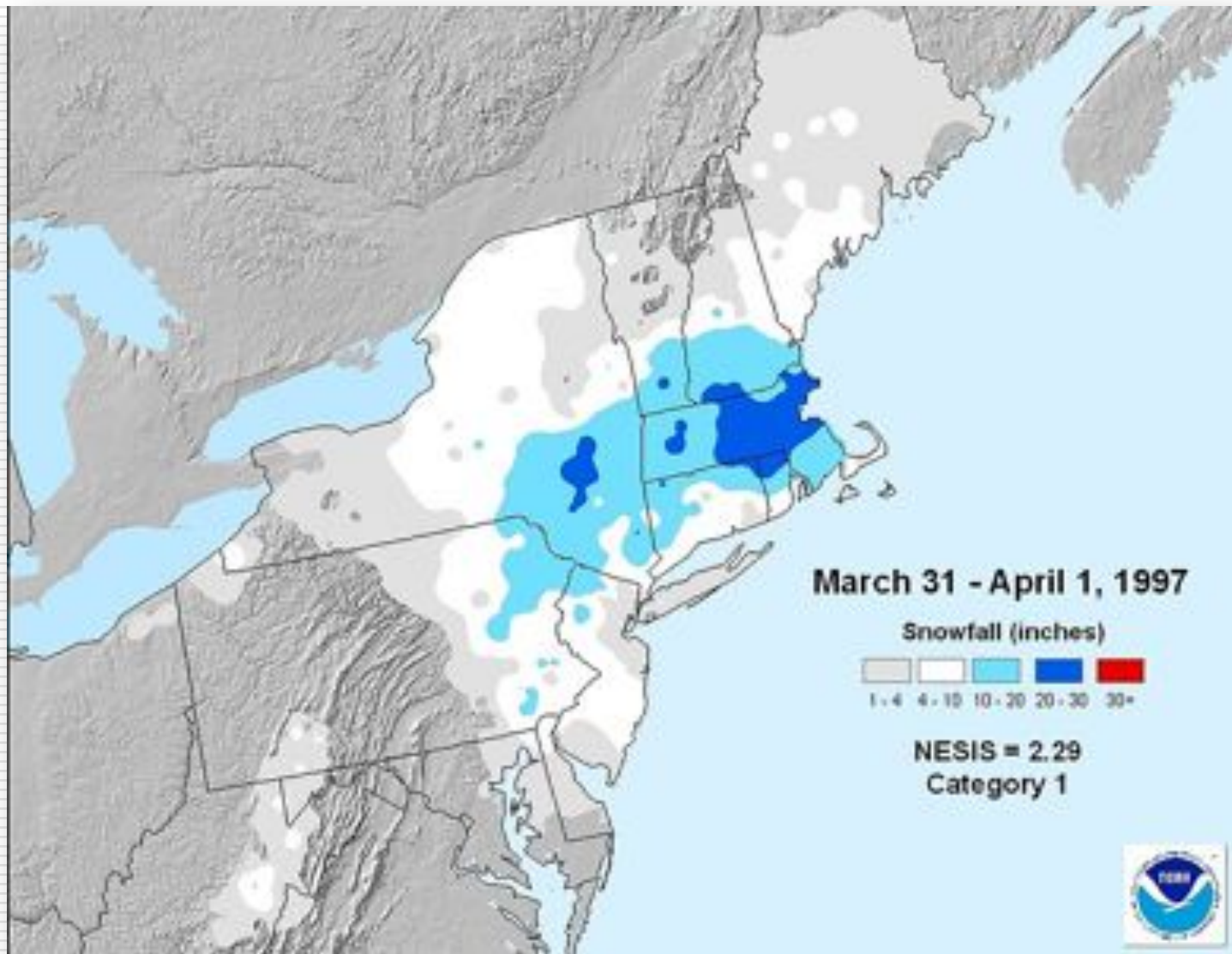
Essex
Hampden
Middlesex
Suffolk

Franklin
Hampshire
Norfolk
Worcester

86°F 

1997 April Fool's Day Blizzard

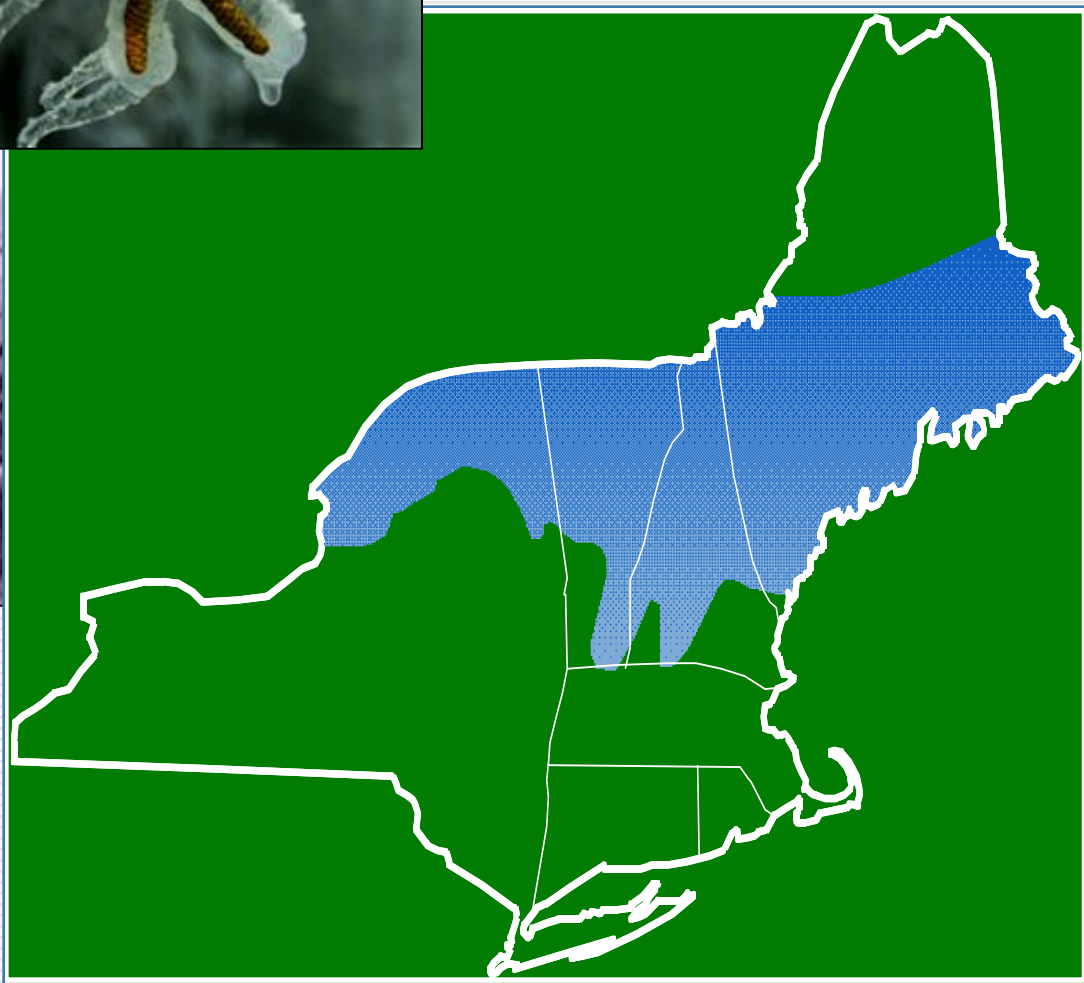


1997 April Fool's Day Blizzard



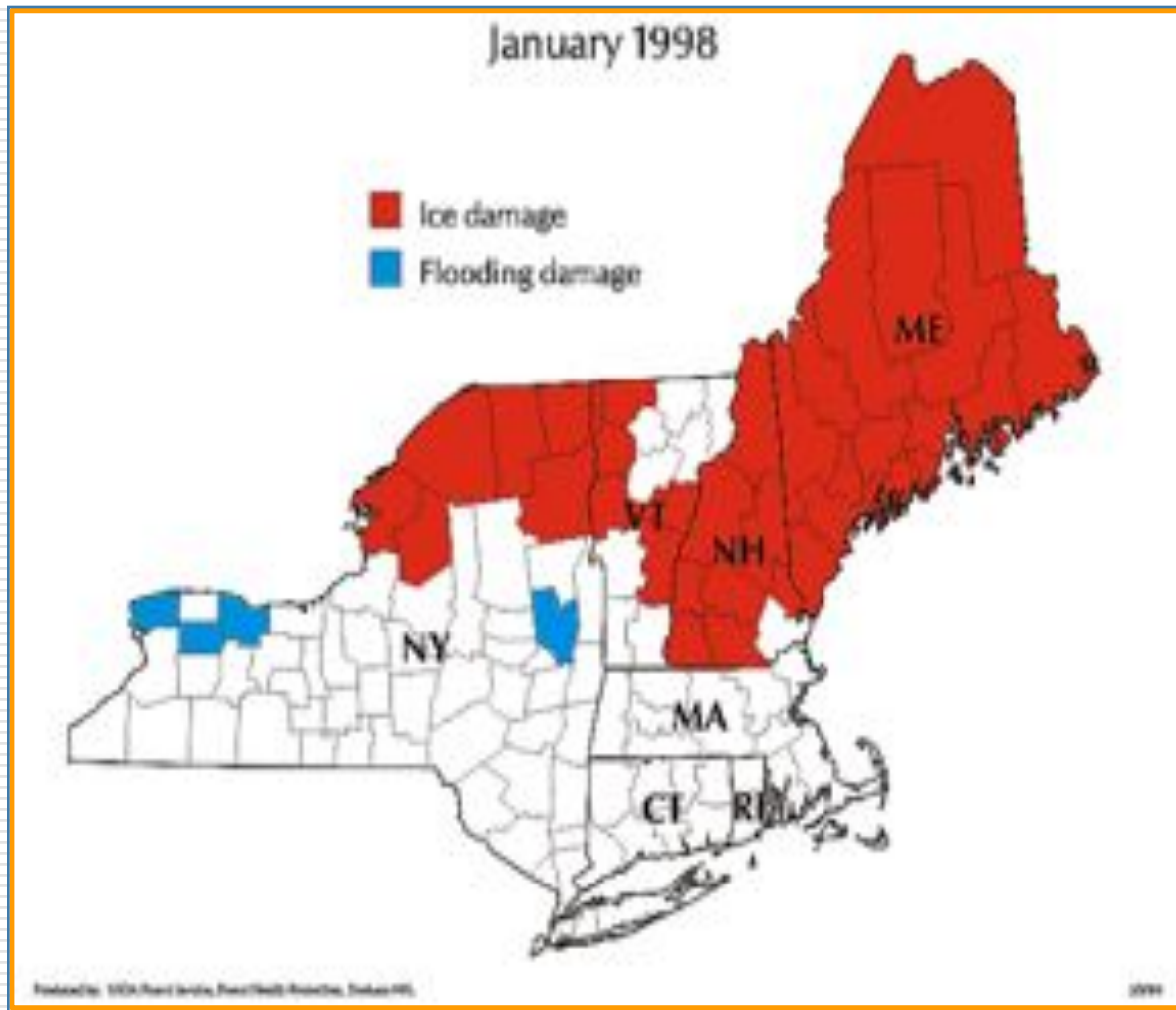
- 700,000 customers Lost Electricity
- Nearly 13% of New England lost power
- Boston's greatest April 24-hr snowfall





1998 Northeast Ice Storm Storm

FEMA Disaster Aid





Tree Damage



Transmission tower outside Montreal

Urban Core Impacts



Downtown
Montréal

Landscape Scale Damage



Central Vermont - January 1998

Historical Tracks of US Hurricanes



Isabel 2003: "A Storm of Trees"



COPING WITH ISABEL: WHAT YOU NEED TO KNOW

13 PAGES OF SPECIAL COVERAGE INSIDE ■ TIPS, CLOSINGS AND INFORMATION ON HOW AND WHERE TO GET HELP/PAGES A20-A21

SATURDAY
September 20, 2003
44 cents
1304 VIA No. 334

The Virginian-Pilot

SERVING HAMPTON, ROADS AND NORTHEASTERN NORTH CAROLINA

Worthy news and information at high
prices only \$1.99

- 1.8 million Dominion customers lost power
- Northern end of Hatteras Village decimated
- At least 17 in four states reported dead



Robert E. Jones, 70, of Hatteras Village, looks exhausted after the storm. He was one of the few who stayed in the village during the storm.

SWEPT AWAY



A 10-foot breakaway in all that Hatteras Island left of the Sea Ball Motel in Hatteras Village in the Outer Banks, which were hit by high winds and high waves as the storm made landfall nearby.

THE OUTAGES

"Catastrophic" damage done to power grid, officials say

BY TERRY RYAN
Hatteras Island had lost power for 12 hours, Dominion Electric Power Corp. officials said today. The company, which serves 1.8 million customers in Virginia and North Carolina, said the damage to the power grid was "catastrophic." The company said it was working to restore power as quickly as possible.



Marine's cleanup crew spent several hours clearing power lines on South Sea Island. The cleanup is expected to take several days.

AFTERMATH Q&A

From downed lines to water, problems Isabel left behind

Q. How will the power come back on?
A. Dominion officials said it would take several days to get power back on. The company said it was working to restore power as quickly as possible.

Q. Are there any other problems?
A. Yes, there are. The storm caused significant damage to the power grid, and there are reports of flooding in some areas.

THE OUTER BANKS

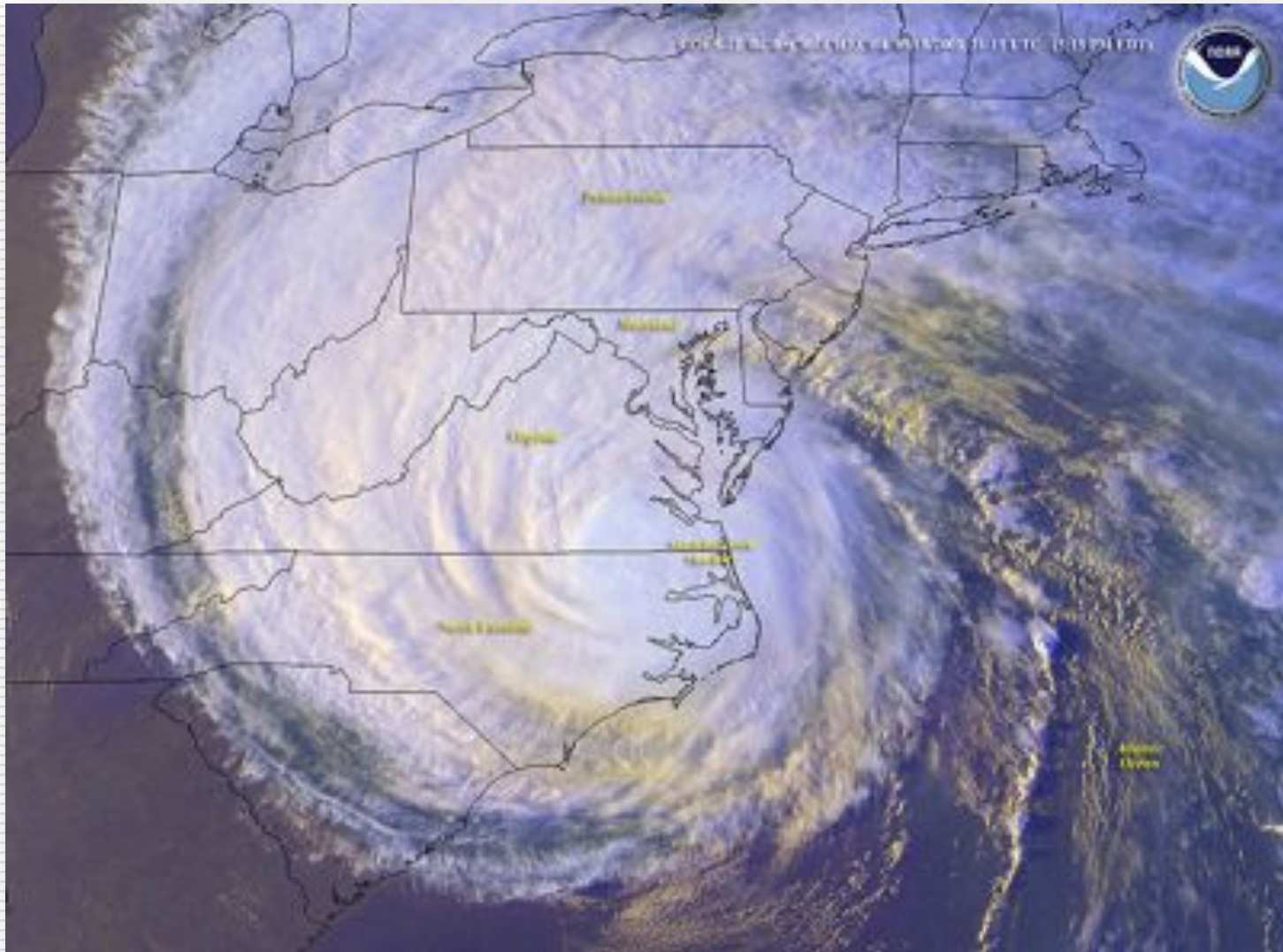
Hatteras Village isolated after hurricane cuts island in half

BY TERRY RYAN
Hatteras Village, N.C., was cut off from the mainland by the storm. The village is isolated, and there are reports of flooding in some areas.

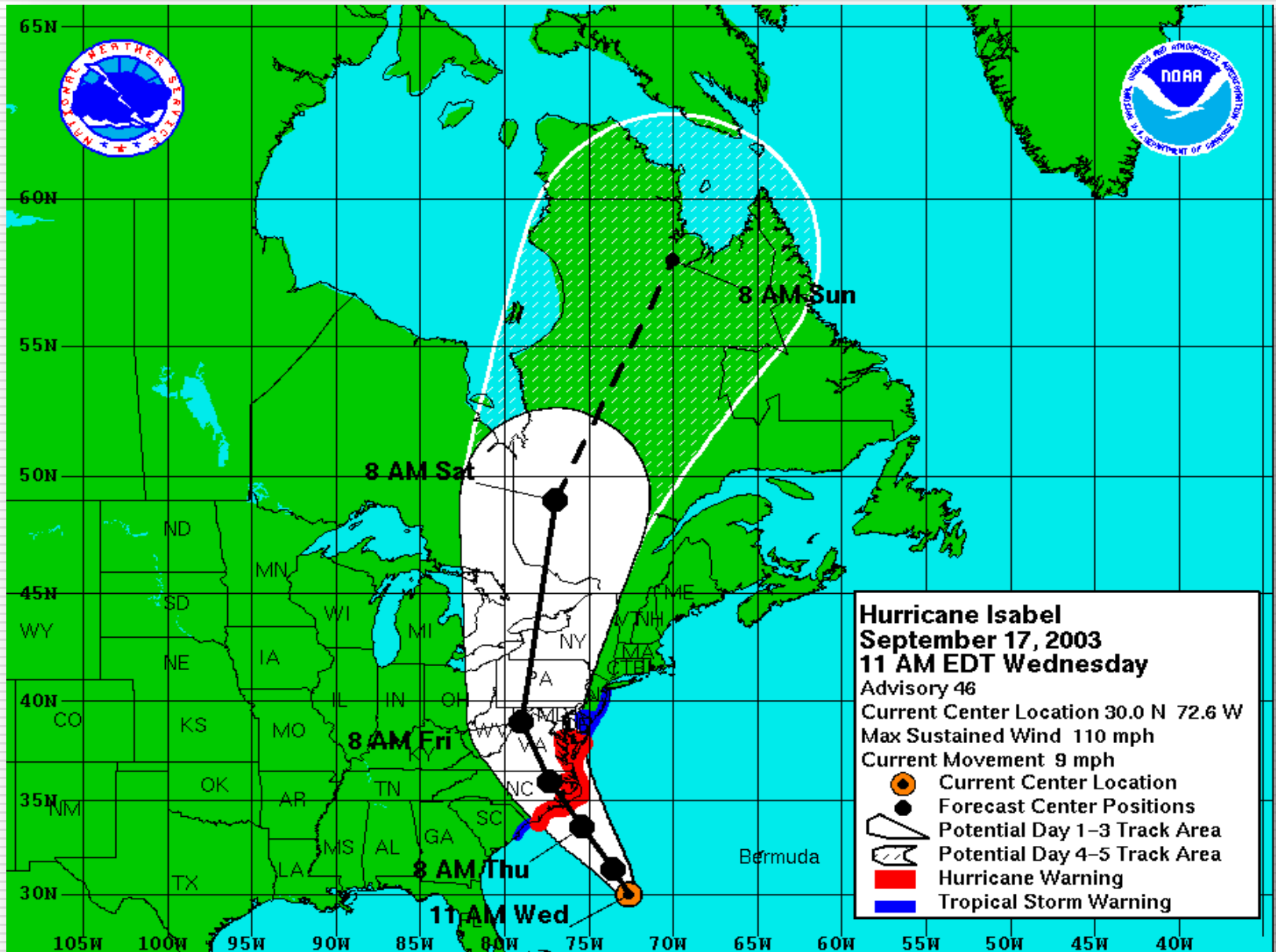


Hatteras Village is isolated from the mainland by the storm. The village is cut off from the mainland, and there are reports of flooding in some areas.

Isabel 2003: “A Storm of Trees”



Isabel 2003: “A Storm of Trees”



Isabel 2003: “A Storm of Trees”



- Affected Maryland and Washington, DC
- \$945 million (2003 USD, (\$1.13 billion 2011 USD)
- Highest Sustained Winds 60 MpH
- Over 2 million households/businesses lost power

Isabel 2003: “A Storm of Trees”



Isabel “wreaked havoc on the forest of urban and suburban trees... Many of them are so big that, when blown over by tropical storm-force winds, they’re likely to find a power line that was once thought safely distant.”

- Pat Michaels
Virginia State
Climatologist

Katrina: Beyond the Trees



Katrina: Beyond the Trees

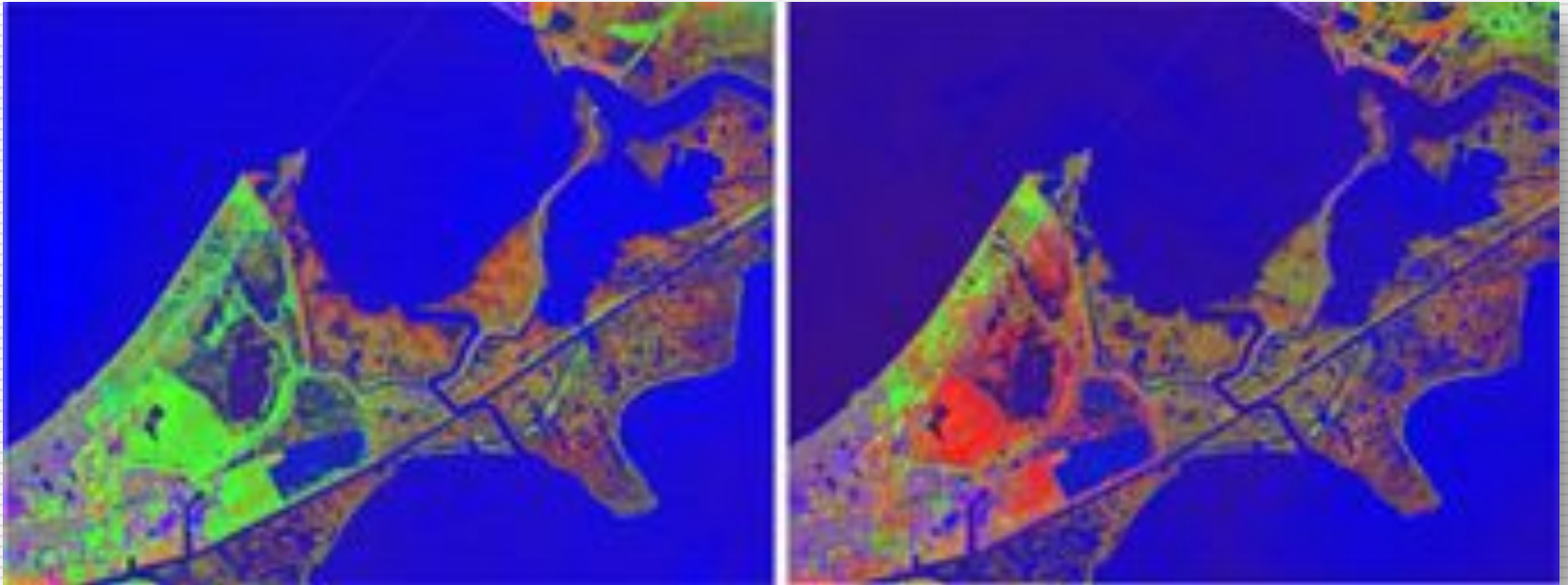


- \$81 Billion in damage
- 1,836 fatalities
- 80% New Orleans submerged
- 3 million without electricity
- 90,000 sq miles declared disaster

Katrina: Beyond the Trees



Katrina: Tree Loss




http://www.nasa.gov/mission_pages/hurricanes/archives/2007/katrina_carbon.html


- 5 million acres affected
- 320 million trees lost

Western/Central Massachusetts

June 1, 2011 Tornado




 My Location
Springfield, MA





 Tornado Watch

Expires: 06/02/2011 12:00 AM
Ma . Massachusetts
Counties Included Are

Essex
Hampden
Middlesex
Suffolk

Franklin
Hampshire
Norfolk
Worcester

86°F 

Western/Central Massachusetts June 1, 2011 Tornado



Western/Central Massachusetts June 1, 2011 Tornado

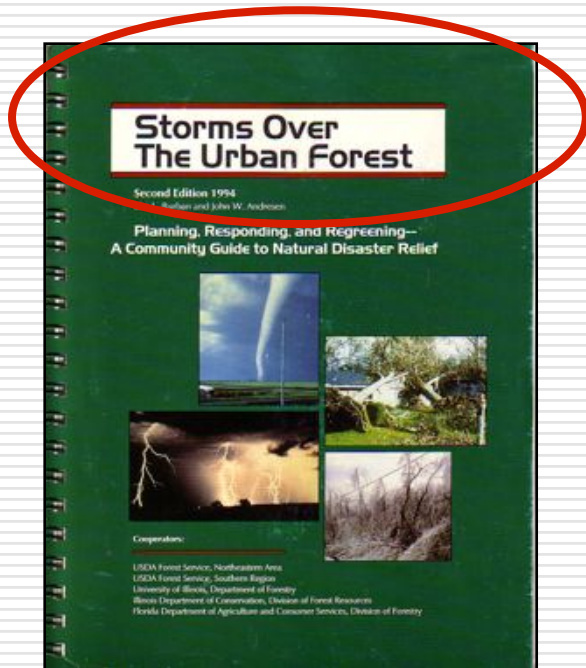


On the ground response and action



On the ground response and action





Tree Emergency Plan Worksheet

For Urban and Community Foresters, Community Leaders, Public Works and Parks Departments, Planners, Councils, and other Public Officials

1. Early Warning System/Weather Forecasting Service — Use an early warning procedure to enhance education, communicate with the National Weather Service, a community meteorological firm, a volunteer volunteer weather observer, or the local police department. Make a procedure in place, you should have at least three hours of lead time before most non-sampling weather events.

Staff Lead: _____

Contact Name: _____
 Address: _____
 Phone: _____
 Mobile: _____
 FAX: _____
 Email: _____

Description of services provided: _____

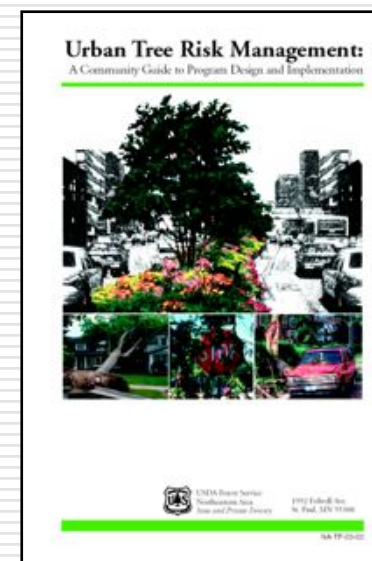
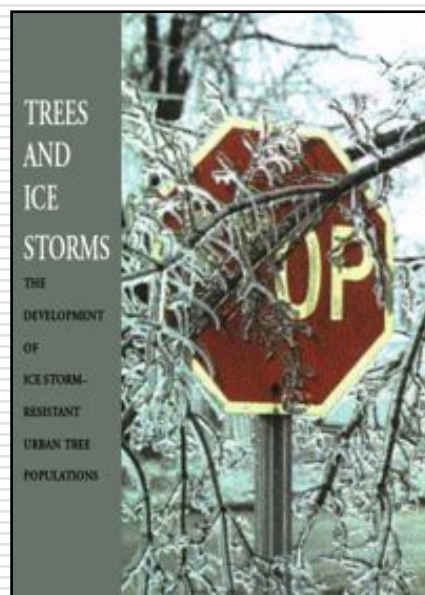
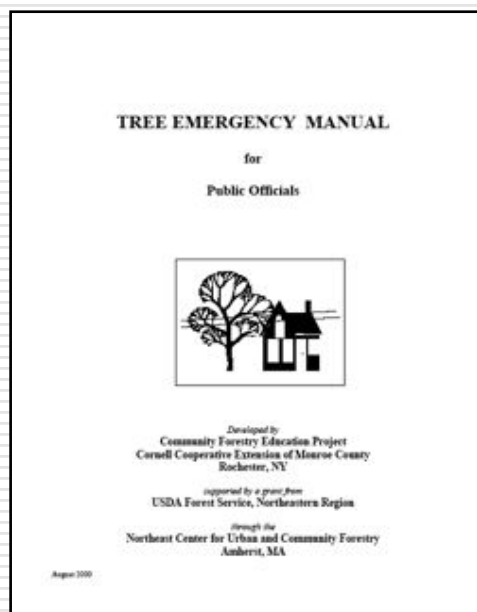
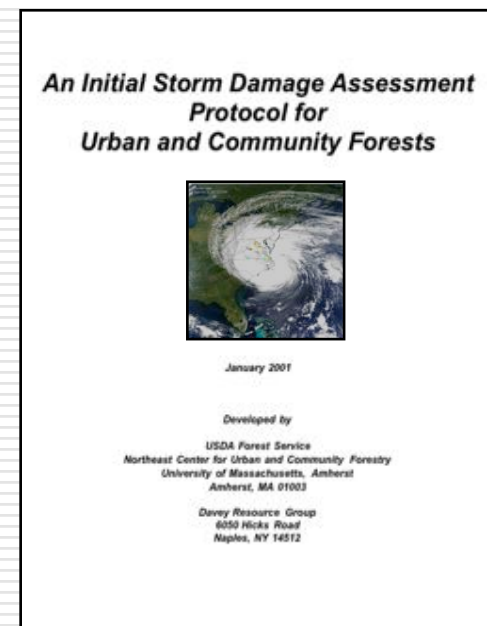
2. Local Emergency Manager — Local contact for a community and responsible for emergency planning and response activities.

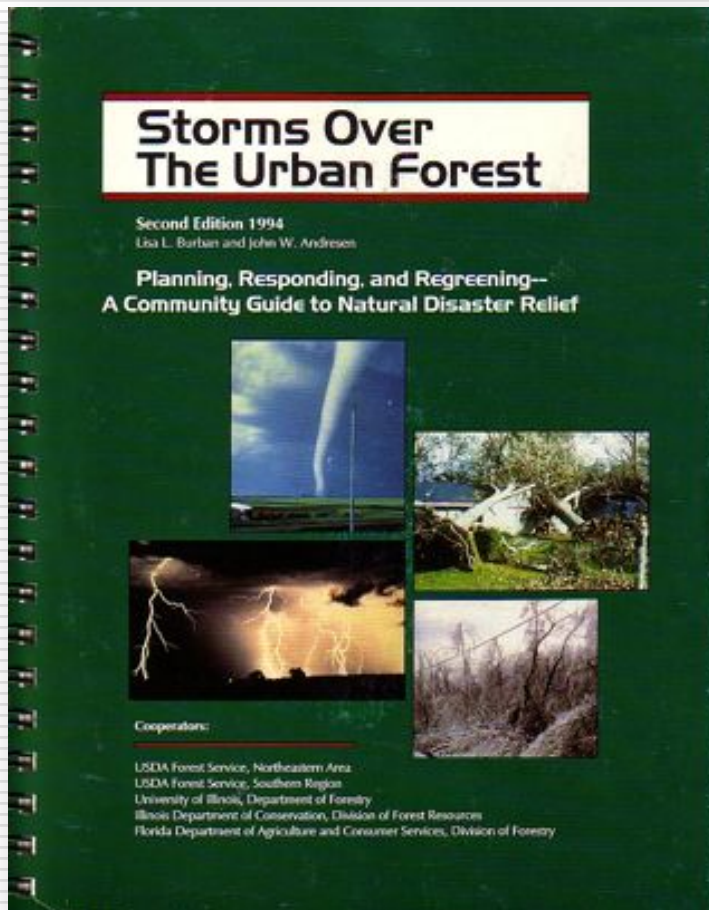
Name: _____ Phone: _____
 Email: _____ Mobile: _____

3. Public Relations Coordinator — This is the individual responsible for primary public relations, media contacts, crisis information and communications about the natural disaster. (You have no knowledge of damage, community losses and capabilities, and no able to make decisions).

Name: _____ Phone: _____
 Email: _____ Mobile: _____

Alternate(s):
 Name: _____ Phone: _____
 Name: _____ Mobile: _____
 Name: _____ Phone: _____
 Name: _____ Mobile: _____





Chapter 1 Introduction

Chapter 2 Coping with Natural Disasters

Chapter 3 Preparing for Natural Disasters

Chapter 4 Natural Disaster Alert, Response and Recovery

Chapter 5 Regreening the Community

Chapter 6 Approaches to Working With Disaster Relief Organizations

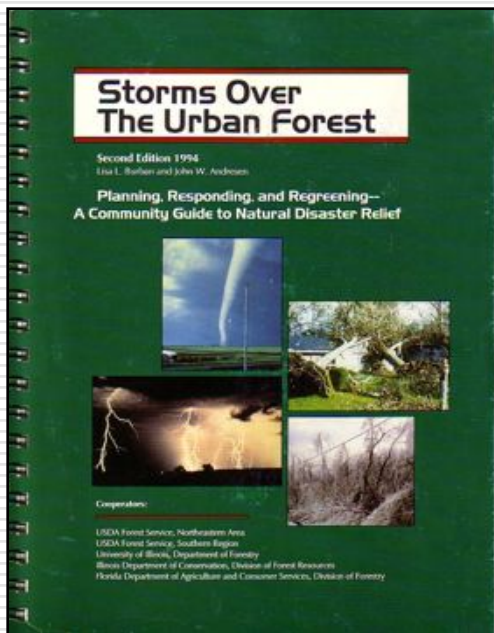
Chapter 7 Tornado Releaf - A Case Study

Chapter 8 Notes from Hurricane Andrew

Chapter 10 References

Chapter 11 Appendix - Key Words

<http://www.na.fs.fed.us/urban>



Tree Emergency Plan Worksheet
For Urban and Community Foresters, Community Leaders, Public Works and Parks Departments, Planners, Councils, and other Public Officials

1. Early Warning System/Weather Forecasting Service — See an early warning procedure to enhance information, communicate with the National Weather Service, a local emergency shelter, a volunteer disaster relief organization, or the local police department. A procedure to be followed by which you will arrive three hours of lead-time before the emergency weather strikes.

Staff Lead: _____

Contact Name: _____
Address: _____
Phone: _____
Mobile: _____
FAX: _____
Email: _____

Description of services provided: _____

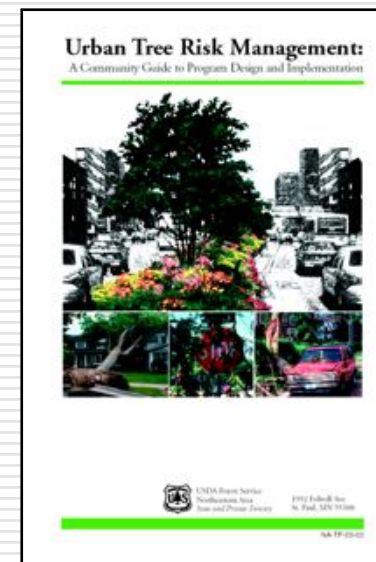
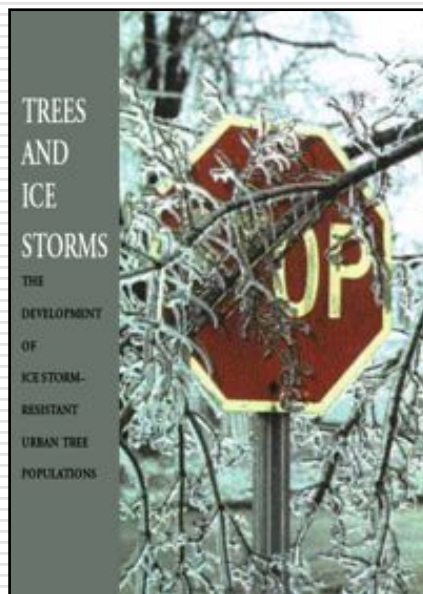
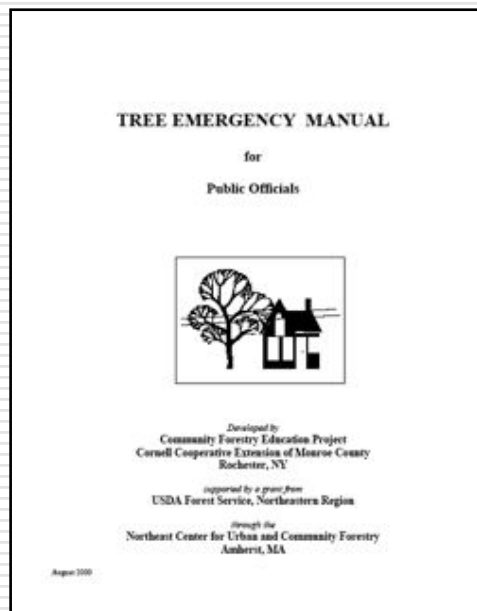
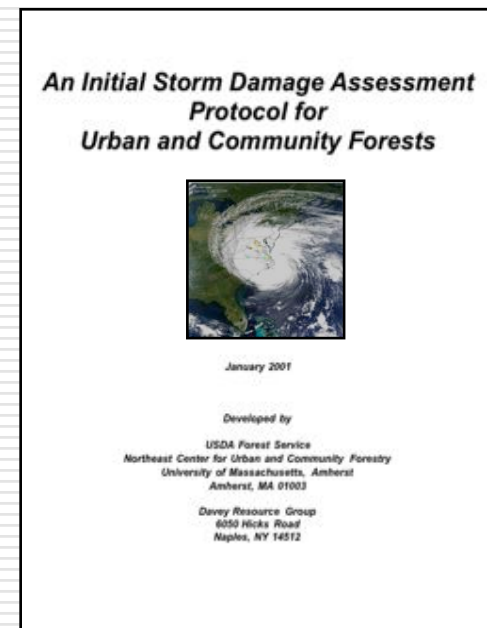
2. Local Emergency Manager — Local contact for a community and responsible for emergency planning and response activities.

Name: _____ Phone: _____
Email: _____ Mobile: _____

3. Public Relations Coordinator — This is the individual responsible for primary public relations, media contacts, crisis information and communications about the natural disaster. (Must have full knowledge of damage, community issues and capabilities, and be able to make decisions).

Name: _____ Phone: _____
Email: _____ Mobile: _____

Alternate(s):
Name: _____ Phone: _____
Mobile: _____
Name: _____ Phone: _____
Mobile: _____



Tree Emergency Plan Worksheet

For: Urban and Community Foresters, Community Leaders, Public Works and Parks
Departments, Planners, Councils, and other Public Officials

1. Early Warning System/Weather Forecasting Service — Use an early warning procedure to enhance mitigation: communicate with the National Weather Service, a consulting meteorological firm, a designated television weather channel, or the local police department. With a procedure in place, you should have at least three hours of lead time before most tree damaging weather strikes.

Staff Lead: _____

Contact Name: _____

Address: _____

Phone: _____

Mobile: _____

FAX: _____

Email: _____ Web Site: _____

Description of services provided:

2. Local Emergency Manager — Lead contact for a community and responsible for emergency planning and response activities.

Name: _____ Phone: _____

Mobile: _____

Role(s): _____

3. Public Relations Coordinator — This is the individual responsible for primary public relations, media contacts, citizen information and communications about the natural disaster. (Must have full knowledge of damage, community issues and capabilities, and be able to make decisions.)

Name: _____ Phone: _____

Mobile: _____

Alternate(s):

Name: _____ Phone: _____

Mobile: _____

Name: _____ Phone: _____

Mobile: _____

Tree Emergency Plan Worksheet

6. Emergency Call Out Procedure — provide contact info for staff

Name: _____	Work Contact: _____	Name: _____
		Phone: _____
		Mobile: _____
		Name: _____
		Phone: _____
		Mobile: _____
		Name: _____
		Phone: _____
		Mobile: _____
Name: _____	Work Contact: _____	Name: _____
		Phone: _____
		Mobile: _____
		Name: _____
		Phone: _____
		Mobile: _____
		Name: _____
		Phone: _____
		Mobile: _____
Name: _____	Work Contact: _____	Name: _____
		Phone: _____
		Mobile: _____
		Name: _____
		Phone: _____
		Mobile: _____
		Name: _____
		Phone: _____
		Mobile: _____

<http://www.na.fs.fed.us/urban>

Tree Emergency Plan Worksheet

11. Procedure for Debris Sealing and Removal

... identify several areas for staging and processing debris. Establish a contract or agreement securing each site. Choose a processing site that is large, flat, well drained and accessible to roads that can support truck weights of at least 2 tons per axle. Identify ways to protect significant trees or cultural resources during processing. Potential sites include undeveloped lots, industrial, commercial, fairgrounds, logging and mill lands. Large parking lots paved into gravel lots. Remember to consider noise implications near residential areas. Identify multiple sites. Annually reconfirm access and availability to those sites. Make sure the site is large enough for bulky considerations (flying debris from log grinders). If possible, identify sites that can be secured fencing.

Site 1 - Location: _____

Contact Name/Phone: _____

Phone: _____

Mobile: _____

Site 2 - Location: _____

Contact Name/Phone: _____

Phone: _____

Mobile: _____

Site 3 - Location: _____

Contact Name/Phone: _____

Phone: _____

Mobile: _____

12. Debris and Brush Removal from Private Property

... identify how you will address this issue. It may be more difficult for private property owners to remove brush and debris. Make a decision as the municipal government for debris collection. Determine if your city has adequate equipment and staff available to accomplish this other municipal task. If it is critical that you provide guidelines for residents. Specify the types, amounts and piling arrangement of the materials that are all allowed. Cities can also assist private homeowners who must contract with private companies for clearing and removal by providing a list of companies that are bonded, professionally trained and insured.

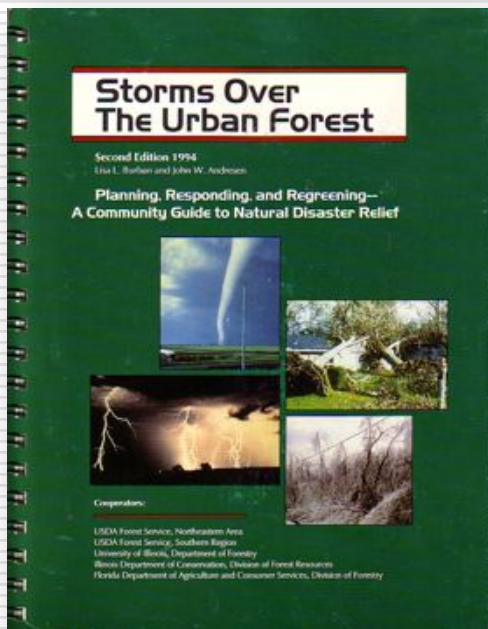
Person Responsible: _____

Phone: _____ Mobile: _____

Minor Storm Policy: _____

Major Storm Policy: _____

Listing of available local contractors: _____



Tree Emergency Plan Worksheet

For Urban and Community Foresters, Community Leaders, Public Works and Parks Departments, Planners, Councils, and other Public Officials

1. Early Warning System/Weather Forecasting Service — Use an early warning procedure to enhance information communications with the National Weather Service, a local weather monitoring station, a volunteer weather station, or the local police department. Make a procedure in place, via which you advise your audience three hours or less time before most tree damaging weather strikes.

Staff List: _____

Emergency Name: _____
 Address: _____
 Phone: _____
 Mobile: _____
 FAX: _____
 Email: _____

Descriptions of services provided: _____

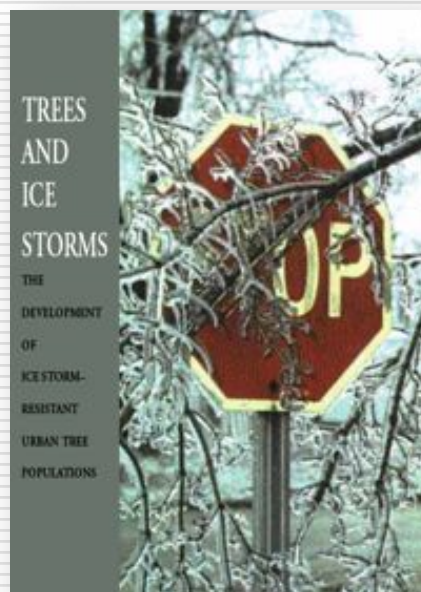
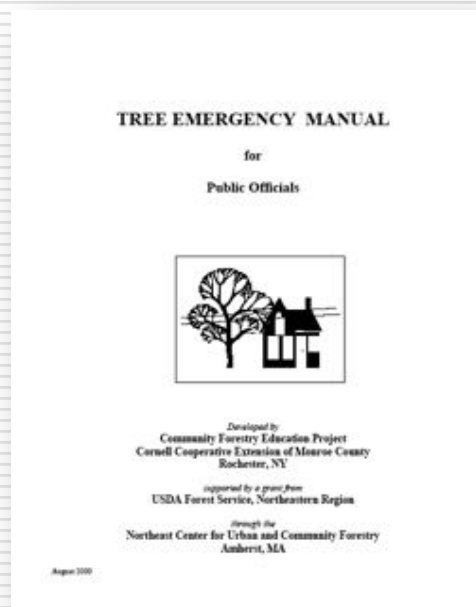
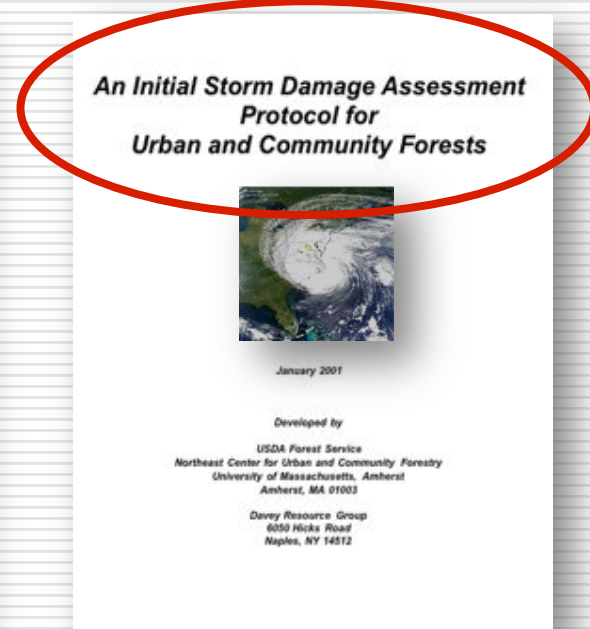
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 Email: _____ Mobile: _____

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Name: _____ Phone: _____
 Email: _____ Mobile: _____

Alternate(s): _____
 Name: _____ Phone: _____
 Email: _____ Mobile: _____



Estimating Storm Damage Costs



i-Tree

Storm

What is i-Tree?

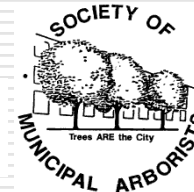
A suite of tools to assess urban vegetation and their ecosystem services and values



v. 3.0 programs

Public-Private Partnership

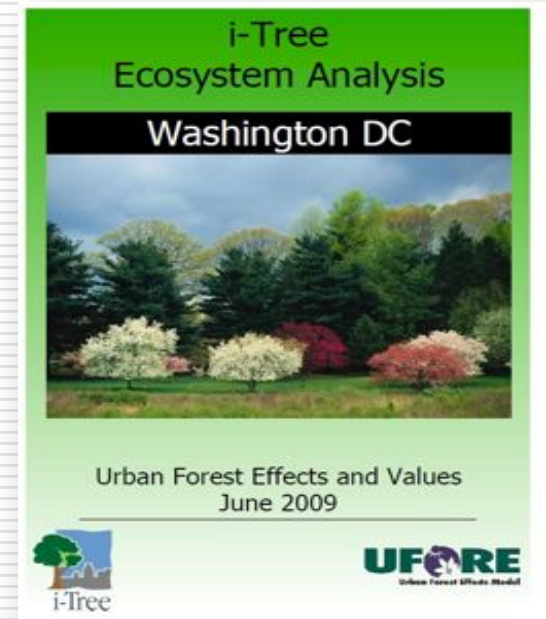
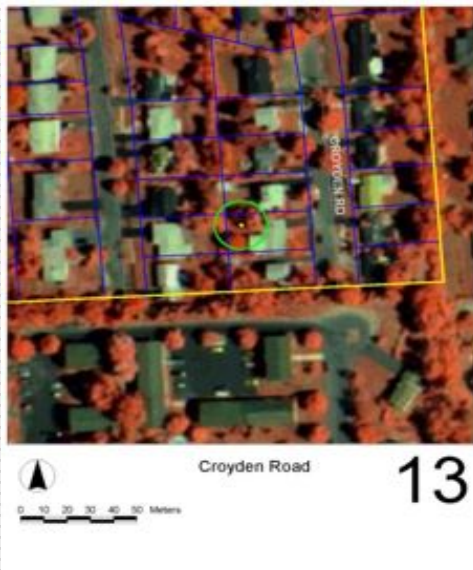
- 🌳 USDA Forest Service
- 🌳 Davey Tree Expert Co.
- 🌳 National Arbor Day Foundation
- 🌳 Society of Municipal Arborists
- 🌳 International Society of Arboriculture
- 🌳 Casey Trees



Goals



- ✿ Simple and low-cost tools and methods to aid in forest planning and management
- ✿ Complete process – start to finish



i-Tree Version 4.0

5 New or Enhanced Tools



i-Tree™

Hydro



i-Tree™

Vue



i-Tree™

Canopy



i-Tree™

Pest



i-Tree™

Design

How Does Storm Work?



- 🌳 Context of Use
- 🌳 Sampling
- 🌳 Data Collection
- 🌳 PDA & Desktop Features

Context of Use




🌳 Planning

- Framed by overall natural disaster plan
 - 🌳 FEMA funding: Pre-Disaster Mitigation Program
 - 🌳 Tree Emergency Plan Worksheet (Burban)

🌳 Recovery

- First 24-36 hours
- Response to state emergency agency

An Initial Storm Damage Assessment Protocol for Urban and Community Forests




January 2001

Developed by

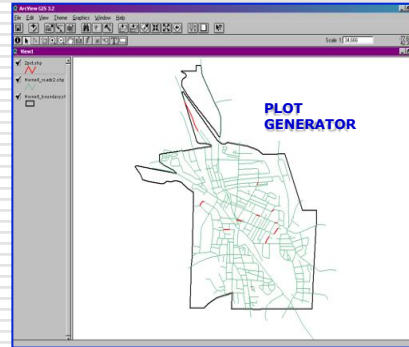
USDA Forest Service
 Northeast Center for Urban and Forestry
 University of Massachusetts
 Amherst, MA 01003

Sherry Richardson, Greg
 603-893-6676
 Seattle, WA 98102



i-Tree

Storm



Random Plots

Page 3A

PRE-Storm Field Data Collection Sheet (Populated Areas)

Community Name: _____										Plot Number: _____	
ON Street: _____					TO Street: _____						
From SW to SE: _____											
Date: _____					Plot Length (ft/m): _____						
ACORN (4th-5th): _____					Subcatchment: _____						
400											
Complete this section only if the plot is near the first driveway.											
Start of plot description: _____											
End of plot description: _____											

ON Right-of-Way Street (Start/End from SW to SE of the Street)										ACORN x 80' Tracer			
Obs. Date	Major Street	Observed to Next Intersection	Observed to Next Intersection	Observed to Next Intersection	Observed to Next Intersection	Observed to Next Intersection	Observed to Next Intersection	Observed to Next Intersection	Observed to Next Intersection	Obs. Date	Obs. Date	Obs. Date	Obs. Date
		ACORN	ACORN	ACORN	ACORN	ACORN	ACORN	ACORN	ACORN				
8-12		3.2		0.75		8-12							
13-16		6.1		1.0		13-16							
16-24		7.7		1.6		16-24							
25-30		10.2		2.0		25-30							
31-36		12.6		2.5		31-36							
37-40		20.0		4.0		37-40							
40+		20.0		0.0		40+							
Tracer						Tracer							

* Fill address for a group that fill entire lot at the edge of the right-of-way.

* Record start time and apply scale. Plot address last number of digits after last column.

* 0 = No tracer used, not include when summed (see Protocol).

* 1 = No tracer present or so removed or falsified to indicate greater than 1 tracer only (see Protocol).

Pre-Storm Sample Survey

[illegible]

Estimating Engine

[illegible]

Post-Storm Survey

[illegible]

Final Damage Estimate

Components



Data Collection- Paper

Form SA
POST-Storm Field Data Collection Sheet (Populated Areas)

Community Name: _____ Plot Number: _____

ON Street: _____ TO Street: _____

FROM Street: _____ Plot Length (Miles): _____

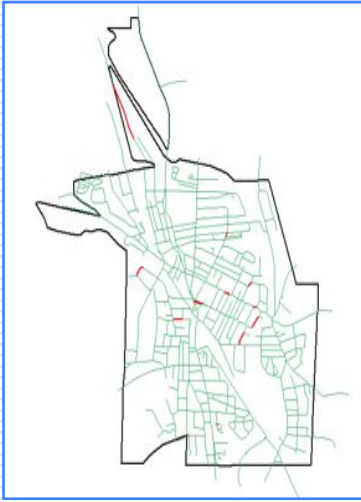
Date: _____ Collected by: _____

ROW Width (Feet): _____

Start of plot description: _____

End of plot description: _____

ROW Trees ONLY										ROW + SF Trees*									
Tree Removals					Tree Pruning					Tree Removals					Tree Pruning				
DBH Class	Number of Trees	Species	Size Class	Notes	DBH Class	Number of Trees	Species	Size Class	Notes	DBH Class	Number of Trees	Species	Size Class	Notes	DBH Class	Number of Trees	Species	Size Class	Notes
6-10	3.2				0-25	0.75				0-100					101-200				
11-15	5.1				26-35	1.0				201-300					301-400				
16-24	7.7				36-45	1.5				401-500					501-600				
25-35	10.2				46-55	2.0				601-700					701-800				
36-45	12.5				56-65	3.0				801-900					901-1000				
46-55	20.4				66-75	4.0				1001-1100					1101-1200				
56-65	28.6				76-85	5.0				1201-1300					1301-1400				
66-75	36.8				86-95	6.0				1401-1500					1501-1600				
76-85	45.0				96-105	7.0				1601-1700					1701-1800				
86-95	53.2				106-115	8.0				1801-1900					1901-2000				
96-105	61.4				116-125	9.0				2001-2100					2101-2200				
106-115	69.6				126-135	10.0				2201-2300					2301-2400				
116-125	77.8				136-145	11.0				2401-2500					2501-2600				
126-135	86.0				146-155	12.0				2601-2700					2701-2800				
136-145	94.2				156-165	13.0				2801-2900					2901-3000				
146-155	102.4				166-175	14.0				3001-3100					3101-3200				
156-165	110.6				176-185	15.0				3201-3300					3301-3400				
166-175	118.8				186-195	16.0				3401-3500					3501-3600				
176-185	127.0				196-205	17.0				3601-3700					3701-3800				
186-195	135.2				206-215	18.0				3801-3900					3901-4000				
196-205	143.4				216-225	19.0				4001-4100					4101-4200				
206-215	151.6				226-235	20.0				4201-4300					4301-4400				
216-225	159.8				236-245	21.0				4401-4500					4501-4600				
226-235	168.0				246-255	22.0				4601-4700					4701-4800				
236-245	176.2				256-265	23.0				4801-4900					4901-5000				
246-255	184.4				266-275	24.0				5001-5100					5101-5200				
256-265	192.6				276-285	25.0				5201-5300					5301-5400				
266-275	200.8				286-295	26.0				5401-5500					5501-5600				
276-285	209.0				296-305	27.0				5601-5700					5701-5800				
286-295	217.2				306-315	28.0				5801-5900					5901-6000				
296-305	225.4				316-325	29.0				6001-6100					6101-6200				
306-315	233.6				326-335	30.0				6201-6300					6301-6400				
316-325	241.8				336-345	31.0				6401-6500					6501-6600				
326-335	250.0				346-355	32.0				6601-6700					6701-6800				
336-345	258.2				356-365	33.0				6801-6900					6901-7000				
346-355	266.4				366-375	34.0				7001-7100					7101-7200				
356-365	274.6				376-385	35.0				7201-7300					7301-7400				
366-375	282.8				386-395	36.0				7401-7500					7501-7600				
376-385	291.0				396-405	37.0				7601-7700					7701-7800				
386-395	299.2				406-415	38.0				7801-7900					7901-8000				
396-405	307.4				416-425	39.0				8001-8100					8101-8200				
406-415	315.6				426-435	40.0				8201-8300					8301-8400				
416-425	323.8				436-445	41.0				8401-8500					8501-8600				
426-435	332.0				446-455	42.0				8601-8700					8701-8800				
436-445	340.2				456-465	43.0				8801-8900					8901-9000				
446-455	348.4				466-475	44.0				9001-9100					9101-9200				
456-465	356.6				476-485	45.0				9201-9300					9301-9400				
466-475	364.8				486-495	46.0				9401-9500					9501-9600				
476-485	373.0				496-505	47.0				9601-9700					9701-9800				
486-495	381.2				506-515	48.0				9801-9900					9901-10000				
496-505	389.4				516-525	49.0				10001-10100					10101-10200				
506-515	397.6				526-535	50.0				10201-10300					10301-10400				
516-525	405.8				536-545	51.0				10401-10500					10501-10600				
526-535	414.0				546-555	52.0				10601-10700					10701-10800				
536-545	422.2				556-565	53.0				10801-10900					10901-11000				
546-555	430.4				566-575	54.0				11001-11100					11101-11200				
556-565	438.6				576-585	55.0				11201-11300					11301-11400				
566-575	446.8				586-595	56.0				11401-11500					11501-11600				
576-585	455.0				596-605	57.0				11601-11700					11701-11800				
586-595	463.2				606-615	58.0				11801-11900					11901-12000				
596-605	471.4				616-625	59.0				12001-12100					12101-12200				
606-615	479.6				626-635	60.0				12201-12300					12301-12400				
616-625	487.8				636-645	61.0				12401-12500					12501-12600				
626-635	496.0				646-655	62.0				12601-12700					12701-12800				
636-645	504.2				656-665	63.0				12801-12900					12901-13000				
646-655	512.4				666-675	64.0				13001-13100					13101-13200				
656-665	520.6				676-685	65.0				13201-13300					13301-13400				
666-675	528.8				686-695	66.0				13401-13500					13501-13600				
676-685	537.0				696-705	67.0				13601-13700					13701-13800				
686-695	545.2				706-715	68.0				13801-13900					13901-14000				
696-705	553.4				716-725	69.0				14001-14100					14101-14200				
706-715	561.6				726-735	70.0				14201-14300					14301-14400				
716-725	569.8				736-745	71.0				14401-14500					14501-14600				
726-735	578.0				746-755	72.0				14601-14700					14701-14800				
736-745	586.2				756-765	73.0				14801-14900					14901-15000				
746-755	594.4				766-775	74.0				15001-15100					15101-15200				
756-765	602.6				776-785	75.0				15201-15300					153				



Sampling Methods

- 🌳 2-3% of blockside mileage
 - Blockside = street segment between road/street corners or ends
- 🌳 Manual Method or Computerized Process
 - Random selection
 - 10 blockside minimum needed for analysis

Sampling Methods



Manual Sampling Method



The Smarter Way



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TIGER/Line Files, Redistricting Census 2000



Content Citation:

Title of Content: [TIGER/Line Files, Redistricting Census 2000](#)

Type of Content: Downloadable Data

Content Publisher: U.S. Bureau of the Census

Publication Date: 2000-02-01

Content Description:

Content Summary: The Redistricting Census 2000 TIGER/Line files are an extract of selected geographic and cartographic information from the TIGER data base. The geographic coverage for a single TIGER/Line file is a county or statistical equivalent entity, with the coverage of the entire set of Redistricting Census 2000 TIGER/Line files including all counties and statistically equivalent entities in the United States and Puerto Rico. The Redistricting Census 2000 TIGER/Line files consist of line segments representing physical features and statistical boundaries.

Content Purpose: In order for others to use the information in the Census TIGER data base in a geographic information system (GIS) or for other geographic applications, the Census Bureau releases to the public extracts of the data base in the form of TIGER/Line files.

Content Themes: Administrative and political boundaries

Source of
TIGER/Line
data as
shape files

Geography Network - Download Census 2000 TIGER/Line Shapefiles - Netscape

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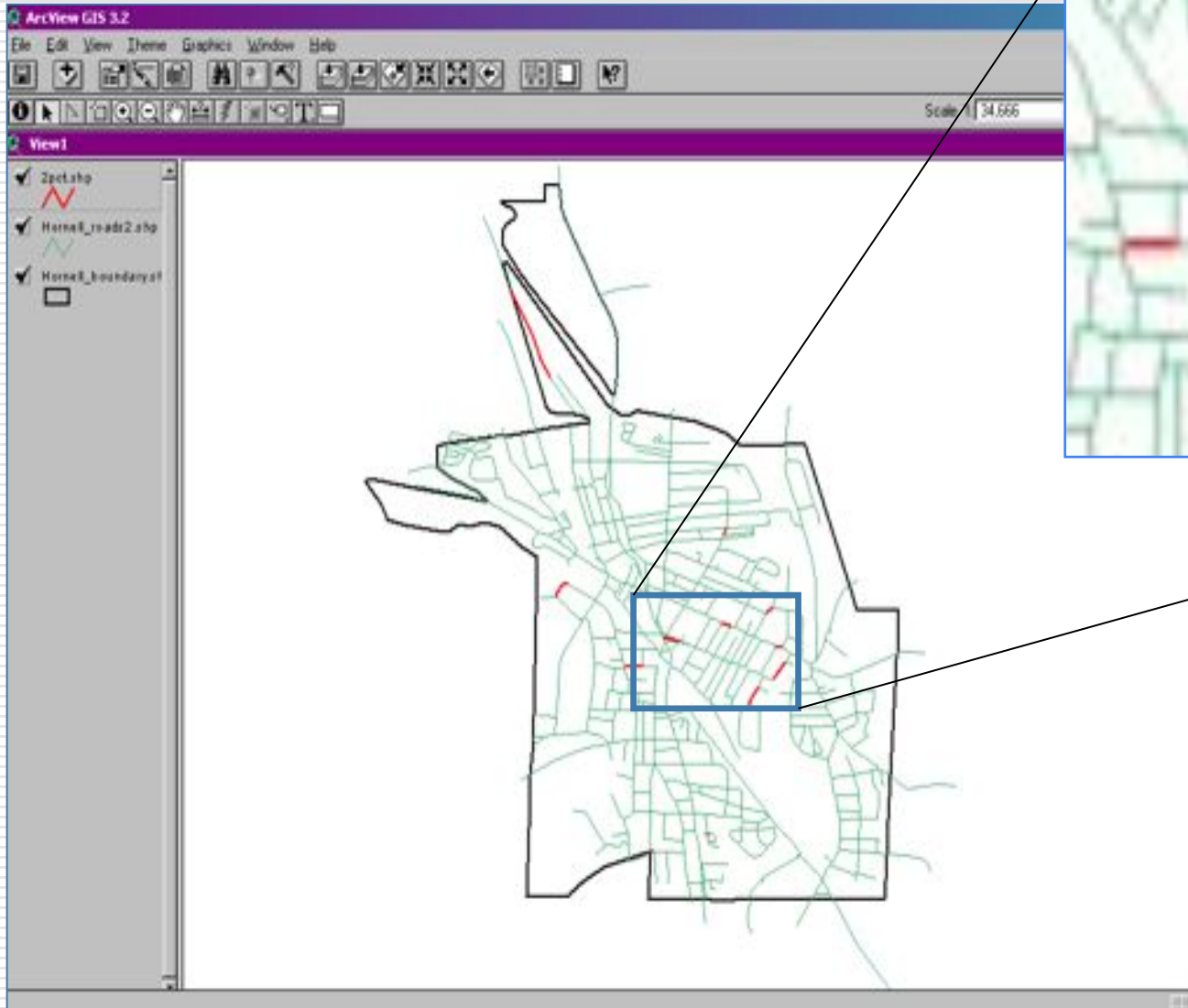
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Technical documentation for PL 94-171 and SF1 data:
[U.S. Census PL 94-171\(PDF\)](#)
[U.S. Census Summary File 1 \(SF1\)\(PDF\)](#)
[ESRI Abbreviated PL 94-171\(PDF\)](#)
[PL 94-171 Quick Reference Guide](#)
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Pick your county

Map of Sample Plots



Components



Data Collection- Paper

Form 5A
POST-Storm Field Data Collection Sheet (Populated Areas)

Community Name: _____ Plot Number: _____

ON Street: _____ TO Street: _____

FROM Street: _____

Date: _____ Plot Length (Feet): _____

ROW Width (Feet): _____ Collected by: _____

Start of plot description: _____

End of plot description: _____

ROW Trees ONLY										ROW + SF Trees*									
Tree Removals	Tree Pruning	Tree Pruning	Tree Pruning	Tree Pruning	Tree Pruning	Tree Pruning	Tree Pruning	Tree Pruning	Tree Pruning	Tree Pruning	Tree Pruning	Tree Pruning	Tree Pruning	Tree Pruning	Tree Pruning				
Tree Removals	Tree Pruning	Tree Pruning	Tree Pruning	Tree Pruning	Tree Pruning	Tree Pruning	Tree Pruning	Tree Pruning	Tree Pruning	Tree Pruning	Tree Pruning	Tree Pruning	Tree Pruning	Tree Pruning	Tree Pruning				
6-12	3.2																		
13-18	5.1																		
19-24	7.7																		
25-30	10.2																		
31-36	12.5																		
37-42	20.4																		
43+	20.0																		
Total																			

*Average = Total - number of 100-foot segments x 100.

Data Collection- PDA



PLOT GENERATOR

Blockside information from the Diagram

Blockside Number	On Street	From Street	To Street
1	Main Street	First Street	West Street
2	First Street	Main Street	Maple Street
3	Maple Street	Dead End	First Street
4	West Street	Main Street	Maple Street
5	Maple Street	First Street	West Street

Sampling Tools

Data Storage & Processing

Plot Number	On Street	From Street	To Street	Tree Removals	Tree Pruning	Tree Pruning	Tree Pruning	Tree Pruning	Tree Pruning	Tree Pruning	Tree Pruning	Tree Pruning	Tree Pruning	Tree Pruning	Tree Pruning
1	Main Street	First Street	West Street	3.2											
2	First Street	Main Street	Maple Street	5.1											
3	Maple Street	Dead End	First Street	7.7											
4	West Street	Main Street	Maple Street	10.2											
5	Maple Street	First Street	West Street	12.5											
Total				20.4											

Reporting

Community: _____ Report Date: 5/12/2005

Note: numbers on this page were generated by a "Storm Damage Estimate Template" as revised in 2004 by the USDA Forest Service and Davis Resource Group using your storm field observations of random plots

ESTIMATED COST OF TREE DAMAGE \$0

COMMUNITY VALUES

Check the numbers to the right, and correct if necessary	Street Miles	Removal Cost/Tree	Pruning Cost/Tree	Brush Cost/Tree
	0	0	0	0

Estimate components

N Street Miles Sampled	Removals	Total Removal Hours	Total Removal Cost	Hazard Pruning	Total Pruning Hours	Total Pruning Cost	Total Canopy Loss	Total Brush on jobs	Total Brush Cost	Total Cost
0	0	0.0	\$0	0	0.0	\$0	0	0.0	\$0	\$0

DETAILED POST-STORM CALCULATION 1: Removals and Hazard Pruning

DBH Class (Inches)	Tree Removal			Tree Pruning			Plot Info
	Total of Removal Trees	Removal Time per Tree	Total Hours for Removal	Total of Pruned Trees	Prune Time per Tree	Total Hours for Pruned Trees	
6-12	0	3.2	0	0	0.75	0	Plot Info Main Street For Street Miles in Sample 0.00
13-18	0	5.1	0	0	1	0	
19-24	0	7.7	0	0	1.5	0	
25-30	0	10.2	0	0	2	0	
31-36	0	12.5	0	0	3	0	
37-42	0	20.4	0	0	4	0	
43+	0	20	0	0	5	0	
All Plots	0	6.2	0	0	2.5	0	
Totals	0	0	0	0	0	0	

Using i-Tree Storm



- 🌳 Examples of Applied Use
- 🌳 Success Stories
- 🌳 Other Points

Data Collection

Form 5.6A
POST-Storm Field Data Collection Sheet (Populated Areas)

Community Name ¹ :			
ON Street:		Plot Number ² :	
FROM Street:			
TO Street:			
Date:			
ROW Width (feet):		Plot Length (feet):	
Collected by:			
Start of plot description:			
End of plot description:			

ROW Trees ONLY							ROW + 50' Trees ³		
Tree Removals				Tree Pruning			Debris Estimate ⁴		
Code Class	Daily Number of Trees cut Tree x	Total # of Trees cut Tree x	Tree Fee (\$ x # of Trees x Rate per Tree)	Total # of Trees pruned Tree x	Tree Fee (\$ x # of Trees x Rate per Tree)	Total # of Trees pruned Tree x	Rate in 100-foot x Segment x	CROWD CODE	CROWD TAMER
6-12			3.2			8.75	0-100		
13-18			5.1			1.0	101-200		
19-24			7.7			1.5	201-300		
25-30			10.2			2.0	301-400		
31-36			12.5			3.0	401-500		
37-42			20.4			4.0	501-600		
43+			25.0			5.0	601-700		
Totals							701-800		
							Below ⁵		
							Total CL		
							Average		
							Total CH		

¹ If public facilities were recorded during set up, list them in same grid plot section.

² Plot address as agreed but do not include corner of the edge of the right-of-way.

³ Crowd + other Crowd codes go in same yards for the whole plot.

⁴ For plots longer than 100 feet, report average (Crowd Loss) or total (Crowd Yards) of the remainder of the plot beyond 100 feet in the same cluster's row.

⁵ Average = Total ÷ number of 100-foot segments examined.



Overview: Pre-storm setup

- Create random sample
 - Before emergency!
 - Use electronic or manual means
- Measure tree density and size class
 - Within ROW
 - Also 50' back from ROW edge
- Take final steps
 - Pre-Storm report form: useful estimate
 - Storage for future use

Data collection: paper forms

- In disaster work, good reason to keep paper as option
 - Electricity not a concern
 - Damage possibility minimal
 - Reduces training needed
- Forms for many different situations
- Copies in User's Manual, or on web

Form 56 POST Storm Field Data Collection Sheet (Populated Areas)

Form 5A POST-Storm Field Data Collection Sheet (Populated Areas)

Community Name ¹ :			
ON Street:		Plot Number ¹ :	
FROM Street:	TO Street:		
Date:	Plot Length (Feet):		
ROW Width (Feet):		Collected by:	

Start of plot description:

End of plot description:

ROW Trees ONLY								ROW + 50' Trees ¹			
Tree Removals				Tree Pruning				Debris Estimate ²			
On-Street	Total Number of Removed Trees	Total # of Removed Trees	Total Feet of Tree (ft) (ft)	Total Number of Pruned Trees	Total # of Pruned Trees	Total Feet of Tree (ft) (ft)	Total Hours for Removal (ft) (ft) (ft) (ft)	Debris in 100-foot Segment	CROWN LOSS	CRACKS	CRACKS
6-12		3.2			3.75			0-100			
13-18		5.1			1.0			101-200			
19-24		7.7			1.5			201-300			
25-30		10.2			2.0			301-400			
31-36		12.5			3.0			401-500			
37-42		20.4			4.0			501-600			
43+		28.0			5.0			601-700			
Totals								701-800			

¹ If debris estimates were recorded during set-up, plot # is same and plot number.

² Rate above is as a group that fall within 10 feet of the edge of the right-of-way.

³ Choose either crown loss or crack loss for the whole plot.

⁴ For plots longer than 100 feet, report average (Crown Loss) or total (Crack Loss) of the remainder of the plot beyond 100 feet in the corresponding row.

⁵ Average = Total ÷ number of 100-foot segments examined.

Extra⁴

Total CL

Average⁵

Total CL

Form 5B POST-Storm Field Data Collection Sheet (Rural Areas)

Community Name ¹ :	
ON Road:	Plot Number ¹ :
Intersection nearest to plot start:	
Approximate distance to intersection:	
Date:	Plot Length (Feet):
ROW Width (Feet):	Collected by:

Start of plot:

End of plot:

On-Right-of-Way Trees (Count trees on both sides of the road)							
Total # of 100-foot Segments	Total Number of 100-foot Segments	Avg. Rate ¹ per Segment	Total Hours for Removal (ft) (ft) (ft) (ft)	Total # of 100-foot Segments	Total Number of 100-foot Segments	Avg. Rate ¹ per Segment	Total Hours for Removal (ft) (ft) (ft) (ft)
		6.2				2.5	
Totals							

¹ If road and plot information was recorded during set-up, plot # is same and plot number.

² On rural roads, removals are only recorded for large trees already in place. Time has been reduced 50% from the above rate, and includes cleanup and disposal.

³ On rural roads, time given is for pruning off limbs or hazardous branches (usually less than 4 inches dia). Time has been reduced 50% from above rate, and does not include other pruning.

⁴ Choose Crown Loss or Crack Loss for the plot. For both Crown Loss with one of these rates: 0.5 (0-20%), 0.5 (21-40%), 0.5 (41-60%), 0.5 (61-80%), 0.5 (81-100%).

⁵ For plots longer than 100 feet, report average (Crown Loss) or total (Crack Loss) of the remainder of the plot beyond 100 feet in the corresponding row.

⁶ Average = Total CL ÷ # of 100' segments

Debris Estimate ²		
Rate in 100-foot Segment	Crown Loss	Crack Loss
0-100		
101-200		
201-300		
301-400		
401-500		
501-600		
601-700		
701-800		
Extra ⁴		
Total CL		
Average ⁵		
Total CL		

Form 5C

POST-Storm Field Data Collection Sheet (Non-linear Maintained Areas)

Community/Facility Name:		Date: _____
Survey Area Location:		
Collected by:	Date:	

Indicate the ways to measure the post-storm		
Ref point 1:	Compass bearing 1:	Distance 1:
Ref point 2:	Compass bearing 2:	Distance 2:
Ref point 3:	Compass bearing 3:	Distance 3:
How many post-storm markers (y/n/g):		Marker type:
Other:		

Maintained Trees							
Tree Characteristics				Tree Status			
DBH Class	Qty of trees for removal	Total dbh removed (inches)	Base area removed (sq ft)	Qty of trees for removal (dbf trees + base area)	Total dbh removed (inches)	Base area removed (sq ft)	Total dbh removed (dbf trees + base area)
6-12			3.2				3.2
13-18			6.1				6.1
19-24			9.1				9.1
25-30			12.2				12.2
31-36			15.3				15.3
37-42			18.4				18.4
43+			21.5				21.5
Total							

FILL IN ONE: _____ CUBIC FEET _____ % OR CUBIC YARDS: _____

* If any post-storm damage was recorded during pre-storm setup, put it in same section.

* Estimate Crown loss with one of three values: 0.2 (0-20%), 0.5 (21-60%), 0.8 (61-100%), or 1.0 (100%).

Form 5D

POST-Storm Field Data Collection Sheet (Non-linear Unmaintained Areas)

Community/Facility Name:		Date: _____
Survey Area Location:		
Collected by:	Date:	

Indicate the ways to measure the post-storm		
Ref point 1:	Compass bearing 1:	Distance 1:
Ref point 2:	Compass bearing 2:	Distance 2:
Ref point 3:	Compass bearing 3:	Distance 3:
How many post-storm markers (y/n/g):		Marker type:
Other:		

Unmaintained Trees							
Qty of trees for removal	Number of trees for removal	Avg. base per removal	Total dbh removed (dbf trees + base area)	Qty of trees for removal	Number of trees for removal	Avg. base per removal	Total dbh removed (dbf trees + base area)
		6.2				3.5	
Total							

FILL IN ONE: _____ CUBIC FEET _____ % OR CUBIC YARDS: _____

* If any post-storm damage was recorded during pre-storm setup, put it in same section.

* Record only large trees (DBH > 10 inches) with a fully developed canopy to be removed.

* Record vacant property for branches - if only a few branches are left.

* Estimate Crown loss with one of three values: 0.2 (0-20%), 0.5 (21-60%), 0.8 (61-100%), or 1.0 (100%).

Data collection: data entry

- Paper forms only
- Easiest to use
Excel's entry form
 - Highlight top row of headers
 - On menu, click
Data → Form
- Can also just start typing at cell A1

The screenshot shows the Microsoft Excel interface with a 'PreData' form overlay. The form is a vertical column of input fields for data entry, including fields for PlotNumber, OnStreet, FromStreet, ToStreet, Date, ROW, Length, CollectedBy, MultiSegment?, Start, End, RuralRoad?, Rural-TotalsROWTrees, ROWS-12, ROW13-18, ROW19-24, ROW25-30, ROW31-36, ROW37-43, ROW43, OFFROW5-12, OFFROW13-18, OFFROW19-24, and OFFROW25-30. The form is titled 'PreData' and has buttons for 'New Record', 'New', 'Delete', 'Find Prev', 'Find Next', 'Criteria', and 'Close'. The background spreadsheet shows columns A, C, D, and E, with row 1 highlighted. The red circle highlights the 'Data' menu path.

Data Collection: Desktop Interface

- Manage Users
- Community Values
- Reference Data
 - TIGER
 - manual
- ROW Info
- Export Data



The screenshot displays the i-Tree Storm desktop interface. At the top, there is a logo for i-Tree Storm, which includes a stylized tree and the text "i-Tree Storm" and "A Storm Damage Assessment Tool". Below the logo, there is a dropdown menu labeled "Select Analysis:" with "Storm" selected. The main window is titled "Setup Questions: i-Tree Storm" and contains several questions and input fields. Questions 1 through 4 are visible, with input fields for "Hourly rate?" and "What is the street mileage of all roads you manage?". Questions 5 through 7 are also visible, with dropdown menus for "What was the source of your tree density numbers?", "What sampling method did you use?", and "How did you get your post-storm information?". Question 8 is a table with three columns: "DBH class", "Removal Hours", and "Pruning Hours". The table lists various tree size classes and their corresponding hours for removal and pruning.

DBH class	Removal Hours	Pruning Hours
6-10	0.75	0.75
11-15	1.25	1.00
16-24	2.75	1.50
25-30	4.25	2.00
31-36	5.75	2.50
37-42	7.25	3.00
43+	8.75	3.50
None (All Trees)	0.25	2.50

Data Collection: Desktop Interface

Setup Questions: i-Tree Storm

1. What is your cost per CuYd for total debris management?

2. Tree removal **Hourly rate?**

3. Tree pruning **Hourly rate?**

4. What is the street mileage of all roads you manage?

5. What was the source of your tree density numbers?

6. What sampling method did you use?

7. How did you get your post-storm information?

8. How many hours does it take to remove and prune a tree for each size class?

DBH class	Removal Hours	Pruning Hours
6-12	3.70	0.75
13-18	5.10	1.00
19-24	7.70	1.50
25-30	10.20	2.00
31-36	12.50	3.00
37-42	20.40	4.00
43+	26.00	5.00
Rural (All Trees)	6.20	2.50

Data Collection: Desktop Interface

Setup Questions: I-Tree Storm Hurricane Adaptation (Beta)

1. What is your cost per CuYd for total debris management?

Help

2. Will you calculate tree removal separately from debris?

No

Help

3. Will you calculate tree pruning separately from debris?

No

Help

4. What is the street mileage of all roads you manage?

0.0

Help

5. Which debris rate do you want to use?

Medium

Help

6. How many hours does it take to remove and prune a tree for each size class?

DBH class	Removal Hours	Pruning Hours
6-12	3.70	0.75
13-18	5.10	1.00
19-24	7.70	1.50
25-30	10.20	2.00
31-36	12.50	3.00
37-42	20.40	4.00
43+	28.00	5.00
Rural (All Trees)	6.20	2.50

PDA Setup Interface

- 🌳 Management of process, data and applications
- 🌳 Simple, intuitive



Overview: Post-storm work

- Revisit sample segments
 - Storm or Hurricane: choose estimation method
 - Indirect by average crown loss class
 - 0-25%, 26-50%, etc.
 - Loss category images available from FS
 - All trees within 50' of ROW
 - Direct as CY of debris
 - Only trees within ROW
 - Hazard pruning by size class
 - Hazard removal by size class
- Enter data, report results

Overview: validity

- Peer reviewed sampling protocols
- Also: storm type factor
 - Tested for ice storms
 - Low variance
 - 2% sample got within 5% of true value in field test
 - Not tested for wind storms
 - Larger variance
 - May affect required sample size
- Area of ongoing i-Tree research

Estimating Engine

I-Tree Storm



Community: Burlington

Report Date:

22-Jul-09

This report was generated by i-Tree Storm v3.0.

Source: <http://www.itreetools.org>

COMMUNITY VALUES			Sampling
Correct numbers to right as needed	Street Miles	125.0	7L
	Removal Cost/hr	\$55.00	
	Pruning Cost/hr	\$55.00	
	Brush Cost/cu yd	\$15.00	
Based on Sample Data	Tree density (per 100' (ROW + 50'))	5.6	1.0%
			No. Samples
Precision Level *	Low		20

* Precision Level indicates overall reliability of input data (see User's Manual)

STORM DAMAGE COST ESTIMATE	\$10,079,769	
Component	Estimate	± SE *
Removals	94,240	832
Total Removal Hours	94,240	10,852
Total Removal Cost	\$5,183,174	\$596,965
Hazard Prune	7,100	665
Total Pruning Hours	14,769	1,407
Total Pruning Cost	\$812,322	\$77,397
Total Debris cu yds	272,285	27,155
Total Debris Cost	\$4,084,273	\$407,325

* SE of Total Debris cu yds is calculated only on direct CY estimates, crown loss estimates are ignored

DETAILED POST-STORM CALCULATION: Hazard Removal and Pruning

DBH Class (inches)	ON Right of Way Trees							
	Hazard Tree Removal				Hazard Tree Pruning			
	Total of Removal Trees	Removal Time per Tree	Total Hours for Removal	Total Hours SE	Total of Prune Trees	Hazard Prune Time per Tree	Total Hours for Hazard Prune	Total Hours SE
6-12	9	3.70	33.3	±19.11	8	0.75	6.0	±1.35
13-18	29	5.10	147.9	±29.67	26	1.00	26.0	±5.76
19-24	25	7.70	192.5	±38.47	24	1.50	36.0	±7.87
25-30	31	10.20	316.2	±56.31	23	2.00	46.0	±10.02
31-36	24	12.50	300.0	±52.68	12	3.00	36.0	±9.36
37-42	12	20.40	244.8	±103.76	12	4.00	48.0	±11.48
43+	9	26.00	252.0	±99.33	7	5.00	35.0	±8.73
All Rural	0	6.20	0.0	±0.00	0	2.50	0.0	±0.00
Totals	179		1495.7	±171.20	112		233.0	±22.20

Data collection: PDA

- Pocket PC only
- Installed on handheld through Start menu
- Data uploaded automatically during synchronization



Reference data (plots)

- TIGER
 - Can upload sample TIGER/Line data
 - Same process as described before
- Manual
 - Can do own sample from map
 - Must be random
- For both, recommended
 - 2% of blocksides
 - 30 minimum (maximum?)

Estimating Costs

I-Tree Storm



Community: Burlington

Report Date:

22-Jul-09

This report was generated by I-Tree Storm v3.0.

Source: <http://www.itreetools.org>

COMMUNITY VALUES			Sampling
Correct numbers to right as needed	Street Miles	125.0	7L
	Removal Cost/hr	\$55.00	
	Pruning Cost/hr	\$55.00	
	Brush Cost/cu yd	\$15.00	
Based on Sample Data	Tree density per 100' (ROW + 50')	5.6	1.6%
			No. Samples
Precision Level *	Low		20

* Precision Level indicates overall reliability of input data (see User's Manual)

STORM DAMAGE COST ESTIMATE	\$10,079,769	
Component	Estimate	± SE *
Removals	\$4,240	832
Total Removal Hours	\$4,240	10,852
Total Removal Cost	\$5,183,174	\$508,865
Hazard Prune	7,100	665
Total Pruning Hours	14,769	1,407
Total Pruning Cost	\$812,322	\$77,397
Total Debris cu yds	272,285	27,155
Total Debris Cost	\$4,084,273	\$407,325

* SE of Total Debris cu yds is calculated only on direct CY estimates; crown loss estimates are ignored

DETAILED POST-STORM CALCULATION: Hazard Removal and Pruning

DBH Class (inches)	ON Right-of-Way Trees							
	Hazard Tree Removal				Hazard Tree Pruning			
	Total of Removal Trees	Removal Time per Tree	Total Hours for Removal	Total Hours SE	Total of Prune Trees	Hazard Prune Time per Tree	Total Hours for Hazard Prune	Total Hours SE
6-12	9	3.70	33.3	±19.11	8	0.75	6.0	±1.35
13-18	29	5.10	147.9	±29.67	26	1.00	26.0	±5.76
19-24	25	7.70	192.5	±38.47	24	1.50	36.0	±7.87
25-30	31	10.20	316.2	±56.31	23	2.00	46.0	±10.02
31-36	24	12.50	300.0	±52.68	12	3.00	36.0	±9.36
37-42	12	20.40	244.8	±93.78	12	4.00	48.0	±11.48
43+	9	26.00	252.0	±99.33	7	5.00	35.0	±8.73
All Rural	0	6.20	0.0	±0.00	0	2.50	0.0	±0.00
Totals	139		1495.7	±171.20	112		233.0	±22.20



Storm User's Manual

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Storm User's Manual

What kinds of storms do you anticipate? Ice storms, hurricanes and floods, smaller-scale disasters?

Different disaster types present different damage and debris profiles, requiring some adjustment to the use of Storm.

Ice Storms: Ice storms tend to have relatively widespread and uniform damage, and the debris is almost exclusively vegetative. Furthermore, the ice-laden debris usually remains at its initial landing place and is not moved around by natural forces. These characteristics permit quick, accurate estimates of potential and actual damage and costs from a small random sample.

What Type of Storm?

Hurricanes and floods: Hurricanes and many floods also produce widespread damage, and Storm will work well to produce a quick estimate of actual damage and costs. A Hurricane Adaptation has been incorporated into Storm that makes use of actual data and practices from a 10% random sample of communities in Florida following the 2004-2005 hurricane seasons. For pre-storm assessments, the Hurricane Adaptation version (beta) predicts average vegetative debris loads based on street mileage and a choice of three damage levels. Because general averages are used, the estimates tend to be more accurate at the larger scale than at the very local level.

What Type of Storm?

Smaller-Scale Disasters: Smaller-scale disasters, including tornados, derechos (straight-line storms associated with thunderstorms), and some floods, present sampling problems since they affect smaller areas. To estimate the damage caused by smaller-scale disasters, the following procedure may be used:

Determine the rough geographic area affected by the disaster. It may be necessary to assess this based on a quick survey of the area, for example, by driving toward the area from different directions and noting where the damage begins, or by using aerial data if available.

Draw a boundary around the affected area on a street map or in the GIS file used for sampling.

Determine the total street miles in the affected area using the scaled map or standard GIS tools.

Establish a suitable sample of the street segments in the area.

What Type of Storm?

Hurricane Adaptation users must also decide: Will you separate estimates for tree removal and tree pruning from estimates of debris removal?

The data collection protocol differs slightly depending on whether you will bid out emergency work in a lump sum for debris (including pruning and removal), or instead break it up by handling the emergency tree pruning and/or removal with a different contract.

Hurricane Considerations

Does your community include rural (unpopulated) roads?

Data collection for rural roads differs slightly from data collection in populated areas. This is mainly because in populated areas FEMA will reimburse costs for debris that can be hauled to the curbside by residents, so trees 50 ft beyond the right-of-way are included in estimations of potential debris. There are manual forms specifically for rural areas and rural plots can be identified in the plot list and PDA.

Rural Roads?

Will you collect data using (a) the i-Tree Storm PDA tool, (b) paper forms for manual data entry, or (c) a non-i-Tree platform?

The Storm software package includes a PDA application for use in data collection. Significant updates have been made for i-Tree v. 3.0, and the PDA application now works seamlessly from within Storm. The program will work with Pocket PC devices running Window's Mobile 2003 (or later).

If your community lacks funding to support the use of PDAs or you simply prefer to use an alternate method, that's no problem. Data collection can be conducted using the paper forms in the Appendix, spreadsheets, etc. If you use the paper forms, data can later be entered directly into Storm's Excel Template. If you would like to use a non-i-Tree platform, look over the data requirements on the forms to get an idea of what is needed. It's a good idea to have the paper forms ready no matter what your decision, as storm-related power outages are likely.

Data Collection Method?

Springfield Massachusetts

June 1, 2011 Tornado



INFORMATIONAL BRIEF

3.0

June 23, 2011

Kipling Street
East Forest Park
Springfield, MA



Tornado Damage Quick Facts Impacts on Springfield's Street Trees

On June 1, 2011 a series of three tornadoes ripped through Western Massachusetts, and included the second strongest tornado ever recorded in Massachusetts, with wind speeds estimated at 134 to 143 mph, according to the National Weather Service. The most severe tornado was the EF-3, on the Enhanced Fujita Damage Classification Scale, that carved a half-mile-wide path for 39 miles from Westfield to Chatham, killing three people and injuring 300. In Springfield, the tornadoes impacted city's South End, Six Corners, East Forest Park and Warren Avenue neighborhoods.

In the neighborhoods of Springfield affected by the storm, damage to the street trees was extensive, destroying or severely wounding the public trees growing in these areas. A team of US Forest Service and City of Springfield personnel conducted a preliminary review of the streets in these neighborhoods, and an initial summary of the storm impacts was developed.

A preliminary review of the storm damage to Springfield public street trees follows here:

- 87 miles of the 450 total miles of city streets were impacted by the storm.
- 16.1 % of Springfield's streets showed some damage to the public trees growing on them.
- approximately 1,340 of the 3,300 street trees, growing in the impacted areas, were destroyed or severely damaged, necessitating removal.
- Immediate impacts include the reduction of canopywater interception by 3,444,183 gallons.
- Reduced storage of 7,220,343 pounds of carbon.
- approximately 441,183 pounds of sequestered CO₂ has been lost.

For more information please contact:



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i-Tree Streets Analysis of Springfield Tornado Impact Zone



Annual Loss in Benefits of Springfield's Street Trees

Annual Benefits of Impact Zone Street Trees

Benefit	Quantity	Impact Zone Value	Loss Value
Energy Saved			
Electricity (MWh)	360.6	\$18,393	\$4,598
Natural Gas (therms)	129,018.6	\$85,439	\$29,903
Total (\$)		\$103,832	\$34,501
Carbon Dioxide			
CO ₂ Sequestered (lbs)	946,377	\$3,123	\$1,093
CO ₂ Released (lbs)	-244,714	-\$808	-\$283
CO ₂ Avoided (lbs)	1,086,259	\$3,585	\$1,255
Total (lbs, \$)	1,787,922	\$5,900	\$2,065
Air Quality			
Avoided pollutants* (lbs)	4954	\$21,451	\$7,508
Deposited pollutants** (lbs)	4264	\$22,958	\$8,035
BVOC emitted (lbs, \$)	-1,140	-\$2,634	-\$922
Total (lbs, \$)	8,078	\$41,775	\$14,621
Storm Water			
Rainfall intercepted (gal)	6,983,576	\$55,872	\$19,555
Aesthetic/Other			
Added Property Value		\$140,569	\$49,199
TOTAL VALUE		\$347,948	\$121,782

*NO₂, SO₂, VOC, PM10 **O₃, NO₂, PM10, SO₂



An Initial Report on the Status of Street Trees in Springfield, Massachusetts



Tornado Damage to Springfield's Street Trees

June 2011

prepared for:

The City of Springfield, Massachusetts

prepared by:

Alex Sherman, City of Springfield
Rob Dill, City of Springfield
Edward Casey, City of Springfield



David V. Bioniaz, USDA Forest Service
Northern Research Station



INFORMATIONAL BRIEF

July 7, 2011

Acacia
Boulevard
Springfield, MA



Tornado Damage Quick Facts Impacts on Springfield's Urban Forest

On June 1, 2011 a series of three tornadoes ripped through Western Massachusetts, and included the second strongest tornado ever recorded in Massachusetts, with wind speeds estimated at 118 to 140 mph, according to the National Weather Service. The most severe tornado was the EF-3, on the Enhanced Fujita Damage Classification Scale, that carved a half-mile-wide path for 19 miles from Westfield to Chatham, killing three people and injuring 300. In Springfield, the tornado impacted city's South End, Six Corners, East Forest Park and Sixteen Acres neighborhoods.

In the neighborhoods of Springfield affected by the storm, damage to the urban forest canopy was extensive, destroying or severely many of the trees growing in these areas. A team of US Forest Service and City of Springfield personnel conducted a preliminary review of the streets in the impacted neighborhoods, and utilized i-Tree modeling software to analyze the impacts of the storm on the urban forest, and an initial summary of the damage a was developed.

A preliminary review of the storm damage to Springfield's urban tree canopy follows here:

- Based on initial estimates, over 13,000 trees were destroyed or severely damaged;
- Immediate impacts include the reduction of rainwater interception by over 7.5 million gallons per year;
- Reduced storage of over 30 million pounds of carbon annually;
- Approximately 1.4 million pounds of sequestered CO₂ has been lost.

For more information please contact:



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Canopy Analysis of Springfield Tornado Zone



i-Tree Canopy Analysis of Springfield Tornado Zone

- Based on initial estimates, over 13,000 trees were destroyed or severely damaged;
- Immediate impacts include the reduction of rainwater interception by over 7.5 million gallons per year;
- Reduced storage of over 30 million pounds of carbon annually;
- Approximately 1.4 million pounds of sequestered CO₂ has been lost.



SPRINGFIELD TORNADO IMPACTS ON TREE CANOPY, TEMPERATURE & HUMIDITY



Feb 2011
USDA Forest Service
Northern Research Station



TREE CANOPY LOSS IN THE TOLLAND
SUBDIVISION WAS EXTENSIVE, WITH MANY
LARGE SWAMP TREES DESTROYED.

The June 2011 Massachusetts tornado profoundly altered the landscape over a wide geographic area.

On June 1, 2011 a series of tornadoes
ripped through Western
Massachusetts, and included the
second strongest tornado ever
recorded in Massachusetts, with wind
speeds estimated at 136 to 145 mph.

According to the National Weather
Service, the most severe tornado was
the EF-3, on the Enhanced Fujita
Damage Classification Scale, that
carved a half-mile-wide path for 88
miles from Westfield to Chanton, killing

three people and injuring 398. In
Springfield, the tornadoes impacted
city's South End, Upper Hill, Main
Center, Cox Corners, East Forest Park
and Sixteen Acres neighborhoods.



CANOPY LOSS



TREE FAILURE



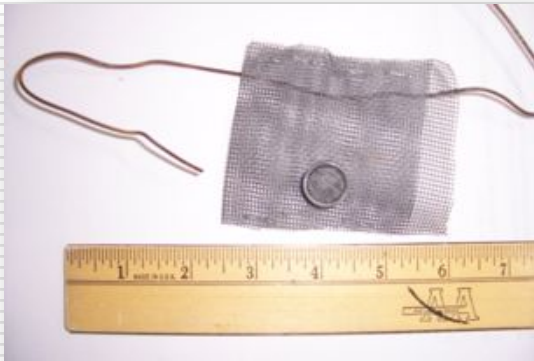
STRUCTURE DAMAGE

Micro-climate Changes in Springfield's Tornado Zone

Micro-climate Changes in Springfield's Tornado Zone



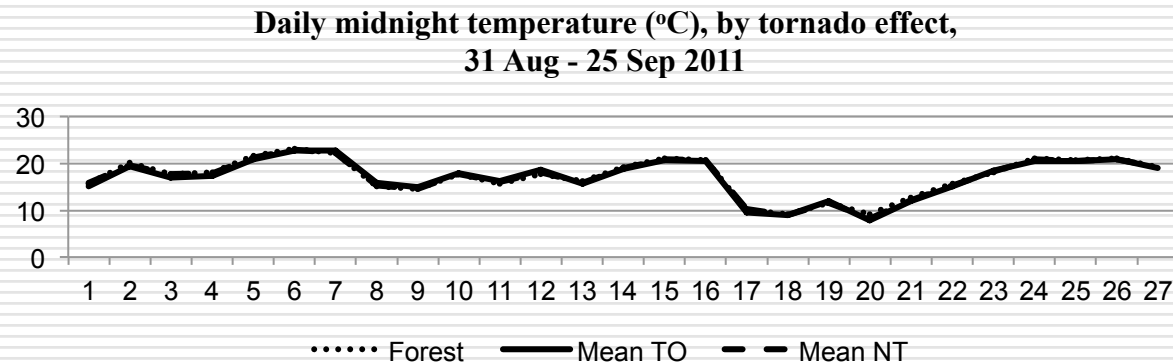
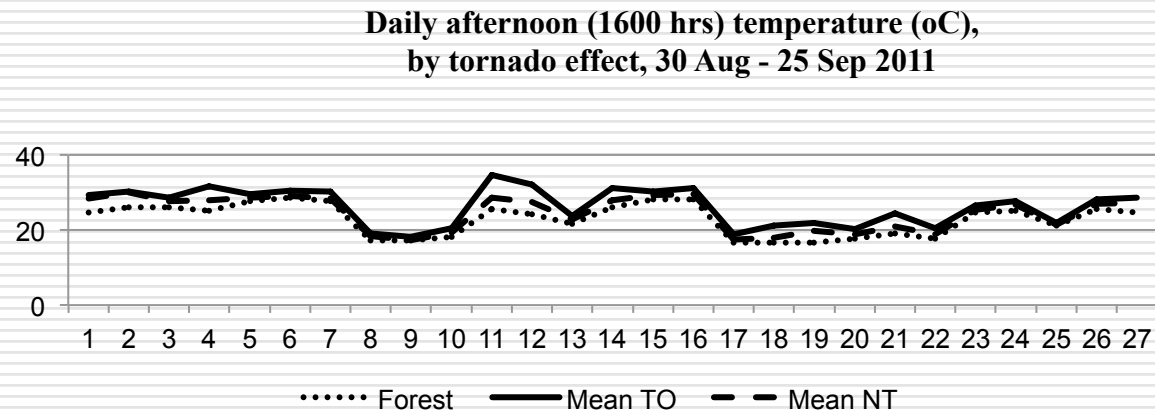
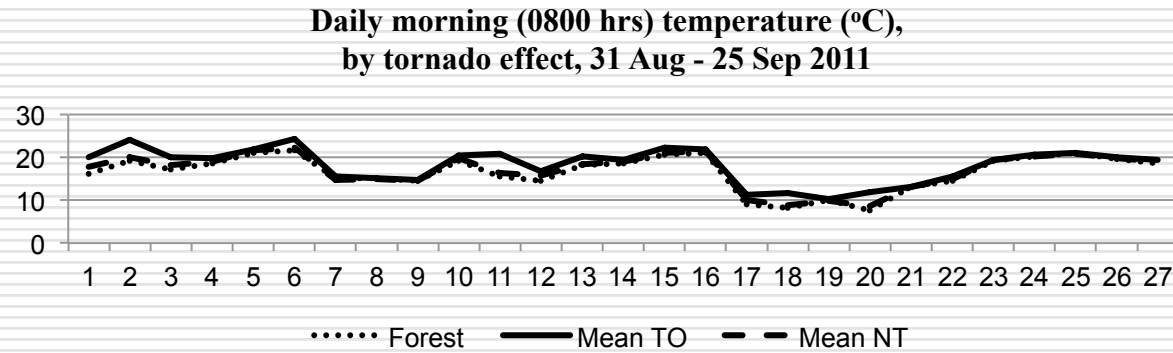
Micro-climate Changes in Springfield's Tornado Zone



Micro-climate Changes in Springfield's Tornado Zone

	Tornado	Non-tornado	Forest
% canopy cover	0.8	44.2	99.7
Morning (0800 hrs)			
Temperature	18.2	17	16.6
%RH	95.4	96	99.4
Afternoon (1600 hrs)			
Temperature	26.4	24.6	21.9
%RH	64.3	67.1	80
Midnight			
Temperature	17	17.1	17
%RH	97.2	95.2	97.6

Figure 2. Daily street-side temperatures (°C) by time of day, East Forest Park, Springfield, MA, 30 Aug – 26 Sep 2011.



REGREEN SPRINGFIELD

Restoring Springfield's Urban Forest...
One Tree at a Time



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June 1, 2011: Springfield in Nature's Crosshairs



On June 1, 2011 a series of three tornadoes ripped through Western Massachusetts, and included the second strongest tornado ever recorded in Massachusetts, with wind speeds estimated at 136 to 165 mph, according to the National Weather Service. The most severe tornado was the EF-3, on the Enhanced Fujita Damage Classification Scale, that carved a half-mile-wide path for 39 miles from Westfield to Chariton, killing three people and injuring 200.

The main path of the storm followed a track through the city of Springfield, MA impacting many of its neighborhoods including the South End, Six Corners, Old Hill, Upper Hill,

East Forest Park and Sixteen Acres neighborhoods. The tornado resulted in major damage to city infrastructure including many buildings and dwellings, power lines, and public shade trees. In the neighborhoods of Springfield affected by the storm, damage to the street trees was extensive, destroying or severely damaging many of the public trees growing in these areas.

The Tornado has left a mark on the City of Springfield that will take many years to erase. This is no more evident than with the loss of the tree resource within the impact zone. The landscape will never be the same as before the storm and it will take many years to recover the canopy cover lost in some areas. While this loss is a tragedy, with reforestation efforts and proper management, the urban forest in these areas can be healthier than it ever has been. There is a great opportunity to apply the latest knowledge and professional practices of urban forestry to ensure healthy and vigorous trees will once again line the streets of the neighborhoods affected.



With your help, Springfield will be able to regreen the devastated neighborhoods and restore its urban forest canopy. Please join in the effort by planting a tree in your own yard, helping to plant trees along our streets and in our parks, or donate your time or funds to neighborhood regreening efforts. With your help, Springfield's urban forest will be restored... one tree at a time.

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USEFUL LINKS

- [City of Springfield Official Tornado Recovery Website](#)
- [Massachusetts DCR Urban & Community Forestry](#)
- [Massachusetts Tree Wardens & Foresters Association](#)
- [Springfield Arbor Alliance](#)
- [Urban Extension - Nursery & Urban Forestry](#)
- [USDA Forest Service Urban & Community Forestry](#)

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Wrap-Up



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