LEAF

Enriching Students.
Sustaining Forests.

The Wisconsin K-12 Forestry Education Program

Wisconsin K-12 Wildland Fire Lesson Guide

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Northeastern Area State and Private Forestry State Fire Assistance Program

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LEAF is a partnership program between

Wisconsin Department of Natural Resources - Division of Forestry

and

Wisconsin Center for Environmental Education

College of Natural Resources
University of Wisconsin-Stevens Point

LEAF - Learning, Experiences, & Activities in Forestry

The Wisconsin K-12 Forestry Education Program

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LEAF was created to help promote forestry education in Wisconsin schools. In 2001, Wisconsin K-12 forestry education stakeholders evaluated the current status of and the needs for Wisconsin-based K-12 forestry education. A variety of programs existed, but voids were identified in delivery and dissemination of educational materials and services. To offer a more unified effort, stakeholders supported the development of a comprehensive program that would enhance existing efforts.

During the spring of 2001, legislation was written to establish the LEAF Program as a partnership between the Wisconsin Department of Natural Resources - Division of Forestry and the Wisconsin Center for Environmental Education at the College of Natural Resources, University of Wisconsin-Stevens Point. Funding for the program is provided through a surcharge on the sale of seedlings from Wisconsin Department of Natural Resources - Division of Forestry nurseries.

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A RATIONALE FOR WILDLAND FIRE EDUCATION IN WISCONSIN

Wildland fire is a major issue that federal, state, and local agencies have to deal with. Nationally, large forested areas of the West and South have burned as a result of drought, hot weather, fuel load, and human carelessness. Here in the Great Lakes Region, our fire regimes, population density, and culture differ from those of the Western and Southern United States. Although historically Wisconsin has experienced major catastrophic fire events, conditions in recent years have limited large-scale fire. Even so, Wisconsin Department of Natural Resources fire crews annually respond to 1,500 fires that burn more than 5,000 acres. Catastrophic fires, such as the Cottonville Fire in Adams County in 2005, still threaten lives, property, and resources.

The wildland/urban interface is increasing in Wisconsin as each year 3,000 new parcels are carved out of existing forestland holdings (based on 2000 to 2005 average). On many of these parcels, homes and cabins are being built. More and more people are moving into forested areas, and estimates predict that housing density in Wisconsin's forested regions will continue to rise. If Wisconsin experiences a large catastrophic fire event, the cost in property alone would be extremely large.

How do most of these fires start? Ninety percent of all wildland fires in Wisconsin are started by humans. As more individuals move into the wildland/urban interface, the number of fires and the possibility for catastrophic fires increase. Burning debris, sparks from equipment such as chain saws and all-terrain vehicles, and campfire/ash disposal are the most common ways that humans cause fire. Each of these modes of fire generation is preventable. Education is necessary to develop an informed and caring citizenry who will take action to prevent useless fires and who support the use of prescribed burning as a management tool.

The LEAF wildland fire materials were created to assist Wisconsin teachers in developing safe and responsible citizens who inhabit or visit wildland areas. The topic of wildland fire has great potential to captivate and interest students. Wildland fires are front-page news events. They are visually and physically powerful natural phenomena with a complex history and a complex role in today's society. Students of all ages tend to be engaged by the awesome nature of wildland fire.

The topic of wildland fire has great potential for integration into many subject areas. The exploration of fire involves hard science disciplines as well as the social sciences. Wildland fire issues are complex, and their resolution requires an understanding of the environment, economics, social policy, and human behavior. The study of wildland fire can help students understand issues in both a landscape and historical context.

When discussing wildland fire, it is very important that both the positive and negative aspects of wildland fire be presented. An understanding of ecological fire (prescribed fire) requires students to use reason and look beyond the danger of fire. This becomes important because the acceptance and use of prescribed fire is necessary to sustain ecosystems and reduce the risk of future catastrophic wildfires.

INTRODUCTION TO THE GUIDE

The ***LEAF Wisconsin K-12 Wildland Fire Lesson Guide*** provides educators with lessons designed to teach students basic wildland fire principles. There is one wildland fire lesson for each unit of the ***LEAF Wisconsin K-12 Forestry Education Lesson Guide*** (K-1, 2-3, 4, 5-6, 7-8, 9-12). Subject areas addressed in the lessons may include English Language Arts, Geography, Health, Mathematics, Science, Social Studies, and Visual Arts. The *Wisconsin Model Academic Standards* were referenced and helped guide the development of the material. The standards, subject areas, and multiple intelligences that each lesson encompasses are listed in the appendix.

The ***LEAF Wildland Fire Lesson Guide*** is based on principles outlined in the ***LEAF Conceptual Guide to K-12 Wildland Fire Education in Wisconsin***. The Conceptual Guide has two main parts – a conceptual framework and a scope and sequence. Together they outline wildland fire education concepts appropriate for Wisconsin's K-12 students and the grade level at which they should be taught. All the information in the Conceptual Guide is organized under four themes – "What Is Wildland Fire?," "Why Is Wildland Fire Important?," "How Do We Manage Wildland Fire?," and "What Is the Future?" (see pages iv to ix).

BACKGROUND SECTION

At the beginning of each lesson in this guide, you will find useful background information for teaching the activities in that lesson. In addition to the lesson-specific background information, this guide contains in-depth wildland fire information on pages 152 to 163. Users of this guide will find the information helpful in expanding personal knowledge of wildland fire science, history, and management.

WEBSITE CONNECTION

Supporting materials for teaching about wildland fire are available on the LEAF website. Resources include full color digital maps and images, in-depth background information, links to web resources, and more. The wildland fire web pages will be updated and enhanced over time, so visit often for the newest materials.

Go to *www.uwsp.edu/leaf* and navigate to the Wildland Fire Resources section.

OTHER LEAF MATERIALS

As Wisconsin's K-12 forestry education program, LEAF's mission is to provide Wisconsin's educators with high quality forestry education materials for use in the classroom and field. This is achieved through workshops, special events, and curriculum consulting.

This ***LEAF Wisconsin K-12 Wildland Fire Lesson Guide*** is a supplement to the ***LEAF Wisconsin K-12 Forestry Education Lesson Guide*** (LEAF Guide). The LEAF Guide is comprised of six grade specific units: K-1, 2-3, 4, 5-6, 7-8, and 9-12. You will find descriptions of the units and lessons on page 178. The LEAF Guide is obtained by participating in a LEAF workshop. Workshop participants receive forestry background information and practical experience using the LEAF Guide. Workshops vary in length and format, sometimes including an option for graduate credit and/or hands-on field experiences.

LEAF WISCONSIN K-12 URBAN FOREST LESSON GUIDE

The *Urban Forest Lesson Guide* uses the places we live to provide a context for understanding forests. Lessons are designed to be used in conjunction with the *LEAF K-12 Forest Lesson Guide*. A section called "LEAF Links" is included in each urban forest lesson and describes when and how to link the urban forest lesson to original LEAF guide lessons.

VISIT OUR WEBSITE AT WWW.UWSP.EDU/LEAF

The LEAF website is a great source for information and resources. On it, you will find:

- Workshops offered
- Information on LEAF special events
- On-line tree identification key
- LEAF lesson enhancements
- Educator opportunities
- On-line publications
- Field experience providers
- School forest information and assistance

LESSON FORMAT

Lesson Grade Level and Title

BIG IDEAS
The subconcepts covered in the lesson as defined by the *LEAF Wildland Fire Conceptual Framework*. (Subconcept Number)

OBJECTIVES
Knowledge and skills students acquire as a result of doing the lesson.

SUBJECT AREAS
List of subjects addressed in the lesson.

LESSON/ACTIVITY TIME
Total time required to complete the lesson and breakdown of time required for each lesson component.

TEACHING SITE
Recommended location for teaching.

NUTSHELL
Brief summary of the lesson.

BACKGROUND INFORMATION
Information that supports, accentuates, and expands on the information addressed in the Procedure.

PROCEDURE
INTRODUCTION
A short discussion or activity that sets the mood for the rest of the lesson.

ACTIVITIES
Step-by-step instructions for the process involved in teaching the concepts.

CONCLUSION
A wrap-up and review of concepts of the lesson.

VOCABULARY
Key terms used or introduced in the lesson.

MATERIALS LIST
Items needed to complete the lesson. Listed as per student, group of students, class, or teacher.

TEACHER PREPARATION
Preparation needed before teaching the lesson.

SAFETY PRECAUTIONS
Necessary precautions to teach the lesson safely.

SUMMATIVE ASSESSMENT
Culminating questions or activities that have students apply learned information or skills to new situations.

REFERENCES
List of materials used in creating the lesson.

RECOMMENDED RESOURCES
Additional books, websites, or materials that will enhance the lesson.

KEY TO SYMBOLS USED THROUGHOUT THE LESSONS
 Teacher Page

 Student Page

 Teacher Page (Key)

7TH-8TH GRADE LESSON
Natural Phenomena Investigators (NPI)

NUTSHELL
In this lesson, students work in teams and use primary data sources, such as weather data and an emergency radio traffic log, to investigate the Cottonville Fire. Using primary documents such as newspaper articles, students study how the fire was suppressed and evaluate successes and limitations to fighting the fire. To conclude, teams are given post-fire landowner dilemmas to discuss.

BIG IDEAS
- In Wisconsin, there are two main types of wildland fire – wildfire and prescribed fire. Wildfires start without the intent of the landowner or land manager and are uncontrolled and unwanted. Prescribed fires are contained and are planned to meet the goals of a landowner or land manager. (Subconcept 1)
- The ignition of wildland fire can be caused by human activity (e.g., debris burning and other outdoor burning, machine sparks, children playing with matches, power lines, fireworks) or natural sources (e.g., lightning, spontaneous combustion). Human activity is responsible for most wildland fires in Wisconsin. (Subconcept 2)
- Fire requires oxygen, heat, and fuel to exist. Collectively these elements are known as the fire triangle. Under most conditions, the three elements can be manipulated to slow or stop the spread of fire. (Subconcept 3)
- Fire behavior is influenced by topography, weather, and fuel characteristics. The fire season is determined by seasonal changes in weather and fuel. (Subconcept 5)
- Wildland fire management has direct and indirect costs and benefits for the economy. Effective wildland fire management requires both financial and human resources. (Subconcept 16)
- The wildland/urban interface is an area where human structures exist among wildland fuels. As people move into fire prone areas, the potential for ignition of wildland fire increases, and buildings and other human-made objects become a possible fuel source. (Subconcept 32)

OBJECTIVES
Upon completion of this lesson, students will be able to:
- Explore the ecologic, economic, and social affects of wildfire.
- Examine multiple data sources to make predictions and draw conclusions about a natural phenomenon.
- Discuss how wildfire behaves and the factors that influence this behavior.
- Analyze wildfire suppression efforts and evaluate challenges in each.

SUBJECT AREAS
Geography, Mathematics, Science, Social Studies

LESSON/ACTIVITY TIME
- Total Lesson Time: 235 minutes
- Time Breakdown:

Introduction	5 minutes
Activity 1	60 minutes
Activity 2	90 minutes
Activity 3	40 minutes
Conclusion	40 minutes

TEACHING SITE
Classroom

MATERIALS LIST

FOR EACH STUDENT

- Student Page **8**, *Fire Tower Map*
- Student Page **10**, *Cottonville Area Map*
- Copy of either Student Pages **12A1-3**, *Suppression Option Report: Fire Containment* OR Student Page **12B**, *Suppression Option Report: Structural Protection* OR Student Page **12C**, *Suppression Option Report: Evacuation* (students divided among three groups)
- Copy of Student Page **13**, *Suppression Option Report Form*
- Copy of Student Pages **15A-B**, *Local Newspaper Reports*
- Copy of Student Page **16**, *Local Newspaper Reports Worksheet*

FOR EACH INVESTIGATION TEAM (4 OR FEWER STUDENTS PER TEAM)

- Copy of Student Page **1**, *Wisconsin Fire Prone Areas* (print in color from the LEAF Wildland Fire Lesson Guide CD-ROM or LEAF website)
- Copy of Student Page **2**, *Area Cover Types* (print in color from the LEAF Wildland Fire Lesson Guide CD-ROM or LEAF website)
- Copy of Student Page **3**, *Cover Type Fire Rating*
- Copy of Student Page **4**, *Wildland Fire History*
- Copy of Student Page **5**, *Area Housing Map*
- Copy of Student Pages **6A-B**, *Weather Data*
- Copy of Student Page **7**, *Circumstances That Led to the Fire*
- Copy of Student Pages **9A-D**, *Cottonville Fire Radio Traffic Transcript*
- One compass overlay (made from Teacher Page **3**, *Compass Overlays*)
- Copy of Student Page **11**, *Fire Behavior Information Sheet*
- Copy of Student Page **14**, *Summary of Cottonville Fire Containment*
- One Dilemma Card from Student Page **17**, *Post-fire Dilemmas*
- Ruler

FOR THE CLASS

- Overhead projector and markers
- Computer and LCD projector
- Chalk/marker board
- Candle
- Glass jar

FOR THE TEACHER

- Video Segments 1, *Breaking News*; 2, *Evening Report*; and 3, *Fire Towers* from the LEAF Wildland Fire Lesson Guide CD-ROM
- PowerPoint Presentations 1, *Cottonville Fire* and 2, *Cottonville Fire Suppression* from the LEAF Wildland Fire Lesson Guide CD-ROM
- Teacher Page **1**, *Master Investigator Notes*
- Overhead transparency of Teacher Page **2**, *Human-caused Fires in 2005*
- Overhead transparency of Teacher Page **3**, *Compass Overlays*
- Overhead transparency of Teacher Page **4**, *Fire Boundary*
- Overhead transparency of Teacher Page **5**, *Fire Progression*
- Overhead transparency of Student Page **8**, *Fire Tower Map*
- Overhead transparency of Student Page **10**, *Cottonville Area Map*
- Ruler

TEACHER PREPARATION

- Make overhead transparencies of Teacher Page **2**, *Human-caused Fires in 2005*, Teacher Page **3**, *Compass Overlays*, Teacher Page **4**, *Fire Boundary*, Teacher Page **5**, *Fire Progression*, Student Page **8**, *Fire Tower Map*, and Student Page **10**, *Cottonville Area Map*.
- Cut apart the individual compasses from the overhead transparency of Teacher Page **3**, *Compass Overlays*.
- Print color copies of Student Page **1**, *Wisconsin Fire Prone Areas* and Student Page **2**, *Area Cover Types* from the LEAF Wildland Fire Lesson Guide CD-ROM or LEAF website.

VOCABULARY

Crown Fire: A fire that spreads across the tops of trees or shrubs.

Fire Behavior: The manner in which a fire reacts to its environment.

Fire Intensity: The amount of heat released per second as a wildland fire burns in a specified area; calculated by measuring the flame length, rate of spread, and heat per unit area.

Fuel Characteristics: Properties including quantity, chemistry, compaction, continuity, moisture content, and size.

Ground Fire: A fire that burns the organic material in the soil layer such as peat or duff.

Ignite: To cause something to start burning.

Land Cover: The ecological features present across the landscape such as forest, urban area, and field.

Phenomenon: An observable fact or event.

Prescribed Fire: A fire used to deliberately burn wildland fuels under specific conditions to meet desired management goals (e.g., fuel management, disease and pest control, wildlife habitat).

Rate of Spread: The speed (feet per minute) at which a wildland fire moves into new fuels.

Spotting: The ignition of new fires outside of the original fire area caused by wind-blown sparks or embers.

Suppression: The act of confining and extinguishing a wildland fire.

Surface Fire: A fire that burns fuels on the forest floor, such as leaf litter and small vegetation.

Torching: The ignition and flare-up of a tree or small group of trees, usually from bottom to top.

Wildfire: A wildland fire that ignites and spreads without the intent of the landowner.

BACKGROUND INFORMATION

THE COTTONVILLE FIRE

On May 5, 2005, a wildfire began in northern Adams County. The fire started in the early afternoon on a day with weather conditions prime for a fire to spread. The day was warm and windy, with gusts up to 22 miles per hour. A relative humidity of 18 percent meant the already dead grasses in the area were now completely dry. This area of the state is known as sand country. The dominant vegetation able to grow in the area is grass, pine, and scrub oak – all species that are known for their ability to burn rapidly and intensely.

The fire rapidly spread through grass, needles, and brush on the ground, then started the tops of nearby pine trees on fire. Immediately after assessing the conditions of the fire, Wisconsin DNR fire personnel activated the Incident Management Team (IMT). Local law enforcement evacuated people ahead of the fire area. More than 100 people were quickly relocated. Fire department resources were assigned to protect the hundreds of homes, cabins, trailers, and outbuildings in the area. More than 200 Wisconsin DNR personnel and support staff from other agencies worked to contain the fire. Air resources dropped water and retardant on the flanks (sides) of the fire and on structures. Thirty-eight tractor plows flanked the fire with ground crews to contain lateral spread.

The fire was finally contained 11 hours later after 3,410 acres burned in a swath one-and-one-half miles wide by seven miles long. Thirty homes and 74 outbuildings were destroyed and 15 were damaged, but 300 buildings were saved due to firefighter assistance. Economic loss from the fire exceeded one million dollars in structural loss, four million dollars in timber loss, and $287,000 in suppression costs. After an investigation, it was determined that the cause of the fire was debris burning. An attempt was made by an individual to burn dry grass around a campfire ring. This uncontained fire cost millions of dollars and affected many individuals.

The Cottonville Fire is used as a case study in this lesson for students to learn about wildland fire and the enormous costs and consequences associated with such a fire.

For more information on wildland fire, see the Wildland Fire Background starting on page 152.

FIRE LOCATION BASICS

A compass is an instrument that uses the 360º in a circle to determine direction. In a fire tower, a map is located on a platform in the center of the tower with a compass that surrounds the map. When smoke is spotted, the person in the tower looks through a device with sites similar to a gun. This device is centered over the location of the fire tower on the map. A reading is taken from this large platform compass and relayed by radio to a dispatch center. At dispatch, a person draws a line on their map from the location of the tower toward the direction of the reported fire. The actual location is not known until a different tower in the area calls in their reading on the fire. Once the second fire tower spotting is drawn on the map, the fire is determined to be at the location where the two lines intersect. These lines are drawn on the map by laying a long straight edge on the map from the center of the compass through the degree reading on the compass.

PLOTTING WIND DIRECTION ON A MAP

The direction wind is blowing can play an important role in the direction a fire burns. To determine the direction a fire moves based on the wind, one puts the center of a compass on the origin of the fire on a map. The compass dial is turned until 0º is oriented to north on the map. Using the available weather data, the wind direction is plotted on the map by laying a straight edge from the center of the compass through the degree reading of the wind direction and drawing a line on the map.

So what is the direction of the wind? When a northwest wind is reported (325º), does that mean the wind is coming from 325º or blowing toward 325º? The answer is coming from 325º. To plot the direction on the map, you then need to use the degrees opposite from 325º. To do that, add 180º if the direction is less than 180º or subtract 180º if the direction is greater than 180º. In this example, a line would be drawn from the fire origin through 145º.

PROCEDURE

INTRODUCTION – BREAKING NEWS

1. Ask students how many of them have watched a movie or show about a natural disaster such as a tornado, hurricane, or earthquake. Tell your students that these events are known as natural phenomena. In this lesson they will be investigating a natural phenomenon that can have both positive and negative effects.

2. Show Video Segment 1, *Breaking News* from the LEAF Wildland Fire Lesson Guide CD-ROM to your students. Tell them it is a news report from WSAW Channel 7 in Wausau from May 5, 2005. After the video is over, ask them what phenomenon they will be investigating. *(Wildfire.)*

ACTIVITY 1 – CIRCUMSTANCES LEADING TO THE FIRE

1. Ask students if they know the three things that fire needs to exist. *(Fuel, oxygen, and heat.)* Set a candle on top of a counter or table in your room. Light the candle. Ask students to repeat the things necessary for fire to burn and have them explain what the fuel is, where the oxygen is coming from, and where the heat came from. Put a glass jar over the candle to smother the flame, being careful not to touch the candle with the jar. Remove the jar and ask what happened to the flame. *(The flame went out due to lack of oxygen.)*

   Tell the students that they need to understand the different types of wildland fire to begin their investigation. There are two types of wildland fire – prescribed fire and wildfire. Describe the difference between them. *(Prescribed fires are deliberately set to manage a resource; wildfires ignite and spread without intent of landowners.)*

   Explain to students that doing such an investigation will help people better understand what happened, why it happened, and what the response was. These are all important steps to take to learn from what occurred and to prevent a similar incident from happening in the future.

2. Tell students you want them to start thinking like investigators. Ask them to brainstorm a list of questions they would need to have answered if they were investigating a car accident. *(E.g., Who was involved in the accident? Were there any injuries? How fast was the car going? Was alcohol involved?)*

3. Divide the students into investigation teams of four or fewer students. Tell the students that the first things they need to investigate are the circumstances that led up to the fire. Ask each investigation team to generate a list of questions they would need to have answered to determine the circumstances that led to the fire. Remind students to keep in mind the three things fire needs to burn. *(E.g., What was the weather the day of the fire? Where did the fire start? How fast did the fire travel? What is the land cover in that area?)* Once teams have had a chance to discuss their questions, have each team share one question they identified. Write them on the board. Continue having groups share ideas until all have been listed.

4. Tell the investigation teams that you will be giving them information to study to help them answer their questions. Explain that some of the information uses what is known as military time. Ask if anyone can explain what military time is. Fill in any gaps by explaining that military time uses a 24-hour clock in which a day runs from midnight to midnight and is divided into 24 hours. Each hour is numbered from 0 to 23. A colon is used to separate hours from minutes. The conventional time of 8:30 a.m. is written as 08:30 in military time. The conventional time of 2:45 p.m. is written as 14:45. Explain that any time after 12:00 noon can be converted from conventional time to military time by adding 12 to it and vice versa.

5. Hand out Student Pages **1-7** to each group. Point out that the area they are studying is in Adams County. Have each team study the evidence and use Student Page **7**, *Circumstances That Led to the Fire* to organize the information. While the students are organizing the information, draw the organizational structure diagramed on Student Page **7**, *Circumstances That Led to the Fire* on the board.

6. Using the information on Teacher Page **1**, *Master Investigator Notes*, summarize the conditions that led to the fire. Explain the information in the order it appears in the notes and fill in the diagram on the board. Have students add any information on their student pages that was missed previously.

7. Ask each investigation team to write a statement using the information from Student Page **7**, *Circumstances That Led to the Fire* that describes the circumstances that led to the fire. Ask for some of the groups to share their statements.

8. Ask the class if the information on the handouts they were given answered all the questions they generated earlier. *(Likely, it has not.)* Ask if anything is missing that is necessary for the phenomenon to happen. *(An ignition source.)* Ask the students if they have an idea of what the ignition source was. Show Video Segment 2, *Evening Report* from the LEAF Wildland Fire Lesson Guide CD-ROM. Tell students it is a newscast from WTMJ Channel 4 in Milwaukee from the evening of May 5, 2005.

9. Ask students what the fire ignition source is in the majority of wildland fires in Wisconsin. *(Humans.)* Show the overhead of Teacher Page **2**, *Human-caused Fires in 2005*. Tell your students that there were 1,517 reported human-caused wildfires in 2005. Have students brainstorm a list of types of human activities that often lead to wildfires. *(Campfires, debris burning, equipment, railroads, smoking.)* Ask them what they believe the number one source is. *(Debris burning.)* Have the investigation teams add the ignition source to the statement they wrote about the circumstances leading to the fire.

ACTIVITY 2 – THE FIRE IN PROGRESS

1. Tell students that now that they have documented the circumstances that led to the fire, it is time to investigate the progression of the fire. The fire started with an ignition point, but ask if students know how firefighters locate the ignition point. *(Someone calls in the fire, a DNR fire plane spots the fire, or someone in a fire tower spots the smoke.)* Ask your students if any of them have ever seen a fire tower. Tell them that Wisconsin currently has 95 fire towers in use each fire season. Tell them that Wisconsin's fire season is usually from the time the snow melts until the grass and trees turn green. During this time period, someone is stationed in each of the towers. Ask your students if they would like to go up in a fire tower. Show Video Segment 3, *Fire Towers* from the LEAF Wildland Fire Lesson Guide CD-ROM.

2. Ask the students how the information from the fire tower was used to locate the fire. *(Using a compass, the direction of the fire was called into the local fire dispatch office. Lines were drawn on a map with compass readings from several fire towers. The location of the fire is where the lines cross.)* Tell the investigation teams that they are going to locate the ignition site of the fire. Hand out Student Page **8**, *Fire Tower Map* to each person on each investigation team. Help them locate the fire towers on the map. Hand out Student Pages **9A-D**, *Cottonville Fire Radio Traffic Transcript*.

   Tell students to read through the radio transcripts for reports of the fire. Have students note the time that the fire was first reported. Ask the students which tower called in first. *(Dyracuse.)* Ask what the compass reading was from the Dyracuse tower. *(175º.)* Have the students use a ruler or straight edge to draw a line from the Dyracuse tower through 175º on the compass to the edge of the map. *(To do this, put the ruler edge on the tower and rotate the ruler around that point until it touches both the tower and the 175º mark.)* Demonstrate the process on an overhead transparency of the map. Repeat this process, again asking for the next tower to report, what time, and what degree reading. *(Necedah. 79º.)* Have the students draw this line on the map. Tell the students that where the two lines intersect is the location of where the fire started.

3. Tell the investigation teams that their next job is to predict what direction the fire burned from the ignition point. Ask them if they have any data that might help them determine the direction the fire burned. Have them review the information they have. They are looking for wind direction on the May 5 weather data found on Student Pages **6A-B**, *Weather Data*. Ask someone to tell you the wind direction at the time of the ignition of the fire. *(225º.)* Ask them what that means. When someone says northwest winds, do they mean it is blowing toward the northwest or from the northwest? *(From the northwest.)* With that said, does a wind direction of 225º mean toward 225º or from 225º? *(From 225º.)* Knowing this information, ask the students to predict the direction of the fire. *(From 225º.)*

   Hand out copies of the Student Page **10**, *Cottonville Area Map* to each student. Have them transcribe the ignition site location from the fire tower map to their new map. Hand out the compass overlays made from Teacher Page **3**, *Compass Overlays* to each team. They will need to share the compasses for the next step. Tell them that you would like to have them draw a line that represents the direction of the fire from the ignition point.

   Ask them, if the wind is from 225º, what direction is it blowing toward. *(180º opposite from 225º, or 45º.)* You may need to review the number of degrees in a circle *(360º)* and what the difference is for the opposite direction. *(180º.)* Once students have determined that the wind is blowing toward 45º, have them take turns using the compass to draw a line at 45º from the ignition site. Show them how to orient the compass on the map using the overhead transparency of Student Page **10**, *Cottonville Area Map*. *(To do this, put the center of the compass on the ignition location. Orient 0º to the north. Rotate the compass so the 0º to 180º line is parallel to the north/south roads and the 90º to 270º line is parallel to the east/west line. Lay a ruler edge on the compass so the edge makes a line from the ignition point out through the 45º mark on the compass.)* Have them draw that line on the Cottonville area map, lift up the compass and continue the line under the compass to the ignition point.

4. Tell the students that now that they have predicted the fire direction, they are going to test whether that was a correct assumption. To do that, they are going to plot the extent of the fire. Ask the investigation teams to study the radio traffic transcript and mark all calls that document the progress of the fire. *(14:17 - fire crossed Chicago Avenue; 15:33 - fire crossed intersection of 9th and Buttercup Avenue; 15:40 - fire jumped Browndeer Avenue at 9th; 15:45 - head of the fire passed 9th Avenue; 16:35 - fire approached County C; 16:40 - fire crossed intersection of 8th and County C; 16:45 - fire crossed 9th and County C; 17:16 - fire crossed 8th and Bighorn Avenue; 17:24 - fire crossed 7th and Bighorn Avenue.)* Once they have done this, have each member locate the points on the map that correspond to the radio traffic records with an "X" and record the time next to the "X."

   Ask your students if this is a true representation of the extent of the fire. *(It doesn't give a true picture of the lateral or sideways extent of the fire.)* Tell them that you have a fire boundary map. Put up an overhead transparency of Teacher Page **4**, *Fire Boundary*. Have each team member transcribe the fire boundaries onto their map. The "X" time points they have plotted on their map should be within the boundaries. When this is completed, each team investigation member should have a map with the boundary of the fire that shows the extent of the fire.

5. Put the overhead transparency of Teacher Page **5**, *Fire Progression* on the overhead projector. Have students transcribe the fire progression lines onto their maps. Ask students if they can determine the speed of the fire's progression. Have the investigation teams discuss this and share their ideas with the class on how to measure the speed. *(The map can be used to measure the speed of the fire in miles per hour.)*

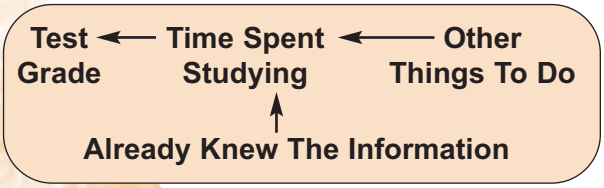
   Explain to students that fires are generally measured in feet per minute. To determine this, they will need to do some conversions. First, have students measure the distance the fire traveled between each time boundary drawn on the map. They should measure perpendicular to the timelines. You may need to demonstrate how to mark the distance on the edge of a piece of paper and compare it to the feet scale of the map scale. Next, have students multiply the distances they measured by 5,280 to convert miles to feet. Since the timelines are in one-hour increments, the distances must now be divided by 60 to give the answer in feet per minute. *(0 to hour 1 = 132 ft/min., hour 1 to hour 2 = 121 ft/min., hour 2 to hour 3 = 110 ft/min., hour 3 to hour 4 = 160 ft/min.)* Once the teams measure the speed, have them write it on their maps between each timeline. This fire was relatively fast moving.

6. Ask students if their assumption of the fire's direction being the same as the wind direction was a correct assumption. *(Not exactly. The fire moved generally in that direction, but did not stay on an exact 45º course.)* Have the investigation teams review the information they currently have and propose why this was not so. Have each group share their ideas. *(Some possible ideas might include land cover and suppression efforts occurring while the fire was burning.)* Tell students you have additional information about fire behavior that might offer some clues. Hand out Student Page **11**, *Fire Behavior Information Sheet* to each team. Have the teams read about fire behavior. Ask the teams to discuss how fire behavior might have affected the direction of the fire. Ask them to share their ideas. *(The type, quantity, and arrangement of fuel the fire was burning through could have affected its speed and direction. Occurring fire behaviors [torching, crowning, and spotting] also played a role.)*

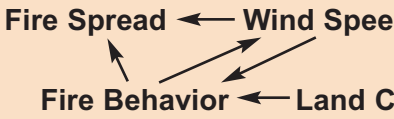
7. Ask the teams to investigate the kinds of behavior the fire exhibits. Have them review the radio traffic transcript and mark items that relate to fire behavior. *(13:43 - torching; 14:17 - crown fire; 15:39 - crown fires; 15:40 - intense flames; 15:45 - surface fire; 16:05 - spotting; 16:25 - spotting; 16:35 - torching; 17:16 - crown fire; 18:03 - surface fire.)* Have groups share the entries they found in chronological order.

8. Show PowerPoint 1, *Cottonville Fire* from the LEAF Wildland Fire Lesson Guide CD-ROM to give students an idea of the intensity of the fire, its rate of spread, and types of behaviors it exhibited. Write the words "intensity," "rate of spread," and "behavior" on the board. Tell students to study the visual to see examples of each of these.

9. Write the following words on the board, "fire spread," "wind speed," "land cover type," and "fire behavior." Tell your students that you would like the investigation teams to discuss the relationships of each and write down how each one relates to the others. Have them share their ideas with the class, then draw a diagram that represents the relationship. The words should be connected by arrows (as in the example found below).



Ask for a volunteer from an investigation team to share their diagram. Have a representative from the team diagram the relationship on the board. Ask the team to define the relationships. Ask if other teams have any different ideas. The following diagram defines the relationship. Use it and the discussion points to guide the teams if needed.



- Fire spread is directly affected by wind speed. The stronger the winds, the faster the fire will spread.
- Land cover type directly affects fire behavior. Pine forests burn fast and hot and torching and crowing are more likely in these forests than in other types of forests.
- Wind speed directly affects fire behavior. Higher winds increase the flow of oxygen to the fire and movement of heat down wind, preheating the vegetation and drying it out. Wind speed increases the intensity of fire and affects its behavior.
- Fire behavior directly affects the spread of the fire. Surface fires and crown fires burn at different intensities and rates. The ability to suppress each varies greatly.
- Fire behavior can affect wind speed. Crown fires can create their own atmospheric conditions, including winds.

10. Recap what the investigation teams have learned so far. Ask for a summary of the conditions that led to the fire. Ask for an incident report as to where the fire was located, how fast it traveled, and how the fire behaved. Tell your investigation teams that they have done a good job so far, but the investigation is not complete. Somehow, the fire eventually stopped.

ACTIVITY 3 – CONTROL OF THE FIRE

1. Read the following report account to the investigation teams:

   The Cottonville Fire was initially reported at 1:31 p.m. to the Adams County Sheriff as a structural fire. Despite rapid response, the fire burned more than seven miles, or 3,410 acres, before it was contained. Many resources were at risk in this fire. By the time it was contained at 12:30 a.m., 90 structures were destroyed, including 30 residences, and 300 structures were saved. An extraordinary number of people and resources were coordinated to suppress the fire. DNR resources included 199 DNR personnel, 76 engines, 38 tractor plows, and four aircraft. Working with the DNR were 22 fire departments, seven private dozers, five wildland fire crews, two aircraft from out-of-state, and 18 other agencies and organizations. The cost of containing the fire was $287,000.

2. Tell the students that their next step in the investigation is to examine what was involved in controlling the fire. The goals of wildfire suppression are to have the least amount of damage to human life, property, and the forest resource. Tell students they will examine the suppression options that were available and determine the role that each played in putting out the fire. At this time, each member of the investigation teams will attend one of three meetings on a particular suppression option.

   Have members of the investigation teams count off by three. Group the ones, the twos, and the threes and assign them to one of the following meeting topics: fire containment, structural protection, or evacuation. Make sure that each investigation team has someone at each meeting.

   Hand out copies of the respective Student Pages **12A-C**, *Suppression Option Reports* and a copy of Student Page **13**, *Suppression Option Report Form* to each student. Ask the students to read the information and discuss how they believe their suppression option should have been used in the Cottonville Fire. Once they have discussed the option, have each student fill out the Suppression Option Report Form to document what they learned.

3. Have the fire investigation teams reconvene. Each member should share the information about the suppression option they learned about at their meeting. The team should discuss what role they think each option played in the arrest of the fire. Have the teams write a paragraph that describes the role they think each played in the arrest. Ask each team to share with the class their ideas on suppression.

4. Show PowerPoint 2, *Cottonville Fire Suppression* from the LEAF Wildland Fire Lesson Guide CD-ROM to give students a visual idea of some of the suppression measures that were in place during the fire. Tell them that now that they have a better idea of what each entails, each team should re-read Student Page **9**, *Cottonville Fire Radio Traffic Transcript* and Student Page **14**, *Summary of Cottonville Fire Containment*. Have the teams discuss the limitations and successes of each option. Ask them to list two limitations and two successes for each option. Have teams share their ideas with the class.

5. Hand one copy of Student Pages **15A-B**, *Local Newspaper Reports* and Student Page **16**, *Local Newspaper Reports Worksheet* to each team. *("Mock Fire Scheduled," "Fire Sweeps Through Big Flats," and "Officials Thankful for Overwhelming Support.")* Tell the students to read the articles and answer the questions on Student Page **16**, *Local Newspaper Reports Worksheet*.

6. Ask the teams if they remember the statistics related to the fire. Were there any human fatalities? *(No.)* How many structures were lost? *(90+.)* How many homes were destroyed? *(30+.)* How many structures were saved? *(300.)* Ask them how they think it was possible for all of these personnel, different fire departments, and different agencies to work together.

   Brainstorm a list of things that needed to take place for this to happen. These should include:

   - people coordinating the effort (the incident command center)
   - communication (radio)
   - intelligence (airplane, towers, observers on the ground)
   - evacuation (sheriffs department, emergency staff)
   - evacuation center with food and shelter
   - equipment ready and available
   - people ready and available
   - wildland fire training of people
   - mock drills

7. Ask your teams to come up with one word that summarizes what is needed to suppress a fire of this magnitude. Have them share their words and comment on each. *(Examples might include prepared, trained, luck, etc.)*

CONCLUSION – POST-FIRE DILEMMAS

1. Tell students that they are now going to look at some of the dilemmas this fire created. Ask someone to define what you mean by the word "dilemma." *(A situation that requires a choice; a predicament that has no clear solution.)* Ask students if they can think of some dilemmas that people who lived in the fire area might have been faced with. *(What to do with their land. Should they rebuild their home.)* Tell the students that many people were affected by this fire and had some difficult decisions to make. Those decisions may have large ecological, economic, or social implications.

2. Hand out a dilemma card from Student Page **17**, *Post-fire Dilemmas* to each investigation team. Have them read each situation and discuss what options are available to solve each dilemma. Have them discuss the pros and cons of each option. Once they have discussed the options, have each student write what they would do and why. Have the individuals share with their team how they would solve the dilemma.

3. Have each group share their dilemma card and what they believe are the options available with the class. Encourage the class to ask questions and suggest any other options they feel might be available. Have each team share the responses their members gave for each dilemma and why they believe it was the right choice.

FORESTERS IN THE CLASSROOM

Wisconsin Department of Natural Resources fire personnel make classroom visits. To find a staff member in your county, go on-line to *www.dnr.state.wi.us/staffdir/SearchCounty.asp*, click on your county, and type "fire" into the subject box.

SUMMATIVE ASSESSMENT

Have your students develop a wildfire awareness campaign that addresses the lessons that could be learned from the Cottonville case study. Have them define goals, identify target audiences, develop simple messages, and describe methods of communication.

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RECOMMENDED RESOURCES

ACTIVITY GUIDE

Wildland Fire Primer: A Guide for Educators prepared by John Owen and Pat Durland. (Boise, ID: U.S. Department of the Interior Bureau of Land Management, National Interagency Fire Center, 2002.) The Wildland Fire Primer presents the concepts and messages that the National Interagency Fire Center determines necessary for effective wildland fire education.

BOOKS

The Great Peshtigo Fire: An Eyewitness Account by Reverend Peter Pernin. (Madison, WI: State Historical Society of Wisconsin. 1999.) This book is an eyewitness account of the Peshtigo Fire by Reverend Peter Pernin. It includes photographs of Peshtigo before and after the fire, maps, and drawings. Available online at *www.library.wisc.edu/etext/WIReader/WER2002-0.html*.

(Continued on page 102.)

RECOMMENDED RESOURCES

BOOKS (CONTINUED)

Introduction to Wildland Fire by Stephen J. Pyne. (New York: John Wiley and Sons, 1996.) This book covers the fundamental physics and chemistry of fire, fire behavior, wildland fuels, the interactions of fires and weather, ecological effects of fires, the cultural and institutional framework of fire management, planning efforts for fire management, suppression strategies, prescribed fires, and global fire management.

MAGAZINE

Spreading Like Wildfire: Planning fire prevention as communities grow into wildlands. (Wisconsin Natural Resources magazine April 2005, PUB FR-309-2005.) A series of articles related to wildland fire in Wisconsin by DNR staff. Available on-line at *www.wnrmag.com/supps/2005/apr05/intro.htm*.

PAMPHLET

Living With Fire. (Wisconsin Department of Natural Resources, PUB FR-275 2006.) An overview of the Cottonville Fire, factors affecting wildland fire, fire history, and property protection tips. Available on the LEAF website: *www.uwsp.edu/leaf* – navigate to the Wildland Fire section and look for educator resources.

WEBSITES

Fire and Aviation Management – National Park Service
www.nps.gov/fire
The U.S. National Park Service offers resources and a variety of wildland fire education materials.

Fire and Aviation Management – USDA Forest Service
www.fs.fed.us/fire/
The USDA Forest Service website contains information about fire management and fire ecology.

Firewise Communities
www.firewise.org
Learn about the Firewise program and find educator resources including videos on a variety of topics such as Firewise building practices and the dynamics of wildfire.

The Great Peshtigo Fire of 1871
www.peshtigofire.info
This site contains a variety of information on the Peshtigo Fire.

National Interagency Fire Center
www.nifc.gov
Find information on current wildfires burning in the U.S., wildland fire statistics, images, educator resources, and much more.

OA Guide to Map and Compass
www.princeton.edu/~oa/manual/mapcompass.shtml
This site provides a basic introduction to the use of a map and compass.

Wisconsin Department of Natural Resources - Forest Fire Program
http://dnr.wi.gov/org/land/forestry/Fire/
Information related to wildland fire in Wisconsin from the Wisconsin DNR. Includes Firewise information, regulations and permits, prevention information, an overview and photos of suppression equipment, weather indices, and the current fire danger around the state.

www.eFire.org
www.efire.org/
An on-line bookstore for wildland fire education. Find wildfire information, links, resources, and materials for purchase.

MASTER INVESTIGATOR NOTES

WISCONSIN FIRE PRONE AREAS
(SEE STUDENT PAGE 1)
- Much of Adams County (site of the fire) is rated as highly fire prone.
- Factors that determine which areas are fire prone include cover type, historic fire patterns, and human population.

AREA COVER TYPES
(SEE STUDENT PAGE 2)
- Land cover in Wisconsin varies from one region to another.
- Adams County is interspersed with agriculture, grassland, jack pine forest, red pine forest, mixed conifer forest, oak forest, mixed deciduous forest, mixed coniferous/deciduous forest, wetland, and forested wetland.

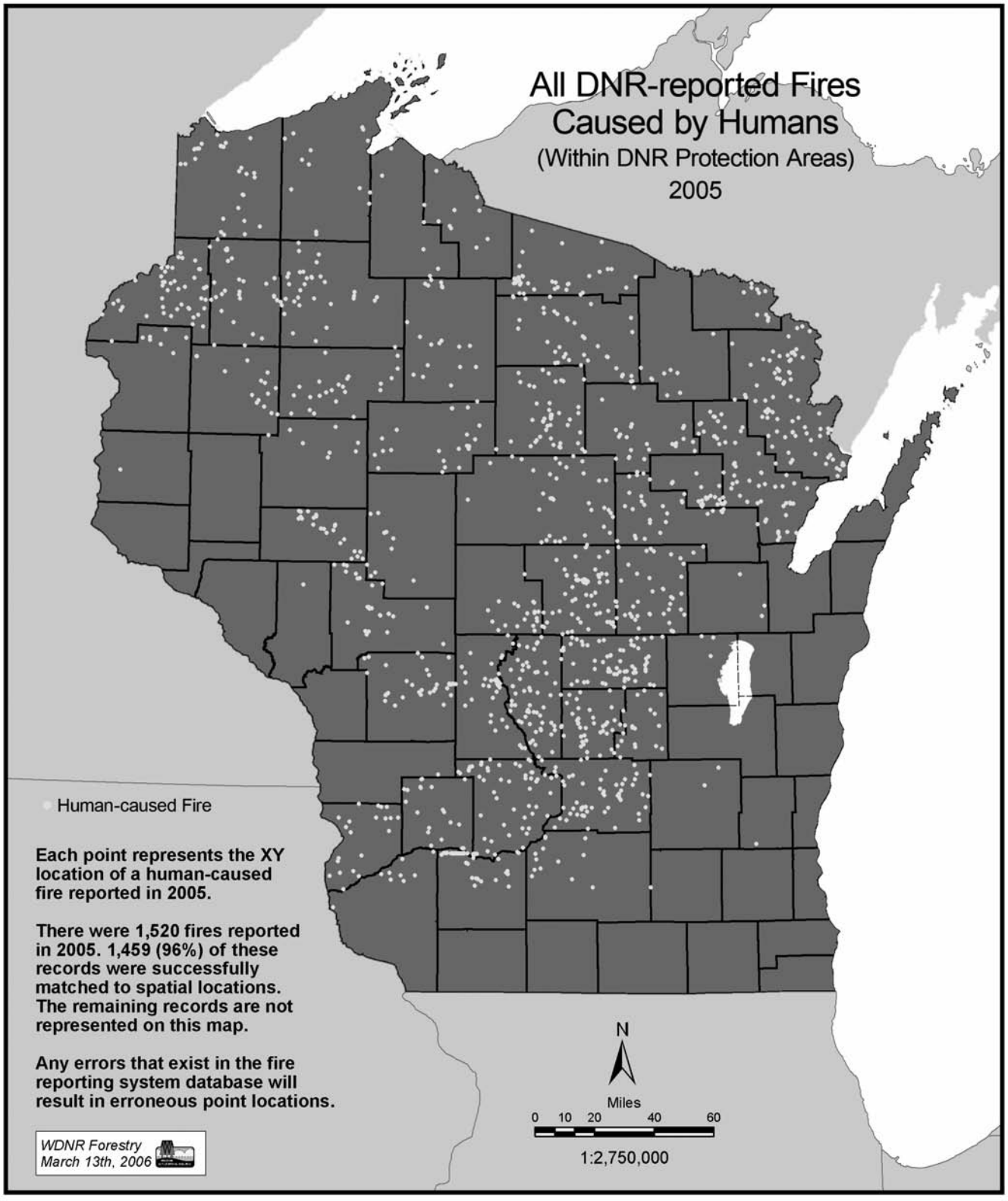
COVER TYPES FIRE RATING
(SEE STUDENT PAGE 3)
- Grasslands, jack pine forest, and red pine forest are susceptible to intense wildfire.
- Oak forest and mixed conifer/deciduous forest can be susceptible to intense fire if the arrangement of fuels allows.
- Agricultural lands may be fire prone or fire resistant depending on the stage of plant growth.
- Not all cover types found in Wisconsin are as fire prone as the cover types found in Adams County.

WILDLAND FIRE HISTORY
(SEE STUDENT PAGE 4)
- Since 1932, there have been 41 major wildland fires in Adams County.
- Darker inlays on the fire locations indicate multiple years of fire.
- The area cover type was jack pine forest prior to European settlement. This forest was maintained by fire.

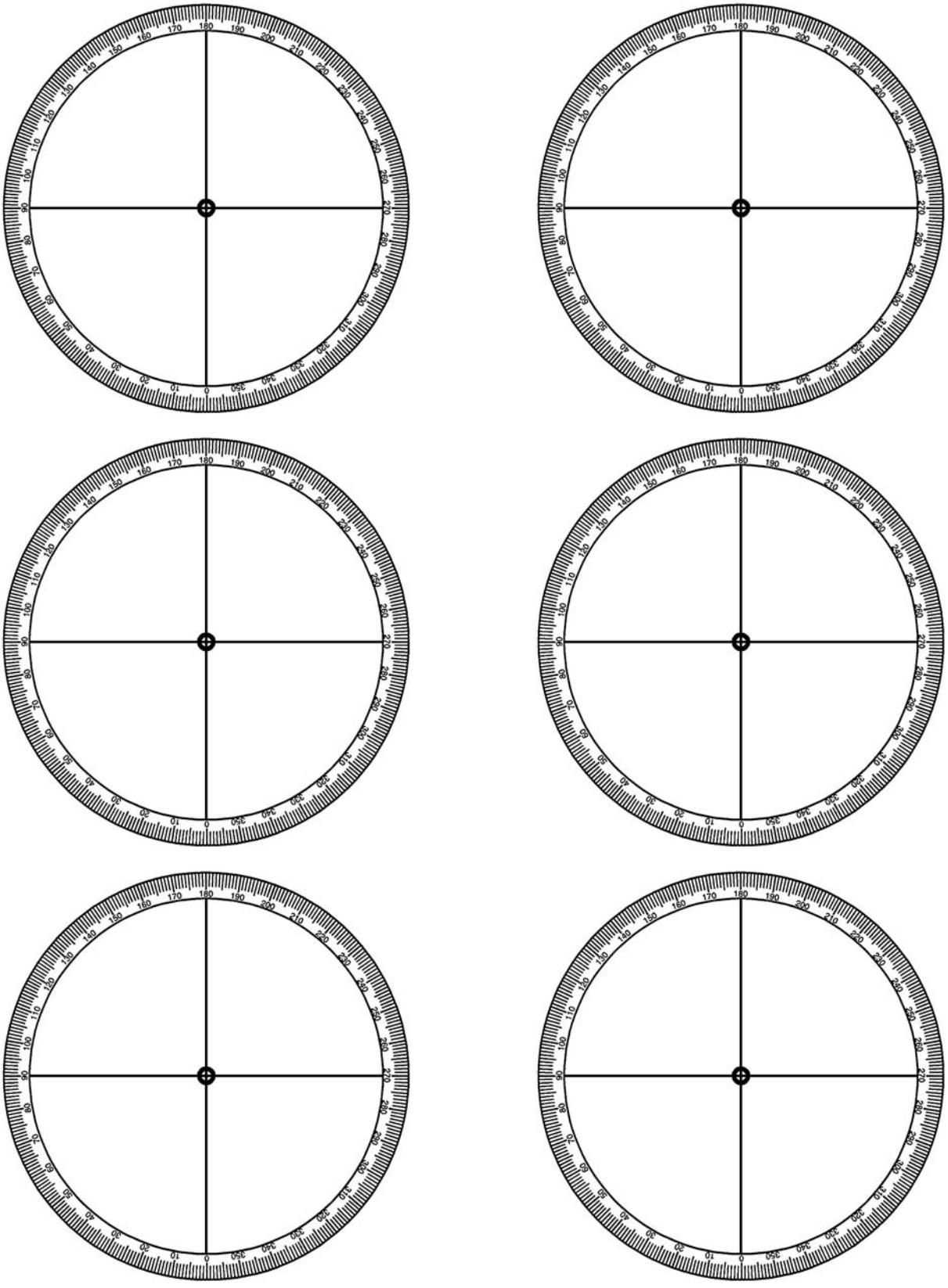
AREA HOUSING MAP
(SEE STUDENT PAGE 5)
- Population density varies in the region, but a number of housing developments exist.
- The more human development in a region, the higher the chance for human-caused fires.

WEATHER DATA
(SEE STUDENT PAGE 6A-B)
- Area rainfall was about 1/3 less than normal.
- Only one rain event the previous month was large enough to temporarily increase fuel moisture content.
- Relative humidity had been variable during the month, but higher temperatures and clear sunny days coupled with lack of rain had started a downward trend in relative humidity since May 3, 2005.
- Fire danger was rated as very high the day of the fire; an increase in wind speed of a few miles per hour would have changed the rating to extreme.

HUMAN-CAUSED FIRES IN 2005

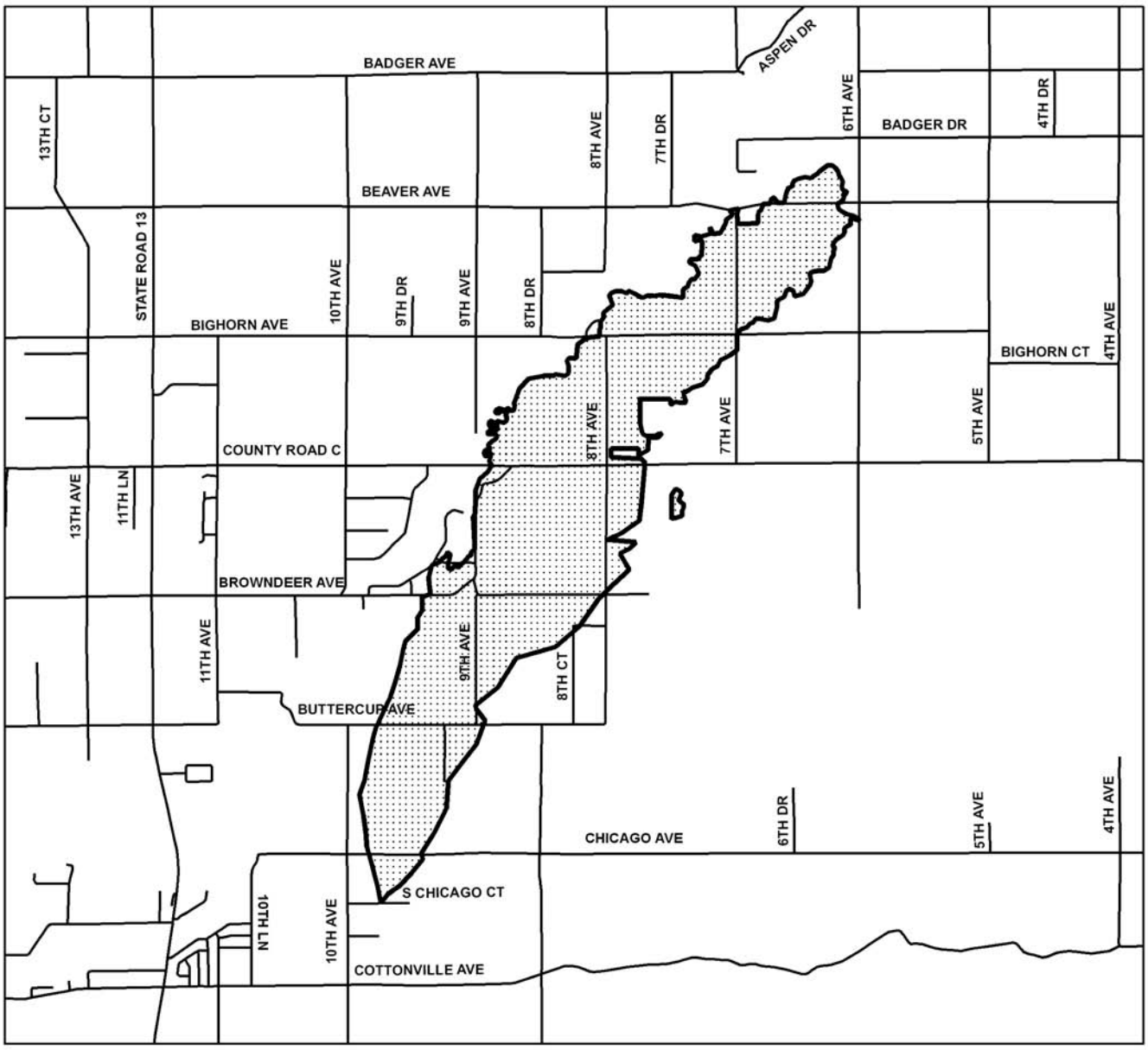


COMPASS OVERLAYS



FIRE BOUNDARY

Adams County, Wisconsin



Miles

0 0.5 1 2 3 4

Map Features

Roads

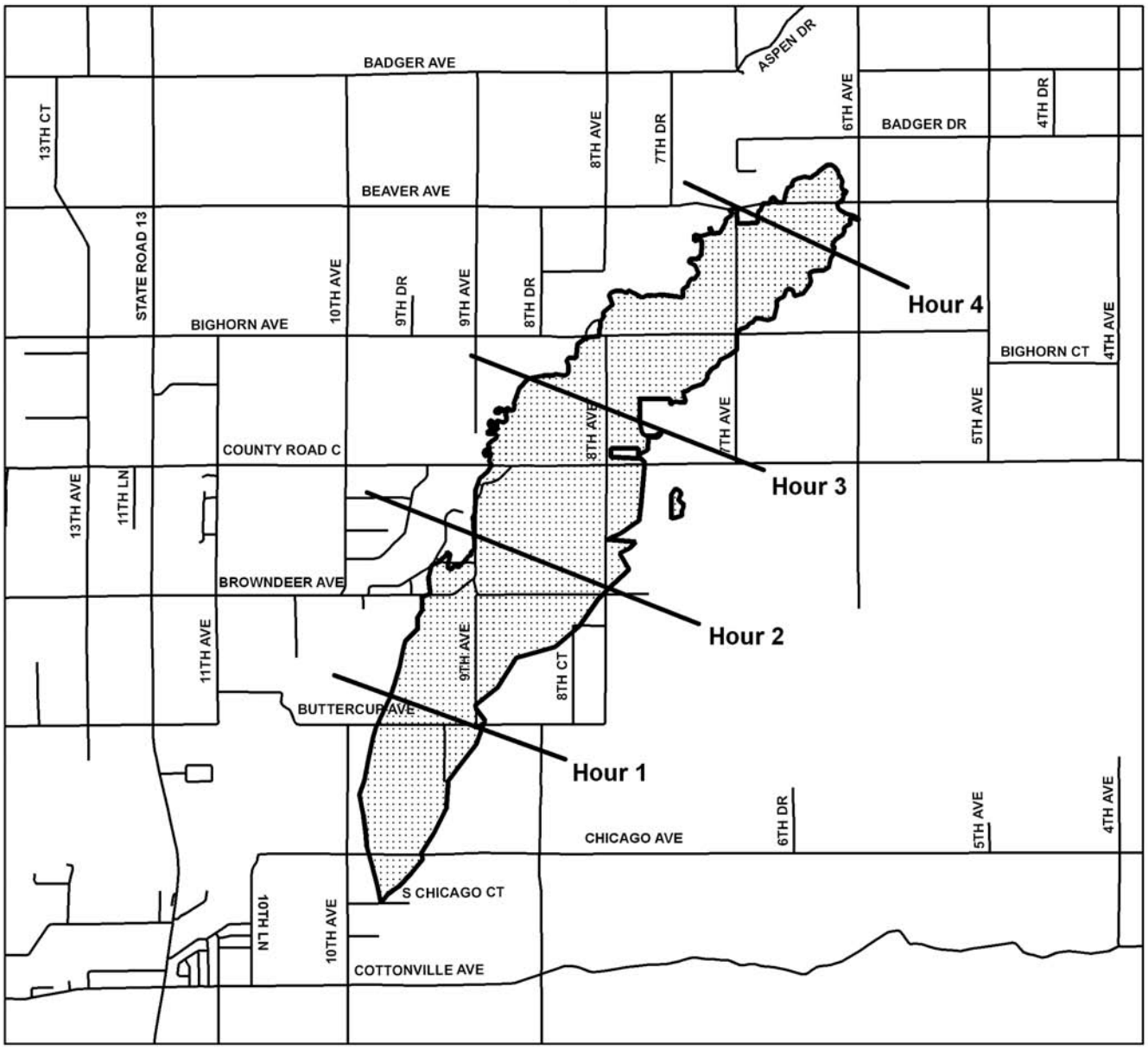
Fire Area

N W E S

Adams County, Wisconsin

FIRE PROGRESSION

Adams County, Wisconsin



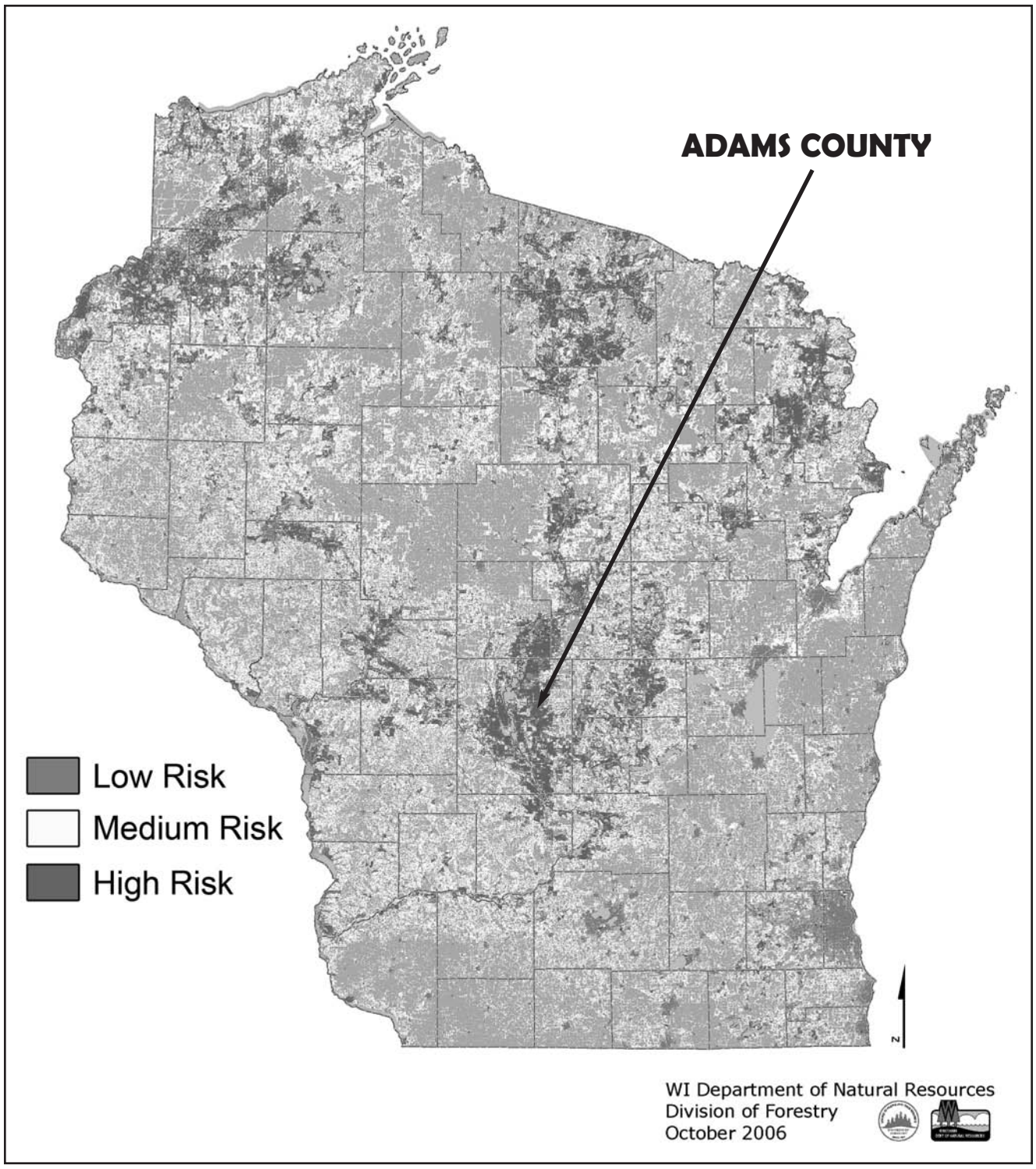
0 0.5 1 2 3 4 Miles

Map Features

- Roads
- Fire Progression
- Fire Area

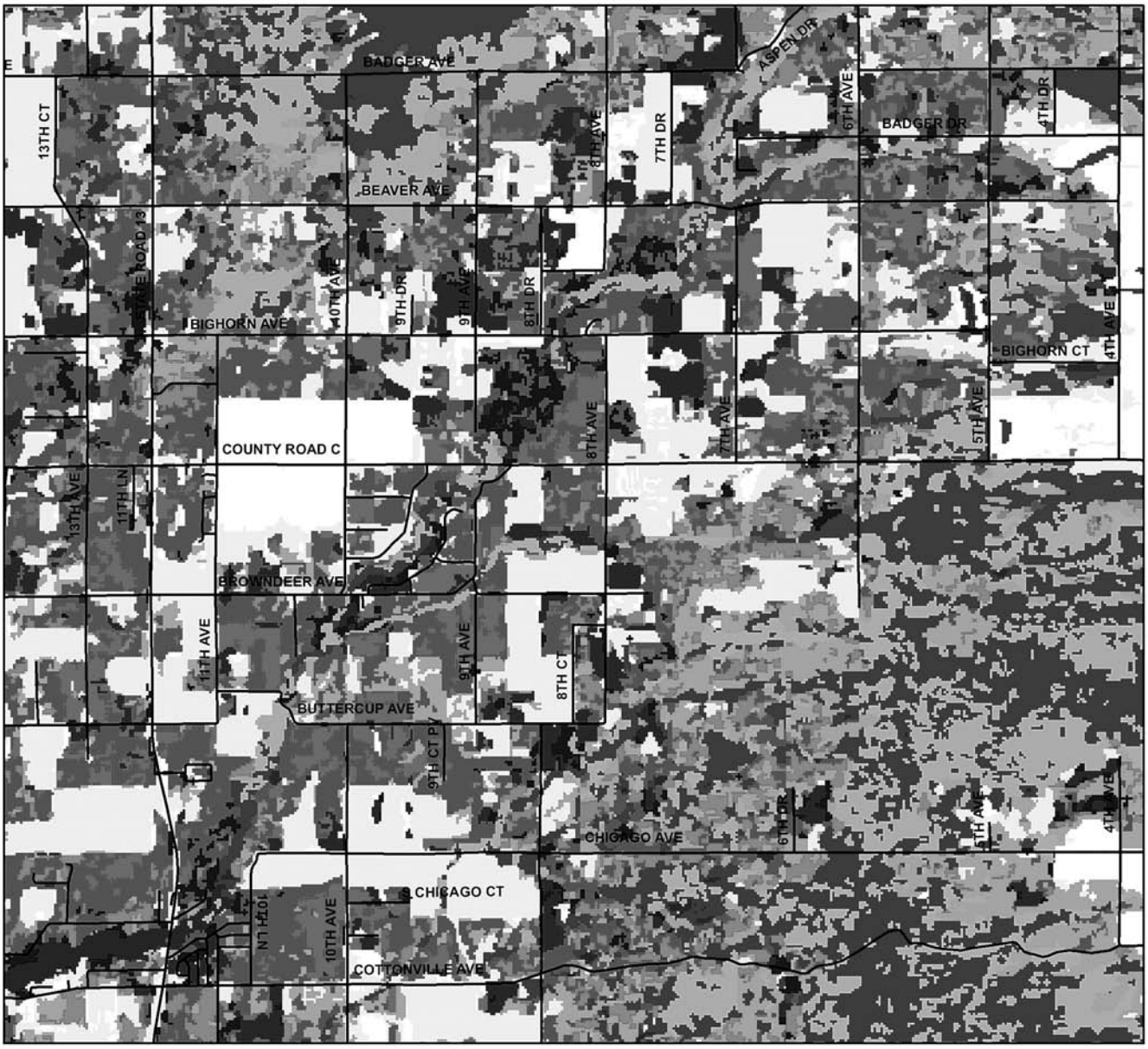
N W E S

WISCONSIN FIRE PRONE AREAS



AREA COVER TYPES

Adams County, Wisconsin



0 0.5 1 2 3 4 Miles

Map Features

Roads

Land Cover Type

Agriculture	Mixed Conifer Forest	Open Water
Grassland	Oak Forest	Wetland
Jack Pine Forest	Mixed Deciduous Forest	Forested Wetland
Red Pine Forest	Mixed Conifer/Deciduous Forest	

N W E S

Adams County, Wisconsin

COVER TYPE FIRE RATING

AGRICULTURE
Agricultural lands vary in their risk of wildfire. In the spring, bare soil is exposed when land is planted. Some fields in this region are planted with cover crops that stay green throughout winter and do not burn. Fire can spread at a slow to medium rate in crop residue such as corn stalks or bean straw depending on the moisture level of the material.

GRASSLAND
Grasses dry out quickly after snow melts, and they burn extremely hot and fast. Grass fires are a threat in the spring until new green growth replaces dead grass.

JACK PINE FOREST
Dense, young stands of jack pine are extremely vulnerable to crowning wildfire. This type of fire behavior is hard to control. A prescribed fire escaped control in 1980 at Mack Lake, Michigan. The fire crowned in a sapling stand, at times spread as fast as 175 feet per minute, and did not slow down until it ran out of jack pines to burn and moved into hardwoods.

RED PINE FOREST
In this region, red pine trees are planted in rows like agricultural crops, forming plantations. Young plantations are vulnerable to crown fire since the trees are planted close together. Dense plantation stands up to 50 feet tall are at high risk of intense crown fire. Red pine is highly flammable and crown fires can reach extremely high temperatures.

MIXED CONIFER FOREST
These forests are composed of jack pine, red pine, and white pine. White pine is not as flammable as jack and red pine, but mixed conifer forests with a high number of jack and red pine trees burn similar to jack or red pine forests.

OAK FOREST
Low-intensity ground fire is common in oak forests because the leaves and small grasses on the forest floor can burn. Many oak trees in this region retain some of their leaves during winter. These leaves can catch on fire if wind increases the intensity of a ground fire and it moves upward or heat from nearby fires provide ignition. Oak trees will typically not burn, but may be killed if a fire gets into the crown of trees.

MIXED DECIDUOUS FOREST
With the exception of some oaks, all deciduous trees lose their leaves in the fall. Fire can move slowly through these forests as it burns leaves on the ground. Mixed deciduous forests with many oak trees may have similar fire intensity to oak forests.

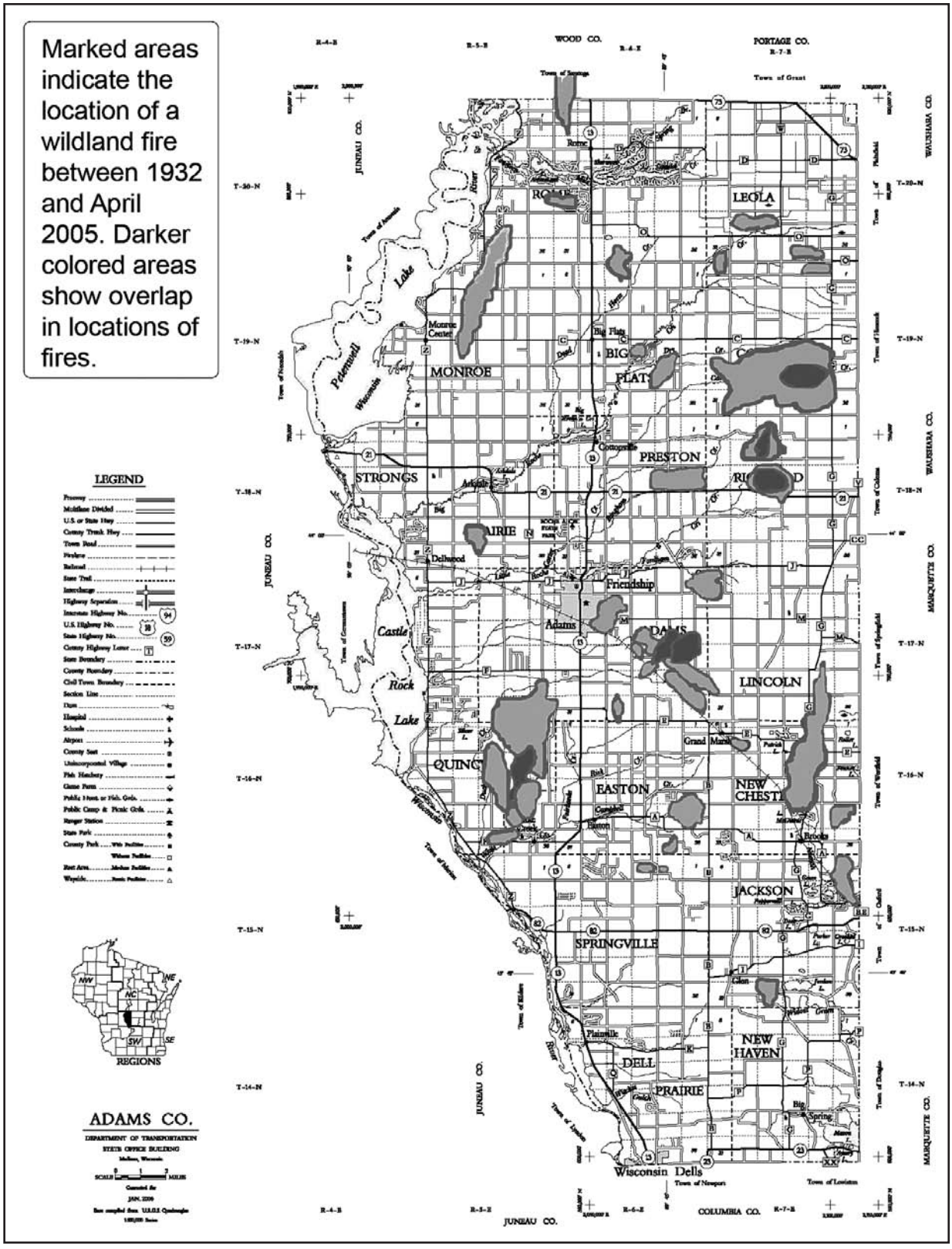
MIXED CONIFER/DECIDUOUS FOREST
Ground and surface fires are common in mixed conifer/deciduous forests. The intensity of fire depends on the arrangement of conifer trees in the forest. If jack and red pine are part of a mixed forest, the forest can have a similar fire situation to a forest containing only jack and red pine.

WETLAND
Wetlands may have vegetation such as cattails and grasses that dry out fast after snow melt and burn extremely hot and fast. Wetland fires remain a threat in the spring until after new green growth replaces the dead plants. If the soil is dry in the wetland, it is possible for the peat soil to catch fire and burn for days.

FORESTED WETLAND
The types of trees found in a forested wetland vary greatly throughout Wisconsin. In this region, forested wetlands tend to be surrounded by nonforested wetlands. Alder, aspen, and maple are common trees present. Some conifers including jack pine are present also. Forested wetlands vary in their risk of wildland fire.

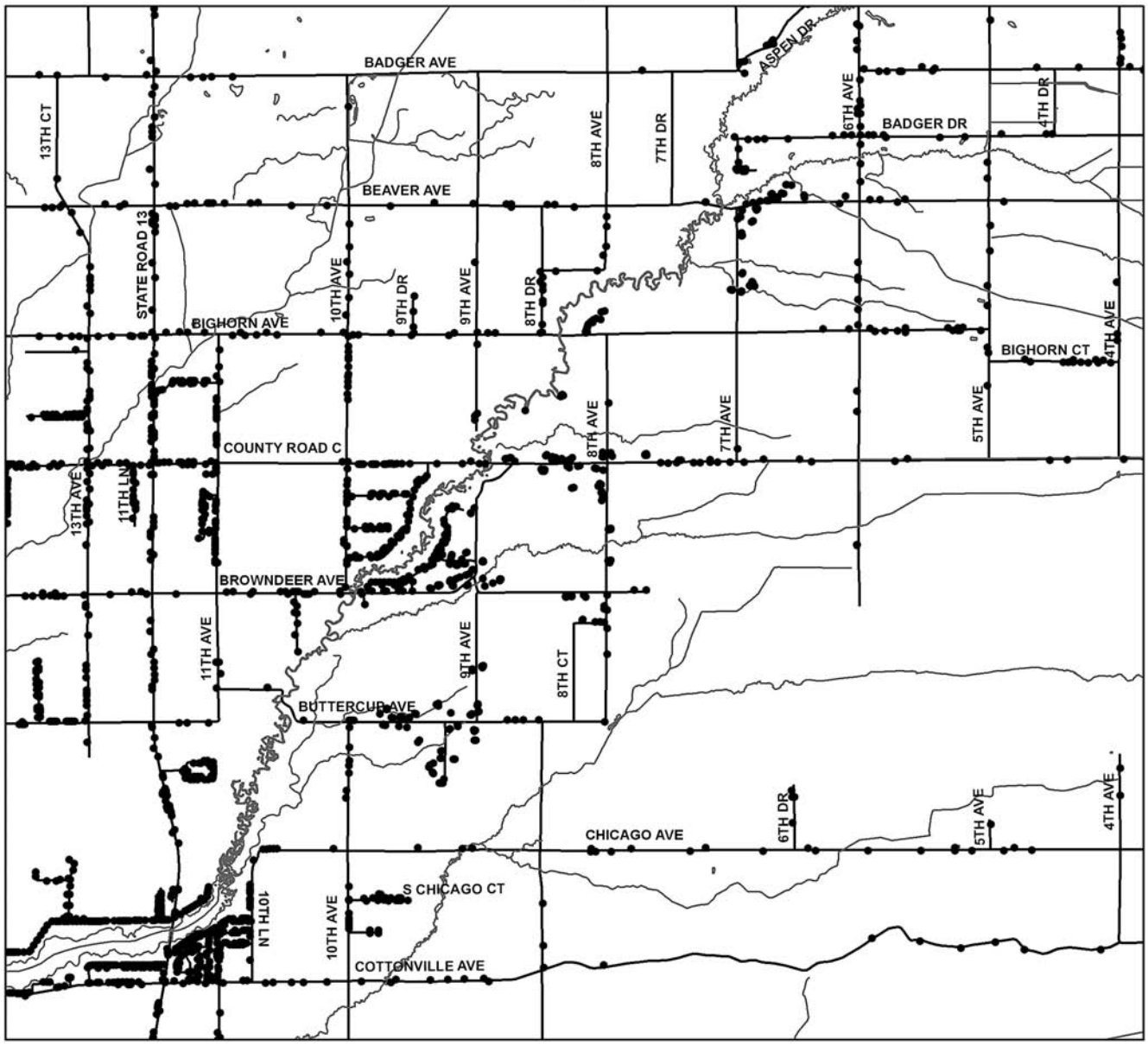
WILDLAND FIRE HISTORY

Marked areas indicate the location of a wildland fire between 1932 and April 2005. Darker colored areas show overlap in locations of fires.



AREA HOUSING MAP

Adams County, Wisconsin



0 0.5 1 2 3 4 Miles

Map Features

- Roads
- Rivers and Streams
- Houses and Other Structures

N W E S

WEATHER DATA

MONTHLY WEATHER DATA, COTTONVILLE AREA

DATE AND TIME	TEMPERATURE (ºF)	RELATIVE HUMIDITY* (%)	WIND SPEED (MPH)	RAIN PER 24 HOURS (INCHES)	DURATION OF RAIN (HOURS)	FIRE DANGER (LEVEL)
April 1, 2005 (13:00)	53.8	30	7.0	0.01	1	High
April 2, 2005 (13:00)	55.9	28	7.3	0.00	0	High
April 3, 2005 (13:00)	63.0	24	8.4	0.00	0	High
April 4, 2005 (13:00)	66.4	29	14.6	0.00	0	Extreme
April 5, 2005 (13:00)	76.8	37	7.3	0.00	0	High
April 6, 2005 (13:00)	69.3	44	4.0	0.00	0	High
April 7, 2005 (13:00)	62.4	27	9.6	0.00	0	Very High
April 8, 2005 (13:00)	66.6	23	7.8	0.00	0	Very High
April 9, 2005 (13:00)	68.2	23	9.6	0.00	0	Very High
April 10, 2005 (13:00)	77.4	33	13.5	0.00	0	Extreme
April 11, 2005 (13:00)	65.1	30	15.0	0.00	0	Extreme
April 12, 2005 (13:00)	54.7	27	13.5	0.07	2	Extreme
April 13, 2005 (13:00)	61.3	12	8.1	0.00	0	Very High
April 14, 2005 (13:00)	70.9	11	5.0	0.00	0	High
April 15, 2005 (13:00)	68.5	15	6.5	0.00	0	High
April 16, 2005 (13:00)	56.1	77	3.5	0.06	3	Moderate
April 17, 2005 (13:00)	68.5	47	4.8	0.19	7	High
April 18, 2005 (13:00)	81.5	26	12.6	0.00	0	Extreme
April 19, 2005 (13:00)	61.3	94	4.1	0.01	1	Low
April 20, 2005 (13:00)	54.7	72	7.3	1.44	8	High
April 21, 2005 (13:00)	58.8	44	7.6	0.00	0	High
April 22, 2005 (13:00)	60.4	38	6.5	0.00	0	High
April 23, 2005 (13:00)	45.1	30	14.6	0.02	1	Extreme
April 24, 2005 (13:00)	52.5	33	16.4	0.00	0	Extreme
April 25, 2005 (13:00)	50.7	67	3.4	0.00	0	High
April 26, 2005 (13:00)	47.8	52	5.9	0.23	10	High
April 27, 2005 (13:00)	42.1	63	9.6	0.03	3	High
April 28, 2005 (13:00)	45.9	40	6.6	0.00	0	High
April 29, 2005 (13:00)	50.2	33	5.3	0.00	0	High
April 30, 2005 (13:00)	45.3	45	8.2	0.00	0	High
May 1, 2005 (13:00)	41.4	58	9.0	0.00	0	High
May 2, 2005 (13:00)	37.2	56	8.9	0.00	0	High
May 3, 2005 (13:00)	52.5	21	8.6	0.00	0	High
May 4, 2005 (13:00)	62.1	20	8.9	0.00	0	Very High
May 5, 2005 (13:00)	72.1	18	9.4	0.00	0	Very High
April Maximum	**81.5**	**94.0**	**16.4**	**1.44**	**10.0**	
April Average	**60.0**	**38.5**	**8.5**	**0.07**	**1.2**	
		Total Rain		**2.06**	**36**	
		Average April Rainfall		**3.01**		

* ***Relative Humidity:*** *The percent of moisture in the air.*

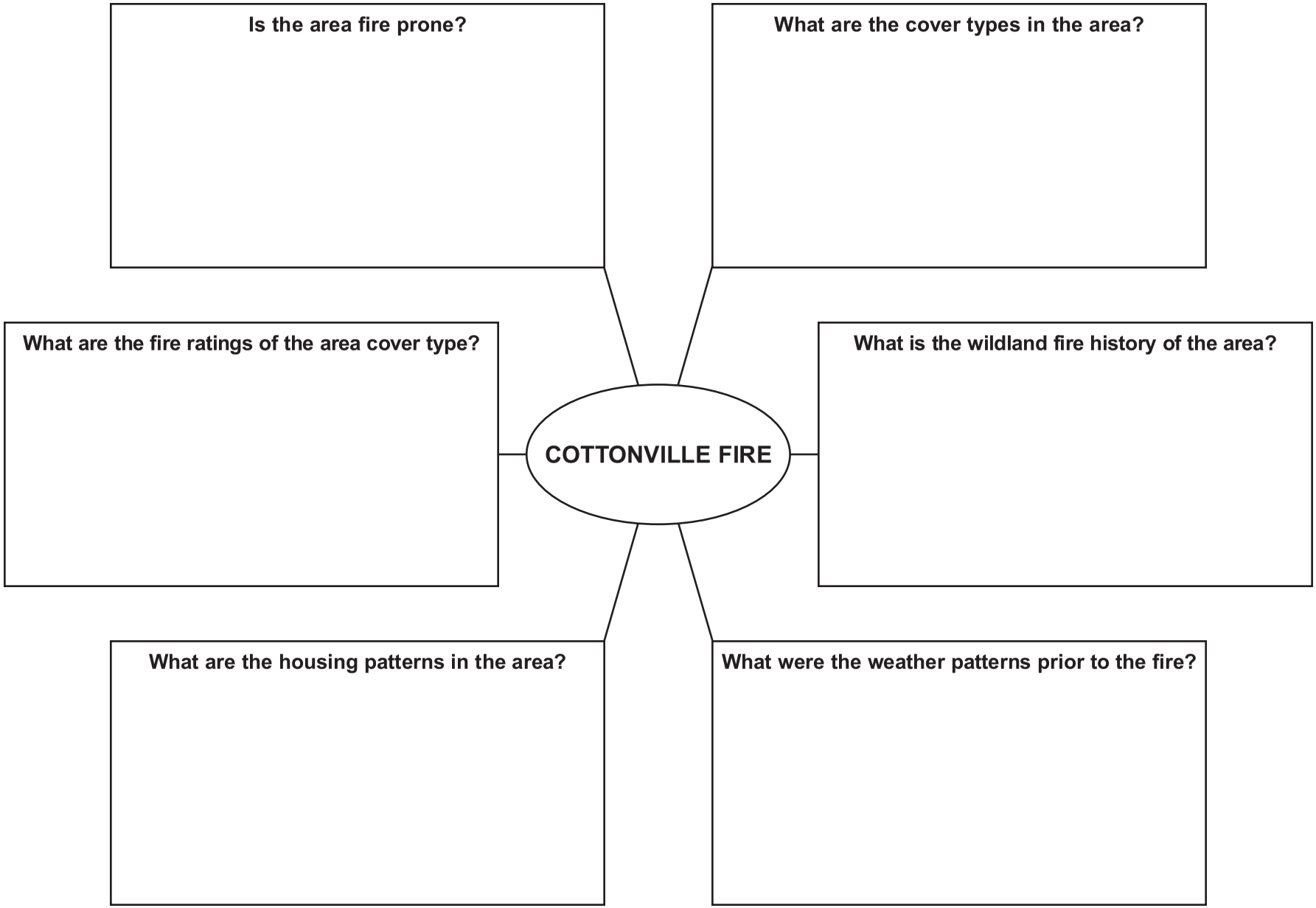
WEATHER DATA

HOURLY WEATHER DATA, COTTONVILLE AREA

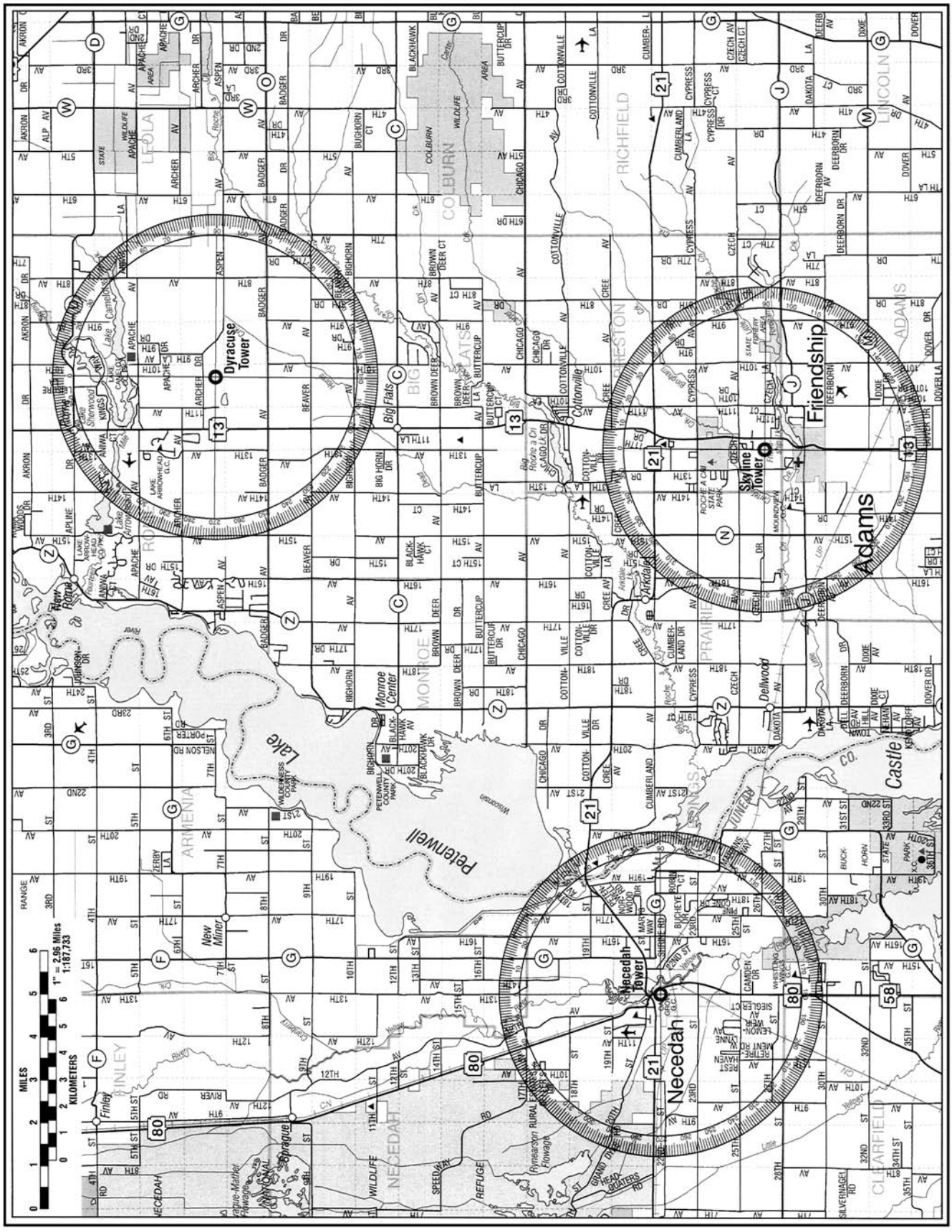
DATE AND TIME	TEMPER-ATURE (ºF)	RELATIVE HUMIDITY* (%)	WIND SPEED (MPH)	MAXIMUM WIND SPEED (MPH)	DIRECTION WIND IS TRAVELING FROM
May 5, 2005 (00:00)	47.1	37	4.4	8.5	180º
May 5, 2005 (01:00)	46.2	38	4.3	7.8	180º
May 5, 2005 (02:00)	35.8	59	1.9	6.3	225º
May 5, 2005 (03:00)	43.3	44	4.5	6.7	180º
May 5, 2005 (04:00)	44.2	41	3.9	7.1	180º
May 5, 2005 (05:00)	43.2	43	3.3	8.1	180º
May 5, 2005 (06:00)	48.4	37	4.9	8.1	180º
May 5, 2005 (07:00)	54.0	30	8.0	12.1	225º
May 5, 2005 (08:00)	60.8	24	9.4	16.0	225º
May 5, 2005 (09:00)	64.6	22	12.8	21.1	225º
May 5, 2005 (10:00)	66.4	22	11.6	18.9	225º
May 5, 2005 (11:00)	70.0	19	10.0	18.5	225º
May 5, 2005 (12:00)	72.1	17	10.8	19.3	225º
May 5, 2005 (13:00)	72.1	18	9.4	20.7	225º
May 5, 2005 (14:00)	73.4	17	14.2	19.9	225º
May 5, 2005 (15:00)	71.8	19	14.0	21.7	225º
May 5, 2005 (16:00)	71.8	20	10.1	22.1	225º
May 5, 2005 (17:00)	71.2	21	10.4	20.3	225º
May 5, 2005 (18:00)	68.0	25	8.0	15.0	225º
May 5, 2005 (19:00)	62.6	30	3.5	11.4	180º
May 5, 2005 (20:00)	57.7	36	3.7	6.3	180º
May 5, 2005 (21:00)	59.9	32	5.1	8.1	180º
May 5, 2005 (22:00)	58.6	33	5.4	10.7	180º
May 5, 2005 (23:00)	58.5	32	6.3	11.7	180º

**** Relative Humidity:*** *The percent of moisture in the air.*

CIRCUMSTANCES THAT LED TO THE FIRE



FIRE TOWER MAP



COTTONVILLE FIRE RADIO TRAFFIC TRANSCRIPT

• All messages are being called into a dispatch center that coordinates radio traffic for the region.
• Brackets [ ] indicate information added for clarification.

TIME	FROM	COMMENTS
13:33	Dyracuse Tower	Small white smoke at 175º.
13:34	Dyracuse Tower	Looks like it is growing.
13:34	Friendship Ranger	I copy the message of reported fire. Will order 2 heavy units, patrol and the SEAT [Single Engine Air Tanker].
13:36	Necedah Tower	Smoke spotted at 79º.
13:36	Skyline Tower	Smoke spotted at 22.5º.
13:38	Friendship Ranger	Start 2 more heavy units this direction. The fire should be in section 03-T18N-R06E.
13:43	Air Attack	The fire is 1 acre, burning in mature pine, some torching. In front of this you've got about 1/2 mile of 10 to 15 foot pine, with one travel trailer that is threatened. Not moving real fast on the ground and staying mostly on the ground, just sporadic torching. When it gets to the short pine, it is probably going to torch.
13:43	Friendship Ranger	Order 2 additional heavy units, for a total of 6 heavy units and 2 rangers. The SEAT was ordered, correct?
13:44	Dispatch	10-4, SEAT is airborne with smoke in sight.
13:46	Knapp Tower	Large smoke at 106º. [This tower is located in Jackson County and is looking more than 35 miles to see this smoke.]
13:47	Friendship Ranger	Order 2 more heavy units. For total of 8, 2 heavy dozers, and 2 additional rangers.
14:05	Friendship Ranger	I am now the Cottonville Incident Commander – this is the Cottonville Fire. Can you order 2 hand crews and 2 additional heavy units?
14:17	Air Attack	Fire crossing the intersection of the pipeline and Chicago Avenue. There are 3 fire departments on scene to aid structure survival. Crown fire behind mobile home and jumping the pipeline gap.
14:20	Incident Commander	I'd like another resource order – 4 additional heavy units, 2 additional rangers, and 2 additional heavy dozers.
14:42	Dispatch (to Stevens Point Fire Crew)	What are the chances of pulling together a 10- or 20-person hand crew?
14:42	Stevens Point Fire Crew	What is the minimum you will take?
14:42	Dispatch	If you can only get 5 we will take them.
14:49	Incident Command	Made contact for Wood County dozer. Party indicated that he had just talked to the operator, and that he was on the way in. The Caterpillar is loaded, so he would be on the way shortly.

COTTONVILLE FIRE RADIO TRAFFIC TRANSCRIPT

TIME	FROM	COMMENTS
14:53	Incident Command	Summary of resources on order. We have – **Heavy Units:** Friendship 1, 2 and 3. Nekoosa 1 and 2. Necedah 1 and 2. Wisconsin Dells 1 and 2. Babcock 1. Whiting 1. **Heavy Dozers:** Nowicki, Adams County, and Wood County are ordered. We are trying to order the Necedah Refuge dozer right now. **Rangers:** Friendship Ranger. Co-op Ranger. Nekoosa Ranger. Jim Barnier. Friendship Leader. Sandhill Forester. Necedah Ranger. Wisconsin Dells Ranger. Babcock Ranger. Whiting Ranger. Most working on evacuation at this time. **Aircraft:** CL-215 has been ordered, but we have not received confirmation and estimated time of arrival. Necedah air tanker and patrol are on scene. Another air attack has been ordered out of Madison, but no confirmation yet. **Stevens Point Fire Crew:** Ordered 2 hand crews [Not mentioned here, but a 5-person Stevens Point Fire Crew responded with Whiting 1.] **Command Center:** Activated. **Fire Departments:** 5 currently on scene protecting structures in 6 zones.
15:00	Incident Command	Head of the fire too hot for ground containment. All heavy units assigned to contain the fire on the flanks as head of the fire advances.
15:03	SEAT Manager	If you have any way of contacting the Incident Command Post we can give each plane 750 gallons of foam. We can give them more foam than retardant. We can only give them maybe 600 gallons of retardant.
15:08	SEAT 1	I am on my way to load foam. I think SEAT 2 is going to head over to Necedah to load retardant, so you'll need a crew there.
15:10	SEAT Manager	Air support, drop your loads on the head of the fire.
15:29	Operations	Advised about the two 5-person Stevens Point hand crews leaving at 16:00, and that one Stevens Point hand crew should already be on scene. The Adams County Sheriffs Department is present and has blocked roads to civilian travel and is helping with evacuation.
15:33	Air Attack	Head of fire crosses the intersection of 9th and Buttercup Avenue – continuing to widen. Appears we have had a slight wind shift.
15:39	Dyracuse Tower	I don't suppose I need to tell you that the flames are shooting out ahead of that. There seem to be crown fires everywhere. When do I bail out of here? Don't forget I am here. I estimate that flames are up a couple hundred feet.
15:39	Dispatch	If you feel the need to get out of the tower, just give us call to let us know you are leaving.
15:40	Air Attack	The fire has jumped Browndeer Avenue at 9th. It seems to be getting wider due to the intense flames in this heavy pine and grassland area.
15:45	Ground Crew	Head of the fire has passed over 9th Avenue. Surface fire burning on both sides of the road.
16:05	Air Attack	Spotting east of fire perimeter in section 24 just south of County C, move heavy unit to respond.
16:25	Dyracuse Tower	[A rather breathless towerman calling to let us know that he is back in the tower, and he had also driven his truck up closer to the tower. He also indicates that he can now see spots ahead of the main fire. He is assured that a plane will be watching for spots.]
16:32	SEAT Manager	SEAT 2 will refuel in Stevens Point after dropping retardant on the fire. I have 2 volunteers from the fire department helping SEAT 1 load at Friendship. I have sent extra foam over.

COTTONVILLE FIRE RADIO TRAFFIC TRANSCRIPT

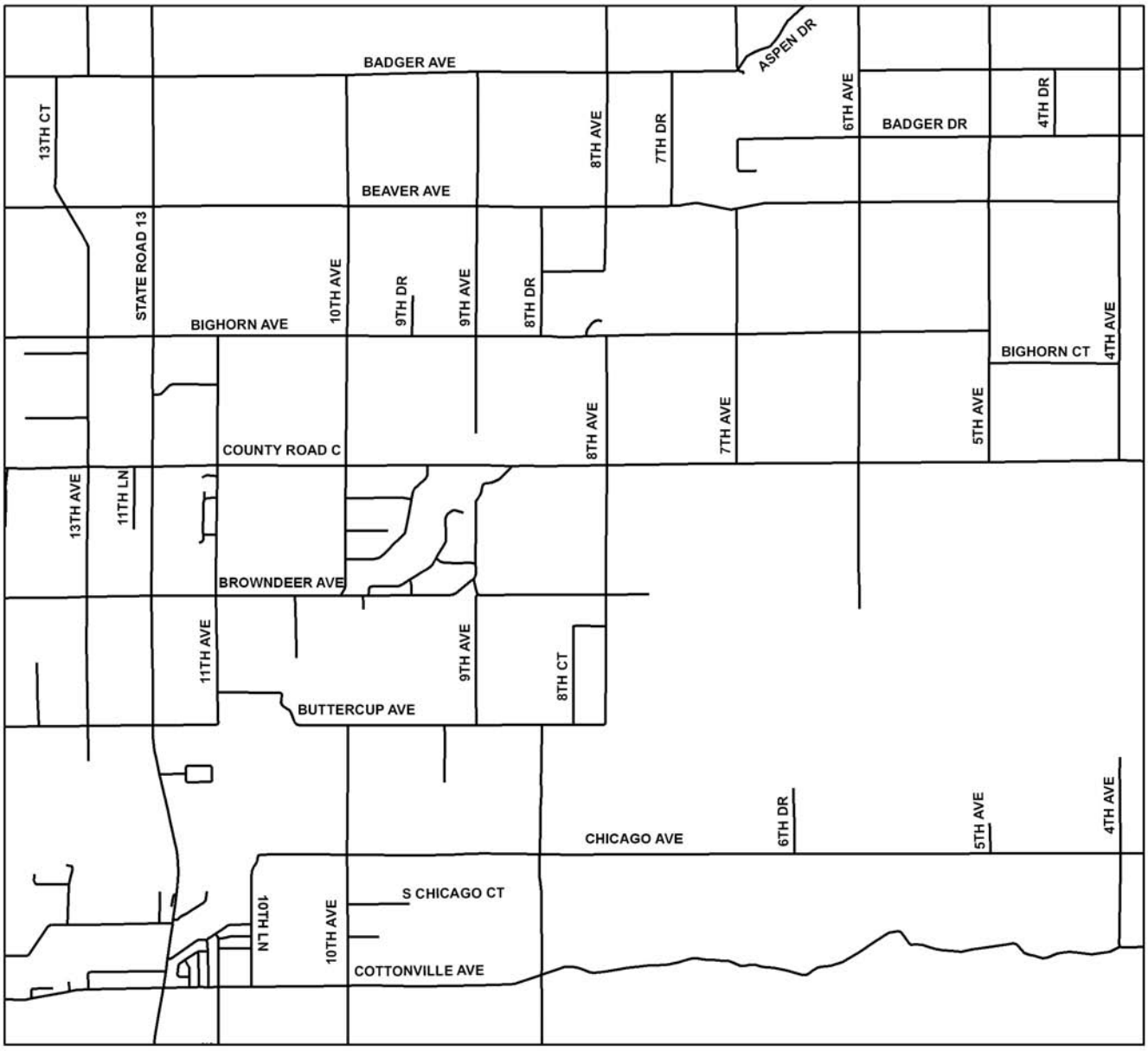
TIME	FROM	COMMENTS
16:35	Air Attack	Torching just spread to canopy approaching County C. Looks like it may jump this gap.
16:40	Incident Command	Resource order – 4 Rangers, 4 Heavy Units, 2 Heavy Dozers, 2 Hand crews (10-person if possible), and from Tomahawk, the equipment truck and cache trailer. 9 fire departments currently on the scene to protect structures in 9 zones.
16:40	Air Attack	Fire crossed the intersection of 8th and County C.
16:43	Stevens Point Fire Crew	Calling to advise that the 2 crews are on their way as of 16:35. Stevens Point Crews 2 and 3.
16:43	Dispatch	Could you possibly find another 20 people?
16:43	Stevens Point Fire Crew	Very doubtful.
16:45	Air Attack	Fire crossed the intersection of 9th and County C.
16:50	Dyracuse Tower	The CL-215 tanker is now here and is flying from the river in Petenwell. Can't see the drops through the smoke from the tower.
16:58	Air Attack	Air assault on head of fire is not effective. Move all air assault to the flanks and Trout Creek housing development.
17:06	National Weather Service (La Crosse)	Requesting a contact number for the Incident Command Post. [The National Weather Service staff was told there is a lot of pine in the fire area and it has made over a 3-mile run, with some structure loss.]
17:10	Dispatch	A second tanker CL-215 plane has been diverted to a fire in Minnesota. They will call when it becomes available again to see what our situation is.
17:16	Air Attack	Fire crosses the intersection of 8th and Bighorn Avenue. The crown fire looks like some kind of monster. That's a hot one crew!
17:24	Air Attack	Fire crossed the intersection of 7th and Bighorn Avenue.
17:27	Stevens Point Fire Crew	I have 4 more people available that could be there by 19:30. Stevens Point Crew 3 was sent with 6 people. 1 person could be pulled from Crew 3 to make a 5-person crew. Will call back with an estimated time of arrival.
17:33	Stevens Point Fire Crew	Caleb from Stevens Point Fire Crew here. Point Crews 2 and 3 are at the Incident Command Post.
17:55	Incident Command	11 fire departments with 127 personnel protecting structures in 13 zones.
18:03	Air Attack	Surface fire at the intersection of 7th and Bighorn Avenue.
18:11	SEAT Manager	The planes can fly until 20:40, a half hour after sunset.
18:26	Incident Command	The current conditions: Temp. 69º, RH 23%., Wind SW 8 to 15. Looking for predicted weather for the night, and was told that we would take the current data and call for an updated spot forecast.
18:28	National Weather Service (La Crosse)	Forecast: Winds continue out of the south but should be dying down to 6 to 8 m.p.h. by 20:00. Relative humidity at 50% by 24:00. Overnight maximum at 75 to 80%. Temp. 55 to 60º by 24:00. Overnight low around 50º. The fire is showing up on the satellite.
18:35	Incident Command	19 fire departments currently working to save structures in 19 zones. Estimate 180 firefighters working structures from local departments.

COTTONVILLE FIRE RADIO TRAFFIC TRANSCRIPT

TIME	FROM	COMMENTS
18:45	SEAT Manager	SEAT 2 is fueling and will be leaving soon.
18:50	Air Attack	Intensity of fire decreasing near the head. Air assault ordered to assist ground forces in controlling the head of the fire.
19:09	SEAT Manager	SEAT 2 is coming to Wisconsin Rapids to refuel and reload. We need to set up for that. Anticipate 2 to 3 loads. Hard to estimate time, as we have no way of knowing how long he might be held over the fire. Best guess is estimated time of arrival of 20 to 30 minutes. There is no fuel available at Friendship.
19:16	SEAT Manager	The Wisconsin Rapids Fire Department will load SEAT 2. SEAT 2 is over the fire and will drop his load soon and head for Wisconsin Rapids, estimated time of arrival 10 minutes. We need to let SEAT 2 know someone will meet him at Wisconsin Rapids. Closed down Friendship for reloading as there is no fuel there.
19:29	SEAT 2	We have a report from a pilot of a fire along railroad tracks 4 miles south of Adams County airport. I have the smoke in front of me right now, looks like a small white, may be growing.
19:42	SEAT 2	Off Friendship, I have that smoke in sight, do you want me to check it out? [No response from dispatch.]
19:43	SEAT 2	I have that smoke in sight, about a mile away, do you want me to check it out?
19:47	SEAT 2	They are running low on fuel at the Wisconsin Rapids airport.
20:16	Adams Sheriff	Calling to follow up on the reported fire along the railroad. Officer is on scene of a controlled burn in that area.
20:24	National Weather Service (La Crosse)	[Calling to see what is happening. Makes comments about last spot forecast being pretty much on target. Noticing relative humidity was up to 24% at 19:00. Winds are 180º at 7 m.p.h. Looking for relative humidity to approach 50% by 24:00.]
20:49	Wisconsin Rapids Airport	Curtis calling to advise they will have fuel about 08:00 in the morning, 7,000 to 8,000 gallons coming.
20:52	SEAT Manager	SEATs are on the ground at Necedah. They will close up shop shortly. Tanker pilots said it was nasty up there.
21:35	Necedah Tower	I just want to say thank God for everybody out there fighting that fire. I saw it from Necedah, 15 miles away, and it's an area I hunted, fished and trapped all my life. God bless you guys all out there. I'm gonna sign off. Be careful out there. I mean, I'm getting to be an old man, but God bless you guys fighting this fire from everywhere you came from. I'll sign off now.
21:35	Dispatch (to Necedah Tower)	Copy that Necedah Tower, appreciate that.
23:11	National Weather Service (La Crosse)	Forecast for the rest of the night: winds south 5 to 8 m.p.h. Relative humidity increasing to 75 to 80% by 07:00. There is some rain on radar, but struggling to get here. Could get in the area from 02:00 to sunrise, will be scattered and light, temperature in the low 50s. For tomorrow morning: 07:00 to12:00 wind switching to southwest at 5 to 10 m.p.h. Rain chance is 25%. Scattered, less than 0.10 inch. Relative humidity starting at 75 to 85%, dropping to 55 to 60% by 12:00. Temperature going from low 50s in the morning to upper 60s by noon.

COTTONVILLE AREA MAP

Adams County, Wisconsin



Map Features

Roads

N
W
E
S

FIRE BEHAVIOR INFORMATION SHEET

HEAT TRANSFER

For fire to spread, heat must move from one piece of burning fuel to another. This movement is called heat transfer. Heat is transferred by radiation, convection, and conduction. Radiant heat is heat that travels in a wave. It is the heat that warms you as you sit near a campfire or a warm stove. Convection heat is heat that moves as heated air or gas. It is the heat that rises off of a campfire or above a boiling pot of water. Conduction is heat that moves through a material. Think of a metal spoon as it comes out of a hot cup of tea. Each of these types of heat transfer can heat, dry, and ignite fuels.

FUEL CHARACTERISTICS

Fuel characteristics determine how intensely a wildland fire burns and how far it spreads. These characteristics include the type of fuel, fuel moisture, and fuel size and shape. The quantity of fuel and the way it is arranged also influence fire behavior.

Fuel types include grass, shrubs, tree litter, and logging slash (brush left behind from logging). Light fuels, such as grass, burn very fast and hot, while heavy fuels, such as logging slash, burn for long periods of time. Light fuels dry much faster than heavy fuels. Their moisture varies throughout the day as temperature, humidity, and wind speeds change. It is often the case that the fire danger increases during the day and decreases as night approaches.

Fire can occur as ground fire (burning organic material in the soil), as surface fire (burning the fuels found directly on the surface of the ground), and as crown fires (fires that move through the tops of trees). Fuels that reach from the ground to the crowns of trees are called ladder fuels. Ladder fuels can cause fire to escalate from a surface fire to a crown fire. When fire enters the crowns of the trees it becomes very dangerous and uncontrollable.

WEATHER AND TOPOGRAPHY

Topography and weather are major influences on fire behavior. Weather is constantly changing because of local, regional, and continental influences. Weather can quickly dry fuels and help spread fire. Three weather characteristics determine the level of fire danger – temperature, wind, and moisture.

As fuels dry, they become more susceptible to fire. Winds can quickly dry fuels and feed flames. As precipitation and humidity decrease, fuel moisture levels decrease. As fuels become heated, they also become more susceptible to fire. The sun and warm air increase fuel temperatures.

Fuel arrangement and weather patterns are influenced by topography. The landscape can influence which fuels get direct sunlight, which fuels receive more moisture from rainfall, and which areas are exposed to wind. Landscape features can also channel wind currents, causing extreme changes in fire behavior. Fire can also move quickly up steep slopes, since heat travels upward preheating and igniting fuels.

EXTREME FIRE BEHAVIOR

Extreme fire behavior creates very dangerous fire situations. It makes wildfires both unpredictable and uncontrollable. Three major extreme fire behaviors are torching, crowning, and spotting. Torching occurs when a surface fire ignites the crowns of trees and shrubs as it advances. This type of fire behavior is caused by an advancing surface fire. Crowning is a behavior where a fire in the crowns of trees moves independently of surface fires. Crown fires are extremely dangerous. Spotting occurs as fire produces sparks or embers that are carried away from the main fire by convection or wind currents. Spot fires start outside of the original fire area.

SUPPRESSION OPTION REPORT: FIRE CONTAINMENT

PURPOSE
To stop the spread of wildfire.

STRATEGIES
FIREBREAK CONSTRUCTION
Creating a “break” or “line” involves removing the flammable organic matter found on or near the surface of the ground (e.g., plants, leaves, sticks, black soil) to expose the mineral soil. Surface fires do not spread in mineral soil. Breaks are constructed to contain the lateral or sideways spread of fire. They can be constructed by hand crews or with heavy equipment such as bulldozers or tractor plows.

Firebreak Construction

WETTING
The application of water increases moisture levels in fuels. Water can be applied on or in front of the fire using aircraft, fire engines, pumps from nearby water sources, and backpack water cans.

Wetting

FUELS REDUCTION
Removing fuels in front of a fire reduces the fire intensity and improves the effectiveness of watering and line construction. Fuels can be removed by clearing vegetation, but are most often removed by lighting surface fires in the wildfire path to burn away the fuel.

Fuel Reduction

EFFECTIVENESS
FIRE BEHAVIOR LIMITATIONS
Fire containment strategies are not effective at the head of the fire when wildfires exhibit extreme fire behavior such as crowning.

HIGH COST OF INVESTMENT
The personnel and machinery used to contain fires requires a large financial investment from local, state, and federal governments.

NEED FOR COOPERATION, ORGANIZATION, AND COMMUNICATION
Fire containment requires the cooperation of fire departments, many state and federal agencies, and all citizens in the area. Effective containment requires well-defined organization, training, practice, and a proven system of communication.

SUPPRESSION OPTION REPORT: FIRE CONTAINMENT

FIRE SUPPRESSION EQUIPMENT

TRACTOR-PLOW UNIT

- Suppresses wildland fires in Wisconsin, especially larger fires or smaller intense fires with poor road access
- Back-mounted plow creates a mineral soil firebreak six feet wide and is intended to contain a wildfire and prevent disasters
- The six-way front blade buries burning debris, separates burn piles, constructs roads, and creates firelines
- Carries 150 gallons of water for protection of the operator and mop-up activities to make sure the fire is completely out
- The tractor is equipped with two fire shelters and a shower system used for operator protection

Tractor-plow

TYPE 4 ENGINE (3-TON) (When paired with Tractor-plow Unit, it is a Heavy Unit.)

- Suppresses wildland fires in Wisconsin where road access is poor and the tractor-plow unit is needed
- Hauls the tractor-plow unit on a trailer
- Carries 850 gallons of water
- Uses a pump to apply and draft water from other various sources (i.e., lakes, rivers, and swimming pools)
- Has foam capability, which prevents water from evaporating quickly and is used for structural protection
- The engine is equipped with a mobile radio for communications and is outfitted with handtools and backpack water cans for a 20-person hand crew

Heavy Unit

TYPE 7 ENGINE (4X4)

- Patrols and is responsible for initial attack suppression of wildland fires in Wisconsin
- Primary source of transportation for foresters and forest rangers
- Has four-wheel-drive capabilities
- Has 150-gallon tank capacity and the ability to pump, draft, and apply water or foam
- Has handtools and backpack water cans to outfit a six-person hand crew and is equipped with mobile radio for communicating with dispatch centers and other vehicles

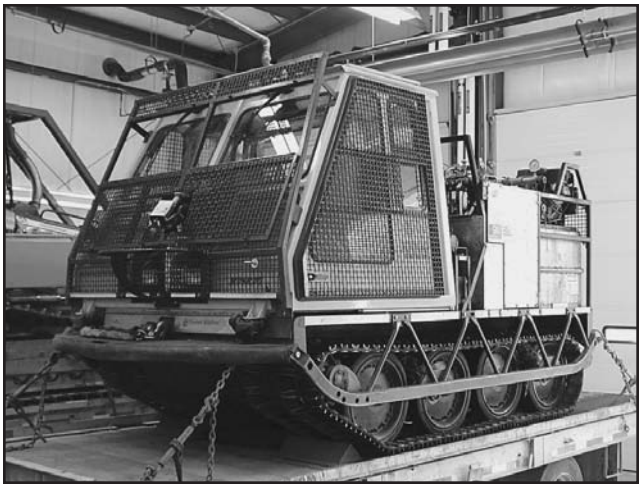
Type 7 Engine

SUPPRESSION OPTION REPORT: FIRE CONTAINMENT

FIRE SUPPRESSION EQUIPMENT

MARSH RIG - MUSKEG LOW GROUND UNIT

- Fights wildland fires in wet-ground situations and extracts stuck firefighting vehicles
- Outfitted with 260-gallon water tank, pump, hosereel, winch, and foam system
- Has powerful three-speed transmission and four-cylinder diesel engine and tops out at 16 m.p.h.
- The tracks supporting the rig are constructed of rubber with steel cross links for grip and durability
- Rides up to four firefighters safely in the partitioned area between the air conditioned cab and water tank



March Rig

SINGLE ENGINE AIR TANKER (SEAT)

- Fights wildland fires from the air and slows the fire until ground units arrive on scene
- Holds one passenger along with 550 gallons of foam, water, or retardant
- Can drop its water mixture to cover 100 feet wide by 400 feet long
- Tops out at 120 m.p.h. with a 58-foot wingspan
- DNR contracts out for SEATs in the spring through private companies. SEAT's are pre-positioned according to fire risk severity

Single Engine Air Tanker

CL-215 PLANE (TANKER)

- Fights wildland fires from the air and slows the fire until ground units arrive on scene
- This plane scoops water from nearby lakes to dump on the fire
- Wisconsin DNR contracts with Minnesota DNR for services of the CL-215s on an as-needed basis

CL-215 Plane

SUPPRESSION OPTION REPORT: STRUCTURAL PROTECTION

PURPOSE

To protect homes and other buildings in the fire path.

STRATEGIES

FIREBREAK CONSTRUCTION

Creating a “break” or “line” involves removing the flammable organic matter found on or near the surface of the ground (e.g., plants, leaves, sticks, and black soil) to expose the mineral soil. Surface fires do not spread in mineral soil. Breaks are constructed around buildings to stop the spread of surface fires that can ignite materials around the foundation. They can be constructed by hand crews using specialized shovels and picks or with heavy equipment such as bulldozers or tractor-plows.

Firebreak Construction

WETTING

The application of water increases moisture levels in fuels. Water is applied directly on structures by aerial drops and heavy trucks. Water can also be used to directly attack approaching fire using fire engines, pumps from nearby water sources, and backpack water cans.

Using A Backpack Water Can

EFFECTIVENESS

FIREWISE BUILDING AND LANDSCAPING

The effectiveness of structural protection depends on how buildings and the surrounding landscape are designed. Buildings that are constructed with fireproof materials like fireproof roofing materials and elevated stone foundations are more likely to be saved. If the area around the house is clear of trees, shrubs, and other flammable materials, firefighters have better access for protection and the fire has less fuel.

HOUSING PATTERNS

Buildings that are spread throughout an area require a lot of resources and time to protect. Fire crews need to find, travel to, and protect each structure individually. Buildings that are grouped in an area can be protected as a single structure. Fire crews can create a single linebreak and focus their efforts on outermost structures.

FIRE BEHAVIOR LIMITATIONS

Crown fires can create flaming debris that travels on air currents causing spot fires. Spot fires on or in a group of structures can make structural protection difficult and dangerous.

SUPPRESSION OPTION REPORT: EVACUATION

PURPOSE

To protect human life in and around the fire area.

STRATEGIES

EVACUATION IN FIRE AREA AND FIRE PATH

The first priority for firefighters is saving human life. In many instances, wildfires have already engulfed or are threatening homes as firefighters arrive on the scene. When firefighters enter an area they move from home to home evacuating people. Evacuation is often difficult since people do not want to leave their possessions.

Evacuation Personnel

EVACUATION SHELTER

Fire evacuation requires that an area be designated and maintained to supply evacuees with food, shelter, and information. The shelter is often the area where officials communicate with local residents and the news media.

Evacuation Shelter

SECURING FIRE PERIMETER

To ensure the safety of local residents, news media, and sightseers, the fire perimeter needs to be secured. Local and state police often post officers at all entry roads into a fire area. They ensure that no one enters and directs them to information sources if they are looking for family members or have other needs.

Securing A Fire Perimeter

EFFECTIVENESS

HOUSING PATTERNS

Evacuation can be very difficult if homes are remote and have only one access road. As fires cut off access and escape routes, people can become stranded.

PLANNING AND COMMUNICATION

The effectiveness of evacuation is dependent on a well-defined plan and the ability to communicate between agencies, with residents, and with the news media.

FIRE BEHAVIOR LIMITATIONS

Firefighters cannot enter areas of extreme fire behavior such as crown fires. Firefighters must make life-or-death decisions during extreme fires, making sure that they protect their own lives.

SUPPRESSION OPTION REPORT FORM

Suppression Option:_____

Purpose:_____

Notes on Strategies:_____

Notes on Effectiveness:_____

SUMMARY OF COTTONVILLE FIRE CONTAINMENT

EVACUATION

The number one concern of both fire and law enforcement personnel is the protection of life, including the evacuation of people in the projected path of the fire. Several fire control and law enforcement personnel noted that in the beginning stages of this fire they were in a race with the oncoming flames to evacuate people from harm's way. If a higher percentage of the residences has been occupied at the time of the fire, the challenge would have been even greater, and the resources involved in evacuation may have been overwhelmed.

FIRE CONTAINMENT

The ground-based wildland fire suppression effort primarily focused on the sides of the fire area using tractor-plow units. Several resources followed to hold the line, making sure the fire did not return to an area it had already burned. Fire line construction groups were formed to create the initial line along both the left and right sides of the fire. Divisions were formed behind the groups to hold, reinforce, and mop-up the fire perimeter. Firefighters encountered intense fire behavior which included rapid spreading with crowning and spotting.

On both sides of the fire, the first two or three tractor-plows were used to create furrows. The tractor-plows following those created a gap in the tree canopy and an area for vehicles to drive. Line construction rates along the right side started out at 5,940 feet per hour, but slowed to about half that due to fuel types and fire behavior conditions. The tractor-plows needed to stop to catch breakout and spot fires a number of times. At one point, the entire right side group was diverted to plow around a 10-acre spot fire.

The most extensive use of aircraft in Wisconsin forest fire history occurred on the Cottonville fire. Initial aerial resources consisted of a DNR fixed-wing aircraft operating as air attack manager. Two Single Engine Air Tankers (SEAT) and a CL-215 air tanker from Minnesota were ordered within the first hour of the fire. Response time for the CL-215 was two hours. The air-attack manager provided direction for SEAT drops, giving intelligence information to initial attack ground forces, and acting as a lookout for resources assigned to the left and right sides of the fire. Initial drops from the planes were directed on the head of the fire but were ineffective. Thereafter, drops were used for support along the sides of the fire and for structural protection. As the fire intensity decreased late in the day, the CL-215 was utilized to support ground resources to slow and control the head of the fire. The fire was contained during the evening after making a run of seven miles and was up to one-and-one-half miles wide through very flammable pine forests.

STRUCTURAL PROTECTION

Local fire departments provided important protection to residences and outbuildings. More than 100 residences in a subdivision two-and-one-half to three miles downwind of the fire were given high consideration when fire department resources were deployed. Geography, a wind shift, and suppression efforts helped protect this subdivision. During the second and third hour of the fire, it grew in size and progressed into more residential areas. Wildland fire pre-suppression training and a mock fire exercise provided the structural fire team experience and confidence in their role.

LOCAL NEWSPAPER REPORTS

Fire Sweeps Through Big Flats; Largest in Wisconsin in 25 Years

By Renee Stevens & Affy Tabrizi, Adams County Times & Friendship Reporter

May 11, 2005

Nine families were left homeless last week, following a devastating forest fire deemed the largest blaze in Wisconsin in the last 25 years. Before it ended, the flames consumed 3,410 acres, mostly in the Town of Big Flats, in a 1-1/2 mile wide by seven-mile long path of destruction that began at south Chicago Court and extended past Beaver Avenue.

Aside from the 13 primary residences lost, 21 seasonal homes and 60 outbuildings were destroyed. Another 15 residences sustained damage. No dollar amount in damages has been determined yet. A rough estimate on the primary home loss, calculated by the Red Cross is approximately $700,000. This does not include the loss of seasonal homes, outbuildings, timber, or damage to other structures. Nor does it include the costs to fight the blaze, which also hasn't been determined yet. These figures are expected to reach "into the millions."

If there is a "good" side to the tragedy, it's that there were no deaths or injuries reported, aside from one firefighter who suffered from dehydration and another who suffered a minor eye injury. Thanks to the incredible response from local and other community emergency personnel 300 homes were saved as well.

Ironically, the fire began in what was meant to be a controlled burn in an effort to make a landowner's property safe for a campfire that evening. Originating in the 900 block of south Chicago Court, the fire was reported out of control around 1:45 p.m. on Thursday, May 5. Fire conditions that afternoon were "Very High" and 10-15 mph winds rapidly drove the flames to the northeast.

A total of 177 firefighters from 20 fire departments responded, including Big Flats, Adams, Friendship, Strongs Prairie, New Chester, Quincy, Rome, Plover, Nekoosa, Rudolph, Pittsville, Town of Grand Rapids, Plainfield, Necedah, Port Edwards and Bancroft. The fire departments focused on protecting structures, while personnel from DNR units in Friendship, Babcock, Poynette, Nekoosa, Waupaca, Necedah, Wisconsin Dells and Whiting concentrated on the forestland. Also joining the teams were a group from U.S. Fish and Wildlife Service and a group from the University of Wisconsin - Stevens Point, plus additional units from as far away as Winter, Wisconsin (in Sawyer Co). Law enforcement personnel from Adams and Waushara Counties, along with the DNR and State Patrol were on duty as well.

With the rapid spread of the fire endangering everything in the path, 125 families were evacuated on Thursday. A command center was set up at the Big Flats Fire Department and a shelter was established at the Pineland Elementary School. Evacuees had only minutes to gather what they could carry and leave their homes. Many had to leave behind pets and other valuable personal items.

Firefighters worked throughout the afternoon Thursday, and into the night. DNR personnel and private contractors used bulldozers to create firebreaks while five planes (one from Minnesota) flew over the area with foam, water and fire retardant material. Dry conditions and wind made it difficult to contain the fire, which was designated both a "running ground fire" and a "crown fire," meaning the flames moved quickly across the ground and from tree top to tree top.

Despite its massive force, however, an amazing and tireless collaboration of all the responding teams helped contain the blaze by 12:30 a.m. Friday. Although it was contained (not spreading further), the flames weren't out until Friday morning. Even then, there were still hotspots that kept personnel patrolling the area until 8 p.m. Sunday evening. Residents were allowed brief visits to their property on Friday, then met with assessors Friday afternoon. By Saturday, all road blocks were lifted and people were allowed back into the area without passes. Nearly 300 Adams-Columbia Electric Co-op customers lost electricity with 25-30 miles of electric line affected. Power was restored to all the 100 of the homes that survived the blaze by noon Friday, with the bulk of the rest restored by Friday evening. ■

Mock fire scheduled in Adams County Sept. 8

Adams County Times & Friendship Reporter

September 5, 2001

A Mock Fire, designed to help fire departments, Emergency Government and Wisconsin Department of Natural Resources (DNR) to dress rehearse for a fire disaster, will start at 8 a.m. Saturday, Sept. 8, at the Big Flats Fire Department/Town Hall, 1004 County Highway C, Adams County.

Jim Barnier, Wisconsin Rapids, fire management officer for the DNR in Wisconsin Rapids, said that the exercise will help the DNR units and local fire fighters improve their coordination on major forest fires. The session will involve several area fire departments, Adam's County sheriff's officers, the Wisconsin State Patrol, DNR wardens, Volk Field ANG, Red Cross, Salvation Army, and amateur radio operators. ■

LOCAL NEWSPAPER REPORTS

Officials Thankful for Overwhelming Support

Adams County Times & Friendship Reporter

May 11, 2005

Big Flats Fire Chief Dick Meyers was the "Structural Branch Fire Boss" for the incident. He said he was overwhelmed with the outpouring of help the crews received, not only from the assisting DNR and fire department personnel, but from very important people behind the scenes, as well. Jane Grabarski and law enforcement personnel helped coordinate the shelter and relief effort, and the many volunteers who worked around the clock to see that firefighters and evacuees had hot meals and plenty of refreshments. Area businesses and residents donated the food and beverages that helped keep firefighters and victims sustained, he said, "And that was greatly appreciated."

"I want to figure out a way to thank each and every one of these people personally," he said. "It's not just the firefighters who did all the work. It was a lot of people working together."

Meyers also commented on the incredible safety record of the teams. "To have this big of a fire and come out of it with no deaths or serious injuries is phenomenal," he marveled, adding that the firefighter who was treated for dehydration was doing fine now. One other firefighter was also treated for a minor eye injury, he said.

However, there was a point during the fire where he feared a major loss of personnel. He recalls seeing 60' high flames at one point near 9th Avenue and County C. He said they had sent the New Chester Fire Crew into the area, then saw the fire coming from the south toward County C. They realized the firefighters were surrounded by flames and thought they had lost them, he said. Fortunately, the New Chester team emerged, blackened by smoke, but physically fine.

One of the things Meyers thought helped immensely was the fact that the department did a training in the exact area of the fire in September 2001. The path of the training was almost identical to that of the fire, he said, and was a "tremendous asset."

Even though the fire is out, Meyers commented that "it's not over." For the victims, it's just beginning, he said, commenting on the range of emotions experienced after such a trauma.

"You never know when it will surface," he said. "At times I went from extreme confidence in our ability to fight the fire, to being extremely overwhelmed by it all. I was affected by the tornado that hit Big Flats 10 years ago, so I understand the loss these people are feeling."

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Other officials who commented included Governor Jim Doyle, who toured the area by helicopter on Friday. "People came together to get this job done," he said, commenting on how "remarkable and resilient" the people in the area are and thanking the firefighters and emergency personnel for their extraordinary efforts.

Doyle, who declared a State of Emergency for Adams County, promised that the State will work closely with the families to help them recover financially. The Department of Commerce will make emergency funds available to low and moderate-income victims and funding will be available to repair any damaged government structures. The Wisconsin Housing and Economic Development Authority will provide funding for temporary housing assistance and the Department of Health and Family Services has been working with local health officials, providing safety and health information as well as tetanus vaccines. They will continue to coordinate with the Adams County Health Department for as long as necessary, Doyle said in a news release.

"It is up to us as representatives of the residents of Big Flats to find all available financial assistance. This is the worst forest fire to hit Wisconsin in more than 25 years and we must assist the victims in any way possible," State Senator Julie Lassa said.

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Among local officials, Adams County Chief Deputy Alex Bebris said, "The evacuation went well. There were no injuries," adding his thanks to law enforcement from Juneau, Wood, Marquette, Waushara and La Crosse Counties, Verona, Onalaska and the City of La Crosse. Sheriff Roberta Sindelar also added her thanks to everyone who assisted in any way.

DNR Operations Chief John Schwingel commented, "This is the worst fire ever in Adams County." He said the DNR will continue to help keep the public informed about fire safety, especially landowners. ■

LOCAL NEWSPAPER REPORTS WORKSHEET

Name_____

Read the newspaper articles and answer the following questions:

1. What is a mock fire?_____
2. What does DNR stand for?_____
3. How many families were homeless?_____
4. How many acres did the fire burn?_____
5. What are the dimensions of the area burned by the fire?_____
6. Where was the fire located?_____
7. How many primary residences were lost?_____
8. What was the cash value of the primary residences?_____
9. Were there any deaths or injuries? Why?_____
10. How many homes were saved?_____
11. Was this supposed to be a controlled burn?_____
12. What was the wind speed at the time of the fire?_____
13. How many fire departments were involved?_____
14. What equipment was used?_____
15. What happened to the electricity in the area?_____
16. Quote one person being interviewed, and name that person._____

POST-FIRE DILEMMAS

RECREATIONAL LANDOWNER
Your 20 acres of land and seasonal cabin have been burned by the fire. You used the land for hunting and vacationing with your family. Approximately 90 percent of the trees on your land are dead or will die because of the fire. Your cabin was insured and you received $50,000 as a settlement. You are pretty sure that your trees are worthless but you haven't looked into it. Your land looks black, charred, and devastated. *What do you do?*

LOCAL HOMEOWNER
Your home was destroyed by the fire. Most of your 10 acres of forest survived. Your house was paid off, but it was not insured. You will not get any money from the insurance company. You do not have enough money to build another house. *What do you do?*

FAMILY TREE FARM
Your father started a tree farm 60 years ago. You managed it with him since you were young. After he passed away, you took control of the farm and invested most of your money in it. You planted thousands of trees, restored wildlife habitat, and have local school groups visit your property every year. You were just about to harvest some of the trees when the fire came through. You lost your trees and the money and time you invested in them. *What do you do?*

INDUSTRIAL LANDOWNER
Your paper mill owns 10,000 acres of red pine plantation. The trees on your property are 50 years old and the forests were ready to be thinned. You would have recovered much of your investment by using the small trees for paper pulp. Before you could conduct the thinning, a wildfire burned through the plantation. The paper mills cannot use trees with any ash on them. *What do you do?*

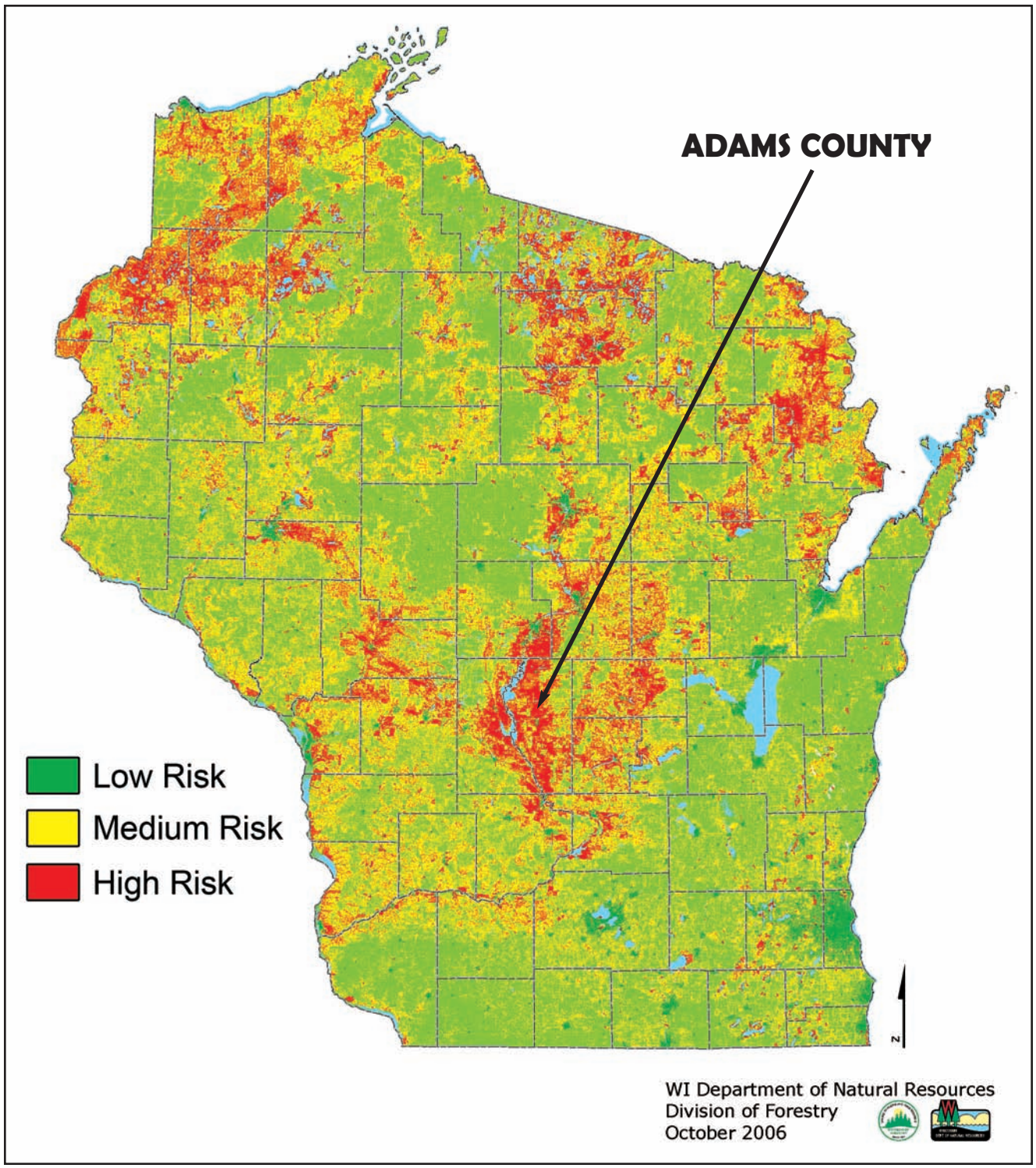
THE FIRE STARTER
You remember it clearly. It was early in the year and you made your first trip to your summer cabin. You got a burning permit and started burning debris in your fire pit at noon (the permit said to wait until 6:00 p.m.). Sparks started some grass on fire and in a matter of moments the fire was out of your control. By the next day, the fire was put out seven miles away and it had destroyed thousands of acres of land. You know it was your fault. *What do you do?*

WISCONSIN DEPARTMENT OF NATURAL RESOURCES
Your responsibilities have been growing but your budget has not. You have had to cut jobs over the last few years, and the public is critical of your work. The Cottonville Fire cost you money. People recognize that you did a great job fighting the fire, but that doesn't immediately help cover the costs. People think that they already pay too many taxes, and that is where your budget comes from. *What do you do?*

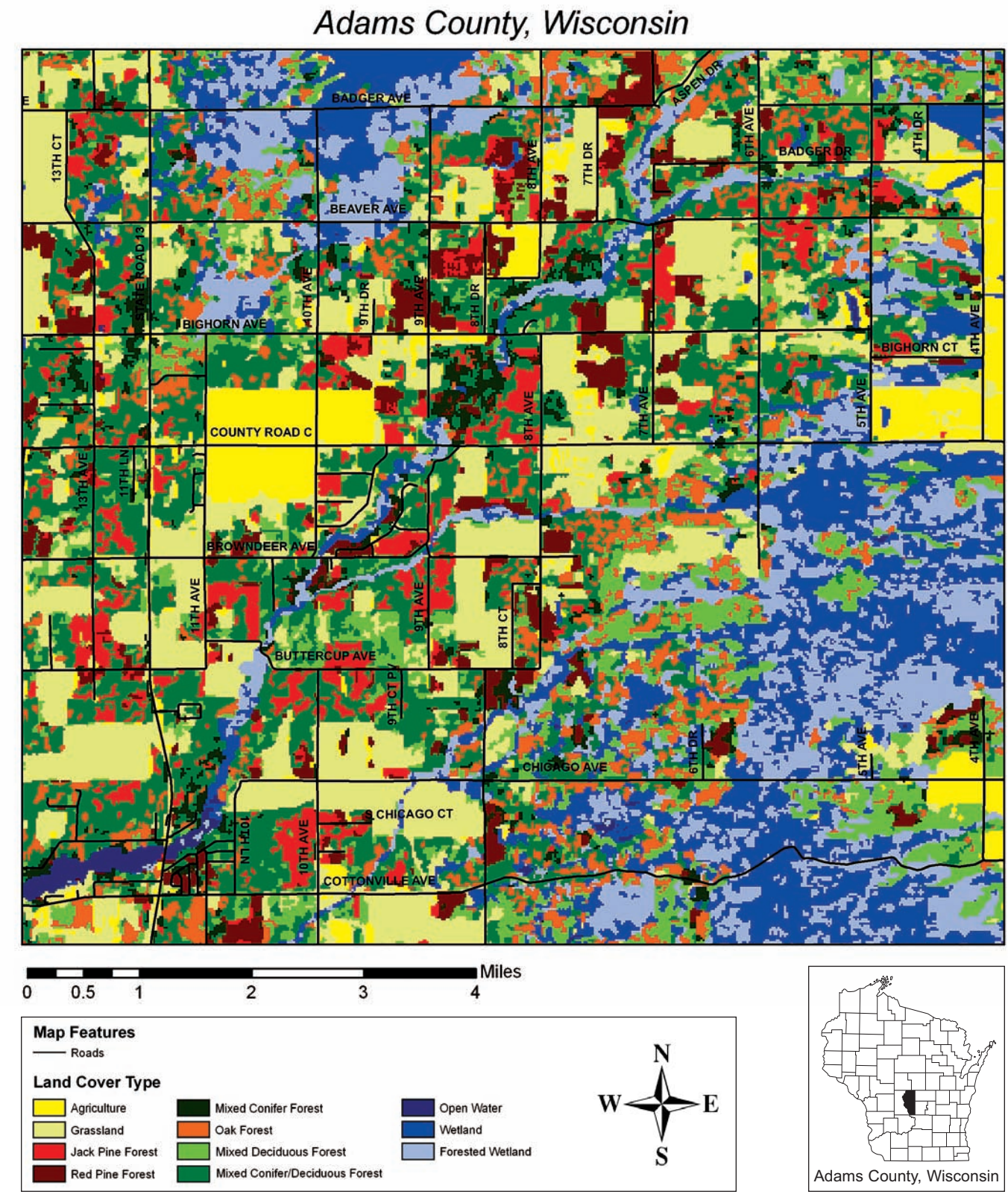
NEARBY SUBDIVISION
You know that it could have been you who was affected by the fire. If the fire had moved to the northwest, your subdivision would have been destroyed. You can't imagine the damage that would have been done. The houses are big and expensive and they are in the same type of forest that burned to the south. *What do you do?*

WISCONSIN LANDOWNER
You saw the fire on the news. It looked terrible. There were pictures on television of the damage that was done to the forests and people's property. You live in the woods. Their houses look like yours. *What do you do?*

WISCONSIN FIRE PRONE AREAS



AREA COVER TYPES



WILDLAND FIRE BACKGROUND

DEFINING WILDLAND FIRE

THE TWO SIDES OF WILDLAND FIRE

Wildland fire includes two types of fire – wildfire and prescribed fire. Wisconsin **wildfires** can start through human causes such as debris burning or arson, or through natural causes such as lightning. Naturally caused wildfires are somewhat rare in Wisconsin, with most wildfires resulting from human activities. Wildfires can take lives, destroy homes and property, and leave charred landscapes. Although not planned by the landowner, wildfire can also have positive effects by helping to maintain fire dependent ecosystems.

Prescribed fires are used to mimic ecological or "natural" fires that have been part of ecosystems throughout history. Prescribed fires are ignited and controlled by land managers. When used safely and correctly they produce outcomes desired by landowners. The outcomes can include such things as restoring animal habitat, reducing fuels to prevent dangerous wildfires, and controlling pests and diseases.

COMBUSTION

Combustion is the act of burning and is a form of oxidation. Oxidation occurs when oxygen is combined with another substance. The rusting of iron ($2Fe + 3O_2 = Fe_2O_3$ + energy) is an example of oxidation. The combustion of gasoline ($2C_8H_{18} + 25O_2 = 16CO_2 + 18H_2O$ + energy) is also oxidation. As you can see in the equation, the combustion of gasoline releases energy. The energy is released from the breaking of the carbon-hydrogen bonds that hold organic compounds together. The energy released is the heat we feel when a fire burns.

Combustion can also be viewed as the opposite of photosynthesis. In photosynthesis, plants create energy from sunlight by combining water and carbon dioxide to make sugar and oxygen ($6CO_2 + 6H_2O = 6H_{12}O_6 + 6O_2$). In combustion, the sugars are broken down. The energy is released as heat, and CO_2 and H_2O are the major components of smoke.

It is important to keep in mind that this is a very simple understanding of combustion and that thousands of chemical reactions are taking place during a wildland fire. But, put simply, the heat from a fire can be seen as the same energy that plants took from the sun. Photosynthesis and combustion (as well as respiration) are the major parts of the carbon cycle – a cycle essential to all life on earth.

THE FIRE TRIANGLE

Fire behavior can be defined as the manner in which fire reacts to the environment. For fire to ignite and spread, three elements must be present – heat, fuel, and oxygen. There must be heat to start and continue the combustion process, fuel to burn, and oxygen to facilitate combustion. The three elements can be seen as sides of the fire triangle. If any one of the sides is removed, the fire will extinguish.

HEAT TRANSFER

For fire to spread, heat must move from one piece of burning fuel to another. This movement is called **heat transfer**. Heat is transferred by **radiation**, **convection**, and **conduction**. Radiant heat is heat that travels in a wave. It is the heat that warms you as you sit near a campfire or a warm stove. Convection heat is heat that moves as heated air or gas. It is the heat that rises off of a campfire or above a boiling pot of water. Conduction is heat that moves through a material. Think of a metal spoon as it comes out of a hot cup of tea. Each type of heat transfer can warm, dry, and ignite fuels.

FUEL CHARACTERISTICS

Fuel characteristics determine how intense a wildland fire burns and how far it spreads. These characteristics include the type of fuel, its chemistry, size, and shape. The quantity of fuel and the way it is arranged also influence fire behavior.

Examples of fuel include trees and tree litter, grass, shrubs, and logging slash. Light fuels, such as grass, burn very fast and hot, while heavy fuels, such as logging slash, burn for long periods of time. Light fuels dry much faster. Their moisture varies throughout the day as temperature, humidity, and wind speed changes. Often the fire danger increases during the day and decreases as night approaches.

Often, the most dangerous characteristic of fuel can be the arrangement. Fire can occur as **ground fire** (burning organic material in the soil), as **surface fire** (burning the fuels found directly on the surface of the earth), and as **crown fire** (fire that moves through the tops of trees). Fuels that reach from the ground to the crowns of trees are called **ladder fuels**. Ladder fuels can cause fire to escalate from a surface fire to a crown fire. When fire enters the crowns of trees, it becomes very dangerous and uncontrollable.

WEATHER AND TOPOGRAPHY

Weather and topography are major influences on fire behavior. Weather is constantly changing because of local, regional, and continental influences – making it difficult to predict fire behavior. Weather influences can dry fuels and cause fire to spread. The three most common weather characteristics that determine when fire danger is high are moisture in the air, temperature, and wind. As precipitation and humidity decrease, fuels become more susceptible to fire. High temperatures and winds can quickly dry fuels and feed flames.

Fuel arrangement and weather patterns are influenced by topography. The landscape can influence which fuels get direct sunlight, which fuels receive more moisture from rainfall, and which areas have more exposure to wind. Landscape features can also channel wind currents, causing extreme changes in fire behavior. Heat travels upward and can preheat and ignite fuels, causing fire to move very quickly up slopes.

EXTREME FIRE BEHAVIOR

Extreme fire behavior creates very dangerous fire situations. It can lead to wildfires that may be unpredictable and uncontrollable. Extreme fire behaviors include torching, crowning, and spotting. **Torching** occurs when a surface fire ignites the crowns of individual trees and shrubs as it advances. This type of fire is spread by an advancing surface fire. **Crowning** occurs when a fire moves into the crowns of trees. **Spotting** occurs as fires produce sparks or embers that are carried away from the fire by convection or wind currents. Spots occur as new fires start outside of the original fire area, usually ahead of the advancing fire.

THE FIRE SEASON

In Wisconsin, most dangerous wildfires occur during the months of March, April, and May. This time of year, known as the **fire season**, is especially dangerous because much of the landscape is absent of living plants, and trees have not yet grown leaves. Green plant material helps maintain moisture levels on the ground, in the shrub layer, and in the forest canopy. Without green plants, dry climate conditions, winds, and increasing temperatures can quickly dry plant material found in grassy and forested areas, creating dangerous fire conditions.

Spring is not the only time of year people in Wisconsin need to be cautious of wildfire. Dry spells throughout summer and fall can also lead to dangerous fire situations. Dangerous fire situations occur when **relative humidity** is low, winds are strong and/or constant, temperatures are high, and fuels are readily available to burn. Fire conditions are constantly monitored by the U.S. Forest Service and the Wisconsin Department of Natural Resources - Division of Forestry. (At the time of printing, the following websites contained up-to-date information on fire conditions – *http://activefiremaps.fs.fed.us* and *www.dnr.state.wi.us/org/land/forestry/Fire/index.htm*.)

FIRE ECOLOGY

Wildland fire harms some species and benefits others, while some species remain unaffected. The interaction between fire and different species causes short and long-term changes in ecosystem functions, forest structure, and ecosystem composition.

Wildland fire influences **ecosystem functions**. Ecosystem functions support life. They include the fixation of energy, the flow of energy through food webs, and the cycling of matter. A very hot fire can remove seed sources and sterilize soil. In such cases, it may take years for a forest to return. A wildland fire that is less extreme can mineralize (decompose) organic material such as leaves, sticks, and logs very quickly – making nutrients available to plants. The process of decomposition that normally occurs on the forest floor can take years, and even decades, without wildland fire. Wildland fire can clear forest trees, shrubs, and other organic material. This increases sunlight penetration and stimulates plant growth, fixing energy into an ecosystem through photosynthesis.

New plant growth after wildland fire provides food to many types of animals. Food webs can be dramatically altered by wildland fire.

Wildland fire changes **forest structure**. Forest structure is the vertical and horizontal spacing of trees in a forest. Vertical layers are the overstory and the understory. Horizontal spacing is the density of tree cover across the landscape. The overstory consists of the largest trees in the forest that capture direct sunlight. The understory consists of smaller trees, shrubs, and herbaceous plants. Below the understory is the leaf litter and the topmost, organic-rich soil layer known as duff. All aspects of forest structure can be altered by wildland fire. For example, over time, fire could change a dense mixed hardwood forest into an oak savanna with widely spaced trees and a grassy understory.

Wildland fire changes the **composition** of an ecosystem. The type and distribution of plants and animals in an area is altered by wildland fire. Many plants cannot survive wildland fire. Maple species are a good examples of plants that cannot survive fire. Plants can also be resistant or resilient to wildland fire. A good example of a resistant plant is a large oak tree. The thick bark on an oak tree protects the living **cambium** from fire's heat. When many other trees and plants die in a wildland fire, large oak trees will remain. Another good example of a resilient plant is a jack pine tree. Wildland fires often destroy entire jack pine stands. Individual jack pine trees cannot survive the heat of a wildland fire. However, jack pine cones open and release seeds during periods of high heat ensuring that jack pine trees will recolonize after a fire.

In general, wildland fire in Wisconsin influences ecosystems in predictable ways. The following summaries of ecosystem responses to fire apply to ecosystems in Wisconsin that are fire dependent and fire tolerant. Though there are often exceptions, the summaries are very useful for understanding the ecological role of fire.

FIRE EFFECTS ON VEGETATION

- Increase in species diversity.
- Increase in biomass production.
- Short-term increase in annual and biennial species.
- Increase in flower, seed, fruit, or nut production.
- Improved forage quality, both in nutrition and palatability.
- Long-term shift in dominance away from plants with most of their biomass above ground to plants with most of their biomass below ground.

FIRE EFFECTS ON ANIMALS

- Initial drop in numbers and species resulting from mortality among invertebrates, reptiles, and small mammals.
- Eventual increase in animal numbers and species resulting from the increase of plant productivity and improved habitat structure.
- Should a species be totally removed or driven out from a site after a fire, it will recover only if individuals from another site are close enough to recolonize it.

FIRE EFFECTS ON SOIL

- Reduction in litter, duff, and humus layers above the mineral soil surface, resulting in warmer soil temperatures.
- Increase in fertility and organic matter within the mineral soil resulting from increased plant root and soil microorganism activity.

WISCONSIN FIRE DEPENDENT ECOSYSTEMS

Fire has been an important part of forest and grassland ecosystems in central and eastern North America for 25 to 30 million years. Many plants and animals have adapted to survive and flourish after wildland fires. For the past five to six thousand years, half the state of Wisconsin has been covered by fire dependent and fire tolerant ecosystems such as prairies, sedge meadows, oak savannas, and pine barrens. Periodic distributed fire has created a mosaic of ecosystems across the landscape – with some ecosystems isolated from wildland fire and others periodically exposed. Wisconsin's ecosystem diversity depends on the periodic occurrence of wildland fire. For more information on specific Wisconsin fire dependent ecosystems, see the LEAF website fire section at *www.leafprogram.org*.

WILDLAND FIRE AND SOCIETY

HUMANS AND FIRE

For wildfires to occur, a source of ignition is needed. In Wisconsin, human activities cause the majority of wildfire ignitions. On average, 97 percent of wildfires each year in Wisconsin are caused by humans. Outdoor burning, sparks from railroads, machinery, and many individual and group activities that occur in rural, forested or grassland areas can cause accidental wildfires. Often these activities involve fireworks, campfires, off-road vehicles, and use of gas-powered tools such as lawnmowers and chain saws. In some instances, wildfires are caused by natural sources such as lightning and microbial activity.

FIRE REGIMES

Regions in Wisconsin differ in **climate**, **topography**, **land cover**, **land use**, and land use history. These differences create distinct fire regimes. A **fire regime** is a cultural and biological system that defines the distribution, intensity, and frequency of fires in a given area. As suggested by the definition, there are two components to a fire regime – human activity and natural processes.

Both human and natural influences change over time. Forest **succession** and **climate change** are examples of natural processes that cause changes on the landscape over time. **Species introduction** and **land conversion** are examples of human activities that cause change.

The relationship between humans and the landscape is complex. It is well understood that today's human activities will influence future fire regimes. We are currently living in fire regimes shaped by the activities of human populations that came before us. An understanding of fire regimes, including both natural and human history, is necessary to manage ecosystems and to reduce the risk of catastrophic fire.

WISCONSIN'S HUMAN FIRE HISTORY

After the recession of the last glaciers, approximately 10,000 years ago, Native American populations migrated into Wisconsin. By the late 1400s, Wisconsin's native population was estimated at 60,000 people. Native people used fire to corral and hunt animals, to create animal habitat, and to clear areas for agriculture. These fires played a partial role in influencing Wisconsin's land cover. In the south, these fires expanded grasslands, prairies, and savannas. In the north, the many small fires cleared trees and shrubs, making way for sun-loving trees and plants. This expanded the patchwork of tree stands with different ages, structures, and compositions that were common across northern Wisconsin.

As European settlers moved to Wisconsin, they began to log, farm, and build towns. The widespread logging in the north and the conversion of the prairies in the south changed the fire regimes. In the north, many small fires were allowed to burn by populations who felt that as long as the fires weren't near their homes, they were only helping clear more farmland. On occasion, the small fires turned into large, intense fires fueled by the dead trees and slash left behind after logging. The extent and intensity of the fires was much greater than the fires started by Native American populations.

The most significant fire in Wisconsin's history was the Peshtigo Fire of 1871 that burned in Wisconsin and Michigan. The fire killed as many as 1,500 people and burned 1.5 million acres. In 1887, a wildfire nearly wiped out the city of Marshfield. In 1894, the Comstock Fire burned 64,000 acres in Barron and Washburn Counties, and the Phillips Fire burned 100,000 acres in Price County. Many other larger fires ravaged the state during this time, but the only documentation is in survey notes, personal journals, and newspaper clippings. Prior to 1930, it is estimated that some 2,500 fires burned half-a-million acres each year.

In the southern part of Wisconsin, the occurrence of fire was reduced due to agriculture. The conversion of land to agriculture and the decrease in fire reduced habitat for many of the large animals that lived in southern Wisconsin at the time. Bison, elk, and cougar that depended on the grasslands, prairies, and savannas were **extirpated** from the landscape.

With the hiring of E. M. Griffith as superintendent of forestry in Wisconsin in 1904, fire control efforts began in earnest. In 1905, Griffith appointed 249 town fire wardens around the state. Over the next 50 years, federal and state agencies, as well as county governments, developed the infrastructure for statewide fire control. A cooperative system of fire towers, radio communications, chartered aircraft, plows, tankers, and paid and volunteer fire fighters was put into place. Through the 1920s, 1930s, and 1940s, fire control efforts gained another powerful tool – fire prevention. In 1944, scattered prevention efforts were unified and nationalized with the use of Smokey Bear. His story and message helped fire prevention and control efforts become more effective.

Today, it is accepted that the effectiveness of fire prevention and suppression has had an impact on forest and grassland ecosystems that depend on fire to maintain their existence. Forest and grassland ecosystems that depend on fire have been severely reduced in size. Periodic fire thins many forests by clearing small trees and shrubs. In the absence of fire, some forests have grown thick with small trees that can fuel very intense wildfires.

In recent years, forest management has proven to be an effective way to reduce fuel buildup and decrease the risk of catastrophic fire. Prescribed fire has been shown to be a safe way to reduce fuel buildup as well as manage fire dependent ecosystems. The safe and correct use of prescribed fire and forest management is increasing, but their benefits are often unknown or misunderstood by the public.

THE COTTONVILLE FIRE

On May 5, 2005, Wisconsin's largest wildland fire in 25 years burned in Adams County, Wisconsin. Since 1932, there have been 41 major fires in the Adams County area. Jack and red pine cover much of this area and are extremely flammable during low moisture periods. Ignition of the fire was started by a human who was burning debris during a dry, warm, and windy day. The fire escaped his control and spread for 11 hours. The fire burned 3,410 acres, 30 homes, 60 outbuildings, and millions of dollars worth of timber. Suppression costs of the fire alone cost more than $287,000. This fire may have been avoided if the individual had followed the guidelines listed on the burning permit he was issued.

WILDLAND FIRE MANAGEMENT

AGENCIES RESPONSIBLE

In Wisconsin, wildland fire management is achieved through cooperation among Wisconsin citizens and municipal, county, state, and federal agencies. The cooperation of local police and fire departments with state and national agencies is essential to wildfire control. In Wisconsin, local fire departments, the Wisconsin Department of Natural Resources, the U.S. Forest Service, the U.S. Fish and Wildlife Service, and agencies from neighboring states all cooperate to manage wildland fire. All these agencies depend on funding from local, state, and federal taxes.

Wildland fire management uses the principles of fire behavior and an understanding of human fire practices to eliminate unwanted fires and promote beneficial ones. The goal of wildland fire management can be cultural (e.g., to protect historic sites from wildfire), ecological (e.g., to use controlled fire to maintain animal habitat), and economic (e.g., to protect property).

WILDFIRE PREVENTION

Wildfire prevention is a strategy used to reduce damage from fire through education, engineering, and enforcement methods. These fundamental steps help prevent accidental ignitions and reduce fire **risks** and **hazards**.

For more than 50 years, Smokey Bear has been at the forefront of wildfire education. Though the Smokey Bear prevention programs are the most visible, many other fire prevention programs exist for K-12 students. A variety of state and national agencies have developed educational materials that advance fire safety messages, help students understand fire ecology, promote the benefits of prescribed fire, and advertise career opportunities in wildland fire management.

It is important that both children and adults understand that outdoor fires can ignite and spread very rapidly. Throughout Wisconsin's history, many destructive fires were started accidentally and grew quickly beyond the control of citizens and sometimes even firefighters. The Cottonville Fire in May of 2005 is a modern example of an accidental ignition, attempted control by a landowner, and a fire that grew rapidly out of control.

Education and engineering methods are used in tandem to protect communities from the risks of wildfire. The Firewise Communities program has been very successful in educating homeowners about the proper location, construction, and landscaping of homes to reduce the risks of wildland fire.

The state of Wisconsin enforces forest fire regulations and restrictions. The regulations make the following activities unlawful:

- Burning without a permit, if required
- Burning materials other than wood, leaves, brush, grass, cardboard, and dry paper
- Failure to extinguish fires
- Allowing fire to escape
- Arson
- Destruction of property
- Negligent handling of burning material

Burning debris is the number one cause of accidental fire in Wisconsin. Burning permits are required in many parts of the state to conduct outdoor burning. Burning permits are free and can be obtained by contacting a local DNR office, emergency fire warden, or local fire official.

WILDFIRE SUPPRESSION

Wildfire suppression involves both **presuppression** activities and the active **suppression** of unwanted fire. Without presuppression preparation, the control of wildfire can be difficult or impossible.

Presuppression activities are conducted to reduce wildfire risk and prepare fire suppression forces. Presuppression activities include the construction and maintenance of roads, airports, and water infrastructure, the training of fire suppression teams, the management of fire prone forests, and the development and testing of suppression equipment.

When a wildfire occurs, fire suppression forces act to protect human life, property, and natural resources – in that order of priority. To accomplish these goals, fire suppression teams use three main strategies – evacuation, fire containment, and structural protection.

Evacuation is conducted to protect human life in and around a fire area. The first evacuation priority is to evacuate people from the fire area and fire path. In many instances wildfires have already engulfed or are threatening homes as firefighters arrive on the scene. Evacuation is often difficult because people do not want to leave their possessions. Fire evacuation requires that an area be designated and maintained to supply evacuees with food, shelter, and information. The shelter is often the area where officials communicate with local residents. To ensure the safety of local residents, news media, and sightseers, the fire perimeter needs to be secured. Local and state police often post officers at all entry roads into a fire area.

As evacuation efforts begin, an incident command center is established to coordinate fire suppression resources and provide information to the news media. Fire suppression teams then plan and initiate fire containment strategies to slow and stop the spread of wildfire. In Wisconsin, a widely used fire containment strategy is fuelbreak construction. Creating a “fuelbreak” or “fireline” involves removing the flammable organic matter found on or near the surface of the ground (e.g., plants, leaves, sticks, and black soil) to expose the mineral soil. Surface fires do not spread in mineral soil. Breaks are constructed to contain the lateral spread of fire. They can be constructed by crews using specialized hand tools or with heavy equipment.

Fire containment also involves the use of water and fuel reduction. The application of water reduces fuel temperatures and limits the oxygen available to a fire. Water can be applied on or in front of the fire using aircraft, heavy trucks, pumps from nearby water sources, and backpack water cans. Removing fuels in front of a fire reduces the fire intensity and improves the effectiveness of water use and line construction.

Fuels can be removed by clearing vegetation, but are also removed by lighting surface fires in the wildfire path. The fires burn away much of the ground level fuel, and when lit correctly, can deprive the wildfire of oxygen.

In tandem with evacuation, fire suppression crews protect structures, placing priority on homes and other buildings that have adequate defensible space. Suppression crews create breaks around structures and apply water from aerial drops by airplanes, heavy trucks, or local water sources. The effectiveness of structural protection depends on building and landscape design, housing patterns, and the intensity and behavior of the fire.

PRESCRIBED FIRE

Prescribed fire is an effective management tool that land managers can use to manipulate vegetation. Fire can be used to create and maintain animal habitat and reduce the risk of wildfire from an overabundance of fuels.

Prescribed fire is essential to the health of many Wisconsin ecosystems. For the 5,000 years prior to European settlement, half the state was covered by fire dependent ecosystems. Today, though, there is a higher frequency of fires and the size of the fires is much smaller, averaging about 10 acres in size. Wisconsin's pre-European history was characterized by infrequent, but very large fires (often greater than 10,000 acres). The large fires sustained ecosystems such as prairies and oak savannas.

Aggressive fire suppression policies protect property and investments and make much of Wisconsin's landscape safe for homes and businesses. This has come at a cost to native ecosystems. As fire has been removed from the landscape, ecosystems have changed, often limiting habitat for certain plants and animals and creating dangerous fire conditions due to the buildup of fuels.

In Wisconsin, an estimated 12,000 to 22,000 acres are purposefully burned using prescribed fire each year. By controlling the timing, frequency, and intensity of fire, fire managers have shown that they can create and sustain fire dependent ecosystems. Through rigorous safety precautions such as monitoring weather and fuel conditions, notifying adjacent landowners, and having suppression crews on-hand, fire managers have shown that prescribed fire is also very safe.

THE WILDLAND/URBAN INTERFACE

Over the last few decades, more and more people have abandoned city and suburban living for a more rural setting. In Wisconsin, new rural houses serve as permanent or seasonal homes and are often found in forested areas. Unfortunately, not everyone adapts to the fire danger that exists in wildland areas and protects their home and property correctly.

Today, not only do firefighters have to deal with the wildland fuels, but the structures that are mixed in with them as well. This area has come to be known as the Wildland/Urban Interface (WUI) and it is one of the biggest challenges to wildland and structural fire agencies. The simple fact is that in the event of a large fire, there will not be enough resources to protect every home.

Put yourself in the driver's seat of a fire truck at the scene of a large fire. Depending on the area, hundreds of homes may be threatened over the course of the fire. Your first priority is the safety of your personnel and citizens in the area. You may have many homes assigned to you to attempt to protect either before or after the fire front passes.

With the water you have, you can probably wet down two or three homes before having to refill your truck with water. On top of all this, you have limited visibility due to smoke, constant radio communications, the confusion of a panicked citizenry evacuating the area, and others trying to enter the area to get a firsthand look. Since time will not allow you to give attention to all the structures in your area before the fire arrives, you must determine where you can safely send your vehicle and personnel.

Unfortunately, even though housing in the WUI is increasing, the number of available firefighters and equipment is not increasing at the same rate. Oftentimes, firefighters in fire prone areas are working as volunteers and may not be fully aware of the potential problems in a community they are helping to protect.

Homeowners and fire officials can form a partnership to increase safety in the WUI. In this situation, homeowners take principle responsibility for assuring low home ignitability. Fire officials provide technical assistance as well as emergency response. The ideal situation is for homes to be designed, built, and maintained to withstand a wildfire without the intervention of the fire department. Homeowners can achieve this by following **Firewise practices**.

Firewise practices focus on three main areas to help property be compatible with the surrounding land – access, the surrounding vegetation and the structure itself.

ACCESS

Would firefighters be able to get to your home if there were a fire in the area? Driveways should be at least 12 feet wide with 14 feet of overhead clearance. Driveways longer than 150 feet or with sharp curves may need to be closer to 20 feet wide. A locked or closed gate can make entry to property impossible.

THE SURROUNDING VEGETATION
How easily can a fire spread from the adjacent vegetation to your home? The area within approximately 30 feet around all structures is thought of as a home's **defensible space**. If modified properly, this area can keep low-intensity surface fire from reaching structures. It can also provide a relatively safe area for firefighters to work in if they are able to help protect a home. This area should be kept mowed short, raked free of fallen leaves and needles, and green throughout the growing season. Remember that spring is when most wildfires occur in Wisconsin; cleanup at this time of year is essential.

THE STRUCTURE ITSELF
How flammable is your home? Any building on a property is potential fuel in a wildfire including garages, campers, and storage sheds. Anything attached to a structure is part of the structure. Roofs, rain gutters, and decks are natural traps for leaves, pine needles, and embers from a fire. These areas should be kept free of all material that could allow an ember to smolder and start a fire. Do not store flammable materials or allow debris to fill in under decks and overhangs. Chimneys, eaves, and vents should be kept covered with wire mesh to keep embers from blowing into structures.

To learn if your community is at risk, visit *www.fws.gov/fire/downloads/listedriskcomm.pdf*.

CAREERS IN WILDLAND FIRE

As development in rural, forested, and grassland areas increases, so does the need for professionals working in the field of wildland fire management. In addition, the effectiveness of prescribed fire and its increased use by many land managers requires professional training.

There are many career paths available in wildland fire management ranging from highly technical careers in research to education and public policy. Careers in wildland fire management include the following fields:

- **Forest Management:** Forestry professionals manage forested areas to reduce the risk of catastrophic fires, produce timber, and sustain forest services.
- **Range Management:** Rangeland professionals manage grasslands for livestock production and habitat conservation.
- **Fire Suppression:** Wildland and structural firefighters control accidental wildfires to protect lives, property, and natural resources.
- **Fire Education:** Communication and education professionals help people take positive actions to prevent destructive wildfire, protect their communities, and ensure that fire remains a part of the ecological landscape.
- **Fire Ecology:** Biologists study and manage ecosystems to sustain native plant and animal communities.
- **Research and Development:** Scientific researchers develop and test technologies and innovations to suppress fires, protect homes, and protect firefighters.
- **Land Use Planning:** Natural and human resource professionals work cooperatively to determine methods and policies to make human communities more compatible with fire prone landscapes.

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APPENDIX

GLOSSARY

BIAS: An opinion or belief that strongly favors one side of an issue.

BURN BARREL: A metal receptacle, most often a barrel, used for burning waste outdoors. Waste includes materials legal to burn such as wood and paper and materials illegal to burn such as plastic and metal.

CAMBIUM: The growing part of a trunk of a tree.

CLIMATE: Weather conditions for a region including temperature, precipitation, and wind.

CLIMATE CHANGE: The long-term fluctuations in precipitation, temperature, and wind caused mainly by variations in earth's orbital rotations, volcanic activity, human land use practices, and the combustion of fossil fuels.

COMPOSITION: The species in a community.

CONDUCTION: Transfer of heat through a material.

CONVECTION: Transfer of heat through a liquid or gas.

CROWN FIRE: A fire that spreads across the tops of trees or shrubs.

CROWNING: The movement of fire from a surface fire into the crown of trees. This is usually accomplished through ladder fuels.

CUTOVER: Land that has been logged. This term is often used as "the Cutover," which refers to northern Wisconsin after it was heavily logged during the period from the 1850s to the 1920s.

DANGEROUS: Something that can hurt you.

DEFENSIBLE SPACE: The area within 30 feet of a structure.

ECOSYSTEM FUNCTION: A function that supports life including the fixation of energy, cycling of matter, and flow of energy through food webs.

EXTIRPATED: The extinction of a species from a specific area.

FIRE BEHAVIOR: The manner in which a fire reacts to its environment.

FIRE INTENSITY: The amount of heat released per second as a wildland fire burns in a specified area; calculated by measuring the flame length, rate of spread, and heat per unit area.

FIRE PREVENTION: A variety of actions taken to decrease the risk of ignition of wildland fires; accomplished through education, engineering, and enforcement of laws.

FIRE REGIME: A cultural and biological system that defines the size, distribution, intensity, and frequency of fire in a given area.

FIRE SEASON: The periods of the year when wildland fires are likely to occur; there are two main fire seasons in Wisconsin – spring (March to June) and fall (September to November).

FIRE TRIANGLE: The three elements (i.e., fuel, oxygen, heat) necessary for combustion to occur.

FIREWISE BUILDINGS: Buildings designed with features that reduce the risk of the building burning in a wildfire. Firewise buildings use fire resistant materials, have open areas without fuels surrounding the house, and have good access roads.

FIREWISE PRACTICES: Actions homeowners can take to protect their homes from wildfire.

FOREST STRUCTURE: The vertical and horizontal spacing of trees in a forest. Vertical layers are the overstory and the understory. Horizontal spacing is the density of tree cover across the landscape.

FOREST THINNING: The removal of some of the trees in a forest; often done to reduce the risk of wildfire.

FUEL: Any material that can burn; any substance that contributes to the growth or spread of fire.

FUEL CHARACTERISTICS: Properties including quantity, chemistry, compaction, continuity, moisture content, and size.

GROUND FIRE: A fire that burns the organic material in the soil layer such as peat or duff.

HAZARD: Potential for a fire to start and spread.

HEAT TRANSFER: Energy transfer by radiation, convection, or conduction.

IGNITE: To cause something to start burning.

INFORMED DECISION: Deciding how to act on something after learning more about it.

KNOWLEDGE: Awareness and understanding of facts.

LADDER FUELS: Fuels which provide a vertical path for fire to move from ground level to the crowns of trees.

LAND CONVERSION: The change of an area from one land use to another.

LAND COVER: The ecological features present across the landscape such as forest, urban area, and field.

LAND USE: The human activities occurring across a landscape such as forest management, land development, and agriculture.

LIKERT SCALE: A rating system used to determine a person's perception of an issue. For example, a number system from 1-5 is used and "1" indicates a respondent strongly agrees with the statement and "5" indicates a respondent strongly disagrees.

NEWS ANCHOR: A person at a television station who reads the news and connects stories to reporters on the scene.

PERCEPTION: The feelings, attitudes, views, and judgments that a person has about something or someone.

PHENOMENON: An observable fact or event.

PRESCRIBED FIRE: A fire used to deliberately burn wildland fuels under specific conditions to meet desired management goals (e.g., fuel management, disease and pest control, wildlife habitat).

PRESUPPRESSION: Activities undertaken to prepare for fire suppression; includes the construction of access roads, preparation of suppression strategies, and training of suppression teams.

PROP: An object used by an actor or actress in a play.

PUBLIC OPINION SURVEY: A survey used to measure public understanding and perception of an issue.

RADIATION: Heat that travels in a wave.

RATE OF SPREAD: The speed (feet per minute) at which a wildland fire moves into new fuels.

RELATIVE HUMIDITY: The ratio of the amount of water vapor in the air at a specific temperature to the maximum amount that the air could hold at that temperature, expressed as a percentage.

RESPONSIBLE ADULT: A grown-up who takes care of something and uses it safely.

RISK: Potential for a fire to ignite.

SAFE: Something that won't hurt you.

SAMPLE POPULATION: The subgroup of a target population that is actually studied.

SAMPLING: The process of selecting a group of people to be studied from within a larger population being studied.

SCIENTIFIC METHOD: A method of research in which a problem is identified or observed, a hypothesis is formulated, and the hypothesis is tested.

SCRIPT: The words that actors read during a play.

SPECIES INTRODUCTION: The arrival and establishment of organisms that are not native to an ecosystem.

SPOTTING: The ignition of new fires outside of the original fire area caused by wind-blown sparks or embers.

SUCCESSION: The gradual change from one biological community to another.

SUPPRESSION: The act of confining and extinguishing a wildland fire.

SURFACE FIRE: A fire that burns fuels on the forest floor such as leaf litter and small vegetation.

SYSTEM DIAGRAM: A tool that helps describe how complex systems work; they are helpful in showing how a change in one factor may affect another factor.

TARGET POPULATION: The group of interest in a research project.

TOPOGRAPHY: The relative elevation and configuration of features in a landscape.

TORCHING: The ignition and flare-up of a tree or small group of trees, usually from bottom to top.

WILDFIRE: A wildland fire that ignites and spreads without the intent of the landowner.

WILDLAND FIRE: An outdoor fire involving primarily vegetative fuels.

WILDLAND/URBAN INTERFACE: An area where human structures are in close proximity to wildland fuels.

WISCONSIN MODEL ACADEMIC STANDARDS

LEAF Wildland Fire lessons address Wisconsin Model Academic Standards in English Language Arts, Environmental Education, Mathematics, Science, Social Studies, and Visual Arts. On the following pages, you will find the standards listed by lesson along with an explanation of how they are addressed by each lesson.

K-1ST GRADE LESSON: MY FEELINGS ABOUT FIRE

VISUAL ARTS A.4.1
Visual Memory and Knowledge

Standard is: Develop a basic mental storehouse of images.

Students give examples of events in their lives that relate to emotions and share examples of safe and dangerous situations.

VISUAL ARTS I.4.1
Personal and Social Development

Standard is: Use art to understand how they feel.

Students indicate their feelings with emotion cards as they look at the pictures of safe and dangerous fire situations.

VISUAL ARTS I.4.3
Personal and Social Development

Standard is: Talk or write about feelings in a work of art.

Students discuss their feelings related to pictures of safe and dangerous fire situations.

2ND-3RD GRADE LESSON: SMOKEYTOONS: A LOOK AT FIRE AND HUMAN BEHAVIOR

SCIENCE D.4.4
Properties of Earth Materials

Standard is: Observe and describe changes in form, temperature, color, speed, and directions of objects and construct explanations for the changes.

Students examine ashes made from burning paper and describe how fire changed the paper to ash.

VISUAL ARTS E.4.3
Visual Communication and Expression

Standard is: Communicate basic ideas by producing popular images and objects such as folk art, traditional arts and crafts, popular arts, mass media, and consumer products.

Students produce comic strips to convey a fire prevention message.

VISUAL ARTS K.4.3
Making Connections

Standard is: Use what they are learning about life, nature, the physical world, and people to create art.

Students use the information they have learned about to create comic strips that convey a fire prevention message.

4TH GRADE LESSON: THE PESHTIGO THEATER COMPANY PRESENTS: THE LIFE OF FIRE

ENGLISH LANGUAGE ARTS A.4.1
Reading and Literature

Standard is: Use effective reading strategies to achieve their purposes in reading.

- Read aloud with age-appropriate fluency, accuracy, and expression
- Discern how written texts and accompanying illustrations connect to convey meaning

Students design a play set from a script and picture and act out the play by reading a script.

ENGLISH LANGUAGE ARTS C.4.2
Oral Language

Standard is: Listen to and comprehend oral communications.

- Recall the content of stories after hearing them, relate the content to prior knowledge, and answer various types of factual and interpretive questions about the stories

Students answer questions after each scene in a play and discuss the answers.

ENGLISH LANGUAGE ARTS C.4.3
Oral Language

Standard is: Participate effectively in discussion.

- Volunteer relevant information, ask relevant questions, and answer questions directly
- Reflect on the ideas and opinions of others and respond thoughtfully
- Ask for clarification and explanation of unfamiliar words and ideas

Students answer and discuss questions after each scene in a play.

SOCIAL STUDIES A.4.4
Geography: People, Places, and Environments

Standard is: Describe and give examples of ways in which people interact with the physical environment including use of land, locations of communities, methods of construction, and design of shelters.

Students participate in a play and discussion that explores the role humans have played in wildland fire and how it has altered our environment.

SOCIAL STUDIES A.4.8
Geography: People, Places, and Environments

Standard is: Identify major changes in the local community that have been caused by human beings, such as a construction project, a new highway, a building torn down, or a fire; discuss reasons for these changes; and explain their probable effects on the community and the environment.

Students participate in a play and discussion that explores how human communities have been altered by wildland fire.

5TH-6TH GRADE LESSON: IN THE HOT SEAT: THE PROCESS AND SCIENCE OF DECISION-MAKING

ENVIRONMENTAL EDUCATION B.8.10
Energy and Ecosystems

Standard is: Explain and cite examples of how humans shape the environment.

Students are faced with a series of dilemmas about human actions and fire and must make decisions on how best to respond.

ENVIRONMENTAL EDUCATION D.8.1
Decision and Action Skills

Standard is: Identify options for addressing an environmental issue and evaluate the consequences of each option.

Students are faced with a series of dilemmas about human actions and fire and must make decisions on how best to respond.

ENVIRONMENTAL EDUCATION D.8.4
Decision and Action Skills

Standard is: Explain the political, legal, and budgetary options for resolving local, state, and national environmental issues.

Students participate in mock town council meeting and lobby for and determine the consequences of the passage of certain legislation.

ENVIRONMENTAL EDUCATION D.8.5
Decision and Action Skills

Standard is: Explain how personal actions can impact an environmental issue.

Students are faced with a series of dilemmas about human actions and fire and must make decisions on how best to respond. Discussion that follows helps students understand the impact of each action.

SCIENCE A.8.6
Science Connections

Standard is: Use models and explanations to predict actions and events in the natural world.

Students use system diagrams to represent how events and outcomes are related.

SOCIAL STUDIES D.8.4
Economics: Production, Distribution, Exchange, Consumption

Standard is: Describe how investments in human and physical capital, including new technology, affect standard of living and quality of life.

Students participate in a mock town meeting where they try to pass legislation that will cost their community money, but will provide for increased safety and quality of life.

SOCIAL STUDIES E.8.5
The Behavioral Sciences: Individuals, Institutions, and Society

Standard is: Describe and explain the means by which groups and institutions meet the needs of individuals and societies.

Students participate in a mock town meeting and learn how the government provides for the needs of citizens and the betterment of society.

7TH-8TH GRADE LESSON: NATURAL PHENOMENA INVESTIGATORS (NPI)

ENGLISH LANGUAGE ARTS A.8.1
Reading and Literature

Standard is: Use effective reading strategies to achieve their purpose in reading including using texts to find information, make decisions, and to select, summarize, and analyze orally and in writing.

Student groups read a variety of textual information to find pertinent information, draw conclusions, and report their findings orally to their investigation group and class.

ENGLISH LANGUAGE ARTS A.8.4
Reading and Literature

Standard is: Read to acquire information including the use of technical resources such as charts, tables, travel schedules, timelines, and manuals.

Students interpret data from a variety of sources including tables, written logs, maps, and background information.

ENGLISH LANGUAGE ARTS B.8.1
Writing

Standard is: Create or produce writing to communicate with different audiences for a variety of purposes including writing a clear and pertinent response to verbal or visual materials that communicate, explain, and interpret the reading.

Student investigation groups review a variety of materials to develop a statement that reflects the circumstances leading to a fire. They are given additional materials and must adjust their statement based on additional knowledge.

ENGLISH LANGUAGE ARTS C.8.1
Oral Language

Standard is: Orally communicate information, opinions, and ideas effectively to different audiences for a variety of purposes.

Student investigation groups are asked to make a statement to the class about their findings.

ENGLISH LANGUAGE ARTS C.8.3
Oral Language

Standard is: Participate effectively in discussion including explaining and advancing opinions by citing evidence and referring to sources.

Students in investigation groups participate in discussions to debate findings and come to a consensus on what to report to the class.

ENGLISH LANGUAGE ARTS F.8.1
Research and Inquiry

Standard is: Conduct research and inquiry of self-selected or assigned topics, issues, or problems and use an appropriate form to communicate the findings, including using multiple sources.

Students research several topics related to wildland fire using a variety of resources provided and work in teams to develop position statements on each.

ENVIRONMENTAL EDUCATION A.8.4
Questioning and Analysis

Standard is: Use critical thinking strategies to interpret and analyze gathered information.

Students use critical thinking to analyze data, primary sources, maps, and definitions to investigate the spread and control of a wildland fire.

ENVIRONMENTAL EDUCATION A.8.5
Questioning and Analysis

Standard is: Use the results of their investigations to develop answers, draw conclusions, and revise their personal understanding.

Students make predictions about the spread of a wildland fire and then use data, primary sources, maps, and definitions to investigate the wildland fire and postulate why their predictions may not have been correct.

MATHEMATICS A.8.1
Mathematical Processes

Standard is: Use reasoning abilities to evaluate information, perceive patterns, identify relationships, evaluate strategies, and justify statements.

Students work in investigation teams to identify relationships, evaluate strategies, and justify statements using primary source documents.

MATHEMATICS D.8.2
Measurement

Standard is: Demonstrate an understanding of basic measurement facts, principles, and techniques.

Students measure the rate of the spread of the fire using locations on a map and the map scale of miles. They compute the rate in feet per minute.

MATHEMATICS E.8.4
Statistics and Probability

Standard is: Use the results of data analysis to make predictions, develop convincing arguments, and draw conclusions.

Student investigation groups use a variety of data, maps, primary sources, and definitions to predict, draw conclusions, and develop convincing arguments to be shared with the class.

SCIENCE C.8.6
Science Inquiry

Standard is: State what they have learned from investigations, relating their inference to scientific knowledge and to data they have collected.

Students discuss information in investigation teams and present their findings to the class.

SCIENCE H.8.3
Science in Social and Personal Perspectives

Standard is: Understand the consequences of decisions affecting personal health and safety.

Students discuss post-fire dilemmas and examine the pros and cons of each action.

9TH-12TH GRADE LESSON: WILDLAND FIRE ISSUES AND EDUCATION

ENGLISH LANGUAGE ARTS F.12.1
Research and Inquiry

Standard is: Conduct research and inquiry on self-selected or assigned topics, issues, or problems and use an appropriate form to communicate their findings.

- Formulate questions addressing issues or problems that can be answered through a well-defined and focused investigation.
- Develop research strategies appropriate to the investigation, considering methods such as questionnaires, experiments, and field studies.
- Evaluate the usefulness and credibility of data and sources by applying tests of evidence including bias, position, expertise, adequacy, validity, reliability, and date.

Students develop, conduct, and analyze the results of a survey to test hypotheses they have written.

ENVIRONMENTAL EDUCATION A.12.3
Questioning and Analysis

Standard is: Evaluate personal investigations and those of others, critiquing procedures, results, and sources of data and suggest improvements to the investigation.

Students conduct a survey and analyze the results. They discuss bias in surveys and how that could be eliminated.

ENVIRONMENTAL EDUCATION A.12.4
Questioning and Analysis

Standard is: State and interpret their results accurately and consider other explanations for their results.

Students analyze data collected from a survey and interpret the findings of the study.

SCIENCE C.12.1
Science Inquiry

Standard is: When studying science content, ask questions suggested by current social issues, scientific literature, and observations of phenomena; build hypotheses that might answer some of these questions; design possible investigations; and describe results that might emerge from such investigations.

Students use the scientific method to generate a hypothesis about a wildfire social phenomena and generate questions as part of a survey to test their hypothesis.

SCIENCE C.12.3
Science Inquiry

Standard is: Evaluate the data collected during an investigation, critique the data-collection procedures and results, and suggest ways to make any needed improvements.

Students conduct a survey and analyze the results. They discuss bias in surveys and how that could be eliminated.

WISCONSIN MODEL ACADEMIC STANDARDS

Standard	K-1st Grade Lesson	2nd-3rd Grade Lesson	4th Grade Lesson	5th-6th Grade Lesson	7th-8th Grade Lesson	9th-12th Grade Lesson
ENGLISH LANGUAGE ARTS						
A.4.1						
A.8.1						
A.8.4						
B.8.1						
C.4.2						
C.4.3						
C.8.1						
C.8.3						
F.8.1						
F.12.1						
ENVIRONMENTAL EDUCATION						
A.8.4						
A.8.5						
A.12.3						
A.12.4						
B.8.10						
D.8.1						
D.8.4						
D.8.5						

(Continued on page 174.)

WISCONSIN MODEL ACADEMIC STANDARDS

Standard	K-1st Grade Lesson	2nd-3rd Grade Lesson	4th Grade Lesson	5th-6th Grade Lesson	7th-8th Grade Lesson	9th-12th Grade Lesson
MATHEMATICS						
A.8.1					✓	
D.8.2					✓	
E.8.4					✓	
SCIENCE						
A.8.6				✓		
C.8.6					✓	
C.12.1						✓
C.12.3						✓
D.4.4		✓				
H.8.3					✓	
SOCIAL STUDIES						
A.4.4			✓			
A.4.8			✓			
D.8.4				✓		
E.8.5				✓		
VISUAL ARTS						
A.4.1	✓					
E.4.3		✓				
I.4.1	✓					
I.4.3	✓					
K.4.3		✓				

SUBJECT AREAS

	ENGLISH LANGUAGE ARTS	GEOGRAPHY	HEALTH	MATHE-MATICS	SCIENCE	SOCIAL STUDIES	VISUAL ARTS
K-1ST GRADE LESSON My Feelings About Fire							
2ND-3RD GRADE LESSON SmokeyToons: A Look at Fire and Human Behavior							
4TH GRADE LESSON The Peshtigo Theater Company Presents: The Life of Fire							
5TH-6TH GRADE LESSON In the Hot Seat: The Process and Science of Decision-making							
7TH-8TH GRADE LESSON Natural Phenomena Investigators (NPI)							
9TH-12TH GRADE LESSON Wildland Fire Issues and Education							

MULTIPLE INTELLIGENCES

Multiple Intelligences can be thought of as different modes of learning and retaining information. Generally, everyone has all the multiple intelligences, but in varying strengths. Students excel when they have an opportunity to express themselves in their preferred intelligences, but also need to have opportunities to strengthen other areas. The table below lists each of the Wildland Fire lessons and the multiple intelligences that are addressed.

V-L: VERBAL-LINGUISTIC
Using language to express ideas and concepts, thinking symbolically and reasoning abstractly, and the ability to create conceptual verbal patterns.

L-M: LOGICAL-MATHEMATICAL
Skillfully able to think logically, inductively, categorically; recognize patterns; and work with abstract concepts.

V-S: VISUAL-SPATIAL
Perceiving images and spatial elements and representing those expressions effectively.

B-K: BODILY-KINESTHETIC
Creatively using the whole body to illustrate ideas and concepts.

M-R: MUSICAL-RHYTHMIC
Discriminating among musical components and using instruments or the voice to express understanding.

INTER: INTERPERSONAL
Demonstrating empathy toward or appreciating the thoughts and feelings of others.

INTRA: INTRAPERSONAL
Analyzing one's own thoughts and motivations and expressing understanding of those thoughts and feelings through behavior.

NAT: NATURALISTIC
Sensing patterns in and making connections with nature and the environment.

	V-L	L-M	V-S	B-K	M-R	Inter	Intra	Nat
K-1st Grade Lesson - My Feelings About Fire	✓	✓	✓			✓		✓
2nd-3rd Grade Lesson - SmokeyToons: A Look at Fire and Human Behavior	✓	✓	✓			✓	✓	✓
4th Grade Lesson - The Peshtigo Theater Company Presents: The Life of Fire	✓	✓		✓		✓	✓	
5th-6th Grade Lesson - In the Hot Seat: The Process and Science of Decision-making	✓	✓	✓			✓	✓	
7th-8th Grade Lesson - Natural Phenomena Investigators (NPI)	✓	✓	✓			✓	✓	
9th-12th Grade Lesson - Wildland Fire Issues and Education	✓	✓				✓		

LESSON CONNECTIONS TO THE *LEAF WILDLAND FIRE CONCEPTUAL GUIDE*

The objectives of each lesson in the ***LEAF Wisconsin K-12 Wildland Fire Lesson Guide*** are based on subconcepts outlined in the ***LEAF Conceptual Guide to K-12 Wildland Fire Education in Wisconsin***. This chart identifies the subconcepts covered by each lesson.

	Theme 1: What Is Wildland Fire?												Theme 2: Why Is Wildland Fire Important?							Theme 3: How Do We Manage Wildland Fire?						Theme 4: What Is the Future?											
Sub-concept	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
K-1st		✓																								✓										
2nd-3rd	✓	✓	✓																							✓										
4th	✓	✓	✓				✓							✓	✓											✓										
5th-6th	✓	✓											✓									✓				✓	✓			✓		✓				
7th-8th	✓	✓	✓		✓											✓																✓				
9th-12th		✓											✓					✓									✓					✓	✓			

LEAF WISCONSIN K-12 FORESTRY EDUCATION LESSON GUIDE OVERVIEWS

This ***LEAF Wisconsin K-12 Wildland Fire Lesson Guide*** is a supplement to the ***LEAF Wisconsin K-12 Forestry Education Lesson Guide*** (LEAF Guide). The LEAF Guide is comprised of six grade specific units: K-1, 2-3, 4, 5-6, 7-8, and 9-12. The LEAF Guide is obtained by participating in a LEAF workshop. Workshop participants receive forestry background information and practical experience using the LEAF Guide. Workshops vary in length and format, sometimes including an option for graduate credit and/or hands-on field experiences.

K-1 UNIT

5 CLASSROOM LESSONS, 1 CAREERS LESSON, 3 FIELD ENHANCEMENTS

The K-1 Unit is an introduction to trees and forests. Students learn about the parts of a tree, what forests are, and why they are important.

LESSON 1 - TREE HARDWARE
Students are introduced to the parts of a tree and its life stages through songs, games, and role playing.

LESSON 2 - WHAT'S IN A FOREST?
Students learn about living and nonliving parts of a forest by playing a game and creating artwork.

LESSON 3 - MY FAVORITE FOREST USE
Students discover the value of forests by studying *Tree Spy* collages and singing a song.

LESSON 4 - FOREST PRODUCT TIME MACHINE
Students explore historical uses of forest resources and compare them to present-day goods by surveying pictures and creating drawings.

LESSON 5 - ANIMALS NEED FORESTS, TOO
Students find out what forests do for animals and play a game to search for basic needs.

CAREERS EXPLORATION
Students learn about forestry-related careers, participate in a matching exercise, and draw their favorite career.

FIELD ENHANCEMENT 1 - ALL ABOUT MY TREE
Students adopt a tree and record their observations to create a class scrapbook.

FIELD ENHANCEMENT 2 - SENSING THE FOREST
Students use all their senses to discover the living and nonliving parts of a forest.

FIELD ENHANCEMENT 3 - SEARCHING FOR BASIC NEEDS
Students examine the needs of animals and evaluate if their playground can support various critters.

2-3 UNIT

6 CLASSROOM LESSONS, 1 CAREERS LESSON, 3 FIELD ENHANCEMENTS

The 2-3 Unit expands on basic ideas about forests and helps students understand their connection to forests. Students learn about energy flow, basic tree identification skills, forest products, and what it means to be a forest steward.

LESSON 1 - TO BE A TREE
Students use their knowledge of tree parts to learn basic tree identification skills. Basic needs and life stages of a tree are also emphasized through a game and drawing activity.

LEAF WISCONSIN K-12 FORESTRY EDUCATION LESSON GUIDE OVERVIEWS

LESSON 2 - WHAT MAKES A FOREST?
Students discover how living things are influenced by nonliving things through a matching activity, song or skit, and creating a class mural of Wisconsin forests.

LESSON 3 - FOREST ENERGY FLOW
Students learn about energy flow in the forest by role-playing producers, consumers, and decomposers.

LESSON 4 - FORESTS ARE IMPORTANT TO ME!
Students explore forest values and discover what forest products come from Wisconsin using a checklist. Creative writing and an art project help students examine why they value forests.

LESSON 5 - DECISIONS, DECISIONS
Students are introduced to the concept of forest management by creating a plan for their schoolyard. A card game and song highlight some of the people involved in forest management.

LESSON 6 - I CAN BE A FOREST STEWARD
Students find out what it means to be a forest steward and make decisions about good stewardship activities through an *I Spy*-like picture and board game.

CAREERS EXPLORATION
Students learn about professionals in Wisconsin with forestry-related careers, match jobs and duties, and draw themselves in a career that interests them.

FIELD ENHANCEMENT 1 - I CAN BE A FORESTER
Students get a taste of what foresters do by collecting and discussing data.

FIELD ENHANCEMENT 2 - OBSERVING FOREST INTERACTIONS
Students explore living and nonliving forest features on a hike and spend time observing and drawing parts of a forest.

FIELD ENHANCEMENT 3 - FOREST ENERGY SCAVENGER HUNT
Students follow the flow of energy in a forest by going on a scavenger hunt.

4 UNIT
7 CLASSROOM LESSONS, 1 CAREERS LESSON, 3 FIELD ENHANCEMENTS

The 4 Unit focuses on Wisconsin forest history. Students learn about the logging days, farming the Cutover, events that led to modern forestry, and why forests are important today.

LESSON 1 - NATIVE AMERICANS AND THE FOREST
Students read the journal of an early explorer to learn what Wisconsin forests were like before European settlement and how Native Americans used the forests.

LESSON 2 - FORESTS BUILT OUR STATE
Students explore the importance of forests to early settlers and learn how forests played a role in settling Wisconsin through a mapping activity.

LESSON 3 - HELP WANTED – LUMBERJACKS
Students examine the steps and people involved in an 1800s logging process by following a tree from northern Wisconsin to a house in Iowa.

LESSON 4 - BROKEN DREAMS
Students experience what it was like to farm in Wisconsin during the "Cutover" by role-playing and studying letters, photographs, and documents.

LESSON 5 - I SAW IT ON THE 6 O'CLOCK NEWS
Students learn about 150 years of events in Wisconsin that have led to the forests of today by participating in a live newscast.

LEAF WISCONSIN K-12 FORESTRY EDUCATION LESSON GUIDE OVERVIEWS

LESSON 6 - FORESTS ARE IMPORTANT TO YOU AND ME
Students discover reasons why Wisconsin forests are important to our quality of life through guided imagery, brainstorming, and an interactive media presentation.

LESSON 7 - SUSTAINING OUR FORESTS
Students are introduced to the sustainability and stewardship of forests by listening to a fable, brainstorming, reading situation cards, and creating an art project.

CAREERS EXPLORATION
Students learn about professionals in Wisconsin with forestry-related careers, play career bingo to learn about skills used in each profession, and describe and draw themselves in a career.

FIELD ENHANCEMENT 1 - UNLOCKING A FOREST'S PAST
Students uncover a forest's history by becoming detectives, collecting data, and making predictions about a forest.

FIELD ENHANCEMENT 2 - ARE FORESTS IMPORTANT TODAY?
Students find out why forests are ecologically, economically, and socially valuable by searching in a forest and playing scavenger hunt bingo.

FIELD ENHANCEMENT 3 - CARING FOR THE FUTURE OF FORESTS
Students learn what a tree needs to grow, how to choose an appropriate site, and how to properly plant a tree by putting one in their schoolyard.

5-6 UNIT
8 CLASSROOM LESSONS, 1 CAREERS LESSON, 3 FIELD ENHANCEMENTS

The 5-6 Unit connects the science of forests with human aspects. Students learn about forest layers, ecosystems, and energy flow. This information is related to the value of trees, forest ownership, and management.

LESSON 1 - ME AS A TREE
Students learn about a tree's functions, basic needs, life stages, and role in the forest community by comparing trees and humans.

LESSON 2 - WHAT MAKES A FOREST?
Students explore parts of forest ecosystems and forest layers through an interactive game and discussion.

LESSON 3 - FORESTS ARE ALWAYS CHANGING
Students examine forest succession, disturbances, and renewability by completing a sustainability worksheet and role-playing.

LESSON 4 - ECOSYSTEM EXTRAVAGANZA
Students are introduced to forest functions such as photosynthesis, energy flow, and the cycling of matter through reading and creating a diagram. The roles of producers, consumers, and decomposers in forests are also examined.

LESSON 5 - WE ALL NEED TREES
Students learn about the values of forests and their impact on the environment by categorizing values and writing and producing a commercial.

LESSON 6 - WHAT IS MANAGEMENT?
Students discover what's happened in Wisconsin's history that led us to modern forestry and about management techniques by creating a timeline and reading a "choose your own adventure" type story.

LESSON 7 - WHO OWNS IT?
Students observe how management goals of landowners impact forest ecosystems by studying a plat map and answering questions. They also learn about the roles individuals and groups play that affect forest management.

LEAF WISCONSIN K-12 FORESTRY EDUCATION LESSON GUIDE OVERVIEWS

LESSON 8 - WHOSE JOB IS IT?
Students learn about stewardship and how their choices affect the future of forests by participating in a mock school board meeting.

CAREERS EXPLORATION
Students become aware of careers that are forestry-related by listening to descriptions of them and playing charades.

FIELD ENHANCEMENT 1 - WOOD'S WORTH
Students make their own tree scale stick and use it to calculate the number of products that can be made from individual trees. They also go on a scavenger hunt to explore many ways that forests are valuable.

FIELD ENHANCEMENT 2 - STUDYING FOREST LAYERS
Students observe the structural layers of a forest and draw a color-coded picture. They also embark on two exploration activities to discover which animals can be found in each of the forest layers.

FIELD ENHANCEMENT 3 - COMPETITION IN A FOREST
Students learn how trees compete for their basic needs through observation and a simulation.

7-8 UNIT

8 CLASSROOM LESSONS, 1 CAREERS LESSON, 3 FIELD ENHANCEMENTS

The 7-8 Unit highlights a wide variety of topics related to Wisconsin's forests. Students learn about forest biomes, types of forests, biodiversity, forest management, forest trends, forest issues, forest products, and sustaining forests.

LESSON 1 - DISCOVERING WISCONSIN'S FORESTS
Students are introduced to the types of forests in Wisconsin and factors that affect their distribution through data comparison, a mapping activity, and video research.

LESSON 2 - BIODIVERSITY AND THE FOREST CONNECTION
Students analyze three ecosystems to determine their interconnections and create a Venn diagram. They also discuss the value of Wisconsin's forests in terms of biodiversity.

LESSON 3 - HOW FORESTS ARE MANAGED
Students explore forest management plans, multiple use, and sustainability through a simulation, video, and game.

LESSON 4 - FOREST MANAGEMENT ISSUES
Students examine forest management, factors that influence decisions, effects, and conflicts through brainstorming, discussion, and issue analysis.

LESSON 5 - MANY FORESTS, MANY VALUES, MANY REASONS
Students assess forest values and discover how forests shape the economy, environment, and society using games, story analysis, and brainstorming.

LESSON 6 - MAKING BROADER CONNECTIONS
Students make connections between forests of Wisconsin and forests worldwide and discuss challenges to Wisconsin's forests by tracing the life cycle of a product and playing Forest Jeopardy. They also participate in a sustainability simulation to learn about demand.

LESSON 7 - KEY STRATEGIES FOR OUR FUTURE
Students learn how science, technology, and collaboration are keys to sustaining Wisconsin's forests by analyzing articles. They then make predictions about the future by creating a *Fantasy Future Forest*.

LEAF WISCONSIN K-12 FORESTRY EDUCATION LESSON GUIDE OVERVIEWS

LESSON 8 - SUSTAINING OUR FORESTS: CITIZENS' ROLES
Students discover how people in Wisconsin practice good forest stewardship and debate their own choices through jigsaw readings and dilemma cards.

CAREERS EXPLORATION
Students learn about professionals in Wisconsin with forestry-related careers and examine the skills, education, and experience necessary for each type of job.

FIELD ENHANCEMENT 1 - TREE IDENTIFICATION
Students are introduced to dichotomous keys and tree identification vocabulary to identify common Wisconsin trees.

FIELD ENHANCEMENT 2 - FOREST MAPPING
Students work in groups to map features of a forest plot using data collection, tree identification, measurement, and ageing.

FIELD ENHANCEMENT 3 - FOREST DIVERSITY
Students study and collect data on three components of diversity that can be found in Wisconsin forests.

9-12 UNIT

5 CLASSROOM LESSONS, 1 CAREERS LESSON

The 9-12 Unit has an environmental science focus. Students learn about forest ecosystem processes, succession, the economics of forest products, and science and technology.

LESSON 1 - THE FOREST ODYSSEY
Students learn about forest ecosystem functions and processes by reading an Aldo Leopold essay, doing research, and creating an original science-based essay as a class.

LESSON 2 - A HISTORY OF SUCCESSION
Students explore how Wisconsin's forests have changed due to human and natural influences through a teacher presentation, readings, and a video. Current changes in Wisconsin's forests are discussed using a Wisconsin Land Cover Map.

LESSON 3 - FOREST BIODIVERSITY: TREE CASE STUDIES
Students study how Wisconsin's climate and natural history influence forest biodiversity. They use case studies to develop insights into the question, "What is a healthy level of forest biodiversity?" In groups, they create an original poster and presentation.

LESSON 4 - THE FOREST MARKETPLACE
Students identify factors that influence the supply of and demand for forest resources using basic economic principles. Using veneer as an example, students use graphs to describe markets in different geographic regions and examine the relationship between Wisconsin's forest resources and those of the rest of the world.

LESSON 5 - FOREST SCIENCE AND TECHNOLOGY
Students analyze the environmental impacts associated with wood, concrete, and steel by creating life cycle analyses. They study the roles that forest management, technology, and consumption play in sustaining forests and develop proposals to reduce the environmental impacts of wood use.

CAREERS EXPLORATION
Students learn about job opportunities in natural resource fields by creating a resume from the education and experiences of college students in Wisconsin.

LESSON FEEDBACK FORM (WILDLAND FIRE LESSON GUIDE)

We want to hear from you! Your comments and suggestions will contribute to the effectiveness of the *LEAF Wisconsin K-12 Wildland Fire Lesson Guide*.

Subject Areas and/or Grade Levels Taught _____

Name (optional) _____

School Name (optional) _____

School Address (optional) _____

School Phone (optional) _____

School Email (optional) _____

What recommendations do you have to improve the guide/lesson? **If comments relate to a specific part of a particular lesson, please list page numbers for reference.**

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Please send comments to: LEAF, WCEE/CNR UWSP, Stevens Point, WI 54481, leaf@uwsp.edu