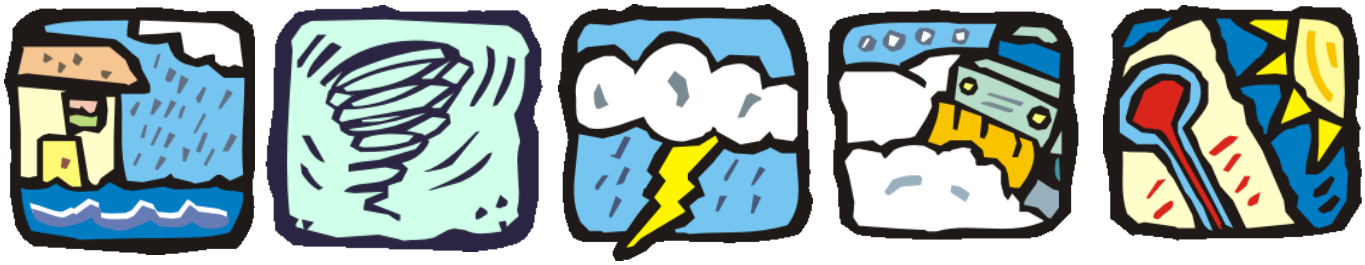


# Natural Hazards Mitigation Plan

## Polk County, Wisconsin

## 2017-2022

West Central Wisconsin
Regional Planning Commission

# POLK COUNTY
# NATURAL HAZARDS MITIGATION PLAN

PREPARED BY:

Polk County Natural Hazards Mitigation Plan Steering Committee
Polk County Emergency Management
Polk County communities

WITH ASSISTANCE BY:

West Central Wisconsin Regional Planning Commission

ADOPTED NOVEMBER 14, 2017
BY THE POLK COUNTY BOARD OF SUPERVISORS

U.S. Department of Homeland Security
Region V
536 S. Clark St., 6th Floor
Chicago, IL 60605-1509

FEMA

March 20, 2018

Ms. Katie Sommers
State Hazard Mitigation Officer
Wisconsin Emergency Management
2400 Wright Street, P.O. Box 7865
Madison, WI 53707-7865

Dear Ms. Sommers:

Thank you for submitting the adoption documentation for the Polk County Hazard Mitigation Plan. The plan was reviewed based on the local plan criteria contained in 44 CFR Part 201, as authorized by the Disaster Mitigation Act of 2000. Polk County met the required criteria for a multi-jurisdiction hazard mitigation plan and the plan is now approved for the county. Please submit the adoption resolutions for any remaining jurisdictions that participated in the planning process.

The approval of this plan ensures continued availability of the full complement of Hazard Mitigation Assistance (HMA) Grants. All requests for funding, however, will be evaluated individually according to the specific eligibility and other requirements of the particular program under which the application is submitted.

We encourage the county to follow the plan's schedule for monitoring and updating the plan, and continue their efforts to implement the mitigation measures. The expiration date of the Polk County Plan is five years from the date of this letter. In order to continue project grant eligibility, the plan must be reviewed, revised as appropriate, resubmitted, and approved no later than the plan expiration date.

Please pass on our congratulations to the county for completing this significant action. If you or the communities have any questions, please contact Christine Meissner at (312) 408-4460 or christine.meissner@fema.dhs.gov.

Sincerely,

Melissa A. Janssen

Melissa A. Janssen
Chief, Risk Analysis Branch
Mitigation Division

U.S. Department of Homeland Security
Region V
536 S. Clark St., 6th Floor
Chicago, IL 60605-1509

FEMA

May 3, 2018

Ms. Katie Sommers
State Hazard Mitigation Officer
Wisconsin Emergency Management
2400 Wright Street, P.O. Box 7865
Madison, WI 53707-7865

Dear Ms. Sommers:

Thank you for submitting the adoption documentation for the Polk County Hazard Mitigation Plan. The plan was reviewed based on the local plan criteria contained in 44 CFR Part 201, as authorized by the Disaster Mitigation Act of 2000. Polk County met the required criteria for a multi-jurisdiction hazard mitigation plan on March 20, 2018 and the plan is now approved for the cities of Amery and St. Croix Falls, the villages of Balsam Lake, Centuria, Clayton, Clear Lake, Dresser, Frederic, Luck, Milltown and Osceola, and the Polk-Burnett Electric Cooperative. Please submit the adoption resolutions for any remaining jurisdictions that participated in the planning process.

The approval of this plan ensures continued availability of the full complement of Hazard Mitigation Assistance (HMA) Grants. All requests for funding, however, will be evaluated individually according to the specific eligibility and other requirements of the particular program under which the application is submitted.

We encourage the county to follow the plan's schedule for monitoring and updating the plan, and continue their efforts to implement the mitigation measures. The expiration date of the Polk County Plan is March 20, 2023. In order to continue project grant eligibility, the plan must be reviewed, revised as appropriate, resubmitted, and approved no later than the plan expiration date.

Please pass on our congratulations to the county for completing this significant action. If you or the communities have any questions, please contact Christine Meissner at (312) 408-4460 or christine.meissner@fema.dhs.gov.

Sincerely,

for Melissa A. Janssen
Chief, Risk Analysis Branch
Mitigation Division

# STATE OF WISCONSIN

***DEPARTMENT OF MILITARY AFFAIRS***

**DIVISION OF EMERGENCY MANAGEMENT**

**Brian M. Satula**
**Administrator**

**Scott Walker**
**Governor**

March 20, 2018

Ms. Kathy Poirier, Director
Polk County Emergency Management
1005 W. Main St., Suite 900
Balsam Lake, WI 54810

Dear Kathy:

It gives me great pleasure to inform you that the *Polk County Natural Hazards Mitigation Plan 2017-2022* has officially been approved by FEMA for the county! Approval for the remaining participating municipalities is contingent upon receipt of their adoption resolutions.

The plan complies with the requirements of the Disaster Mitigation Act of 2000. Polk County is eligible to apply for funding through the Hazard Mitigation Grant Program, Pre-Disaster Mitigation program, and Flood Mitigation Assistance program through March 19, 2023, for projects identified in the Plan. Per regulation, the Plan must be updated and resubmitted for approval every five years to remain eligible for mitigation funding.

Along with the FEMA Meets Requirements letter, you received the Local Mitigation Plan Review Tool, which includes recommended revisions for the five-year update.

Congratulations on the approval of your Plan! Our office commends the County for its commitment to mitigation and reducing future disaster losses, and we look forward to working with you in the future.

If you have any questions, please call me at (608) 242-3214, or Katie Sommers at (608) 242-3222.

Sincerely,

Sean Rausch
Disaster Response and Recovery Planner-Mitigation

Enclosure

Cc: Randy Books, Northwest Regional Emergency Management Director
Anita Smith, Northwest Regional Emergency Management Office Operations Associate
Chris Straight, West Central Wisconsin Regional Planning Commission

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## LIST OF APPENDICES

# SECTION I. INTRODUCTION

## A. PURPOSE OF THE PLAN

The Polk County Natural Hazards Mitigation Plan has been prepared with financial support due to the County's application for, and award of, Pre-Disaster Mitigation (PDM) Grant Program funds. These funds are disbursed by the Federal Emergency Management Agency (FEMA) through Wisconsin Emergency Management (WEM).

The primary focus of the plan is to evaluate the County's potential exposure to natural disasters and identify appropriate mitigation strategies. Consistent with the Code of Federal Regulations, the County decided to limit the scope of this planning effort to natural hazards at this time, though this plan conforms with Federal all hazards mitigation planning requirements.

> The Code of Federal Regulations states...
>
> "The local mitigation plan is the representation of the jurisdiction's commitment to reduce risks from natural hazards, serving as a guide for decision makers as they commit resources to reducing the effects of natural hazards."
>
> (44 CFR Part 201.6, pp 8851)

Development of the plan will help the County and its communities identify its highest natural disaster risks, assess the magnitude of the vulnerabilities should an event occur, and develop strategies for reducing these vulnerabilities. Through this process, the County can address issues related to the protection of life, property, and critical services, and the reduction of costs associated with natural disaster relief and rescue efforts. Completion and approval of the plan will also continue to make Polk County and participating jurisdictions eligible to apply for future hazard mitigation project funds through the Federal Emergency Management Agency.

## B. PLANNING PROCESS

Polk County contracted with West Central Wisconsin Regional Planning Commission to update its hazards mitigation plan previously adopted by Polk County in March 2012 and approved by FEMA later that same month. This updated plan identifies strategies to mitigate the risks and vulnerabilities associated with natural hazards in the County, including its incorporated communities. Since FEMA requires plans be updated on a five-year cycle from the date of their approval, this previous plan will be referred to as the 2012 plan in this update.

Development of the *Polk County Natural Hazards Mitigation Plan* was based on the planning requirements and guidance provided by the Federal Emergency Management Agency (FEMA) [1] and the Wisconsin Department of Military Affairs, Wisconsin Emergency Management.[2] As

[1] Federal Emergency Management Agency, Hazard Mitigation Planning and Hazard Mitigation Grant Program, 44 CFR Parts 201 and 206 (Washington: Government Printing Office, February 26, 2002) 8844-8854.
[2] Wisconsin Emergency Management, Resource Guide to All Hazards Mitigation Planning in Wisconsin. April 2003.

such, the plan meets the requirements of the Disaster Mitigation Act of 2000. The plan's scope is inclusive of all of Polk County and is considered a multi-jurisdictional plan under Federal guidelines, with the exception of the Village of Turtle Lake. The Village of Turtle Lake primarily lies within Barron County and has been included as part of the Barron County Multi-Hazard Mitigation Plan update. Turtle Lake was consulted during this plan update and Polk County Emergency Management will continue to coordinate with the Village and Barron County Emergency Management on hazard mitigation issues as required.

To guide the plan's development, the County established a Natural Hazards Mitigation Plan Steering Committee, shown in **Table 1** below. Committee members were selected from those County departments involved in emergency management issues, in addition to representatives from local municipalities and the private sector. In addition to bringing insight on their respective roles, the Committee members also are very knowledgeable of the issues and concerns of the County's residents. The Committee was responsible for overseeing the development of the plan, providing input and review of information and materials, and reviewing and approving the release of the draft plan prior to the start of the adoption process.

**Table 1. Polk County Natural Hazards Mitigation Plan Steering Committee**

| Name | Representative of: |
|---|---|
| James Beistle | Supervisor, Town of St. Croix Falls |
| Tim Strohbusch | Police Chief, Clear Lake Police Department |
| Sara McCurdy | Commissioner, Polk County Land Information Department |
| Ed Johansen | Operations Manager, Polk-Burnett Electric Cooperative |
| Joshua Kelch | Operations Manager, Polk County Highway Dept. |
| Deb Peterson | Director, Polk County Parks, Buildings, & Solid Waste Dept. |
| Kathy Poirier | Coordinator, Polk County Emergency Management |
| Tim Ritten | Director, Polk County Land & Water Resources Department |
| Dale Wood | Resident and Polk County Fairgrounds Board |
| Janis Larson | Resident and Polk County Fairgrounds Board |
| Dean Johansen | Chair, Polk County Board of Supervisors |

Update of the plan began in May 2016. A total of four (4) Steering Committee meetings were held to discuss the plan's development, identify local natural hazard issues, formulate strategy recommendations, and review the draft plan.

The general stages of plan development included: (1) initial data collection and development of the community profile; (2) review of the hazard risks and 2012 plan strategies by the Steering Committee and stakeholders; (3) community vulnerability and risk assessment; (4) development of the mitigation plan [goals, objectives, strategies, and action plan]; and (5) development of the plan maintenance and coordination strategy. This process is further summarized in **Figure 1** at the end of this section.

A summary of plan changes since the 2012 plan is provided in **Appendix N**, and includes a brief synopsis of how the Steering Committee reviewed and analyzed each section of the plan. Committee members also reviewed the full draft version of the plan during the planning process and these comments were discussed at their fourth meeting.

The community profile contains a mix of 2010 and more recent American Community Survey (ACS) U.S. Census data. Though outdated, the 2010 data is often used since the margins of error for ACS sampling can be sizable in less populated rural areas. The mapping work as part of the community profile (**Section II**) and assessment of hazard conditions (**Section III**) was performed using ESRI-based Geographic Information Systems, allowing greater manipulation and analysis from the use of a consistent base map. Maps included in this plan are for general planning purposes only and do not constitute legal documents or formal surveys. The flood assessment methodology is further detailed in **Appendix B**.

A series of key stakeholder interviews, including both public and private sectors, was performed by West Central Wisconsin Regional Planning Commission (WCWRPC) staff to further complement the issue and strategy identification process. These interviews included discussions with emergency management personnel from adjacent counties. The complete list of these interviews is included in **Appendix C**. Additional input was received from local town, village, and city governments as described within **Section I.C.** below.

With consideration of National Weather Service historical data, recent events, and the scope of the 2012 plan, the Steering Committee agreed that this plan update should continue to focus on the same natural hazards with the addition of a brief section on invasive species and diseases.

With the guidance provided by these interviews, meetings, and previous planning steps, the Steering Committee discussed changes, trends, and progress since the 2012 plan and developed the updated goals and strategies. In June 2017, the full draft plan was released for public review and submitted to Wisconsin Emergency Management and FEMA for pre-review in July 2017. On November 17, 2017, the County Board considered and adopted the *Natural Hazards Mitigation Plan* update at a duly called and noticed public meeting. A copy of the County's adopting resolution and related meeting minutes are included in **Appendix A**.

## C. MULTI-JURISDICTIONAL PLANNING APPROACH

The *Polk County Natural Hazards Mitigation Plan* is a multi-jurisdictional plan and encompasses all incorporated and unincorporated jurisdictions within Polk County, with the exception of the Village of Turtle Lake, which is part of the Barron County planning effort as mentioned previously. All municipalities in Polk County with 100-year floodplains identified on Flood Insurance Rate Maps (FIRMs) are participants in good standing in the National Flood Insurance Program (NFIP), except for the Village of Clear Lake, which is discussed in the flood assessment of Section III.B.iv.

All participating jurisdictions in Polk County were actively involved in the planning process through the following means:

- The Steering Committee included representation from different areas in the County and numerous organizations.
- A presentation on the planning effort was made to the Polk County Towns Association on 10/27/16. A customized risk assessment survey with hazard risk map was then mailed to each town to identify hazards and potential mitigation strategies. A sign-in sheet for this meeting is included in Appendix C.
- A meeting was held with each participating village and city on the planning effort, and input was obtained on issues or potential strategies. Unique hazard-related issues or strategies for each community were identified. Sign-in sheets for these meetings are included in Appendix C.
- Additional follow-up contacts were made with local jurisdictions as needed. In early 2017, draft strategies were sent to each village and city for further comment.

The following jurisdictions have adopted this plan update by resolution:

| *Jurisdiction* | *Adoption Date* |
|---|---|
| Polk County (encompasses all unincorporated areas) | November 17, 2017 |
| Village of Balsam Lake | November 6, 2017 |
| Village of Centuria | December 11, 2017 |
| Village of Clayton | March 5, 2018 |
| Village of Clear Lake | April 10, 2018 |
| Village of Dresser | November 6, 2017 |
| Village of Frederic | November 13, 2017 |
| Village of Luck | March 21, 2018 |
| Village of Milltown | November 15, 2017 |
| Village of Osceola | March 13, 2018 |
| City of Amery | February 7, 2018 |
| City of St. Croix Falls | October 23, 2017 |

Adopting resolutions for all of the above jurisdictions are in **Appendix A**. Polk-Burnett Electric Cooperative also actively participated in this plan update. Electric cooperatives and municipal utilities are potentially eligible for FEMA hazard mitigation grant funding, much like a municipality. A letter of plan approval from Polk-Burnett Electric Cooperatives is also included in Appendix A.

## D. COMMUNITY INVOLVEMENT

The planning process included the following activities to encourage community input and involvement:

- **Steering Committee Meetings.** The four (4) Steering Committee meetings were properly noticed and open to the public. Agendas and sign-in sheets for the Steering Committee meetings are included in Appendix C.
- **Key Stakeholder Interviews.** The key stakeholder interviews obtained input from many local public and private stakeholders who are also community members.
- **Review of Local Plans.** Local comprehensive plans, ordinances, and other documents were reviewed, discussed, and considered when available and pertinent. When appropriate, guidance and clarification from these other documents and plans were integrated into this document.
- **Town Government Meeting and Input.** On October 27, 2016, a presentation on the planning effort was made to the Polk County Towns Association. This was followed by a brief, customized survey to each town to obtain local input on hazard "hotspots," vulnerabilities, and potential mitigation strategies. Once the Steering Committee developed the draft strategy recommendations, the draft strategies were sent to each town for review and comment.
- **Emergency Services Meeting and Input.** On August 30, 2016, a presentation on the plan update was made at the Polk County Emergency Services Meeting with various fire, EMS, and law enforcement present. Issues and trends were briefly discussed and each department was asked to complete a survey regarding hazard risks and potential mitigation actions identified.
- **Public Information and Plan Review Meeting**. On August 29, 2017, a public informational and plan review meeting was held to provide the public the opportunity to review and comment on the proposed plan update. Advertisement of this meeting included a notice in the local newspaper and posting in the standard places per County procedures and in accordance with State of Wisconsin law. A copy of the meeting notice is included in **Appendix D**. No changes to the plan were suggested or recommended as a result of the public informational meeting.
- **Plan Adoption.** Following conditional approval of the plan by Wisconsin Emergency Management, this natural hazards mitigation plan was adopted via resolution by the Polk County Board, nine villages, and two cities in duly called and noticed public meetings.

**Figure 1. Polk County Natural Hazards Mitigation Planning Process Diagram**

**Plan Initiation**
scope: local decision to proceed, contract w/ WCWRPC
County roles: mandate to proceed, establish Steering Committee
RPC roles: facilitate process and pre-planning
Cmte roles: initial meeting on process & scope of plan update

**Community Profiling**
scope: data-collection phase (inventory, stats, uses, trends)
local roles: assist w/ data collection, including existing plans
RPC roles: data collection, analysis, & compilation
Cmte roles: review & discuss findings; additional insights & direction
other issues: identification of critical facilities; initial contacts

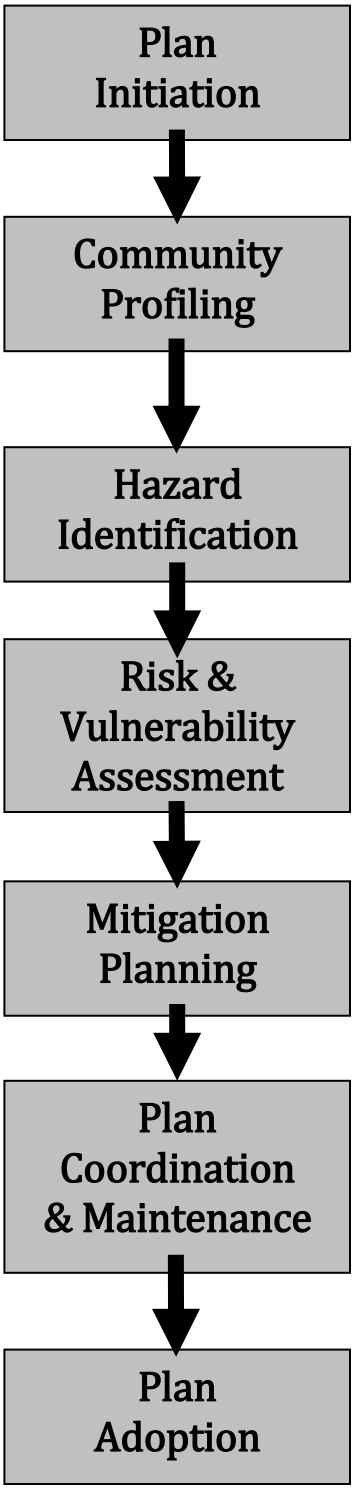
**Hazard Identification**
scope: update data and re-confirm key hazards; finalize scope
local roles: assist w/ data collection (historical records on events)
RPC roles: data collection (w/ NOAA data) & facilitation
Cmte roles: review and confirm key hazards

**Risk & Vulnerability Assessment**
scope: identify risks (full history & trends), and vulnerabilities (estimate potential losses to assets)
local roles: identify issues, concerns, & "hotspots"
RPC roles: data collection, analysis, & facilitation
Cmte roles: review & discuss findings; providing insights & direction

**Mitigation Planning**
scope: goals, objectives, strategies, & action plan
local roles: identify current activities & progress on 2012 plan
RPC roles: facilitation, analysis & guidance on strategies
Cmte roles: update goals; review and prioritize strategies
other issues: cost-benefits analysis; resource/action plan

**Plan Coordination & Maintenance**
scope: relationship to other plans & future plan review/updates
local roles: help identify links to other plans; vision for reviews
RPC roles: facilitation & suggestions
Cmte roles: review & modify/amend recommendations
other issues: re-assess evaluation process

**Plan Adoption**
scope: Cmte review-> municip. review-> State & FEMA pre-review-> public info meeting-> Cmte approval if amended-> County & local adoption-> formal State & FEMA approval
local roles: facilitate public meetings, notifications, & adoption
RPC roles: assist w/ public hearings & modifications to plan
Cmte roles: consider public input & approve draft plan
other issues: special mailings; media



# SECTION II.
# COMMUNITY PROFILE – POLK COUNTY

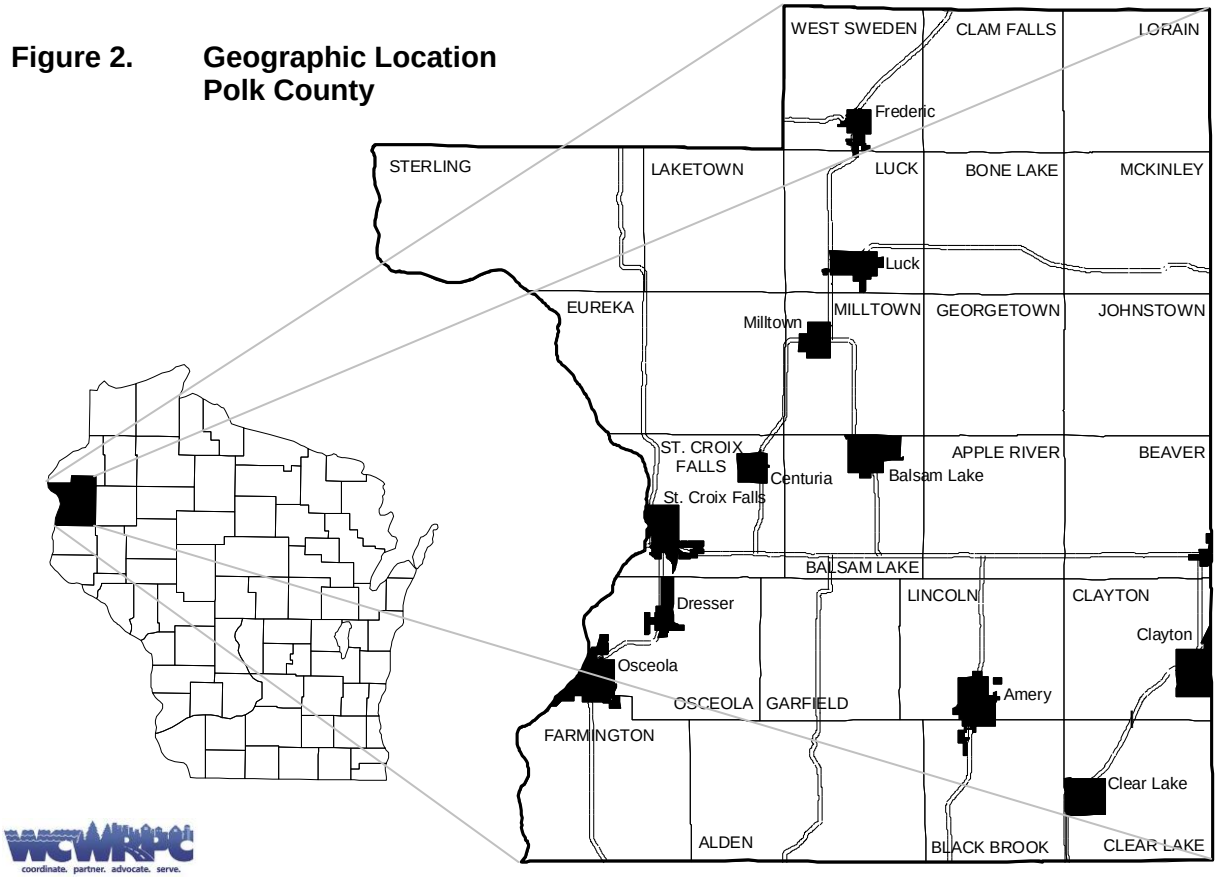
The community profile section of the plan provides background data for a better understanding of the general characteristics of Polk County. Included in this section is a description of natural and demographic characteristics, general development trends, and an inventory of critical facilities.

## A. GEOGRAPHIC LOCATION

Polk County is located in west-central Wisconsin along the Minnesota-Wisconsin border (see **Figure 2**). The County has a total surface area of 619,520 acres, or 968 square miles, of combined land and water area. The County is bordered on the west by the St. Croix River, the north by Burnett County, the east by Barron County and the south by St. Croix County. The Minneapolis/St. Paul Metropolitan Statistical Area borders Polk County to the south and west.

Polk County is comprised of all or parts of 36 civil divisions, consisting of 24 towns, 10 villages and 2 cities. The Village of Balsam Lake, population 1,010, is the county seat. The County has 3 towns, 1 village, and 2 cities with populations over 2,000, with the City of Amery being largest (2,902).

**Figure 2. Geographic Location Polk County**



## B. NATURAL FEATURES AND ENVIRONMENT

Generally, the topography of Polk County is moderately rolling, becoming increasingly more rugged in the western portion of the County, particularly in the St. Croix River valley.

Surface features in the County have been formed or modified by two distinct periods of glaciation. Pitted glacial outwash covers much of the County, resulting in many lakes, wetlands, and areas of uneven topography. A series of glacial end moraines traverse the County from southwest to northeast. The area between the moraines is quite level and much of the County's best agricultural land is found here.

A band of trap rock (an intrusive igneous rock) is exposed at several points between Dresser and the Clam Falls area. Exposed dolomite limestone is found in the southwest part of the County, and the exposed sandstone bedrock in the area known as The Dalles of the St. Croix is largely responsible for the scenic beauty in this area.

Local relief in Polk County is over 600 feet, ranging from 680 feet above mean sea level at the St. Croix River on the County's western extreme to over 1,400 feet in the north-central and eastern areas.

## i. Watersheds

Shown in **Figure 3** are the watersheds that are wholly or partially located within Polk County. A watershed is an area of land that drains or "sheds" its water to a lake, river, stream, or wetland. Some watersheds encompass several hundred square miles, while others may be small, covering only a few square miles that drain into a lake.

Watersheds are important to understand since the effects of natural and man-made activities in one area can have a direct impact on other areas. For example, runoff from a heavy rainfall upstream in a watershed will eventually reach the down stream part of the watershed. Polk County almost entirely drains into the St. Croix River, with the exception of a small part of the southeast corner of the County lying within the Chippewa River Basin.

## ii. Lakes, Rivers, and Streams

Polk County has a total surface water area of 22,626 acres consisting of 437 lakes (20,900 acres) and about 200 miles of rivers and streams as shown in **Figure 3**. The St. Croix River is the County's most significant surface water feature, bordering the County along the length of its western border. The river has been designated by Congress as the Lower St. Croix National Scenic Riverway under the National Wild and Scenic Rivers Act.

## iii. Wetlands and Floodplains

Wetland areas within the watersheds can affect the water levels of rivers and creeks flowing through Polk County. Wetlands are defined by the State Statute as "an area where water is at, near, or above the land surface long enough to be capable of supporting aquatic or hydrophytic (water-loving) vegetation and which has soils indicative of wet conditions." Wetlands may be seasonal or permanent and are commonly referred to as swamps, marshes, or bogs. Wetland plants and soils have the capacity to store and filter pollutants, replenish groundwater supplies, store floodwaters, and maintain stream flows. The wetland areas within Polk County are delineated on **Figure 4**.

**Figure 4** also delineates the 100-year floodplain areas of Polk County as identified in the final Flood Insurance Rate Maps (D-FIRMS) effective September 16, 2011. Figure 4 shows that wetlands constitute a large portion of the County's floodplains. These areas perform an important flood storage function. The floodplain and flood-hazard areas within the County associated with these water bodies are discussed later within **Section III. Assessment of Hazard Conditions** of this report.

**Figure 3. Polk County Surface Water and Watersheds**

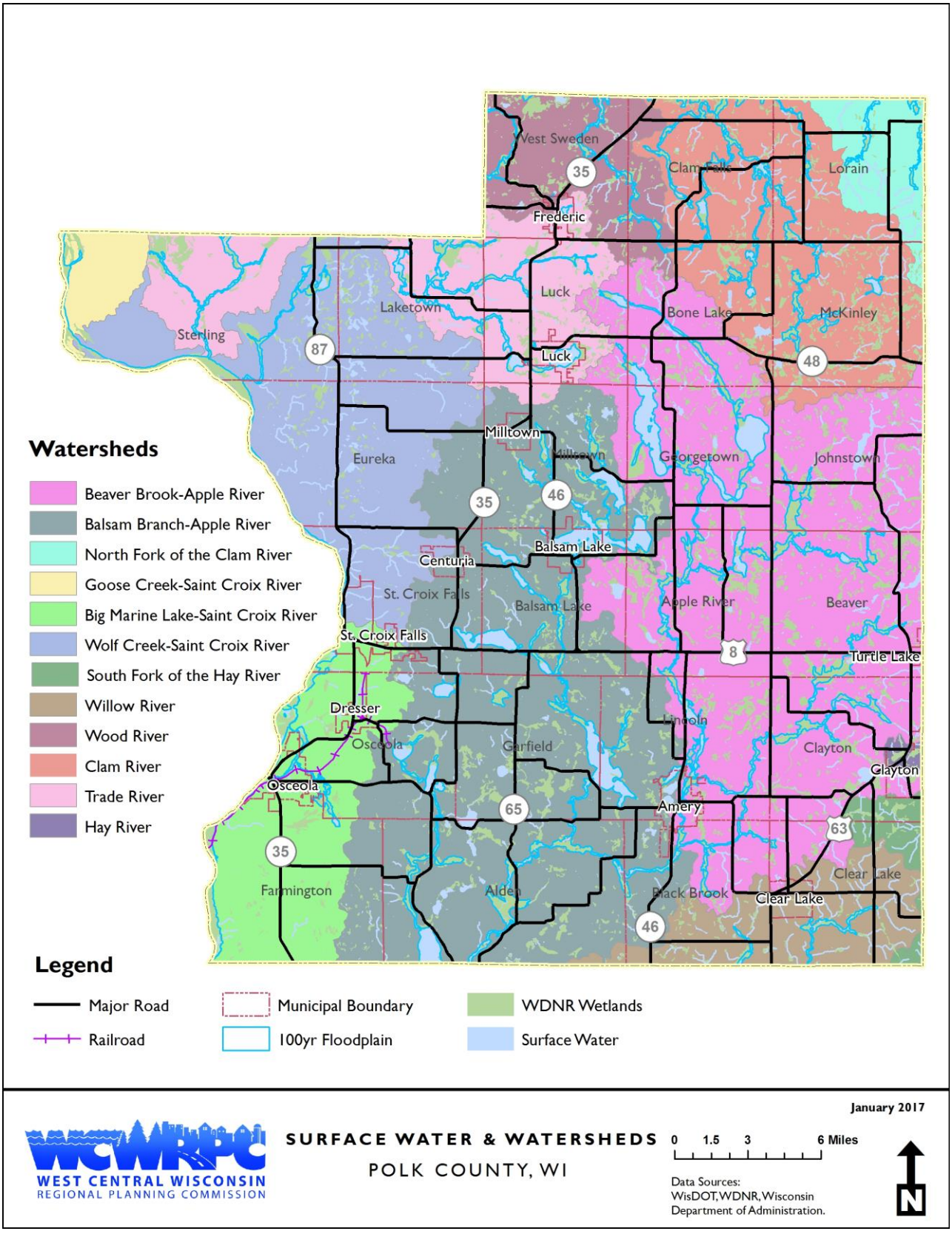
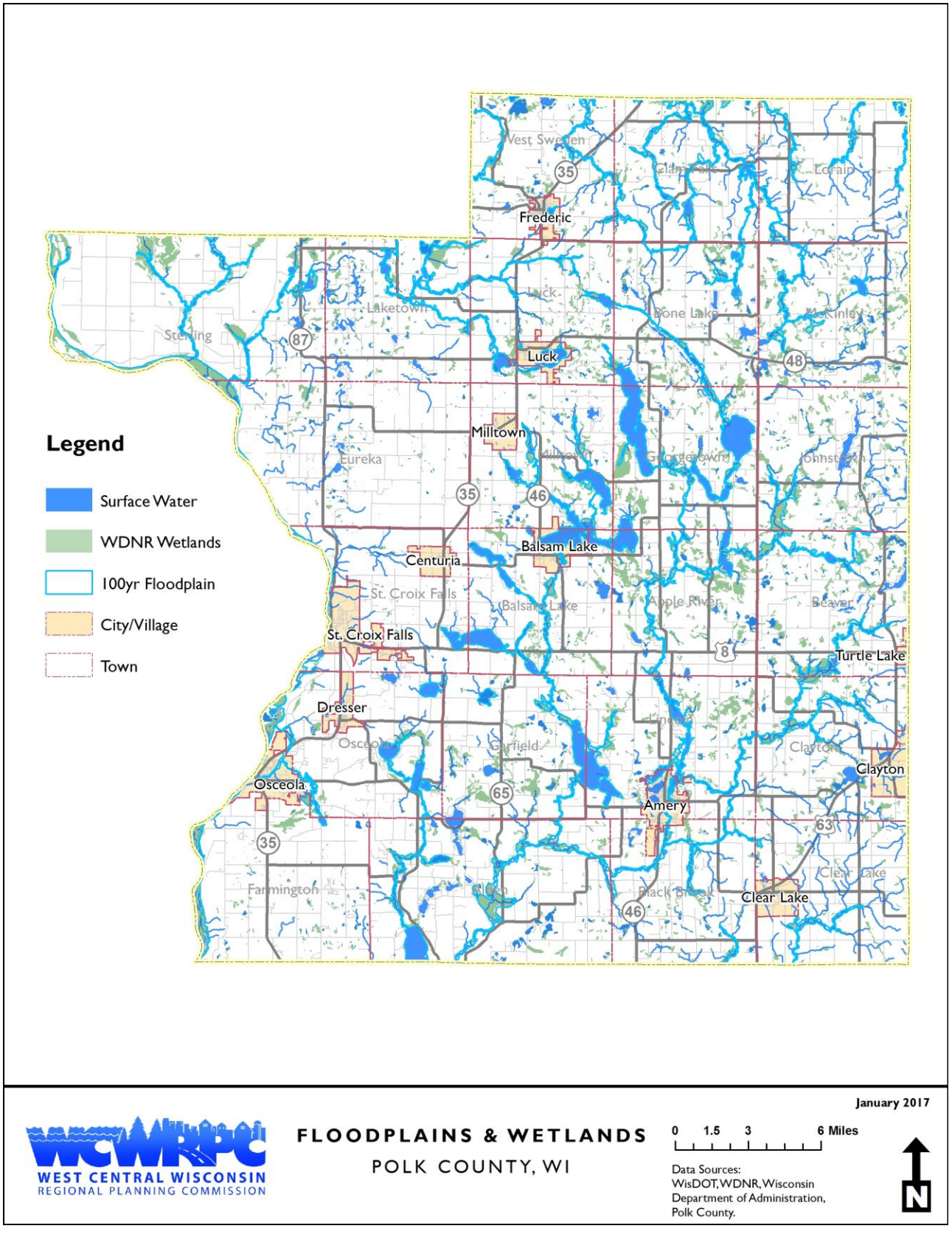


**Figure 4. Polk County Floodplains & Wetlands**



### iv. General Climate

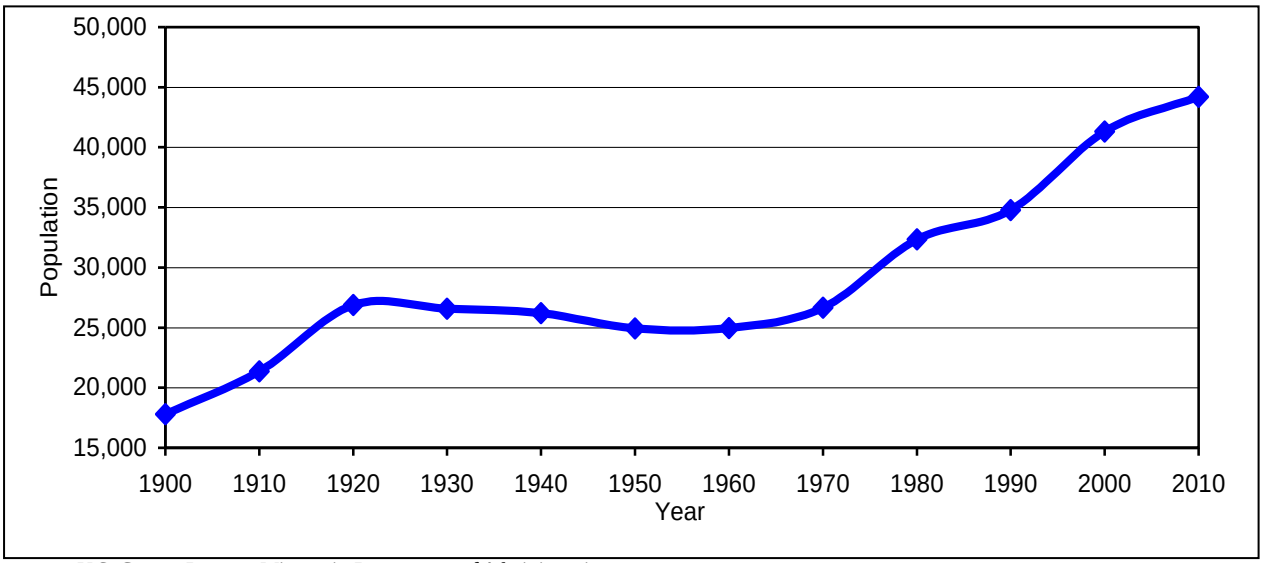
The climate of Polk County is classified as mid-latitude continental. Warm, humid summers and cold, snowy winters are the main characteristics. The average monthly temperature ranges from 15 degrees Fahrenheit in January to 73 degrees Fahrenheit in July. Annual precipitation averages 32 inches, with approximately two-thirds of this occurring as rain. Seasonal snowfall ranges from 12 to 75 inches. Polk County is susceptible to a range of natural hazards, including flooding. A description of these natural hazards, along with historical trends and current risks, is included in **Section III** of this report.

## C. DEMOGRAPHIC, ECONOMIC, AND LAND USE PROFILE

### i. Population

Polk County had a 2015 population estimate of 44,744, which is a seven percent increase since 2000 and a significant decrease in the growth rate compared to the previous decade (see **Figure 5**). Since 1960, the County's population has increased significantly, with the County's highest growth decade in the 1970s (21.3%). The population growth rate declined somewhat in the 1980s (7.5%) only to have the 1990s (18.8%) approach the growth of the 1970s.

**Figure 5. Polk County Historical Population • 1900 to 2010**




*source: U.S. Census Bureau; Wisconsin Department of Administration*

**Figure 6** on the following page shows the population change for Polk County communities between 1970 and 2010. The highest growth during this period occurred in the Town of Osceola, Town of Balsam Lake, and Village of Balsam Lake. But two trends are apparent. First, the highest growth since the 1970s has largely occurred in unincorporated towns, with the exception of the Village of Osceola, which has experienced significant growth. Second, the southwestern part of the Polk County (closest to the /Minneapolis-St. Paul-Bloomington MSA) has grown faster than the remainder of the County.

**Figure 6. Polk County Population Change • 1970 to 2010**

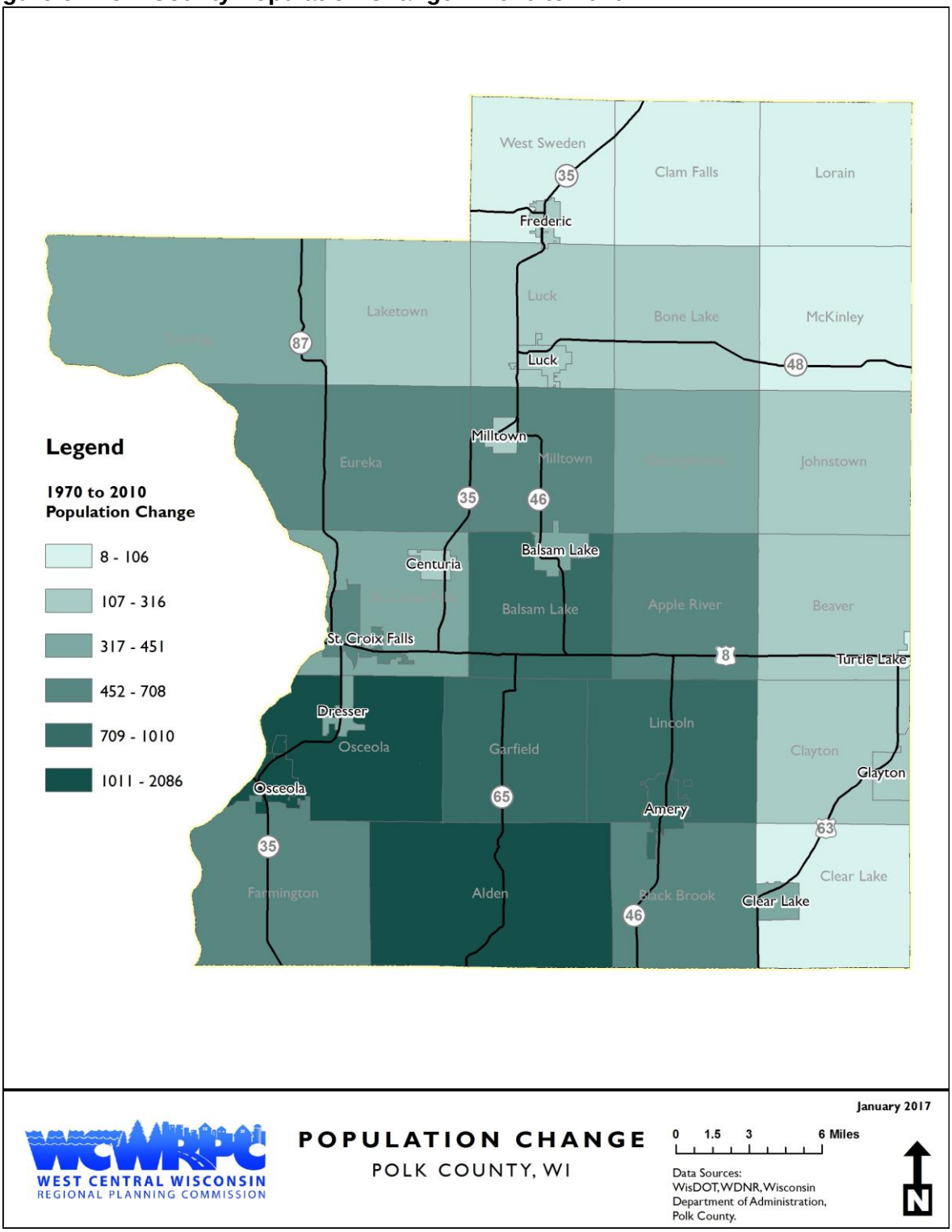



**Table 2** provides population trends for 1970 to 2010 by municipality. From 2000 to 2010, the Town of Osceola had the highest rate of population growth as a percentage of its population in Polk County at 36.9 percent.

## Table 2. Polk County Population Trends • 1970 to 2010

| | Year | | | | | Percent Change | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 1970 | 1980 | 1990 | 2000 | 2010 | '70-'80 | '80-'90 | '90-'00 | '00-'10 |
| **Towns** | | | | | | | | | |
| Alden | 1,406 | 1,862 | 2,133 | 2,615 | 2,786 | 32.4% | 14.6% | 22.6% | 6.5% |
| Apple River | 544 | 819 | 815 | 1,067 | 1,146 | 50.6% | -0.5% | 30.9% | 7.4% |
| Balsam Lake | 631 | 960 | 1,067 | 1,384 | 1,411 | 52.1% | 11.1% | 29.7% | 2.0% |
| Beaver | 641 | 755 | 663 | 753 | 835 | 17.8% | -12.2% | 13.6% | 10.9% |
| Black Brook | 775 | 949 | 964 | 1,208 | 1,325 | 22.5% | 1.6% | 25.3% | 9.7% |
| Bone Lake | 416 | 466 | 503 | 710 | 717 | 12.0% | 7.9% | 41.2% | 1.0% |
| Clam Falls | 522 | 614 | 596 | 547 | 596 | 17.6% | -2.9% | -8.2% | 9.0% |
| Clayton | 713 | 789 | 780 | 912 | 975 | 10.7% | -1.1% | 16.9% | 6.9% |
| Clear Lake | 793 | 777 | 744 | 800 | 899 | -2.0% | -4.2% | 7.5% | 12.4% |
| Eureka | 1,043 | 1,135 | 1,201 | 1,338 | 1,649 | 8.8% | 5.8% | 11.4% | 23.2% |
| Farmington | 1,156 | 1,195 | 1,267 | 1,625 | 1,836 | 3.4% | 6.0% | 28.3% | 13.0% |
| Garfield | 768 | 1,010 | 1,107 | 1,443 | 1,692 | 31.5% | 9.6% | 30.4% | 17.3% |
| Georgetown | 526 | 746 | 780 | 1,004 | 977 | 41.8% | 4.6% | 28.7% | -2.7% |
| Johnstown | 328 | 401 | 410 | 520 | 534 | 22.3% | 2.2% | 26.8% | 2.7% |
| Laketown | 725 | 909 | 921 | 918 | 961 | 25.4% | 1.3% | -0.3% | 4.7% |
| Lincoln | 1,198 | 1,683 | 1,835 | 2,304 | 2,208 | 40.5% | 9.0% | 25.6% | -4.2% |
| Lorain | 275 | 280 | 299 | 328 | 284 | 1.8% | 6.8% | 9.7% | -13.4% |
| Luck | 663 | 863 | 880 | 881 | 930 | 30.2% | 2.0% | 0.1% | 5.6% |
| McKinley | 297 | 337 | 327 | 328 | 347 | 13.5% | -3.0% | 0.3% | 5.8% |
| Milltown | 691 | 943 | 949 | 1,146 | 1,226 | 36.5% | 0.6% | 20.8% | 7.0% |
| Osceola | 769 | 1,066 | 1,337 | 2,085 | 2,855 | 38.6% | 25.4% | 55.9% | 36.9% |
| St Croix Falls | 783 | 873 | 1,034 | 1,119 | 1,165 | 11.5% | 18.4% | 8.2% | 4.1% |
| Sterling | 379 | 497 | 591 | 724 | 790 | 31.1% | 18.9% | 22.5% | 9.1% |
| West Sweden | 691 | 718 | 682 | 731 | 699 | 3.9% | -5.0% | 7.2% | -4.4% |
| **sub-total** | **16,733** | **20,647** | **21,885** | **26,490** | **28,843** | **23.4%** | **6.0%** | **21.0%** | **8.9%** |
| **Villages** | | | | | | | | | |
| Balsam Lake | 648 | 749 | 792 | 950 | 1,009 | 15.6% | 5.7% | 19.9% | 6.2% |
| Centuria | 632 | 711 | 790 | 865 | 948 | 12.5% | 11.1% | 9.5% | 9.6% |
| Clayton | 306 | 425 | 450 | 507 | 571 | 38.9% | 5.9% | 12.7% | 12.6% |
| Clear Lake | 721 | 899 | 932 | 1,051 | 1,070 | 24.7% | 3.7% | 12.8% | 1.8% |
| Dresser | 533 | 670 | 614 | 732 | 895 | 25.7% | -8.4% | 19.2% | 22.3% |
| Frederic | 908 | 1,039 | 1,124 | 1,262 | 1,137 | 14.4% | 8.2% | 12.3% | -9.9% |
| Luck | 848 | 997 | 1,022 | 1,210 | 1,119 | - | - | - | -7.5% |
| Milltown | 634 | 732 | 786 | 888 | 917 | 15.5% | 7.4% | 13.0% | 3.3% |
| Osceola | 1,152 | 1,581 | 2,075 | 2,421 | 2,568 | 37.2% | 31.2% | 16.7% | 6.1% |
| Turtle Lake* | 0 | 0 | 6 | 65 | 93 | 0.0% | 0.0% | 983.3% | 43.1% |
| **sub-total** | **6,382** | **7,803** | **8,591** | **9,951** | **10,327** | **22.3%** | **10.1%** | **15.8%** | **3.8%** |
| **Cities** | | | | | | | | | |
| Amery | 2,126 | 2,404 | 2,657 | 2,845 | 2,902 | 13.1% | 10.5% | 7.1% | 2.0% |
| St. Croix Falls | 1,425 | 1,497 | 1,640 | 2,033 | 2,133 | 5.1% | 9.6% | 24.0% | 4.9% |
| **sub-total** | **3,551** | **3,901** | **4,297** | **4,878** | **5,035** | **9.9%** | **10.2%** | **13.5%** | **3.2%** |
| **Total** | **26,666** | **32,351** | **34,773** | **41,319** | **44,205** | **21.3%** | **7.5%** | **18.8%** | **7.0%** |

*Portion of Turtle Lake located in Polk County only.

*source: U.S. Census Bureau*

The following communities also had high population growth: Town of Eureka (23.2%), Village of Dresser (22.3%), and Town of Garfield (17.3%) A number of municipalities experienced population losses, including the towns of Georgetown, Lincoln, Lorain, and West Sweden, and the villages of Frederic and Luck.


At approximately 46.4 persons per square mile on average, Polk County remains quite rural overall. The majority of residents continue to reside in the unincorporated towns and the percentage of the County's population in unincorporated areas continues to increase.

The average age of Polk County residents increased 7.3 years from 1980 to 2000 to 38.7 years. By 2010, the average age was 42.5 years, which was above the State of Wisconsin 2010 median age of 38.4 years. According to the 2015 estimates, about 29.3 percent of the population is under the age of 25, and 17.8 percent was age 65 and over.

Overall, Polk County's population is relatively homogenous, with 95.5 percent of the population in the White-alone racial group in 2015. During the previous decade, the population in other racial groups increased, with the White Hispanic and American Indian races increasing most in Polk County. In the past few years, the Hispanic population has passed the American Indian population as the County's largest minority population. Language and cultural barriers can pose challenges to education and outreach on weather awareness, available shelters, agricultural best practices, regulations, etc.

As shown in **Table 3**, the Wisconsin Department of Administration (WisDOA) projects a 21.8 percent increase (+9,620 residents) in the Polk County population between 2010 and 2040. Like recent trends, the percentage increases are projected to be highest in many of the towns. The largest rates of increase (all over 30 percent) are expected in the Towns of Beaver, Black Brook, Eureka, Farmington, Garfield, and Osceola, and the Village of Dresser. It is notable that Polk County's population is projected to peak in about 2035.

**Table 3. Polk County Population Projections • 2010 to 2040**

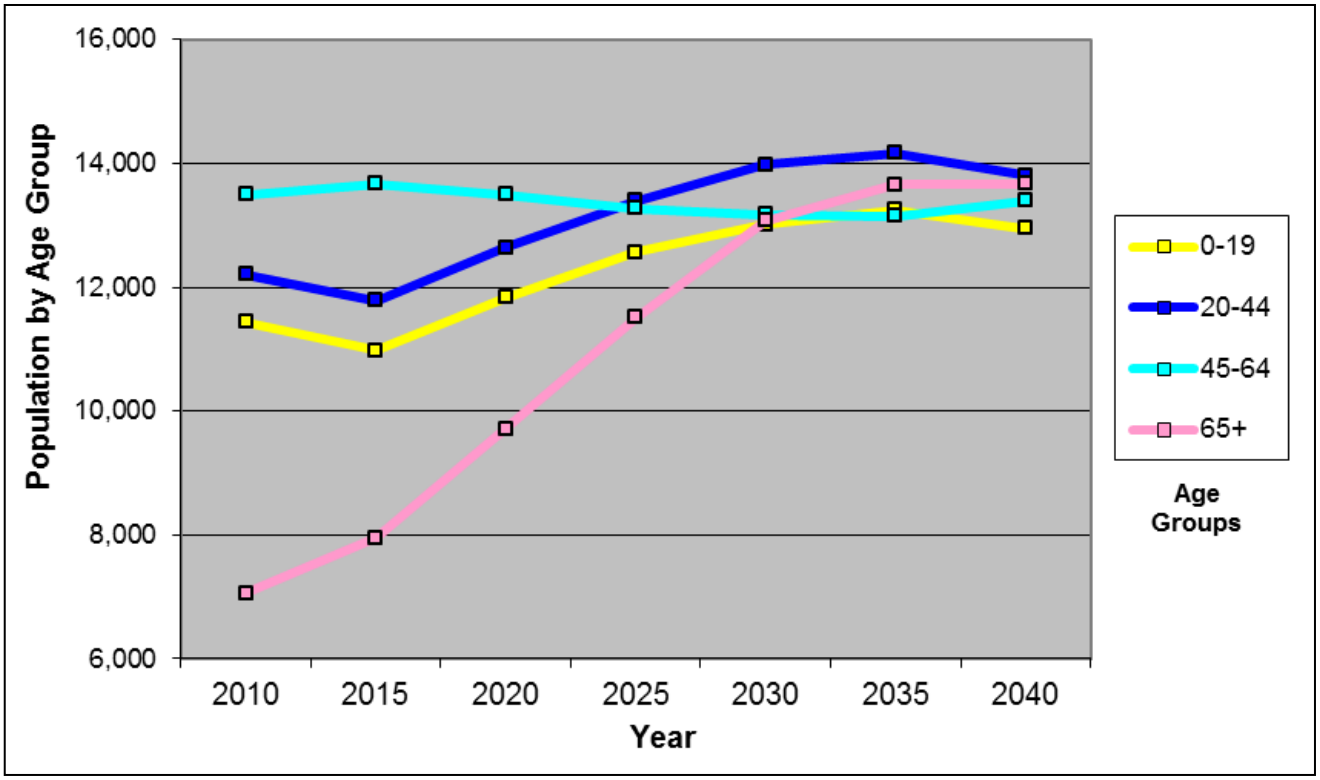
| Municipality | Census 2010 | Estimate 2016 | Proj. 2020 | Proj. 2025 | Proj. 2030 | Proj. 2035 | Proj. 2040 | % Change 2010-2040 |
|---|---|---|---|---|---|---|---|---|
| **Towns** | | | | | | | | |
| Alden | 2,786 | 2,790 | 3,035 | 3,250 | 3,420 | 3,495 | 3,475 | 24.7% |
| Apple River | 1,146 | 1,160 | 1,260 | 1,350 | 1,430 | 1,470 | 1,470 | 28.3% |
| Balsam Lake | 1,411 | 1,396 | 1,505 | 1,590 | 1,660 | 1,680 | 1,660 | 17.6% |
| Beaver | 835 | 838 | 930 | 1,015 | 1,085 | 1,125 | 1,140 | 36.5% |
| Black Brook | 1,325 | 1,340 | 1,470 | 1,590 | 1,685 | 1,740 | 1,745 | 31.7% |
| Bone Lake | 717 | 722 | 785 | 840 | 885 | 910 | 905 | 26.2% |
| Clam Falls | 596 | 612 | 635 | 675 | 700 | 710 | 700 | 17.4% |
| Clayton | 975 | 986 | 1,070 | 1,145 | 1,210 | 1,240 | 1,235 | 26.7% |
| Clear Lake | 899 | 898 | 990 | 1,060 | 1,125 | 1,155 | 1,155 | 28.5% |
| Eureka | 1,649 | 1,668 | 1,840 | 2,000 | 2,140 | 2,220 | 2,240 | 35.8% |
| Farmington | 1,836 | 1,843 | 2,030 | 2,195 | 2,335 | 2,410 | 2,425 | 32.1% |
| Garfield | 1,692 | 1,694 | 1,880 | 2,035 | 2,175 | 2,250 | 2,270 | 34.2% |
| Georgetown | 977 | 989 | 1,050 | 1,110 | 1,155 | 1,170 | 1,155 | 18.2% |
| Johnstown | 534 | 528 | 570 | 605 | 630 | 640 | 635 | 18.9% |
| Laketown | 961 | 972 | 1,030 | 1,085 | 1,130 | 1,140 | 1,120 | 16.5% |
| Lincoln | 2,208 | 2,206 | 2,270 | 2,355 | 2,410 | 2,395 | 2,325 | 5.3% |
| Lorain | 284 | 279 | 280 | 285 | 285 | 280 | 265 | -6.7% |
| Luck | 930 | 909 | 960 | 1,005 | 1,030 | 1,030 | 1,005 | 8.1% |
| McKinley | 347 | 352 | 375 | 395 | 415 | 420 | 415 | 19.6% |
| Milltown | 1,226 | 1,230 | 1,325 | 1,415 | 1,490 | 1,520 | 1,510 | 23.2% |
| Osceola | 2,855 | 2,869 | 3,235 | 3,545 | 3,825 | 3,995 | 4,055 | 42.0% |
| St Croix Falls | 1,165 | 1,162 | 1,245 | 1,315 | 1,370 | 1,385 | 1,370 | 17.6% |
| Sterling | 790 | 775 | 835 | 885 | 925 | 940 | 930 | 17.7% |
| West Sweden | 699 | 692 | 715 | 740 | 750 | 740 | 715 | 2.3% |
| **Subtotal:** | **28,843** | **28,910** | **31,320** | **33,485** | **35,265** | **36,060** | **35,920** | **24.5%** |
| **Villages** | | | | | | | | |
| Balsam Lake | 1,009 | 1,010 | 1,070 | 1,135 | 1,185 | 1,200 | 1,185 | 17.4% |
| Centuria | 948 | 943 | 985 | 1,035 | 1,070 | 1,075 | 1,055 | 11.3% |
| Clayton | 571 | 567 | 625 | 670 | 710 | 730 | 730 | 27.8% |
| Clear Lake | 1,070 | 1,061 | 1,130 | 1,185 | 1,225 | 1,235 | 1,210 | 13.1% |
| Dresser | 895 | 899 | 1,000 | 1,085 | 1,160 | 1,205 | 1,215 | 35.8% |
| Frederic | 1,137 | 1,133 | 1,155 | 1,180 | 1,190 | 1,165 | 1,110 | -2.4% |
| Luck | 1,119 | 1,096 | 1,100 | 1,115 | 1,120 | 1,085 | 1,030 | -8.0% |
| Milltown | 917 | 912 | 975 | 1,030 | 1,070 | 1,085 | 1,070 | 16.7% |
| Osceola | 2,568 | 2,598 | 2,820 | 3,020 | 3,185 | 3,255 | 3,245 | 26.4% |
| Turtle Lake* | 93 | 92 | 95 | 95 | 95 | 90 | 85 | -8.6% |
| **Subtotal:** | **10,327** | **10,311** | **10,955** | **11,550** | **12,010** | **12,125** | **11,935** | **15.6%** |
| **Cities** | | | | | | | | |
| Amery | 2,902 | 2,918 | 3,120 | 3,295 | 3,425 | 3,460 | 3,410 | 17.5% |
| St. Croix Falls | 2,133 | 2,097 | 2,285 | 2,430 | 2,540 | 2,585 | 2,560 | 20.0% |
| **Subtotal:** | **5,035** | **5,015** | **5,405** | **5,725** | **5,965** | **6,045** | **5,970** | 18.6% |
| **Polk County** | **44,205** | **44,236** | **47,680** | **50,760** | **53,240** | **54,230** | **53,825** | **21.8%** |

*Portion of Turtle Lake located in Polk County only.

*source: U.S. Census Bureau & Wisconsin Department of Administration, Demographic Services Center, as of 12/28/16*

**Figure 7** shows Polk County's projected population by age group, reflecting that the baby boomer generation is dramatically becoming a larger proportion of the County's population. Between 2005 and 2040, the number of residents ages 65 and over is projected to more than double. This trend has serious future implications for services, housing, and the labor force.

**Figure 7. Polk County Age Group Projections • 2010 to 2040**




*source: Wisconsin Department of Administration, 2014*

## ii. Housing

As residential growth occurs in Polk County, so does the value of improvements which could potentially be vulnerable to natural hazard events. And the continued population growth in Polk County has created a corresponding demand for additional housing as shown in **Table 4** below. During the 1980s, the growth in housing units was nearly double the County's population growth, likely reflecting a sizable jump in seasonal homes during the time period. During the 1990s, the County's population grew by 18.8 percent, above the housing unit increase. During the past decade, the growth in the percentage of housing units more than doubled the growth in population during the same time period.

**Table 4. Polk County Housing Unit Change • 1980 to 2010**

| Year | Number of Housing Units | Numerical Change | Percent Change |
|---|---|---|---|
| 1980 | 16,228 | | |
| 1990 | 18,562 | +2,334 | +14.4% |
| 2000 | 21,129 | +2,567 | +13.8% |
| 2010 | 24,248 | +3,119 | +14.8% |

*Source: 1980, 1990, 2000, & 2010 Census*

Shown in **Table 5** are the housing unit projections for Polk County for the years 2010 through 2040 based on the previous population projections and maintaining the 2010 radio of housing units per resident (1.8 persons per housing unit).

**Table 5. Polk County Housing Unit Forecast • 2010 to 2040**

| | 2010 *Census* | 2015 *Projection* | 2020 *Projection* | 2025 *Projection* | 2030 *Projection* | 2035 *Projection* | 2040 *Projection* |
|---|---|---|---|---|---|---|---|
| Population | 44,205 | 44,390 | 47,680 | 50,760 | 53,240 | 54,230 | 53,825 |
| Housing Units | 24,248 | 24,661 | 26,489 | 28,200 | 29,578 | 30,128 | 29,903 |
| Housing Unit Change | | +1.8% | +7.4% | +6.5% | +4.9% | +1.9% | -0.1% |

*Source: WCWRPC based on U.S. Census and Wisconsin Department of Administration estimates*

Approximately 20 percent of the County's total housing supply in 2010 (or 4,885 units) were seasonal, which is an increase in the number of seasonal units since 2000 (4,211). Seasonal units are used or intended for use only in certain seasons (e.g., beach cottages and hunting cabins) or for weekend or occasional use throughout the year. Seasonal units may also include quarters used for seasonal workers such as loggers. Despite this growth in seasonal units, there is anecdotal evidence that the number of seasonal units is decreasing over much of the region as these structures are being converted to year-round homes, which has implications for local and emergency services.

Also of interest, 77 percent of all housing units in Polk County in 2015 were owner-occupied (not rented), which is significantly above the State of Wisconsin average of 68.1 percent. Only 16.1 percent of the County's housing units were located within 3+ multi-unit structures (e.g. apartments), which is far below the State-wide average of 22.4 percent. A total of 1,990 housing units (8.2 percent of all units) in 2015 were mobile homes, almost triple the State of Wisconsin average of 2.9 percent.

## iii. Economic Overview

Economic characteristics and growth influence land use and may present unique hazard mitigation and emergency response challenges. The extent to which economic activities are vulnerable to natural hazard risks varies by the characteristics of the activity and the level of preparedness. The economy of a county is an important determining factor driving land use and development. **Table 6** shows the employment trends between 2006 and 2016 by industry sector in Polk County. There are over 1,100 payrolled business locations in Polk County, resulting in over 18,200 jobs.

**Table 6. Polk County Establishments & Employment By Industry Sector**

| Industry Sector (2-digit NAICS) | 2016 Payrolled Business Locations | 2006 Jobs | 2016 Jobs | 2006 - 2016 % Change | 2016 Location Quotient |
|---|---|---|---|---|---|
| Manufacturing | 109 | 3,900 | 3,906 | 0% | 2.72 |
| Government | 123 | 2,677 | 2,712 | 1% | 0.97 |
| Health Care and Social Assistance | 109 | 2,202 | 2,699 | 23% | 1.17 |
| Retail Trade | 134 | 1,960 | 1,908 | (3%) | 1.00 |
| Administrative and Support and Waste Management and Remediation Services | 46 | 531 | 1,389 | 162% | 1.22 |
| Accommodation and Food Services | 113 | 1,292 | 1,153 | (11%) | 0.74 |
| Construction | 109 | 1,367 | 925 | (32%) | 0.94 |
| Other Services (except Public Administration) | 82 | 755 | 656 | (13%) | 0.75 |
| Crop and Animal Production | 34 | 516 | 553 | 7% | 2.50 |
| Professional, Scientific, and Technical Services | 73 | 398 | 509 | 28% | 0.43 |
| Wholesale Trade | 42 | 504 | 379 | (25%) | 0.54 |
| Finance and Insurance | 48 | 476 | 354 | (26%) | 0.50 |
| Transportation and Warehousing | 38 | 331 | 266 | (20%) | 0.44 |
| Arts, Entertainment, and Recreation | 20 | 272 | 238 | (13%) | 0.77 |
| Information | 15 | 331 | 185 | (44%) | 0.55 |
| Real Estate and Rental and Leasing | 25 | 132 | 114 | (14%) | 0.38 |
| Utilities | 7 | 116 | 104 | (10%) | 1.60 |
| Management of Companies and Enterprises | 4 | 15 | 76 | 407% | 0.29 |
| Mining, Quarrying, and Oil and Gas Extraction | 3 | 23 | 55 | 139% | 0.75 |
| Educational Services | 6 | 37 | 52 | 41% | 0.11 |
| **Totals** | 1,139 | 17,835 | 18,234 | 2% | |

*Source: EMSI.*

In recent years, the Administrative, Support, Water Management, and Reclamation Services sector has been growing at a faster rate in Polk County. These jobs provide routine support services for the day-to-day operations of other organizations and residents. Although growing no jobs from 2006 to 2016, Manufacturing employs the most people in the County. Retail Trade experienced a three percent decline in employment, but has the most Payrolled Business Locations.

In 2015, about 60.5 percent of the workers living in the County were employed within Polk County. In addition, the County has a 29.6 minute mean travel time to work, and 57.9 percent of employed residents commuted 20 minutes or longer, which is a significant increase from 1990 (39.7 percent) and 2000 (50.8 percent). In short, Polk County residents are commuting longer distances to their place of employment, which partly reflects the in-migration of new residents during recent decades and people commuting to St. Croix County and the Twin Cities. The 2015 per capita personal income in the County of $50,714 was 95 percent of the State average.

## iv. Property Values

A disaster event can result in impacts to the natural environment, life and safety, the economy, structures, and personal property. This sub-section provides insight into the taxable improvements and personal property within Polk County.

According to the Wisconsin Department of Revenue, the aggregated assessed value for Polk County was just over 4.3 billion.[3] **Table 7** at the right summarizes the 2015 Statement of Assessments for the County. This reflects the overall rural nature of Polk County, with a relatively high proportion of the aggregate value in land and a much lower proportion in personal property when compared to urban areas.

**Table 7. Polk County 2015 Assessed Total Values**
*(not equalized)*

| | |
|---|---|
| Land | $ 1,464,296,250 |
| Improvements | $ 2,804,124,200 |
| Real Estate | $ 4,268,420,450 |
| Personal Property | $ 66,524,130 |
| Aggregate | $ 4,334,944,580 |

From 2009 to 2015, the County's total assessed value of improvements by almost $140 million, not adjusting for inflation, (4.8 percent). This decrease is most likely due to the Great Recession in the mid and late 2000s. **Table 8** further breaks down the 2015 assessed values by primary land uses. The large percentage of the improvements value is residential, and the relatively low values in commercial and manufacturing also reflect the rural nature of Polk County.

**Table 8. Polk County Assessed Value by Land Use • 2015**

| Use | Number of Parcels | Land Value | Number of Improved Parcels | Improvements | Total |
|---|---|---|---|---|---|
| Residential | 26,060 | $ 1,036,527,800 | 20,946 | $ 2,330,982,300 | $ 3,367,510,100 |
| Commercial | 1,568 | 73,459,600 | 1,257 | 271,182,500 | 344,642,100 |
| Manufacturing | 139 | 10,383,500 | 109 | 84,794,000 | 95,177,500 |
| Agricultural | 10,172 | 35,109,600 | 0 | 0 | 35,109,600 |
| Undeveloped | 8,761 | 42,008,950 | 0 | 0 | 42,008,950 |
| Forest | 5,128 | 200,852,500 | 0 | 0 | 200,852,500 |
| Ag Forest | 3,626 | 54,536,400 | 0 | 0 | 54,536,400 |
| Other | 1,171 | 11,417,900 | 1,167 | 117,165,400 | 128,583,300 |
| Totals | 56,625 | $ 1,464,296,250 | 23,479 | $ 2,804,124,200 | $ 4,268,420,450 |

*source: Wisconsin Department of Revenue. 2015 Statement of Assessments.*

Not included in the above values are tax-exempt properties. Polk County has over 60,000 acres of public resource lands, mostly forested, which are tax-exempt. Governmental facilities and schools constitute the largest portion of those existing improvements not included in Tables 7 and 8, though other facilities on tax-exempt lands owned by non-profit institutions (e.g., churches) are also not included.

[3] Wisconsin Department of Revenue, Bureau of Equalization. 2015 Statement of Assessments, Unequalized assessed values are used to best represent the actual value of improvements. Not all assessed values were available for all categories.

## v. General Development Pattern

Polk County is located northeast of the Minneapolis-St. Paul metropolitan area, and is contiguous to the Minneapolis-St. Paul Metropolitan Statistical Area (MSA). The Census Bureau defines a Metropolitan Statistical Area (MSA) as a county or counties with a central city of at least 50,000 people, a total population over 100,000 people, and significant social and economic ties which exist between the central city and any outlying counties that are included. Based on that definition, St. Croix County became part of the Minneapolis-St. Paul MSA in 1980 and Pierce County in 1990. Consequently, even though Polk County is not currently a part of the MSA, it is apparent that the influence of the metro area is spreading, and that Polk County is becoming more economically and socially interconnected to the MSA.

**Figure 8** shows the general land cover in Polk County. Forests and hay/pasture dominate most of the county. In 2014, the county had an overall population density of 46.4 persons per square mile, which is much less than the State of Wisconsin density of 86.8 persons per square mile. Based on State official population projections, the county's density is projected to increase to 56.3 persons per square mile by 2040. Population growth and development has occurred disproportionately in the southwestern portion of the County.

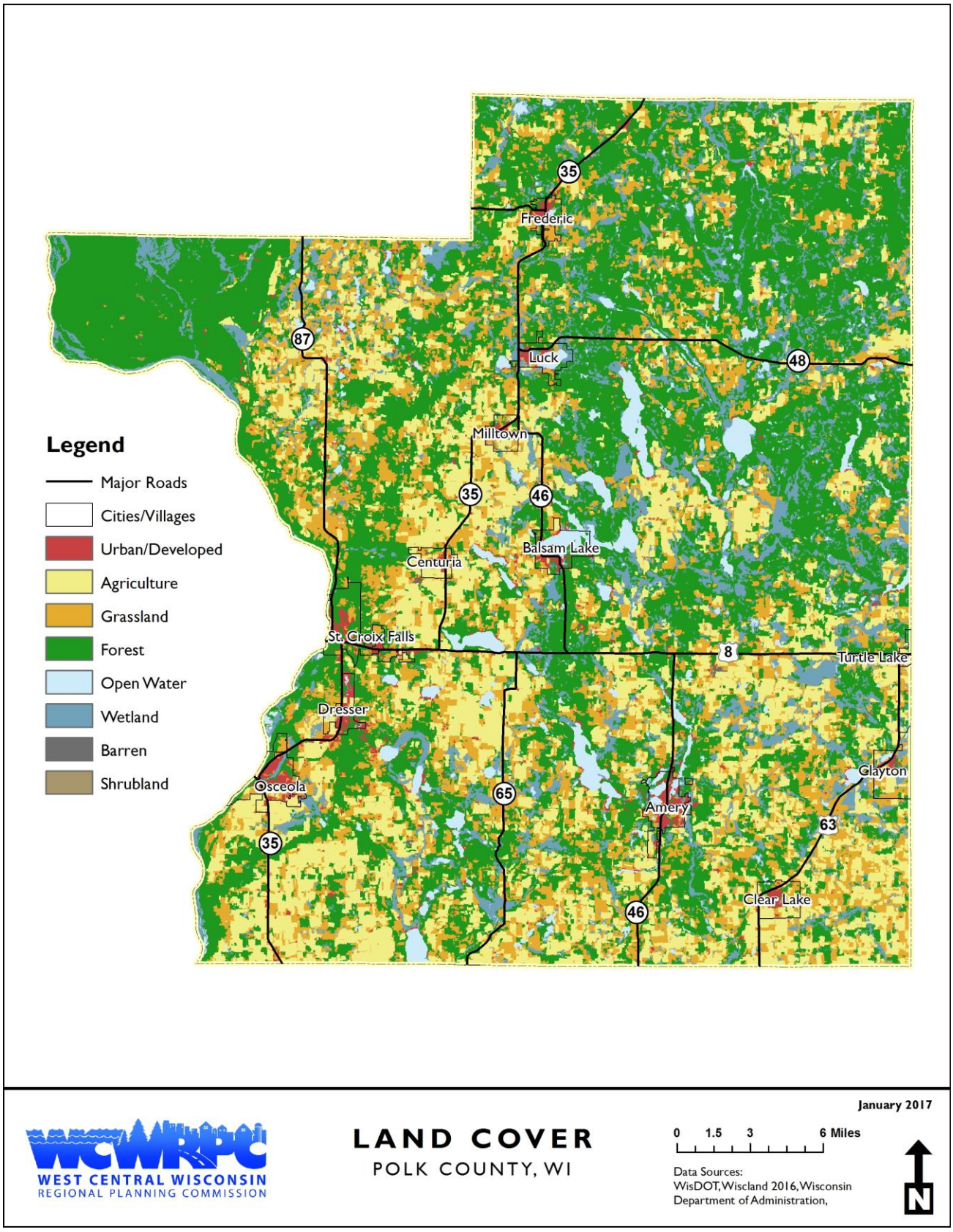
Between 2012 and 2015, Polk County experienced an increase of 233 (23,246 and 23,479) improved, assessed parcels, or an average increase of 77 parcels per year. The far majority of these improvements occurred on residential-assessed parcels. The County experienced a net loss of seven commercial improved parcels and no net change in manufacturing improved parcels.

Almost 76 percent of all residential-improved parcels and over 94 percent of all residential-assessed acreage in Polk County are located in the unincorporated towns. Residential development in unincorporated areas is typically at low densities within Polk County, with some higher concentrations of residential development occurring along or near lakes. Most commercial and industrial uses tend to be located within incorporated areas or within highway corridors.

While the unincorporated towns in Polk County have 48 percent of the assessed commercial and manufacturing acreage in the county, the per-acre combined assessed value of commercial and manufacturing land and improvements are over eight times higher in cities and almost four times higher in villages, compared to the towns. This reflects that commercial activity in cities and villages is more intensive, concentrated, and includes commercial or industrial uses much larger in scale than in the towns.

The most prevalent land uses in Polk County are agricultural and forest. In fact, almost 75 percent of the assessed land in the county is considered agricultural or forest. Land assessed as "undeveloped" accounts for another 14 percent of the assessed land in the county. When including the acres of public natural resource lands, over 90 percent of the county is in agricultural, forest, wetlands, surface waters, or is otherwise undeveloped.

**Figure 8. Polk County Land Cover**



## vi. Implications

Polk County population and development trends have many implications for emergency services and hazard mitigation, including:

1. Increases in population, housing, and other new development increases the vulnerabilities to hazard risks. Growth can also increase the risk of flooding by increasing stormwater runoff, disrupting natural drainage systems, and reducing flood storage.
2. Increases in population and housing also result in increasing demand for emergency services, which is a special challenge during current governmental budgetary conditions.
3. With the largest percentages of growth occurring in rural areas, costs to provide services and emergency response times increase. In addition, communications and mitigating potential impacts are often more challenging (e.g., warning systems, public storm shelters).
4. The county has experienced a recent trend of an in-migration of Hispanic residents who may have differing expectations of emergency service levels, may not be aware of local emergency procedures or contacts, and may not have knowledge of local hazard risks or event history. For many of the Hispanic population, English is second language.
5. Polk County's population is aging. Demands for senior services in the county will only increase, including for emergency response. The aging population poses unique challenges for emergency preparedness and response services, such as sheltering-in-place and evacuation strategies. Large numbers of seniors who reside in rural areas may need special attention during a hazard event (e.g., transportation for dialysis during a winter storm, access to medicine).
6. The County's growth, overall, is projected to peak or plateau in about 2035. As such, the next 10-20 years may pose the greatest labor and provision-of-services challenges for the foreseeable future, until the "boomer generation" plateaus as a percent of the overall population.
7. There is significant geographic variability in the county's population and development trends with more population and growth generally in areas south of US Highway 8 and west of Highway 46. Emergency service's needs, mitigation priorities, and local resources will vary by community and area.
8. In some areas, there have been significant numbers of new slab-on-grade residential construction during the past decade. These housing units may not have access to a safe room or storm shelter. Large numbers of mobile homes also exist in the county, which are more vulnerable during certain types of storm events.
9. Polk County's many farming and agricultural operations have unique hazard risks and vulnerabilities that must be considered, prepared for, and mitigated, if possible. The large amount of public and private forest lands and shoreland development, with associated outdoor recreational uses and seasonal homes, also has unique risks and challenges.
10. Manufacturing continues to be a large part of the County's economy, but does have inherent disaster risks and vulnerabilities, such as larger-span buildings, concentrations of employees, and hazardous materials.

## vii. Potential Impact of the St. Croix Crossing Project

The new Highway 64 bridge crossing near Stillwater (about 30 minutes south of Osceola) is expected to open in late 2017. This $600+ million bridge project will replace an older, aging lift bridge that was the cause of extended traffic jams and safety concerns. Many have speculated that the new bridge will be spur significant growth within Polk County.

A 2014 University of Wisconsin-Extension study suggests that the likely impacts may not change the economic and demographic landscape to the extent that many believe. Key findings from this study suggest:

- New bridges can facilitate growth, but do not drive or spur growth. An area tends to continuing growing at a similar pace after bridge completion; there is no growth "spike" following completion.
- Growth outside the Twin Cities central metro area has decreased dramatically. While Polk County's demographics is aging, Millennials are preferring to live in urban areas. This is consistent with similar national trends. The study suggests that St. Croix County will continue to grow, but, for the foreseeable future, this growth will likely be at a rate that is less than the 1990s and 2000s. A similar trend is likely for Polk County, though the study did focus on St. Croix.
- The decisions made by communities (e.g., policies, infrastructure, quality of life) have the potential to shape and influence growth.
- The improved river crossing will significantly decrease drive times and will increase access to jobs in the area (reverse, urban-to-rural commuters). But communities will also need to attract and retain residents and businesses on the basis of other local economic and quality-of-life characteristics.
- Most employment growth in the region (and nationally) is driven by new startups and through the expansion of existing businesses. It is unlikely that the bridge project would be a major contributing factor for the relocation of numerous major employers to western Wisconsin.

One segment of the economy that could experience significant benefits from the new bridge crossing is tourism. However, potential impacts to tourism were not analyzed as part of the 2014 UW-Extension study.

## D. CRITICAL FACILITIES & EMERGENCY SERVICES

For this hazard mitigation planning effort, a critical facility is defined as either:

(1) a facility in either the public or private sector that provides essential products or services to the general public, is otherwise necessary to preserve the welfare and quality of life in Polk County, or fulfills important public safety, emergency response and/or disaster recovery functions; or,

(2) a high potential loss facility (e.g., nuclear plant, military installation, extreme hazardous materials plant) with possible substantial secondary impacts resulting from a natural hazards event. No high potential loss facilities were identified in Polk County.

The primary critical facilities in Polk County include:

- government buildings & utilities
- hospitals and primary clinics
- Pre-K through 12 schools
- radio and cell towers
- law enforcement and emergency services facilities
- assisted living facilities and nursing homes
- child care centers (not mapped)
- high voltage transmission lines, substations, and other regional utility lines

The Polk County Land Information Department has been proactive in its development of G.I.S. databases that map the majority of these facilities as listed in **Appendix E**. The general locations of most facilities are shown in **Figure 9** on the following page, in addition to approximate locations of the major natural gas and electric transmission lines and substations. Not surprisingly, higher concentrations of facilities are located in the cities and villages.

Appendix E does not include all critical facilities at this time, such as radio/cell tower locations and all public utilities. In some cases, certain critical facilities are not listed or mapped due to security reasons. Child care facilities and certain other long-term care facilities (e.g., group homes) are included in Appendix E but have not yet been mapped. For reference, the boundaries for fire and ambulance services within Polk County are shown in **Figures 10** and **11.**

About 52 percent of Polk County is served by the Polk-Burnett Electric Cooperative, with two independent electric providers (Northwestern Wisconsin Electric Company and Xcel Energy) serving an additional 23 percent each. The remainder of the County is served by three electric cooperatives (St. Croix, Barron, and Dunn cooperatives). Electric cooperatives and municipal utilities are eligible for FEMA hazard mitigation grant funding, but it is strongly recommended that they actively participate in the development of a hazard mitigation plan and include their projects within said plan.

The risk and vulnerability assessment (**Section III.B.**) further analyzes the critical facilities to determine potential impacts by a natural hazard event. Overall, tornadoes were viewed as the greatest hazard threat to the critical facilities of Polk County as reflected in Appendix E.

**Figure 9. Polk County Critical Facilities**

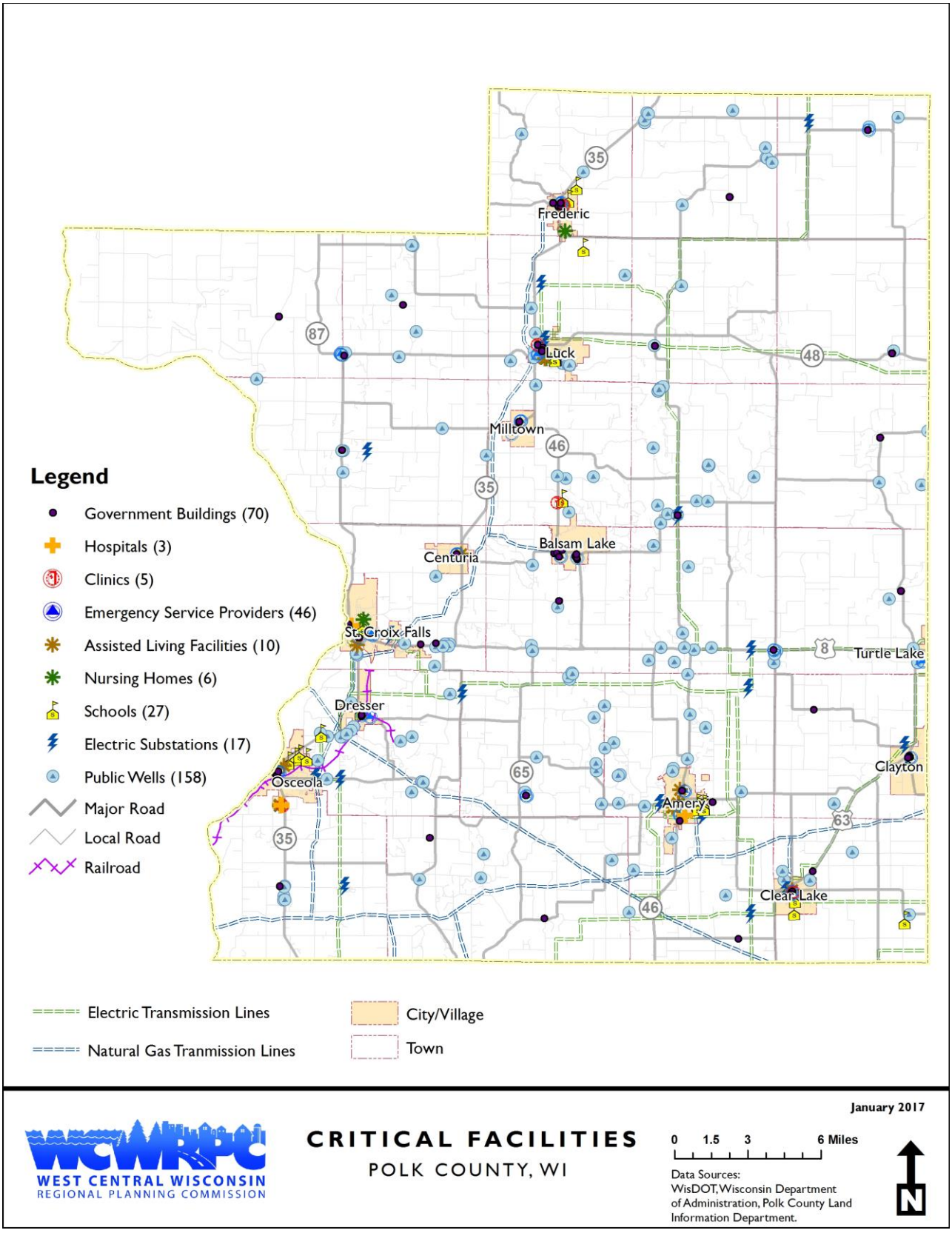


**Figure 10. Primary Fire Department Service Areas in Polk County**

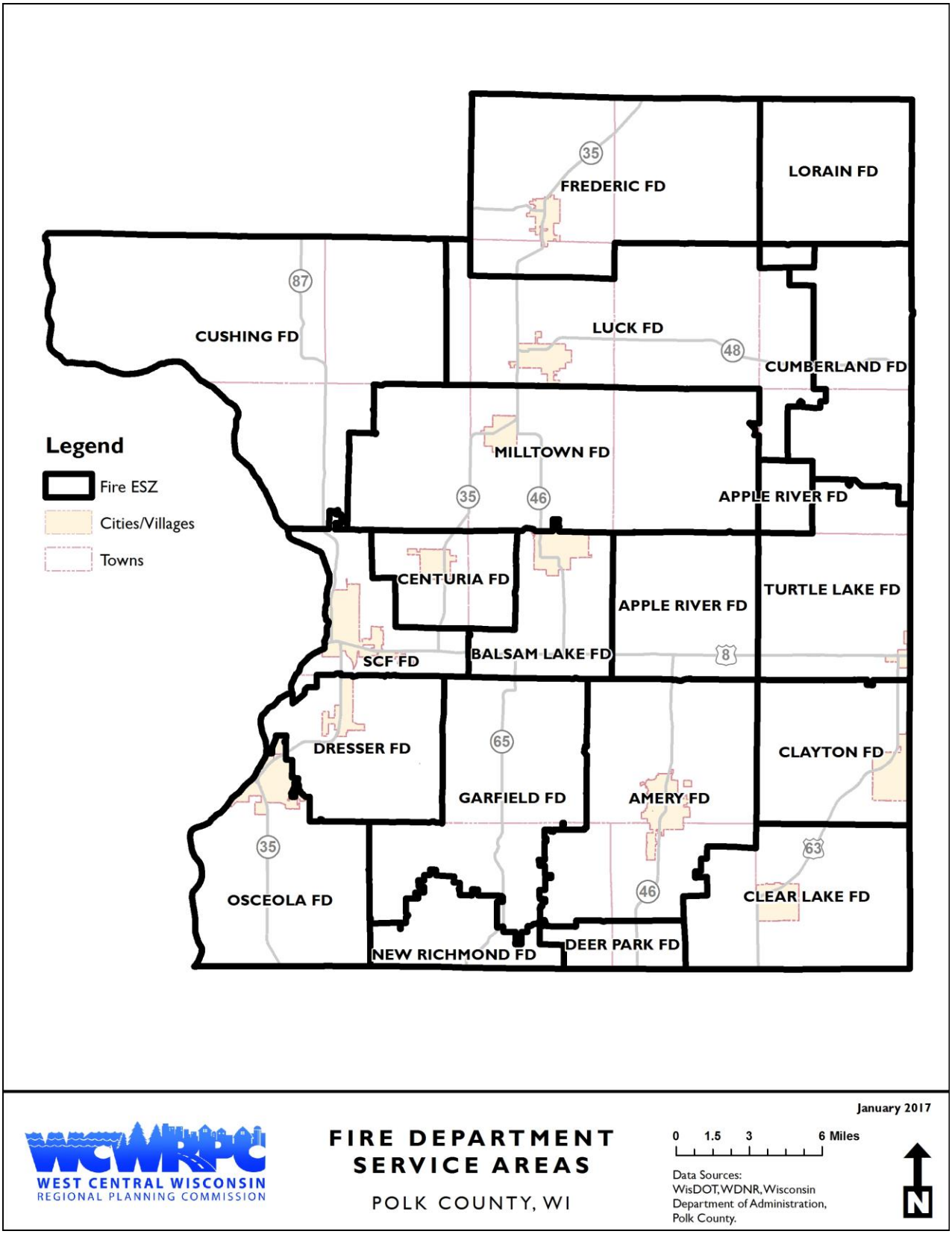
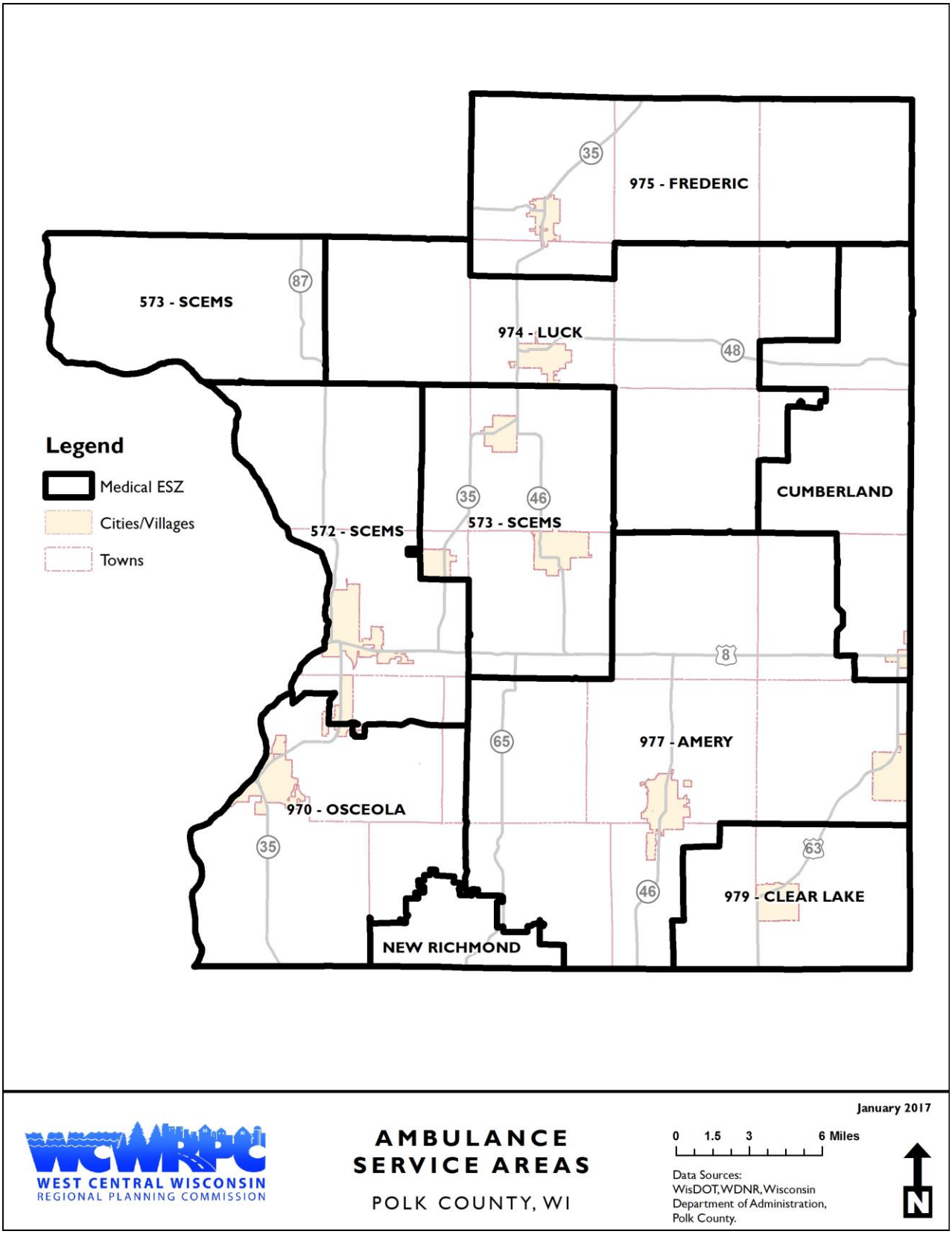


**Figure 11. Primary Ambulance Service Areas in Polk County**



## E. HAZARDOUS MATERIAL STORAGE AND USE

Hazardous materials can present special risks to humans and the environment at the time of disaster as well as necessitate special precautions and resources for post-disaster clean-up. As of March 2017, there were 51 Tier Two Reporting facilities and 8 EHS Planning facilities located within Polk County. A Tier Two facility, by law (SARA Title III), is required to prepare or have available a Safety Data Sheet (SDS) for a hazardous chemical present at the facility and must submit annual reports to Wisconsin Emergency Management (WEM), Polk County Local Emergency Planning Committee (LEPC), and the local fire department. EHS (Extremely Hazardous Substances) facilities store and/or use one or more of over 300 chemicals with extremely toxic properties, and must also maintain the MSDS and prepare annual reports. EHS Planning facilities have extremely hazardous substances in such quantity (thresholds vary by type) that an emergency plan must be prepared by the owner/operator and submitted to WEM and the LEPC.

The majority of these facilities are located within incorporated areas, with a number of cities and villages having between four and six such facilities. For security reasons, the names, addresses, and types of chemicals at each of these facilities are not included within this report, but are on file at the Polk County Emergency Management Office for reference, as needed.

During Steering Committee meetings and the key-informant interview process, no unique natural hazard vulnerabilities were identified for any of the Tier Two or EHS facilities. A G.I.S. database with the locations for most of these facilities is maintained by Polk County and was used to compare to these locations to the official flood insurance rate maps; none of these facilities was identified as being sited within a 100-year floodplain.

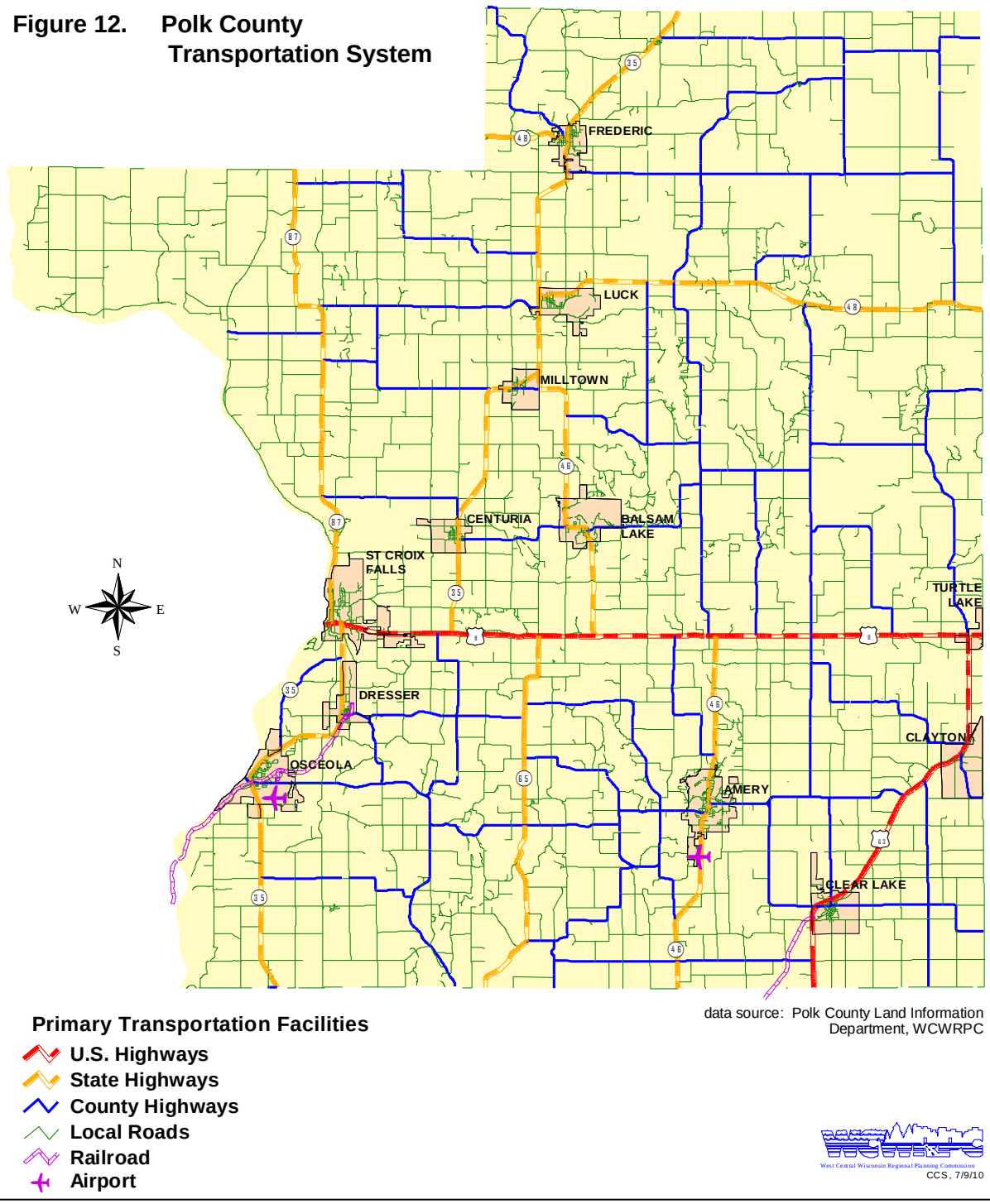
## F. TRANSPORTATION SYSTEMS

Providing an uninterrupted transportation network is critical to Polk County, given that residents often travel significant distances for services, critical facilities, and employment. The highway system serving Polk County links residents and businesses to the employment centers and services in the Twin Cities area as well as in St. Croix and Barron counties. As stated previously, Polk County residents are commuting farther to their place of work. Increasing commuter traffic to the metropolitan area to the southwest has resulted in high traffic volume growth rates. Approximately 40 percent of employed residents commuted to places of work outside Polk County.

The County's size and road miles can be a challenge for road crews and emergency personnel during and after a natural hazard event (e.g., snow removal, downed trees, culvert washouts). Polk County maintains over 331 miles of county trunk highway (see **Figure 12**), reflecting the largely rural nature of much of the County. Only 159.2 miles of highways with State jurisdiction exist in the County. The County also has 72 bridges, 21 of which are owned by the County and 13 owned by the State of Wisconsin. Rail service in the County has diminished over the past century, with current service limited to Osceola and Dresser through a Canadian National line. The two public airports in Amery and Osceola have no scheduled passenger service, and the

Minneapolis-St. Paul International Airport is expected to continue to provide the primary commercial air service for Polk County residents and businesses. While rail service has decreased, recreational transportation systems have increased. Polk County boasts over 360 miles of snowmobile trails, 27.8 miles of ATV/trail bike trails, almost 70 miles of cross-country ski trails, a 30-mile horseback trail, and over 131 miles of hiking and walking trails, not including snowmobile club trails, bicycle paths/routes, city and village trails, and private trails.

**Figure 12. Polk County Transportation System**



# G. HISTORIC PROPERTIES AND DISTRICTS

Historic structures, sites, and districts are sometimes targeted for hazard mitigation strategies due to their unique, often irreplaceable, social value. According to the National Register of Historic Places,[4] Polk County has a total of twelve historic properties and one historic district that have received Federal historic landmark designation.

| # | Historic Site | Address | City | Listed |
|---|---|---|---|---|
| 1 | Polk County Courthouse | Main Street | Balsam Lake | 1982 |
| 2 | Frederic Depot | 210 Oak Street W. | Frederic | 2003 |
| 3 | Seven Pines Lodge | SE of Lewis | Lewis | 1978 |
| 4 | First Baptist Church | 201 3rd Avenue | Osceola | 2008 |
| 5 | Geiger Building (old courthouse) | 201 Cascade Street | Osceola | 1985 |
| 6 | Alan A. Heald House | 202 Sixth Avenue | Osceola | 1985 |
| 7 | Minneapolis, St. Paul, & Sault Saint Marie Railway Deport | 114 Depot Road | Osceola | 2000 |
| 8 | Osceola Commercial Historic District | downtown Osceola | Osceola | 2000 |
| 9 | Cushing Land Agency Building | 106 S. Washington St. | St. Croix Falls | 2005 |
| 10 | Dalles Bluff Site | restricted[5] | St. Croix Falls | 1981 |
| 11 | Lamar Community Center | NE of St. Croix Falls | St. Croix Falls | 1982 |
| 12 | St. Croix Falls Auditorium | 201 N. Washington St. | St. Croix Falls | 2007 |
| 13 | Thomas Henry Thompson House | 205 South Adams St. | St. Croix Falls | 1984 |

There have been no known natural hazards events which have substantially impacted any of the above historic properties. Most of these historic buildings are very well constructed, and they continue to serve as an important vestige of Polk County's past.

The above list is not inclusive of all sites of historic and cultural significance, however. Additional structures undoubtedly qualify as National Register candidates. The Wisconsin Architecture & History Inventory (AHI) identifies 143 buildings, structures, or objects in Polk County, which illustrate Wisconsin's unique history, including the above twelve. Such sites are quite varied and include churches, cemeteries, homes, and barns as well as archeological sites. A detailed assessment of the vulnerability of each of these sites to natural hazard events is not currently available.

[4] Wisconsin Historical Society. http://www.wisconsinhistory.org/pdfs/nr.pdf. May 9, 2017
[5] Restricted to protect this unique site of archeological significance.

# SECTION III.
# ASSESSMENT OF HAZARD CONDITIONS

In order to more effectively evaluate potential hazard mitigation alternatives and develop feasible strategies to address the risks associated with the identified hazards, the County must:

- identify the hazards which are thought to pose the greatest risk to the residents of the County;
- profile the extent and severity of past hazard events that have affected the County; and
- assess the vulnerability of the community to the risk of future hazard events.

## A. HAZARD IDENTIFICATION

Although Polk County could potentially be at risk from a number of different natural hazards, this plan will attempt to narrow the scope of the hazards that will be addressed to those natural hazards that pose the most substantial risks.

### i. Hazard Events Historical Summary

Since 1953, there have been four Presidential Declarations for a Major Disaster that included Polk County:

April 1965 – Tornadoes, severe storms, and flooding in Wisconsin (specifics for Polk County not available)

July 2000 – Flash flooding resulted in roughly $600,000 in estimated damage in Polk County

April 2001 – Flooding due to heavy snow melt with over $1.6 million in estimated damage, including damages at Kennedy's Mill Dam and Woodley's County Dam

September 2002 – Flash flooding with roughly $575,000 in damages, with the Village of Osceola hardest hit due to a dam failure

While the above four catastrophic events were of sufficient severity to warrant major Federal assistance, there have also been two Presidential Emergency Declarations for events encompassing Polk County. Federal Emergencies were also declared for the 1976 drought and for high winds, hail, and heavy rain in the fall of 1977. During an emergency or major disaster declaration, Federal assistance will supplement State and local efforts.

Polk County has been included in additional State of Wisconsin or USDA Disaster Declarations for the impacts of drought and storm damage to agricultural crops, including events in 1976, 2003, 2005, 2006, 2007, 2009, and 2013 (contiguous county). However, relying on Federal emergency and disaster declarations as a measure of risk can be misleading.

While significant damage occurs during a declared disaster or emergency, the declaration area typically involves multiple counties and a sizable percentage of the damage can also be limited

to a certain area. Further, disaster events do occur that can be deadly and cause severe damage; but the total damages do not rise to the thresholds to qualify for Federal funding. The Winter 2014 Polar Vortex is one such event that caused major damages to water lines throughout Polk County, but this disaster was not declared. Such events can be especially hard on small communities when Federal assistance is not available.

To assist in determining what hazards should be evaluated in the plan, National Climatic Data Center (NCDC) information from the National Weather Service (NWS) was used. This data describes past, reported weather events and the resulting deaths, injuries, and damages associated with each of these events. Data for a wide variety of events has been maintained, while some older data is only available for tornado and thunderstorm-related events.

During the period from January 1, 1993, through September 2016, Polk County has experienced 327 weather hazard events reported to the National Climatic Data Center, as shown in **Table 9**.

**Table 9. Natural Hazard Events • Jan 1993 through Sept 2016**
**Polk County (NCDC data only; some event data may be regional)**

| Event | Number of Occurrences | Reports/ Year | Deaths | Injuries | Reported Property Damage | Reported Crop Damage |
|---|---|---|---|---|---|---|
| Dense Fog | 1 | 0.04 | 0 | 0 | 0 | 0 |
| Extreme Heat | 12 | 0.5 | 0 | 0 | 0 | 0 |
| Flood/Flash Flood | 11 | 0.5 | 0 | 0 | $13.9 mil. | 0 |
| Hail | 71 | 3.0 | 0 | 0 | $168,648 | 0 |
| Tornado/Funnel Cloud | 13 / 5 | .5 / .2 | 0 | 1 | $333,867 | 0 |
| Lightning | 1 | 0.04 | 0 | 0 | $794,065 | $78,445 |
| Thunderstorm/High Winds | 126 | 5.3 | 0 | 0 | $6.8 mil. | $131,436 |
| Blizzard, Ice, and Winter Storm | 86 | 3.7 | 0 | 0 | 0 | 0 |
| Extreme Cold/Freezing | 15 | 0.6 | 1 | 0 | 0 | 0 |
| **TOTAL** | **326** | **17.1** | **1** | **1** | **$22 mil.** | **$209,881** |

*Sources: National Climatic Data Center (NCDC) <http://www4.ncdc.noaa.gov/cgi-win/>;*
*Reports and data may be regional in scope for some events; some events/storms may have multiple reports.*
*Damage estimates adjusted to 2009 dollars based on Consumer Price Index by U.S. Bureau of Labor Statistics*

Only one of the events in Table 9—a February 1996 ice storm—included a death, though that death may have occurred outside Polk County since it was a regional event. Table 9 shows thunderstorms and winter storms are the most frequently occurring natural hazard events. The most damaging events since 1993, in terms of property, have been flooding and flood damage, especially to roads and infrastructure. However, looking farther back into history, tornadoes were likely to have been the most devastating natural disaster in terms of damage and deaths since 1950, with 31 reported tornadoes resulting in four deaths, 18 injuries, and over $61 million in reported damages.

It should be noted that some event types in Table 9 are often related; a thunderstorm event could include high winds, hail, and flooding. Further, a single storm event can trigger multiple event reports for different communities within the County. Other times, an event may be regional in nature, so the impacts and damages may be reported for multiple counties.

The actual number of events and their impacts are likely significantly higher for many of the above hazards. For instance, a lightning event may not be reported unless there is related damage. Damages and expenses related to a natural hazard event often go unreported or are under-reported, in particular for smaller events where a disaster declaration has not occurred and crop damage covered by insurance. This data and its limitations are discussed in more detail for each hazard later in this document.

## ii. Polk County Hazards Prioritization

During the development of the 2012 *Polk County Natural Hazard Mitigation Plan*, Steering Committee members reviewed and discussed the NOAA data and other initial hazard information. Based on this discussion and each member's personal experiences, each Committee member rated the risk of a natural hazard event occurring and the vulnerability or impacts if such an event should occur. Identification of the hazards for inclusion in this risk and vulnerabilities survey was based on the hazards identified in the *Resource Guide to All Hazards Mitigation Planning in Wisconsin* prepared by Wisconsin Emergency Management.

The 2012 "risk and vulnerabilities survey" was revisited as part of the 2017 mitigation plan update. For each hazard type, each Committee member was asked to assign ratings of 0 to 5 (0-no risk or vulnerability, 1-low, 3-moderate, 5-high) to reflect their opinion of which hazards pose the greatest risks and vulnerabilities for Polk County. A composite overall average risk rating for each hazard was then calculated by totaling the average risk rating from each respondent and dividing by the total number of respondents. The compiled results of the updated survey are shown in **Table 10**.

**RISK VS. VULNERABILITY**

For purposes of this plan, the following definitions are used:

| | |
|---|---|
| ***RISK:*** | *Probability and frequency of occurrence in the future.* |
| ***VULNERABILITY:*** | *If the event occurs, what are the impacts?* |

An additional column is included in Table 10 indicating whether the hazard was included in the 2012 county hazard mitigation plan. After review of the results, the Committee identified those hazards that should be addressed as part of the 2017 plan update, which is reflected in the far right-hand column of Table 10.

As reflected in Table 10, the Steering Committee felt that the 2017 hazard mitigation plan update should again be limited to natural hazards. Winter storms and tornadoes continue to be the top of the hazard risks facing Polk County residents and communities. Somewhat surprisingly, invasive species and diseases also appeared among the top hazard threats. While invasives are typically not addressed through emergency management initiatives or local mitigation plans, the Committee decided to include a brief section in the mitigation plan update on this threat, largely for educational purposes. Of the hazards to be included in the plan, only flooding and wildfire (and potentially invasives) have geographic areas or locations of higher risk, as will be identified later in this section. It was also decided to include a special analysis on long-term power outages since this is a critical vulnerability which could be related to a number of natural hazard events (e.g., ice storm, tornado, heavy winds).

While hazard materials spills are also a significant concern, there are formal planning requirements and response procedures already in place; and the Committee wished to avoid unneeded duplication. Likewise, robust planning, procedural, and coordination efforts also exist for pandemics and similar public health threats that will be briefly discussed and referenced in this mitigation plan update.

**Table 10. POLK COUNTY HAZARDS RISK & VULNERABILITIES SURVEY RESULTS – MAY 2016**

| Hazard | Risk | Vulner-ability | Com-bined Avg | in 2012 Plan? | Section of 2017 Plan |
|---|---|---|---|---|---|
| **Natural Hazards** | | | | | |
| Riverine or Overbank Flooding | 2.1 | 1.7 | 1.9 | x | flooding |
| Overland or Stormwater Flooding | 2.1 | 1.7 | 1.9 | x | flooding |
| Heavy Snow Storm and Blizzards | 3.5 | 2.9 | 3.2 | x | winter storms & extreme cold |
| Ice Storms and Sleet | 3.4 | 2.9 | 3.2 | x | winter storms & extreme cold |
| Winter Kill of Crops | 2.5 | 2.0 | 2.3 | x | winter storms & extreme cold |
| Extreme Cold | 3.1 | 2.3 | 2.7 | x | winter storms & extreme cold |
| Forest or Wild Fire | 2.3 | 2.3 | 2.3 | x | wildfire |
| Tornadoes | 2.7 | 3.3 | 3.0 | x | tornadoes |
| High Winds | 2.9 | 2.5 | 2.7 | x | thunderstorms & high winds |
| Thunderstorms, Lightning, Hail, etc. | 3.4 | 2.0 | 2.7 | x | thunderstorms |
| Extreme Heat | 2.4 | 1.7 | 2.0 | | |
| Drought | 2.5 | 2.3 | 2.4 | x | drought |
| Agricultural Pests & Diseases | 2.3 | 2.5 | 2.4 | | |
| Landslides or Sinkholes | 1.0 | 1.5 | 1.2 | | |
| Earthquakes | 0.3 | 2.3 | 1.3 | | |
| Pandemics/Public Health Disease | 2.1 | 3.2 | 2.6 | | no; existing plans referenced |
| Invasive Species & Diseases | 3.1 | 3.3 | 3.2 | | invasive species & diseases |
| **Technological Hazards** | | | | | |
| Haz Mat Incident - Fixed | 1.8 | 2.7 | 2.2 | | |
| Haz Mat Incident - Transportation | 2.5 | 3.0 | 2.7 | | |
| Groundwater Contamination | 2.2 | 2.9 | 2.6 | | |
| Animal Waste Management | 2.1 | 2.1 | 2.1 | | |
| Long-Term Power Outage | 2.2 | 2.7 | 2.5 | x | brief overview |
| Nuclear Power Plant Incident | 0.3 | 2.3 | 1.3 | | |
| Dam Failure Flooding | 1.5 | 2.1 | 1.8 | x | flooding |
| Passenger Air or Rail Incident | 0.6 | 1.3 | 0.9 | | |
| **Human-Induced Hazards** | | | | | |
| Active Shooter & Workplace Violence | 1.9 | 2.9 | 2.4 | | |
| Terrorism, Domestic | 1.7 | 2.5 | 2.1 | | |
| Terrorism, International | 1.1 | 2.0 | 1.6 | | |
| Cyber Attacks | 2.3 | 2.8 | 2.5 | | |
| Civil Unrest or Institutional Riot | 0.9 | 1.7 | 1.3 | | |

0 -- none; extremely low
1 -- low; minimal
2 – some; of concern
3 – moderate; substantial
4 -- high; serious
5 -- very high; extreme

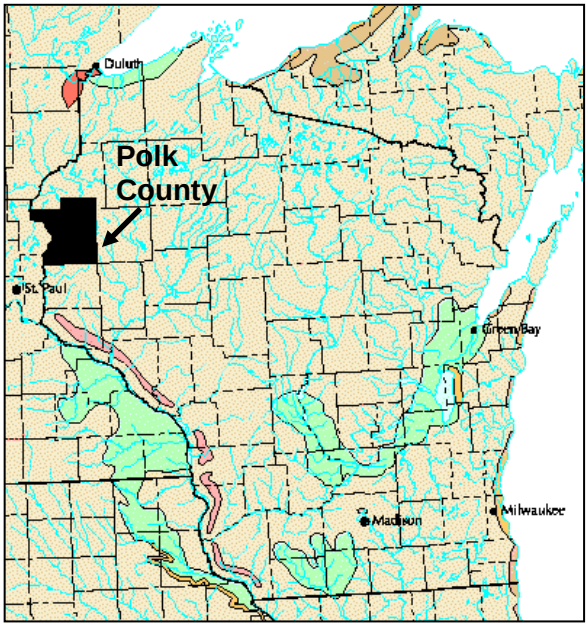
## iii. Other Natural Hazards of No Significant Risk

Although there are other natural hazards that could potentially impact the County, there are very few or no records of the following events occurring in Polk County in the NOAA database. In order to meet the comprehensive requirements for developing an all hazards mitigation plan, these other natural hazards are identified and described below. It is important to note that these hazard events may still pose some threat to the community, but they were considered by the Steering Committee to either have a minimal chance of occurring, pose a minimal widespread risk to the safety of residents or property, or offer only very limited mitigation options.

### Landslides & Land Subsidence

The term landslide includes a wide range of ground movement, such as rock falls, deep failure of slopes, and shallow debris flows. Although gravity acting on a steep slope is the primary reason for a landslide, there can be other contributing factors. Erosion by surface waters or excess weight from rain, snow or man-made structures may stress weak slopes to failure. Slope material that becomes saturated with water may develop a debris flow or mudflow.

**Figure 13. Landslide Hazards in Wisconsin**




*source: U.S. Geologic Service. Landslide Overview Map of the Conterminous United States. <http://landslides.usgs.gov/html_files/landslides/nationalmap/national.html>.*

The USGS *Landslide Overview Map of the Conterminous United States*[6] (excerpt for Wisconsin in **Figure 13**) identifies no large-scale landslide risks for the Polk County area.

According to the USGS topographic maps and U.S. Natural Resources Conservation Service soil maps for Polk County, there are 95,661 acres that potentially have a slope of 13 percent or greater representing 16.3% of the total Polk County land base. Of this, 31,105 acres (5.3% of Polk County) have slopes of 21 percent or greater. The majority of these steep slopes are located in the far western and far northern and far southern portions of the County. Additional localized and site-specific variations in topography and slope may exist. Past glacial activity has created some topography in Polk County that is scenic, but may also be very sensitive to development.

While there are steeper areas, the area's soils pose more of a gradual erosion risk, rather than the sudden, large-scale movement of ground associated with landslide hazards. Stormwater runoff, along with river flow, ice build-up, and normal temperature fluctuations, has created serious riverbank erosion and washouts concerns for some locations, such as along the east banks of the St. Croix River in the Osceola area, which will be discussed in the flooding assessment section.

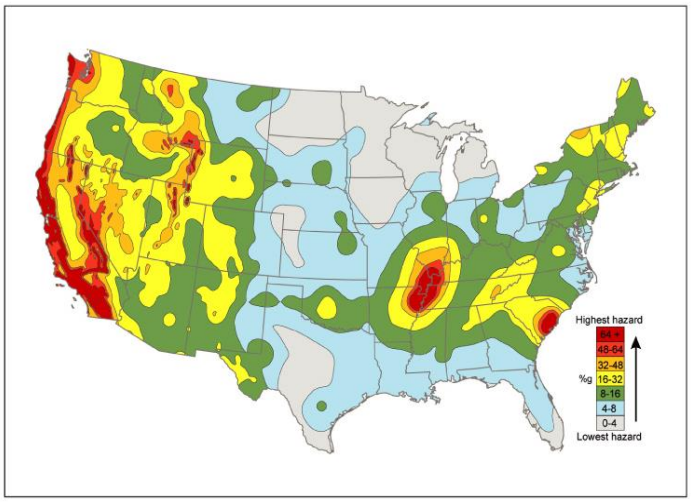
[6] U.S. Geological Survey. Landslide Overview Map of the Conterminous United States. <http://landslides.usgs.gov/html_files/landslides/nationalmap/national.html>

Land subsidence is an event in which a portion of the land surface collapses or settles. Common locations of subsidence are in areas having karst topography or in areas in which large quantities of groundwater have been withdrawn. Polk County is not an area of significant karst topography which could contribute to land subsidence. There are no records of substantial damage or injury from large landslides or land subsidence within Polk County.

## Earthquakes

According to the U.S. Geological Survey, there have been 19 earthquake events in Wisconsin, with none noted for west-central Wisconsin. Where readings are available, these events were relatively small, most being 3.0-3.8 on the Richter Scale in size and the largest being an intensity of 5, which may be strong enough to crack some plaster, but not cause serious damage. Due to the lack of recent events, some geologists question whether many of these events were true earthquakes, but rather quarry collapses, blasts, etc.

**Figure 14. U.S. Geological Survey Earthquake Hazard-Shaking Map**




*source: U.S. Geological Survey. Earthquake Hazard in the Heart of the Homeland. <http://pubs.usgs.gov/fs/fs-131-02/CUShazard.html>.*

The nearest active earthquake fault outside of Wisconsin is the New Madrid Fault which has a seismic zone that stretches from northeast Arkansas to southern Illinois. As **Figure 14** shows, the Polk County area falls within the lowest earthquake hazard-shaking area, with the different colors representing the levels of horizontal shaking that have a 1-in-50 chance of being exceeded in a 50-year period. Similarly, Polk County falls within a 0%g peak ground acceleration (PGA) zone as shown on the USGS PGA values map for the United States, with a 10 percent chance of being exceeded over 50 years; Polk County is a non-affected area.[7] The earthquake threat to Polk County is considered very low.

## Fog

Fog is low-level moisture that can reduce visibility. It can occur in isolated low-lying areas or be a widespread event that can cover several counties. In general, fog is often hazardous when the visibility is reduced to 1/4 mile or less. Thick fog reduces visibility, creating a hazard to motorists as well as to air traffic. Airports may close because of heavy fog. The intensity and duration of fog varies with the location and type of fog. Generally, strong winds tend to prevent fog formation. In Polk County, fog occurs infrequently and is typically a short-term weather

[7] U.S. Geologic Service. Peak Acceleration (%g) with 10% Probability of Exceedance in 50 Years. map. <http://geohazards.cr.usgs.gov/eq/pubmaps/US.pga.050.map.gif> November 1996.

event lasting only for portions of a day. The NCDC database only includes one dense fog record from November 19-20, 2007, which included Polk County.

## Coastal Hazards (Hurricanes, Tsunamis, Tidalwaves, Waterspouts, etc)

Coastal hazards can cause increases in tidal elevations (storm surges), high winds, and erosion caused by tropical cyclones (such as hurricanes) or the sudden displacement of water (such as tsunamis from earthquakes). Polk County is located in the upper Midwest, approximately 1,000 miles from the Atlantic Ocean, 1,200 miles from the Gulf of Mexico, and 2,000 miles from the Pacific Ocean. Polk County also has no large inland lakes within its boundaries. Such coastal hazards have no direct impact on Polk County and only occasionally indirectly impact the County in the form of thunderstorms, which are discussed separately.

## Extreme Heat

In contrast to other natural hazard events, the occurrence and impacts of extreme heat are often more difficult to recognize. Excessive or extreme heat is a slowly evolving phenomenon that can catch many people by surprise. Unlike tornadoes or thunderstorms that normally develop and occur more quickly and with more observable characteristics, a heat wave typically builds slowly over time. Because of this creeping effect, it is important for forecasters and officials to be constantly aware of heat and humidity conditions in order to properly warn and protect citizens.

Heat waves usually consist of high temperatures and high relative humidity. This combination makes it difficult for the human body to dissipate heat through the skin and sweat glands. Sweating will not cool the human body unless the water is removed by evaporation. High relative humidity retards evaporation and, thus, inhibits the cooling process. The National Weather Service (NWS) uses the heat index as a measure of the combined effects of high temperatures and high relative humidity, shown in **Table 11**.

**Table 11. Heat Index Table**
**(Heat Index Values in Degrees Fahrenheit)**

| Temperature (°F) | Relative Humidity (PERCENT) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 |
| **70** | 65 | 66 | 67 | 68 | 69 | 70 | 70 | 71 | 71 |
| **75** | 70 | 72 | 73 | 74 | 75 | 76 | 77 | 78 | 79 |
| **80** | 75 | 77 | 78 | 79 | 81 | 82 | 85 | 86 | 88 |
| **85** | 80 | 82 | 84 | 86 | 88 | 90 | 93 | 97 | 102 |
| **90** | 85 | 87 | 90 | 93 | 96 | 100 | 106 | 113 | 122 |
| **95** | 90 | 93 | 96 | 101 | 107 | 114 | 124 | 136 | |
| **100** | 95 | 99 | 104 | 110 | 120 | 132 | 144 | | |
| **105** | 100 | 105 | 113 | 123 | 135 | 149 | | | |
| **110** | 105 | 112 | 123 | 137 | 150 | | | | |
| **115** | 111 | 120 | 135 | 151 | | | | | |

*Source: National Weather Service*

Heat is the number-one weather-related killer in the United States and Wisconsin. From 1979 to 1999, excessive heat exposure caused 8,015 deaths in the United States. During this period, more people died from extreme heat than from hurricanes, lightning, tornadoes, floods, and earthquakes combined.

Although Wisconsin may not be thought of as a high risk area for deadly heat waves, every year the State of Wisconsin experiences a period or series of periods in which the temperature and humidity produce a heat index which could be harmful to human health. From 1986 to 2003, there were 197 deaths directly or indirectly attributed to heat in Wisconsin. The following are examples of recent heat wave events affecting Wisconsin:

- During the summer of 1995, two heat waves affected most of Wisconsin. Together, they resulted in 154 heat-related deaths and an estimated 300 to 400 heat-related illnesses. This makes the combined 1995 summer heat waves the biggest weather-related killers in Wisconsin for the past 50 years, far exceeding tornado deaths.
- In 1999, heat waves occurred on July 23rd-25th and 29th-31st. Collectively, these heat waves were directly and indirectly responsible for 20 deaths.
- Several heat waves from mid-July through early August 2001 claimed fifteen lives across Wisconsin. Additionally, it is estimated that 300 or more were treated at hospitals for heat-related conditions.

From 2011 through November 2016, Polk County experienced two extreme heat weather events according to the NCDC database. This is in addition to ten heat-related events between 1993 and 2010 reported in the 2012 hazard mitigation plan. While this averages to one event every two years, it is not uncommon to have multiple events reported in a single year (e.g., 1999, 2001). In addition, extreme heat events commonly last multiple days. All of the Polk County events were reported in the months of June, July, or August, except for one record warmth event on October 12, 1995. Most of these events affected large regions or all of Wisconsin.

To date, the NCDC database identifies no deaths or serious injuries within Polk County related to extreme heat, though deaths and injuries often go unreported to the database. However, temperatures in excess of 90°F pose a risk of heat-related illness and death, especially when humidity levels exceed 35 percent. The risk is highest for individuals who are suffering from chronic illnesses and for those who are not acclimated to these conditions. Most health-related illnesses involve the elderly, especially those residing in urban areas for which temperatures can be further elevated due to the urban heat island effect. However, people on certain medications, isolated individuals who live alone and seldom leave their home, infants and young children, persons with chronic heart or lung problems, overweight people, persons with disabilities, and people who work outside are also at greater risk during extreme heat events. Research findings strongly suggest that heat index values of 90 to 105 make sunstroke, heat cramps, and heat exhaustion possible with prolonged exposure and/or physical activity. Heat index values of 105 to 130 degrees make sunstroke, heat cramps, and heat exhaustion likely with prolonged exposure and/or physical activity. Shown in **Table 12** are the potential dangers associated with heat index temperatures.

**Table 12. Apparent Temperature Heat Stress Index (Dangers Associated with Heat Index Temperatures)**

| Category | Apparent Temperature (Heat Index - °F) | Associated Dangers |
|---|---|---|
| Caution | 80-90°F | Exercise more fatiguing than usual. |
| Extreme Caution | 90-105°F | Heat cramps, exhaustion possible. |
| Danger | 105-130°F | Heat exhaustion likely. |
| Extreme Danger | Greater than 130°F | Heat stroke imminent. |

*Source: National Weather Service*

Any time the temperature and humidity combine to produce a heat index that could cause health concerns for humans, the National Weather Service will issue various statements on heat conditions. For example, the NWS issues "Heat Advisories" when it expects the daytime heat index to equal or exceed 105° for 3 hours or more and the nighttime heat index equals or exceeds 80° for any 24-hour period. The NWS issues "Excessive Heat Warnings" when it expects the daytime heat index to equal or exceed 115° for 3 hours or more and the nighttime heat index equals or exceeds 80° for any 24-hour period. The NWS may issue an "Excessive Heat Watch" 24 to 8 hours in advance of anticipated heat wave conditions.

Currently, Polk County Emergency Management distributes educational information via local media on steps to minimize the impacts of extreme heat. The Polk County Aging Office also distributes similar educational information through its newsletter to the County's elderly; and its meal delivery personnel help maintain watch over elderly clients who might be more at-risk of succumbing to the impacts of extreme heat.

Summer 2011 was accompanied by periods of extreme heat in Polk County, and cooling shelters were designated in some communities. Demands for power were high as air conditioners worked overtime. To the west in Minnesota, severe storms resulted in power loss for some areas. As such, this hazard was re-evaluated by the Steering Committee during the planning process for potential inclusion in the Risk and Vulnerability Assessment section.

While extreme heat is a concern for the residents of Polk County, widespread serious injuries or fatalities were deemed to be unlikely in the County. The Steering Committee recognized the risks and vulnerabilities of extreme heat to local residents, but believed current mitigation efforts were adequate to address these concerns and the risks were not significant enough to warrant a full analysis at this time. However, if changes to Wisconsin's climate continue as discussed in the next sub-section, extreme heat risks and vulnerabilities may warrant more attention during the next or future plan updates.

## iv. Possible Hazard Impacts of Climate Change

When analyzing hazard risks, it should be remembered that the assessment is largely based on past weather events and existing development trends. Projecting future risks and vulnerabilities is also subject to the influence of possible large-scale, longer-term climatic changes.

There is ongoing debate over the existence, causes, severity, and impacts of global climatic changes, such as global warming. According to the U.S. Environmental Protection Agency:

> "According to the National Academy of Sciences, the Earth's surface temperature has risen by about 1 degree Fahrenheit in the past century, with accelerated warming during the past two decades. There is new and stronger evidence that most of the warming over the last 50 years is attributable to human activities.... Rising global temperatures are expected to raise sea level, and change precipitation and other local climate conditions. Changing regional climate could alter forests, crop yields, and water supplies. It could also affect human health, animals, and many types of ecosystems.... Most of the United States is expected to warm, although sulfates may limit warming in some areas. Scientists currently are unable to determine which parts of the United States will become wetter or drier, but there is likely to be an overall trend toward increased precipitation and evaporation, more intense rainstorms, and drier soils."[8]

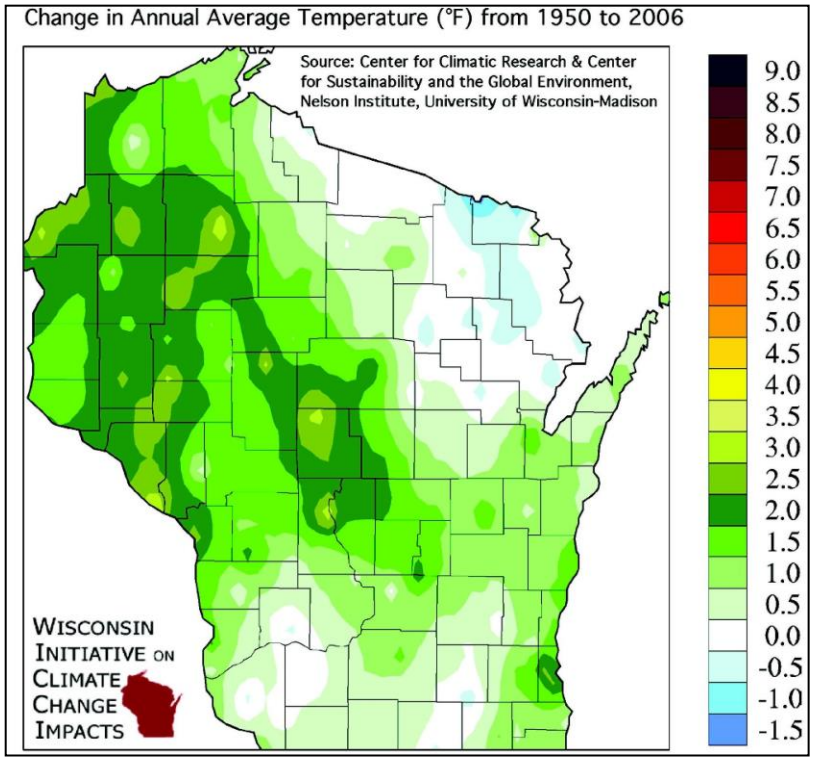
Regardless of the debate over the causes of climate change, there is clear evidence that Wisconsin's climate is indeed changing. The 2003 report entitled *Confronting Climate Change in the Great Lakes Region* published by the Union of Concerned Scientists and the Ecological Society of America projected that by 2030, summers in Wisconsin may resemble those in Illinois, overall, in terms of temperature and rainfall. By 2100, the summer climate will generally resemble that of current-day Arkansas, and the winter will feel much like current-day Iowa.

To further document these climate changes and explore their impacts on our State, the Wisconsin Initiative on Climate Change Impacts (WICCI) was formed as a collaborative effort of the University of Wisconsin and the Wisconsin Department of Natural Resources.

The following are some of the key climatic trends being experienced in Polk County and Wisconsin according to the WICCI analysis available at www.wicci.wisc.edu:

- Polk County's average temperatures are rising and are projected to continue to rise. **Figure 15** shows that the annual average

**Figure 15. Wisconsin Temperature Change**




[8] U.S. Environmental Protection Agency. http://yosemite.epa.gov/oar/globalwarming.nsf/content/impacts.html

temperature in Polk County has increased between 1.5º F and 2.5º F between 1950 and 2006. Between 1980 and 2055, annual average temperatures are projected to increase by about 6.5º F in the County.

- Polk County is experiencing more annual precipitation and is expected to get wetter in the future, but there is significant seasonal and geographic variation to the precipitation. **Figure 16** shows that the annual average precipitation has increased in Polk County over the past fifty years, overall, while **Figure 17** shows that summer precipitation has remained unchanged or has been decreasing as one moves north. Overall, WICCI projects Polk County's annual average precipitation to increase by about 2.0 inches per year between 1980 and 2055.
- Heavy precipitation events are expected to increase in Polk County. Currently, northern Wisconsin experiences heavy precipitation events of two or more inches about seven times in a decade (once every 17 months). **Figure 18** shows that Polk County is projected to experience about 2.5 more heavy precipitation events per decade by 2055, which is a 36 percent increase for one event every 12.6 months.

These climatic changes, should they continue, have significant natural hazard implications. Most of our existing best practices and infrastructure are based on historic events and do not fully accommodate these climatic trends.

Increased temperatures would result in more frequent heat waves and evaporation of surface waters. Increased precipitation and heavy precipitation events would potentially result in more flooding. One must keep in mind the seasonality of these changes. More precipitation during the winter months increases the potential for heavy snows and ice storms. Higher temperatures during the summer months could result in more frequent agricultural droughts and increasing demand for irrigation.

Such changes in climate could have some positive natural hazard impacts. For instance, the winter season would be shorter overall, with fewer days of extreme cold. But other problems may also be exacerbated, such as plant and animal diseases and infestations, Lyme's disease, air quality changes, and decreasing water quantity.

Given the ongoing debate in the scientific community, it is not appropriate to debate the causes of climate change within this document. Regardless of the cause, it is important that Polk County officials and residents remain aware that the hazard trends presented in this report may change in the future; and, in some cases, the frequency and magnitudes of disaster events may intensify. Communities and residents should keep informed on climate change research and use their best judgment as to the most appropriate action and response. The WICCI webpage www.wicci.wisc.edu includes suggestions on how communities may prepare for and adapt to such changes.

**Figure 16. Wisconsin Precipitation Change**

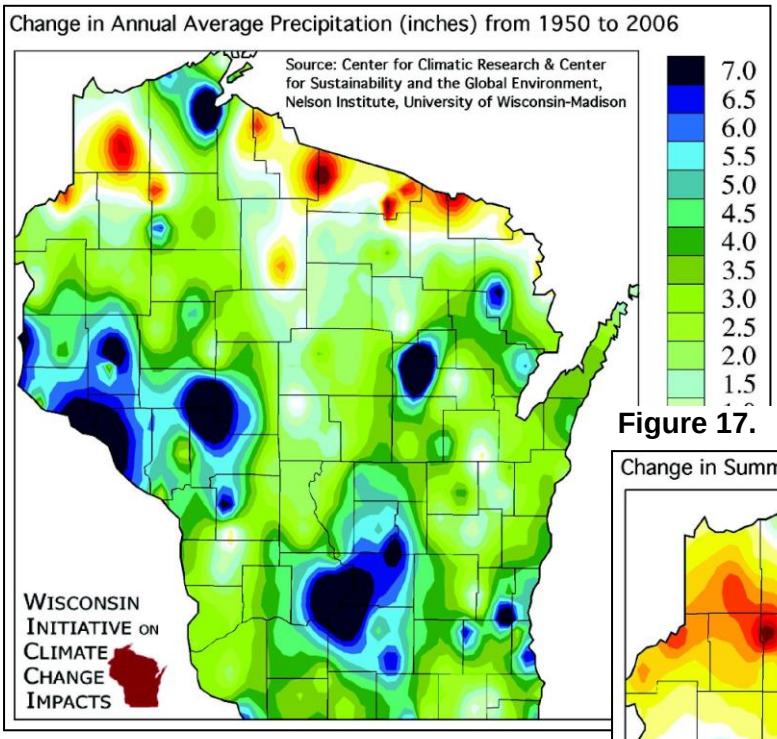



**Figure 17. Wisc. Summer Precipitation Change**

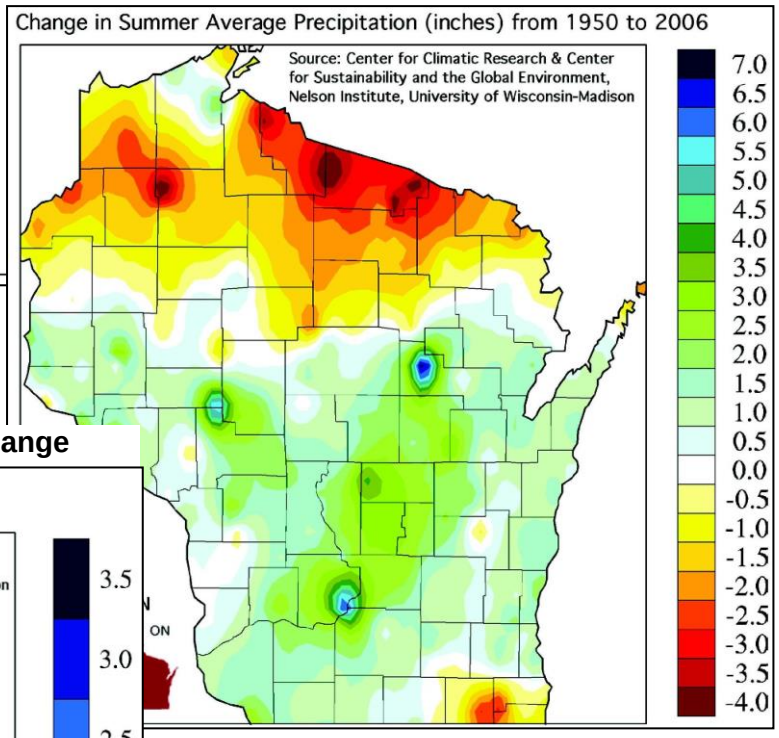
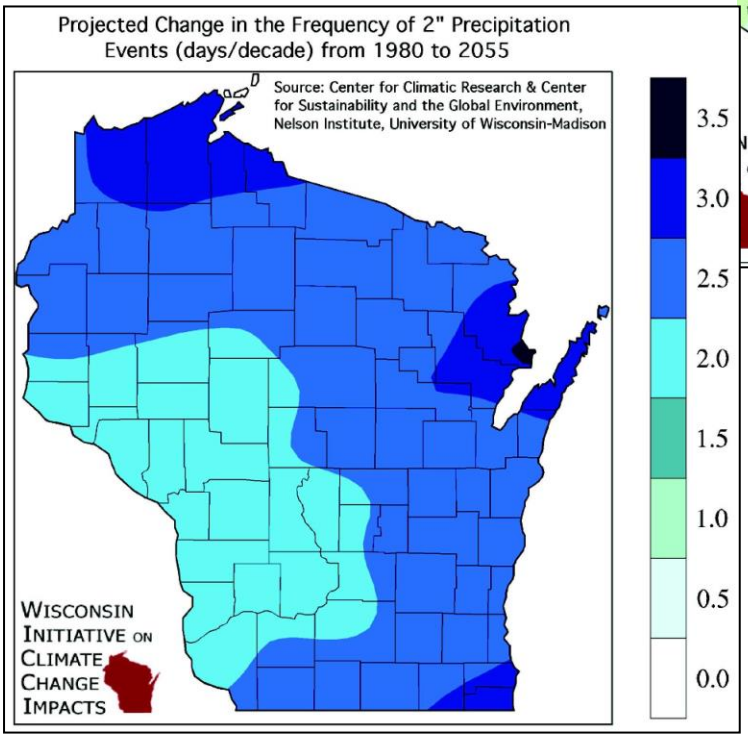



**Figure 18. Wisc. Heavy Precipitation Change**



## B. RISK AND VULNERABILITY ASSESSMENT

This section is organized by the six natural hazards identified previously as having the highest overall disaster threat to Polk County, with the addition of a special threat analysis for long-term power loss and a brief invasive species assessment. For the purposes of this plan, some hazards have been grouped into related hazard topics in order to better organize and describe the extent of the potential risk and vulnerability. For instance, the winter storms assessment includes extreme cold and ice storms.

The assessment for each of the six hazards generally includes the following sub-sections:

- **Summary** of risks, vulnerabilities, and issues.
- **Risk Assessment** defines the hazard, identifies past events, and discusses the probability of reoccurrence.
- **Vulnerability Assessment** assesses potential impacts to people, property, and critical facilities. The vulnerability assessment for critical facilities is expanded upon in **Appendix F**.
- **Unique Jurisdictional Risks and Vulnerabilities** analyzes the related hazard risks and vulnerabilities for participating cities and villages which are further expanded upon by the table and maps in **Appendix G**.

With the exceptions of flooding and, to some extent, wildfire, the natural hazard threats facing Polk County typically do not have defined hazard areas. Most events facing County residents often affect large areas, or are even county-wide, such as a drought or an ice storm.

**Comments on the Special Threat Analysis – Long-Term Power Loss**

Since multiple types of natural hazards, as well as technological failures and man-made threats, could potentially result in long-term power loss in Polk County, the following sub-section provides a special, topical analysis. This approach allows additional attention to this critical threat, while avoiding undue repetition within the individual natural hazard assessments sub-sections (i.e., winter storms, tornadoes).

Keeping with the scope of this plan, only power outages related to natural hazard events are explored, though many of the same vulnerabilities would be shared, regardless of the cause.

# Special Threat Analysis – Long-Term Power Loss

Many of the highest-rated natural hazard events facing Polk County in Table 9 have the potential to cause an extended and widespread loss of electrical power. More specifically, above-ground power lines and transmission towers can be damaged by ice storms, heavy snows, tornadoes, and high straight-line winds. Elevated power lines in wooded areas have the greatest vulnerability. Such infrastructure can also be damaged by wildfire, lightning, and flooding, though the impacts are typically much more localized.

## *Risk Assessment – Long-Term Power Loss*

Three natural hazard threats pose the biggest power-loss threat within Polk County: (1) a large ice storm, possibly in conjunction with heavy/wet snow; (2) the high winds associated with unstable summertime weather patterns; or (3) high winds during a blizzard. However, it is large ice storms which often pose the greatest threats due to the potential to affect entire regions during times of year when the vulnerabilities due to the loss of power are at their highest.

From 1993 through September 2016, there have only been two ice storm events reported for Polk County—one occurring in January 1994 and one in January 1996. Neither of these events resulted in large-scale, long-term power outages.

However, the risk of a long-term event is very real. For example, the March 1976 ice storm was one of the worst natural disasters to hit Wisconsin, although Polk County was not one of the 22 counties that were part of this disaster declaration. Ice accumulations of up to five inches were reported, and high winds of 60 mph made the situation worse. Up to 100,000 people were without power at the height of this storm. Serious winter or ice storms in central Wisconsin also occurred in December 1904, February 1922, February 1936, and November 1943, though data on the impacts are limited.

**January 2009 Kentucky Ice Storm**
*picture from Mark Garland, Kentucky Div of Emgy Mgmt*

In January 1998, an ice storm hit the Montreal area and left over four million residents without power. Some areas were without power for over three weeks. The January 2009 ice storm which hit Kentucky

resulted in $616 million in damages, 36 fatalities, and 700,000 customers without power at its peak; 50,000 customers were still without power after two weeks, and it took 38 days for full restoration.

While the focus of power loss is often on ice storms due to their widespread nature, other natural events can also result in a sizable loss of power. In fact, high winds appear to be a more frequent cause of widespread loss of power due to a natural hazard event. In July 1991, a particularly violent and widespread straight-line wind (or derecho) lasted 17 hours and stretched from South Dakota to western Pennsylvania, including parts of Wisconsin. This event caused over $100 million in damage and resulted in power loss to nearly one million customers. A similar event in May 1998 which blew through central Wisconsin resulted in at least $500 million in damage; and over two million people were without electrical power, some for over 10 days. More recently, the 2011 Burnett County straight-line wind left some areas without power for about a week. And in July 2016, severe thunderstorms left about 250,000 Xcel Energy customers in the Twin Cities metropolitan area without power.

Other wind events have resulted in localized power losses in Polk County, though the long-term loss of power exceeding 24 hours is quite rare and has been limited to a very small number of customers in recent history. The most significant event in recent history noted during the planning effort was a snow storm about three years ago that left the Village of Clear Lake without power for about 24 hours. Polk-Burnett Electric Cooperative reported no weather-related outages exceeding 24 hours since 2010. Fairly widespread outages impacting more than one electric provider have occur in recent years in Polk County, but for less than twelve hours.

There are three primary electrical providers in Polk County:

Polk-Burnett Electric Cooperative (serves approximately 50-55% of the County area)
Xcel Energy (serves approximately 20-25% of the County area)
Northwestern Wisconsin Electric Co. (serves approx. 20-25% of the County area).

The remainder of the County area is served by three additional cooperatives—Barron Electric, St. Croix Electric, and Dunn Electric.

While Polk County has not recently experienced a long-term power outage event, a look at the recent causes of power outages for Polk-Burnett Electric provides further insight into the potential risk. The numbers in **Table 13** are for the full Polk-Burnett Electric Cooperative, which includes significant coverage in adjacent counties, especially within Burnett County to the north.

**Table 13. Polk-Burnett Electric Cooperative Power Outages • 2013-2015**

| Outage Cause | # of outages | | | | # customers affected | # outage hours |
|---|---|---|---|---|---|---|
| | 2013 | 2014 | 2015 | Total | | |
| Tree | 114 | 220 | 130 | 464 | 19,184 | 46,539 |
| Weather | 142 | 44 | 81 | 267 | 1,903 | 6,966 |
| All Other | 901 | 813 | 1,019 | 2,733 | 43,604 | 54,329 |
| Total | 1,157 | 1,077 | 1,230 | 3,464 | 64,691 | 107,834 |

source: Polk-Burnett Electric Cooperative, 12/8/16

The above table shows that a very small percentage of outages—about 7.7 percent—were directly caused by weather, such as ice damage and lightning strikes. An additional 13.3 percent were tree-related (non-human) such as tree limbs falling on power lines. Many of these tree-related outages may also be related to weather, such as high winds, heavy snow, or ice. Within the "All Other" category in Table 13, some of the causes were unknown or not available; it is possible that a small number of these may also be weather-related.

Perhaps more notable is that a tree- and weather-related outage typically affected more customers for more time than the combined "all other" outage. While an average of 16 customers were affected by an "all other" outage, 29 customers lost power for the average tree/weather outage. And the average tree/weather outage had more than triple the lost customer hours than that of an "all other" outage—73.2 total customer hours without power per outage compared to 19.9 hours, respectively.

In summary, a widespread, long-term power outage event covering most or all of Polk County would be rare, but the potential does exist. Based on discussions with personnel from area electric providers, it is estimated that only about five or six long-term power outage events have likely impacted the region during the past century, but these have not approached the scale of the 1976 Wisconsin, 1998 Montreal, or 2009 Kentucky outages.

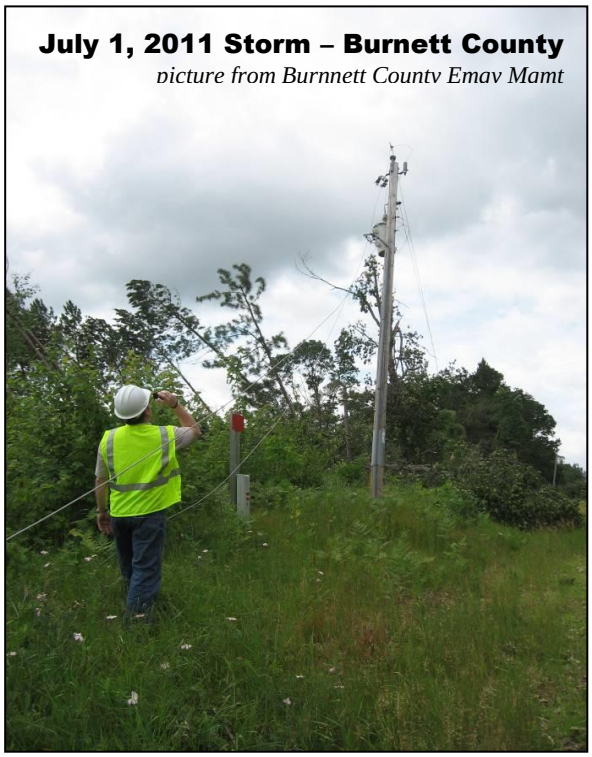
## *Vulnerability Assessment – Long-Term Power Loss*

While rare, the impacts and costs of a long-term power outage event can be tremendous. Extended power loss in Polk County due to a natural storm event would likely involve many downed trees and power lines. Downed lines present safety hazards for residents, travelers, and emergency responders. Response can be further hampered by blocked roads from power lines and debris.

Replacement costs for power lines vary based on physical-site conditions, but are approximated as follows:

| | |
|---|---|
| Single Phase – Overhead (Rural): | $42,000/mile |
| Single Phase – Underground (Rural): | $35,000/mile |
| Single Phase – Underground (Lake): | $60,000/mile |
| Three Phase – Overhead (Rural): | $82,000/mile |
| Three Phase – Underground (Rural): | $100,000/mile |

The estimated mileage of the elevated power lines in Polk County is not available. There are over 3,300 miles of line in the entire Polk-Burnett system, with approximately 1,767 miles (54%) of overhead line. For comparison, Xcel Energy has 408 miles of overhead distribution line and 94 miles of underground distribution line; this does not include transmission lines.

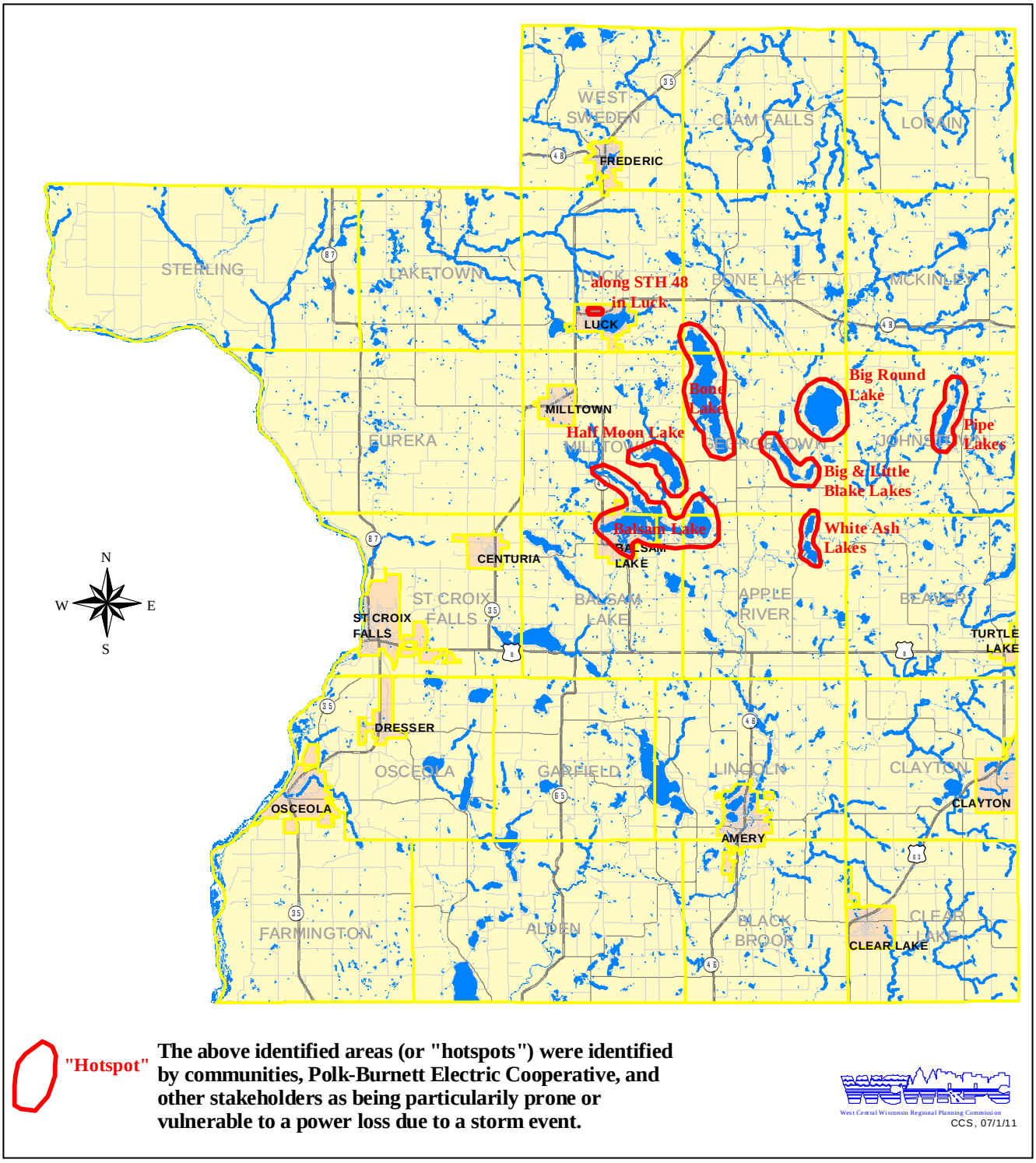

**July 1, 2011 Storm – Burnett County**
*picture from Burnnett County Emav Mamt*

Given the above replacement costs, the potential damages to overhead power lines from a severe storm event in Polk County could easily be in the millions.

With forest the predominate land cover over approximately one-third of Polk County (*see Section II.D.*), a significant portion of these overhead lines are most at risk of damage due to falling trees or limbs. Polk-Burnett Electric Cooperative identified the lakes region within the towns of Bone Lake, Milltown, Balsam Lake, Johnstown, and Georgetown as being the most susceptible to power loss during high winds due to development density and the number of trees as shown in **Figure 19**. Northwestern Electric also confirmed that lake areas posed the largest outage concerns, while also being areas more costly to bury lines, but did not identify any specific areas in Polk County especially prone to outages.

Electrical providers in the County have buried some electric lines in the most at-risk areas, such as near wooded lakes. And some local electric providers have a policy of moving toward all below-ground power lines through attrition and as part of annual work plans.

**Figure 19. Areas Prone to Power Loss Due to Storm Events**




For example, the Polk-Burnett Electric Cooperative has been actively burying lines in areas prone to outages and as a means of improving redundancy, averaging about 15-20 miles per year across their territory. Since the 2012 plan, the Cooperative has buried over 100 miles of previously overhead lines, including in the Pipe, Bone, Blake,

and Half-Moon Lake areas, and is looking at more, including possible projects in the Pipe, North White Ash, and White Ash Lakes areas in 2018. The loss of power due to falling limbs has been further significantly mitigated through proactive, aggressive tree-trimming programs by the electric providers serving Polk County. But even with such efforts, many wooded and lakeshore areas are still prone to power outages.

Given recent experiences elsewhere, it is not unrealistic to imagine a significant portion of the County's population and facilities could be without power for one to three weeks should a 50- or 100-year event occur. Following the 2009 Kentucky storm, 37 percent of affected customers were still without power after one week and seven percent were without power after two weeks. During the Kentucky event, carbon monoxide from improper generator use was the largest cause of death. But it must be remembered that the potential impacts for Polk County could be much more severe—Kentucky's temperature warmed well above freezing following their ice storm. In comparison, Amery's mean January temperature of 12.4ºF [9] could prove quite deadly should power be lost and transportation systems hindered for an extended time. This is discussed more in the winter storms assessment.

Long-term power outage (LTPO) planning has been receiving increased attention in Wisconsin during the last decade. Realizing the seriousness of this threat, Polk County Emergency Management and other local stakeholders participated in a series of regional-level workshops and tabletop exercises in 2010 on this topic. Based on these workshops and exercises, the following groups and critical facilities were identified as being especially vulnerable or important during a long-term power outage event:

- Independent Special Needs Populations
- Assisted Living Facilities and Hospitals
- Municipal Utilities and Emergency Fuel
- Emergency Response Providers, Communications, & Operations Centers
- Emergency Shelters and Food Distribution Sites (i.e., schools)

Overall, Polk County is a relatively rural county, posing challenges to public communication, response, and recovery, including the provision of services to independent populations who may have special needs during a LTPO event (e.g., dialysis, oxygen/ventilator, medicines).

[9] National Climatic Data Center. Amery Station Summary of Monthly Normals, 1981-2010. https://www.ncdc.noaa.gov/cdo-web/quickdata

Seniors living alone in rural areas are of special concern. In 2016, Polk County had an estimated 7,874 residents ages 65 and over. This number is expected to nearly double by 2035. In 2016, the Northwest Wisconsin Aging & Disability Resource Center (ADRC) provided meals to about 175 different clients in Polk and Burnett counties on an average day, many of whom reside alone. Over 70 percent of these meals are home-delivered. Seniors may not be prepared for the loss of these services during a widespread power outage or other disaster.

The ADRC has been promoting individual emergency planning for senior and clients, with emergency contact information and other preparedness actions. Many electric providers (e.g., Polk-Burnett Electric Cooperative, Xcel Energy) have made efforts to tag "critical accounts" that may need attention during an outage, such as residents on oxygen, but the providers may not be aware of all such circumstances. Providers also encourage household planning. For example, the following statement is provided to Xcel Energy's "critical accounts":

> "An approved medical designation on the customer's account does not guarantee uninterruptible utility service or immediate restoration of utility service. Inform customers of the importance of having a household backup plan in place for use of their medical equipment should a disruption of utility service occur."

As of spring 2017, Polk County had six nursing homes, ten assisted living facilities, and fourteen other residential care facilities, many of which are believed to be without emergency power generation. During an LTPO event, most of these facilities would initially shelter-in-place, though medicine, equipment, and municipal water and sewer would become very serious concerns after the first 24-48 hours if power is not restored. Recent LTPO exercises have increased attention to these concerns. During the planning effort, the ADRC noted that some of these long-term care facilities have begun to develop more detailed emergency plans, while some are also approaching County offices looking for model LTPO plans for their facilities (which are not currently available through the County) and with expectations of County emergency and evacuation support (which may not be available during an event). The County's three hospitals have undertaken actions to be prepared for such an event and the Northwest Wisconsin Healthcare Coalition can provide some preparedness planning assistance.

As discussed in Appendix G, no cities and villages identified a specific neighborhood or "hotspot" that was particularly prone to repetitive power outages. Residential neighborhoods with older trees or built within wooded areas of cities and villages can be more vulnerable to outages, though tree trimming has largely mitigated past trouble areas. Appendix H notes that most cities and villages do have emergency power generator needs for utilities and critical facilities.

The availability of emergency power generators for utilities, communications, cell/communication towers, shelters, emergency operations, fuel sources, and critical facilities is crucial to mitigating the potential impacts of a LTPO event. As shown in Appendix H, most city and village halls are designated as emergency operations centers (EOCs), but most lack emergency power generation. Further, emergency fuel planning (and agreements) is advised since demands may be high on limited fuel sources for response vehicles, electric crews, and power generators should an extended outage occur. Generators are available at County government buildings, as well as at communication towers that are fueled with LP.

An extended power outage would also be a major concern for the smaller dairies and large livestock barns in the County. In nearby Barron County, about 14,000 turkeys were lost when a generator went down. Jennie-O, which owns a number of turkey barns in Polk County, has been installing remote monitoring systems and generator connections at its barns; when monitoring indicates, local contacts are made to check on conditions and mobile generators are provided if needed. Not all farmers may have access to emergency power for an extended outage lasting many days. An extended outage would also have ramifications for areas businesses and the local economy. Small businesses without a continuity strategy may especially be vulnerable.

In short, a long-term, widespread power outage is one of the greatest natural hazard vulnerabilities facing Polk County. As the Kentucky experience shows, total costs in response and damages can be in the tens of millions or greater. Significant threats to life and safety exist due to downed lines, fire, improper generator use, loss of access to medical treatments, extreme cold, and loss of food and other utilities.

Cooperation, communication, and planning with power providers and critical facilities are key to preparing for and mitigating the impacts of power loss. Based on discussions with representatives from Xcel Energy, Polk-Burnett Cooperative, and Northwestern Electric Company, the following additional insights should be considered:

- Involving utility providers in disaster event exercises and incident command system (ICS) training is very important. Advanced notice for such trainings and workshops is required due to the time commitments involved.
- Communication between electric providers and utilities, emergency management personnel, service providers, and local communities can be vital during a LTPO event to help protect the safety of responders and residents. This includes notifying electric restoration crews of known road washouts,

flooding areas, etc. For a major disaster, utilities may provide a liaison at the County Emergency Operations Center.

- During a disaster or power outage, electric providers can "ping meters" to help identify areas with outages, possible downed power lines, etc.
- Utilities and electric providers often maintain lists of critical clients that will be a priority for power restoration. Considering the critical clients of utilities may help the public sector in prioritizing the clearing of roadways from debris, etc.
- Electric providers and utilities have a key public informational role during an outage. In addition to working with media and social media, many providers, such as Xcel Energy and Polk-Burnett Electric Cooperative, have web-based power outage maps.
- It is important that emergency response and public-sector road crews understand the risks of working near downed power lines and how power is restored.
- More public education is needed on how safety issues during a power outage, how to get information during an outage (e.g., media, websites, mobile apps), and how power is restored. The websites of area electric providers is a great place to start:

https://www.xcelenergy.com/outages_and_emergencies
https://www.polkburnett.com/content/electric-safety
http://www.nweco.com/electric-safety.html

The lessons learned from past LTPO workshops and exercises have been integrated into a state-level report which is available at the Wisconsin Emergency Management website or from West Central Wisconsin Regional Planning Commission. The recommendations of the State report were considered during this hazard mitigation planning effort and, when appropriate, have been integrated into the mitigation strategies found later in this document.

## i. Tornadoes

Tornadoes are typically linked with severe thunderstorm events. It is sometimes difficult to determine the difference between the impacts of a tornado versus very high winds. As such, the discussion in this sub-section includes significant overlap with the thunderstorm assessment.

### *Summary—Tornadoes*

*Risk – Relative to other parts of the State, Polk County has a moderately high frequency of reported tornado events. From 1950-2016, there have been 26 tornado reports for Polk County, resulting in four deaths, 18 injuries, and over $61 million in property damage. All four of the deaths and the far majority of the injuries and damages were the result of two tornado events in 1952 and 1953. It is expected that a tornado touchdown will continue to be reported for Polk County once every two years.*

*Vulnerabilities – Tornadoes and high winds can have similar impacts, though tornadoes have the potential to be more devastating and violent for a smaller area. All structures and critical facilities are vulnerable, but especially large-span buildings, unanchored trailer homes, campgrounds, structures with substantial numbers of people (e.g., schools, hospitals), and residents without access to a storm shelter or safe room. Above-ground utilities are also vulnerable. Average annual property, injury, and death losses for Polk County are estimated at $857,988 due to tornado events and approximately $1.5 million for thunderstorm-related high winds.*

1. Overall, the risks and vulnerabilities related to tornadoes and high winds for Polk County are not unique and not site-specific. Measures to mitigate will largely focus on emergency preparedness, storm shelters, notification systems, and related education.

2. Polk County has an estimated 1,990 trailer homes (8.2% of all housing units). Few regulations exist which require the designation of storm shelters or emergency planning for mobile homes parks or rental apartment buildings. The number of mobile homes in the County may be decreasing.

3. Polk County has a strong tourist economy with increasing numbers of campgrounds, RV parks, resorts, and recreational rental properties. Many of these recreational locations lack formal plans or policies, emergency siren or warning systems, or designated storm shelters. Further, the visitors using these facilities may not be aware of local risks, shelter options, warning systems, etc.

4. The Polk County Fairgrounds in St. Croix Falls and Trollhaugen near Dresser pose unique severe weather vulnerabilities given that they host large events during severe weather season.

5. Overhead power lines in wooded areas are especially vulnerable to high winds. Related risks and vulnerabilities were previously discussed in the *Special Threat Analysis—Long-Term Power Loss* section.

6. The majority of the existing warning sirens do not have battery back-up and some cannot be triggered remotely. A number of cities and villages are in need of additional sirens or to replace aging equipment. Sirens were also identified as a need for a number of unincorporated areas where a concentration of residential development exists. The demand for siren may be decreasing, however, as emergency notifications are now available through smart phones. NOAA All Hazards Weather Radios is another alternative, though there is a gap in coverage within the central portion of Polk County.

7. All but three incorporated municipalities currently have a public storm shelter, though some communities may need alternative or additional sites in the future. Some current shelters are located on property not owned by the municipality with no formal shelter agreement or policies.

## *Risk Assessment—Tornadoes*

### The Hazard

Tornadoes are relatively short-lived local storms composed of an intense rotating column of air, extending from a thunderstorm cloud system. It is nearly always visible as a funnel, although its lower end does not necessarily touch the ground. Average winds in a tornado, although never accurately measured, are between 100 and 200 miles per hour; however, some tornadoes may have winds exceeding 300 miles per hour.

For reference, the following are the National Weather Service definitions of a tornado and funnel cloud:

**Tornado** - A violently rotating column of air that is touching the ground.

**Funnel Cloud** - A rapidly rotating column of air that does not touch the ground.

A tornado path averages four miles, but may reach up to 100 miles in length. Widths average from 300 to 400 yards, but tornadoes have cut swaths a mile or more in width. Severe tornadoes, or groups of two or three funnel clouds can also travel together. On the average, tornadoes move between 25 and 45 miles per hour, but speeds over land of up to 70 mph have been reported. Tornadoes rarely last more than a couple of minutes over a single spot or more than 15 to 20 minutes in a ten-mile area, but their short periods of existence do not limit their potential devastation. Though similar in potential impact, high-wind events, straight-line winds, derechos, and downbursts are defined within the thunderstorms sub-section.

Shown in **Table 14** is the Enhanced Fujita (EF) Scale, recognized as the accepted tornado magnitude measurement rating and is based on damage estimates for a 3-second wind gust.

**Table 14. Tornado Magnitude Measurement Enhanced Fujita (EF) Scale**

| Operational EF-Scale | Wind Speed (miles per hour) | Character of Damage | Relative Frequency (percent) |
|---|---|---|---|
| EF0 (GALE) | 65-85 | Minor or No Damage | 53.5 |
| EF1 (WEAK) | 86-110 | Moderate Damage | 31.6 |
| EF2 (STRONG) | 111-135 | Considerable Damage | 10.7 |
| EF3 (SEVERE) | 136-165 | Severe Damage | 3.4 |
| EF4 (DEVASTATING) | 166-200 | Devastating damage | 0.7 |
| EF5 (INCREDIBLE) | Over 200 | Extreme damage | <0.1 |

*Source: National Oceanic Atmospheric Administration (NOAA)*

The EF scale replaced the original Fujita scale in 2006 and takes into account 28 different damage indicators for a more accurate indication of tornado strength. The new EF scale does have higher wind speed thresholds, and a larger percentage of reported tornadoes will likely fall within the EF0 category. A lower percentage will fall in each of the higher categories. None of the tornadoes recorded on or before January 31, 2007, will be re-categorized.

The following types of damage could be expected for each EF-Scale tornado:

**F0** Some damage to chimneys; breaks branches off trees; pushes over shallow-rooted trees.

**F1** Peels surface off roofs; mobile homes badly damaged or overturned; moving autos pushed off roads; attached garages may be destroyed.

**F2** Roofs torn off well-constructed homes; mobile homes demolished; large trees snapped or uprooted; light-object missiles generated; cars lifted off ground.

**F3** Entire stories of well-constructed homes destroyed; trains overturned; trees debarked.

**F4** Well-constructed houses leveled; cars thrown and large missiles generated.

**F5** Strong frame houses lifted off foundations and carried considerable distances; automobile-sized missiles fly through the air in excess of 100 meters; trees debarked; steel reinforced concrete structures badly damaged.

The destructive power of the tornado results primarily from its high wind velocities and sudden changes in pressure. Wind and pressure differentials probably account for 90 percent of tornado-caused damage. Tornadoes are generally associated with severe storm systems which are often accompanied by hail, torrential rain, flooding, and intense lightning.

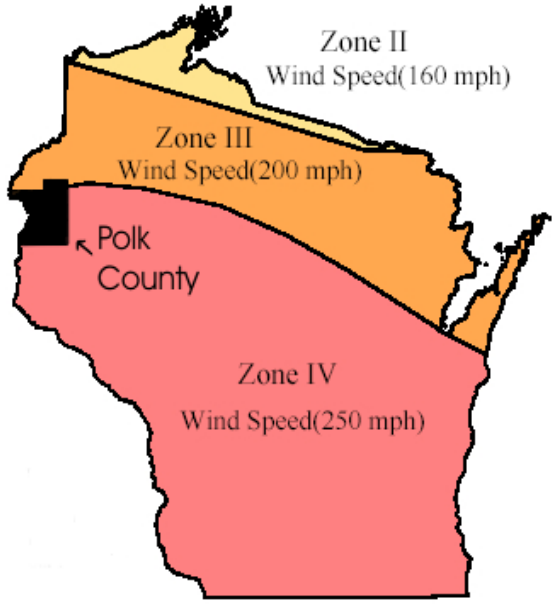
## Regional Trends

On the basis of 40 years of tornado history and more than 100 years of hurricane history, the United States has been divided into four zones that geographically reflect the number and strength of extreme windstorms.

Zone IV has experienced the most and the strongest tornado activity, with wind speeds of up to 250 mph, and includes nearly all of Polk County (see **Figure 20**).

Wisconsin lies along the northern edge of the nation's maximum frequency belt for tornadoes (known as "tornado alley") which extends northeastward from Oklahoma into Iowa and then across to Michigan and Ohio. Generally, the frequency and severity of tornado events decreases as one travels north.

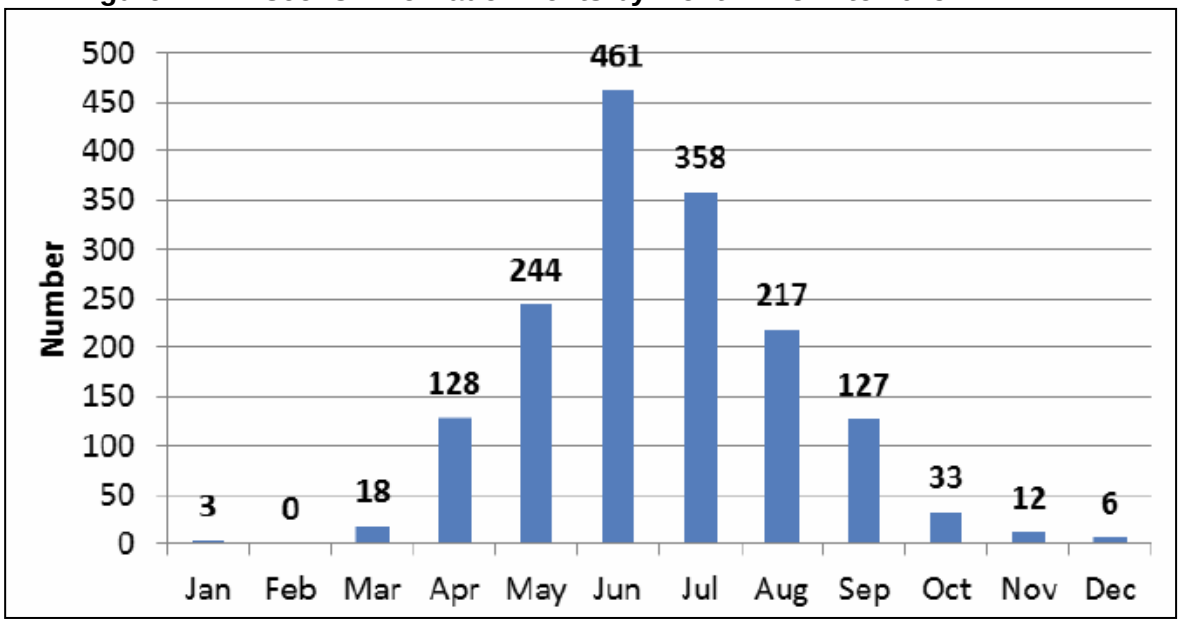
**Figure 20. Design Wind Speed Map of Wisconsin**




*adapted from "Design Wind Speed" map from FEMA's "Taking Shelter from the Storms: Building a Saferoom in Your House"*

Tornadoes have occurred in Wisconsin in every month except February, as shown in **Figure 21** below:

**Figure 21. Wisconsin Tornado Events by Month • 1844 to 2015**

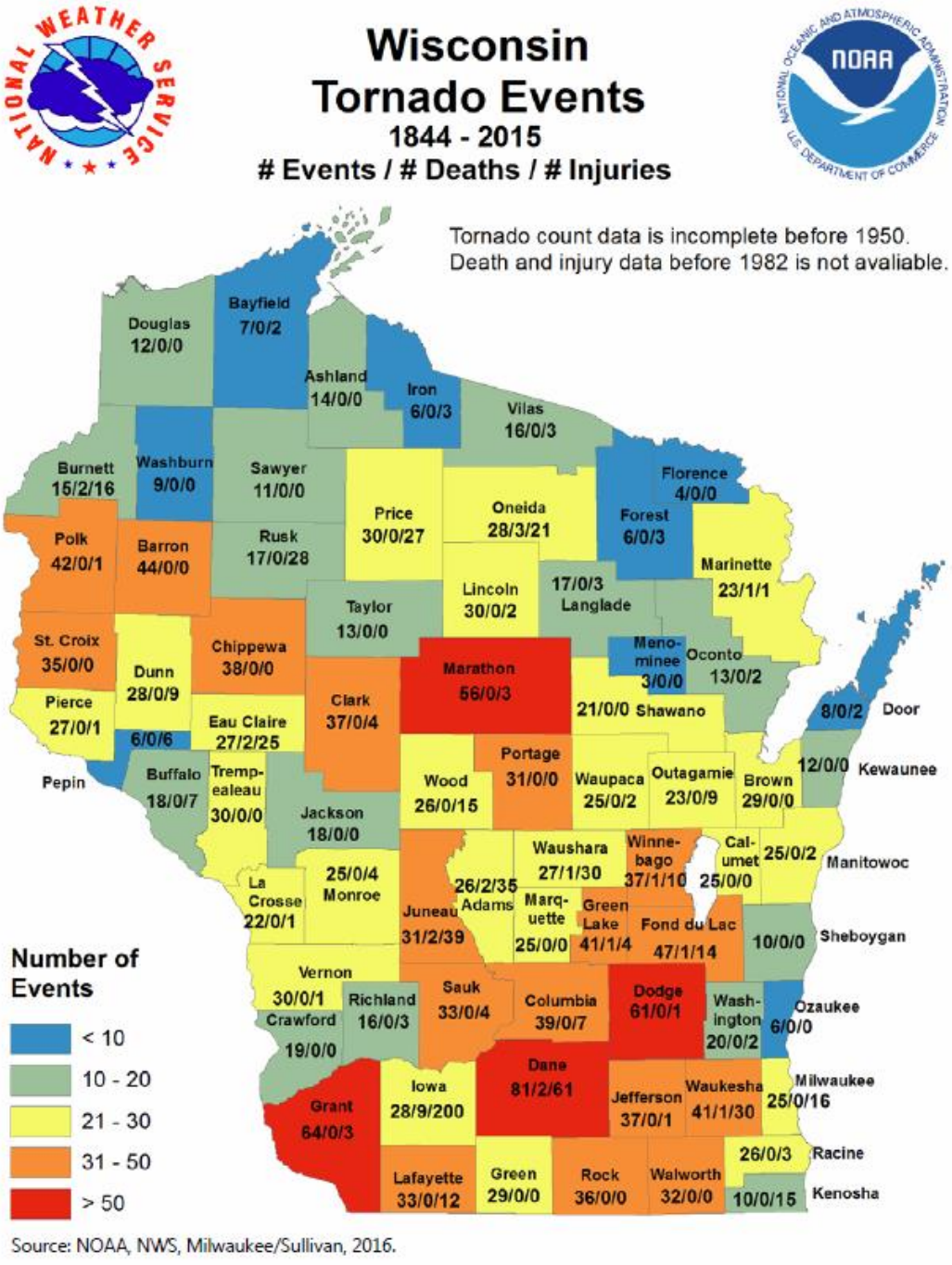



*source: WEM THIRA based on NWS, Milwaukee/Sullivan, 2016*

Wisconsin's tornado season runs from the beginning of April through September. The most severe tornadoes typically occur during April, May, and June. Many tornadoes strike in late afternoon or early evening. However, tornadoes have occurred during other times of the day. Personal property damage, deaths, and injuries have and will continue to occur in Wisconsin.

From 1980 to 2015, Wisconsin experienced 22 significant tornado events, including twelve EF-3, three EF-4, and one EF-5 tornado. **Figure 22** below shows that the Polk County area has had a relatively high number of tornadoes with 42 reported tornadoes between 1844 and 2015.

**Figure 22. Wisconsin Tornado Events • 1844 to 2015**




**Siren, WI - June 2001 Tornado**

The potential destructiveness of tornadoes remains fairly fresh in the minds of many Polk County residents due to two fairly recent and substantial tornado events in the region. On June 18, 2001, an F3 tornado with a 27-mile path hit the Village of Siren approximately five miles to the north, resulting in three deaths, 16 injuries, 167 destroyed homes, and 280 damaged homes. More recently, about 50 miles east of Polk County, an F3 tornado hit the City of Ladysmith on September 2, 2002, injuring 37 and resulting in over $20 million in damage. Many long-time residents of the region also recall the devastating Colfax Tornado of 1958 which had a 32-mile path, caused at least 19 deaths, and resulted in severe damage. However, such events were mentioned much less frequently during the update of this plan compared to similar planning efforts in the region in 2005, demonstrating that past events can quickly fade from memory.

**Ruins of the New Richmond Methodist Church,**

Fewer Polk County residents are likely aware that the deadliest tornado in Wisconsin history (and 9th deadliest in U.S. history) occurred about five miles south of the county line. On June 12, 1899, a strong storm with heavy rain and hail hit the City of New Richmond in St. Croix County. Hundreds of visitors were in town that day for the circus which ended around 4:30 pm, just when the storm began. A powerful tornado struck close to 6 pm. Passing through the very center of town, the tornado leveled buildings and sent debris flying. Half of the city was destroyed and 117 people were killed. This tornado originated on Lake St. Croix, about five miles south of Hudson. The tornado moved to

the northeast, east of Hudson, in the direction of New Richmond, leveling farms near Burkhardt and Boardman. Over 300 buildings were damaged or destroyed. The great visibility of the tornado may have prevented an even higher death total. While not a massive tornado, the combination of time and position was unfortunate.

## Local Events

According to Wisconsin Emergency Management, there have been 42 tornadoes reported for Polk County between 1844 to 2015. Only six other Wisconsin counties reported more tornadoes during this timeframe, including Barron County immediately to the east with forty-four reports.

**Table 15** shows the tornadoes reported to the National Climatic Data Center (NCDC) for Polk County from 1950 through September 2016. However, some events have likely gone unreported if not confirmed or the impacts were not significant, in particular for the funnel cloud events for which data was not been kept until 1993.

From January 1993 through September 2016, there have been thirteen tornado and five funnel cloud event reports for Polk County. This averages to one tornado event report approximately every two years, though one storm system can spawn multiple tornadoes or there can be multiple reports for a single tornado. Funnel cloud reports are less frequent, with about one such report every five years.

**Table 15. Tornado Events • 1950 to September 2016**
**Polk County**

| Location | Date | Time | Mag | Deaths | Inju-ries | Property Damage | Crop Damage |
|---|---|---|---|---|---|---|---|
| **Tornado Events** | | | | | | | |
| Polk Co. (not specified) | 6/23/1952 | 9:30 PM | F3 | 2 | 6 | 22,520,284 | 0 |
| Polk Co. (not specified) | 5/10/1953 | 7:10 PM | F2 | 2 | 9 | 22,351,592 | 0 |
| Polk Co. (not specified) | 7/10/1966 | 7:00 PM | F2 | 0 | 2 | 1,841,937 | 0 |
| Polk Co. (not specified) | 6/12/1967 | 8:45 AM | F2 | 0 | 0 | 178,679 | 0 |
| Polk Co. (not specified) | 7/30/1968 | 9:00 PM | F1 | 0 | 0 | 1,714,907 | 0 |
| Polk Co. (not specified) | 7/26/1969 | 8:00 PM | F1 | 0 | 0 | 162,613 | 0 |
| Polk Co. (not specified) | 8/8/1973 | 5:00 PM | F1 | 0 | 0 | 1,344,116 | 0 |
| Polk Co. (not specified) | 10/9/1973 | 1:00 AM | F1 | 0 | 0 | 134,412 | 0 |
| Polk Co. (not specified) | 7/30/1977 | 5:28 PM | F3 | 0 | 0 | 9,847,979 | 0 |
| Polk Co. (not specified) | 5/9/1980 | 1:30 PM | F0 | 0 | 0 | 8,691 | 0 |
| Polk Co. (not specified) | 8/3/1981 | 2:30 PM | F0 | 0 | 0 | 65,653 | 0 |
| Polk Co. (not specified) | 8/3/1981 | 2:35 PM | F0 | 0 | 0 | 65,653 | 0 |
| Polk Co. (not specified) | 4/26/1984 | 9:25 PM | F1 | 0 | 0 | 574,386 | 0 |
| Centuria | 7/9/1999 | 11:41 AM | F0 | 0 | 0 | 0 | 0 |
| Balsam Lake | 7/9/1999 | 11:52 AM | F0 | 0 | 0 | 0 | 0 |
| Clam Falls | 7/8/2000 | 5:40 PM | F0 | 0 | 0 | 0 | 0 |
| Luck | 8/14/2000 | 7:35 PM | F0 | 0 | 0 | 0 | 0 |
| Clear Lake | 6/11/2005 | 1:40 PM | F0 | 0 | 0 | 0 | 0 |
| Milltown | 5/26/2007 | 15:44 PM | F0 | 0 | 0 | 0 | 0 |
| East Farmington | 5/25/2008 | 16:17 PM | F0 | 0 | 0 | 0 | 0 |
| Balsam Lake | 7/27/2010 | 6:16 PM | F0 | 0 | 0 | 110,684 | 0 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Turtle Lake | 7/27/2010 | 6:34 PM | F1 | 0 | 0 | 110,684 | 0 |
| Luck | 8/7/2010 | 10:37 PM | F0 | 0 | 1 | 112,499 | 0 |
| Range | 7/19/2011 | 6:30 PM | F0 | 0 | 0 | 0 | 0 |
| Luck | 5/27/2012 | 7:13 PM | F0 | 0 | 0 | 0 | 0 |
| Little Falls | 6/17/2015 | 4:30 PM | F0 | 0 | 0 | 0 | 0 |
| **Funnel Cloud Reports** | | | | | | | |
| Range | 6/7/2005 | 3:24 PM | N/A | 0 | 0 | 0 | 0 |
| Clayton | 6/7/2005 | 3:53 PM | N/A | 0 | 0 | 0 | 0 |
| Amery | 6/7/2005 | 4:26 PM | N/A | 0 | 0 | 0 | 0 |
| Clam Falls | 5/26/2007 | 4:13 PM | N/A | 0 | 0 | 0 | 0 |
| Range | 7/20/2010 | 5:15 PM | N/A | 0 | 0 | 0 | 0 |
| | **31 reports** | | | **4** | **18** | **$61,144,767** | **none reported** |

*source: National Climatic Data Center (NCDC)*
*Damage estimates in 2016 dollars based on Consumer Price Index by U.S. Bureau of Labor Statistics*

The tornado events reported in Table 15 have resulted in four deaths, eighteen injuries, and over $61 million of estimated property damage in current dollars. No associated crop damage was reported, though undoubtedly occurred. All but two the tornadoes occurred during the months of May through August. The far majority of the events occurred between the hours of 2:00 PM and 10:00 PM.

Also notable is that all of the deaths, almost all of the injuries, and over 70 percent of the damages in Table 15 are associated with two events in 1952 and 1953. In June 1952, a tornado left an eight-mile path of destruction from Centuria to Half-Moon Lake north of Balsam Lake. A dozen homes in the Village of Centuria were destroyed and two resorts were struck. In May 1953, high winds and tornadoes struck the western part of the State. A farmer in the Amery area and a young girl near Frederic were killed due to barn collapses. Temporary power and communication outages in the surrounding areas accompanied both of these events. These facts demonstrate that the total impacts in Table 15 can change dramatically depending where a tornado should strike.

## Relative Level of Risk

The Polk County Steering Committee rated tornadoes tied with heavy snow as the highest overall natural hazard concern. This is likely due to the potential destructiveness of such events, the possibility of a tornado touchdown anywhere in the County, and the recent history of tornado events in the region (e.g., 2001 Siren tornado). Based on the thirteen tornado reports since 1993, **It is probable that a tornado will continue to touch down and be reported for Polk County once every two years on average.**

Although the improvement of technology has enabled meteorologists to better identify and predict the conditions that are favorable for tornado development, there is no precise way to predict the formation, location, and magnitude of a tornado. And, there is no predictable pattern that can be used to accurately predict future tornado events.

## *Vulnerability Assessment—Tornadoes & High Winds*

Due to the potential impacts similar to those of tornadoes, high wind vulnerabilities are discussed within this section, though their risk assessment (e.g. history, frequency) is discussed with thunderstorms.

### Potential Impacts

Tornadoes and high winds have no defined hazard area within Polk County. Due to the unpredictable nature of tornadoes and lack of specific hazard areas, the assessment of potential community impacts as a result of a tornado is difficult to quantify.

Tornadoes and high winds are capable of killing or injuring residents and damaging or destroying homes, businesses, public buildings, and infrastructure. This destruction can occur as a result of high winds or by airborne debris that can be carried by the tornado. Tornadoes can uproot trees and topple power lines, impacting the supply of electrical service to local homes and businesses. Roadways can also be blocked by debris, and debris can accumulate in rivers or stormwater systems and contribute to washouts or flooding.

All above-ground structures are vulnerable to a tornado or strong high winds. As discussed previously, Polk County has about $3 billion in assessed improvements and personal property, most of which would be vulnerable during such events. This total does not include structures located on tax-exempt properties such as municipal buildings, churches, and certain utilities.

Further, damaged buildings may pose additional safety concerns due to structural instability, damage to electrical systems, or gas leaks. Specific data on the structural condition of buildings in Polk County is not available. About 17 percent of the County's housing stock was built in 1939 or earlier, but this does reflect condition, and older structures are often more likely to have basements compared to new construction in some areas.

In addition to direct impacts to buildings, economic losses can be experienced when a business sustains direct damage from the event or when supporting infrastructure (e.g., utilities, services) are not available for extended periods. Such a business closure may be temporary, but could have large impacts on the local economy and related services, while some smaller or struggling business may fail.

Based on a review of the community and past tornado impacts, it was determined that the following general types of properties are especially vulnerable to tornado and high wind events:

- Mobile homes, especially those which are unanchored
- Homes with crawlspaces (elevated and more susceptible to lift)
- Buildings with large spans (e.g., airport hangars, pole barns, gyms, factories)
- Residents in slab-on-grade structures without access to a safe-room or storm shelter
- Campgrounds, trailers, and resort properties without storm shelters
- Above-ground power lines, especially in wooded areas
- Critical facilities and historic sites, due to their high value to the community

Mobile homes, in particular, are vulnerable to tornado and high wind events. According to the National Weather Service, between 1995 and 2002, there were 415 tornado fatalities in the United States. Forty-one percent (41%) of these fatalities occurred in mobile homes, which constitute just 7.5 percent of the nation's housing supply.

As discussed previously, Polk County had 1,990 mobile homes in 2015, constituting about 8.2 percent of the total housing supply, nearly triple the State average. **Figure 22** on the following page shows the locations of thirty-five mobile home parks in Polk County, though some of these may be used for seasonal housing. According to the Wisconsin Department of Commerce, there are 32 licensed manufacturing housing communities in Polk County with 918 sites. The majority of the parks in Figure 22 are located within cities or villages.

Many communities do not require mobile homes to be anchored or tied down, unless the mobile homes are newer and fall under more recent State installation codes. Whether older mobile homes are anchored is not known in most cases. The majority of communities also do not specifically require mobile home parks to have designated storm shelters or an emergency operating plan, though these could potentially be required as part of a conditional use permit. And to the knowledge of local officials, nearly all of the mobile home parks in Polk County do not offer an on-site storm shelter. All incorporated municipalities, except Centuria, Dresser, and St. Croix Falls, have a storm shelter available for the public.

Throughout most areas of the region, new mobile home development is minimal and it is not believed that a new mobile home park has been developed over the past decade. In fact, the number of mobile homes may be decreasing in some areas. Other types of manufactured or pre-fabricated homes have become a preferred option of affordable housing. These units are typically well-secured to a permanent foundation, but usually lack a basement or safe room for a storm shelter. Data on homes with crawlspaces or without basements is currently not collected as part of the Federal census and is not available. During the planning process, it was stated that new residential development in Polk County has typically included a basement or crawlspace. This is contrary to many surrounding counties which have experienced a high percentage of slab-on-grade construction during the past decade.

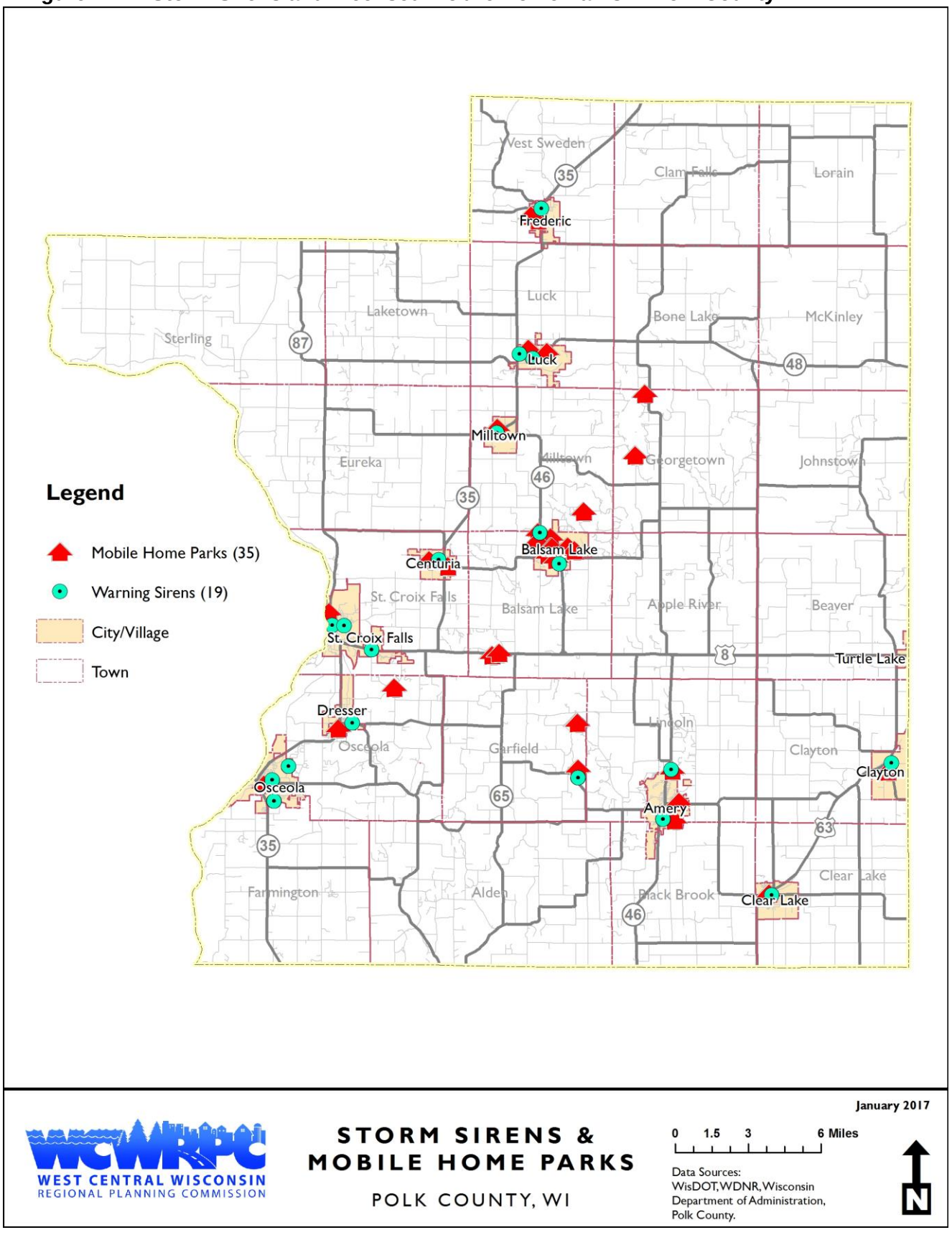
Tents and trailers at campgrounds are particularly vulnerable to tornado and high wind events as was experienced nearby in the City of Cumberland (Barron County) during a Summer 2010 wind storm. The 2009 *Polk County Outdoor Recreation Plan* stated that there were 23 licensed public, private, and group campgrounds in the County, the majority of which are private. Polk County owns and operates one campground with approximately ten sites at Apple River Park north of Amery. The campground has a small restroom, but no designated storm shelter.

**Did you know?**

**25% of businesses do not re-open following a major disaster.**

***– The Institute for Business & Home Safety***

**Figure 22. Storm Sirens and Licensed Mobile Home Parks in Polk County**



Wisconsin's Interstate State Park managed by WDNR has 85 family campsites and a primitive group camp that accommodates 60 people. Information is posted for all guests on actions in case of severe weather and a weather radio is available at the ranger station. Nearby warning sirens in St. Croix Falls and Taylor Falls can be heard from most, if not all, of the park. The concrete park office is used as a weather shelter and is open to the public. Park staff, supplemented by the St. Croix Falls Fire Department, drive through the campground and alert guests of approaching severe weather when warnings occur. Compared to previous mitigation plans, the need for severe weather shelters at other campgrounds, RV parks, and resorts in Polk County was a growing concern during the planning process.

In the first part of Table 16, Wisconsin Emergency Management has projected average annual loss estimates for tornado events for Polk County based on past event history from 1950 through 2015.[10] WCWRPC produced a revised tornado loss estimate based on the events and damages reported in Table 15, which reflect significantly higher losses but the same number of deaths and injuries over an additional year. Loss estimates for high winds were developed by WCWRPC using a similar approach and the data provided in Table 20 in the thunderstorms assessment.

**Table 16. Polk County Tornado & Straight-Line Wind Loss Estimates**

| **Tornado Loss Estimates (Wisconsin Emergency Management)** | | | |
|---|---|---|---|
| **Avg. Damage per Tornado (1950-2015)** | **Annual Probability** | **Estimated Future Annual Loss to Property** | **Estimated Future Annual Loss Due to Death or Injury** |
| $357,601 (27 events) | 0.4100 | $146,292 | $496,727 |
| **Tornado Loss Estimates (WCWRPC)** | | | |
| **Avg. Damage per Tornado (1950-2016)** | **Annual Probability** | **Estimated Future Annual Loss (property)** | **Estimated Future Annual Loss Due to Death or Injury** |
| $926,436 (26 events) | 0.3900 | $361,310 | $496,678 |
| **Thunderstorm High Wind Loss Estimates (WCWRPC)** | | | |
| **Avg. Damage per T-Storm Wind (1993-2016)** | **Annual Probability** | **Estimated Future Annual Loss (property)** | **Estimated Future Annual Loss Due to Death or Injury** |
| $285,748 (124 events) | 5.3913 | $1,540,553 | $0 (no injuries or deaths reported) |

*Source: State of Wisconsin Homeland Security Council THIRA & SPR, updated January 2017; National Climatic Data Center (NCDC); and, West Central Wisconsin Regional Planning Commission (WCWRPC).*

The methodology used to develop the first tornado loss estimate is described in the State THIRA & SPR footnoted below. It incorporates the average damage per tornado, an annual probability of a tornado event, and average injuries and deaths per event based on historic data from the National Climatic Data Center (NCDC). On average, each injury was given a monetary value of

[10] State of Wisconsin Homeland Security Council THIRA & SPR, updated January 2017

$288,000 per injury, while deaths were given a monetary value of $6.9 million per death based on FEMA guidance for benefit-cost calculations.

The WCWRPC estimation used a very similar approach based on the NCDC data provided in Tables 15 and 20, which were adjusted to 2016 dollars. The Wisconsin Emergency Management estimates for injuries and death were then added. Since the bulk of the tornado-related property damage occurred in 1952 and 1953, the average damage per tornado was much higher when the past damages were adjusted to current dollars. Projected annual high wind property losses greatly exceeded those of tornadoes due to the much higher frequency of high wind events and the shorter time period from which the high wind data was derived (1993-2016). However, no deaths or injuries have been reported for high wind events in Polk County, unlike tornadoes.

Though Polk County has had a relatively high number of reported tornadoes, it is also been relatively lucky in terms of damages. According to Wisconsin Emergency Management, Polk County ranked 31st overall among Wisconsin's 72 counties for annual tornado property damage risk based upon the above WEM loss estimates. In terms of death and injury risk, Polk County ranked 23rd.

Average total losses (property and people) from tornado events in Polk County can be estimated between $643,019 to $857,988 annually, with the understanding that damages may not be incurred every year. Average annual straight-line wind losses were significantly higher at about $1.5 million per year. But it must be kept in mind that the estimates in Table 16 are based on those events reported to the NCDC. No recent events have struck a high-density developed area and some damages and injuries likely have gone unreported, in particular for the high wind events. Crop and forest damage are often not included in the above numbers.

While few, if any, buildings can withstand the direct impact of a large-magnitude tornado, large-span structures can be particularly vulnerable to high wind damage. Data on the number of large-span structures in Polk County is not available, though some, such as school gymnasiums, are addressed in the critical facilities vulnerability assessment. Most of these large-span buildings tend to be large storage buildings, garages, or barns, which are common throughout the County. Many of these are relatively inexpensive to construct and are used for storage or livestock. Of greater vulnerability, due to contents and risk of injury or death, are industries or big-box commercial buildings which have large-span structures. Most of these are located near or within the incorporated areas.

Agricultural-related damages include structures (e.g., barns), livestock, and crops. No tornado-related crop damage was reported since 1950 and only $123,000 in high-wind crop damage was reported. Based on the NCDC records, it is not certain if crop damage reports were tracked prior to 1993, or they may have been combined with other property damage. But, as the two deaths associated with collapsing barns in May 1953 demonstrated, livestock barns and structures are quite vulnerable to high winds and tornadoes. There were no natural areas or environmental characteristics within Polk County which were identified as being uniquely vulnerable to tornadoes or high winds.

Continuing changes in land-use and development patterns will influence the County's potential for future exposure to tornadoes. As discussed previously, Polk County is continuing to grow and develop. This creates an increasing exposure to the number of residents and properties that are at risk from future tornado events.

## Vulnerable Critical Facilities

All critical facilities are susceptible to being hit by a tornado. A more robust assessment of community assets (critical facilities) and their susceptibility to tornadoes and other hazard events is located in **Appendix F**. Above-ground electrical infrastructure is particularly vulnerable to tornadoes and high winds and was discussed previously in the *Special Threat Analysis—Long-Term Power Loss* section. Above-ground communications infrastructure is also vulnerable and high winds in August 2010 twisted one of the County's radio communications towers.

Though no critical facilities have been impacted by tornadoes in recent years, the vulnerability assessment did yield that tornadoes and high winds represent the highest vulnerability and risk to the critical facilities of Polk County. The 27 schools were of special concern due to:

- large numbers of individuals present, including school-age children or when being used as a storm shelter in some communities
- most having large span areas, such as gyms and theaters, which are especially vulnerable to tornadoes and high winds

Long-term care and assisted-living facilities are also vulnerable due to the age and/or health of residents. Most of these facilities are also single-story structures for reasons of mobility and have a designated storm shelter area, instead of a basement. As of Spring 2017, Polk County had sixteen nursing homes and assisted living facilities, as well as fourteen other long-term residential care facilities. Hospitals were also identified as being of significant concern due to their potentially vulnerable population, emergency response functions, and importance to the community. Polk County has three hospitals located in Amery, Osceola, and St. Croix Falls. Two communities—Amery and Osceola—have municipal airports with hangars, structures, and aircraft which can be particularly vulnerable to tornadoes and high winds. Since the 2006 plan, the Village of Osceola now requires all aircraft to be properly tied-down.

## Polk County Fairgrounds

The annual County Fair occurs during severe weather season. In an average day, 9,000 persons visit, with peak attendance of 5,000 to 6,000 at a single time. Onsite camping of 200 units is available for Fair vendors and volunteer staff.

At least once every 2-3 years, the County Fair is evacuated due to severe weather warnings. A school located about 0.5 miles to the southwest is available as a storm shelter, but the distance is excessive and pedestrian are forced to walk under trees and power lines. Evacuations are chaotic with pedestrians attempting to get to their vehicles, parents arriving to pick-up children, and traffic back-ups leaving the site. One or more shelter/safe room projects are under consideration, perhaps in conjunction with grandstand improvements.

Nearby slab-on-grade apartments and long-term care facilities could also take advantage of such a shelter if appropriately sized.

## *Unique Jurisdictional Risks or Vulnerabilities—Tornadoes & High Winds*

During the planning process, each incorporated area was analyzed to provide insight into the extent of its vulnerabilities to tornadoes and high wind events. The extent of the vulnerabilities identified by the communities was largely limited to recent events, mobile home parks, large-span buildings, and slab-on-grade construction as summarized in the *Unique Jurisdictional Risk or Vulnerabilities Table* in **Appendix G**. **Appendix H** summarizes current mitigation efforts for each incorporated community, including safe rooms/storm shelters and notification systems/sirens needs.

Tornadoes pose no risks or vulnerabilities unique to individual incorporated jurisdictions (villages and cities), with two exceptions:

- The Village of Dresser identified Trollhaugen as a unique vulnerability given that events can attract over 1,000 attendees and camping is provided on site.
- The City of St. Croix Falls identified the County Fairgrounds as a unique vulnerability as previously discussed.

The Village of Centuria has the most significant tornado history when the June 1952 tornado destroyed a dozen homes and caused serious damage throughout much of the community. A May 1953 tornado caused significant damage within the City of Amery. More recently, a July 2010 tornado resulted in significant damage in the Village of Balsam Lake, including downed trees, roof damage, and severe damage to one home and a garage. Other communities noted that there have been tornado touchdowns in close proximity, but the events have missed most incorporated areas. As discussed in Appendix G, the cities and villages reported that high straight-line winds are much more common. Downed trees, roof damage, and

***from The Rhinelander Daily News, June 24, 1952***

# Dozen Homes Demolished in Village of Centuria

By The Associated Press

A tornado slashed across Wisconsin's Indianhead county last night in the wake of violent electrical storms, killing at least two persons in Polk County when it smashed at the village of Centuria.

**The dead**

**Irvin Koshatka, 35, killed in the basement of his father's home when the tornado lifted the house from its foundation and drove it against a tree.**

**Martin Walker, 62, killed while sitting in his living room when the tornado blasted his house to fragments.**

At least three other persons were injured critically. They were 2-months-old Marjorie Kashatka, a niece of Irvin's, visiting with her family from Cass Lake, Minn.; Mrs. Martin Walker and Frank Sonderlik, 80, who was struck by a falling tree.

A dozen homes in the village were demolished by the tornado, which struck at 9:30 last night and left giant footsteps of destruction across an eight mile path from Centuria to Half-Moon Lake near Milltown. Two resorts were struck at the lake, and at least one vacationing family was left out in the storm when a cabin was destroyed.

Reports of the loss in life and property damage were slow to come in because telephone and utility lines were down all over the area. Centuria was wi[illegible]ter overnight until an emer[illegible]mp was rigged today.

O. W. Peterson, president of the Centuria State Bank, said the tornado cut a 75-foot swath across the village.

The electrical storms both preceded and followed the tornado elsewhere in the area. At Superior, [illegible]

scattered debris are the most commonly noted types of wind damage. Power loss due to downed trees is also fairly common in some of the older neighborhoods.

As mentioned previously, the majority of mobile home parks and critical facilities lie within the cities and villages. Most communities commented that many of the newer homes and senior living facilities were slab on grade without basements for shelter. The same can be said of many manufacturing and commercial buildings, which are also sometimes large-span buildings and have an elevated vulnerability to tornadoes and high winds. Centuria and Amery noted that some multi-family residential buildings are also slab-on-grade without basements.

Overall, community vulnerability increases with development density, population density, type of development, and value of improvements, so different communities do have varying levels of vulnerability. And, as more growth and development occurs, this vulnerability also increases. As such, cities and villages are the highest vulnerability areas, as well as those areas with higher populations, larger numbers of housing units, and higher assessed value per square mile described previously in **Section II. Community Profile.**

## *Weather Warning Sirens*

The public relies heavily on emergency or weather warning/storm sirens for notification of potentially approaching storms or tornadoes. The existing sirens are all located in incorporated areas as shown previously in **Figure 26**.

A brief inventory of weather warning siren needs was conducted as part of this planning effort as discussed in Appendix H. Many existing sirens lack battery back-up. New sirens may be needed in some communities (i.e., Clear Lake, Dresser, Luck, Milltown, Osceola) to have full geographic coverage due to growth, topography, etc., or to replace aging equipment. There are also unincorporated and seasonal use areas with significant population concentrations which would also benefit from siren coverage.

All sirens are triggered locally, though some communities during interviews did express an interest in having County Dispatch trigger sirens. A number of communities (i.e., Luck, Centuria, Clear Lake) expressed interest in adding a system to allow for the remote triggering of their sirens.

An emerging theme during this plan update is that some local officials believe that sirens are be becoming less important for weather warnings due to the ability of the public to obtain emergency notifications through smart phones.

## ii. Winter Storms and Extreme Cold (including blizzards and ice storms)

### *Summary—Winter Storms*

*Risk – Since 1993, Polk County has experienced approximately 3.5 to 4.0 winter storm and/or extreme cold events per year on average. True blizzards are quite rare. Less severe freezing rain and winter storm conditions do occur much more frequently and can still be dangerous. Should the climate change as predicted, the winters could become shorter with fewer extreme cold events, but would also be wetter with more potential for heavy snow or ice storm events.*

*Vulnerabilities – Most vulnerable are travelers, above-ground utilities (especially in wooded areas), crops (especially alfalfa), and persons exposed to extreme cold. The 2014 Polar Vortex demonstrated that infrastructure, especially public water systems, is vulnerable to extreme cold, especially if there is little or no snow cover.*

1. The potential for a large-scale ice storm resulting in a long-term power outage, especially during very cold temperatures, is likely the most significant winter storm threat facing Polk County. Overhead power lines in wooded areas and older neighborhoods with trees are especially vulnerable to high winds, heavy snow, and ice storms. Some critical facilities and some local emergency operations centers do not have emergency generators. Additional emergency response planning and exercises may be needed on this topic. This topic was discussed previously in greater detail.

2. Though there are scattered areas prone to drifting of snow on roadways, many of these concerns have been largely mitigated through snow fencing and improved equipment (wing plows). Some areas particularly prone to drifting problems were identified, but feasible options to further mitigate these concerns are limited in most cases. As a more cost-effective alternative, more public education through local media and social media on winter driving safety may be needed.

3. The U.S. Highway 8 hill in St. Croix Falls is especially dangerous under slippery conditions. When the highway is icy, east-bound truck traffic has jack-knifed as they attempt to ascend the hill.

4. Winter kill of crops, especially alfalfa, can be significant during extended periods of cold when there is little or no snow cover which requires farmers to purchase supplemental feed. Though more rare, early frost events (e.g., September 1974) can nearly wipe out an entire corn and soybean crop.

5. No cities or villages identified a "hotspot" especially vulnerable to frequent water main breaks, winter-related accidents, or similar types of problems. The Village of Luck

identified some lakeshore erosion concerns along the west shore of Big Butternut Lake for which ice action is a contributing factor.

## *Risk Assessment—Winter Storms*

### The Hazard

Winter storms can vary in size and strength and include heavy snowstorms, blizzards, freezing rain, sleet, ice storms, and blowing and drifting snow conditions. Extremely cold temperatures accompanied by strong winds can result in wind chills that cause bodily injury such as frostbite and death.

A variety of weather phenomena and conditions can occur during winter storms. The following are National Weather Service-approved descriptions of winter storm elements:

| | |
|---|---|
| *Heavy Snowfall:* | The accumulation of six or more inches of snow in a 12-hour period, or eight or more inches in a 24-hour period. |
| *Winter Storm:* | The occurrence of heavy snowfall accompanied by significant blowing snow, low wind chills, sleet, or freezing rain. |
| *Blizzard*: | The occurrence of sustained wind speeds in excess of 35 miles per hour accompanied by heavy snowfall or large amounts of blowing or drifting snow. |
| *Ice Storm*: | An occurrence where rain falls from a warm and moist upper layer(s) of the atmosphere to colder and dryer layer(s) at or near the ground, freezes upon contact with the ground, and accumulates on exposed surfaces. |
| *Freezing Drizzle/Rain:* | The effect of drizzle or rain freezing upon impact on objects that have a temperature of 32º Fahrenheit or below. |

Dangerously cold conditions can be the result of extremely cold temperatures or the combination of cold temperatures and high winds. The combination of cold temperature and wind creates a perceived temperature known as "wind chill."

Wind chill is the apparent temperature that describes the combined effect of wind and air temperatures on exposed skin. When wind blows across the skin, it removes the insulating layer of warm air adjacent to the skin. When all factors are the same, heat loss is greater with increased wind speed, thereby resulting in a colder feeling. As winds increase, heat is carried away from the body at a faster rate, driving down both the skin temperature and, eventually, the internal body temperature. Shown in **Table 17** are the calculated wind chill temperatures as a result of specified air temperatures and wind speed.

**Table 17. Wind Chill Table**
**(Wind Chill Values in Degrees Fahrenheit)**

| Temperature (°F) | Wind Speed (MPH) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 5 | 10 | 15 | 20 | 25 | 30 | 35 | 40 | 45 |
| **30** | 25 | 21 | 19 | 17 | 16 | 15 | 14 | 13 | 12 |
| **25** | 19 | 15 | 13 | 11 | 9 | 8 | 7 | 6 | 5 |
| **20** | 13 | 9 | 6 | 4 | 3 | 1 | 0 | -1 | -2 |
| **15** | 7 | 3 | 0 | -2 | -4 | -5 | -7 | -8 | -9 |
| **10** | 1 | -4 | -7 | -9 | -11 | -12 | -14 | -15 | -16 |
| **5** | -5 | -10 | -13 | -15 | -17 | -19 | -21 | -22 | -23 |
| **0** | -11 | -16 | -19 | -22 | -24 | -26 | -27 | -29 | -30 |
| **-5** | -16 | -22 | -26 | -29 | -31 | -33 | -34 | -36 | -37 |
| **-10** | -22 | -28 | -32 | -35 | -37 | -39 | -41 | -43 | -44 |
| **-15** | -28 | -35 | -39 | -42 | -44 | -46 | -48 | -50 | -51 |
| **-20** | -34 | -41 | -45 | -48 | -51 | -53 | -55 | -57 | -58 |

*Source: National Weather Service*

## Regional Trends

Most winter storm events are typically regional in nature and are not limited to a localized area or county. However, levels of snowfall or ice accumulations can vary significantly over relatively short distances.

Much of the snowfall in Wisconsin occurs in small amounts of between one and three inches per occurrence. Heavy snowfalls that produce at least eight to ten inches of accumulation occur on average only five times per season. True blizzards are rare in Wisconsin. They are more likely to occur in northwestern Wisconsin than in southern portions of the State, even though heavy snowfalls are more frequent in the southeast. However, blizzard-like conditions can exist during heavy snowstorms when gusty winds cause the severe blowing and drifting of snow.

Both ice and sleet storms can occur at any time throughout the winter season from October into April. Early- and late-season ice and sleet storms are generally restricted to northern Wisconsin. Otherwise, the majority of these storms during the winter months occur in southern Wisconsin. In a typical winter season, there are 3 to 5 freezing rain events; and a major ice storm occurs on a frequency of about once every other year. If a half-inch of rain freezes on trees and utility wires, extensive damage can occur, especially if accompanied by high winds that compound the effects of the added weight of the ice. There are also between three to five instances of glazing (less than 1/4 inch of ice) throughout the State during a normal winter.

## Local Events

From 1971 to 2000, the mean annual snowfall for Polk County has been 40 to 60 inches. According to the National Weather Service, the worst snow storms in the State of Wisconsin from 1881 to present which potentially included Polk County are:

- **March 2-4, 1881** - Southern / Central - Blizzard - 2 to 4 feet of snow. Drifts to 20 feet. Milwaukee reported 28.5 inches.
- **January 15, 1887** - Southern / Central - Snowstorm - 2 feet of snow. Huge drifts.
- **January 30-February 1, 1915** - Southern / Central - Heavy snow / ice – severe glazing. 10 inches of snow in Milwaukee.
- **February 12-14, 1923** - Statewide - Blizzard - Heavy snow - severe drifting.
- **February 8-10, 1936** - Statewide - Blizzard - severe drifting.
- **November 6-8, 1943** - Statewide - Heavy snow / ice - 10 to 18 inches of snow. Roads blocked for several days.
- **January 28-30, 1947** - Southern / Central - Blizzard - 10 to 27 inches. Drifts to 15 feet. Roads blocked.
- **November 9-10, 1975** – Northern – Major snowstorm – 10 to 14 inches. Edmund Fitzgerald sinks in Lake Superior.
- **January 22-23, 1982** - North half - Blizzard - 10 to 20 inches. Superior had 19 inches.
- **November 30 - December 2, 1985** - Statewide (except southeast corner) - Widespread snows of 10 to 18 inches. Madison had about 10 inches.
- **October 31 - November 2, 1991** - Northwest / West Central - Blizzard - "Halloween Storm" - 15 to 30 inches, 6 to 10 foot drifts. 30 inches in Burnett, Douglas, Polk and St. Croix counties.
- **January 26-27, 1996** - Statewide - Heavy snow - 6 to 18 inches. Localized amounts of 16 to 18 inches fell along a line from La Crosse to Green Bay.
- **March 13-14, 1997** - West Central / Northeast - Snowstorm - 12 to 28 inches. 28 inches at Wautoma in Waushara County.
- **January 21-22, 2005** - Statewide - Blizzard (gusts to 50 mph) - 6 to 15 inches. Although winds gusted up to 50 mph in some areas and visibilities were reduced to less than 1/4 mile due to falling or blowing snow, many areas didn't experience these conditions for 3 hours or more to classify as a full blizzard. Nonetheless, heavy snow and very windy conditions created near white-out conditions especially in the south and east. The heaviest totals occurred near Lake Michigan due to additional lake effect, where some areas ended up near 15 inches.
- **March 18-19, 2005** – West-central – Winter Storm – 18 to 23 inches in a swath from southern Buffalo County to western Jackson County, with 12 to 15.6 inches in La Crosse County. The maximum of 23 inches occurred in northwestern Jackson County.
- **March 13-14, 2006** – West-central to North-central– Winter Storm – 17 to 32 inch swath from St. Croix County northeast to Iron County. Thundersnow enhanced the accumulations. Very poor visibility resulted from gusty winds around 30 mph, and drifting resulted in hundreds of accidents. Locals said it was the worst storm since the 1980s.

- **February 23-26, 2007** – West-central (through southern and eastern Wisconsin) – Blizzard - Two-round storm, with one overnight the 23rd to 24th, and the second round overnight the 24th into the 25th. Leftover snow accumulations continued overnight the 25th into the 26th. In counties surrounding La Crosse, 8 to 15.6 inches (Galesville) fell in round one, while round two produced 6 to 12.5 inches (Sullivan NWS office) over the southern three-fourths of the State. The leftover snow added another 1 to 4 inches, except for 6 to 14 inches from New London into Door County. Many locations totaled 20 to 25 inches for this long-duration two-punch episode from around La Crosse to Port Washington and a small part of Door County. Gusty winds generated snow drifts up to 5 to 7 feet in height.
- **Winter 2014 Polar Vortex** - In winter 2014, Wisconsin experienced a polar vortex. That happens when the cold air cell that is usually centralized in the Arctic splits into smaller cells and those cells travel farther south, cooling the northern hemisphere continents more than normal and warming the Arctic. Statewide, it was the fifth coldest December (2013) through February stretch on record with fourteen locations in the state setting new record low average temperatures. Unfortunately the record cold temperatures also coincided with a propane shortage throughout the Midwest. Many residences in the rural parts of the state rely on propane for heat. When the shortage hit, many people had to move to shelters or stay with friends or relatives. Staying in other places was an option for some, but when home temperatures drop, permanent damage can occur when water pipes freeze and burst. Because of the shortage, propane prices soared; and those without standing contracts spent a lot more than they had planned on.

  In Polk County, the extremely low temperatures and lack of snow cover resulted in frost depths of up to 10 feet in some areas and caused immense damage to infrastructure in all cities and villages except Clayton and Frederic. Table 18 identifies those uninsured damages incurred by Polk County municipalities as reported to Wisconsin Emergency Management in hopes of obtaining a Federal Disaster Declaration and related grant funding. A disaster declaration would not be approved. According to Amery Public Works, when one pipe was cut in May, the line was still frozen.

  As Table 18 shows, most of the damage was associated with breaking and thawing out water mains and lines, though some street and other infrastructure damage did occur. Appendix G provides additional insight into this event by community. During the mitigation plan update process, municipal officials and public works staff noted that this was an extremely unusual and rare event, and many commented that they had never experienced anything similar in their time residing within the community.

**Table 18. Winter 2014 Polar Vortex Damages in Polk County**

| City or Village | Roads & Bridge Damage | Utility Damage | Total Damage | Frost Depth (Inches) | Community Comments |
|---|---|---|---|---|---|
| City of Amery | | $24,000.00 | $24,000.00 | 108.00 | Utility Breaks/Frozen lines - overtime and repair costs. |
| City of St. Croix Falls | $6,000.00 | $13,044.55 | $19,044.55 | 108.00 | |
| Village of Balsam Lake | | $13,261.00 | $13,261.00 | 120.00 | The frost depth ranged from 96 to 144 inches depending on the area. We used the average of the range. The depth of the frost was determined by actual excavation |
| Village of Centuria | | $29,100.95 | $29,100.95 | 78.00 | I don't have a budget number for main breaks so I figured the excess in comparison to other years for the numbers. Also included is our overtime and our ongoing water tower repairs. I don't have a final cost on the water tower or the insurance payments we may or may not receive. Frost depth was determined by "actual excavation" and the NWS website. |
| Village of Clear Lake | | $3,781.70 | $3,781.70 | 78.00 | We have extra costs of $3,256 to an outside contractor for thawing of frozen water lines and overtime costs of $525.70 for our employees. The depth of the frost was measured at sewer manholes in the streets. |
| Village of Dresser | | $13,480.40 | $13,480.40 | 96.00 | 21 homes and businesses on Temporary/Emergency Water. Rain Water in Areas as needed. 1 Water Main Break on 4/10/14. 8 Inch Sewer Main Located in the Industrial Park froze, affecting multiple businesses. The Village of Dresser determined our frost depth by the depth of the Sewer Main in the Industrial Park that froze. Approximate Depth of Sewer Main 6 1/2 to 7 1/2 feet - approximately 8 feet (96 inches) of frost in order for the main to freeze. |
| Village of Luck | | $19,689.49 | $19,689.49 | 96.00 | 2014 Village of Luck Utility Breaks/Freezes.The depth of the frost was measured at various manholes. Majority of cost was for excavation, replacement of two laterals and road/curb and gutter repair. Added damage amounts on 7/31/2014 |
| Village of Milltown | | $6,616.45 | $6,616.45 | 102.00 | The depth of the frost was measured in the manholes. |

| | | | | | |
|---|---|---|---|---|---|
| Village of Osceola | | $58,339.53 | $73,883.78 | 96.00 | Overtime for public works employees. Cost for contractor to thaw frozen lateral water lines. Cost for material, fitting, hose, and plumber for setting up temporary water to homes. Cost for water distribution of winter water. Cost to treat excess winter water. Water main break repairs, contractor and materials. We determined the frost levels by checking it in the nearest manholes. Added 5/12/2014 - 6th Avenue from Chieftain to Oakey Park - Replace 250 feet of watermain that was frozen and damaged. (Additional $30,000.00 in costs) |
| **Totals** | **$6,000.00** | **$181,314.07** | **$202,858.32** | | |

Shown in **Table 19** is a listing of winter storm events, including winter storms, heavy snowfall, freezing rain/ice, blizzards, and periods of extreme cold, that have been recorded by the National Climatic Data Center for Polk County since 1993. Prior to 1993, winter storm data for Polk County was not available through the National Climatic Data Center.

**Table 19. Winter Storm Events • January 1993 – February 2, 2016**
**Polk County**

| Location | Date | Time | Type | Deaths | Injuries | Property Damage |
|---|---|---|---|---|---|---|
| Statewide | 1/13/1993 | 12:00 AM | Heavy Snow | 0 | 0 | 0 |
| Regional | 2/20/1993 | 10:00 PM | Heavy Snow | 0 | 0 | 0 |
| Regional | 4/15/1993 | 4:00 AM | Heavy Snow | 0 | 0 | 0 |
| Regional | 11/25/1993 | 1:00 AM | Heavy Snow | 0 | 0 | 0 |
| Statewide | 1/13/1994 | 6:00 AM | Cold | 0 | 0 | 0 |
| Regional | 1/26/1994 | 8:00 PM | Heavy Snow/ice Storm | 0 | 0 | 0 |
| Regional | 4/29/1994 | 12:00 PM | Heavy Snow | 0 | 0 | 0 |
| Regional | 11/27/1994 | 9:00 AM | Heavy Snow | 0 | 0 | 0 |
| Northern | 2/10/1995 | 9:00 PM | Cold | 0 | 0 | 0 |
| Regional | 3/4/1995 | 6:00 PM | Heavy Snow | 0 | 0 | 0 |
| Regional | 3/27/1995 | 3:00 AM | Heavy Snow | 0 | 0 | 0 |
| Regional | 12/13/1995 | 6:00 AM | Heavy Snow | 0 | 0 | 0 |
| Regional | 1/17/1996 | 9:00 PM | Ice Storm | 0 | 0 | 0 |
| Regional | 1/18/1996 | 5:00 AM | Heavy Snow | 0 | 0 | 0 |
| Regional | 1/31/1996 | 5:00 AM | Extreme Cold | 0 | 0 | 0 |
| Regional | 2/1/1996 | 12:00 AM | Extreme Cold | 1 | 0 | 0 |
| Regional | 2/8/1996 | 12:00 AM | Freezing Rain | 0 | 0 | 0 |
| Regional | 3/24/1996 | 1:00 AM | Heavy Snow | 0 | 0 | 0 |
| Regional | 11/23/1996 | 12:00 AM | Heavy Snow | 0 | 0 | 0 |
| Regional | 12/14/1996 | 4:00 PM | Heavy Snow | 0 | 0 | 0 |
| Regional | 12/23/1996 | 9:00 AM | Heavy Snow | 0 | 0 | 0 |
| Regional | 1/4/1997 | 5:00 AM | Heavy Snow | 0 | 0 | 0 |
| Regional | 1/15/1997 | 5:00 PM | Extreme Windchill | 0 | 0 | 0 |
| Regional | 3/13/1997 | 1:00 AM | Winter Storm | 0 | 0 | 0 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Regional | 1/11/1998 | 10:00 AM | Winter Storm | 0 | 0 | 0 |
| Regional | 3/8/1999 | 8:00 AM | Winter Storm | 0 | 0 | 0 |
| Regional | 12/28/2000 | 2:00 AM | Winter Storm | 0 | 0 | 0 |
| Regional | 1/29/2001 | 7:00 PM | Winter Storm | 0 | 0 | 0 |
| Regional | 3/12/2001 | 12:00 AM | Heavy Snow | 0 | 0 | 0 |
| Regional | 11/26/2001 | 1:00 PM | Winter Storm | 0 | 0 | 0 |
| Regional | 3/8/2002 | 6:00 PM | Winter Storm | 0 | 0 | 0 |
| Regional | 3/14/2002 | 8:00 AM | Winter Storm | 0 | 0 | 0 |
| Regional | 2/2/2003 | 8:00 PM | Winter Storm | 0 | 0 | 0 |
| Regional | 11/22/2003 | 6:00 PM | Winter Storm | 0 | 0 | 0 |
| Regional | 12/9/2003 | 3:00 AM | Winter Storm | 0 | 0 | 0 |
| Regional | 2/1/2004 | 2:00 AM | Winter Storm | 0 | 0 | 0 |
| Regional | 3/5/2004 | 12:00 AM | Winter Storm | 0 | 0 | 0 |
| Regional | 8/21/2004 | 2:00 AM | Frost/freeze | 0 | 0 | 0 |
| Regional | 1/1/2005 | 2:00 PM | Winter Storm | 0 | 0 | 0 |
| Regional | 1/21/2005 | 2:00 PM | Winter Storm | 0 | 0 | 0 |
| Regional | 3/12/2006 | 8:00 PM | Winter Storm | 0 | 0 | 0 |
| Regional | 2/24/2007 | 7:30 AM | Winter Storm | 0 | 0 | 0 |
| Regional | 3/1/2007 | 12:00 AM | Winter Storm | 0 | 0 | 0 |
| Regional | 12/1/2007 | 9:30 AM | Winter Storm | 0 | 0 | 0 |
| Regional | 12/22/2007 | 6:15 AM | Winter Storm | 0 | 0 | 0 |
| Regional | 2/10/2008 | 2:00 AM | Cold/wind Chill | 0 | 0 | 0 |
| Regional | 2/19/2008 | 6:00 PM | Cold/wind Chill | 0 | 0 | 0 |
| Regional | 3/17/2008 | 6:55 AM | Heavy Snow | 0 | 0 | 0 |
| Regional | 3/31/2008 | 10:00 AM | Heavy Snow | 0 | 0 | 0 |
| Regional | 4/1/2008 | 12:00 AM | Heavy Snow | 0 | 0 | 0 |
| Regional | 4/10/2008 | 3:00 PM | Winter Storm | 0 | 0 | 0 |
| Regional | 12/30/2008 | 7:15 AM | Winter Storm | 0 | 0 | 0 |
| Regional | 1/15/2009 | 12:00 AM | Cold/wind Chill | 0 | 0 | 0 |
| Regional | 2/26/2009 | 12:00 PM | Winter Storm | 0 | 0 | 0 |
| Regional | 10/12/2009 | 6:00 AM | Winter Weather | 0 | 0 | 0 |
| Regional | 12/8/2009 | 1:00 PM | Winter Storm | 0 | 0 | 0 |
| Regional | 12/23/2009 | 8:00 PM | Winter Storm | 0 | 0 | 0 |
| Regional | 11/13/2010 | 3:00 AM | Winter Storm | 0 | 0 | 0 |
| Regional | 12/10/2010 | 11:00 PM | Winter Storm | 0 | 0 | 0 |
| Regional | 2/20/2011 | 12:00 PM | Winter Storm | 0 | 0 | 0 |
| Regional | 12/31/2011 | 9:00 PM | Winter Weather | 0 | 0 | 0 |
| Regional | 3/22/2011 | 4:00 PM | Winter Storm | 0 | 0 | 0 |
| Regional | 2/28/2012 | 5:00 PM | Winter Storm | 0 | 0 | 0 |
| Regional | 12/9/2012 | 2:00 AM | Winter Storm | 0 | 0 | 0 |
| Regional | 1/27/2013 | 3:00 PM | Winter Storm | 0 | 0 | 0 |
| Regional | 2/10/2013 | 5:00 AM | Winter Storm | 0 | 0 | 0 |
| Regional | 3/4/2013 | 12:00 PM | Winter Storm | 0 | 0 | 0 |
| Regional | 4/11/2013 | 3:00 AM | Winter Storm | 0 | 0 | 0 |
| Regional | 4/18/2013 | 11:00 AM | Winter Storm | 0 | 0 | 0 |
| Regional | 4/22/2013 | 7:00 PM | Winter Storm | 0 | 0 | 0 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Regional | 5/1/2013 | 5:00 PM | Winter Storm | 0 | 0 | 0 |
| Regional | 12/2/2013 | 6:00 AM | Winter Storm | 0 | 0 | 0 |
| Regional | 1/5/2014 | 8:00 PM | Extreme Cold/Wind Chill | 0 | 0 | 0 |
| Regional | 1/14/2014 | 5:00 AM | Winter Storm | 0 | 0 | 0 |
| Regional | 1/23/2014 | 6:00 AM | Extreme Cold/Wind Chill | 0 | 0 | 0 |
| Regional | 1/27/2014 | 2:00 AM | Extreme Cold/Wind Chill | 0 | 0 | 0 |
| Regional | 1/30/2014 | 6:00 AM | Winter Storm | 0 | 0 | 0 |
| Regional | 2/20/2014 | 10:00 AM | Winter Storm | 0 | 0 | 0 |
| Regional | 2/27/2014 | 6:00 AM | Extreme Cold/Wind Chill | 0 | 0 | 0 |
| Regional | 3/2/2014 | 3:00 AM | Extreme Cold/Wind Chill | 0 | 0 | 0 |
| Regional | 4/3/2014 | 2:00 PM | Winter Storm | 0 | 0 | 0 |
| Regional | 4/16/2014 | 6:00 AM | Winter Storm | 0 | 0 | 0 |
| Regional | 11/10/2014 | 4:00 AM | Winter Storm | 0 | 0 | 0 |
| Regional | 12/23/2015 | 9:00 AM | Winter Storm | 0 | 0 | 0 |
| Regional | 1/17/2016 | 6:00 AM | Extreme Cold/Wind Chill | 0 | 0 | 0 |
| Regional | 2/2/2016 | 12:30 PM | Winter Storm | 0 | 0 | 0 |
| | | | **86 events** | **1** | **0** | ***none reported*** |

*source: National Climatic Data Center (NCDC)*
*Damage estimates in 2016 dollars based on Consumer Price Index by U.S. Bureau of Labor Statistics*

From 1993 through September 2016, Polk County has experienced 3.7 winter storm events per year on average, with a total of 86 reported events over the 23-year period. These events were further characterized by 20 heavy snowfall events, 49 winter storms (*mix of snow, ice, wind*), two ice storms, 14 extreme wind chill or cold, and two freezing rain or frost events. Noticeably absent are any blizzards. One event, an August 2004 early freeze, is notably out-of-season. The list also includes four April and one October winter events.

However, based on County Highway Department winter storm reporting to the Wisconsin Department of Transportation, salt, sand, and other de-icing and anti-icing agents are required much more frequently. During the past five winter seasons, Polk County has experienced an average of 17.2 freezing rain event days and 39.2 winter storm evet days per year and cost the County Highway Department an average of $728,250 annually in material, equipment, and labor.

All events reported were regional or statewide in nature, also affecting areas outside Polk County. The single death associated with the above storms occurred within Eau Claire County when a woman locked herself in the garage and died due to exposure to extreme cold. Additional deaths and injuries as a result of traffic accidents, frost bite, etc. associated with these events likely occurred, but were not reported to the National Weather Service.

Drifting of snow on many of the roads of Polk County is common during winters when snow and high winds are present, though this has been less of a problem in recent years due to weather patterns, improved equipment, furrowing, and snow fencing. The following snow drifting "hotspots" were identified during the planning process:

- CTH "W" in the Town of West Sweden where limited right-of-way hinders snow removal.

- STH 35 west and southwest of Milltown. A hillside adjacent to STH 35 just west of Milltown contributes to drifting and visibility problems.
- CTH "V" and USH 8 east of Range to the county line.
- CTH "F" in the Ubet Flats. The road level in this area is the same as the surrounding landscape which contributes substantial drifting.
- Osceola to Farmington along STH 35, including the hill near CTH "M" and STH 35 in Osceola.
- The Town of Alden noted that while winters in recent years (prior to 2010) have not been severe, there could be many areas which may pose a challenge for local snow removal crews to keep clear.
- The Town of Eureka identified 193rd Avenue at the point it turns north and the intersection of 210th Avenue and 220th Street as being locations especially prone to severe snow drifting.

The County Highway Department also noted a unique concern with rock slides along Highway 243 due to freeze-thaw cycles.

### Relative Level of Risk

During the risk assessment survey for this mitigation plan update, the Steering Committee ranked heavy snows as the highest natural hazard risk facing Polk County; ice storms closely followed. This high ranking was primarily due to their frequency in the past and probability of reoccurrence and the related health and safety vulnerabilities. Long-term power outage planning efforts within the region, as discussed previously in this plan, further validated these concerns.

**The probability of reoccurrence of winter storm events for Polk County is expected to be consistent with recent trends, with 3.5 to 4.0 severe winter storm events, on average, occurring each year.** Less severe freezing rain and winter storm conditions do occur much more frequently, but can these events can still be very dangerous for drivers, pedestrians, etc. Should Wisconsin's climate change as discussed previously, Polk County could experience warmer, shorter, and wetter winters overall, which could mean fewer extreme cold events, but increased potential for heavy snow and ice storms.

## *Vulnerability Assessment—Winter Storms*

Winter storms have no defined hazard area within Polk County, and, as the data previously showed, most of these storms are regional in nature. Due to the irregular nature of these events and lack of specific hazard areas, the assessment of community impacts as a result of winter storms is difficult to quantify.

Winter storms pose a serious health and safety threat to area residents and can result in significant damage to property and infrastructure. Heavy snow or accumulated ice can: cause the structural collapse of buildings; down power lines, severely affecting electrical power distribution; cause accidents (e.g., traffic crashes, slipping/falling); or restrict mobility of

emergency assistance or access to services. Most structures in Polk County were built to standards that considered snowloads and needed insulation, so this aspect was deemed a relatively low concern.

In addition to the health risks directly related to exposure to cold temperatures, residents are also susceptible to other risks associated with extremely cold temperatures. For example, many homes could become too cold either due to a power failure or because the heating system isn't adequate for the weather. Water lines can break. When people begin to use space heaters, wood stoves, and fireplaces to stay warm, the risk of household fires increases as well as the risk of carbon monoxide poisoning. There can be economic impacts from the closure of businesses due to lack of mobility or power loss, but these are almost always very short-term impacts.

## Accidents and Exposure

According to the National Weather Service, approximately 70 percent of serious injuries resulting from winter storms are vehicle accidents, with prolonged exposure to the cold constituting another 25 percent. And it does not require a disaster event to incur traffic-related or exposure injuries during the winter months.

Prolonged exposure to the cold can cause frostbite or hypothermia and become life threatening. When exposed to cold temperatures or low wind chills, one's body begins to lose heat faster than it can be produced. The result is hypothermia or abnormally low body temperature. A body temperature that is too low can affect the brain, making the victim unable to think clearly or move well. This makes hypothermia particularly dangerous because a person may not know it is happening and won't be able to do anything about it. Hypothermia occurs most commonly at very cold temperatures, but can occur even at cool temperatures (above 40°F) if a person becomes chilled from rain, sweat, or submersion in cold water. Victims of hypothermia are most often elderly people with inadequate food, clothing, or heating; babies sleeping in cold bedrooms; children left unattended; adults under the influence of alcohol; mentally ill individuals; and people who remain outdoors for long periods such as the homeless, hikers, hunters, etc.

Frostbite is an injury to the body that is caused by freezing. Frostbite causes a loss of feeling and color in affected areas. It most often affects the nose, ears, cheeks, chin, fingers, or toes. Frostbite can permanently damage the body, and severe cases can lead to amputation.

## Long-Term Power Loss

Of greater concern is the long-term loss of power due to ice storms, winds, and/or heavy snows, especially during extremely cold temperatures. Long-term power loss poses one of the greatest (if not THE greatest) natural hazard vulnerabilities facing Polk County. This threat was discussed previously within the special analysis on long-term power loss.

## Winter Kill and Frost Impacts on Agricultural Crops

Winter crops are vulnerable to winter kill during periods of extreme cold without sufficient snow on the ground to help act as an insulator. Four inches of snow cover will allow up to a 20ºF difference in temperature between the soil and air, and will prevent the premature breaking of

dormancy during temporary warm spells. Some amount of winter kill is fairly frequent and can be expected almost annually; more substantial winter kill events can be expected to occur one or two seasons each decade on average (about a 10% to 20% chance per year) based on recent trends.

Alfalfa is especially vulnerable to winter kill, compared to other forage types. In 2002-2003, it was estimated that about 61 percent of the Polk County alfalfa acreage was impacted to varying degrees resulting in a 48 percent reduction in the County's alfalfa yields or about $5 million in lost value overall. Winter kill was also high in the winter of 2008-2009. To provide an understanding of the potential vulnerability, in 2012 Polk County farmers harvested 46,800 tons of alfalfa (dry) on 20,205 acres planted.

from Wisconsin State Journal, Sept. 10, 1974

# Frosted Farmers Seek Federal Aid

By ROBERT C. BJORKLUND
State Journal Farm Editor

Farmers by the hundreds were turning to government disaster programs Monday for help after a costly frost emergency in western and northern Wisconsin.

The state's weekly crop summary was dominated by the tragic reports from nearly half of the state's counties that substantiate earlier farm loss estimates of corn and soybeans of more than $100 million.

**THE WISCONSIN** Farmers Home Administration (FHA) office at Stevens Point has started receiving applications for special aid programs and Henry Zech, farmer program specialist, said that the drought, followed by the unusually early frost, "will be a tremendous economic loss to Wisconsin."

Wayne Danielson, Cadott, a dairyman and also a member of the State Board of Agriculture, said that agricultural officials in Chippewa County now estimate that only 10 per cent of the thousands of acres of corn planted for grain will yield mature corn.

In the words of a Jackson County farmer, "the roof fell in on us as hard frost took care of both corn and soybeans and most everything else."

**THE POLK** County estimate is that more than 80 per cent of the corn and soybean crops were ruined.

Richard Webb, executive director of the Chippewa County Agricultural Stabilization and Conservation (ASC) office, said that as many as 1,600 of the county's 1,900 farms with a corn allocation will seek aid under the government's new "disaster payments" program.

The county boards in most of the frost-stricken counties are expected to have their counties designated as eligible for the emergency loan program, and thus eligible for 5 per cent interest loans.

**TO BECOME** eligible, the farmer must establish that he had a 10 per cent loss of his corn crop.

Webb said that up to 150 farmers a day are applying for disaster eligibility in Chippewa County.

"We're in rough shape up here and we've applied for the 5 per cent disaster loans and the emergency livestock feeding program," he said.

A Clark County farmer said that in his area there were five straight nights of frost.

To the south and east of the frost line, the corn looks good, but Marvin Heiser, crop reporting specialist, said that it needs about three weeks of favorable weather to mature for grain.

"**ONLY 20** per cent of the corn intended for grain in Wisconsin has begun to dent, compared with 55 per cent last year and 50 per cent in the past 10 years," Heiser said.

Soil moisture is 50 per cent short in the state and 50 per cent adequate. The west and north central areas are the driest and the southwest, with the best corn in the United States, is in the best shape for moisture.

Bernard Chapman, of the Bloomington area in Grant County, said that much of his corn is dented and a frost won't hurt too much. However, the ears are not all filled out on the ends, indicating some pollination problems.

The big worry for many southwest Wisconsin farmers is root damage. There is a row or two in the fields where the corn is down either because the heavy rains after planting leached out the chemical protection or it was lost by erosion.

The loss of feed for cattle due to winter kill can be a significant hardship on a producer. At about $1,500 of additional feed per mature cow for a year and with 42,815 head of cattle in the County, feed replacement costs can accumulate quickly. And since alfalfa is a relatively low-value crop, it is typically uninsured.

These additional costs can result in loss of revenue to the individual producer and can be added costs to manufacturers (e.g., dairies, grocery stores, food processing) and consumers. Late fall alfalfa or hay cuttings can further contribute to winter kill since time is not allowed for adequate re-growth of ground cover which provides an additional insulating blanket. And periods of freezing and thawing in the spring can contribute to frost heaving within certain types of soils, leading to additional crop damage.

While less frequent, early frosts can also severely impact agricultural crops. The most significant early frost in recent history transpired in September 1974. This severe frost event occurred on multiple nights, included much of northern and western Wisconsin, and stretched as far south as Kansas. It was reported that more than 80 percent of the soybean and corn crops in Polk County were ruined during this event. Combined with the impacts of a summer drought, the soybean and corn losses were near 100 percent in nearby Dunn, Chippewa, and Eau Claire counties. In today's dollars, the total statewide crop losses as a result of the September frost were estimated at more than $520 million.

Overall, Polk County farmers are aware of the winter-related agricultural risks and most use best management practices to mitigate these risks.

## Summary of Potential Vulnerabilities

Based on interviews, town surveys, and consideration of the previous analysis, it was determined that the following general types of facilities and community assets are most vulnerable to winter storm events:

- Residents and travelers
- Vulnerable populations, such as elderly (especially during extreme cold events)
- Above-ground power lines, especially in wooded areas
- Agricultural crop losses, especially alfalfa

Although the improvement of technology has enabled meteorologists to better forecast and track winter storms, there is no precise way to predict the location and severity of their associated risks. As shown in Table 19, there is no predictable pattern of occurrence, associated risk characteristics, and resulting damage that can be identified and used to make detailed projections on future winter storm events.

Overall, there is a very low vulnerability to structures in Polk County due to winter storms. Some occasional roof damage due to ice damming or bursting of inadequately buried water lines can be expected, but such damage is almost always isolated, not officially reported, and/or remedied by the homeowner with an insurance claim. It is unfeasible to maintain a database accurately detailing the structural condition of all $2.8 billion in assessed improvements in Polk County to determine which structures may be more vulnerable to the impacts of future winter storm events.

The continuing changes in land-use and development patterns can influence the County's potential for future exposure to winter storms. As discussed previously, Polk County is continuing to grow and develop. This creates an increasing exposure to the number of residents and properties that could be at risk from future winter storm or extreme cold events.

## Vulnerable Critical Facilities

A more robust assessment of the County's assets (critical facilities) and their susceptibility to winter storms is located in **Appendix F**. The greatest winter storm-related vulnerability for Polk County's critical facilities is the widespread loss of electric power and potential damage to public

water systems. The risks and vulnerabilities related to this threat were discussed previously.

While there are few long-term physical impacts on roads from a hazard mitigation perspective, travel upon sidewalks, roads, and bridges is often hazardous under icy or heavy snow conditions, as discussed previously. Such road conditions can also impair the function of critical facilities (e.g., staffing at hospitals or schools) and increase emergency response time. Roads in shaded, wooded areas can be especially icy and hazardous.

## *Unique Jurisdictional Risks or Vulnerabilities—Winter Storms*

Winter storms pose no risks or vulnerabilities unique to individual jurisdictions. Winter storms and extreme cold events are typically large-area or regional events, occurring countywide. The level of vulnerability increases in areas of higher population, development density, and supportive infrastructure as described previously in **Section II. Community Profile**. Any notable differences between municipalities regarding the vulnerability of winter storm and extreme cold events are further discussed in the *Unique Jurisdictional Risk or Vulnerabilities Table* in **Appendix G.**

The previous discussion on the 2014 Polar Vortex and Appendix G identifies the vulnerabilities of extreme cold on municipal water systems. Prior to this event, water line breaks were largely scattered and often limited to laterals. Water-dripping programs are often used to help mitigate potential damage. As budgets allow, older water lines potentially more prone to breaks are typically replaced and buried deeper as part of street projects. Some mobile homes can be more vulnerable to the water pipe breakage since the lines are often less insulated than in standard home construction.

No communities noted a serious problem with the loss of power due to the damage to overhead power lines. The Village of Luck noted that ice build-up and the freeze-thaw cycle is a contributing cause to shoreland erosion problems along the west shore of Big Butternut Lake. Ice damming on the St. Croix River occurs north of the dam in St. Croix Falls about once every 10-12 years and resulting in damage to a park pier and outside stairs at a home, but no serious damages to date.

Most of the participating cities and villages did not identify specific streets that were uniquely prone to ice accumulation or drifting. The exception is the City of St. Croix Falls. Louisiana and Kentucky Streets in the City are sometimes closed due icy conditions on their steep hills. Of greater concern is east-bound traffic on U.S. Highway 8 within the City. As east-bound traffic crosses the St. Croix River, it must ascend a steep, long hill. At times, ice or snow conditions are such that travelling up the hill is dangerous, if not impossible, for some vehicles. Such circumstances have led to traffic accidents and the “jack knifing” of semi-trucks in the past.

## iii. Thunderstorms and High Winds

Thunderstorms encompass lightning, heavy rains, high winds, and hail and are intricately linked with some of the other hazards, such as tornadoes and flooding. Due to the similarities in impacts, the vulnerabilities associated with high winds are largely discussed as part of the previous tornado sub-section (III.B.i.) and are not repeated here. Flooding as a result of heavy rains is analyzed as part of the next sub-section (III.B.iv.).

### *Summary—Thunderstorms*

*Risk – Thunderstorms are the most frequent natural hazard event reported for Polk County, with high winds and hail the most common attributes. Severe thunderstorms should be expected on an average of four to five days each year based on official reports, with about half of all reported events accompanied by high winds and about 40%-45% accompanied by hail.*

*Vulnerabilities – Most events pass with only minor debris clean-up, but associated high winds, hail, lightning, and heavy rains can all cause significant damage, injury, or death. As in tornado events, all structures are vulnerable, but especially large span buildings, unanchored trailer homes, aircraft, and structures with substantial numbers of people (e.g., schools, hospitals). Above-ground utilities are also vulnerable to high winds and lightning strikes, especially in forested areas. And past hail and high wind events have caused significant crop damage and damage to barns.*

1. The actual damages and expenses related to thunderstorm events are likely significantly much greater than shown in the official reports, though most storms pass with minimal damage. If adequately covered by insurance, options to mitigate thunderstorm risks in Polk County are very limited.

2. High winds are the most destructive component of thunderstorms in Polk County. It is often difficult to distinguish between the impacts of a tornado and those of a very high wind storm. Refer to the tornado sub-section for the discussion of vulnerabilities and issues related to high winds (Section III.B.i.).

3. Refer to the Flooding sub-section for the discussion of risks, vulnerabilities, and issues related to flooding (Section III.B.iv.).

4. No specific problem areas or priorities regarding thunderstorms were identified during the planning process, with the exception of tornadoes and high winds discussed in the previous sub-section and flooding discussed later in this report.

## *Risk Assessment—Thunderstorms*

### The Hazard

**Thunderstorms** are severe and violent forms of convection produced when warm, moist air is overrun by dry, cool air. As the warm air rises, thunderheads (cumuli-nimbus clouds) form which cause the strong winds, lightning, thunder, hail and rain associated with these storms. The National Weather Service definition of a severe thunderstorm is a thunderstorm event that produces any of the following: winds of 58 miles per hour or greater (often with gusts of 74 miles per hour or greater), hail 3/4 inch in diameter or greater, or a tornado.

The thunderheads formed may be a towering mass six miles or more across and 40,000 to 50,000 feet high. They may contain as much as 1.5 million tons of water and enormous amounts of energy that often are released in the form of high winds, excessive rains, and three violently destructive natural elements: lightning, hail, and tornadoes.[11]

A thunderstorm often lasts no more than 30 minutes, as an individual thunderstorm cell frequently moves between 30 to 50 miles per hour. Strong frontal systems, though, may spawn more than one squall line composed of many individual thunderstorm cells. These fronts can often be tracked from west to east. Because thunderstorms may occur singly, in clusters, or as a portion of large storm lines, it is possible that several thunderstorms may affect a single area in the course of a few hours.

**Lightning** can strike anywhere. Lightning is formed from the build-up of an electrical charge in a cloud. When this charge is big enough, the air ionizes and a discharge occurs with another cloud, the ground, or the best conducting object. The resulting electric charge reaches temperatures higher than 50,000°F. This rapid heating and subsequent cooling causes the air to expand and contract, which results in thunder.

**Hail** is the accumulation of ice crystals due to warm, moist air rising rapidly into the freezing temperatures of the upper atmosphere. When frozen droplets accumulate enough weight, they fall as precipitation. Hail or sleet occurs when these frozen ice balls do not fully melt upon descent, and they can reach the size of softballs.

**High winds** are those winds of 58 miles per hour or greater. High winds can affect much larger areas than a tornado and occur for a longer period of time. More intense types of high winds are downbursts or straight-line winds.

Straight-line winds are often responsible for most of the wind damage associated with a thunderstorm. These winds are often confused with tornadoes because of similar damage and wind speeds. However, the strong and gusty winds associated with straight-line winds blow roughly in a straight line unlike the rotating winds of a tornado.

**Downbursts (straight-line winds)** are unrelated to tornadoes, but can have similar impacts and destructive power. A downburst is a strong, violent downdraft, initiated by rapidly descending

[11] Tornadoes and high wind vulnerabilities (potential impacts) are discussed separately in Section III.B.ii.

rain and/or rain-cooled air beneath a thunderstorm. The result is an outburst of straight-line winds on or near the ground in a single direction. They may last anywhere from a few minutes in a small scale micro-burst to periods of up to 20 minutes or longer, known as a macro-burst. Wind speeds in downbursts can reach 150 mph, which is similar to that of a strong tornado.

Downburst damage is often highly localized, typically covering 2.5 miles or less in width, and resembles that of tornadoes. A long-lived, widespread, and quickly travelling thunderstorm event producing numerous downbursts along its path is known as a **derecho**. The last major derecho event impacting Wisconsin in July 1995 included parts of nine states and one Canadian providence. Damages in Minnesota alone from this event were estimated at over 5 million downed trees and exceeded $30 million in 1995 dollars.[12] There are significant interactions between tornadoes and downbursts, and a tornado's path can also be affected by downbursts. Because of this, the path of a tornado can be very unpredictable.

High-wind risks and past events are discussed here due to their relationship to thunderstorms and the method of data collection by the National Climatic Data Center, though the destructive impacts and vulnerabilities related to thunderstorms with high, straight-line winds are at times difficult to distinguish from the concentrated cyclical winds of a tornado. Some local debate continues on whether the damage from one recent event in the region was the result of high, straight-line winds (as officially recorded) or a tornado. Further, tornado and thunderstorm/high wind events are very often related and part of the same storm cell, making it a challenge to distinguish the impacts. High wind impacts were discussed previously as part of the tornado vulnerability assessment.

## Local Events

Thunderstorms are the most common natural hazard event for Polk County. Shown in **Table 20** below is a listing of severe thunderstorms that have been reported to the National Climatic Data Center for Polk County since 1956. Data prior to 1980 is limited; more complete data is available since 1994.

From January 1994 through September 2016, Polk County experienced 198 severe thunderstorm, hail, and high-wind events of varying magnitude, for an average of approximately nine severe thunderstorms reported each year. Table 20 also shows that thunderstorms can occur throughout the year, with the highest frequency during the months of May through August.

Many of the events reported in Table 20 are for the same storm cells recorded for different parts of the County; multiple reports within a single day for large storm cells are not uncommon. The 150 reported thunderstorms since January 1994 occurred on 100 unique dates, for an average of 4.5 severe thunderstorm days per year. Prior to 1993, specific locations for storm events were not typically provided in the database.

[12] National Oceanic and Atmospheric Administration. *Derecho Series in July of 1995* webpage. http://www.spc.noaa.gov/misc/AbtDerechos/casepages/jul1995derechopage.htm#2nd1995.

Although the storms listed in Table 20 are classified as thunderstorms, each of these storms had its own unique characteristics and associated risks to residents and property in Polk County, such as high winds and hail. Other risks associated with thunderstorms that have been documented with these storms include the potential for excessive rains, leading to flash flooding and the potential to spawn tornadoes, which is discussed in other sections.

**Table 20. Severe Thunderstorm Events (and associated hazards) • 1957 to Sept 2016 Polk County**

| Location | Date | Time | Type | Mag | Property Damage | Crop Damage |
|---|---|---|---|---|---|---|
| Polk Co. (not specified) | 6/30/1956 | 10:00 PM | Hail | 1.50 in. | 0 | 0 |
| Polk Co. (not specified) | 6/9/1961 | 6:00 PM | Hail | 2.00 in. | 0 | 0 |
| Polk Co. (not specified) | 4/1/1963 | 4:20 PM | Hail | 1.50 in. | 0 | 0 |
| Polk Co. (not specified) | 7/12/1966 | 0:30 AM | T-storm Wind | 0 kts. | 0 | 0 |
| Polk Co. (not specified) | 7/7/1970 | 6:30 PM | Hail | 2.00 in. | 0 | 0 |
| Polk Co. (not specified) | 8/13/1971 | 3:00 PM | T-storm Wind | 0 kts. | 0 | 0 |
| Polk Co. (not specified) | 8/8/1973 | 5:00 PM | Hail | 1.75 in. | 0 | 0 |
| Polk Co. (not specified) | 6/16/1979 | 12:15 PM | T-storm Wind | 0 kts. | 0 | 0 |
| Polk Co. (not specified) | 7/15/1980 | 9:30 PM | T-storm Wind | 52 kts. | 0 | 0 |
| Polk Co. (not specified) | 6/13/1981 | 10:30 AM | T-storm Wind | 0 kts. | 0 | 0 |
| Polk Co. (not specified) | 6/13/1981 | 10:50 AM | T-storm Wind | 0 kts. | 0 | 0 |
| Polk Co. (not specified) | 6/14/1981 | 5:15 AM | T-storm Wind | 0 kts. | 0 | 0 |
| Polk Co. (not specified) | 6/14/1981 | 4:00 PM | T-storm Wind | 60 kts. | 0 | 0 |
| Polk Co. (not specified) | 8/3/1981 | 1:58 PM | Hail | 2.75 in. | 0 | 0 |
| Polk Co. (not specified) | 3/12/1982 | 5:10 PM | T-storm Wind | 52 kts. | 0 | 0 |
| Polk Co. (not specified) | 7/6/1982 | 0:55 AM | T-storm Wind | 0 kts. | 0 | 0 |
| Polk Co. (not specified) | 7/6/1982 | 1:15 AM | T-storm Wind | 0 kts. | 0 | 0 |
| Polk Co. (not specified) | 7/6/1982 | 1:15 AM | T-storm Wind | 0 kts. | 0 | 0 |
| Polk Co. (not specified) | 7/6/1982 | 1:25 AM | T-storm Wind | 0 kts. | 0 | 0 |
| Polk Co. (not specified) | 7/6/1982 | 1:35 AM | T-storm Wind | 0 kts. | 0 | 0 |
| Polk Co. (not specified) | 9/5/1982 | 8:05 AM | Hail | 1.75 in. | 0 | 0 |
| Polk Co. (not specified) | 7/3/1983 | 12:50 PM | T-storm Wind | 0 kts. | 0 | 0 |
| Polk Co. (not specified) | 7/3/1983 | 12:50 PM | T-storm Wind | 0 kts. | 0 | 0 |
| Polk Co. (not specified) | 7/3/1983 | 12:50 PM | T-storm Wind | 0 kts. | 0 | 0 |
| Polk Co. (not specified) | 7/3/1983 | 12:50 PM | T-storm Wind | 0 kts. | 0 | 0 |
| Polk Co. (not specified) | 7/3/1983 | 12:50 PM | T-storm Wind | 0 kts. | 0 | 0 |
| Polk Co. (not specified) | 7/3/1983 | 12:50 PM | T-storm Wind | 0 kts. | 0 | 0 |
| Polk Co. (not specified) | 7/19/1983 | 3:15 PM | T-storm Wind | 0 kts. | 0 | 0 |
| Polk Co. (not specified) | 7/19/1983 | 3:15 PM | T-storm Wind | 0 kts. | 0 | 0 |
| Polk Co. (not specified) | 7/19/1983 | 3:15 PM | T-storm Wind | 0 kts. | 0 | 0 |
| Polk Co. (not specified) | 7/19/1983 | 3:15 PM | T-storm Wind | 0 kts. | 0 | 0 |
| Polk Co. (not specified) | 7/19/1983 | 3:30 PM | T-storm Wind | 0 kts. | 0 | 0 |
| Polk Co. (not specified) | 7/19/1983 | 3:40 PM | T-storm Wind | 0 kts. | 0 | 0 |
| Polk Co. (not specified) | 7/19/1983 | 3:45 PM | T-storm Wind | 0 kts. | 0 | 0 |
| Polk Co. (not specified) | 4/26/1984 | 9:30 PM | Hail | 1.75 in. | 0 | 0 |
| Polk Co. (not specified) | 10/16/1984 | 8:00 PM | T-storm Wind | 0 kts. | 0 | 0 |
| Polk Co. (not specified) | 4/12/1985 | 4:15 PM | Hail | 1.75 in. | 0 | 0 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Polk Co. (not specified) | 4/21/1985 | 10:50 PM | T-storm Wind | 0 kts. | 0 | 0 |
| Polk Co. (not specified) | 5/14/1985 | 7:00 PM | T-storm Wind | 0 kts. | 0 | 0 |
| Polk Co. (not specified) | 5/30/1985 | 10:00 PM | T-storm Wind | 0 kts. | 0 | 0 |
| Polk Co. (not specified) | 7/4/1986 | 2:58 AM | T-storm Wind | 0 kts. | 0 | 0 |
| Polk Co. (not specified) | 7/4/1986 | 6:00 PM | T-storm Wind | 0 kts. | 0 | 0 |
| Polk Co. (not specified) | 7/18/1986 | 6:40 PM | T-storm Wind | 0 kts. | 0 | 0 |
| Polk Co. (not specified) | 7/19/1986 | 1:20 AM | T-storm Wind | 61 kts. | 0 | 0 |
| Polk Co. (not specified) | 7/19/1986 | 1:30 AM | T-storm Wind | 61 kts. | 0 | 0 |
| Polk Co. (not specified) | 7/24/1986 | 2:10 PM | T-storm Wind | 0 kts. | 0 | 0 |
| Polk Co. (not specified) | 7/11/1987 | 7:30 AM | T-storm Wind | 0 kts. | 0 | 0 |
| Polk Co. (not specified) | 8/3/1988 | 9:40 PM | T-storm Wind | 56 kts. | 0 | 0 |
| Polk Co. (not specified) | 8/3/1988 | 10:10 PM | T-storm Wind | 56 kts. | 0 | 0 |
| Polk Co. (not specified) | 8/7/1988 | 6:00 PM | T-storm Wind | 0 kts. | 0 | 0 |
| Polk Co. (not specified) | 6/7/1989 | 12:20 PM | Hail | 1.75 in. | 0 | 0 |
| Polk Co. (not specified) | 6/2/1990 | 1:15 PM | T-storm Wind | 52 kts. | 0 | 0 |
| Polk Co. (not specified) | 5/28/1991 | 9:10 PM | Hail | 0.75 in. | 0 | 0 |
| Milltown | 5/8/1993 | 8:30 PM | Lightning | N/A | 794,065 | 78,445 |
| Osceola | 4/26/1994 | 11:35 AM | Hail | 0.75 in. | 0 | 0 |
| St. Croix Falls | 5/30/1994 | 4:00 PM | T-storm Winds | 0 kts. | 76,486 | 1,530 |
| East Farmington | 6/25/1994 | 4:00 PM | T-storm Winds | 0 kts. | 0 | 76,486 |
| St. Croix Falls | 7/19/1994 | 5:00 PM | Heavy Rain | N/A | 76,486 | 0 |
| Deer Park | 6/25/1995 | 2:45 PM | T-storm Winds | 52 kts. | 0 | 0 |
| Deer Park | 6/25/1995 | 2:45 PM | T-storm Winds | 52 kts. | 0 | 0 |
| Caroline | 6/25/1995 | 4:00 PM | T-storm Winds | 0 kts. | 0 | 0 |
| Balsam Lake | 7/14/1995 | 5:30 PM | T-storm Winds | 0 kts. | 0 | 0 |
| Balsam Lake | 7/14/1995 | 5:30 PM | T-storm Winds | 0 kts. | 0 | 0 |
| Osceola | 8/12/1995 | 3:00 AM | T-storm Winds Hail | 1 kts. | 0 | 0 |
| Amery | 8/12/1995 | 3:10 AM | Hail | 2.50 in. | 0 | 0 |
| Plymouth | 8/13/1995 | 3:22 PM | Hail | 1.75 in. | 0 | 0 |
| Osceola | 8/13/1995 | 5:40 PM | T-storm Winds | 0 kts. | 0 | 0 |
| Osceola | 8/13/1995 | 5:40 PM | T-storm Winds | 0 kts. | 0 | 0 |
| Frederic | 5/17/1996 | 10:27 PM | Hail | 1.75 in. | 0 | 0 |
| Luck | 5/17/1996 | 10:30 PM | Hail | 2.50 in. | 143,046 | 0 |
| Frederic | 5/18/1996 | 10:27 PM | Hail | 1.75 in. | 0 | 0 |
| Frederic | 5/18/1996 | 11:30 PM | T-storm Wind | 55 kts. | 0 | 0 |
| Centuria | 5/19/1996 | 12:55 AM | T-storm Wind | 55 kts. | 0 | 0 |
| Balsam Lake | 5/19/1996 | 1:05 AM | T-storm Wind | 60 kts. | 0 | 0 |
| Balsam Lake | 7/1/1997 | 8:05 PM | T-storm Wind | 55 kts. | 0 | 0 |
| Frederic | 8/3/1997 | 7:35 PM | T-storm Wind | 55 kts. | 0 | 0 |
| Luck | 8/3/1997 | 7:35 PM | T-storm Wind | 55 kts. | 0 | 0 |
| Milltown | 8/15/1997 | 5:50 PM | T-storm Wind | 50 kts. | 0 | 0 |
| St Croix Falls | 8/15/1997 | 5:50 PM | Hail | 1.75 in. | 0 | 0 |
| Frederic | 5/30/1998 | 8:05 PM | Hail | 0.75 in. | 0 | 0 |
| Milltown | 5/30/1998 | 8:45 PM | Hail | 1.00 in. | 0 | 0 |
| Dresser | 9/25/1998 | 11:15 PM | Hail | 1.00 in. | 0 | 0 |
| Lewis | 9/26/1998 | 12:10 AM | Hail | 1.50 in. | 0 | 0 |
| Luck | 6/5/1999 | 3:50 PM | Hail | 1.00 in. | 0 | 0 |
| Milltown | 6/5/1999 | 3:53 PM | Hail | 1.75 in. | 0 | 0 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Milltown | 7/3/1999 | 4:50 AM | T-storm Wind | 55 kts. | 0 | 0 |
| Eureka Center | 7/13/1999 | 11:00 PM | Hail | 0.75 in. | 0 | 0 |
| Osceola | 7/23/1999 | 1:02 AM | T-storm Wind | 55 kts. | 0 | 0 |
| Osceola Muni Arpt | 7/23/1999 | 1:04 AM | T-storm Wind | 56 kts. | 0 | 0 |
| Centuria | 7/23/1999 | 1:15 AM | T-storm Wind | 52 kts. | 0 | 0 |
| Luck | 7/23/1999 | 1:35 AM | T-storm Wind | 55 kts. | 0 | 0 |
| Clayton | 7/23/1999 | 1:45 AM | T-storm Wind | 55 kts. | 0 | 0 |
| Luck | 7/30/1999 | 4:45 PM | T-storm Wind | 52 kts. | 0 | 0 |
| Clam Falls | 7/8/2000 | 6:38 PM | Hail | 1.75 in. | 0 | 0 |
| Milltown | 8/8/2000 | 5:30 PM | T-storm Wind | 50 kts. | 0 | 0 |
| Frederic | 8/8/2000 | 5:36 PM | Hail | 2.75 in. | 0 | 0 |
| Clam Falls | 8/8/2000 | 5:55 PM | Hail | 1.00 in. | 0 | 0 |
| Clear Lake | 8/8/2000 | 6:00 PM | Hail | 1.00 in. | 0 | 0 |
| Frederic | 8/14/2000 | 9:05 PM | Hail | 1.75 in. | 0 | 0 |
| St Croix Falls | 5/1/2001 | 5:22 PM | Hail | 0.75 in. | 0 | 0 |
| Amery | 5/15/2001 | 7:18 PM | T-storm Wind | 55 kts. | 0 | 0 |
| Amery | 5/15/2001 | 7:25 PM | Hail | 0.75 in. | 0 | 0 |
| Milltown | 6/11/2001 | 4:20 PM | T-storm Wind | 55 kts. | 1,023,974 | 0 |
| Turtle Lake | 6/11/2001 | 4:38 PM | T-storm Wind | 55 kts. | 0 | 0 |
| Frederic | 6/18/2001 | 5:20 AM | Hail | 1.75 in. | 0 | 0 |
| Luck | 6/18/2001 | 5:45 AM | Hail | 1.75 in. | 0 | 0 |
| Osceola | 7/17/2001 | 10:35 PM | T-storm Wind | 50 kts. | 12,802 | 0 |
| Clear Lake | 7/23/2001 | 5:30 AM | Hail | 2.00 in. | 25,602 | 0 |
| East Farmington | 6/25/2002 | 7:10 PM | T-storm Wind | 60 kts. | 0 | 0 |
| East Farmington | 6/25/2002 | 7:10 PM | Hail | 1.75 in. | 0 | 0 |
| East Farmington | 6/25/2002 | 7:26 PM | Hail | 1.75 in. | 0 | 0 |
| Osceola | 7/3/2003 | 12:35 AM | T-storm Wind | 52 kts. | 0 | 0 |
| Regional | 4/18/2004 | 1:00 PM | High Wind | 59 kts. | 0 | 0 |
| Centuria | 4/18/2004 | 4:00 PM | T-storm Wind | 55 kts. | 0 | 0 |
| Luck | 4/18/2004 | 4:03 PM | T-storm Wind | 56 kts. | 0 | 0 |
| Balsam Lake | 4/18/2004 | 7:20 PM | T-storm Wind | 50 kts. | 0 | 0 |
| Luck | 5/8/2004 | 12:15 AM | Hail | 0.75 in. | 0 | 0 |
| Dresser | 5/9/2004 | 5:15 PM | Hail | 0.75 in. | 0 | 0 |
| St Croix Falls | 8/2/2004 | 6:30 AM | T-storm Wind | 52 kts. | 0 | 0 |
| Amery | 8/2/2004 | 6:52 AM | T-storm Wind | 52 kts. | 0 | 0 |
| Amery | 8/8/2004 | 6:40 PM | Hail | 0.75 in. | 0 | 0 |
| Horse Creek | 9/5/2004 | 5:35 PM | T-storm Wind | 50 kts. | 0 | 0 |
| Balsam Lake | 9/5/2004 | 5:55 PM | T-storm Wind | 50 kts. | 0 | 0 |
| Countywide | 10/29/2004 | 6:35 PM | T-storm Wind | 55 kts. | 0 | 0 |
| Balsam Lake | 6/7/2005 | 2:50 PM | Hail | 0.75 in. | 0 | 0 |
| Clear Lake | 6/11/2005 | 1:40 PM | T-storm Wind | 55 kts. | 0 | 0 |
| Clayton | 6/11/2005 | 1:50 PM | T-storm Wind | 52 kts. | 0 | 0 |
| Countywide | 6/20/2005 | 1:10 PM | T-storm Wind | 52 kts. | 0 | 0 |
| St Croix Falls | 6/20/2005 | 1:15 PM | Hail | 0.75 in. | 0 | 0 |
| Osceola | 6/27/2005 | 5:58 PM | T-storm Wind | 51 kts. | 0 | 0 |
| Countywide | 6/27/2005 | 6:00 PM | T-storm Wind | 52 kts. | 0 | 0 |
| Countywide | 7/23/2005 | 10:00 AM | T-storm Wind | 52 kts. | 0 | 0 |
| Amery | 9/12/2005 | 10:45 PM | T-storm Wind | 75 kts. | 4,759,316 | 0 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Clear Lake | 7/25/2006 | 3:30 PM | T-storm Wind | 55 kts. | 0 | 0 |
| East Farmington | 7/25/2006 | 4:40 PM | T-storm Wind | 55 kts. | 0 | 0 |
| Amery | 7/25/2006 | 4:45 PM | T-storm Wind | 52 kts. | 0 | 0 |
| Dresser | 7/25/2006 | 4:45 PM | T-storm Wind | 55 kts. | 0 | 0 |
| Luck | 9/16/2006 | 10:30 PM | T-storm Wind | 52 kts. | 0 | 0 |
| Amery | 9/16/2006 | 10:40 PM | T-storm Wind | 52 kts. | 0 | 0 |
| St Croix Falls | 9/16/2006 | 10:45 PM | T-storm Wind | 52 kts. | 0 | 0 |
| St Croix Falls | 5/23/2007 | 2:30 PM | T-storm Wind | 54 kts. | 0 | 0 |
| Frederic | 5/23/2007 | 3:00 PM | T-storm Wind | 52 kts. | 0 | 0 |
| Indian Creek | 5/23/2007 | 3:15 PM | T-storm Wind | 52 kts. | 0 | 0 |
| Frederic | 6/7/2007 | 5:30 PM | T-storm Wind | 55 kts. | 0 | 0 |
| Milltown | 6/20/2007 | 4:25 PM | Hail | 0.75 in. | 0 | 0 |
| Milltown | 6/20/2007 | 4:25 PM | Hail | 0.75 in. | 0 | 0 |
| Luck | 6/20/2007 | 5:20 PM | Hail | 0.75 in. | 0 | 0 |
| Cushing | 6/20/2007 | 5:55 PM | Hail | 1.75 in. | 0 | 0 |
| Wanderoos | 7/3/2007 | 1:35 PM | T-storm Wind | 52 kts. | 0 | 0 |
| Amery | 7/3/2007 | 1:40 PM | T-storm Wind | 52 kts. | 0 | 0 |
| Amery | 7/3/2007 | 1:45 PM | T-storm Wind | 52 kts. | 0 | 0 |
| Balsam Lake | 7/8/2007 | 2:00 PM | T-storm Wind | 52 kts. | 0 | 0 |
| Turtle Lake | 7/8/2007 | 2:03 PM | Hail | 1.00 in. | 0 | 0 |
| Amery | 7/8/2007 | 2:15 PM | T-storm Wind | 50 kts. | 0 | 0 |
| Wanderoos | 7/8/2007 | 2:15 PM | T-storm Wind | 55 kts. | 0 | 0 |
| Milltown | 7/8/2007 | 2:20 PM | T-storm Wind | 55 kts. | 0 | 0 |
| Clayton | 8/11/2007 | 8:00 PM | Hail | 0.75 in. | 0 | 0 |
| Milltown | 8/13/2007 | 8:25 PM | T-storm Wind | 52 kts. | 0 | 0 |
| Osceola | 8/13/2007 | 8:31 PM | Hail | 0.75 in. | 0 | 0 |
| Milltown | 9/20/2007 | 8:32 PM | T-storm Wind | 50 kts. | 0 | 0 |
| Indian Creek | 9/20/2007 | 8:45 PM | T-storm Wind | 50 kts. | 0 | 0 |
| Range | 9/20/2007 | 8:50 PM | T-storm Wind | 50 kts. | 0 | 0 |
| Dresser | 9/30/2007 | 2:15 AM | T-storm Wind | 50 kts. | 0 | 0 |
| St Croix Falls | 9/30/2007 | 2:20 AM | T-storm Wind | 52 kts. | 0 | 0 |
| Luck | 9/30/2007 | 2:30 AM | T-storm Wind | 50 kts. | 0 | 0 |
| Osceola Muni Arpt | 5/25/2008 | 4:16 PM | Hail | 0.75 in. | 0 | 0 |
| Horse Creek | 5/25/2008 | 4:20 PM | T-storm Wind | 55 kts. | 0 | 0 |
| Lykens | 5/25/2008 | 4:30 PM | Hail | 0.75 in. | 0 | 0 |
| Clayton | 5/25/2008 | 4:45 PM | Hail | 0.75 in. | 0 | 0 |
| Clayton | 5/25/2008 | 4:45 PM | Hail | 0.75 in. | 0 | 0 |
| Clayton | 6/14/2008 | 9:28 PM | T-storm Wind | 52 kts. | 0 | 0 |
| Amery Muni Arpt | 7/10/2008 | 5:44 PM | Hail | 1.75 in. | 0 | 0 |
| Osceola Muni Arpt | 7/11/2008 | 7:55 PM | T-storm Wind | 55 kts. | 0 | 0 |
| Wanderoos | 7/11/2008 | 8:00 PM | T-storm Wind | 52 kts. | 0 | 0 |
| Amery | 7/11/2008 | 8:20 PM | T-storm Wind | 52 kts. | 0 | 0 |
| Horse Creek | 7/19/2008 | 2:50 PM | T-storm Wind | 56 kts. | 0 | 0 |
| Frederic | 7/25/2008 | 1:20 PM | Hail | 0.75 in. | 0 | 0 |
| Luck | 8/3/2008 | 1:50 PM | T-storm Wind | 60 kts. | 0 | 0 |
| Clayton | 9/26/2008 | 10:50 PM | Hail | 0.75 in. | 0 | 0 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Richardson | 5/5/2009 | 2:25 PM | Hail | 1.00 in. | 0 | 0 |
| Cushing | 5/5/2009 | 3:45 PM | Hail | 0.75 in. | 0 | 0 |
| Lewis | 5/5/2009 | 3:45 PM | Hail | 1.00 in. | 0 | 0 |
| Clayton | 7/22/2009 | 2:55 PM | Hail | 1.00 in. | 0 | 0 |
| Osceola Muni Arpt | 7/24/2009 | 7:08 AM | Hail | 0.75 in. | 0 | 0 |
| East Farmington | 8/8/2009 | 7:40 AM | T-storm Wind | 50 kts. | 0 | 0 |
| Horse Creek | 8/8/2009 | 7:47 AM | T-storm Wind | 50 kts. | 0 | 0 |
| East Farmington | 8/8/2009 | 9:20 PM | T-storm Wind | 61 kts. | 0 | 0 |
| East Farmington | 8/8/2009 | 9:25 PM | T-storm Wind | 61 kts. | 0 | 0 |
| Richardson | 7/7/2010 | 4:55 PM | T-storm Wind | 52 kts. | 0 | 0 |
| Amery | 7/11/2010 | 3:51 PM | Hail | 1.00 in. | 0 | 0 |
| Loraine | 7/14/2010 | 9:40 AM | Hail | 0.75 in. | 0 | 0 |
| Loraine | 7/20/2010 | 1:03 PM | Hail | 1.25 in. | 0 | 0 |
| Balsam Lake | 7/20/2010 | 4:50 PM | Hail | 1.25 in. | 0 | 0 |
| Range | 7/20/2010 | 5:13 PM | Hail | 1.75 in. | 0 | 0 |
| Clayton | 7/20/2010 | 5:31 PM | Hail | 0.88 in. | 0 | 0 |
| Balsam Lake | 7/27/2010 | 6:20 PM | T-storm Wind | 56 kts. | 16,026 | 0 |
| St Croix Falls | 8/10/2010 | 6:00 PM | T-storm Wind | 52 kts. | 0 | 0 |
| Nye | 8/10/2010 | 6:05 PM | T-storm Wind | 52 kts. | 0 | 0 |
| Clear Lake | 8/10/2010 | 11:00 PM | Heavy Rain | N/A | 0 | 0 |
| Dresser | 8/13/2010 | 3:45 PM | T-storm Wind | 52 kts. | 10,684 | 0 |
| Loraine | 8/13/2010 | 4:15 PM | T-storm Wind | 52 kts. | 0 | 0 |
| Clayton | 9/21/2010 | 1:35 AM | T-storm Wind | 52 kts. | 0 | 0 |
| Bunyan | 9/21/2010 | 1:40 AM | T-storm Wind | 61 kts. | 26,710 | 53,420 |
| Regional | 10/26/2010 | 4:00 PM | High Wind | 35 kts. | 26,710 | 0 |
| Horse Creek | 5/9/2011 | 5:45 AM | Hail | 0.88 in. | 0 | 0 |
| Ubet | 5/30/2011 | 10:10 AM | Hail | 0.75 in. | 0 | 0 |
| Joel | 5/30/2011 | 10:35 AM | Hail | 1 in. | 0 | 0 |
| Osceola Airport | 7/1/2011 | 6:30 PM | Thunderstorm Wind | 59 kts. | 53,649 | 0 |
| Amery | 7/1/2011 | 6:40 PM | Thunderstorm Wind | 50 kts. | 0 | 0 |
| Balsam Lake | 7/1/2011 | 8:00 PM | Thunderstorm Wind | 56 kts. | 0 | 0 |
| Frederic | 7/19/2011 | 6:06 PM | Thunderstorm Wind | 56 kts. | 16,095 | 0 |
| Luck | 7/19/2011 | 6:10 PM | Thunderstorm Wind | 52 kts. | 0 | 0 |
| Range | 7/19/2011 | 6:28 PM | Thunderstorm Wind | 56 kts. | 0 | 0 |
| Range | 7/19/2011 | 6:30 PM | Thunderstorm Wind | 69 kts. | 536,485 | 0 |
| Clayton | 8/2/2011 | 3:49 AM | Thunderstorm Wind | 52 kts. | 0 | 0 |
| Osceola | 8/2/2011 | 8:05 AM | Thunderstorm Wind | 56 kts. | 21,459 | 0 |
| Dresser | 8/2/2011 | 8:08 AM | Thunderstorm Wind | 52 kts. | 2,682 | 0 |
| Luck | 8/2/2011 | 8:13 AM | Thunderstorm Wind | 50 kts. | 0 | 0 |
| Osceola Airport | 4/15/2012 | 7:25 PM | Hail | 0.75 in. | 0 | 0 |
| St. Croix Falls | 5/19/2012 | 6:35 PM | Thunderstorm Wind | 52 kts. | 2,102 | 0 |
| Luck | 5/19/2012 | 6:48 PM | Thunderstorm Wind | 52 kts. | 4,205 | 0 |
| Frederic | 5/27/2012 | 6:20 PM | Thunderstorm Wind | 56 kts. | 21,024 | 0 |
| Frederic | 5/27/2012 | 6:37 PM | Hail | 0.88 in. | 0 | 0 |
| Osceola Airport | 6/10/2012 | 8:35 PM | Thunderstorm Wind | 56 kts. | 10,512 | 0 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Centuria | 6/10/2012 | 8:50 PM | Thunderstorm Wind | 52 kts. | 0 | 0 |
| St. Croix Falls | 6/14/2012 | 2:05 PM | Hail | 0.88 in. | 0 | 0 |
| Osceola Airport | 8/3/2012 | 10:50 PM | Thunderstorm Wind | 52 kts. | 0 | 0 |
| Centuria | 8/3/2012 | 10:55 PM | Thunderstorm Wind | 52 kts. | 0 | 0 |
| Little Falls | 8/3/2012 | 11:05 PM | Thunderstorm Wind | 52 kts. | 0 | 0 |
| Horse Creek | 8/3/2012 | 11:05 PM | Thunderstorm Wind | 52 kts. | 0 | 0 |
| Range | 8/3/2012 | 11:25 PM | Thunderstorm Wind | 52 kts. | 0 | 0 |
| Clear Lake | 5/19/2013 | 5:00 PM | Thunderstorm Wind | 50 kts. | 0 | 0 |
| Amery | 5/19/2013 | 5:05 PM | Thunderstorm Wind | 50 kts. | 0 | 0 |
| Clayton | 5/19/2013 | 5:08 PM | Thunderstorm Wind | 52 kts. | 0 | 0 |
| Clayton | 5/31/2013 | 4:25 PM | Hail | 0.88 in. | 0 | 0 |
| Horse Creek | 6/17/2013 | 12:25 PM | Hail | 0.75 in. | 0 | 0 |
| Horse Creek | 6/17/2013 | 12:27 PM | Hail | 0.75 in. | 0 | 0 |
| Horse Creek | 6/17/2013 | 12:36 PM | Hail | 0.75 in. | 0 | 0 |
| Lewis | 8/6/2013 | 6:16 PM | Hail | 1.25 in. | 0 | 0 |
| McKinley | 7/26/2014 | 7:35 PM | Hail | 2.5 in. | 0 | 0 |
| McKinley | 7/26/2014 | 7:43 PM | Hail | 2.75 in. | 0 | 0 |
| Cushing | 9/3/2014 | 6:52 PM | Thunderstorm Wind | 61 kts. | 0 | 0 |
| Luck | 9/3/2014 | 7:05 PM | Thunderstorm Wind | 61 kts. | 0 | 0 |
| Luck | 7/12/2015 | 9:00 PM | Thunderstorm Wind | 52 kts. | 0 | 0 |
| Milltown | 7/13/2015 | 2:10 PM | Thunderstorm Wind | 52 kts. | 5,091 | 0 |
| Milltown | 7/13/2015 | 2:10 PM | Hail | 0.88 in. | 0 | 0 |
| Balsam Lake | 7/13/2015 | 3:10 PM | Hail | 0.88 in. | 0 | 0 |
| Clear Lake | 7/21/2016 | 3:45 AM | Thunderstorm Wind | 61 kts. | 100,000 | 0 |
| Amery | 8/19/2016 | 2:55 AM | Thunderstorm Wind | 52 kts. | 0 | 0 |
| Milltown | 8/19/2016 | 2:58 AM | Thunderstorm Wind | 52 kts. | 500 | 0 |
| Osceola Airport | 9/21/2016 | 5:00 PM | Thunderstorm Wind | 56 kts. | 0 | 0 |
| | 251 events | | | | $7,765,711 | $209,881 |

*Source: National Climatic Data Center (NCDC)*
*Damage estimates in 2016 dollars based on Consumer Price Index by U.S. Bureau of Labor Statistics*

Of the 100 reported severe thunderstorm event days recorded in Table 20 since January 1994, 55 had high winds associated with them, 42 included hail, and two were noted for heavy rains. No severe lightning events were reported for the timeframe, though many of the high wind thunderstorm events were also accompanied by heavy rains and lightning. No deaths or injuries associated with these storms were listed in the database. It must be noted that the NCDC database is not inclusive of all damage estimates from hazards in the County. Damages to buildings and crops as well as general debris clean-up costs are often under-reported and no damage data for any thunderstorm event was estimated prior to 1993.

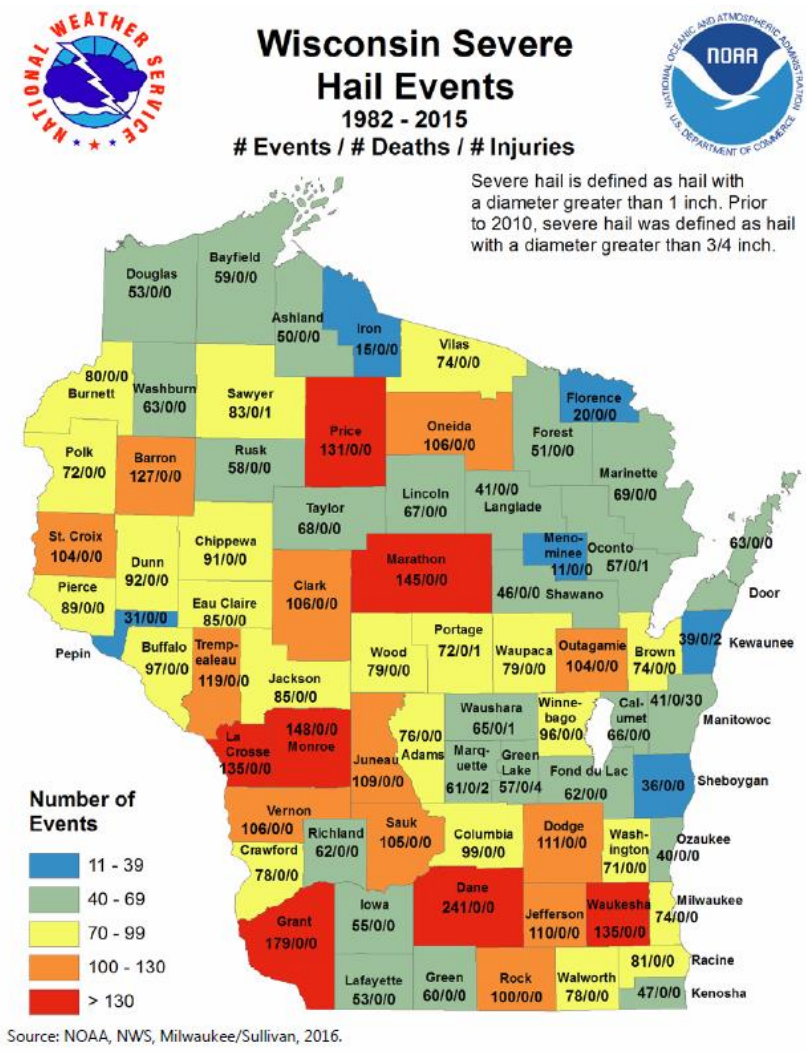
Two significant thunderstorm events have occurred in the last decade:

**June 11, 2001** – This thunderstorm caused damage in a path from the west-central portion of the County to the southeast corner. High winds caused the majority of the storm damage. Total reported damages were approximately $1.5 million (adjusted for 2017 dollars), significantly above the estimate in the NCDC database shown in the previous table.

**September 12, 2005** -- Over 65 percent of the reported damages in the previous table are associated with a single high wind event in September 2005. During this event, straight-line winds estimated at 85 MPH struck the Amery area. Minor damage was reported for numerous structures while major damage was reported for one home and twelve businesses. Seven additional business structures in Amery were destroyed. A nearby feed mill and warehouse owned by the local farmers co-op was also destroyed. Moderate damage was also reported to the airport hangars and many trees in the area were severely damaged. State Highway 46 was temporarily closed due to debris.

More recently, the Village of Luck experienced significant wind damage to businesses and homes (most roof damage) and many trees downed in 2013, which is not included in the NCDC data. The July 2015 storms that struck the Village of Milltown caused significant tree damage in the community and heavy rains resulted in basement flooding.

**Figure 23. Reported Hail Events in Wisconsin**




Source: NOAA, NWS, Milwaukee/Sullivan, 2016.

Compared to its neighbors in Wisconsin, Polk County has experienced fewer hail events in recent decades (see **Figure 23**). From 1982 to 2015, there have been 72 hail events reported for Polk County with no deaths or injuries. According to NCDC records, the most significant hail storm event in Polk County in recent memory occurred in the Luck area in May 1996. Over $143,000 in damages was reported, mostly consisting of damage to vehicles in a used vehicle lot.

The National Weather Service is able to forecast and track thunderstorms that are capable of producing severe weather conditions such as high winds, hail, lightning, and possibly tornadoes. Although the improvement of technology has enabled meteorologists to better forecast and monitor thunderstorms, there is no precise way to make long-term predictions of location, severity, and associated risks. As shown in Table 20, there are no clear trends which

can be used to make projections on the impacts of future thunderstorm events.

## Relative Level of Risk

Thunderstorms are the most frequent natural hazard event in Polk County as reflected by its relatively high ranking (see Table 10). **Based on recent trends, it is expected that an average of four to five severe thunderstorm, high wind, and hail event days will continue to be reported in Polk County each year**, with the potential for multiple storm reports in a single day. High winds will continue to be the most common type of severe thunderstorm report with serious hail occurring as part of 40%-45% of reported storms. The highest frequency of severe thunderstorm events will occur during the months of May through August.

# *Vulnerability Assessment—Thunderstorms*

## Potential Impacts

**Thunderstorms** have no defined hazard area within Polk County. Due to the irregular nature of these events and lack of specific hazard areas, the impacts as a result of a thunderstorm are difficult to quantify. As Table 20 showed, most thunderstorm events occur with minimal negative impacts; and this trend will likely continue.

In general, thunderstorms, high winds, and associated hazards can cause damage to houses or property, uproot trees, and topple (or cause lightning damage to) above-ground power or telephone lines. Above-ground power lines are especially vulnerable in wooded areas with significant residential development, such as older neighborhoods and new subdivisions within pine plantations, where adjacent trees can be blown down onto the lines. Roadways can also be blocked by debris; and debris can accumulate in rivers or stormwater systems, contributing to washouts or flooding.

**Note:**

**High wind vulnerability is further explored as part of the tornado sub-section.**

Severe thunderstorms can cause injury or death from lighting, falling trees, downed power lines, and high-wind impacts. They may cause power outages, disrupt telephone service, and severely affect radio communications and surface/air transportation, which may seriously tax the emergency management capabilities of the affected municipalities. Stormwater and other flooding impacts are discussed separately as part of the flooding hazard assessment in Section III.B.iv.

**Hail** can cause serious injury and damage to buildings, personal property (vehicles), and crops. The most serious damage occurs when hailstones reach a diameter of 1.5 inches, which happens in less than half of all such storms. Hail and high winds can also cause significant damage to agricultural crops.

Based on the 72 reported hail events in Polk County from 1982-2015, Wisconsin Emergency Management estimated that future annual hail damages in Polk County would be $8,013.[13] This amount is low given that only $176,290 in property damage was reported in the County during that period and there were not related injuries. This is likely, in part, due to the lack of reports. Barron County, immediately to the east, had 130 reported hail events with over $36 million in reported property damage.

**Lightning** can result in serious injury, start fires, short-out electrical systems, cause widespread losses of power, and even cause death. Between 1995 and 2002, there were 364 deaths due to lightning in the United States. In Wisconsin, insurance records show that annually, one out of every fifty farms is struck by lightning or has a fire which may be caused by lightning. Large outdoor gatherings can also be particularly vulnerable to lighting strikes that may result in injuries or death.

Based on key informant interviews, past-event history, and a review of the community, it was determined that the following general types of facilities and community assets are most vulnerable to thunderstorm (non-flooding) events:

- Mobile homes, especially those unanchored (high winds)
- Large-span buildings and buildings with many windows (high winds, hail)
- Above-ground power lines, especially in wooded areas (high winds, lightning)
- Agricultural crops (high winds, hail)

Overall, most thunderstorms result in minor damage to most buildings and structures, though all improvements and structures are potentially vulnerable to varying degrees (see Section II.C.iv. Property Values). Older, deteriorating structures may be more vulnerable (17% of the County's housing stock was built before 1939), though the condition of a structure is not inherently linked to age. Some more common impacts include leaks and flooding basements during heavy rains; damage to personal property or windows due to hail; or wind damage to roofs, trees, etc. Thunderstorm damage to structures is typically remedied by the individual owner, utilizing insurance as needed, and is not officially reported to County Emergency Management or other governmental entity. However, some high, straight-line wind events can approach tornado velocity, effectively yielding the same vulnerabilities as a tornado event, especially for mobile homes. Debate continues among some local residents whether the impacts of certain past events were the result of tornadoes or high, straight-line winds. Please refer to the vulnerability assessment for tornadoes in the previous section for a discussion of the potential vulnerabilities due to high winds.

The continuing changes in land-use and development patterns can influence the County's potential for future exposure to thunderstorms. As discussed in the community profile, Polk County is continuing to grow and develop. This creates an increasing exposure to the number of residents and properties that could be at risk from future events. Although new development is managed to ensure adequate protective services are provided and construction is governed by the

[13] State of Wisconsin Homeland Security Council THIRA & SPR, updated January 2017

most current building codes, continued growth increases the vulnerability to natural hazard events.

## Vulnerable Critical Facilities

A more robust assessment of the community assets (critical facilities) and their susceptibility to thunderstorms is located in **Appendix F**. The vulnerability assessment shows that utilities and infrastructure, and, in particular, above-ground power and communication lines, have the greatest vulnerability to thunderstorm events from downed power lines and lightning strikes. It is worth noting that it has been necessary to evacuate the Polk County Fairgrounds on occasion due to severe weather.

High winds and lightning can also affect radio communications and antennas, potentially impacting weather warning systems and the coordination of emergency response providers. Lightning does occasionally strike infrastructure as noted in the following sub-section. Power or communications outages as a result of thunderstorm events can indirectly affect the function of other critical facilities (e.g., hospitals, schools, government offices). Risks and vulnerabilities associated with power outages are discussed previously in the *Special Threat Analysis—Long-Term Power Loss* at the beginning of this chapter.

# *Unique Jurisdictional Risks or Vulnerabilities—Thunderstorms*

Like tornadoes and winter storms, thunderstorms pose no risks or vulnerabilities unique to individual jurisdictions. The level of vulnerability increases with development density, population density, age/condition of structures, and value of improvements. As such, cities and villages are the highest vulnerability areas as well as those areas of with higher populations, larger numbers of housing units, and higher assessed value per square mile described previously in Section II.C. & D. of the Community Profile.

During community meetings on this project, high straight-line winds and downbursts were the most frequently mentioned thunderstorm hazard, though a few communities have also experienced property damage from hail. Any notable differences between municipalities regarding their vulnerability to thunderstorms are further discussed in the *Unique Jurisdictional Risk or Vulnerabilities Table* in **Appendix G**. The vulnerabilities related to high winds were largely covered previously as part of the tornado section.

A number of municipalities also noted the lightning strikes have occurred to various infrastructure in recent memory:

- Village of Clayton – 2011 strike to a well
- Village of Frederic - #4 well has been struck by lightning
- Village of Luck – strike at water tower and twice at wastewater plant; 2010 especially bad

## iv. Flooding
## (including dam failure, riverine, & stormwater flooding)

### *Summary—Flooding*

*Risk – Within the past twenty-five years, most significant flooding in Polk County has fallen into one of four general categories: road damage and closures due to stormwater flooding, fluctuating water levels on seepage lakes, stormwater flooding in developing areas, and flooding along the Apple River. There has also been significant damage related to dam failure, in particular within the Village of Osceola in September 2002. There have been four Presidential Disaster Declarations involving flooding in Polk County (1965, 2000, 2001, 2002). It is likely that Polk County will continue to experience a serious, damage-causing flood event every two to three years on average, though the risk of flash flooding may be increasing.*

*Vulnerabilities – Most flood-related damage in Polk County during recent decades has been road-related and scattered basement flooding due to stormwater or flash flooding. Structures or improvements within a dam's shadow or in a floodplain are also vulnerable, but such flooding events have been rare for most of the County. An estimated 607 principal structures were identified as potentially being located in the 100-year floodplain in Polk County, with an estimated $74.8 million in assessed improvements. Over 98% of the assessed parcels were in residential use with the greatest concentrations on lakes. Over half of these structures were located in the towns of Lincoln, Georgetown, Alden, and Apple River. Of the 57 dams in the WDNR database for Polk County, only four are high-hazard dams and four are significant-hazard dams.*

1. From 1978 to May 2017, there were only fourteen National Flood Insurance Program (NFIP) claims for Polk County with $323,542 total paid, with no Repetitive Loss Properties[14]. However, five of these fourteen claims were on Sand Lake in the Town of Osceola. As of May 2017, a total of 65 NFIP policies were active for Polk County landowners, 49 of which were in the unincorporated towns. No cities or villages identified significant overbank flooding concerns during this plan update.

2. Significant stormwater system and culvert improvements have been made within the County to address many stormwater problem areas in previous mitigation plans, yet numerous problem areas still exist, especially in "low areas" with high groundwater tables. Flood damage at the County Highway "B" bridge downstream of Atlas Dam and the periodic topping of the Clam Falls Dam at County Highway "I" are two priority concerns in the unincorporated areas. Most incorporated communities had some level of stormwater flooding concerns as identified later in this section and Appendix G.

[14] A Repetitive Loss Property (RLP) has 2 or more NFIP claims of $1,000 or more in a 10-year period.

3. Dam-related issues identified during the planning process include:

   a) The Clam Falls Dam has an undersized spillway and can be topped if more than 1.5"-2" of rain; this poses a risk to nearby roads and still remains a concern as identified in the 2006 mitigation plan.

   b) A number of dams, such as the Black Brook Dam, have bridges and roads in their dam shadows. Emergency operating plans have been established for high- and significant-hazard dams, in addition to some other dams with critical infrastructure located downstream.

   c) 1-2 homes, some farm buildings, and the CTH "B" bridge lies within the dam shadow of the County-owned Atlas Mill Dam. Some scouring at the bridge has occurred.

   d) There is an opportunity to add G.I.S. data coverages for additional dam shadows, then use the proposed Reverse 9-1-1 system to notify residents near these areas.

4. Most structures outside the 100-year floodplain do not have flood insurance, though these areas may be prone to stormwater or flash flooding. Approximately one-third of all NFIP claims nationwide are for damages outside the 100-year floodplain. Major concerns exist regarding inaccuracies with current 100-year floodplain boundaries and D-FIRMs.

5. With the 2011 Flood Insurance Rate Map (FIRM) update, a small area of 100-year floodplain was identified in the Village of Clear Lake. Since the Village has not adopted floodplain zoning, it has "sanctioned status" under the NFIP and residents are not able to access federal flood insurance.

6. Polk County and its communities maintain policies and floodplain zoning to discourage future development in 100-year floodplains and other areas particularly prone to flooding. Flood vulnerabilities in floodplain areas are more likely to increase from increasing frequency of heavy storm events, loss of natural flood storage areas, and increased run-off from non-floodplain areas.

## *Risk Assessment--Flooding*

### The Hazard

Flooding is the only natural hazard with officially defined hazard areas within Polk County. As such, flooding receives the greatest level of analysis within this plan.

**Flooding** is defined as a general condition of partial or complete inundation of normally dry land from the overflow of inland waters, or the unusual and rapid accumulation or runoff of surface waters from any source. Often, the amount of damage from flooding is directly related to land use. If the ground is saturated, stripped of vegetation, or paved the amount of runoff increases and contributes to flooding. Additionally, debris carried by the flood can damage improvements and infrastructure, or can obstruct the flow of water and further add to flooding.

For Polk County, flooding can be further subdivided into three primary types: (1) lake or riverine flooding, (2) stormwater or overland flooding, and (3) flooding resulting from dam failure.

**Lake or Riverine Flooding (Overbank) -** Major floods in Wisconsin have, for the most part, been confined either to specific streams or to locations which receive intense rainfall in a short period of time. Flooding which occurs in the spring due to snow melt and/or prolonged periods of heavy rain is characterized by a slow buildup of flow and velocity in rivers, streams, or lakes over more than six hours and often over a period of days. This buildup continues until the river, stream, or lake overflows its banks for as long as a week or two, then slowly recedes. Generally, the timing and location of this type of flooding is fairly predictable and allows ample time for evacuation of people and property.

**Key Definition**

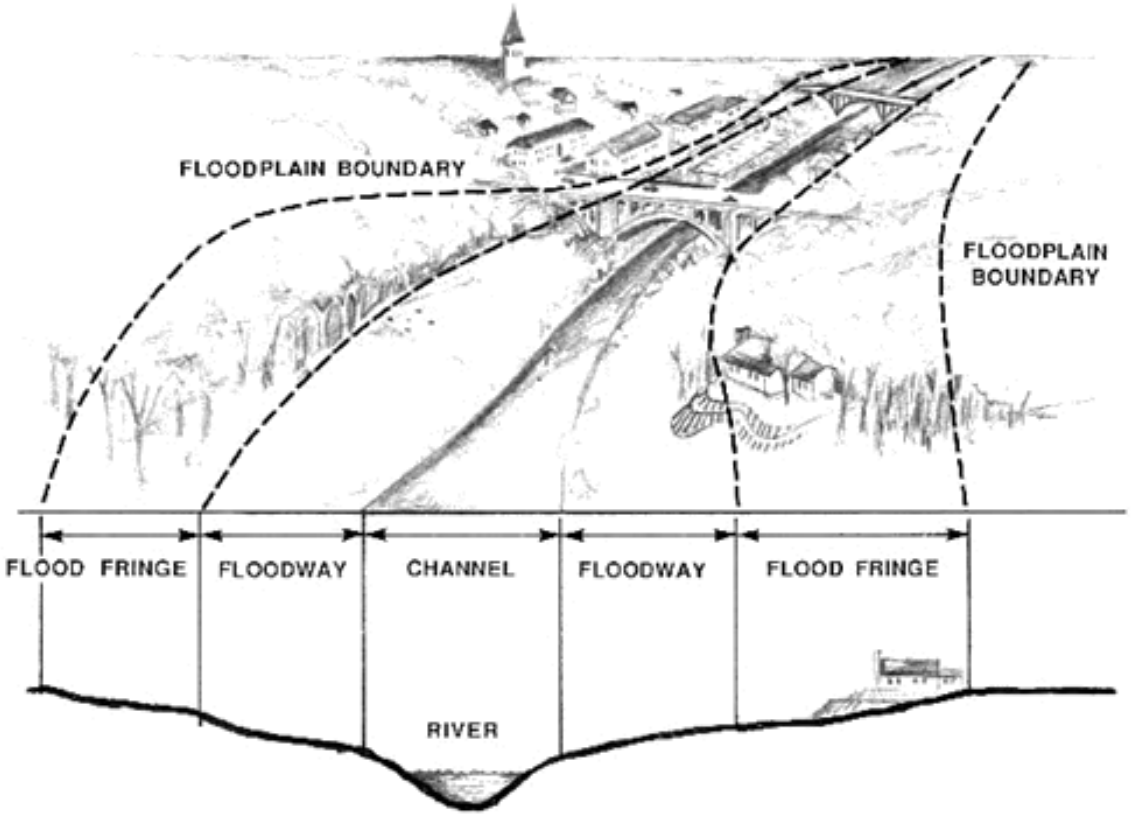
A 100-year flood has a 1% chance of being equaled or exceeded in any given year.

For regulatory purposes, the terms "100-year flood" and "floodplain" are commonly used. A **100-year flood**, often referred to as a **regional flood, special flood hazard area,** or **base flood**, is a flood that has a one percent chance of being equaled or exceeded in any given year. This can be misleading as a 100-year flood is <u>not</u> a flood that will occur once every 100 years. The 100-year flood, which is the standard used by most Federal and State agencies, is used by the National Flood Insurance Program (NFIP) as the standard for floodplain management and to determine the need for flood insurance.

A **floodplain** is that land which has been or may be covered by floodwater during a flood event and includes the floodway and floodfringe areas (see **Figure 24**). The **floodway** is the channel of a river or stream and those portions of the floodplain adjoining the channel required to carry the regional flood discharge. Since it is associated with moving water, the floodway is the most dangerous part of the floodplain. The **floodfringe** is the portion of the floodplain outside of the floodway, which is covered by flood water during the regional flood and is generally associated with the storage of water rather than flowing water. The floodfringe is also that part of the floodplain in which development may be allowed in some communities, subject to floodplain development standards.

The **regional flood elevation** is the elevation determined to be representative of large floods known to have occurred in Wisconsin or which may be expected to occur on a particular lake, river, or stream at a frequency of one percent during any given year. The **flood protection elevation** is an elevation which is 2 feet above the regional flood elevation as defined by the Wisconsin Department of Natural Resources. Development is sometimes allowed within the floodfringe if the structure is raised above the flood protection elevation. However, development in the flood fringe can decrease important floodwater storage; hydraulic analysis is often needed to ensure that the development will not result in increased flooding in adjacent areas or farther downstream.

**Figure 24. Elements of a Floodplain**




*Source: Minnesota Department of Natural Resources.*

Often, the term "floodplain" is used inappropriately by assuming that floodplains are limited to the 100-year floodplain boundary. This is not the case, and a floodplain can be identified for a 500-year flood or other such level of risk.

The 100-year floodplain is a guide for regulatory and insurance purposes. Floods greater than a 100-year regional flood event can and do occur. Nationwide, approximately 25 percent of all National Flood Insurance Program claims are for structures outside the 100-year floodplain. This is a surprisingly high number, since many homes or structures outside the 100-year floodplain do not have flood insurance; and flood insurance is typically not required by lending institutions for mortgages on structures not within the 100-year floodplain. But this demonstrates that most properties are at risk of flooding to some degree.

Generally, the 100-year floodplain should be considered the high flood-hazard risk area. The 100-year floodplains are shown as the "A" zones on the FEMA Flood Insurance Rate Maps (FIRMs). Nationwide, 26 percent of the 100-year floodplains experience or exceed a 100-year flood event within a typical 30-year mortgage period. The 500-year floodplains (the shaded "X" zones on the FIRM maps) are the medium-risk flood-hazard areas. The remaining unshaded "X" zones on the FIRM maps should be considered the low-risk flood-hazard areas.

Also, high-hazard flood areas can exist that are not shown on the Flood Insurance Rate Maps. And floodplains can change in hazard risk and size as development occurs or with other physical changes in the environment or climate. Municipalities can take the initiative to have new flood risks added to the FIRM maps as a Letter Of Map Change (LOMC) or otherwise consider them during their planning and regulatory processes. Allowing inappropriately planned development to occur with knowledge of such potential hazards could be a source of potential liability for a community should a flood event occur which impacts the development.

Updated Flood Insurance Rate Maps (FIRMs) for Polk County became effective in September 2011. These updated maps are available in a digital format (D-FIRMs). Most floodplain areas were digitized from the existing floodplain maps and adjusted to best-available topographic information; no countywide LIDAR data was available at that time in order to improve accuracy. A handful of areas had more detailed studies performed in past years which provided additional information incorporated into the D-FIRMs, such as the determination of base flood elevations on Balsam Lake, Big Butternut Lake, and Clam Falls Flowage. The Village of Osceola had two-foot contour data which was also used. According to the FEMA Flood Insurance Rate Study dated September 16, 2011, only one LOMC was incorporated into the updated D-FIRMs. County and local officials continue to have major concerns with inaccuracies in the current D-FIRMs and 100-year floodplain boundary that makes enforcement more difficult and decreases public trust in floodplain management efforts. In 2015 and 2016, Polk County completed a LIDAR project and now has 2 foot topographic data available countywide.

**Stormwater Flooding (Overland) and Flash Flooding (Overbank or Overland) -** The type of flooding which occurs primarily from surface runoff as a result of intense rainfall is referred to as stormwater flooding or overland flooding. These flooding events tend to strike quickly and end swiftly. If 6” of rain falls on 2,000 square feet of roof and concrete (about the size of a typical roof, driveway, and garage), 1,000 square feet of stormwater will runoff from that single home.

Flash flooding is more difficult to distinguish and can, in fact, be either riverine (overbank) or stormwater (overland) flooding. In this plan, flash flooding has been grouped with stormwater flooding due to its often unpredictable nature and the intense, rapid rise and velocity of the water levels. For prediction and warning purposes, floods are classified by the National Weather Service into two types: those that develop and crest over a period of approximately six hours or more, and those that crest more quickly. The former are referred to as "floods" and the latter as "flash floods." Like stormwater flooding, flash flooding is typically the result of intense rainfalls possibly in conjunction with already saturated soils, though very sudden snow melts can also contribute to stormwater or flash flooding.

Areas with steep slopes and narrow stream valleys are more vulnerable to stormwater and flash flooding, as the water can achieve high velocity in a short time. Developed areas with substantial impervious surfaces can further contribute to stormwater and flash flooding. Flash floods often occur in smaller watersheds or are very localized and are, therefore, not necessarily reflected on most FEMA Flood Insurance Rate Maps. Flash flooding can also be the result of dam failure.

**Dam Failure** - According to the FEMA Federal Guidelines for Dam Safety, dam failure is defined as a:

> "Catastrophic type of failure characterized by the sudden, rapid, and uncontrolled release of impounded water or the likelihood of such an uncontrolled release. It is recognized that there are lesser degrees of failure and that any malfunction or abnormality outside the design assumptions and parameters that adversely affect a dam's primary function of impounding water is properly considered a failure. These lesser degrees of failure can progressively lead to or heighten the risk of a catastrophic failure. They are, however, normally amenable to corrective action. (FEMA 148)."

Technically, dam failure could be considered a man-made hazard and, thus, outside the scope of this hazards mitigation plan. However, given the County's ownership and management of a number of dams and the inherent relationship and similarities between dam failure and other types of flooding, a decision was made to include a discussion of this hazard as part of the flooding assessment.

Dam failure can occur from structural problems at the dam, hydrologic problems, malfunction of equipment, or human error in the monitoring or release of water. As such, dam failure can occur with little or no warning and on clear days with no rain, unlike the other types of flooding.

Older dams which have been poorly maintained have a larger potential of dam failure. Hydrologic problems may occur when there is heavy precipitation or snow melt, resulting in more water being impounded than by design or more than the spillway can handle, resulting in adjacent flooding, overtopping, or structural failure. A partial or complete failure of a dam can release great amounts of water, leading to loss of life and substantial damage downstream. A dam failure may lead to additional failures of other downstream dams. And the sudden, prolonged disappearance of an impoundment due to dam failure can also have serious impacts on wildlife habitat, recreation, and tourism. Polk County's floodplain ordinance includes the dam failure or hydraulic shadows of high and significant hazard dams.

## Regional Trends

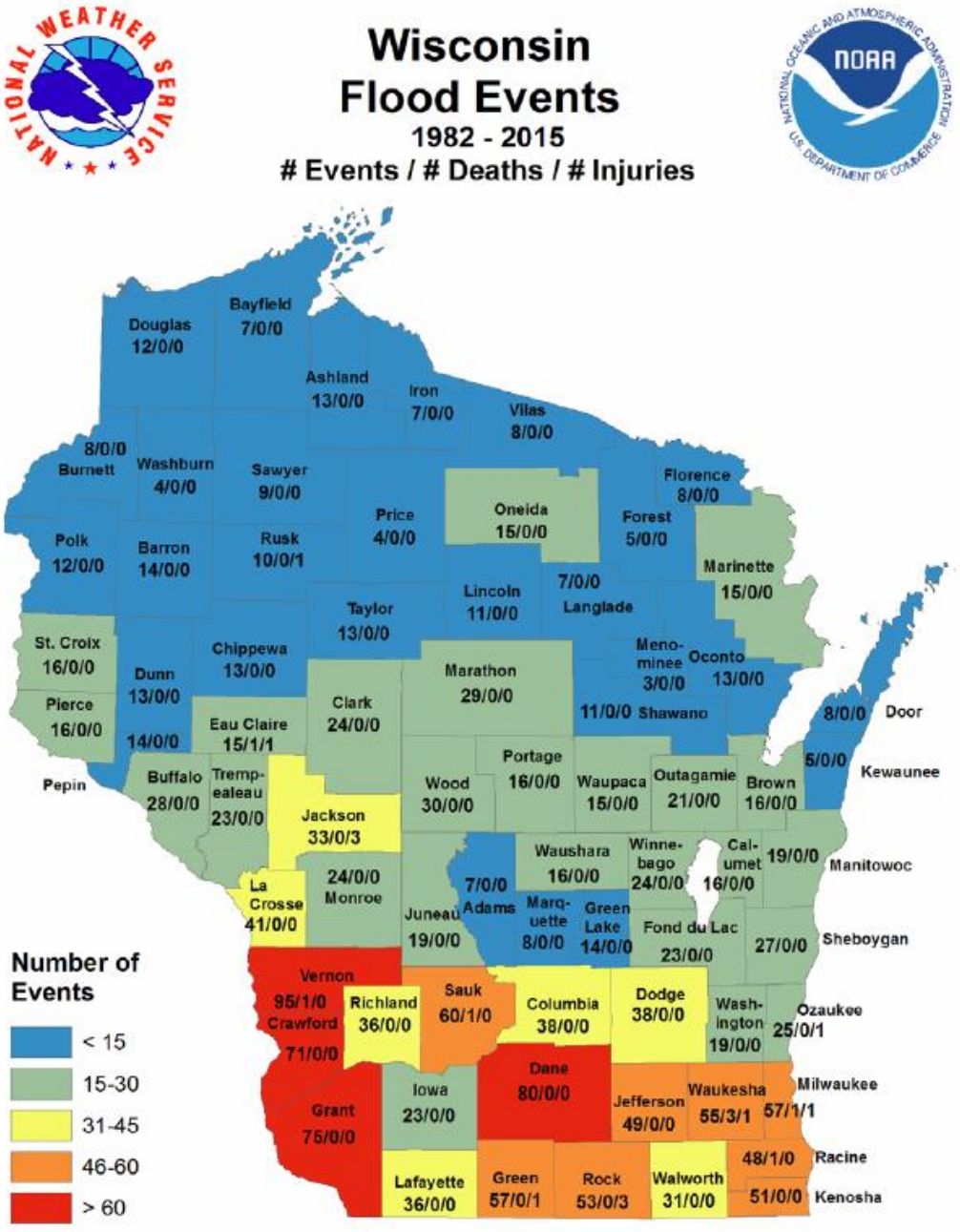
Wisconsin has experienced a significant flooding event at least once every decade since 1880. Flooding has been a principle cause of damage in 32 of 46 Presidential Disaster Declarations and one of six Presidential Emergency Declarations in Wisconsin from 1971 through June 2016. Flood events tend to cause the most widespread damages of all Wisconsin's natural hazards. Low-lying areas of the counties that border Wisconsin's largest rivers, the Mississippi and the Wisconsin, are particularly prone to flooding of both the main channels and smaller tributaries. Smaller rivers, such as the Chippewa, Menomonee, Kickapoo, Pecatonica, Bad, Wolf, and Milwaukee Rivers, are also regularly experience periodic flooding.

Understanding flood risk in Wisconsin is important, especially as lands previously dedicated to agricultural or preservation uses are developed. Throughout recent years, flooding in Wisconsin has changed in scale and scope. This is due largely to the increasing demand for housing along

Wisconsin's waterfronts, land use changes that reduce natural flood storage capacity, and recent trends toward increasing precipitation amounts.

**Figure 25** below shows the county-by-county distribution of flood events across Wisconsin for the period of 1982-2015. Notice that the southern part of the state has most of the flood events. Hilly terrain in the southwestern counties and the built-up urban areas in the southeast are factors that increase the chances of flooding. Very few injuries and deaths are recorded during the 28 year period. Flood events in recent decades tend to affect a greater number of counties and result in increasingly costly damages.

**Figure 25. Reported Flooding Events in Wisconsin by County, 1982 to 2015**




Source: NOAA National Weather Service, Milwaukee/Sullivan, WI, 2016.

The majority of the most widespread and damaging floods on record in Wisconsin occurred between 1990 and 2010. From 1971 until 1993, the total flood damages in Wisconsin from major floods were estimated at $160.4 million. Then in June-August 1993, flooding over large areas of the State resulted in an estimated $740 million in damages from this single summer. Even worse flooding damage was experienced in Wisconsin in June 2008 with damages estimated at roughly $763 million. In short, since 1992, flood damages from major events in Wisconsin have exceeded $2.3 trillion.

There have been very few dam failures in Wisconsin that resulted in major damages or loss of life. The June 1993 flood event included the failure of an embankment associated with the Hatfield Dam on the Black River which contributed to flooding damage downstream in the City of Black River Falls. In June 2008, the Lake Delton Dam broke which resulted in mudslides which washed out a number of homes. Closer to home in 2002, a small privately owned dam in Osceola washed out and caused significant damage to a mobile home park. Many of Wisconsin's approximately 3,800 dams are small logging or milling dams built prior to 1900 and have little or no associated vulnerabilities. Between 1990 and 1995, more than 75 dam failures were documented in Wisconsin. Several of these incidents resulted in injuries and serious property damage, but no loss of life.

## Local Events

Since 1953, there have been four Federal Major Disaster Declarations which encompassed Polk County—April 1965, June/July 2000, April/May 2001, and September 2002. All four of these events involved flooding. The fact that three of these events have occurred since 2000, supports the opinions of many local officials that stormwater and flash flooding problems have been increasing in recent years for many areas of the County.

Most of the County's rivers and lakes stay within their banks during heavy rains or spring run-off. For those areas prone to overbank flooding, precautions have been implemented to mitigate flood damage, such as floodplain zoning and dam controls. The most significant flooding problems over the past decade have occurred when natural or man-made drainage and stormwater systems have been unable to handle heavy rain events, especially in low-lying areas or when the ground is already saturated.

Data from the National Climatic Data Center for flood events is not available for prior to 1993 (see **Table 21**) and only includes eleven flood event reports for Polk County, with a number of reports for a single date. Table 21 also indicates that flood-related damages have been relatively low over the past decade, though most damages are under-reported or go unreported to the National Weather Service. No injuries or deaths associated with the events were reported in Polk County.

**Table 21. Flood Events in NCDC Database ● Jan 1993 to Sept 2015 Polk County**

| Location | Date | Time | Type | Property Damage | Crop Damage |
|---|---|---|---|---|---|
| Regional | 4/6/1997 | 6:00 AM | Flood | $13,261,643 | 0 |
| Regional | 4/1/2001 | 12:00 PM | Flood | $0 | 0 |
| Osceola | 9/1/2002 | 1:30 AM | Flash Flood | $522,209 | 0 |
| St Croix Falls | 7/23/2005 | 10:30 AM | Flash Flood | 0 | 0 |
| Countywide | 10/4/2005 | 6:15 PM | Flash Flood | 0 | 0 |
| Regional | 10/4/2005 | 11:00 PM | Flood | 0 | 0 |
| Clayton | 8/11/2010 | 1:00 AM | Flash Flood | 0 | 0 |
| Clayton | 8/11/2010 | 1:00 AM | Flash Flood | 0 | 0 |
| Clayton | 7/16/2011 | 7:00 AM | Flash Flood | 0 | 0 |
| Lewis | 5/27/2012 | 10:00 PM | Flash Flood | $105,121 | 0 |
| Clayton | 9/17/2015 | 7:00 AM | Flash Flood | 0 | 0 |
| | | | 11 events | $13,888,974 | $0 |

*source: National Climatic Data Center (NCDC)*
*Damage estimates in 2016 dollars based on Consumer Price Index by U.S. Bureau of Labor Statistics*

A closer review of the recent flood events in Polk County provides a better understanding of the frequency, characteristics, and damages related to recent flooding in the County.

**April 1997** On April 12, the St. Croix River reached a crest about 3.5 inches above flood stage at Stillwater, MN, which was the third highest crest ever measured. Landing Park in Osceola was inundated by flooding. No specific information on the types of flood damages as a result of this event within Polk County is available. This must have been a relatively localized flooding since the event did not make Wisconsin Emergency Management's (WEM's) list of major flooding events in Wisconsin.

**June/July 2000** Severe thunderstorms accompanied by heavy rains, high winds, and stormwater flooding struck Polk County. This event was part of a Presidential Disaster Declaration, though it is strangely absent from the NCDC database. Damages in Polk County were estimated at $592,500 (over $838,000 in 2017 dollars), the majority of which were due to the washout of roads, shoulders, and culverts. Statewide, flooding damage during this spring and summer period is estimated at $72 million.

**April 2001** Heavy snow fall during the winter largely remained on the ground through March, then rapidly melted. Water quickly began to fill ditches, streams, and rivers. Two significant rainfall events further contributed to the flooding. Kennedy's Mill Dam became clogged with debris causing an adjoining embankment to collapse, but damages were confined to the area just downstream of the dam and no structures (except the dam and a town road downstream) were impacted. Some leaks and erosion also occurred at Woodley's Country Dam, which was privately owned at the time, and the dam came close to failure, but local emergency measures saved the structure. Total damages in the County from this event were estimated at $1,600,717 (over $2.2 million today), but are not included in the NCDC database shown in the previous table. Statewide flooding damage was estimated at $84.2 million in April 2001.

**September 2002** This was Polk County's third flood-related Presidential Disaster Declaration in three years with characteristics similar to the June 2000 event with stormwater flooding and high winds as a result of thunderstorms. More than five inches of rain fell within a few hours resulting in documented damages of $3 million according to WEM records. The Village of Osceola was the hardest hit in the 2002 disaster when a privately owned dam failed and caused damage to a private mobile home park and the Village-owned Mill Pond Park. This dam failure also caused damage to the lower dam which runs under State Highway 35, Wilkes Glen Park, and Cascade Falls on the St. Croix River. But on a regional scale, the damages associated with this event in the Osceola area were overshadowed by the tornado which struck the City of Ladysmith about 85 miles to the east in Rusk County.

During the 2002 flooding, the St. Croix River exceeded the 100-year flood and was the largest flood on historic record. Water rushed down-river at a rate of 62,000 square feet per second or 26.7 million gallons per minute. However, damage within the St. Croix River floodplain was minimal and limited primarily to parks and landings.

**July 2005** Localized stormwater or flash flooding occurred throughout the region when several inches of rain fell in less than two hours. The City of St. Croix Falls was especially hard hit, and a significant washout occurred at the intersection of Kentucky Street and Adams Street just east of Highway 87.

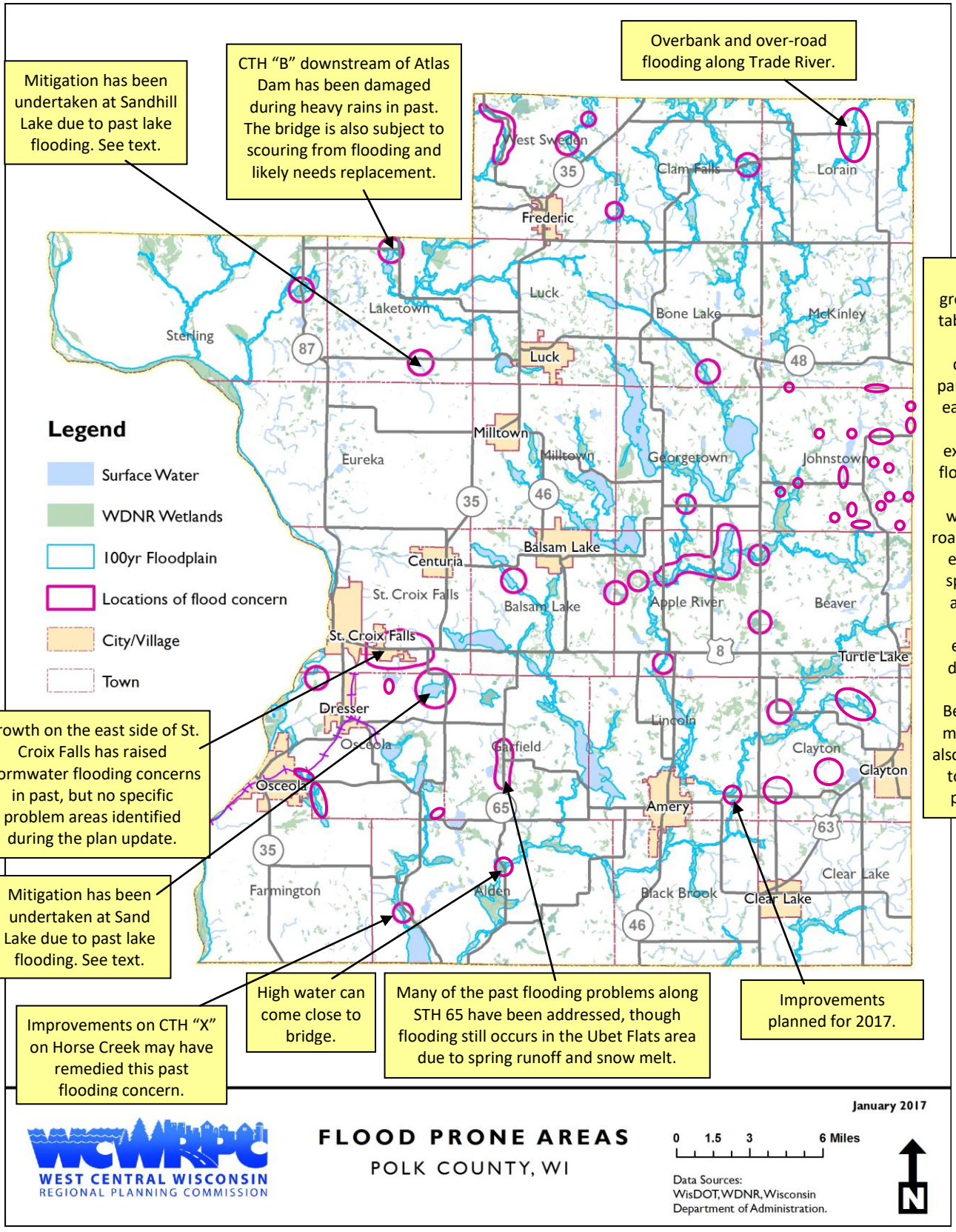
**October 2005** Heavy rains were experienced countywide, especially in northern parts of the County, leading to stormwater/flash flooding. Several roads were flooded. Some driveways were damaged and washouts were reported in and around some culverts. A number of roads in northern portions of the County between Frederic and Lewis remained flooded for multiple days.

**August 2010** Several rounds of heavy rainfall led to significant flash flooding throughout parts of west-central Wisconsin. Southern portions of Polk County were particularly affected. An observer in Clayton, Wisconsin, reported basement flooding with approximately two inches of water covering the floor.

**Appendix I** lists the FEMA project applications for Polk County as a result of the 2000, 2001, and 2002 disaster events. Altogether, $3,028,989 (over $4 million in today's dollars) in applications were submitted, which addressed damages in 18 of the County's 24 towns and five cities and villages. Over one-third of these damages were road, culvert, and shoulder repairs associated with flash flooding.

During the planning process, County staff and local officials identified a number of areas in unincorporated Polk County which are particularly prone to flooding as shown in **Figure 26**; flooding concerns of villages and cities will be individually discussed later in this section.

**Figure 26. Areas of Flooding Concern (Unincorporated Towns Only)**



These rural Polk County flooding concerns generally fell into four categories:

1) **Road Damage and Closures Due to Stormwater and Flash Flooding, especially in "Low Areas" –** Unless otherwise noted in Figure 26, the "hotspots" identified for the unincorporated towns on the previous map are primarily associated with over-the-road flooding and potential roadway closures and related damage, rather than damage to buildings and structures. Such flooding events can result in vehicle accidents and deaths, as well as damage to road shoulders, culverts, bridges, etc. The "hotspots" include those identified during the 2006 and 2012 hazard mitigation planning efforts, unless town officials, County Highway staff, or others noted changes. For example, the Town of Johnstown identified multiple areas prone to washouts of culverts during a 100-year storm that were not included in the previous plan, though the Town noted that last major event occurred about 25 years ago.

   During the 2006 planning process, Town of Alden Chairman Brad Johnson wrote, "The largest hazard, as far as frequency, is heavy rain. We have not experienced heavy flooding in a specific area repeatedly, but it has created problems in various areas."[15] The Town of Alden experience is shared by much of the County, where heavy rains can produce stormwater flooding "hotspots", but the risk of damage due to repetitive riverine or lake flooding is relatively minimal. The Town of Osceola also added four areas at risk of flood damage as part of this plan update.

   One interviewee during the 2012 planning effort noted that heavy rains and flooding seem to have been worse in the northern portion of the County in recent years. Yet Figure 26 shows that flooding problems are located throughout the County in low areas where roads cross or follow streams, wetlands, and areas with high groundwater tables, in particular in the eastern parts of the County. One such area is along CTH "D" north of Range which is frequently underwater and lacks sufficient ditching. Similarly, the Town of Clayton identified additional areas of such flooding in the community as part of this mitigation plan update (i.e., 105th Ave between 10th & 20th Streets, 20th St. dead end, 25th St. between 150th and 120th Aves, Barbo Lake Rd to 90th Ave and Magnor Lake Lane to 40th St.

   It is notable that numerous flood "hotspots" identified in the 2006 and 2012 hazard mitigation plans have been mitigated through road, culvert, and/or ditch improvements and were deemed to no longer be flooding "hotspots." For example, significant roadway improvements have been made along STH "65", CTH "A", STH "87", and USH "8". Improvements were made to CTH "W" in the Town of West Sweden which has decreased the problem areas from about six in the past down to one or two spots.

2) **Fluctuating Seepage Lakes** – Overall, water levels at most lakes in the County have been very stable. But two seepage lakes, in particular, have had past problems with flooding. Seepage lakes are primarily spring-fed with no natural outlet. Due to drought

[15] Johnson, Brad. *Letter to West Central Wisconsin Regional Planning Commission on Local Hazards.* letter dated 12/5/03.

conditions over five of the last seven years, water levels of these seepage lakes have been down and no significant flooding problems have been reported.

The 2006 plan identified two seepage lakes—Sand Lake (Town of Osceola) and Sand/Sandhill Lake (Town of Laketown)—as the only overbank flooding hotspots in unincorporated Polk County which had repetitive problems in the past, could potentially impact a large enough area, and include multiple improved properties to potentially warrant site-specific mitigation activities. Together, properties at these two locations represent six of the fourteen NFIP claims in Polk County to date. Significant development has occurred around both of these lakes. At least 20 lakeshore homes can be found at Sand (or Sandhill) Lake in the Town of Laketown, while over 45 surround Sand Lake in the Town of Osceola.

Mitigation measures have been undertaken at both locations, and no additional damage or problems have occurred in the interim. At Sand Lake in the Town of Laketown, cabins were moved farther back from the lake; and an overflow pipe was installed to help maintain water levels. At Sand Lake in the Town of Osceola, local springs have greatly contributed to the flooding problems in the past, but there has not been reoccurring problems since the recent raising of the adjacent road. Both locations are being monitored and no further action is warranted at this time.

3) **Stormwater Run-off in Developing Areas** – Stormwater runoff problems have also been a concern for some residential subdivision and commercial developments. Recently, more attention has been given to stormwater management during the planning and site plan review process by both local governments and builders to address this concern. Those areas experiencing new development are particularly prone to stormwater problems, especially those growth areas of south-west and south-central portions of the County as discussed in the ***Community Profile—General Development*** section earlier in the Plan. Also prone to stormwater runoff issues are areas at the interface of incorporation boundaries, as stormwater moves from municipality to municipality. A number of cities and villages have had such issues, as will be explained later in ***Unique Jurisdictional Risks or Vulnerabilities—Flooding*** section.

4) **Flooding along the Apple River** – Over the past fifty years, damage from overbank flooding along Polk County rivers has been relatively small. The St. Croix River has been well above flood stage numerous times in the last two decades with minimal damage, though numerous roads and bridges were underwater in 2001. According to the FEMA Flood Insurance Study dated September 16, 2011, "[f]looding problems in Polk County are due primarily to the overflow of the Apple River," though the study does not identify the extent of these problems. To date, there have only been two National Flooding Insurance Program policy claims for properties on the Apple River. Based on the town hazard surveys, the most significant flooding concerns along the Apple River are concentrated in the Town of Apple River.

It is important to note that of the major flood events since 1997, there have been three instances of significant damage at dam structures. Two of these dams (Woodley and Osceola) have since been removed, while significant improvements have been made to Kennedy's Mill Dam. However, these events demonstrate the important of dam maintenance and monitoring as well as the potential risks downstream within the dam shadow.

Notably absent from Figure 26 and the previous discussion are any concerns with overbank flooding along the St. Croix River. The St. Croix River is a National Wild and Scenic River. This status, combined with local floodplain management and extensive public-owned lands along the river, has mitigated the potential of building and property damage. Flood impacts along the St. Croix are typically limited to recreational areas, such as boat landings. A picnic area within Interstate State Park is frequently flooded in the spring or following severe rain events which prevents access, but actual damage is relatively minimal.

## Relative Level of Risk

Flooding in Polk County will continue to be a significant risk for residents and improvements. The drought for much of the past decade likely contributed to a reduction of recent flood events, though there have been about seven significant flood events in the County over the past decade. A smaller overland or stormwater flood event can be expected to occur annually in some areas, with multiple events in a single year not uncommon. Such flash flooding can be expected to primarily result in basement flooding, washing out of road infrastructure, and contributing to soil and bank erosion. Those areas most prone to the typical annual riverine flooding associated with snow melt are well known and potential damages have been largely mitigated.

**Based on the past two decade, it is likely that Polk County will continue to experience one serious, damage-causing flood event every two to three years on average.** Some of these events may be localized in nature, only impacting a portion of the County, while multiple events may be experienced in the same year or even month. Flash flooding due to heavy rains will be the most frequent cause of flood damage in the County and can occur any time of the year. Significant overbank and flash flooding caused by heavy snow melt, often in conjunction with rainfall, can be anticipated once or twice a decade, typically in the months of March, April, or May. These events also have the potential to cause significant damage, but as the September 2002 flood showed, the riverine flooding risks tend to be greater along the smaller rivers, rather than the St. Croix River. Flooding on seepage lakes is also very difficult to predict due to the cyclical nature of the groundwater levels and seriousness of the recent droughts.

**If the dams within Polk County continue to be well maintained, flooding related to dam failure should not occur and is not expected.** In fact, most of the smaller, privately owned dams would cause very minimal or no damage downstream if a failure should occur. The larger dams with significant- or high-hazard ratings were built to strict engineering standards, have related emergency plans, and are more closely monitored. Yet the County does have a recent history of damage or washout of dams, so ongoing attention to this risk is needed.

## *Vulnerability Assessment--Flooding*

Flooding can be the most destructive of hazards, affecting large areas for long periods of times. Since flooding is tied to topography, a substantial amount of flood damage is the result of basement flooding, though floods can also move or destroy entire structures. Deaths and injury are relatively rare with river and lake flooding, since adequate warning time is usually available, though flash floods or dam failures can be very deadly as they may form very swiftly.

Floods can wash out roads, hindering the flow of traffic, and can cause havoc to water supply and wastewater treatment systems. Debris carried by flooding can result in direct damage to bridges, structures, or property; or this debris can obstruct the flow of water, causing additional flood damage. The resulting moisture build-up in the home (HVAC systems, carpeting, drywall, etc.) can cause additional, long-term health problems with mold and mildew once the floodwaters have retreated. Nearly half of all reported flood damage in Wisconsin in the 1990s was to crops, though obtaining accurate crop damage estimates at the county level is difficult. Polk County also lacks the large expanses of river bottomland found in other areas of the State.

### Potential Development in Floodplains

In 2003, the Polk County Land and Water Resources Director stated that impervious surfaces along the lakes had tripled in the previous ten years. However, new floodplain development has decreased dramatically overtime with stricter enforcement of floodplain zoning and a decrease in available shoreland properties.

Data was not readily available to perform a comprehensive, detailed vulnerability assessment of flooding in Polk County. Instead, through the use of D-FIRM maps and available G.I.S. data, those principal structures potentially located within a 100-year floodplain were identified. This information can be further supplemented through the previously provided flooding "hotspots" map (Figure 26) to guide the development and prioritization of flood-related mitigation strategies. A full description of the flood assessment methodology and related data challenges is included in **Appendix B**.

**Figure 27** on the following page identifies the 100-year floodplains within Polk County. Areas of 100-year flood[16] were taken from the recently produced Digital Flood Insurance Rate Maps (D-FIRMs) which became effective in September 2011.

Figure 27 also shows the location of all likely taxable, principal structures located partially or wholly within the 100-year floodplains of Polk County using the methodology discussed in Appendix B. Principal structures are those buildings located on a parcel within which the main use of the parcel takes place. For most parcels, the principal structure will be a home or commercial business, as opposed to ancillary structures (e.g., garages, barns, sheds, boat houses). Data for individual structures is not currently available (e.g., number of stories, existence of basements, individual building value, building elevation), so we are unable to confirm if a specific building is elevated above (or below) the base flood elevation, nor can we estimate potential flood damage by individual structure.

[16] Also commonly known as "Zone A or AE" when referring to FEMA FIRM maps.

**Figure 27. Polk County Floodplains & Potential Floodplain Structures**

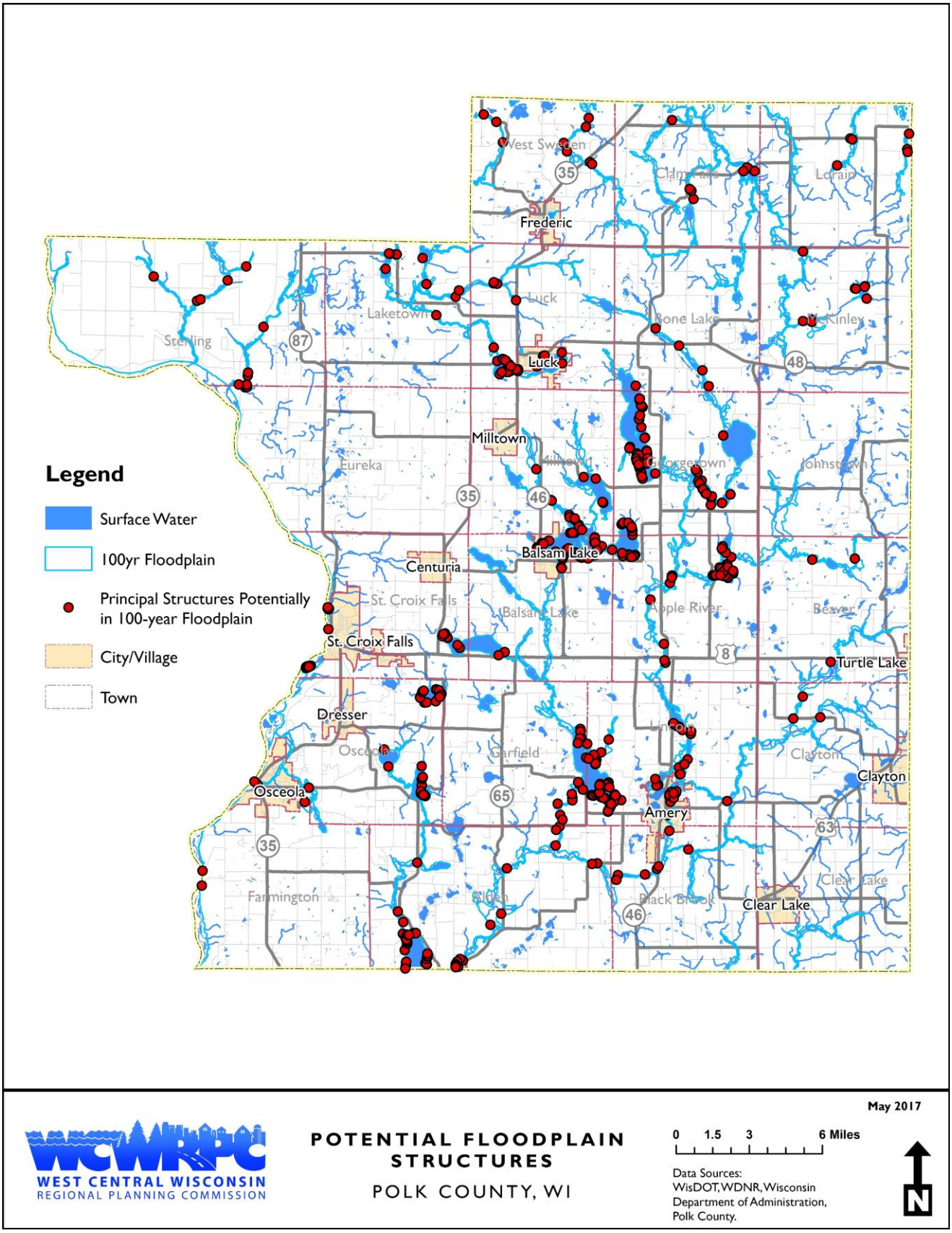


**Table 22** on the following page provides a synopsis of those potentially floodprone principal structures by municipality. The assessed use and estimated value of improvements is based on 2016 tax data for those parcels (not individual buildings) associated with each of the principal structures identified in Figure 27.

In total, 607 principal structures have been identified as potentially being located within the 100-year floodplain in Polk County. Of these, over 98 percent are likely residential in nature; only eleven commercial and one other structures were identified. No industrial/manufacturing structures were identified as being potentially located in a 100-year floodplain. The total estimated assessed value of improvements for those parcels with a principal structure likely within the floodplain is $74.8 million.

Almost 90% of these principal structures potentially located in a 100-year floodplain were located in an unincorporated town. Further, over 56 percent of these structures were concentrated in four towns—Town of Lincoln (117), Town of Georgetown (98), Town of Alden (65), and Town of Apple River (62). The Town of Georgetown was highest in terms of assessed improvements on these "floodplain parcels" at over $16.8 million.

It must be noted that **the structures identified on Figure 27 and in Table 22 may not have had flooding problems in the past**. To the contrary, the majority of these properties have no history of flooding and may not be vulnerable to flooding in the future. In some cases, due to topography at the building site or construction methods, the structure may actually be elevated higher than the adjacent 100-year floodplain.

Further, as discussed in Appendix B, for properties with multiple buildings and ancillary structures, the exact use and nature of each structure within the floodplain is not known and tax assessment data is only available at the parcel level, not for specific structures. And in some cases, an ancillary structure (e.g., barn, shed, boathouse) is located in the floodplain but is not reflected in Figure 27 or Table 22 since the principal structure on that parcel was located outside the delineated floodplain. In short, this analysis should only be used as a general guide and not for site-specific, flood-related decision-making.

The map also shows the lack of development in the floodplain of the St. Croix River, the County's biggest river. Much of the 100-year floodplain along the St. Croix within Polk County is State and Federally owned and managed for recreation. Further, the St. Croix River has Federal Wild and Scenic River status which significantly regulates development and encroachment along the river. Some annual snow melt flooding on the river is not uncommon, through the actual vulnerability to structures and improvements is very low.

**Table 22. Principal Structures potentially in 100-Year Floodplain**

| MUNICIPALITY | # PCLS W/PRINC STRUCTURES | RESI-DENTIAL USE | RESID. IMP VALUE | COMM-ERICAL USE | COMM. IMP VALUE | OTHER USE | OTHER IMP VALUE | TOTAL ASSESSED IMP |
|---|---|---|---|---|---|---|---|---|
| ALDEN | 65 | 65 | $10,266,500 | 0 | $0 | 0 | $0 | $10,266,500 |
| APPLE RIVER | 62 | 61 | $5,663,800 | 1 | $173,000 | 0 | $0 | $5,836,800 |
| BALSAM LAKE | 16 | 16 | $2,006,900 | 0 | $0 | 0 | $0 | $2,006,900 |
| BEAVER | 1 | 1 | $55,000 | 0 | $0 | 0 | $0 | $55,000 |
| BLACK BROOK | 5 | 5 | $446,300 | 0 | $0 | 0 | $0 | $446,300 |
| BONE LAKE | 3 | 3 | $552,500 | 0 | $0 | 0 | $0 | $552,500 |
| CLAM FALLS | 7 | 7 | $610,500 | 0 | $0 | 0 | $0 | $610,500 |
| CLAYTON | 3 | 3 | $264,700 | 0 | $0 | 0 | $0 | $264,700 |
| CLEAR LAKE | 0 | 0 | $0 | 0 | $0 | 0 | $0 | $0 |
| EUREKA | 3 | 3 | $250,100 | 0 | $0 | 0 | $0 | $250,100 |
| FARMINGTON | 1 | 1 | $36,300 | 0 | $0 | 0 | $0 | $36,300 |
| GARFIELD | 17 | 17 | $2,999,000 | 0 | $0 | 0 | $0 | $2,999,000 |
| GEORGETOWN | 98 | 98 | $16,861,500 | 0 | $0 | 0 | $0 | $16,861,500 |
| JOHNSTOWN | 0 | 0 | $0 | 0 | $0 | 0 | $0 | $0 |
| LAKETOWN | 11 | 10 | $689,600 | 1 | $11,700 | 0 | $0 | $701,300 |
| LINCOLN | 117 | 114 | $10,798,200 | 3 | $219,100 | 0 | $0 | $11,017,300 |
| LORAIN | 5 | 5 | $389,700 | 0 | $0 | 0 | $0 | $389,700 |
| LUCK | 35 | 35 | $2,478,200 | 0 | $0 | 0 | $0 | $2,478,200 |
| MCKINLEY | 8 | 8 | $658,000 | 0 | $0 | 0 | $0 | $658,000 |
| MILLTOWN | 23 | 22 | $3,661,600 | 0 | $0 | 1 | $170,000 | $3,831,600 |
| OSCEOLA | 36 | 35 | $4,189,200 | 1 | $244,800 | 0 | $0 | $4,434,000 |
| ST CROIX FALLS | 7 | 7 | $765,500 | 0 | $0 | 0 | $0 | $765,500 |
| STERLING* | 7 | 7 | $493,000 | 0 | $0 | 0 | $0 | $493,000 |
| WEST SWEDEN | 9 | 9 | $819,200 | 0 | $0 | 0 | $0 | $819,200 |
| V-BALSAM LAKE | 34 | 32 | $4,171,700 | 2 | $573,900 | 0 | $0 | $4,745,600 |
| V-CENTURIA | 0 | 0 | $0 | 0 | $0 | 0 | $0 | $0 |
| V-CLAYTON | 0 | 0 | $0 | 0 | $0 | 0 | $0 | $0 |
| V-CLEAR LAKE | 0 | 0 | $0 | 0 | $0 | 0 | $0 | $0 |
| V-DRESSER | 0 | 0 | $0 | 0 | $0 | 0 | $0 | $0 |
| V-FREDERIC | 1 | 0 | $0 | 1 | $12,500 | 0 | $0 | $12,500 |
| V-LUCK | 10 | 9 | $1,219,500 | 1 | $91,000 | 0 | $0 | $1,310,500 |
| V-MILLTOWN | 0 | 0 | $0 | 0 | $0 | 0 | $0 | $0 |
| V-OSCEOLA | 4 | 3 | $293,300 | 1 | $186,600 | 0 | $0 | $479,900 |
| V-TURTLE LAKE | 0 | 0 | $0 | 0 | $0 | 0 | $0 | $0 |
| C-AMERY | 12 | 12 | $1,074,500 | 0 | $0 | 0 | $0 | $1,074,500 |
| C-ST CROIX FALLS | 7 | 7 | $1,439,100 | 0 | $0 | 0 | $0 | $1,439,100 |
| **TOTAL** | **607** | **595** | **$73,153,400** | **11** | **$1,512,600** | **1** | **$170,000** | **$74,836,000** |

A number of additional tax-exempt properties were identified during this flood analysis with structures located near or potentially within the 100-year floodplain. These include:

- Various structures with uses not identified: Town of Apple River (1), Town of Lorain (2), and Town of Sterling (1)
- Park and recreational structures, including at camps: Town of Garfield (multiple at Garfield Town Park), Town of Lincoln (multiple on a private property), Town of Osceola (multiple at Lotus Lake County Park), Town of St. Croix Falls (multiple at Intestate Park), City of St. Croix Falls (multiple at Lions Park)
- Village of Luck: School district building.
- City of St. Croix Falls: Hydroelectric Plant and St. Croix National Scenic Riverway buildings.

## HAZUS Analysis of Flood Vulnerabilities

HAZUS is a natural hazard loss estimation software package which is used in conjunction with geographic information system (GIS) software to simulate potential losses due to flooding, earthquakes, and hurricanes. HAZUS is distributed free-of-charge through FEMA and is becoming the national standard for disaster modeling for these events.

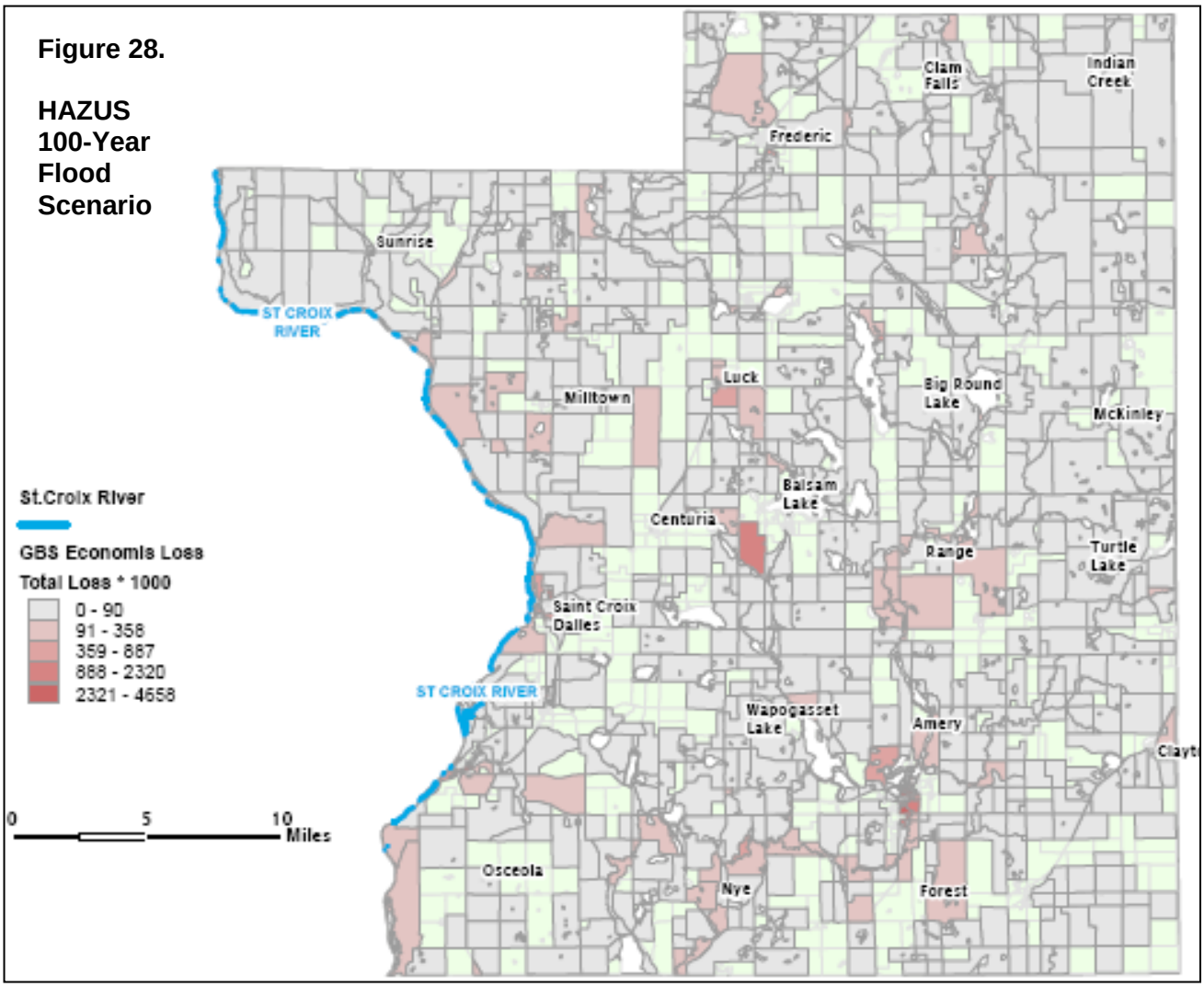
In 2008, Wisconsin Emergency Management prepared flooding analysis reports for each county in the State using the latest HAZUS software (HAZUS-MH) for a 100-year flood scenario. Based on this analysis, the scenario showed that Polk County flood damage would quite scattered. Some concentrations of areas of higher risk are found along the Apple and St. Croix Rivers as shown in **Figure 28** below. Twenty-three census blocks, in particular, would experience losses exceeding $1 million. An estimated 154 buildings (150 residential and 4 commercial) would be damaged for total building losses of $39.3 million and total economic losses of $91.3 million. No industry, critical facilities, or other structures were damaged under the HAZUS scenario, though 976 households would be displaced.

While the above scenario does attempt to consider flood depth and topography using the enhanced quick look (EQL) function, the analysis relies heavily on State and Federal data sources, such as census block information. Parcel data for Polk County was not used. The potential exists to supplement the HAZUS scenario with local data in the future, though this does require expertise and knowledge of the HAZUS-MH software package.

The comparison of the HAZUS scenario with the analysis in Figure 27 and Table 22 does show that the overbank flood vulnerability in Polk County is scattered, and both analyses note sizable risks along portions of the Apple River and within the Village of Balsam Lake. Both analyses also showed that the flood risk is primarily limited to residential structures and a handful of commercial structures.

**Figure 28.**

**HAZUS 100-Year Flood Scenario**




The size of the census blocks used in the HAZUS analysis, however, resulted in a higher estimated risk in certain areas compared to the previous analysis, such as along the St. Croix River and northwest of Frederic, which may be misleading. The other major difference is that the HAZUS analysis estimated much lower losses along many of the lakes, which does reflect that water levels along many of the lakes are fairly stable. However, Figure 27 and Table 22 are based on newer D-FIRM maps and do consider that the primary structures in these rural lakefront development areas tend to be concentrated nearer to the shorelines, while the HAZUS methodology assumes building inventories are dispersed evenly across census blocks.

## Projecting Future Flood Vulnerabilities

Three primary factors are key to projecting future flood vulnerabilities:

1) **Changes in Precipitation** - Section III.A.iv. previously discussed predicted climate changes for the region, including more precipitation during the winter months and more frequent heavy rainfall events. The projected 36 percent increase in 2" rainfall events per decade would likewise

increase flooding potential and may result in additional areas being considered 100-year floodplains in the future. However, with a projected increase in summer drought conditions, surface water levels would likely be lower overall. No detailed modeling on the full impacts of such climate changes on Polk County surface waters has been performed. As one local official stated during the planning process, "What used to be a 10-year storm is now annual."

2) **Changes in Flood Storage** – Overall, the floodplains and wetlands of Polk County are well protected. Encroachment of wetlands and new development often require the creation of new flood storage areas. Instead, the loss of flood storage will primarily be the accumulated loss or disruption of smaller stormwater storage areas, natural infiltration systems, and natural drainage systems. Every hardscape which is created (e.g., buildings, roads, parking lots), results in a change in potential stormwater or flood storage. This factor can be mitigated through stormwater management planning and mechanisms such as rain gardens, natural swales, rain barrels, pervious surfaces, and the creation and maintenance of flood storage areas.

3) **Floodplain Development** – While demand for shoreland living is high, new floodplain development is well regulated and rarely allowed. Public land ownership and restrictive easements along the St. Croix River further limit potential floodplain development in Polk County. Very little new floodplain development is occurring, so the number of structures in Table 22 should not significantly increase over time unless the physical extent of the 100-year floodplain grows. The overall vulnerability of floodplain development is expected to increase as the market value of these structures increases and some older, seasonal structures are renovated as year-round retirement homes.

In short, floodplain development vulnerabilities are projected to increase in the future not from new development within the floodplain, but rather from increasing precipitation (and runoff), the increasing market value of existing structures, and the improvement of existing structures. No significant floodplain development is currently planned. Instead, the increasing flood vulnerability in Polk County will likely be from overland stormwater flooding as a result of additional heavy rainfall events and changes in natural stormwater storage and drainage patterns as new development occurs.

## National Flood Insurance Program Claims and Repetitive Loss Properties

As of May 2017, there were a total of 65 National Flood Insurance Program (NFIP) flood insurance policies in Polk County with an average premium of $655. This is an increase from active policies in 2010. The majority of these NFIP policies (49) were for property in the unincorporated towns. Of the incorporated communities, the Village of Balsam Lake had the highest number of policies with seven, followed by the cities of Amery and St. Croix Falls with three each.

Since 1978, there have been 14 NFIP claims within Polk County with $323,542 in paid claims for damage and contents. Due to confidentiality, further information and locations for claims is very limited. Further investigation of their locations during the 2012 mitigation plan update yielded that the community names given in the NFIP records are not accurate in some cases—none of the claims were verified as being located within the Village of Luck or City of St. Croix

Falls. Nearly all of the claims are located within the unincorporated towns, with one additional claim in the Village of Osceola and one location unknown:

- Town of Osceola (5 locations on Sand Lake)
- Town of Laketown (3 locations on Little Mirror, Sand Lake, and Long Trade Lake)
- Town of Apple River (2 locations on Apple River and Balsam Lake)
- Town of Lincoln (1 location on Apple River Flowage)
- Town of St. Croix Falls (1 location)
- Village of Osceola (1 unverified location)

Based on available records, it does not appear that any property had more than one claim. Sand Lake in the Town of Osceola represented the only area with a concentration of claims, all of which were made in 1983-1985. Except for the Village of Osceola claim, no other NFIP claims have been made in Polk County since 2001.

No Repetitive Loss Properties (RLP) have been identified for Polk County. Repetitive Loss Properties are those properties participating in the National Flood Insurance Program that have filed two or more NFIP claims of $1,000 or more in a 10-year period.

### Critical Facilities in Floodplains

As the natural hazards vulnerability assessment in **Appendix F** discusses, critical facilities located in floodplains are primarily limited to infrastructure (e.g., roads, bridges, dams). Community interviews and G.I.S. analysis was used to identify critical facilities potentially at risk of flooding. G.I.S. point data is available for the following critical facilities: governmental, nursing homes, hospitals, schools, and hazardous materials facilities. Of these, only the Luck School was identified as being located (albeit partially) within a 100-year floodplain. No County buildings were identified as having flooding problems. The electric company in Frederic is located in a low area, but has not had flooding problems in recent memory according to Village officials. Stormwater wash-outs and damage to roads, culverts, and bridge abutments have been the most common flood-related problems in the past for unincorporated Polk County.

## *Risk and Vulnerability Assessment – Agricultural Flooding*

As will be discussed later in the drought assessment, agriculture is a big part of Polk County's landscape and economy. Though the focus of the flood assessment has been on principal structures and infrastructure, it is important to recognize the flooding risks to agriculture.

### Agricultural Flooding

Approximately 42 percent of reported damages from Wisconsin floods between 1993 and 2000 were from crop losses. Flooding can have additional agricultural impacts as well. Since many floodplains are used for forage, the loss of these crops (e.g. alfalfa) may require farmers to supplement feed for livestock. Due to the low value of forage and high insurance costs, most farmers do not have multi-peril crop insurance for forage crops. The remaining forage in flooded areas can be lower in quality, reducing milk production and complicating or reducing pregnancies and births. Feed and water quality problems which result in sick animals also

increase veterinary costs. Agricultural flooding impacts can also be long-term and more difficult to quantify. The harvesting of crops in wet areas can compact soils, further reducing crop yields for years to come.

Fewer than 1,000 acres of non-forest, cropped agricultural lands fall within the 100-year floodplains of Polk County. While crop damage due to flooding is occasionally experienced in some areas, statistics regarding crop losses in the past or future vulnerability due to flooding is not readily available. These potential losses can vary depending on the type of crops planted, though it is common practice to often use such floodprone areas for hay, forestry, or pasture. While prolonged flooded conditions are not common, periods of excessive soil wetness can delay spring planting and indirectly hinder yields by shortening the growing season.

Standing water following heavy rains or prolonged wet periods is a more significant problem for croplands which is not limited to floodplains. Denitrification and oxygen depletion of crops can severely reduce yields or result in plant death after prolonged water logging.

An additional agricultural flood-related threat is associated with non-point pollution, such as manure, nutrient, and pesticide run-off. Heavy rains, flooding, and unexpected snow melt can result in heavy run-off into surface waters, resulting in high levels of nutrient loading and contaminants. Heavy rains and ice damming can also result in the failure of improperly maintained or sited manure storage facilities. Some small fish kills due to run-off have occurred in Polk County in the past. And such non-point pollution can create health concerns for swimming and fishing, thus impacting tourism. Issues related to animal waste and nutrient management are primarily monitored and addressed by local farmers and the Polk County Land and Water Resources Department with partnership support of the Polk County UW-Extension Office and other State and Federal agencies (e.g., DATCP, WDNR, NRCS). However, it is very important to note that many sources of non-point pollution are not agricultural related, such as urban stormwater, road and parking lot run-off, and soil erosion from new development.

In addition, about 5,800 acres of forest lands and 5,100 acres of forested wetlands are located in floodplains, though past impacts of flooding on forest lands in Polk County are believed to have been minimal. Compared to other agricultural croplands, forested areas are typically less impacted by and more resilient to flooding. The potential flood impacts to these forest lands are considered minimal, overall, though river or lake flooding can cause some trees to topple, especially in areas of steep slopes or within the floodway. New plantings, if covered by floodwaters for an extended time, would be most vulnerable.

Overall, riverine or lake flooding of agricultural and forest lands is largely addressed by the individual landowner with a relatively low vulnerability. Local farmers are very aware of the flood risks and vulnerabilities on their lands and, if needed, most obtain crop insurance to mitigate the impacts of flooding on their farm businesses. In fact, the 2008 Farm Bill now requires insurance in order to be eligible for disaster assistance. **Riverine and spring snow-melt flooding of some croplands is an annual event in some locations, and this is anticipated to continue in the future. And an occasional manure storage facility failure can be**

**expected.** But with nutrient management practices and care in application, the natural hazard threats to water quality from agricultural practices can be mitigated.

Agricultural flooding does not require additional mitigation action by Polk County or its municipalities within the scope of this plan at this time. County officials note that prevention is the best way to avoid additional scrutiny and rules which can pose additional hardships to the farmer. Emptying storage facilities on schedule, avoiding spreading prior to rain or heavy snow melt, planting fall cover crops, and following a nutrient management plan are all important steps to preventing manure spills and runoff.

## *Unique Jurisdictional Risks or Vulnerabilities—Flooding*

The number and value of structures potentially within the high-hazard floodplains areas of each incorporated community was previously discussed (see Figure 27 and Table 22). This sub-section summarizes the specific flooding issues and areas of concern unique to each of the cities and villages in the County as further summarized in the table and maps in **Appendix G**. For most of these communities, overland stormwater flooding has been of more significant concern in recent years rather than overbank flooding. In fact, many Polk County villages do not have a designated 100-year floodplain within their municipal limits.

The effective date of the current Flood Insurance Rate Maps (FIRMs) for NFIP-mapped communities in Polk County is September 16, 2011. As of 9/16/11, all applicable cities and villages have adopted the revised NFIP maps and are fully participating in the NFIP program, except for the Village of Clear Lake which was mapped for the first time in 2011. The NFIP status and effective map dates of each community's initial Flood Hazard Boundary Map (FHBM) and initial FIRM are also noted. The Villages of Centuria, Clayton, Dresser, and Milltown have no 100-year floodplain.

**Village of Balsam Lake** *(NFIP participant; FHBM 5/3/74; initial FIRM 7/1/88)*
The Village of Balsam has significant 100-year floodplain and lakefront development, and has more principal structures potentially located in the floodplain compared to other cities and villages in the County. However, river and lake levels fluctuate little within the Village; and no history of overbank flooding or related damage was identified by Village officials. Stormwater improvements have been completed in the business park and Park Point Drive areas since the previous plan. No significant stormwater flooding issues or vulnerabilities were identified.

**Village of Centuria** *(NFIP not applicable)*
The Village of Centuria has no 100-year floodplain. There are no significant issues, and past problem areas have been largely addressed.

**Village of Clayton** *(NFIP not applicable)*
The Village of Clayton has no 100-year floodplain, and no known stormwater flooding damage to structures has occurred in recent years. Stormwater has infiltrated the sewer system on the north side in the past, but most of these problems have been resolved since the previous plan. A

ditch on private land east of 10th Street needs clearing, but flood damage to date has been limited to adjacent farm fields.

**Village of Clear Lake** *(NFIP being considered locally; FHBM none; initial FIRM 9/16/11)*
The Village of Clear Lake has a very minimal amount of 100-year floodplain in the far northern portion of the Village, with no development or identified vulnerabilities in the immediate area. This area was mapped for the first time in 2011. Stormwater drains from the north through the Village, but there is typically minimal standing water with no major damage in recent years. Past problems with stormwater infiltration into wastewater system through manholes and, potentially, basements and sump pumps continues to be a concern.

**Village of Dresser** *(NFIP not applicable)*
The Village of Dresser has no 100-year floodplain. Stormwater drains through the community from the hills to the north and east and exits the community on its west side into fields and through ditches. Areas of the community have no stormwater systems, though significant improvements have been made since 2005, including a past area near the school and child care center could. Stormwater improvements are needed in the Peterson Drive neighborhood on the south side of the Village; many homeowners use sump pumps in this area. Significant basement flooding has occurred in one home and options are being considered. These problems could escalate if additional growth occurs on the southwest side. See the hazard map in Appendix G for additional discussion and locations.

**Village of Frederic** *(NFIP participant; FHBM 5/31/74; initial FIRM 9/1/86)*
According to Village officials, Frederic's 100-year floodplain areas have no history of flooding concerns or structures at risk. Two areas of stormwater flooding concern were identified. Portions of the industrial park flooded three to four times in 2010, with water up to a foot deep on Industrial Way, but this has not been a concern since. A second significant stormwater flooding concern is behind the library located downtown, which has increased as a concern since the 2012 plan and has damaged vehicles. See the hazard map in Appendix G for additional discussion on these areas and additional stormwater flooding concerns.

**Village of Luck** *(NFIP participant; FHMB 5/24/74; initial FIRM 7/2/87)*
Though some structures are located within the 100-year floodplain, including a portion of the school, there has been no recent history of overbank flooding in the community. Topography along the lake minimizes the potential for lake flooding. Letters of Map Amendment (LOMAs) have been used to remove some buildings from the official 100-year floodplain maps. Silt build-up and beaver dams are ongoing maintenance concerns for some other floodplain concerns which could contribute to over-the-road flooding if not addressed, though the area on the northwest side of Luck has been "cleaned-out" and provides more storage. Stormwater run-off from the north has been causing some basement flooding. This run-off problem has been exacerbated by the re-designed Highway 48 and the new curb-and-gutter which has effectively created a dam with no outlet to the lake for overland flood waters. Some stormwater management activities are being addressed as part of a lake management grant project.

**Village of Milltown** *(NFIP not applicable)*
The Village of Milltown has no 100-year floodplain. Past problems with stormwater entering basements and backing-up wastewater systems to the south of Main Street to Bank Street appears to have been addressed through the installation of balltraps and other improvements. A significant problem has been stormwater flooding on Main Street, which has occurred 3-5 times in the past decade and has entered the first floor of multiple buildings. Flood waters have reached depths of 6-8 inches and have caused damage in the first floor of one structure which is not elevated above these flood depths.

**Village of Osceola** *(NFIP participant; FHMB 5/24/74; initial FIRM 1/5/84)*
As noted previously, no significant structural damage occurred as a result of the 2002 record-setting flood on the St. Croix River; and there is very little floodplain development within the Village.

The failure of the Upper Osceola Dam in September 2002 was the most significant flood event in the Village in recent history. The dam failure caused significant damage downstream to a mobile home park, community park, highway bridge, and Cascade Falls, along with contributing to significant silt loading to endangered mussel habitat on the St. Croix River. This failed dam was later removed, flood mitigation funding was obtained for the buy-out of at-risk mobile homes, and improvements have been completed at the Highway 35 bridge. To date, the complete removal of the dam appears to have largely addressed the past problems of flooding on Osceola Creek.

Today, stormwater flooding is the more significant concern for the Village of Osceola and a stormwater system study is underway. Stormwater draining towards the St. Croix River has contributed to road washout concerns on Ridge Road and on 2nd Avenue, which are located along steep slopes, with some recent repairs being made along Ridge Road. Third Avenue south of the railroad tracks has experienced over-the-road flooding every 2-4 years due to spring ice damming, but no significant related damages have occurred to date. See the hazard map in Appendix G for additional discussion on these areas and additional stormwater flooding concerns.

**Village of Turtle Lake** *(NFIP not applicable)*
The Village of Turtle Lake has no 100-year floodplain. The Village of Turtle Lake was not part of the scope of this planning effort. The Village is largely located in Barron County and is covered under Barron County hazard mitigation planning initiatives.

**City of Amery** *(NFIP participant; FHMB 12/28/73; initial FIRM 9/18/91)*
Amery has significant 100-year floodplain, though the Amery Dam is managed for flood control. During the 2001 flooding, which was the last major event on the Apple River, the river within

the City of Amery did not leave its banks, with the possible exception of some flooding along Riverside Boulevard.

The only significant flooding concern in the community is along an urban creek and drainage system which flows through the middle of the City. The culvert under Highway 46 for this creek constricts flow and has caused some localized flooding. Prior to 2015, there had been no significant damages related to this concern. In July 2015, severe flooding along this drainageway damages culvert and street infrastructure, along with two nearby commercial businesses.

**City of St. Croix Falls** *(NFIP participant; FHMB 5/24/74; initial FIRM 5/1/87)*
Like Osceola, the historic flood on the St. Croix River in 2002 demonstrated that the risk of riverine flooding along the St. Croix is relatively low. The municipal piers/docks were damaged in 2013 flooding. The City's wastewater treatment facility has come close to being flooding and can become an "island" during times of flood with access limited. Ice damming has been a more significant river flooding concern about once a decade, but no serious structure damage has been reported in recent memory.

Like many communities, stormwater flooding has been a bigger problem in St. Croix Falls, with the steep hillsides a contributing factor. Substantial progress has been made in system improvements in recent years and one home prone to flood damage was acquired using mitigation grant funds. The north side of the City along State Highway 87 has had a history of flooding problems and may require additional improvements and mitigation in the future. Continued stormwater planning and management is needed for commercial development and increasing hardscape within the growth area along U.S. Highway 8 on the east side of the City.

## *Polk County Dams—Vulnerability to Dam Failure*

As of January 2017, Polk County had 44 existing dam and 55 planned/unbuilt dams in the WDNR dam database summarized in **Appendix J**. Most dams in Polk County are small earthen works for livestock or recreational ponds. In nearly all cases, if these smaller dams failed, the runoff and impacts downstream would hardly be noticed. Of the existing dams in Polk County, 26 are classified as small and all of the planned/unbuilt dams are small.

The dams of Polk County are shown in **Figure 29**, along with their Wisconsin Department of Natural Resources hazard ratings.[17] Hazard ratings are assigned by the Wisconsin Department of Natural Resources based on the potential for loss of life or property damage should the dam fail.

The dam hazard ratings are defined by FEMA as follows:

**Low Hazard** Dams assigned the low-hazard potential classification are those where failure or mis-operation result in no probable loss of human life and low economic and/or environmental losses. Losses are principally limited to the owner's property. Large low-hazard dams are inspected every ten years by the Wisconsin DNR Dam Safety Engineer, and the spillway must be sized to accommodate a 100-year event.

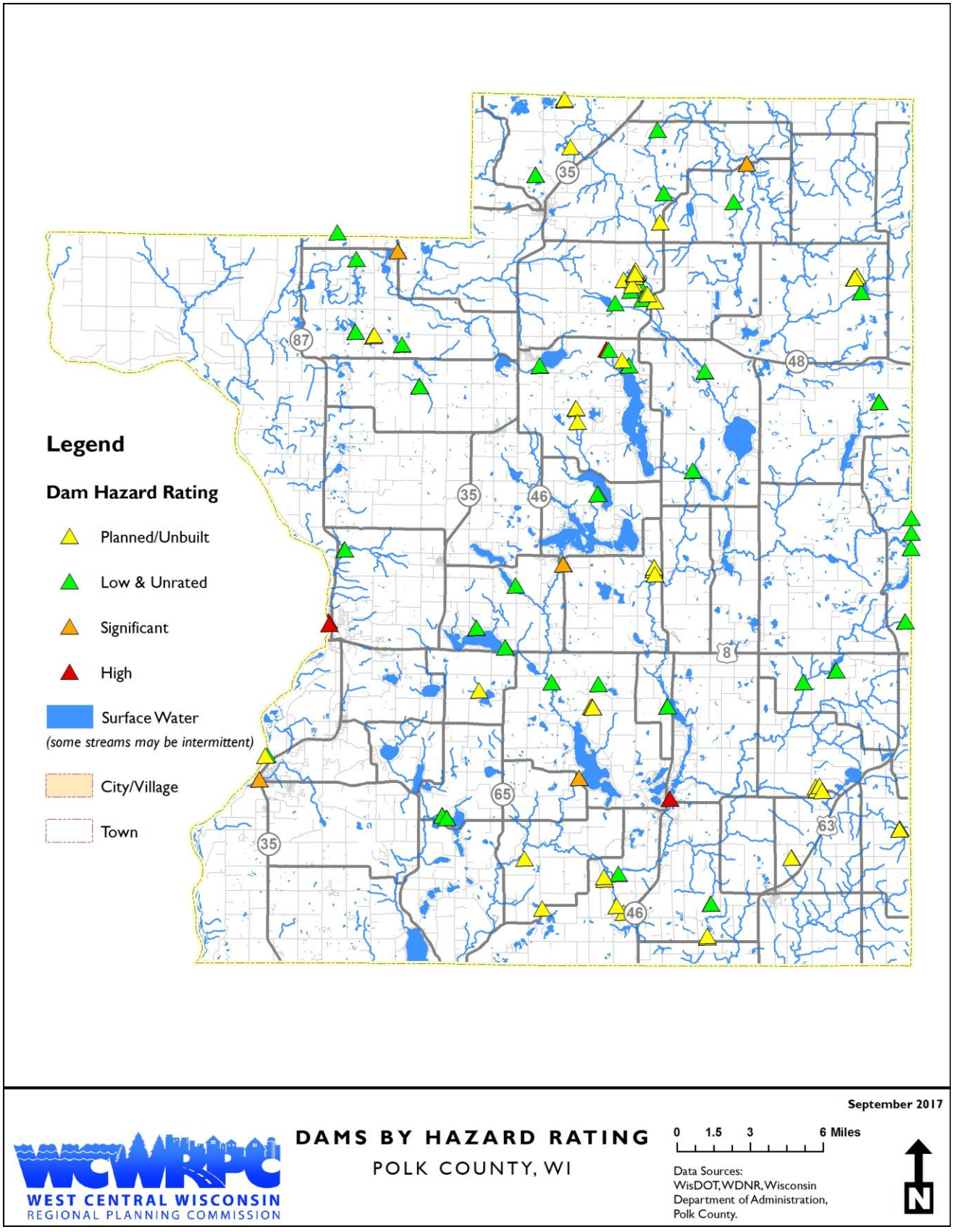
**Significant Hazard** Dams assigned the significant-hazard potential classification are those dams where failure or mis-operation results in no probable loss of human life but can cause economic loss, environmental damage, disruption of lifeline facilities, or can impact other concerns. Significant-hazard dams are often located in predominantly rural or agricultural areas but could be located in areas with population and significant infrastructure. Large significant-hazard dams must be inspected every five years ($5^{th}$ year private engineer; $10^{th}$ year WDNR Dam Safety Engineer), and the spillway must be sized to accommodate a 500-year event.

**High Hazard** Dams assigned the high-hazard potential classification are those where failure or mis-operation will probably cause loss of human life. Large, high-hazard dams must be inspected every two years ($2^{nd}$, $4^{th}$, $6^{th}$, $8^{th}$ years private engineer; $10^{th}$ year WDNR Dam Safety Engineer), and the spillway must be sized to accommodate a 1,000-year event.

All large dams on navigable waters are required to have a dam failure analysis which shows the hydraulic shadow and structures subject to potential flooding should a failure occur. The geographic scope of this analysis should extend downstream until the dam failure shadow converges with the 100-year floodplain. These analyses are used to determine the hazard rating. Floodplain zoning controls can then be put into place for the dam shadow. For dams without an analysis, an estimated hazard rating is given by the WDNR Dam Safety Engineer based on development and zoning controls downstream of the dam.

[17] Two existing small dams and five planned dams did not have locations in the WDNR G.I.S. database.

**Figure 29. Polk County Dams (existing and planned) by Hazard Rating**



As identified in Appendix J, Polk County has eighteen large dams. Twelve of these large dams are rated low-hazard due to lack of vulnerabilities downstream. Three of the large dams have a high-hazard rating and three have a significant-hazard rating. Two small dams—Lower Osceola and Sucker/Wapogasset Lake—also have significant-hazard rating.

**High Hazard Dams (4)**

Only three dams in Polk County have been given HIGH-hazard ratings:

1) ***St. Croix Falls Dam*** *(owned by Xcel Energy)*
   In terms of maximum storage feet, this is the second largest dam in Polk County; and it is the largest in term of structure size and height. It is actively used for power generation and is in good repair. If a sudden dam failure should occur, there would be potential bridge damage on Highway 8 at St. Croix Falls and Highway 243 at Osceola, which would significantly impact travel. However, development within the dam shadow has been limited due to scenic easements, public lands, floodplain zoning, and topography along the St. Croix River. No concerns regarding this dam were noted. An emergency plan for this dam is maintained by Xcel Energy and is on file in the Sheriff's Department and the Polk County Emergency Management Office. Xcel Energy is currently updating its Emergency Action Plans for its hydro projects, with anticipated completion by the end of 2017. Exercises (table-top and functional) for Xcel's dams are ongoing and rotated between its hydro projects annually.

2) ***Amery Dam*** *(owned by City of Amery and Town of Lincoln)*
   This dam is managed, in part, for flood control. Significant repairs were made to this dam in 1993 and all new stop logs were installed on the west side in 2016. No concerns regarding this dam were noted.

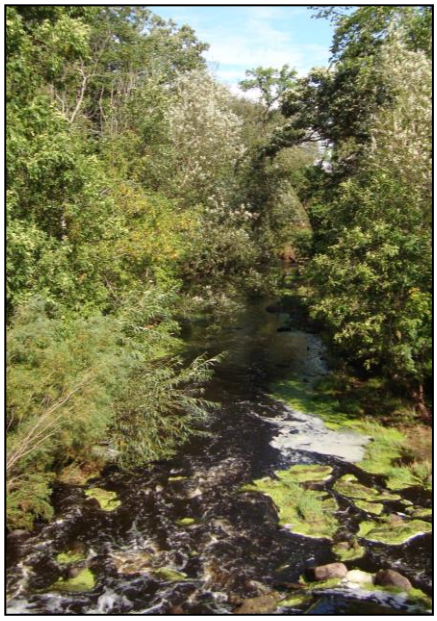
3) ***Straight River Flowage/Schilling/Whalen Log Dam*** *(owned by Town of Bone Lake)*
   No specific concerns regarding this dam were noted. While this dam is officially rated as a high hazard dam, its estimated rating is "low." With action, such as dam shadow zoning, it may be possible to reduce its official rating.

Since the 2012 mitigation plan, Godfrey Dam in the Town of Clam Falls and the privately owned Big Rock Creek Farm Dam were reclassified from high hazard to low hazard when dam shadow zoning was adopted.

**Significant Hazard Dams (4)**

Five additional dams were given SIGNIFICANT-hazard ratings by the WDNR:

1) ***Atlas Feed Mill/Long Trade Lake Dam*** *(owned by Polk County)*
   This dam was reconstructed in 1994. An emergency operating plan was recently updated by the County. There is limited development within the dam shadow, including 1-2 homes and a county highway bridge which is in need of reconstruction or replacement according to the County Highway Department.



**downstream of**
**Atlas Feed Mill Dam**

2) ***Lower Osceola Dam*** *(owned by Village of Osceola)*
This dam is part of the State Highway 35 structure within the Village of Osceola on Osceola Creek. The structure was recently re-built as part of highway improvements. No concerns regarding this dam were noted.

3) ***Sucker Lake/Wapogasset Dam*** *(owned by Wapogasset Lake Association)*
No concerns regarding this dam were noted.

4) ***Lower Balsam Lake Dam*** *(owned by Village of Balsam Lake)*
The hazard rating of this dam was reduced from "high" to "significant" in 2010, following adoption of appropriate floodplain zoning within the hydraulic shadow by the County. No concerns regarding this dam were noted.

5) ***Clam Falls Dam*** *(owned by Northwestern Wisconsin Electric Company)*
This dam has been leased by Northwestern Electric for hydro-electric power generation. The 2006 hazard mitigation plan noted that the Clam Falls Dam is being topped with significant rainfalls of 1.5 inches or more within a short time. This concern with the dam being topped several times over the past decade was again noted during this plan update. The dam structure is built into a highway which results in dangerous conditions and road closures when topped. The 2006 plan states that the dam owner was intending to install steel slide gates to allow easier and safer control of water levels, but no actions or improvements at this dam have been noted in the interim. A failure analysis for the dam has been approved by WDNR. According to WDNR in late 2016, the dam owners have five years to address undersized spillways.


**Clam Falls Dam and adjacent highway**

**<u>Dam Removals (3)</u>**

There have been three fairly recent dam removals, two of which addressed significant concerns identified in the 2006 hazard mitigation plan. In 2006, the **Upper Balsam Lake Dam** owned by Northwestern Wisconsin Electric Company was abandoned. Also in 2006, the abandonment of the privately owned **Upper Osceola Dam** was completed. More recently, Polk County acquired the **Ridler/Woodley Dam** on the Apple River which was removed in 2009 and was a priority concern in the 2006 plan.

**Woodley Dam was removed in 2009**

**Other Dam Concerns or Notes**

1) ***Black Brook Dam*** *(owned by North American Hydro)*
   This is an electric power-producing dam located in the Town of Black Brook. An emergency plan for this dam is maintained by the owner which includes bridge-closing procedures in case of a dam failure. The potentially impacted bridges are all located downstream in the Town of Alden. Copies of the plan are on file with the Sheriff's Department, the Polk County Emergency Management Office, Highway Department, Amery area emergency responders, Amery School District, and the Town of Alden. No action on this dam is currently needed, though it is important to keep the emergency plan updated.

The previous discussion of the April 2001 flood event described the most recent, significant dam failure in Polk County at the County-owned D.D. Kennedy Dam. This is a low-hazard dam, so the damages were largely limited to the washout of a town road downstream and the dam structure itself.

It was also noted during the planning effort that some improvements on the small Blake Lake Dam are planned due to April 2014 flooding damage to a walking bridge. The Town of Bone Lake suggested the grant funding could be pursued for the installation of a dam on the Straight River if additional flood control is needed.

As documented previously, development and population growth in Polk County have been generally highest in those towns with significant surface waters. There continues to be development pressure along the shorelines of the County, including above and below dams. Overall, **the potential of dam failure in Polk County is considered quite low**, though the potential for damage and injury is high should failure of a larger dam occur. Polk County and its municipalities continue to work with the Wisconsin Department of Natural Resources to ensure proper maintenance of the dam facilities in the County and mitigate the potential vulnerabilities should failure occur.

## v. Drought

### *Summary—Drought*

*Risk – Drought-related risks and vulnerabilities for Polk County are generally three-fold: (1) impacts to agricultural crops and livestock, (2) impacts to surface and ground water quality and quantity; and (3) increased wildfire risks. While Polk County experienced a series of drought years between 2003 and 2009, serious droughts have been experienced about once every four to five years on average. The most devastating regional droughts last occurred in 1976/1977 and 1988/1989. Some climate change projections have agricultural droughts, especially during the summer months, increasing in frequency.*

*Vulnerabilities – Agricultural crops have the highest vulnerability to drought in Polk County. Almost 50 percent of the County's assessed land base is in agricultural use, and the market value of crops produced in 2012 (which was a drought year) exceeded $67.6 million. During the 2003 drought, it is estimated that the County lost in the neighborhood of $5.77 million in grain corn and soybean value alone. During the 1976/1977 and 198/89 droughts, some private wells dried up and needed to be replaced. And more recently, water levels on many lakes and ponds have been significantly lower (until they rebounded in Summer 2010), with a range of habitat, recreational, shoreland erosion, water quality, and property value implications. Wildfire risks and vulnerabilities also increase during drought periods, which are discussed further in the wildfire section.*

1. Most agricultural producers have adequate crop insurance to cover drought-related losses, though some do take chances. Crop insurance is prohibitive for many, if not most, smaller specialty crop operations, CSAs, and direct-market farms.
2. Good soil health practices can help mitigate drought impacts by allowing precipitation to infiltrate, thereby making cropland soils more resilient, while replenishing groundwater supplies.
3. Overall, groundwater quantity and quality have been good, but demands for groundwater have been increasing for new development, industrial use, irrigation, etc. In all, there are 95 permitted high-capacity wells in Polk County, of which 27 were for agricultural irrigation; these numbers are relatively low. From 1979 to 2005, it is estimated that water use in Polk County more than doubled from 5.4 million to 10.9 million gallons per day. One town expressed concern with the impacts of high capacity wells on nearby residential wells during times of drought.
4. Surface water concerns related to drought include lower water levels on many seepage lakes and streams in the County, reduced water quality, and changing water temperature impacts on trout and other wildlife. Fish kills at Long Trade Lake (Atlas Mill Dam) were a very real concern in Summer 2008 and 2009.

## *Risk Assessment--Drought*

### The Hazard

A drought is an extended period of unusually dry weather which may be accompanied by extreme heat (temperatures which are ten or more degrees above the normal high temperature for the period). Drought conditions may vary from below normal precipitation for a few weeks to a severe lack of normal precipitation for multiple months.

There are two basic types of drought in Wisconsin—agricultural and hydraulic. Agricultural drought is a dry period of sufficient length and intensity that markedly reduces crop yields. Hydraulic drought is a dry period of sufficient length and intensity to affect lake and stream levels and the height of the groundwater table. These two types of drought may, but do not necessarily, occur at the same time. Soil types greatly influence agricultural drought risk. Some sandier, well-drained soils experience drought-like effects almost annually, and can experience the lowest yields when a true drought is declared.

### Regional and Local Trends

Drought is a relatively common phenomenon in Wisconsin and has occurred statewide in 1895, 1910, 1939, 1948-1950, 1955-1959, 1976-77, 1987-1989, 2003, 2005, and 2006-2007. The drought of 1929-1934 (Dust Bowl Years) was probably the most significant in Wisconsin history, given its duration; some of areas of the State experienced drought effects until the early 1940s. A Presidential Emergency Declaration was issued for the statewide drought in 1976, during which agricultural losses in the State were estimated at about $2.6 billion in today's dollars and some private wells in Polk County dried up.

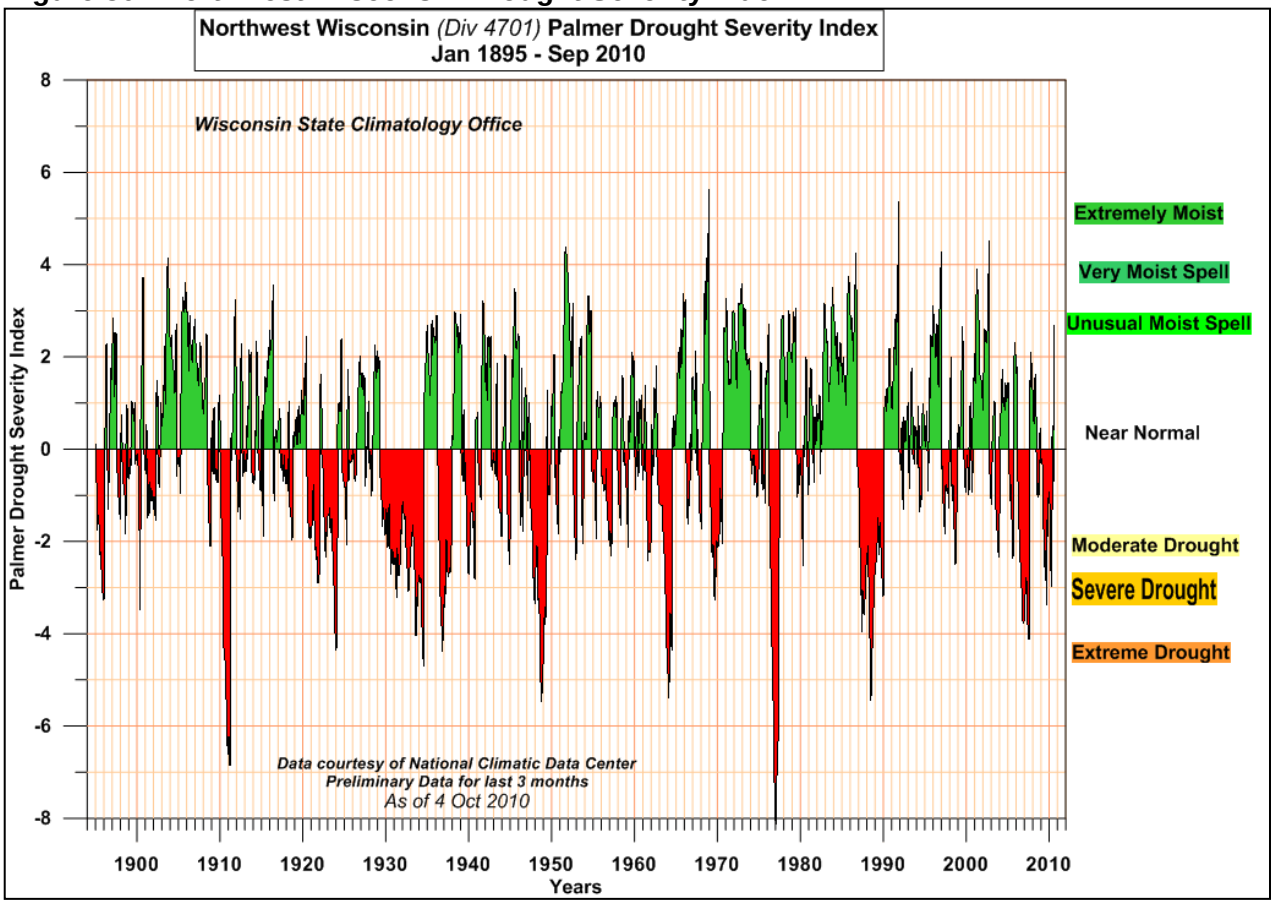
Point wells in certain areas of the County also dried up during the drought of 1987-1989, and agricultural losses in the State were estimated at approximately $2.7 billion in today's dollars. The 19870-1989 drought not only had below-normal precipitation, but also was characterized by persistent dry air and above-normal temperatures. Heatwaves killed an estimated 5,000 people nationwide and contributed to high livestock loss. An estimated 52% of Wisconsin's 81,000 farms had crop losses of 50% or more, with 14% of farmers suffering losses of 70% of more.

Until 2000, drought conditions were impacting corn and soybean yields to some degree in Polk County about once in every decade. However, beginning about 2003, northern Wisconsin experienced ongoing drought conditions as shown in **Figure 30**, with serious impacts to agricultural producers and hydraulic levels of surface and ground waters. As a result, the Governor issued State of Emergency drought declarations, which included Polk County, in 2003, 2005, 2006, 2007, and 2009.

Summer 2010 brought some significant relief from the region's drought conditions, as a new record for the average statewide summer rainfall was established (18.65 inches). In June through September 2010, northwest Wisconsin experienced total monthly rainfall amounts of about 2 inches or more above the mean in each of these four months. Though the rainfall provided relief for agricultural crops, water levels in many surface waters remained below average and monthly rainfall amounts were still below average for six of the months of the year.

A nearly statewide drought would again impact Polk County during the 2012 summer and fall seasons, resulting in reduced crop and alfalfa yields. As feed costs rose, some farmers were forced to sell-off some livestock. There were many reports of wells in Wisconsin running dry and some well depths had to be increased in order to find water. The drought was generated by a large, warm blocking high pressure in the upper levels of the atmosphere which was centered over the middle of the nation in May and June. Part of this high pressure expanded north into the western Great Lakes region in July, forcing storms to stay mostly north of Wisconsin as the summer progressed. The drought started across the southern third of counties in June and steadily expanded north during July and August. Eventually, the southern two-thirds of the state was in severe (D2) to extreme (D3) drought status. The drought continued into December due to a very dry November.

**Figure 30. Northwest Wisconsin Drought Severity Index**




2013 would be an another drought year for the region. The U.S. Secretary of Agriculture issued a USDA drought disaster declaration that included St. Croix County; as a contiguous county, Polk County farmers suffering losses were also able to obtain Federal emergency loans.

Additional information on these historic droughts can be found in Section 3.5.2 the *State of Wisconsin Homeland Security Council Threat & Hazard Identification and Risk Assessment (THIRA)* amended in January 2017.

As discussed in Section III.A.iv., research from the Wisconsin Initiative on Climate Change Impacts[18] (WICCI) shows that annual precipitation in Polk County has been increasing since 1950, though most of these increases have been occurring during the winter months. During the summer months, average precipitation levels have been decreasing over the northern half of the County. Concurrently, Polk County's average annual temperatures have increased 1.5ºF to 2.5ºF since 1950. WICCI has projected that Polk County's climate will continue to become much wetter overall, but drier during the summer months, with significantly higher temperatures.

## Relative Level of Risk

The future incidence of drought is highly unpredictable and may also be localized. Some sandier, well drained soils of the County may experience drought-like conditions on a nearly annual basis. Since 1970, there have been eleven years in which Polk County has experienced significant drought conditions, though six of these years have occurred since 2000. **If weather patterns return to longer-term trends, drought conditions can be expected to occur every four to five years on average (1 to 2 drought years per decade).** As the drought history showed, a single drought event can span multiple years. However, the frequency of drought events, especially agricultural drought, could be expected to increase under the projected scenarios provided by the Wisconsin Initiative on Climate Change Impacts.

# *Vulnerability Assessment—Drought*

The impacts of drought are varied and far-reaching. Droughts may cause a shortage of water for human and industrial consumption, hydroelectric power, recreation, and navigation. Water quality may decline, and the number and severity of wildfires may increase. As land is cleared by wildfire, loss of vegetation can result in flooding, even from average rainfall following drought conditions. Severe droughts may result in the loss of agricultural crops and forest products, undernourished wildlife and livestock, and lower land values.

## Snapshot of Polk County's Agricultural Economy

Drought can impact parts or all of Polk County's agricultural base, which is vital to the area's economy. Nearly half of all assessed lands in the County are agricultural. According to the latest U.S. Census of Agriculture, there were 1,313 farms in Polk County in 2012 that produced over $167 million in agricultural products with 1,121 hired and payrolled farm workers.

According to the 2012 Census of Agriculture, Polk County had approximately 159,940 acres in crop production, in addition to an estimated 283,778 turkeys, 42,815 head of cattle, 4,811 layers, and 2,481 sheep and lambs. In 2012, the County ranked very high among all Wisconsin counties in a number of agricultural statistics, including #4 in turkeys, #10 in sheep and lambs, and #6 in the value of sales by poultry and eggs.

In 2012, Polk County ranked 33$^{th}$ in the State of Wisconsin in the market value of agricultural products sold with over $167 million, which was an increased from a 37$^{th}$ ranking in 2007. Of

[18] Wisconsin Initiative on Climate Change Impacts website: www.wicci.wisc.edu

this value, about 41 percent was the value of crops, including nurseries and greenhouses, and about 59 percent was the value of livestock, poultry, and their products.

Other notable trends include:

- From 1997 to 2012, the County experienced a 14 percent reduction in total cropland acres (186,609 ac. in 1997 vs. 159,940 ac. in 2012).
- The number of farms in Polk County decreased from 1,659 farms in 2002 to 1,313 farms in 2012.
- The average farm size decreased by 18 acres from 2002 (213 ac.) to 2012 (195 ac.).
- Between 2002 and 2012, the number of farms that sell agricultural products to individuals for consumption (direct market farms) increased from 120 farms to 168 farms, respectively, and the total value sold increased to $894,000.
- The number of dairy farms has decreased 78 percent from 696 farms in 1987 to 154 farms in 2012. However, the market value of milk from cows is still very significant at over $63 million in 2012 and constituted about 38 percent of the County's total agricultural product sold.

## Drought Vulnerabilities and Potential Impacts on Agriculture

It is very unlikely that any single hazard would endanger all livestock or crops, though large proportions could be at-risk from a prolonged, severe drought or the introduction of a new a pest or disease. With milk production constituting a very large percentage of the total market value, yet being concentrated in an increasingly smaller number of farms, threats to this industry are particularly important.

Large-scale impacts to crops or livestock from a drought or other natural hazard can also have devastating impacts on the local economy, related industries (e.g., food processing), and related service providers. The state of the agricultural economy is tenuous for the local farmer, and a hazard event may result in farmers making fewer purchases or getting out of the business all together. Our local, small town economies are already going through significant transitions with the decreasing number of farms. Additional farm losses would further impact local businesses (e.g., implement dealers, feed stores, granaries, food processing, banks, general goods). To compensate for additional farm losses, the costs for such services may also be increased, or the local businesses may close, further burdening the remaining farmers in the area.

In general for Wisconsin, droughts have the greatest impact on agriculture. Even small droughts of limited duration can significantly reduce crop growth and yields, adversely affecting farm incomes and the local economy, while making crops more susceptible to pests and diseases. More substantial events can decimate cropland, result in a total loss, and put a farmer out of business. Droughts also greatly increase the risk of forest fires and wildfires because of extreme dryness. The loss of vegetation due to drought can result in flooding, even from an average rainfall. These impacts are often exacerbated by extreme heat and elevated temperatures.

The vulnerability to agricultural drought is high for Polk County. Crop yields can dramatically decrease; and livestock, especially those kept in close quarters, can experience decreased milk production or even death. Since the severity of drought can vary, determining its financial impacts on crop and livestock operations is difficult.

To gain insight into potential crop losses, the Polk County University of Wisconsin-Extension Office provided total crop cash receipts for the years of two droughts (1977 and 1989), and the receipts for each of the following non-drought years (1978 and 1990). These losses are summarized in **Table 23**. Using the 2016 inflation-adjusted numbers, we see a decrease in receipts of $5 to $7 million in drought years, representing a 50% to 75% drop.

**Table 23. Estimated Cash Crop Receipts Comparison**

| Cash Crop Receipts for Polk County Producers | 1977 | 1978 | difference | 1989 | 1990 | difference |
|---|---|---|---|---|---|---|
| | almost $2.4 mil. | almost $4 mil. | approx. $1.6 mil. | $4.8 mil. | $8.6 mil. | $3.8 mil. |
| *adjusted 2016* | $9.6 mil. | $15.0 mil. | $5.4 mil. | $9.4 mil. | $16.2 mil. | $6.8 mil. |

*Sources: Ryan Tichich. Polk County University of Wisconsin-Extension.*
*Adjusted 2016 estimates based on Consumer Price Index by U.S. Bureau of Labor Statistics*

More recently, the agricultural drought in 2003 resulted in the following losses according to the USDA-Farm Service Agency County Emergency Board:

| | |
|---|---|
| alfalfa | 32% yield reduction and estimated $3 million loss |
| other hay | 32% yield reduction and estimated $200,000 loss |
| soybeans | 46% yield reduction and estimated $1.67 million loss |
| corn | 26% yield reduction and estimated $4.1 million loss |

These losses are a significant financial hardship, especially for an industry that is struggling overall.

A quick look at Polk County's two biggest cash crops provides insight into the current extent of this vulnerability. In 2016, over 9.1 million bushels of grain corn and 1.77 million bushels of soybeans were produced in Polk County. In March 2017, U.S. grain corn prices averaged $3.49 per bushel and soybeans averaged $9.69 per bushel. If we apply these prices to 2016 production, there is over $48 million in value for these two crops along.

Typically, farmers will supplement feed before allowing a drop in milk production due to drought. Additional feed purchases could also vary based on drought severity and length, but $1,500 of additional feed per mature cow is not unrealistic ($1,500 x 42,500 head of cattle = $63.8 million) resulting in many millions in required supplemental feed for Polk County farmers under a typical, single-season drought event. Drought conditions can also result in the build-up of nitrates in feed and silage to levels that are toxic to cattle. In recent years, there has been a small number of cattle deaths in the region due to nitrate toxicity. Extreme heat and drought can also result in the build-up of toxic gases within grain silos to lethal levels or result in fires or explosions. Extreme heat within large confined livestock buildings can also be a concern.

***SOIL HEALTH***
***AS A DROUGHT MITIGATION TOOL***

*Soil health best management practices, such as cover crops and reduced tillage, can improve soil health and make cropland more resilient to drought. Good soil health allow precipitation to infiltrate, thereby increasing moisture in the soil and helping to recharge groundwater.*

*The conservation of Polk County's farmland soils is important to current and future generations of farmers. Soils that are physically and biologically healthy can produce higher crop yields with fewer external inputs, which is great for the pocketbook.*

*Healthy soils are also important to the quality of groundwater and surface waters. As precipitation infiltrates, it naturally filters the water. The soils and nutrients stay in place, rather than run-off. Healthy soils reduce erosion, flooding, and pollutant/nutrient loading to surface waters, while increasing the recharge of the groundwater.*

The far majority of local farmers undertake some management practices to reduce the vulnerabilities associated with drought conditions, but some knowingly take chances. Most farmers carry some type of crop insurance, especially in drought-prone areas. Most farmers also participate in Farm Service Agency programs which require multi-peril crop insurance and protect losses at average County yields. But such insurance is very expensive, and participation will often increase as the price received for the commodity increases. It is typically not cost-effective to insure low-value crops, such as alfalfa. And for many smaller specialty growers and community-supported agricultural operations, it is extremely cost-prohibitive to carry crop insurance.

## Other Potential Drought Vulnerabilities

Drought conditions can stress forest vegetation, making it more vulnerable to certain pests and diseases. And the potential for wildfires can increase. These risks and vulnerabilities are discussed within the next section which covers wildfires.

Drought conditions can also dry up private wells and ponds, as well as impact surface and ground water levels. Private wells dried up within Polk County in 1976 and 1988/1989. Under such circumstances, wells are often re-drilled at significant cost; or a farmer whose livestock relied on a pond in the past may have to install a well and pump to provide water for stock. County staff noted that water levels had decreased significantly on Long Trade Lake (Atlas Mill Dam) and some other seepage lakes during the drought years of the last decades, which increases the potential for sizable fish kills, but surface waters have rebounded since.

Agricultural irrigation has been increasing in the County due to recent drought events, which does have the potential to further impact groundwater levels in some areas. The sizable aquaculture industry has also increased agricultural groundwater demands. As of Spring 2017, the Wisconsin DNR reports that 95 high-capacity wells have been permitted for Polk County with withdrawals since 2010, of which 27 were used for agricultural irrigation. Regardless of the increased demand, ground quantity in the County is reported as being good overall.

Spring-fed or seepage lakes and ponds with no inlet or outlet have been especially vulnerable to long-term droughts and decreasing groundwater levels within the County. The result is a loss of habitat and recreational value, falling property values in shoreline areas, and potential shoreline encroachment.

Also, as surface waters decrease, shoreline areas are more vulnerable to erosion, water temperatures can change, and contaminants and nutrients (phosphorus) become concentrated that further contribute to toxicity, algal blooms, eutrophication, and fish kills. Some of the longer-term consequences of rising temperatures and drier summers were discussed previously in the section on the possible hazard impacts of climate change, such as the loss of cold-water trout streams and further loss of surface waters through increasing evaporation.

### Vulnerable Critical Facilities

No critical facilities or infrastructure are directly vulnerable to drought, with the exception of water supplies. Overall, private and community wells have excellent water quality and quantity to meet existing demand, though there are some private wells that have run dry during drought periods. Groundwater quantity in Polk County is good overall.

However, the demand for water is increasing substantially. Between 1979 and 2005, it is estimated that water use in Polk County have more than doubled from 5.4 million gallons per day to 10.9 million gallons per day.[19] In 2015, Polk County was ranked 36th highest of Wisconsin's 72 counties in terms of groundwater withdrawals. Residential growth, aquaculture, and public use were identified as some of the primary reasons for this increase. And when an extreme drought occurs (e.g., 1976, 1988) or if prolonged droughts continue to increase in frequency, it should be expected that some private wells may need replacing and water demands for irrigation would further increase. Even so, no municipalities reported drought-related concerns for infrastructure or critical facilities.

## *Unique Jurisdictional Risks or Vulnerabilities—Drought*

The *Unique Jurisdictional Risk or Vulnerabilities Table* in **Appendix G** notes that all participating cities and villages currently have good well capacity for fire protection, drinking water, etc., except for the City of St. Croix Falls, which may need additional storage capacity. Additional wells and water system improvements may be required in cities and villages as growth and new development occurs.

[19] USGS and UW-Stevens Point-Wisconsin Center for Land Use Education.

## vi. Wildfire

### *Summary—Wildfire*

*Risk – About 40% of Polk County's landscape is forested, though the predominance of hardwoods in the forested areas of the County and the fragmentation of forest lands helps to limit fire sizes. In many areas, grass fires can be of greater risk due to their ability to spread and to quickly change direction and intensity.*

*The last major forest fire in Polk County occurred in 1945 when 4,970 acres were burned in the Town of Sterling. Within the WDNR Intensive Fire Protection areas of the County, an average of ten to twelve wildfires occur each year, with a fire greater than 20 acres in size occurring about once every two to three years. However, this wildfire data is limited to about one-quarter of the County with Intensive Fire Protection; wildfire data is not centrally collected for the remaining portion of the County with Cooperative Fire Protection. The frequency of wildfire events will likely increase due to population growth, development in wildland-urban interface areas, and changes to seasonal housing in the most at-risk communities.*

*Vulnerabilities – Residents, homes, agricultural operations, and other structures within or adjacent to areas of vegetative fuels susceptible to wildfire are the most at risk. Parts or all of eight Polk County municipalities are located in a WDNR intensive fire protection area. Six additional municipalities have been rated as communities-at-risk largely due to the predominance of hazard fuels (e.g., pine, oak) and development within the wildland-urban interface. Together, these fourteen communities represent about 45% of the County's population and 38% of the total assessed value of improvements. Polk County has a relatively modest amount of County Forest land (abt. 17,166 acres), though an additional 75,000 acres or so is held privately in managed forest and significant State and Federal forested lands also exist. In 2012, WDNR estimated that the County had over 12.5 million oven-dry tons of live timber biomass.*

1. Non-railroad equipment (e.g., sparks from graders, farm & logging equipment, vehicle exhaust) and debris burning (e.g., brush, burning barrels) were the primary ignition sources for all reported wildfires in the Intensive Fire Protection area for 2003 to 2016.
2. The western three-quarters of the Town of Sterling falls within the Northwest Sands wildfire landscape which has the highest level of risk in Wisconsin and has been a priority focus for WDNR mitigation efforts.
3. Residential development has been occurring within some forested areas and former pine plantation. Some landowners are unaware of the risks and do not maintain defensible spaces around structures.
4. Some roads and numerous driveways are inaccessible by larger response vehicles. This problem is typically more serious in wooded areas and, often, in areas with significant waterfront development. Overall, access to water for fire protection is good, though some fire departments and communities identified a need for additional dry hydrants.

5. Some landowners are absentee and may be unaware of local burning permit and forest fire warning systems, and enforcement of burning permits between municipalities can vary significantly.

6. No municipalities identified critical concerns or priority strategies related to wildfire. The Town of Bone Lake noted a higher wildfire risk in the Straight Lake Park and McKenzie areas. During the 2012 mitigation plan, the Town of Eureka identified a few areas with a higher risk of wildfire, such as pine plantation. The Village of Luck identified concerns on the east end of the community where residential development has occurred in wooded areas on long, dead-end roads.

7. Support for continuing current educational efforts was expressed. There may be a need for additional educational signage or Firewise-type efforts in higher-risk areas. No critical gaps in wildfire training, gear, or equipment were specifically noted during the planning effort.

8. Climate changes plus increasing threats to forest health from disease and pests may contribute to increases in the number of wildfire events in the future. Drought conditions, such as those experienced over the past seven years, are pronounced in areas of sandy soils, such as those found in the pine barrens of the Town of Sterling. A Jack Pine Budworm outbreak is possible, if not probable, for this area in the near future.

## *Risk Assessment—Wildfire*

### The Hazard

A **wildfire**, in the context of this plan, is an uncontrollable fire spreading through vegetative fuels, exposing and possibly consuming structures. They often begin unnoticed, spread quickly, and are usually signaled by dense smoke that may fill the area for miles around. Wildfires can be human-caused through arson, campfires, prescribed burns, or carelessness, or can be caused by natural events such as lightning.

Any wildfire in Wisconsin, no matter what type of vegetation it is burning, is legally termed a "forest fire." A forest fire is defined in Wisconsin State Statues as "an uncontrolled, wild or running fire burning in forest, marsh, field, cutover, or other lands." As such, wildfire and forest fire are often used interchangeably within this plan.

This document also does not attempt to make great distinctions between the different types of wildfires, though more wildfire data is available for the WDNR Intensive Fire Protection area, which has a higher predominance of forest vegetation. It is not uncommon for a large wildfire to include a mix of vegetative types. Grass fires fueled by low-lying vegetation are generally more easily controlled compared to a wildfire in a forest area, but also will typically spread the most quickly. Grass fires can be the most dangerous in terms of safety due to the highly variable speed, intensity, and direction. In wooded settings, access is often the biggest challenge. In areas of hardwoods, a wildfire is typically less intense, with the fire being commonly limited to the leaf litter. Wildfires in coniferous forest which climbs into the top of the tree canopy (crown fires) can be the most difficult to control and can produce spotting when large, burning embers

are blown to areas outside of the main fire. Regardless of the fuel types, local topography and weather conditions also influence the characteristics of a wildfire.

## Regional Trends

Wildfires are not uncommon for Wisconsin and can occur at any time of the day and during any month of the year, though the peak fire season in Wisconsin is typically from March through November; and the season length and peak months varies from year-to-year. Land use, vegetation, amount of combustible materials present, and weather conditions (e.g., wind, low humidity, lack of precipitation) are the chief factors determining the number of fires and acres burned. Forest fires are more likely when vegetation is dry from a winter with little snow cover, followed by a spring and summer with sparse rainfall.

**Did you know?**

**The 1871 Peshtigo fire resulted in the greatest single loss of human life due to wildfire in American history.**

The most disastrous forest fire in Wisconsin history occurred on October 8, 1871, when more than 1.2 million acres were burned and the communities of Peshtigo and Brussels were obliterated. "All hell rode into town on the back of a wind" one survivor described. In about two hour's time, a swath of forest ten miles wide and 40 miles long was burned. Though overshadowed by the Great Chicago Fire of the same time period, the Peshtigo fire resulted in 1,152 people killed, 350 missing, and an estimated 3,000 people left homeless.

More recently, a total of 4,144 forest fires and wildfires occurred in Wisconsin during the drought year of 1976, with drought conditions continuing into 1977. Likewise, 1988 was one of the driest years on record, with a total of 3,242 fires occurring and 9,740 acres burned in Wisconsin.

The April 1977 Five Mile Tower Fire which started in northern Washburn County burned 22 square miles at a rate of one mile every 41 minutes and destroyed 64 structures. The book "*Monster Fire at Minong—Wisconsin's Five Mile Tower Fire of 1977*" by Bill Matthias provides an excellent account of this project fire and its impacts on fire management in its aftermath.

In April 1980, more than 16,000 acres were burned and over 200 buildings were lost in the Ekdall Church and Oak Lake fires. The Ekdall Church fire originated less than 20 miles north of Polk County in the Grantsburg area. The fire started in oak scrub and timber slash, but embers then created spot fires in a nearby pine plantation. Within three hours time, the fire was consuming 1,000 to 1,600 acres an hour. Within eight hour's time, it had run nine miles and was 2.5 miles in width at its widest point.

More recently, the May 5, 2005, Cottonville wildfire began in northern Adams County; and 3,410 acres of grass, pine, and scrub oak burned quickly before the fire was contained eleven hours later. During the fire, over 100 people were evacuated. Nine year-round residences, 21 seasonal homes, and at least 60 outbuildings were completely destroyed. Lack of access (long, narrow driveways) and a lack of defensible spaces around buildings were significant contributing factors to the loss of these structures, offering important lessons to be learned.


Closer to home, one of the largest wildfires to hit Wisconsin in over 33 years, the 2013 Germann Road fire consumed 7,499 acres and destroyed 104 structures (23 of them residences) in the Towns of Gordon and Highland in Douglas County and the Town of Barnes in Bayfield County. An estimated 350 structures were saved due to fire control efforts. The fire began around 2:45 p.m. on May 14, 2013, burning a swath nearly 10 miles long and a mile and a half wide before being declared 100 percent contained on May 15 at 9 p.m. The fire was started unintentionally from a logging crew harvesting timber on industrial timber lands. The Germann Road Fire occurred in the same fire landscape as the Town of Sterling and parts of northern Polk County, which highlights the seriousness of the local wildfire risk.

## Local Events

Forest fire is not a new threat to Polk County. In 1898, an "immense sea of flames" burned over 600 square miles of pine lands in northern Wisconsin and Minnesota.[20] Just over four years later, a great forest fire again ravaged the region resulting in over 1,000 persons homeless and leaving large portions of Cumberland and Turtle Lake in ruins and resulted in "heavy loss of farm property" in eastern Polk County.[21]

As the pine forests were logged and agriculture came to dominate much of Polk County, the forest fire risk also changed. The potential for a large forest fire was chiefly limited to forested areas less suitable for agriculture and in the "resort areas" typically associated with recreational surface waters.

The Daily Northwestern
Oshkosh, October 3, 1898

# MANY ARE HOMELESS.

MUCH DISTRESS AMONG WISCONSIN FOREST FIRE SUFFERERS.

## AID IS SADLY NEEDED.

**Anjt. Gen. Boardman Has Reported Over 250 Families Left Homeless and in Need of Assistance—Reported Loss Will Be Large.**

Madison, Wis., Oct. 3.—Adjutant General Boardman who is in the northern part of the state investigating the needs of forest fire sufferers sent the following report from Rice Lake to Governor Scofield: "At Cumberland there are sixty-three families burned out, most of whom have lost everything. At Barron there are twenty-three reported now, fifteen of whom are entirely destitute. The needs of these people are similar to those at Turtle Lake. They are all farmers. At Cumberland shipment should be made to S. H. Waterman, mayor of the city. At Barron, to R. L. Haskins, chairman of relief committee. Will wire you later regarding condition of people in the country tributary to this place. Mr. Wyman is now with me.—C. R. Boardman."

Cumberland, Wis., Oct. 3.—General Boardman and party, representing the state plan of relief, arrived Sunday morning and after taking a census of the people in the fire district drove to Rice Lake. General Boardman has listed seventy-three destitute families in the town of Cumberland, forty families in the towns of Stanford and Rice Lake, thirty families in the towns of Clinton and Barron, and nineteen families in the city of Cumberland, all of whom need immediate assistance. He has arranged for distribution of relief from Turtle Lake, Cumberland, Rice Lake and Baron and supplies will be forwarded immediately to these points.

The danger is now thought to be over, though it is still unsafe to travel through some of the burned districts in the vicinity of Cumberland. The property loss in this county will aggregate $400,000, besides the farm buildings and crops. A large amount of stock has been burned and much hardwood timber destroyed. A crew of men was engaged today burning the bodies of animals in the fire district south of here. They were strewn along the highways and through the timbered sections.

[20] The Daily Gazette. Janesville, WI. Number 148 and 149. 9/4/1894 & 9/5/1894.
[21] The Daily Northwestern. Oshkosh, WI. 10/3/1898. The Weekly Wisconsin. Milwaukee, WI. 10/8/1898

In May 1945, a large fire burned 4,970 acres in the Town of Sterling. This represents the last major wildfire event in Polk County. But this also reflects that there is the potential for a major fore fire in Sterling today.

**Figure 31** on the following page shows the approximate location of the 118 reported wildfires in Polk County between 2003 and 2016, which are identified in the WDNR database. However, caution should be used when interpreting this data. These wildfire reports are mostly limited to events which involved the WDNR and lie within the intensive protection area that constitutes about one-third of the County; wildfires do occur in the remaining cooperative protection areas, but are not typically reported.

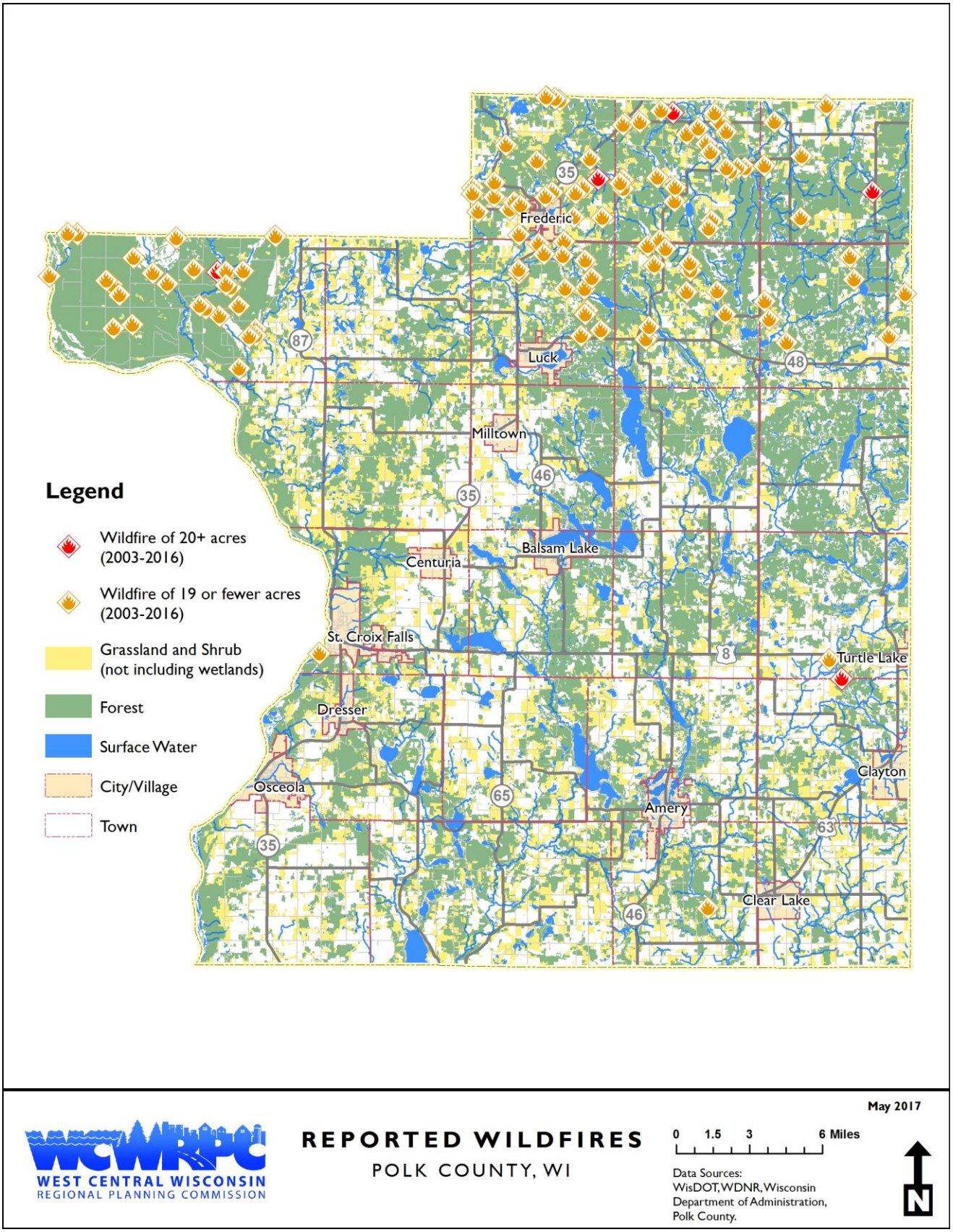
The Town of Sterling had the greatest number of reported wildfires during this period with 28, closely followed by the Towns of Clam Falls (26) and West Sweden (22). Together, these three towns had 64.4 percent of all reported fires. From 2003 to 2016, an average of nine wildfire events were reported per year in Polk County within the WDNR database. Wildfires were reported in every month except January and February during the time period. By far, the largest number of wildfires occurred in the month of April with 51 fires (43% of all reported fires).

Of the 118 reported wildfires during this time period, 109 (or 92%) were less than ten acres in size. Only five fires were greater than 20 acres, within only one of these larger than 40 acres. The largest fire recorded for the time period was estimated to have covered 153 acres in March 2010 in the Town of Sterling. During the event, the fire jumped the Trade River, which became a challenge for responders. As the fire approached structures, air support was called, significant damage to structures was avoided.

There has not been a Presidential Disaster Declaration for a wildfire in Polk County, and research for the preparation of this plan did not discover any recent serious injuries or deaths related to a large wildfire event. According to the WDNR, there have been no recent "project class" wildfires in Polk County with an Incident Command Center and fires lasting eight or more hours.

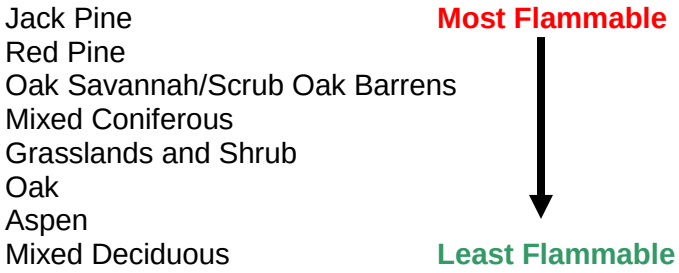
As part of this plan update, all towns were sent a survey requesting the identification of any unique natural hazard and emergency management concerns or needs in their communities. Of the respondents, only the Town of Bone Lake noted elevated wildfire concerns in the Straight Lake Park and McKenzie areas. During the 2012 planning effort, the Town of Eureka identified pine plantations in Sections 18 and 19 as a wildfire concern. More generally in 2012, the Town of Alden noted that "access for emergency vehicles on private roads is a very serious concern" and that "additional first responders would be great".

**Figure 31. Reported Wildfires in Polk County • 2003-2016**



## Risk Factor – Vegetative Fuels

Vegetative cover type is directly related to wildfire risk. The degree of flammability for different vegetative covers is in the general following order:




The above is highly influenced by local soil type. For example, Oak forests on silt loam soils where more moisture is retained in the soil have a lower wildfire risk compared to Scrub Oak Barrens that are typically found on sandier, excessively drained soils.

Approximately 40 percent (about 252,000 acres) of Polk County is forested and 26 percent (about 160,000 acres) is non-agricultural shrub and grasslands. But keep in mind that many forested areas are actively managed for timber production; thus, vegetative characteristics can change from year-to-year as part of the timber growth and harvesting cycle. As shown in Figure 31, deciduous trees (e.g., aspen, oak, maple) are, by far, the predominant forest type. While some significant areas of pine and other coniferous forest exists, the County no longer has the vast expanses of pine forest which were burned in the deadly fires of the late 19$^{th}$ Century. In addition, forest lands in the County have been increasingly fragmented over time, which reduces the chance of a large-scale wildfire event.

Most of the forest lands in the County are privately owned. There are approximately 17,000 acres of County Forest, five county parks, and over 43,000 acres of State and Federal recreational lands and natural areas. Almost 40% of this public land is located in the Town of Sterling. The Town of Sterling also owns approximately 3,000 acres and retains its own forester. Though public forest lands tend to be more actively managed against wildfire risks, not all of these public lands are forested. Of the private forest lands, over one-third (about 75,000 acres) are in Managed Forest Law or Forest Crop Law status.

Forest health also influences the risk of wildfire ignition and can increase the difficulty of fire suppression. Tree damage from storm events, diseases, insect infestation, and exotic species can weaken plants, making them more susceptible to storm damage, or can kill a forest stand outright. The Wisconsin Department of Natural Resources has rated signification portions of Polk County, especially in the north half, as having medium or high levels of risk for experiencing 25% of more tree mortality between 2009 and 2024 due to native and exotic insects and diseases.[22] Wisconsin's average annual temperature has also been increasing, with shorter

[22] Wisconsin Department o f Natural Resources. *Wisconsin Statewide Forest Assessment 2010.*

winters and recent droughts,[23] which not only affects forest health, but also increases the wildfire risk.

Forests have a natural life cycle. Humans can interrupt this cycle by introducing new species or diseases, encouraging certain growth patterns, or through timber harvest practices. Characteristics such as dense stands of unmanaged pine plantation or creating large piles of slash can increase wildfire risks. Creating brush piles and allowing for the accumulation of dead plant litter in home ignition zones or along roadways also increases wildfire risks. Forest management practices can increase wildfire risks or help to mitigate the ignition or spread of wildfires.

## Risk Factor - Ignition

Most wildfire starts are human-caused, whether accidental or deliberate. And areas of higher population within wildlands can be expected to have a higher risk of ignition. Of the fires shown in Figure 31, 34 percent were caused by equipment (non-railroad), such as sparks from road graders, car exhaust, and logging or farm equipment. About 30 percent were ignited through debris burning (e.g., brush piles, trash), which is the most common source of wildfire ignition in Wisconsin. Only seven wildfires were caused by campfire and two from fireworks. Five were purposefully set, likely with malicious intent or for the excitement.

## Review of WDNR Wildfire Risk Assessments

In 2008, the WDNR-Division of Forestry performed a statewide wildfire risk assessment to identify those communities most at risk. **Figure 32** on the following page shows the result of this risk assessment.

Three inputs were used to determine the risk as reflected by the three individual maps at the bottom of the figure:

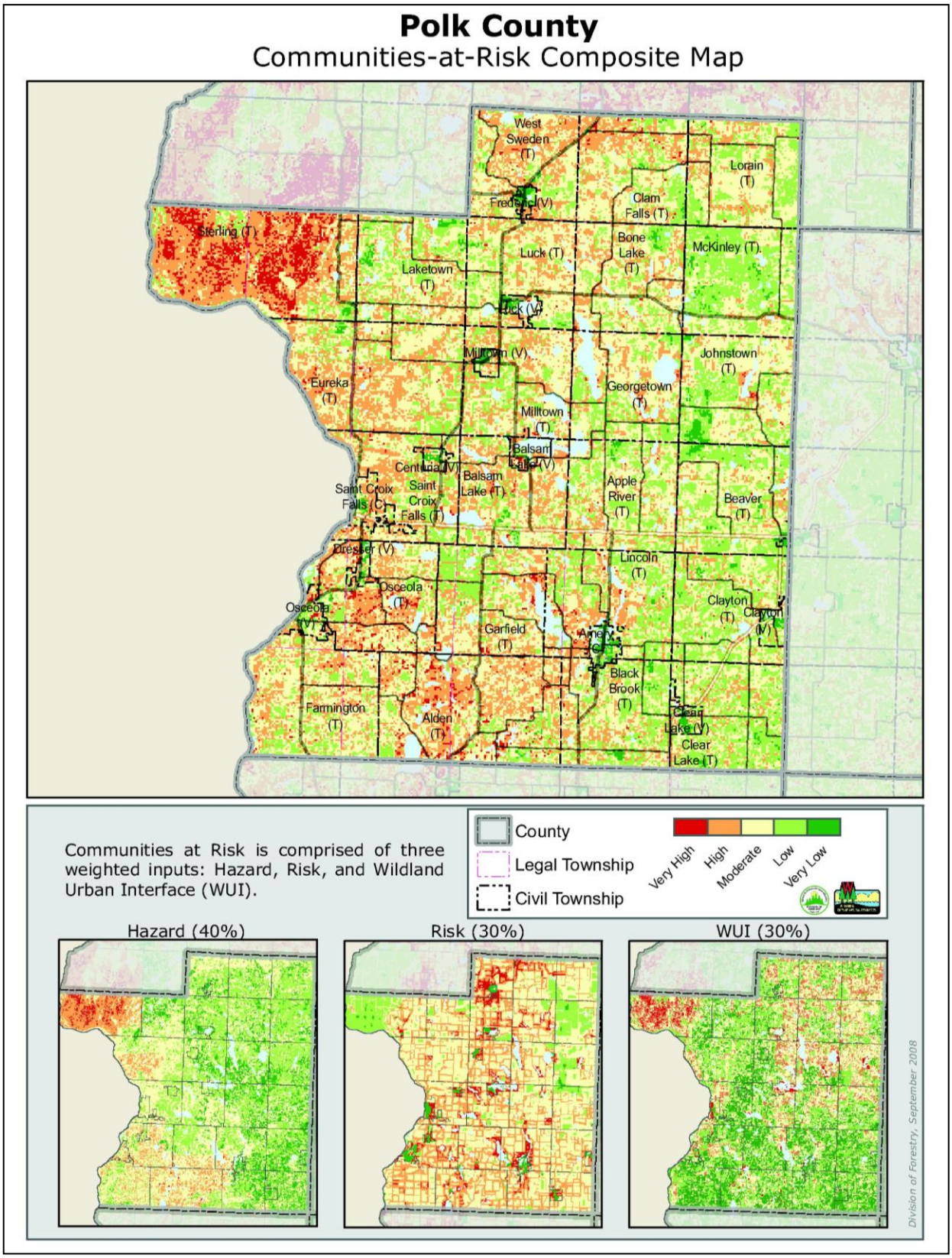
- Hazard (Wildfire Fuels) – The hazard encompasses vegetative fuel types based on satellite imagery, historic fire regime data, pre-settlement vegetative data, and moisture index data.
- Risk (Potential for Ignition) – The risk is based on past fire occurrence data, population density, and distance from roads and railroads.
- Wildland-Urban Interface (Value) – The wildland-urban interface (WUI) reflects housing density and the proximity to flammable vegetation, thus reflecting the potential value of development (and residents) at risk of destruction by wildfire.

The main map in Figure 32 is a weighted composite of each of the three factors—hazard (40%), risk (30%), and WUI (30%). After weighting occurred, natural breaks were used in the model to identify the different risk ratings. Wildfire planning and preparedness resources can then be focused on those communities and areas of highest concern.

Within Polk County, only the Town of Sterling was rated as having a very high risk overall. But as the "risk map" on the previous page reflects, Sterling's development levels are relatively low and the municipality received a medium risk.

[23] Ibid.

**Figure 32. Polk County Communities-at-Risk Map (Wildfire)**



Seven other municipalities were rated as communities of high risk as shown in **Table 24**. Seven additional towns not shown in Table 24 were rated as communities-of-concern: Black Brook, Bone Lake, Clam Falls, Farmington, Garfield, Lincoln, and Milltown.

**Table 24. Communities-at-Risk (Wildfire)**

| Municipality | Hazard (40%) | Risk (30%) | WUI (30%) | 2009 Pop. Est. | 2000 to 2030 prj. Pop. Change |
|---|---|---|---|---|---|
| Alden (T) | H | H | M | 2,959 | +52.6 |
| Balsam Lake (T) | M | H | H | 1,462 | +41.0 |
| Balsam Lake (V) | M | H | VH | 1,082 | +45.5 |
| Eureka (T) | H | H | M | 1,634 | +60.8 |
| Osceola (T) | H | H | M | 2,818 | +125.4 |
| St. Croix Falls (T) | M | H | M | 1,267 | +46.6 |
| Sterling (T) | VH | M | VH | 790 | +34.9 |
| West Sweden (T) | M | VH | H | 771 | +17.4 |

The Polk County towns with the highest wildfire risks are also some of the fastest growing communities in the County, so the risk of ignition will likely similarly grow. And as the housing discussion early in this document identifies, it is some of these same areas which have significant seasonal housing, with many of these homes are transitioning to year-round housing. For instance, in the 2000 Census, over 45 percent of the housing in the Town of Balsam Lake was seasonal, with the greatest use during the summer months. Many of these landowners are absentee and may not be fully aware of local burning permit requirements, local warning systems, and the wildfire risks. But as retirees and commuters begin to live year-round in these formerly seasonal homes, wildfire ignition could proportionately increase, especially during the non-summer months when populations have traditionally been lower.

The risk areas identified in Figures 31 and 32 are also consistent with the fire landscapes identified by the Wisconsin DNR in their *Wildland Fire Management Program Assessment* completed in March 2010. This assessment divided the State into 16 management zones based on vegetation, ecology, soils, development, and forest sizes. The zones were then used to help guide and prioritize resources and mitigation efforts.

The far southeastern portion of the County largely falls into the "Western Prairie" fire landscape which has limited potential for a fire in excess of 500 acres. The majority of the County falls within the "St. Croix Moraines" fire landscape which has a higher wildfire risk due to development in wooded areas and pockets of sand and conifers, but the potential for a fire of 500+ acres is not high. The analysis recommends limited mitigation activities for this area which focus on specific situations, in addition to possible school fire prevention programming and local public service announcements when the fire danger is elevated.

The western half of the Town of Sterling is part of the "Northwest Sands" fire landscape, which has the highest level of wildfire risk in the State. The potential for very large wildfires within this landscape are possible. School fire protection programming, mitigation planning, pubic relations efforts, and targeted outreach is supported in this area.

While the fire landscape approach is valuable for State- and regional-level resource planning, the communities-at-risk assessment (Figure 32) provides a better understanding of local variations. For instance, the Town of Sterling may have the physical landscape of continuous pine and sandy soils which support the potential of very large wildfires. But there are other areas of the County which do not have the extensive pine forest but are also of wildfire concern due to higher levels of development.

## WDNR Fire Protection Areas

About 76 percent of Polk County has Cooperative Fire Protection, while the remaining 24 percent has Intensive Fire Protection. These are defined as follows:

**Intensive Fire Protection** areas are the most heavily forested and contain the most fire hazards and risks in the State. Limited assignment of skilled personnel, specialized equipment, and facilities provide for an adequate degree of forest fire prevention, detection, and suppression efficiency and effectiveness at a minimum cost. Wisconsin Department of Natural Resources (WDNR) equipment is designed to suppress fires that are beyond the capability of the local fire department. The WDNR by statute takes whatever action is necessary to suppress the fires. Fire detection is provided by WDNR aircraft, and there is a strong reliance on public reporting of fires. Burning permits are required whenever the ground is not snow-covered. In 2016, new antennas were installed at the Town of Sterling Town Hall should an incident command post be needed at the site during a wildfire event.

WDNR has produced G.I.S.-based structure zone maps for the intensive fire protection area to assist with emergency response and has provided these maps to Polk County for use. No community wildfire protection planning efforts have been completed or proposed for Polk County, in large part due to the relatively sparse population within most of this protection area. However, there have been periodic bulk mailings on Firewise materials (e.g., creating defensible spaces), wildfire awareness signage installed, public service announcements in local media, and other public awareness outreach. There is also a high level of coordination between WDNR and local fire departments within this area and local fire departments participate in WDNR field exercises with structural protection about once every five years in Grantsburg. Additional WDNR training and/or exercises are available annually each winter.

**Cooperative Forest Fire Protection** is aid and counsel from WDNR, upon request, to the town authorities who are legally responsible for forest fire prevention, detection, and suppression activities in territory outside boundaries of established extensive fire control areas. Town Chairmen, by virtue of their office, are fire wardens. Costs of forest fire prevention and suppression incurred by a town chairman, acting in his capacity as town fire warden, are paid by the town. Burning permits are issued when the town board deems it necessary.

The intensive fire protection areas of Polk County are reflected in Figures 31 and 32. Most or all of the towns of West Sweden, Clam Falls, Lorain, Luck, Bone Lake, and McKinley, as well as the Village of Frederic, fall within the WDNR Webster Fire Response Unit which is part of the Cumberland Dispatch Group. The majority of the Town of Sterling (from River Road to the west) falls within the WDNR Grantsburg Fire Response Unit which is also part of the Cumberland Dispatch Group.

Local volunteer fire departments play a very important role in fighting wildfires, and most departments maintain mutual aid agreements with neighboring fire departments. When surveyed, no fire departments noted specific wildfire equipment needs, though some concerns with communication equipment and the transition to narrow-banding was noted. Two departments (Apple River and Cushing) noted a need for dry hydrants. Six of the eight departments responding to the mitigation survey ranked maintaining an adequate emergency response vehicle envelope along driveways as a moderate, moderately high, or critical concern. Many departments participate in some level of training with long-term care facilities, public housing, or other such critical facilities in their respective districts.

## Other Risk Factors

As part of the mitigation plan update, a survey was distributed to fire departments in the County, with eight of the departments responding. **Access for emergency vehicles** was the most common concern, especially on private roads and driveways in lake areas. On a scale of 1 to 5, with 5 being a critical concern, the average rating was 3.4 with three departments rating access concerns as 4 or higher.


Some private roads/driveways in the County do not have adequate clearance and/or cannot support larger emergency vehicles. Longer, dead-end roads also exist that can complicate access and evacuation, especially if pull-offs and turn arounds are not adequate for larger equipment. Many long, privately owned roads and driveways exist near lakes and along rivers, with some of these leading to multiple homes or cabins. And many homes cannot be seen from public roadway due to vegetation. Access can be further complicated by gated driveways or other obstructions and seasonably wet roads that can make access difficult or unwise. Residential homes on islands pose an additional very unique concern. All of these conditions, especially if signage is inadequate, can result in slowed emergency response, unsafe working conditions for firefighters, and dangerous conditions during evacuations.

A number of fire department noted a potential need for **dry hydrants** for improvement fire protection—Luck Fire Department (1 @ Bass Lake), St. Croix Fall Fire Department (1 @ Deer Lake), Clayton Fire Department (1 in Town of Clayton; 1 in Town of Vance Creek), Balsam Lake Fire Department (1 at each boat landing on Balsam Lake; 1 at Goose Lake landing), and Osceola Fire Department (1 @ Mill Pond). The City of Amery also identified a potential need for 1-2 dry hydrants on lakes.

**Other equipment needs** identified by fire departments included emergency power generators and portable scene lighting. A number of departments encouraged **more public education** on

wildfire and flood risks, as well as the importance of maintaining the visibility of fire/address signs and housing numbers. One department suggested additional **coordinated awareness related to search and rescue** would be valuable for emergency response teams.

### Relative Level of Risk

The wildfire risk is considered low-to-moderate for Polk County overall. This is in large part due to most of the forest lands being significantly fragmented and having predominantly deciduous vegetation which will help slow and limit the spread of wildfires.

**In the near term, it can be expected that Polk County will continue to experience nine to ten wildfires per year on average within the intensive fire protection area**, and perhaps greater if current droughty conditions continue or worsen. **The far majority of these fires will be small, with a wildfire greater than 20 acres in size occurring about once every two to three years.** Estimates for wildfires in the remaining 76 percent of the County within cooperative fire protection are not currently available. Vegetation fuel types and the fragmented forest landscape combine to make the fast-spreading, regional fires of the late 1800s very unlikely within Polk County for the foreseeable future**.**

However, a number of factors could significantly contribute an increase in the number and size of wildfires over the long term. Foremost, population increases, development in the wildland-urban interface, and the transition from seasonal to year-round housing has great potential to increase the frequency of wildfires in Polk County. Climate changes, insect infestation, and plant disease are additional factors which may also increase wildfire risks.

## *Vulnerability Assessment—Wildfire*

### Potential Impacts

Forest fire can cause significant injury, death, damage to property, and loss of natural resources. As shown in Table 25, those communities most at-risk of wildfire had over $1 billion in equalized assessed improvements on 9,400 parcels and over $9.1 million in assessed personal property in 2016, as well as a combined population of over 16,300. The far majority of these improved parcels were residential, with commercial and manufacturing uses largely concentrated in the villages. It is worth noting that the improvements identified do not include tax-exempt uses (e.g., governmental, non-profits) and some types of exempt personal property, such as farm equipment and certain industrial equipment.

Among the fourteen communities most at-risk, those within the Intensive Fire Protection areas are generally less developed and are projected to grow at a slower rate. This reflects that the fire protection areas are determined based more on vegetation types, rather than population and development vulnerabilities which were included as part of the risk input reflected in the Figure 32. Similarly fire risk also within individual communities.

Table 25 includes half of Polk County's 24 unincorporated towns, about 45 percent of the County's population, 40 percent of the County's improved parcels, and 38 percent of the

County's total improvements. While we do not have the wildfire data to state with certainty that the above communities have a higher wildfire risk than all other municipalities in Polk County, their WNDR risk rating and intensive fire protection status and was based, in part, upon their vegetative fuels types and wildfire vulnerabilities.

**Table 25. Population and Improvements of Communities Most At-Risk**

| Municipality | Population | | | 2016 Assessed Improvements | | 2016 Assessed Value of Personal Property (non-exempt) |
|---|---|---|---|---|---|---|
| | Est. 2016 | Proj. 2040 | % Chng. '16-'40 | # of Imp. Parcels | Total Value of Improvements | |
| Grantsburg Fire Response Unit — Intensive Fire Protection | | | | | | |
| Sterling (t) (75%) | 775 | 930 | 20.0% | 520 | $33,342,700 | $632,400 |
| Webster Fire Response Unit — Intensive Fire Protection | | | | | | |
| Bone Lake (t) (67%) | 722 | 905 | 25.3% | 528 | $60,767,600 | $393,190 |
| Clam Falls (t) | 612 | 700 | 14.4% | 373 | $26,742,900 | $293,200 |
| Lorain (t) | 279 | 265 | -5.0% | 208 | $14,043,900 | $153,400 |
| Luck (t) (48%) | 909 | 1,005 | 10.6% | 506 | $42,085,300 | $273,400 |
| Frederic (v) | 1,133 | 1,110 | -2.0% | 480 | $43,589,700 | $1,754,100 |
| McKinley (t) (80%) | 352 | 415 | 17.9% | 308 | $23,000,600 | $218,800 |
| West Sweden (t) | 692 | 715 | 3.3% | 433 | $40,403,800 | $80,800 |
| Other Communities-at-Risk (see Table 24) | | | | | | |
| Alden (t) | 2,790 | 3,475 | 24.6% | 1,491 | $200,301,400 | $228,700 |
| Balsam Lake (t) | 1,396 | 1,660 | 18.9% | 1,207 | $136,390,100 | $288,400 |
| Balsam Lake (v) | 1,010 | 1,185 | 17.3% | 583 | $75,731,400 | $975,300 |
| Eureka (t) | 1,668 | 2,240 | 34.3% | 817 | $87,428,400 | $178,800 |
| Osceola (t) | 2,869 | 4,055 | 41.3% | 1,280 | $199,733,200 | $1,187,700 |
| St. Croix Falls (t) | 1,162 | 1,370 | 17.9% | 690 | $91,050,100 | $1,582,400 |
| Totals | 16,369 | 20,030 | 22.4% | 9,424 | $1,074,611,100 | $8,240,590 |

* These towns are partially within an intensive fire protection area with a rough percentage in parenthesis, though numbers provided are for the entire town.

For 2012, WDNR estimated that there was near 12.5 million oven-dry tons of live timber biomass in Polk County, less than five percent being a variety of pine.[24] County, State, and Federal harvest timber value per acre in 2014 in Wisconsin ranged from $686 to $720 per harvested acre. To provide a rough idea of the value of the County and private productive forest in the County, the 252,000 forested acres would have a timber value of about $176.4 million at $700 per acre at maturity. However, timber values vary by forest type, forest age, and market conditions.

Polk County sustainably manages 17,166 acres of County Forest lands, which is an important source of income for the County. The County Forest is managed to mitigate the potential of large wildfires and a range of other forest-related hazards (e.g., drought, invasive species) through the *Polk County Forest 15-Year Comprehensive Land Use Plan* and prescribed land

[24] http://dnr.wi.gov/topic/ForestBusinesses/documents/tables/BiomassByCounty.pdf

practices (e.g., selective cutting, fire lanes, forest roads, disease prevention), which was last updated in 2016. Privately owned woodlots are sometimes less intensely managed than adjacent County Forest lands, especially in cases of absentee land ownership.

Not only are public forest lands an important direct income source for Polk County through logging, but it is an important recreational resource as well. The loss of related tourism would also reduce revenues for Polk County campgrounds, resorts, and other businesses, though no current study on the extent of potential financial impacts is available. Forest landowners would also incur significant costs associated with salvage and restoration following a large forest fire event.

Within non-wooded areas, wildfires in grasslands have the potential to spread more quickly than fires in wooded areas. Homes, agricultural operations, livestock, crops (especially hay and grains), and travelers on roadways are all potentially vulnerable, depending on proximity to vegetative fuel. Large, contiguous areas of grasslands do exist within the County.

### Vulnerable Critical Facilities

Any critical facility located in pine plantation, forested area, or adjacent to grasslands is potentially at risk from wildfire. Within forested areas with Intensive Fire Protection, vulnerable critical facilities are primarily limited to above ground utilities, such as power lines. Electric substations in the Village of Frederic and Town of Luck may be in forested areas, as well as the Bone Lake Town Hall. A number of substations are located within forested areas of other parts of the County, but no critical facilities were identified as being uniquely vulnerable to wildfire.

While not technically critical facilities, Polk County does have approximately 85 campgrounds, tourism-related cottages, RV parks, and resorts, many of which are located within the at-risk communities and other forested areas of the County. For such facilities, the priority concern is for the visitors as a potential source of fire ignition and as a vulnerability should a wildfire occur.

## *Unique Jurisdictional Risks or Vulnerabilities—Wildfire*

All participating cities and villages currently have good well capacity for fire protection, though the Village of Clear Lake noted that an additional water tower may be needed in the future if significant new development occurs.

Only the Village of Frederic and a small portion of the Village of Luck are located within a WDNR intensive fire protection area. A number of municipalities (e.g., Balsam Lake, Amery) noted residential development in forested areas, but no unique concerns were identified. Only the Village of Luck identified a significant wildfire concern during the planning process. The Village noted that residential development has occurred in wooded areas along the north and south sides of Big Butternut Lake on the east end of community. This risk is heightened due to access being limited to long dead-end streets which could pose evacuation challenges during an event.

## vii. Invasive Species


Polk County's rural, largely undeveloped landscape, and its natural flora and fauna, is at the very heart of the community's character. The county's surface waters, forested areas, wetlands, prairie remnants, and wildlife serve vital economic, recreational, and natural resource functions. Invasive species threaten these roles and benefits of our natural environment.

This section is unique and not intended as a comprehensive assessment for a number of reasons, most notably: (a) there is a very wide variety of invasives to be concerned with, including new and emerging threats; (b) the characteristics and management of these threats are dynamic and frequently change; (c) there are many existing plans, programs, and resources already dedicated to addressing these threats; and (d) invasive species is not typically a natural disaster threat with emergency management or response implications. In short, this section is to raise awareness of invasive species threats and their potential implications, rather than to duplicate existing efforts or quantify vulnerabilities.

### *Risk Assessment—Invasive Species*

#### The Hazard

The legislature has officially defined invasive species in Wisconsin Statutes as "nonindigenous species whose introduction causes or is likely to cause economic or environmental harm or harm to human health." These species can be aquatic or terrestrial weeds, insect pests, nuisance animals, or disease-causing organisms. They can occur in all types of habitats and affect urban and rural areas throughout the state. Therefore, a species is regarded as invasive if:

- it has been introduced by human action to a location, area, or region where it did not previously occur naturally (is not native);
- it becomes capable of establishing a breeding population in the new location without further intervention by humans;
- it spreads widely throughout the new location;

In Polk County, invasive species are managed through the classification of terrestrial and aquatic organisms. Terrestrial invasives come in many forms including plants, animals, insects, fungi and diseases. They affect the health of our forests, prairies, parks, urban landscapes and more. When these landscapes are unhealthy, all the benefits they provide to us are at risk.

Aquatic invasive species (AIS) are non-indigenous species that dwell in water or wetlands whose introduction cause, or is likely to cause, economic or environmental harm or harm to human health. When AIS arrive in Polk County they have a competitive advantage over native species because they lack natural predators, parasites, pathogens, diseases, and competitors to keep their populations in check. As a result, populations of AIS can explode and outcompete native species

by using available resources. Additionally, many AIS have life strategies which give them a competitive advantage over native species. Strategies include high reproductive rates, early seasonal growth and development, and tolerance for a wide range of environmental conditions. Invasive species can come from other parts of the United States or from other countries and can be released either intentionally or unintentionally. Modes and reasons for introduction can vary widely and include: ballast water for shipping, food sources, bait sources, and the garden/aquarium plant trade. Although some species may have been introduced through natural migration, humans are the primary way invasive species are spread. AIS can displace native species; reduce wildlife habitat; and negatively impact property values, recreational activities, tourism, and industries.

## Regional Trends

Invasive species impact Wisconsin citizens and habitats of every type–from power companies to municipal foresters to holiday boaters, from meandering rivers to state parks to citizen backyards and gardens. As a result, invasive species management has grown as a state priority over recent decades. Working with numerous partners, the Department of Natural Resources has been engaged in work to prevent the arrival of new invasive species, detect new infestations, respond to invasions, and control invasive species populations.

In 2009, Wisconsin established a comprehensive Invasive Species Identification, Classification, and Control rule (ch. NR 40, Wis. Adm. Code) to regulate some of the most threatening invasive species. The rule creates a comprehensive, science-based system with criteria to classify invasive species into two categories: "**prohibited**" and "**restricted**." With certain exceptions, the transport, possession, transfer and introduction of prohibited species is banned. Restricted species are also subject to a ban on transport, transfer and introduction, but possession is allowed, with the exception of fish and crayfish. The department may issue permits for research or public display of any listed invasive species. For species other than invasive fish and crayfish, permits may also be issued for other purposes.

There are several field guides and species identification tools published by the Wisconsin Department of Natural Resources and other partner organizations to aid in the identification and management of invasive species. The following pages include thumbnail images and location maps for 32 common terrestrial invasive plants and 16 selected regulated aquatic invasive species in Wisconsin. These common species sheets can also be accessed online on the Wisconsin Department of Natural Resources website using the following links below:

Common Terrestrial Invasive Plants
http://dnr.wi.gov/topic/invasives/documents/wi_common_inv_montage%283-25%29.pdf

Selected Regulated Aquatic Invasive Species
http://dnr.wi.gov/topic/Invasives/documents/NR40Aquatics.pdf

# Common Terrestrial Invasive Plants in WI

Please report any **prohibited** species (as indicated by red on the maps). Provide the following data: exact location, land ownership (if known), population size, a photo or voucher specimen, and your contact information.

**To report a sighting send an email to: Invasive.Species@wi.gov or CALL 608-267-5066**


For more information about NR 40 (WI's Invasive Species Rule), Restricted, or Prohibited species please visit: www.dnr.wi.gov/invasives/classification

# Common Terrestrial Invasive Plants in WI


Bureau of Endangered Resources
and Division of Forestry
Wisconsin Department of Natural Resources
Box 7921
Madison, WI 53707-7921

DNR PUB-FR-456-2010

PRINTED ON RECYCLED PAPER

WISCONSIN DEPT. OF NATURAL RESOURCES

# Selected Regulated Aquatic Invasive Species in WI


Floating water hyacinth
*(Eichhornia crassipes)*


Starry stonewort
*(Nitellopsis obtusa)*


Hydrilla
*(Hydrilla verticillata)*


Anchored water hyacinth
*(Eichhornia azurea)*


Water lettuce
*(Pistia stratiotes)*


Faucet snail
*(Bithynia tentaculata)*


European frog-bit
*(Hydrocharis morsus-ranae)*


Brittle naiad
*(Najas minor)*


New Zealand mud snail
*(Potamopyrgus antipodarum)*


Spiny water flea
*(Bythotrephes cederstroemi)*


Malaysian trumpet snail
*(Melanoides tuberculata)*


Duck lettuce
*(Ottelia alismoides)*


Java waterdropwort
*(Oenanthe javanica)*


Quagga mussel
*(Dreissena rostriformis)*


Yellow floating heart
*(Nymphoides peltata)*


Brazilian waterweed
*(Egeria densa)*

Report any **prohibited** species as soon as possible by emailing: **Invasive.Species@wi.gov.**
This publication does not list all the regulated species. For the full list of Prohibited or Restricted species please visit:
**www.dnr.wi.gov** keyword: **invasives**

Asian clam
*(Corbicula fluminea)*

Floating marsh pennywort
*(Hydrocotyle ranunculoides)*

Didymo
*(Didymoshenia geminata)*

Giant salvinia
*(Salvinia molesta)*

Red swamp crayfish
*(Procambarus clarkii)*

Water spinach
*(Ipomoea aquatica)*

Killer algae
*(Caulerpa taxifolia)*

Asian marshweed
*(Limnophila sessiliflora)*

Indian swampweed
*(Hygrophila polysperma)*

Aquatic forget-me-not
*(Myosotis scorpiodes)*

Spiny naiad
*(Najas marina)*

Curly-leaf pondweed
*(Potamogeton crispus)*

Zebra mussel
*(Dreissena polymorpha)*

Rusty crayfish
*(Orconectes rusticus)*

Chinese mystery snail
*(Cipangopaludina chinensis)*

Yellow Iris
*(Iris pseudacorus)*

**Prohibited Species** **Restricted Species**

**www.dnr.wi.gov** keyword: **invasives**

Bureau of Science Services
Wisconsin Department of Natural Resources
P.O. Box 7921
Madison, WI 53707-7921



PUB-SS-1162 2016

## Local Trends

Exotic (invasive) species have little or no habitat value for the wildlife of Polk County. They tend to grow so profusely that they overtake and strangle out any native species growing in the vicinity. Once the habitat for our wildlife changes, the wildlife will move elsewhere.

The following invasive species of greatest concern have been identified in Polk County:

- **Common & Glossy Buckthorn (terrestrial)** These tall understory shrubs or small trees can grow up to 25' tall and has spread throughout much of Wisconsin and are encroaching upon Polk County from the south. Buckthorn invades oak forests, riparian woods, savannas, prairies, old fields, and roadsides. Common Buckthorn thrives particularly on well-drained soils, while Glossy Buckthorn can form dense thickets in wetlands and a variety of upland habitats. It leafs out very early and retains its leaves late into the growing season, giving them a longer growing season than native plants, which can be helpful in identifying patches of Buckthorn in late fall. Buckthorn lacks "natural controls", like insects or disease that would curb its growth. Somewhat similar, **Exotic Bush Honeysuckle** is another invasive bush that is encroaching upon Polk County from the south and also holds its leaves later into the fall, though it seldom grows more than 10 feet in height.

  ***Impacts***

  Buckthorn is a very serious threat to the future of Polk County forests, wetlands, prairies, and other natural habitats. Buckthorn, along with Honeysuckle, out-competes native plants for nutrient, light, and moisture and, essentially, can form an impenetrable layer of vegetation. It also contributes to erosion by shading out forest floor cover, thereby degrading wildlife habitat. Buckthorn also serves as host to other pests, such as crown rust fungus and soybean aphid. Altogether, Buckthorn has the potential to severely impact hunting and recreational tourism, while reducing timber values and property values. A massive effort would be required to substantially reduce this threat. Initially efforts should focus on protecting areas with little or no Buckthorn.

- **Giant & Japanese Knotweed (terrestrial)** There are over 100 confirmed sites of Japanese Knotweed in Polk County. The arching stems of this perennial (which grows to heights of 5-10 feet in large clones up to several acres in size) are hollow and bamboo-like, a reddish-brown to tan color. Even though they die in winter, they remain upright. Each spring it regrows from its extensive root system at a tremendous rate. Mature leaves are 3 - 5" wide and 4 - 9" long, lighter on the lower surface and egg shaped; young leaves are heart shaped. Lacy 2" long clusters of tiny greenish-white flowers are produced in late summer and held upright at the leaf base. Japanese knotweed reproduces occasionally by seed, but spreads primarily by extensive networks of underground rhizomes, which can reach 6 feet deep, 60 feet long and become strong enough to damage pavement and penetrate building foundations.

  ***Impacts***

  Introduced in the late 1800s, Giant and Japanese Knotweed is now found throughout much of North America. It is especially widespread in the Midwest. It is often considered

to be the most troublesome weed in Great Britain. It grows in a variety of habitats, in many soil types, and a range of moisture conditions. Of particular concern is its tendency to invade valuable wetland habitat and line the banks of creeks and rivers where it often forms an impenetrable wall of stems, crowding out native vegetation and leaving banks vulnerable to erosion when it dies in winter. It is also found along roads, railroads, utility pathways and strip-mining areas. In addition to spreading by rhizomes and seed, it is often spread by streams, by transportation of fill dirt, or through roadside plowing. Knotweed can also damage the foundations of nearby structures and there has been cases in which banks have been unwilling to provide a mortgage due to the existence of Knotweed..

- **Spotted knapweed (terrestrial)** is a short-lived perennial that got its name from the spots formed by black margins on the flower bract tips. Spotted knapweed typically forms a basal rosette of leaves in its first year and flowers in subsequent years. Flowers are purple to pink with 25 to 35 flowers per head. Plants bloom from June to October, and flower heads usually remain on the plant. Flower heads are oblong or oval shaped and are single or in clusters of two or three.

  ***Impacts***
  Spotted knapweed reduces or displaces desirable plant species, thereby reducing livestock and wildlife forage. It is a highly competitive weed that invades disturbed areas and degrades desirable plant communities and has the ability to form monocultures. Spotted knapweed infestations can also have higher surface water runoff and higher sediment yields than native species. The sap of spotted knapweed can cause skin irritation in some people.

- **Oriental Bittersweet (terrestrial)** is another growing concern in Polk County. Oriental bittersweet (also known as round-leaved or Asiatic bittersweet) is a perennial, deciduous, woody climbing vine that can be easily confused with American Bittersweet. Oriental bittersweet can be found in grasslands, woodland edges, forests, roadsides, and beaches and its seeds are easily disbursed as birds eat the fruit or people use it in floral arrangements.

  ***Impacts***
  This quickly growing vine may grow in nearly pure stands and can overtop native plants and tall trees, thereby shading, girdling, and eventually downing them.

- **Leafy spurge (terrestrial)** grows in dense clumps with one or more shoots coming from a woody root crown. It has non-woody, hairless stems, which can reach 3 feet or more in height. Leaves are alternate and pointed. Flowers are yellow with large, round, greenish-yellow bracts which develop in mid-June. Pink buds on the root crown sprout readily and produce new shoots, adding to the weed's rapid spread. Although the plant appears to be delicate, its strength is in its extensive root system. New infestations often appear in small clumps, which quickly spread.

***Impacts***

Leafy spurge is an aggressive invader and once present can completely overtake large areas of open land. Leafy spurge possesses several characteristics that allow it to spread rapidly and displace native grasses in only a few years. The species puts on growth early in the spring, allowing it to shade natives and dominate available moisture and nutrients. It is allelophatic, which means it emits chemicals from its roots that retard the growth or seed germination of other plants. Also, like other exotic invasive plants, it lacks the insects and fungi that preyed on it in its native land. The plant can reach densities of up to 1,800 stems per square yard. Roots can reach depths up to fifteen feet, and laterial spread of up to thirty-five feet. This deep root system makes eradication of the species extremely difficult. Even if the foliage of the plant is destroyed, the roots will regenerate new shoots.

Leafy spurge can be catastrophic to grasslands for both economic and ecological reasons. The plant is not palatable to cattle and is considered a serious pest in the grasslands of the Great Plains. It is estimated that the plant reduces the productivity of grazing land by 50 to 75 percent. It currently inhabits about three million acres of rangeland in the U.S., and economic losses in just four states alone exceed $100 million annually. In natural areas, leafy spurge reduces species diversity and habitat for wildlife, creating a monoculture with little to no forage or shelter value.

- **Purple loosestrife (terrestrial)** is an attractive wetland perennial plant from Europe and Asia that was introduced to North America without the specialized insects and diseases that keep it in check in its native lands. Freed from its natural controls, purple loosestrife grows taller and faster than our native wetland plants. These advantages and prolific seed production have allowed it to invade many Wisconsin wetlands to the near total exclusion of most other vegetation. Once established, it literally shades everything else out. Loosestrife has spread rapidly in Wisconsin over the last 20 to 30 years. This perennial can range in height up to 9 feet with a dense bush growth of 1-50 stems. Showy flowers vary from purple to magenta and bloom from July to September. Leaves are opposite, nearly linear, and attached to four- to many-sided stems without stalks.

  Purple loosestrife was first introduced as a garden perennial from Europe during the 1800's. The plant was first detected in Wisconsin in the early 1930's, but remained uncommon until the 1970's. It is now widely dispersed in the state, and has been recorded in 70 of Wisconsin's 72 counties. Low densities in most areas of the state suggest that the plant is still in the pioneering state of establishment.

  This plant's optimal habitat includes marshes, stream margins, flood plains, sedge meadows and wet prairies. It is tolerant of moist soil and shallow water sites such as pastures and meadows, although established plants can tolerate drier conditions. Purple loosestrife has also been planted in lawns and gardens, which is often how its seed has gotten into many of our wetlands, lakes and rivers. Purple loosestrife spreads mainly by seed, but it can also spread from root or stem segments.

***Impacts***

The plant's ability to adjust to a wide range of environmental conditions gives it a competitive advantage. Purple loosestrife displaces native wetland vegetation and degrades wildlife habitat. As native vegetation is displayed, rare plants are often the first species to disappear. Eventually, purple loosestrife can overrun wetlands thousands of acres in size, and almost entirely eliminate the open water habitat. The plant can also be detrimental to recreation by choking waterways. A mature plant can annually produce over 2 million tiny seeds, its primary dispersal agent. It can also grow from bits of root or broken stem that readily root in moist soil. Water, animals (especially birds), boats, construction equipment, and people can transport its seeds long distances and they may remain viable in soil for many years. Some uniformed gardeners still buy or trade and plant purple loosestrife.

- **Wild chervil (terrestrial)** is a biennial or short-lived perennial plant of the parsley family. Seedlings develop into a rosette during the first year. In the second year, the plants produce hollow flower stems, usually 3-4 feet tall (can reach 6 feet). The stems are branched and covered in soft hairs, particularly near the base. The leaves are alternate, nearly hairless, and divided into smaller, fern-like leaflets. The base of each leaf surrounds the stem. Tiny, white flowers with 5 notched petals bloom from late May to early July of the second year. Individual flower stems form a small cluster. The flowers of several of these small umbels together form a larger umbel resembling an umbrella. The thick taproot of wild chervil has lateral buds at the top of the root which allow for re-sprouting. The taproot of mature plants may be up to 6 feet deep.

  ***Impacts***

  Wild chervil will grow in a variety of soil types, but prefers rich, moist soils. It may be found along roadsides, open woods, pastures, and disturbed areas. Spreading can be caused by the movement of seeds in water, by birds and by mowing equipment; as well as by lateral budding at the top of the root. This plant completes with others for light, space and nutrients and may shade out surrounding vegetation.

- **Wild parsnip (terrestrial)** is an eye-catching, non-native weed that hails originally from Europe and Asia. Although not a native plant, wild parsnip has likely become "naturalized" in all of Wisconsin's 72 counties and is here to stay. It is wide spread in Polk County and very large patches are easily seen along Highway 63 when in bloom.
  Wild parsnip grows in large patches or as scattered plants along roadsides, in abandoned fields, on pastures, on restored prairies, and in disturbed open areas. Wild parsnip has rosettes that grow close to the ground and bear leaves averaging six inches in height. The plant has a long, thick taproot, which is edible. Flowering plants produce a single, thick stem that contains hundreds of yellow umbellate flowers. Wild parsnip has small, flat slightly ribbed seeds that can stay viable in the soil for 4 years. Depending on the habitat and growing conditions, individual flowering plants range to over four feet in height. Leaves are alternate, pinnately compound, branched, and have saw-toothed edges.

***Impacts***

The fact that wild parsnip is spreading is one more reason people are coming into more frequent contact with it. The plant has become a weed of special concern along roadsides and in abandoned fields. Like many other introduced plants, it is very aggressive and spreading rapidly. Unlike benign weeds, wild parsnip can take over an area, outcompeting native plants. The ecological impact of this invader puts it high on the hit list of land managers.

In addition to it outcompeting our native plants, wild parsnip has harmful characteristics that can cause 'burn-like' conditions on our skin. There are chemicals in the wild parsnip that cause what dermatologists call "phyto-photo-dermatitis." That means an inflammation (itis) of the skin (derm) induced by a plant (phyto) with the help of sunlight (photo). When absorbed by skin, the chemicals are energized by ultraviolet light (present during sunny and cloudy days) causing them to bind with nuclear DNA and cell membranes. This process destroys cells and skin tissue, though a reaction takes time to produce visible damage. A Polk County Highway Department employee recently experienced significant burns from Wild Parsnip. The Highway Department is now spraying Wild Parnsip along highways in an attempt to control this invasive. In mid cases, affected skin reddens and feels sunburned. In more severe cases, the skin reddens first, then blisters rise - some are impressively large- and for a while the area feels like it has been scalded. Places where skin is most sensitive (arms, legs, torco, face and neck) are most vulnerable. Moisture from perspiration speeds the absorption process. Burning is inevitable if skin comes in contact with juice from cut or broken stalks, leaves or flowers.

Blisters appear a day or two after sun exposure. Soon after blisters rupture and the skin begins to heal. One of the wild parsnip's "signature" effects is a dark red or brownish discoloration of the skin in the area where the burn occurred. This hyper-pigmentation can persist in the skin for as long as two years. Unlike poison ivy, the reaction caused by contact with Wild Parsnip sap is not an allergic reaction. Toxin in the sap is absorbed by the skin and energized by ultraviolet light.

- **Curly leaf pond weed (aquatic)** is a submersed invasive aquatic plant that forms surface mats that interfere with aquatic recreation. It is similar in appearance to many native pond weeds but can be distinguished from others by its unique life cycle. It is generally the first pond weed to come up in the spring and usually dies off and drops to the lake bottom by early July. Curly-leaf pond weed was the most severe nuisance aquatic plant in the Midwest until Eurasian watermilfoil appeared.

  ***Impacts***

  The two main problems caused by curly leaf pondweed are: 1) the formation of dense mats in late spring and early summer which may interfere with recreation and limit the growth of native aquatic plants, and 2) the mid-summer dieback of the plant which can cause rafts of dying curly leaf to pile up on shore, increase phosphorus concentrations in the lake and could lead to an increase in algae. Curly leaf pondweed can spread from

plant fragments, so it is important to clean all vegetation off your boat and equipment before you leave a water access. Once introduced, curly leaf pondweed spreads rapidly.

Curly leaf pondweed's unique life cycle gives it competitive advantages over many native aquatic plants. It becomes invasive in some areas because of its tolerance for low light and low water temperatures. These tolerances allow it to get a head start on and outcompete native plants in the spring. Unlike most native plants, curly leaf pondweed plants remain alive, slowly growing even under thick ice and snow cover. Therefore, it is often the first plant to appear after ice-out. In mid-summer, when most aquatic plants are growing, curly leaf plants are dying back. Before they die, they form vegetative propagules called turions (harden stem tips) that disperse by water movement. Turions lay dormant during the summer when native plants are growing and most germinate in the fall when most native vegetation has died back.

- **Eurasian water milfoil (aquatic)** is a submersed aquatic plant native to Europe, Asia, and northern Africa. It is the only non-native milfoil in Wisconsin. Like the native milfoils, the Eurasian variety has slender stems whorled by submersed feathery leaves and tiny flowers produced above the water surface. The flowers are located in the axils of the floral bracts, and are either four-pedaled or without petals. The stem thickens below the inflorescence and doubles its width further down, often curving to lie parallel with the water surface as much as 33 feet in length and frequently forming dense mats and/or canopies. Eurasian water milfoil is can be difficult to distinguish from Northern water milfoil. Eurasian water milfoil has 9-21 pairs of leaflets per leaf, while Northern milfoil typically has 7-11 pairs of leaflets.

  ***Impacts***
  Eurasian milfoil can form large, floating mats of vegetation on the surface of lakes, rivers, and other water bodies, preventing light penetration for native aquatic plants and impeding water traffic. The plant thrives in areas that have been subjected to various kinds of natural and manmade disturbances.

- **Spiny water flea (aquatic)** are not actually insects, but are tiny crustaceans, related to shrimp and lobster. They get their name because they have a long, sharp barbed tail spine. They are large zooplankton measuring about 1 centimeter in length and are active from late spring to late fall. Spiny water fleas can rapidly reproduce in summer because adult females can produce young without mating, at a rate of 10 young every two weeks.

  ***Impacts***
  Spiny water fleas eat zooplankton and thus compete directly with small fish that also need to eat zooplankton. Research shows that perch aren't growing like they should and some young can't survive because of the lack of food. Young fish have trouble eating these water fleas due to their long, spiny tails. A decrease in small fish populations could also take away a food source for larger sport fish. Because the fleas don't have many predators, their populations grow rapidly as they continue to eat up much of the zooplankton.

Fishing, boating, and other water recreational equipment can transport spiny waterfleas and their eggs to new water bodies. Their resting eggs can survive long after the adults are dead, even under extreme environmental conditions.

- **Zebra mussel (aquatic)** is a tiny (1/8" to 2") bottom-dwelling clam native to Europe and Asia. **One Zebra mussel has been discovered in Deer Lake in Polk County.** This invasive was introduced into the Great Lakes in 1985 and have been spreading throughout them since that time. They were most likely brought to North America as larvae in ballast water of ships that traveled from fresh-water Eurasian ports to the Great Lakes. Zebra mussels look like small clams with a yellowish or brownish D-shaped shell, usually with alternating dark - and light-colored stripes. They can be up to two inches long, but most are under an inch. Zebra mussels usually grow in clusters containing numerous individuals. Zebra mussels are the only fresh-water mollusks that can firmly attach themselves to solid objects - submerged rocks, dock pilings, boat hulls, water intake pipes and other mussels. They are generally found in shallow (6-30 feet deep), algae-rich water.

  ***Impacts***
  Because zebra mussels feed by drawing water into their bodies and filtering out most of the suspended microscopic plants, animals, and debris for food, their presence can lead to a depleted food supply for other aquatic organisms, including fish. Although zebra mussels can initially result in clearer water, the resulting higher light penetration fosters growth of rooted aquatic plants which although creating more habitat for small fish, may inhibit the larger, predatory fish from finding their food. This thicker plant growth can also interfere with boaters, anglers and swimmers. Zebra mussel infestations may also promote the growth of blue-green algae, since they avoid consuming this type of algae but not others.

  Zebra mussel invasions are cause for serious concern. They have caused millions of dollars of economic losses, declines of native species, and have dramatically altered aquatic ecosystems. These small mussels clog water intakes and damage equipment by attaching to boat motors or any hard surface. They can damage ecosystems by farming fisheries, smothering native mussel and crayfish and littering beaches with their sharp shells. Some beaches along Lake Michigan are now unusable due to these shells. These mussels also attach to the shells of native mussels in great masses, effectively smothering them. Industries spend millions to clean pipes fouled by zebra mussels and these costs are passed to the consumer. Lock and dam operators on the Mississippi River and raw water users have also incurred costs. The estimated annual cost of controlling zebra mussels in the Great Lakes now range from $100 to $400 million.

  In addition to economic impacts, zebra mussels can have a profound environmental impact. A huge population of zebra mussels can damage an ecosystem's sustainability as it damages the base of the food web having the potential to destabilize the entire ecosystem. Mussels accumulate organic toxins, and then excrete these same toxins and

pass these toxins up the food chain. Biological effects on other species include: loss of cover, nesting sites and forage; changing competitive relationships; fouling native mussels; and changing food availability.

**Table 26** documents the location and presence of the most common aquatic invasive species in Polk County which includes curly leaf pondweed, Chinese mystery snails, banded mystery snails, rusty crayfish, purple loosestrife, Japanese/giant knotweed, and Eurasian water milfoil.

While the current greatest terrestrial risks described previously focus on plant species (e.g., Buckthorn, Wild Parsnip), there are terrestrial invasive pests (e.g., Emerald Ash Borer, Gypsy Moth) and plant diseases (e.g., Oak Wilt) that are also of concern due to impacts on our native trees and habitats, while potentially increasing wildfire risk.

## Relative Level of Risk

The occurrence and spread of invasive species and plant diseases in Polk County will continue to be a very significant threat in the future and should continue to be planned for and aggressively managed. But the risks of additional outbreaks remain very high due to the movement of firewood, vegetation for landscaping, and wildlife from outside the county. Changes to the climate, drought, warmer winters, and water conditions have the potential to further exacerbate these risks by encouraging the spread and making native plants more vulnerable.

**Table 26. Common Aquatic Invasive Species in Polk County by Waterbody**

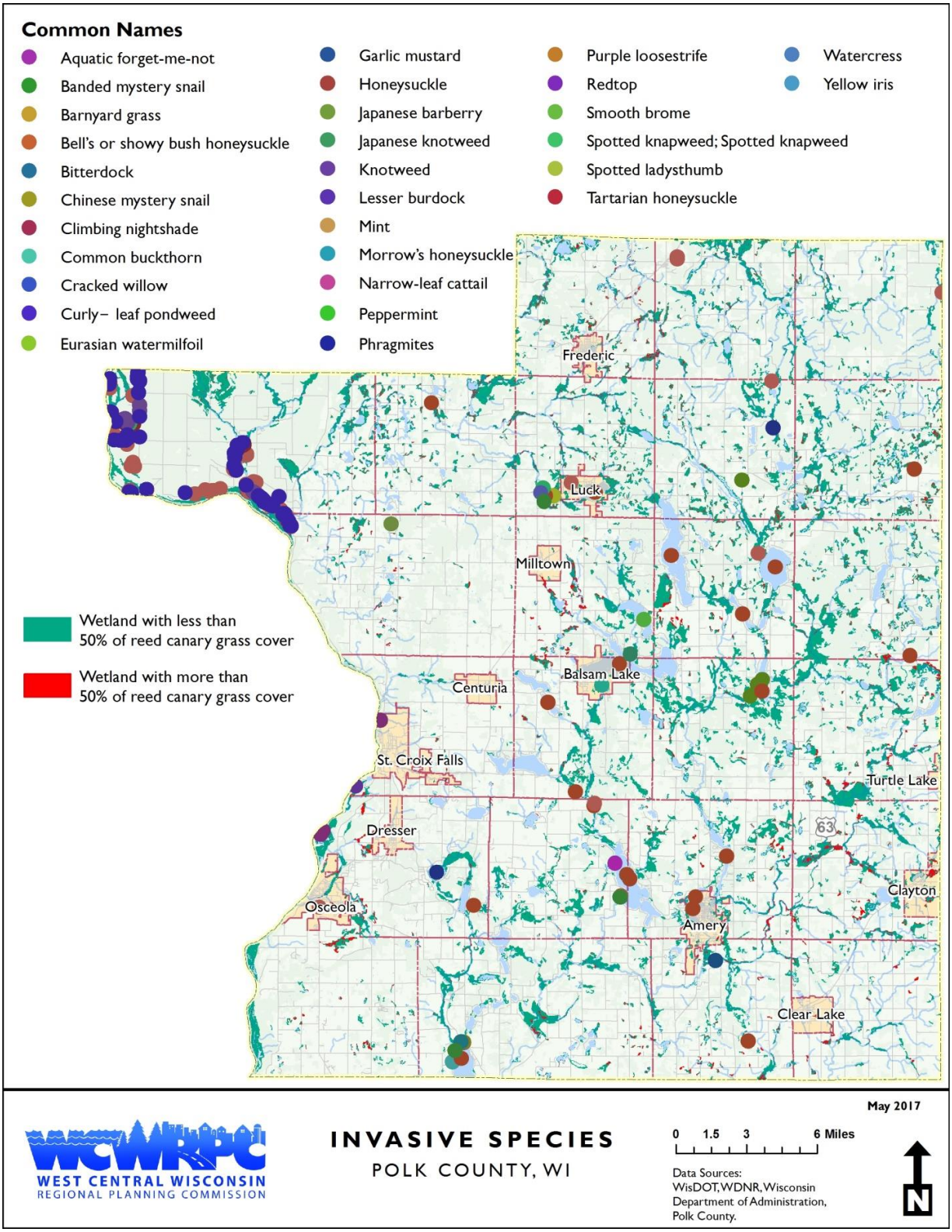
| Waterbody Name | Waterbody ID Code (WBIC) | Banded Mystery Snail | Chinese Mystery Snail | Curly-Leaf Pondweed | Eurasian Water Milfoil | Giant and Japanese Knotweed | Purple Loosestrife | Rusty Crayfish |
|---|---|---|---|---|---|---|---|---|
| Alabama Lake | 2449200 | | | x | | | | |
| Antler Lake | 2449400 | | x | | | | | |
| Apple River | 2614000 | | x | x | | | | x |
| Apple River Flowage | 2624200 | | | x | | | | |
| Balsam Branch | 2618300 | | | x | | | | x |
| Balsam Lake | 2620600 | | x | x | | x | x | |
| Bear Trap Lake | 2618100 | | x | x | | | | |
| Big Blake Lake | 2627000 | x | x | x | | x | | |
| Big Butternut Lake | 2641000 | x | x | x | | | | |
| Big Lake | 2615900 | x | x | x | | x | x | |
| Big Round Lake | 2627400 | | | x | | | | |
| Black Brook Flowage | 2621900 | x | x | x | | | | |
| Bone Lake | 2454400 | x | | x | | | | |
| Bone Lake | 2628100 | x | x | x | | | | |
| Camelia Lake | 2079400 | | x | | | | | |
| Cedar Lake | 2615100 | | x | x | x | x | | |
| Church Pine Lake | 2616100 | | x | | | | | |
| Clam Falls Flowage | 2666400 | | x | x | | | | |
| Clear Lake | 2623500 | | x | | | | | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Deer Lake | 2460500 | | | x | | | | |
| Deer Lake | 2619400 | | x | x | | | | |
| Fox Creek | 2626800 | | | | | | | x |
| Grimhs Lake | 2467400 | | | | | | x | |
| Half Moon Lake | 2621100 | x | x | x | | | | x |
| Herby Lake | 2468900 | | | x | | | | |
| Horse Lake | 2616200 | | | x | | | | |
| Horseshoe Lake | 2470100 | | x | | | | | |
| Horseshoe Lake | 2630100 | | | x | x | | | |
| Lake O' the Dalles | 2634200 | | | x | | | | |
| Little Butternut Lake | 2640700 | | | x | | x | | |
| Little Mirror Lake | 2477100 | | | x | | | | |
| Long Trade Lake | 2640500 | | | x | x | | | |
| Lotus Lake | 2616900 | | | | | | x | |
| Loveless Lake | 2620000 | | | x | | | | |
| Lower Pine Lake | 2479900 | | x | | | | | |
| Magnor Lake | 2624600 | x | x | x | | | | |
| McKenzie Lake | 2667300 | | x | | | | | |
| Mud Lake | 2619100 | | | x | | | | |
| North Pipe Lake | 2485700 | x | x | | | | | |
| North Twin Lake | 2623900 | | x | x | | | x | |
| North White Ash Lake | 2628800 | x | x | x | | | x | |
| Osceola Creek | 2632700 | | | | | | | x |
| Pike Lake | 2624000 | | x | x | x | | | |
| Pine Lake | 2489900 | | x | | | | | |
| Pine Lake | 2490400 | | x | x | | | | |
| Pipe Lake | 2490500 | | x | | | | | |
| Round Lake | 2616400 | | | x | | | | |
| Sand Lake | 2495000 | | x | x | | | | |
| Sandhill Lake | 2495400 | | x | x | | | | |
| Silver Lake | 2496700 | | x | | | | x | |
| South Twin Lake | 2623800 | | x | | | | | |
| St. Croix River | 2634400 | | | | x | x | | x |
| Staples Lake | 2631200 | x | x | x | | | | |
| Swede Lake | 2500500 | | x | | | | | |
| Trade River | 2636000 | | | | | | | x |
| Unnamed | 2658800 | | | x | | | | |
| Wapogasset Lake | 2618000 | | x | x | | x | | x |
| Ward Lake | 2599400 | | x | | | | | |
| White Ash Lake | 2628600 | | x | x | | | x | |
| Willow River | 2606900 | | | | | | | x |
| Wood River | 2642900 | | | | | | | x |

*Source: Polk County Aquatic Invasive Species (AIS) Strategic Plan, 2015-2020*

**Figure 33. Identified Invasive Species in Polk County**

This map shows known locations that have been identified, inventoried, and mapped. Additional locations are known, but have not been mapped. For example, Polk County Land & Water Resources staff indicated that many more locations with Curly Leaf Pondweed exist in the County but have not yet been added to the GIS database.



## *Vulnerability Assessment—Invasive Species*

### Potential Impacts

Impacts from invasive species vary by the type of species (aquatic vs. terrestrial) along with local conditions or human factors that influence how invasive species are introduced and spread throughout an ecosystem. For example, aquatic invasive species often leave their predators and competitors behind in their native ecosystems. Without these natural checks and balances they are able to reproduce rapidly and out-compete native species. Once established, they can alter ecological relationships among native species and can affect ecosystems function, economic value of ecosystems and human health.

Humans have created conditions where plants and animals can aggressively invade and dominate natural areas and water bodies in three ways:

- introducing exotic species (from other regions or countries) who lack natural competitors and predators to keep them in check;
- disrupting the delicate balance of native ecosystems by changing environmental conditions -- e.g., stream sedimentation, ditching, building roads) or by restricting or eliminating natural processes (fire for example); in such instances, even some native plants and animals can become invasive; and
- spreading invasive species through various methods. Some examples:
    - moving watercrafts from waterbody to waterbody without removing invasive plants and animals;
    - carrying seeds of invasive plants on footwear or pet's fur;
    - mowing along roadsides;
    - importing firewood and leaving in campgrounds;
    - driving and biking with invasive seeds in tire treads.

The net result is a loss of diversity of our native plants and animals as invasive species rapidly multiply and take over. About 42 percent of the species on the federal Threatened or Endangered species lists are at risk primarily because of invasive species.

In the United States, over $137 million is spent annually as a result of invasive species. Since its inception in fiscal year 2004, the Wisconsin Aquatic Invasive Species Grant Program has invested about $9 million in grants to reimburse local projects to monitor and control invasive species. The follow are the primary vulnerabilities from the spread of invasive species in Polk County.

**Economic Concerns**

In Wisconsin, some industries affected negatively by invasive species include sport and commercial fishing, forestry, agriculture, and raw water users including power companies, industrial water users, and municipal water plants. These expenses are passed on to Wisconsin consumers, such as in higher water and electric bills.

The Great Lakes sport and commercial fishing industry, valued at almost $4.5 billion and supporting 81,000 jobs, is at risk due to the growing numbers of invasive species present in its

waters. For example, invasive round gobies eat the eggs of sport fish such as small-mouth bass, trout and sturgeon in the nearshore areas of Lake Michigan.

There have been negative economic impacts due to the VHS restrictions on baitfish sales and fish hatchery/stocking operations. Other negative impacts include but are not limited to the reduction of property values. One study shows that property values have decreased as much as 19% on lakes infested by Eurasian water milfoil.

Invasive shrubs such as non-native buckthorns and honeysuckles prevent the regeneration of young trees, causing a long term but very serious impact on forestry in Wisconsin – a $28 billion a year industry with 66,000 jobs. In Wisconsin alone, 2015 spending on invasive species totaled approximately $8.4 million.

Many of the invasive plants that impact our natural areas are also agricultural weeds and are frequently spread along and from corridors that cut through the landscape, like roads, rail lines and utility corridors. In 2001, Wisconsin Electric Power Company reported that they were spending $1.2 million per year in the control of zebra mussels on their Lake Michigan power plants. These animals congregate on and clog intake and distribution pipes.

**Health Concerns**

Some invasive species may cause significant health problems. For example, a South American strain of human cholera-causing bacteria was found in ballast water tanks of ships in the port of Mobile, Alabama in 1991. Also, sharp zebra mussel shells can cut the feet of unsuspecting swimmers and waders.

Health risks aren't only confined to water-dwelling invasive species. Simply rubbing against wild parsnip with bare skin can cause burned and blistered arms and legs. This roadside and grassland invasive is spreading rapidly in Wisconsin, but few people know of its dangerous impacts.

Invertebrates are increasingly becoming vectors for serious diseases of humans, livestock and wildlife. In Wisconsin we have recently seen the expanded range of the lone star ticks previously found only to our south. We now have at least six serious tick-borne diseases affecting thousands of people per year.

**Ecological Concerns**

The introduction of invasive species disrupts natural communities and ecological processes. This disruption alters the role of competition and predation in many different ways, including ruffe and round goby outcompeting native species and the negative impacts that has had on the food web. Other negative impacts include the displacement of native species with the loss of species diversity and degradation of habitats due to invasive species like garlic mustard, honeysuckle and other shrubs, purple loosestrife, and Eurasian water-milfoil among others. These invasive plants and animals also have the potential to be vectors for diseases that threaten the health of the ecosystem. Many of the constraints that invasive species face in their native range (e.g. diseases and pests) are absent in Wisconsin, which allows them to rapidly multiply at the expense of native plant and animal species.

The net result is a loss of diversity of our native plants and animals as invasive species rapidly multiply and dominates forests, grasslands, wetlands and water bodies. About 42% of the species on the federal endangered of threatened or endangered species lists are at risk primarily because of invasive species.

In our waterways, the rapid spread of zebra and quagga mussels shows how profoundly an invasive species can alter the environment. These small mussels with huge appetites for microscopic plants and animals rapidly reproduce and are capable of severely altering their environment by reducing the food supply for native organisms and by enhancing conditions for the rapid growth of blue-green algae and aquatic vegetation.

In our woodlands, garlic mustard can completely cover the ground with first- and second-year plants in a matter of a few years. This European garden herb not only reduces light and nutrient resources needed by native wildflowers, it is also thought to secrete a chemical into the soil that inhibits the mycorrhizal fungi necessary for tree growth.

**Recreation Concerns**

Invasives can also alter your recreational activities. Hunters, hikers and birdwatchers can find that they are no longer able to walk in their favorite natural areas. Thorny multiflora rose, dense stands of buckthorn and other invaders fill in the understory of once open forests and grasslands. As habitat is modified by such invasive plant species, the wildlife that depends on native species also declines. Invasive animals such as the mute swan can also change our wildlife opportunities by chasing away waterfowl from the waterbodies they occupy.

Non-native earthworms and generalist native species like white-tail deer tend to increase in weedy habitats, and in turn they alter soil chemistry and structure and decrease native plant species and increase weedy non-natives. Gardeners who have the Asian jumping worm in their yards may find that worms have altered what they are able to grow.

Fishing outings can result in disappointment when aquatic invasive species modify our lake and stream habitats. Eurasian water milfoil can clog boat motors and invasive animals such as the rusty crayfish gobble up aquatic plants like underwater lawn mowers, reducing habitat for native fish at every stage of their life cycle. The invading crayfish may even eat the eggs of some of our favorite sport fish. This threatens a national sport and commercial fishing industry that supports 81,000 jobs in the Great Lakes region.

## Vulnerable Critical Facilities

No critical facilities were identified as being uniquely vulnerable to invasive species. However, transportation routes, including logging roads and ATV trails, can contribute to the spread of invasive plants, as vehicles and their tires can spread the seeds of invasives.

## Multi-Jurisdictional Risks and Vulnerabilities

During the plan update process, city and village officials indicated that they largely looked to Polk County Land & Water Resources, volunteer groups, and lake associations/districts to take

the lead locally on invasive species issues. As noted in Appendix G, Buckthorn, Wild Parsnip, and aquatic invasives were the most frequently noted concerns. Some cities, villages, and towns have been taking action to remove or control terrestrial species that they are aware of in parks and ditches. However, there is also a lack of awareness of these concerns in some communities, including the ability to identify species and actions that can be taken my local communities to help with prevention or control.

## Related Plans and Programs

Educating landowners, lake users, and visitors is vital to combating these risks. There is a wealth of information available through the Wisconsin Department of Natural Resources, University of Wisconsin-Extension, and many other federal, state, local, and non-profit agencies on these issues. Partnerships are also important, such as the efforts of some of the following agencies and non-profit organizations:

**Invasive Plants Association of Wisconsin (IPAW)** is a nonprofit organization whose mission is to promote better stewardship of the natural resources of Wisconsin by advancing the understanding of invasive plants and encouraging the control of their spread. IPAW's main goals in achieving this mission are geared toward being an umbrella organization for Cooperative Invasive Species Management Areas (CISMAs) while creating an effective way in which to reach legislators to voice the concerns about invasive species control. Although IPAW is Wisconsin-based, we serve the entire Upper Midwest. IPAW has approximately 200 members. These members include researchers, foresters, landscapers, horticulturalists, agronomists, prairie restorationists, aquatic ecologists, and concerned citizens. Our members come from nearly every academic discipline and many different public, private, and nonprofit institutions.

Online at: www.ipaw.org

**Midwest Invasive Plan Network (MIPN)** formed in 2002 and the purpose of this group is to reduce the impact of invasive plant species in the Midwest. MIPN primarily works with partners in the upper Midwestern states of Illinois, Indiana, Iowa, Michigan, Minnesota, Missouri, Ohio, and Wisconsin, and the Province of Ontario, Canada.

Organizational focal areas were solidified in a strategic vision developed in 2009 and include the following:

- Development of invasive species spread prevention measures, particularly those that engage the green (nursery and landscape) industry
- Promoting early detection and rapid response programs and methods
- Promoting consistent regional methods for inventorying, monitoring and tracking invasive plants and encouraging cross-boundary data sharing
- Serve as a bridge between the research and land-management communities by compiling and sharing research findings with land-managers and communicating research needs observed by partners in the field to research institutions
- Development of regional outreach and education, including publications and conferences.
- Cultivation of sustainable financial support for MIPN and its mission

As a regional network, MIPN draws on the knowledge, experience, and enthusiasm of a diverse group of participants and partners. MIPN's full-time Coordinator position is funded through both federal and private funding sources, including membership contributions. The Morton Arboretum hosts MIPN's Coordinator, providing office space, basic supplies, and administrative and accounting services. The Nature Conservancy of Indiana, Purdue University, the U.S. Forest Service, and the Wisconsin Department of Natural Resources each played a major role in MIPN's development over the years.

Online at www.mipn.org

**St. Croix - Red Cedar Cooperative Weed Management Area (CWMA)** encompasses St. Croix, Polk, Barron, Washburn, and Burnett Counties. The group assembled in 2013 and appointed its first coordinator in 2014. Today, the CWMA is a collaborative of invasive species managers that include county governments, Wisconsin state agencies, federal agencies, private landowners, and non-profits. The CWMA operates according to a very new memorandum of understanding (2016) and works to accomplish actions in its new Strategic Management Plan (2016) and biennial work plan (2016).

Since its formation, the St. Croix - Red Cedar CWMA has been very active in training and enabling citizens to prevent and control invasive species. Specific activities have included:

- Hosting in-field identification and control trainings for citizens on species such as Japanese knotweed, garlic mustard, invasive honeysuckles, and spotted knapweed. Trainings have typically included hands-on removal or dispersal of biological control agents.
- Offering an in-service training for foresters on preventing and managing for invasive species.
- Assembling and operating a traveling trailer with invasive species removal tools and herbicide equipment. The trailer and equipment were funded through a grant from the Wisconsin Department of Natural Resources. Today, the trailer is housed in the Polk County Land and Water Resources Department. Any partner willing to sign a Trailer Operations Agreement can take and use the trailer and its equipment for invasive species educational and control events.

Online at: www.scrcinvasives.org

**U.S. Fish and Wildlife Service** is the only agency of the U.S. Government whose primary responsibility is the conservation of the nation's fish, wildlife, and plants. Because of our responsibilities, the Service is very concerned about the impacts that invasive species are having across the Nation. Invasive plants and animals have many impacts on fish and wildlife resources. Invasive species degrade, change or displace native habitats and compete with our native wildlife and are thus harmful to our fish, wildlife and plant resources.

Online at: www.fws.gov

The **Office of Oceanic and Atmospheric Research (OAR)** - or "NOAA Research" - provides the research foundation for understanding the complex systems that support our planet. Working in partnership with other organizational units of the National Oceanic and Atmospheric Administration, a bureau of the Department of Commerce, NOAA Research enables better forecasts, earlier warnings for natural disasters, and a greater understanding of the Earth. Our role is to provide unbiased science to better manage the environment, nationally, and globally.

Online at: www.research.noaa.gov

**Wisconsin Lakes**, formerly known as the Wisconsin Association of Lakes, is the only statewide non-profit organization working exclusively to protect and enhance the quality of Wisconsin's 15,000 lakes. We are the citizen arm of the Wisconsin Lakes Partnership.

Online at: www.wisconsinlakes.org

**The Wisconsin Lakes Partnership** brings science, education and citizens together to empower people to work together to care for our lakes. Recognized as a national model of collaboration, they work cooperatively with two other groups to support our lakes: The Wisconsin Department of Natural Resources (WDNR) supplies technical expertise and regulatory authority; the University of Wisconsin-Extension (UWEX) provides educational materials and programs; and Wisconsin Lakes serves as the voice for concerned citizens, communities and lake groups statewide.

Online at: www.wisconsinlakes.org/wi-lake-partnership/

The **Aquatic Nuisance Species (ANS) Task Force** was established by Congress with the passage of the Nonindigenous Aquatic Nuisance Prevention and Control Act (NANPCA) in 1990 and reauthorized with the passage of the National Invasive Species Act (NISA) in 1996 (collectively, the Act). Composed of 13 Federal and 15 ex-officio members, it is the only Federally-mandated intergovernmental organization solely dedicated to preventing and controlling ANS.

The Act charges the ANS Task Force with implementing the Act by developing and executing a program that:

- Prevents the introduction and dispersal of ANS;
- Monitors, controls and studies such species;
- Conducts research on methods to monitor, manage, control and eradicate such species;
- Coordinates ANS programs and activities of ANS Task Force members and affected state agencies; and
- Educates and informs the general public and program stakeholders about the prevention, management, and control of these species.

Co-chaired by the U.S. Fish and Wildlife Service and the National Oceanic and Atmospheric Administration, the ANS Task Force works in conjunction with Regional ANS Panels and issue-specific committees to coordinate efforts among Federal and State agencies as well as efforts of the private sector and other North American interests. The ANS Task Force strives to create opportunities and synergies among members and participants to work collaboratively by sharing resources, expertise, and ideas across agency and organizational lines.

Online at: www.anstaskforce.gov

Other key partners in addressing invasive species in Polk County include:

- Polk County Association of Lakes and Rivers;
- St. Croix River Association;
- National Park Services; and
- Wisconsin Sea Grant.

There are also numerous plans and policies in place to address the risks associated with invasive species in Polk County. Chapter NR 40 as required by Wisconsin Statute §23.22 defines the Wisconsin Department of Natural Resources program for the identification, classification, and control of invasive species. From this guidance, best practices are integrated into county-level plans, such as the *Polk County Land and Water Resource Management Plan*. The Polk County Forestry and Parks Department maintains the County's forested lands in accordance with the *Polk County 15-Year Comprehensive Forest Land Use Plan* which includes measures to mitigate the risks and vulnerabilities associated with tree-related invasives. Polk County Land and Water Resources Department has also developed and takes the lead in implementing the *Polk County Aquatic Invasive Species (AIS) Strategic Plan*. And the St. Croix River Association has also completed a basin-wide AIS Strategic Plan. Additional plans are in place at the Federal and State levels, as well as lake association and district plans and private woodlot management plans.

# SECTION IV.
# CURRENT MITIGATION ACTIVITIES

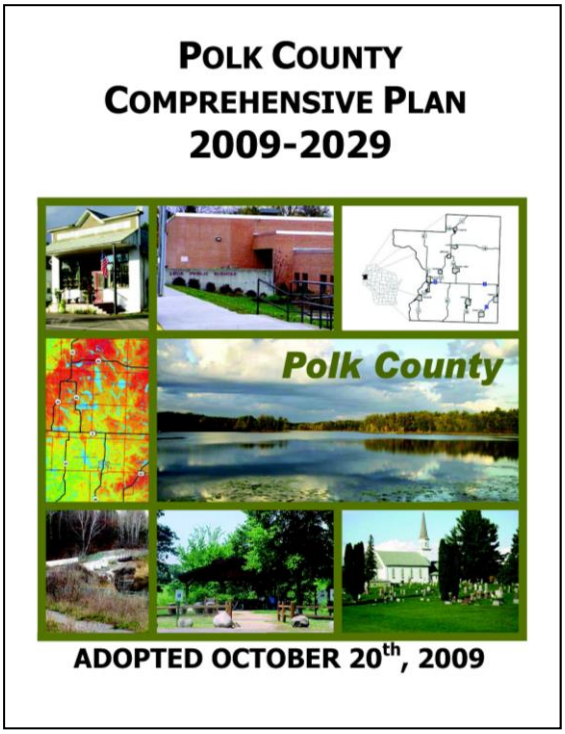
Before developing a mitigation strategy, it is important to consider the mitigation activities and strategies already implemented. Polk County and its municipalities have been proactive in mitigating the impacts of natural hazards. The following section summarizes the key county-level mitigation- and preparedness-related activities that are being carried out within the County and demonstrates a strong tradition of communication and inter-agency cooperation. **Appendix H** provides additional insight into recent or current mitigation activities for each of the participating cities and villages in Polk County, along with some of the related challenges for these communities. Section V discusses those mitigation activities completed for each of the strategy recommendations from the 2012 plan.

## A. PLANNING AND REGULATORY ACTIVITIES

For a broad review of the various plans and land use policies in Polk County, please refer to the *Inventory of Plans, Programs, and Land Use Policies in West Central Wisconsin* compiled by West Central Wisconsin Regional Planning Commission in October 2008.

### Comprehensive Planning

Polk County and all participating cities and villages have adopted comprehensive plans under Wisconsin Statute §66.1001. These plans provide a vision for future development and identify strategies to help achieve this vision. Mitigating hazards, floodplain management, and other emergency preparedness measures can be an important component of these plans. The relationship between this mitigation plan and the Polk County Comprehensive Plan is further considered and discussed in Section VI. A. Mitigation Goals and Section VII.A. Plan Coordination.




### Building & Sanitary Permits

Building permits under the Uniform Dwelling Code are required for all new one- and two-family dwellings and are administered through the local city, village, or town. In addition, a Sanitary Permit through Polk County is also required for new private, on-site wastewater treatment systems (POWTS).

## Land Use Controls

At the County level, the ordinances described in this section are primarily enforced through the Polk County Land Information Department-Zoning Division. Many cities, villages, and towns also enforce similar ordinances for their jurisdictions.

**Zoning** – The majority of towns in Polk County are covered under the *Polk County Comprehensive Land Use Ordinance*, more commonly known as the Zoning Ordinance. The exceptions are:

- Have their own zoning – Farmington, Garfield, St. Croix Falls
- Unzoned – Clam Falls, Georgetown, Lorrain, Laketown, Sterling

The County's zoning ordinance does not require that emergency storm shelters/safe rooms or related emergency plans be provided for mobile home park development, though such actions could potentially be pursued as part of conditional use permitting. Right-of-way and driveway standards for County highways and local roads are regulated by the jurisdiction that is responsible for the roadway.

**Subdivision Regulations –** The *Polk County Subdivision Ordinance* covers all unincorporated areas of the County and includes a site plan review process by the Land Records Director and County Surveyor, working in conjunction with the Land & Water Resources Department. The 1996 ordinance update increased attention to stormwater issues, and the County may require the applicant to submit stormwater management and erosion control plans based upon accepted State of Wisconsin guidelines. Drainageway easements may be required to accommodate anticipated stormwater discharge from the development. Many of the cities, villages, and towns have also adopted subdivision regulations with similar standards.

**Floodplain Ordinances –** In order to better protect the residents of Polk County, and to minimize the loss of property, the State of Wisconsin, under Wisconsin Statute 87.30(1), requires counties, cities and villages to adopt and enforce floodplain zoning. In addition, Wisconsin Administrative Code NR116, Floodplain Management Program, has been promulgated for the protection of property and public investments from the effects of flooding. Development within the floodplain is analyzed through the use of the Flood Insurance Rate Maps (FIRM) developed by the Federal Emergency Management Agency (FEMA) and site surveys as needed. NFIP participation and floodplain mapping were discussed in more detail in the flooding assessment of Section III.B.iv.

**Polk County Shoreland Protection Zoning Ordinance –** This ordinance was last updated in 2016. Shorelands provide valuable habitat for both aquatic and terrestrial animals and vegetation, and also act as buffers and, thus, serve to protect water quality. However, shorelands are also considered prime residential building areas because of their scenic beauty. Recognizing this conflict, and in order to maintain the environmental, recreational, and economical quality of our water resources, the State of Wisconsin requires counties to adopt and enforce a shoreland ordinance.

As required by the State, shorelands are defined as:

- all land within 1,000 feet of the ordinary high water mark of a lake, pond or flowage; or
- all land within 300 feet of the ordinary high water mark of a river or stream or to the landward side of the floodplain, whichever is greater.

The ordinance regulates development in shoreland areas to the extent allowed for under State law. Similarly, most cities and villages regulate shoreland areas through shoreland-wetland zoning. These ordinances are an important stormwater management tool to help protect buildings, infrastructure, and water quality.

## Land Information and Parcel Mapping

The Polk County Land Information Department-GIS Division has a very strong working relationship with the County's Emergency Management Department. The Geographic Information Systems (GIS) Division provides Enhanced 9-11 System mapping for the County, including rural addressing, and maintains a growing GIS dataset in terms of usefulness for hazard mitigation management. Parcel mapping for Polk County has been completed, and many of the critical facilities in the County have been mapped as previously discussed in Section II.D. Mobile home parks, resorts, and campgrounds have also been mapped for reference.

## Land and Water Resources Department

Polk County has an active Land and Water Resources Department responsible for a variety of educational, advocacy, and enforcement activities to protect the farmlands, waters, and natural resources of the County under the guidance of the *Polk County Land and Water Resource Management Plan*. This department provides water management planning for surface waters, works closely with lake districts and lake associations in the County, administers the volunteer-supported Adopt-a-Stream program, takes a lead role in combatting invasive species, work with the agricultural community (e.g., nutrient management, promoting best management practices), and performs a wide variety of other related activities. The department also enforces a number of related ordinances, such as the *Polk County Non-Metallic Mining Ordinance*, *Polk County Illegal Transport of Aquatic Plants and Invasive Animals Ordinance*, and the two ordinances summarized below.

**Polk County Stormwater Management and Erosion Control Ordinance** – This ordinance is intended to meet the current State of Wisconsin construction site erosion control and post-construction stormwater management regulatory requirements. The Polk County Land and Water Resources Department enforces the County's stormwater management and erosion control ordinance which requires permitting, site planning, and/or erosion control measures depending

on site conditions, land use, and the amount of land disturbance. This ordinance applies to all of the unincorporated towns, unless a town adopts its own ordinance which is at least as restrictive of the county ordinance. Cities and villages often have similar ordinances.

**Polk County Manure and Water Quality Management Ordinance** – The Polk County Land and Water Resources Department also administers an ordinance requiring nutrient management plans for agricultural operations greater than 300 animal units or for the doubling of herd sizes in sensitive areas. Additional standards and planning may apply in Water Quality Management Areas due to local physical characteristics (e.g., depth to bedrock, karst).

### St. Croix National Scenic Riverway – Federal Wild and Scenic River

Flooding vulnerabilities along the County's most notable water body—the St. Croix River—are very low, largely due to the river's Federal Wild and Scenic River status. The far majority of the floodplain along the River is federally or State-owned, and development along the river is mostly limited to park and recreational land. Scenic easements and shoreland setbacks apply to the remaining private lands, which has limited floodplain development. Management of the St. Croix National Scenic Riverway falls under the National Park Service in cooperation with the states, counties, and local jurisdictions along the riverway. Additional partners, such as the St. Croix River Association, perform a variety of advocacy and support roles.

## B. PHYSICAL CONSTRUCTION ACTIVITIES

Natural hazard impacts, especially for flooding in Polk County, can potentially be mitigated through infrastructure improvements and construction projects. Such activities can range from the construction of stormwater retention ponds to the installation of storm shelters to the removal of homes from flood-prone areas. These tend to be very costly projects for which grant dollars are often pursued or required. Some activities, such as the use of snow fences in areas prone to drifting snow, are less costly and temporary methods of hazard mitigation employed by Polk County.

### Road and Culvert Improvements

In Polk County, such projects are often in response to a hazard event, such as those funding requests to FEMA for recovery from flooding in 2000 and 2001. Most of these projects tend to be road, culvert, and drainage system repairs or improvements to mitigate a stormwater/flash flooding hazard or over-the-road flooding. The County and many local municipalities replace culverts and make other road improvements as time and money allow. As noted previously in the flooding assessment (Section III.B.iv.), a number of flooding and stormwater flooding "hotspots" identified in the previous mitigation plans have since been addressed and do not appear in this plan update.

### Flood Control by Dams

Section III.B..iv. previously discussed the location, ownership, and condition of dams in Polk County. According to the FEMA Flood Insurance Program Study dated September 16, 2011, "Polk County has no existing flood protection measures." However, many of the dams in Polk

County play an important role in flood control. Maintenance at the County- or municipal-owned dams, such as vegetation removal and repairs due to animal damage, is ongoing. Policies, warning systems, and evacuation procedures are in place for the County-owned dams; and these will be reassessed based on future dam shadow analysis or environmental changes. Emergency contact information for the larger dams is available in the Polk County Emergency Management Office. Polk County Emergency Management has established warning systems and evacuation procedures for those persons in areas that may flood due to dam failures. This includes road closings and rerouting of traffic to keep travelers out of these danger areas. Such a procedure with alternative routes has been developed in the event of a failure at the Black Brook Dam, for example.

Xcel Energy has developed emergency action plans for all of their power dams. Copies of these plans are available at the Sheriff's Department, Polk County Emergency Management Office, and the Northwest Area Wisconsin Emergency Management Office. Included in the plans are the warning procedures, areas of anticipated flooding if a failure should occur, and extensive mapping of the associated river systems. The large Xcel Energy dam at St. Croix Falls has two on-site operator shifts and an alarm system tracked remotely in Eau Claire. When a watch or warning is required, Xcel's dispatch in Eau Claire would be alerted; and the necessary local contacts down river from the dam would be made.

## Other Flood Mitigation Improvements

Recent flood mitigation efforts in Polk County have primarily been limited to planning and regulatory strategies and improvements to infrastructure. Many of the communities have undertaken various surface and sub-surface stormwater system improvements. In the unincorporated towns, such improvements are largely limited to ditches, culverts, and road right-of-ways, except in some developing areas and subdivisions. More extensive stormwater improvements and controls can be found in the cities and villages. The 2006 plan noted that homes have been moved to prevent damage from future lake flooding at Sand Lake in the Town of Laketown. And the Village of Osceola implemented a buy-out and removal of trailer homes from the Osceola Creek floodplain. Similar flood mitigation and stormwater management improvements are ongoing by the County, cities, villages, and towns based on need and as priorities and resources allow.

## Other Infrastructure Activities

While most recent efforts across Polk County have focused on stormwater system improvements, ongoing maintenance of the County's infrastructure and properties is also required. Local utilities maintain aggressive tree-cutting programs to reduce the frequency of downed power lines, with some power lines being buried in areas prone to weather-related outages. Polk County Emergency Management also maintains a limited stock of sandbags to assist in flood containment and has worked with schools, businesses, and municipalities to identify "best available" severe weather/tornado safety areas.

# C. EMERGENCY PREPAREDNESS AND COMMUNICATION ACTIVITIES

## Flood Monitoring Systems

The flooding of area rivers and streams is typically a result of persistent heavy rainfall or significant snowmelt during the spring. During these conditions, the County utilizes a combination of resources to assist them in evaluating the potential flood conditions. Most notably, the National Weather Service observes, predicts, and provides warnings related to storm events and flooding, which are closely monitored by Polk County Emergency Management.

For the St. Croix River, the National Weather Service's Advanced Hydrologic Prediction Service provides on-line access to river gauge observations, 48-hour forecasts, and warnings:

http://water.weather.gov/ahps2/index.php?wfo=mpx

Gauges are available at Danbury, St. Croix Falls, and Stillwater. This information is used to predict the crest of rising waters and time of the crest. The National Weather Service also provides longer-term flood outlooks which are also available via their website and periodic webcasts.

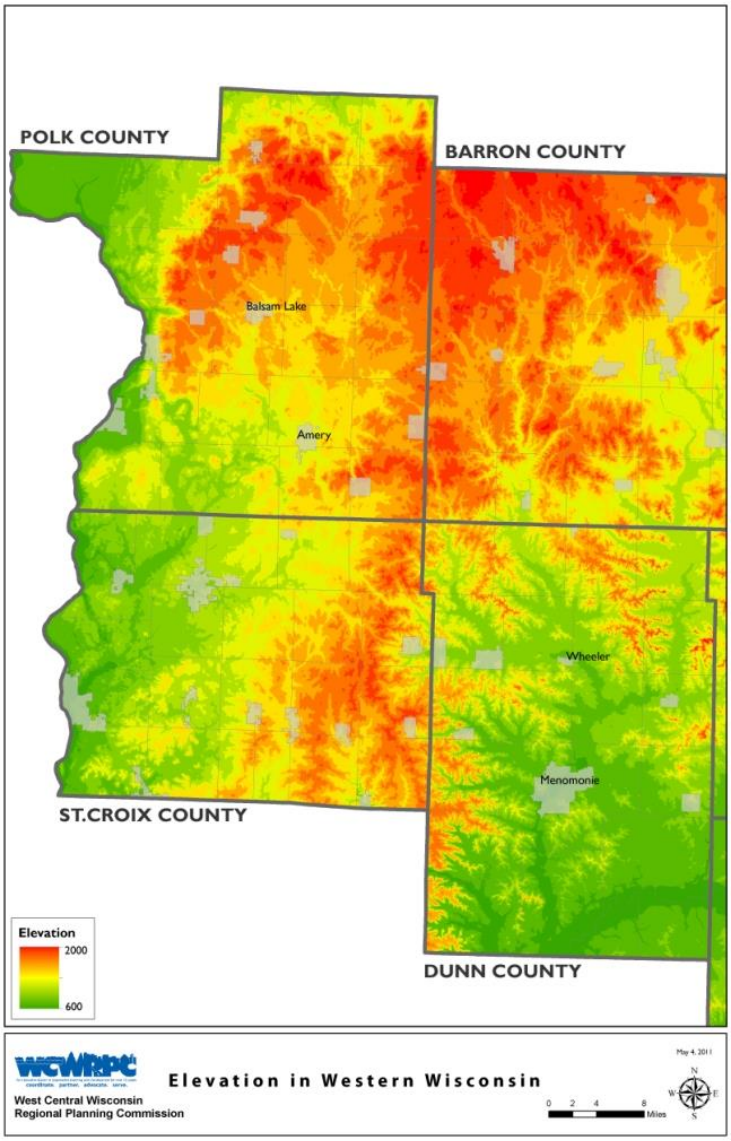
When conditions are favorable for a flood, the National Weather Service issues a warning alerting people to the potential through radio, television, and weather alert radios. When conditions begin to threaten an area, residents are further notified through press releases and press interviews. Law enforcement and other emergency service agencies also notify residents of the advancing flood using public address systems on emergency vehicles and through door-to-door contacts. Since flash flooding can occur quickly, people are alerted as early as possible of the flood potential so they are aware and watchful of changing conditions. The observations of law enforcement and fire agencies add assistance in determining the timing and need for evacuations.

When a disaster is imminent or does occur, the public is informed of changing conditions and predictions through an incident command system. Typically, there is not an urgent, immediate need to evacuate people quickly. Should it be determined that an area will be inundated by floodwaters, residents are notified by public service agencies that are monitoring conditions. People can evacuate with their own resources. Emergency service agencies ensure that notifications are received in the local area through announcements and door-to-door contacts as determined necessary.

## NOAA All Hazards/Weather Radios

According to the National Weather Service website, Polk County is primarily served by four NOAA radio stations located at: Menomonie WI, Spooner WI, Pine City MN, and Minneapolis/St. Paul MN. The NOAA coverage area maps show nearly complete coverage, except in some areas along the St. Croix River and a few other isolated locations due to topography.

However, during community meetings, some residents noted that there was weak or no coverage in some central portions of the County (i.e., Balsam Lake area). This was confirmed by WCWRPC staff during the 2012 mitigation planning effort with the use of a personal NOAA All Hazards Radio with a built-in standard antennae; reception was very poor or non-existent in the municipal buildings of Balsam Lake, Amery, and Clayton.




The map to the left shows that the region's topography is the likely cause of the poor weather radio reception in central Polk County. Signals from the Wheeler, Spooner, and Pine City towers are blocked by large changes in elevation, while signal strength from Minneapolis tower is weak due to the distance involved.

According to the National Weather Service (NWS), there is a seventh NOAA weather radio frequency available. However, the tower site must be carefully selected to maximize coverage. Weather radio stations must be on a radio tower, not a water tower or other such structure.

Initial equipment costs for the transmitter, antenna, etc., would likely exceed cost $30,000. Funds must also be available for ongoing maintenance and tower rent, if applicable. If these barriers can be overcome, there is the possibility of adding an additional weather radio frequency to improve coverage in central Polk County. To date, discussions have not yielded a solution. And as the capability and use of smart/mobile phone warning systems and applications (apps) increase and become more popular, the demand for improving weather radio coverage may be decreasing.

## Other Weather Warning Systems


Polk County Emergency Management coordinates with the National Weather Service in training and sponsoring a semi-formal network of volunteer Skywarn Spotters which assist local law enforcement in watching and identifying potentially hazardous severe weather. Many local municipalities use their local fire siren as a weather warning device, though coverage areas are limited outside the incorporated areas. Television, radio, and the Internet are other primary ways local residents receive weather warning information.

Polk County also has a memorandum of agreement with Chisago County, Minnesota, to the west. Since severe thunderstorms almost always travel from a generally west-to-east route in the region, Chisago County would typically experience such weather prior to Polk County. When severe weather occurs in Chisago County, its dispatch will notify Polk County's Dispatch.

Most smart phones and mobile devices are enabled to receive Wireless Emergency Alerts (WEAs) based on proximity to cell towers with coverage areas that best match the zone of an emergency. Pre-authorized national, state or local government authorities may send alerts regarding public safety emergencies, such as evacuation orders or shelter–in-place orders due to severe weather, a terrorist threat, or a chemical spill, to the WEA system. In addition, a variety of smart phone apps exist that provide additional real-time severe weather and emergency alerts and information, such as the Red Cross *Emergency* app and the National Weather Service mobile weather app.

## Communications

Overall, emergency communications in Polk County are in solid shape. Polk County has a single emergency dispatch and paging system for the entire County and an agreement has been executed with Barron County to provide back-up 9-1-1 service if needed. An enhanced 911-system with fire numbers is in operation. A GIS-based autodialer system (i.e., Reverse 911) has been approved for implementation in 2017-2018. Polk County has completed implementation of the key recommendations in a 2006 study to make its emergency communications backbone infrastructure narrow-banded and P-25 compliant and is well positioned for the foreseeable future. The backbone tower system is in place, and the replacement of older portable radio equipment with digital-capable equipment for narrow-banding was completed in 2011. Additional equipment is being updated to digital.

Though much improved, some gaps exist in emergency communications (cell and radio coverage) due to local topography, such as the valley along the St. Croix River. Some responders noted that reception can be especially poor when inside brick or block buildings or in basements in some areas.

## Emergency Response and Operating Plans

All incorporated cities and villages of the County, and many of the towns, have adopted emergency operating plans, though many of these plans are in need of updating. Polk County also maintains an *Emergency Operating Plan* which identifies evacuation and shelter arrangements. This plan details how hospitals within the County will coordinate with responding agencies to ensure the best utilization of services and mitigate the loss of life or injury from a disaster situation. A County emergency animal disaster plan is included as an appendix to the *Emergency Operating Plan*.

To test existing emergency plans and procedures, Polk County Emergency Management periodically coordinates and conducts disaster and mock event exercises with municipal emergency medical personnel, local hospitals, ambulances, police, County Sheriff's Office, and volunteers.

## Planning for Pandemics

As of May 2017, the United States is not currently experiencing an influenza pandemic according to the U.S. Center for Disease Control. The CDC states that it is impossible to predict when the next pandemic will occur or how bad a future pandemic will be, so advanced planning is needed.[25] A great variety of mitigation and planning measures for pandemics have been undertaken in the last decade since the SARS epidemic in 2002-2003. Avian Fu (H5N1) and Swine Flu (H1N1) outbreaks have further increased awareness, cooperation, monitoring, and planning for large-scale disease or viral outbreak. Activities are being undertaken at all levels of government—from international to local.

A wealth of information on pandemic flu and related plans can be found at http://www.pandemicflu.gov/ which is managed by the U.S. Department of Health and Human Services. The State of Wisconsin maintains a similar website focusing on State initiatives and threats at: http://pandemic.wisconsin.gov.

Within Polk County, the Public Health Office has been the primary coordinating entity on pandemic flu. Local planning and preparedness activities have been occurring under the coordinating efforts of the Western Regional Partnership for Public Health Preparedness (WRPPHP), the State-recognized consortium for the region. Additional information regarding WRPPHP and their activities can be found at their website: http://www.wrpphp.org.

The addition of this sub-section is intended to recognize that planning for pandemics is a very important emergency preparedness activity for Polk County. Given the other intensive efforts underway to address this potential threat, the Steering Committee decided to not include pandemic flu within the scope of this plan. However, this does not diminish its importance or the efforts being made to plan for a possible outbreak.

[25] https://www.cdc.gov/flu/pandemic-resources/monitoring/current-situation.html

# D. EDUCATIONAL AND OUTREACH ACTIVITIES

The following is a synopsis of the many educational and public outreach activities regarding natural hazard risks and mitigation in Polk County. This description is not exhaustive or complete.

## General Public Education on Natural Hazard Risks

Polk County Emergency Management has a variety of materials available covering a wide range of hazard mitigation and preparedness topics. This information is distributed countywide throughout the year by use of displays, news media, radio, County web site, presentations to local groups, etc. Information and media packets are disseminated in conjunction with an associated season, with a substantial effort to educate the public on natural hazards made during Tornado and Severe Weather Awareness Week in April. During the mitigation plan update, the Steering Committee suggested that more educational and partnership efforts targeting private-sector businesses may be needed.

**Did you know?**

**75% of companies without a business continuity plan fail within 3 years of a disaster.**
***– Crisis Management International***

## Outreach to Seniors and Long-Term Care Facilities

The area aging office (Aging Disability & Resource Center of Northwest Wisconsin) works cooperatively with Polk County Emergency Management to prepare seniors and those with special needs for disaster events. The ADRC office assists clients with developing safety plans including emergency contacts, supplies, and preparing for an extended power outage.

Information is distributed through the ADRC newsletter, through its "meals-on-wheels" service, and at the meal sites. The monthly newsletter has a 3,000-4,000 circulation in Polk and Burnett counties, making it an excellent educational tool.

In 2016, the ADRC provided "meals-on-wheels" services to about 125 different clients on an average day, many of whom reside alone, and about 50 meals at the three County meal sites. The addition of a fourth meal site is under consideration.

The Aging Office also maintains a contact list of rural elderly residents through its "meals-on-wheels" and assistance programming. Their familiarity and relationship with these residents would be critical should emergency assistance to special populations be needed. These drivers know which of their clients may be most at risk should an event occur. Such contacts are also made to those who might be more at-risk during periods of high temperature.

Polk County offices and local fire departments receive continuing interest by long-term care facilities on emergency planning and preparedness issues and a template for such planning is available through County Emergency Management. As of January 2017, Polk County had six nursing homes, ten assisted living facilities, and fourteen other long-term care facilities. Some of these facilities are now turning to the County with expectations for planning assistance, evacuation assistance, or other such support.

## Educational Efforts Related to Agriculture

The Polk County University of Wisconsin-Extension Office, County Land and Water Resources Department, and the local USDA Farm Services Agency implement various educational efforts on mitigating the impacts of natural hazards upon agricultural operations. These efforts include pamphlets, press releases, presentations, web sites, and one-on-one discussions with farmers. Some common educational themes include: how to minimize the winter kill of alfalfa, controlling pests and invasive species, bio-security, nutrient management, manure storage, soil health, and crop residue management to prevent losses in times of drought. The Extension Office often works through local agri-businesses for distribution of this information.

Polk County farmers may contact the Polk County University of Wisconsin-Extension Office, the Polk County Land and Water Resources Department, and the Farm Service Agency Office for information and guidance related to drought and other weather-related disasters. Various Federal and State publications are available from these agencies on ground water movement, the hydrologic cycle, soil conservation, and irrigation methods. These agencies will also be the lead agencies in obtaining emergency food and water supplies for agricultural use.

## Educational Efforts Related to Forestry and Wildfire

The Wisconsin Department of Natural Resources, the UW-Extension Office, Polk County Land and Water Resources Department, the Polk County Forest Administrator, and local fire departments work cooperatively to educate residents, visitors, and landowners on wildfire risks and appropriate preventive practices. Educational efforts also encompass working with landowners on woodlot management and methods to reduce the vulnerabilities to pests or disease (e.g., gypsy moth, oak wilt, emerald ash borer).

Wildfire educational outreach particularly targets the intensive protection areas in the northern portions of the County though: radio and newspaper public service announcements, Smokey Bear presentations at schools and events, fire danger signs, distribution of educational materials, and similar activities. Educational pamphlets on burning permits are periodically distributed with tax bills in select towns. The WDNR periodically conducts workshops and exercises in the area on wildfire issues and techniques for local fire departments and emergency management personnel, with a large tabletop simulated incident command system exercise in the area about once every five years. The WDNR efforts are increasingly taking an all-hazard approach to preparedness and mitigation, as reflected in their compilation of the structure zone maps (emergency map books) that are useful during a variety of emergency scenarios.

# E. STRATEGIC PARTNERSHIPS

Based on past events locally and in the region, the residents of Polk County respond to the call for help in times of need, as reflected by the volunteer Skywarn Spotter network. And such

cooperation does not stop at municipal or county lines. Police services fall under the statewide Wisconsin mutual aid agreement, with additional support and coordination through Wisconsin Emergency Management—Emergency Police Services in times of crisis. County-wide mutual aid is now in place for fire protection. Mutual aid agreements exist with adjacent county emergency management offices, though such intergovernmental support has been available in the past during times of need (e.g., the Siren tornado). Hospitals in Polk County have mutual aid agreements with those in Hennepin and Ramsey counties in Minnesota. Additional support for mitigation and response is also available from the Federal and State government in times of need.

Informal or "handshake" mutual aid is still quite common between many communities for other services, such as public works, though formal agreements are becoming more common due to liabilities, funding resources, and the sophistication of equipment and required training. This is discussed further in Appendix H.

Additional support for mitigation and response is also available from other private and governmental sources. For example, many county offices coordinate and work closely with private sector and non-profit entities for disaster preparedness and during an emergency, including health care providers, electric providers and other utilities, Salvation Army, religious organizations, and youth groups. The Polk County Interfaith Caregivers are a particularly valuable resource for supporting the County's seniors and adults with disabilities. Housing authorities, community action programs, and care facilities are other important partners.

During times of drought, the Polk County Land and Water Resources Department works with the UW-Extension Office and USDA Farm Service Agency to survey crop damage and soil status for drought declarations. The County and its municipalities work closely with the Wisconsin Department of Natural Resources on topics such as wildfire prevention, floodplain management, and dam safety.

## West Central Wisconsin Regional Planning Commission (WCWRPC)

Polk County is a member of WCWRPC, and three representatives from Polk County are members of the Commission's governing body. WCWRPC provides community planning, economic development, and grantsmanship support for Polk County and local communities. This document represents the second hazard mitigation planning effort facilitated by WCWRPC on behalf of Polk County. WCWRPC has also partnered with Wisconsin Emergency Management, county emergency management offices, and other stakeholders to facilitate regional long-term power outage planning efforts, educating on continuity planning, and encouraging private-public partnering.

An innovative leader in responsible planning and development for over 40 years.
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## ARES/RACES

ARES/RACES functions in Polk County are coordinated through the Polk County Amateur Radio Association. ARES (Amateur Radio Emergency Service)/RACES (Radio Amateur Civil Emergency Service) groups are typically made up of residents who provide

volunteer communication support using HAM radios in times of extraordinary need. During time of war, only RACES members may use amateur HAM radios. The ARES/RACES group's radios have the advantage of being operable on batteries and having a large broadcast area. Equipment for the group's use is available within the County's old law enforcement building. The group is further deploying members to assist emergency services and expanding their automatic packet reporting system (APRS). Recruitment of additional members is also a need.

### American Red Cross

Polk County is served by the Northwest Wisconsin Chapter of the American Red Cross. Working with County Emergency Management and local communities, the Red Cross takes a lead role in the identification of emergency shelters (not storm shelters) in Polk County. Shelters have been identified in every city and village.

On-call volunteers are provided locally for the victims of emergencies through the Red Cross Disaster Action Teams (DAT). The County has a good DAT core group, but there is a need for more volunteers. House fires are the most common emergency for which the Red Cross is contacted, but it has responded to flooding and other past emergencies in Polk County.

### St. Croix Chippewa Tribe

The St. Croix Band of Lake Superior Chippewa Indians has a small community of about 52 homes, a health clinic, and a community center at Round Lake Village. The community center is available for use as a Red Cross shelter. Scattered Tribal heirship lands are also located within the County. Intergovernmental agreements may be advisable in some cases to ensure the ongoing provision of County and local emergency services on Tribal trust and heirship lands.

In recognition of the St. Croix Chippewa Nation's sovereign status, Polk County has executed a memorandum of understanding with the St. Croix Chippewa, which covers EPCRA planning and review related to hazardous materials and includes Tribal representation on the Polk County Local Emergency Planning Committee.

## F. OTHER MITIGATION AND EMERGENCY MANAGEMENT CHALLENGES

The following issues address multiple hazard types or identify opportunities to improve hazard response and recovery:

1. Emergency vehicles have difficulty accessing some driveways due to width, height clearance, or grades. These problems are often localized in wooded areas, areas of waterfront development, and hilly areas. During the town hazard survey, the Town of Alden described access for emergency vehicles on private roads as a "very serious

concern." Six of the eight fire departments responding to a mitigation survey ranked driveway access as being a moderate or higher concern within their service areas.

2. Development with lengthy cul-de-sacs and dead ends has occurred in some areas and communities of the County, which can pose access and egress challenges for emergency vehicles and snow removal.

3. Some communities have not formally adopted mutual aid agreements for public works and heavy equipment, though many are using the Rural Water Association's model. It is not entirely clear if this model applies to all services and support beyond water and wastewater systems. But cooperation between municipalities is strong when emergencies do occur and improving such public works partnering was a reoccurring theme throughout the city and village meetings.

4. Volunteer and donation management are very important aspects of response and recovery, and come with associated risks (e.g., liability, loss of funding opportunities) if not properly managed.

5. Emergency management and hazard mitigation planning is often a low priority for communities, with the exception of maintaining basic fire, police, first responder, and ambulance services. Local emergency response plans can quickly fall out of date due to turnover of local government officials, and these plans (and associated maps, resident information, etc.) may not be readily available to local officials should a disaster occur. It is also fairly common that hazard mitigation and emergency response issues are not integrated into other local planning and regulatory efforts, such as comprehensive plans. Education and outreach to cities, villages, and towns on emergency management issues is an ongoing effort and challenge. During the town hazard survey and city and village meetings, more emergency management training for employees and elected officials was an identified need. Not all individuals identified in local emergency operating plans have basic ICS training.

6. Recruiting and sustaining a volunteer base for community services (e.g., fire departments, First Responder, Red Cross Disaster Action Teams, ARES/RACES) is an ongoing challenge. The many opportunities for volunteerism and public service place great demands on volunteers, some of whom may become "burned out" with time. As more and more residents travel further for employment, it is increasingly difficult for many would-be volunteers to be on-call for emergency situations. The ever-increasing amount of time being required for training and certification is an additional barrier. The Red Cross and some small fire departments are struggling to maintain an adequate volunteer base.

7. Polk County has a "boiler plate" continuity of government plan. This plan needs to be revisited, updated, and expanded.

8. During meetings and interviews, the need for municipal and private-sector employees to be prepared at home was discussed. An individual who is prepared at home will be more able to assist with response and continuity for their place of employment or community.

9. The current County Emergency Operating Plan does not include a section or annex regarding livestock-related events (e.g., manure spills, disease outbreak, animal mass casualty, carcass disposal).

10. Many public- and private-sector resources are available for disaster response and recovery, though these resources may not be aware of how they fit into the emergency response and ICS systems or how they will be notified when a disaster occurs.

11. Emergency responders, storm shelters/safe rooms, and recovery shelters should have policies and an understanding of how to handle evacuation situations involving pets, especially for seniors.

12. Mitigation planning is not typically well-integrated into community comprehensive plans in the past.

Additional disaster threats and concerns expressed during interviews and community meetings not addressed in this natural hazards mitigation plan included: manure management and spills; pharmaceuticals in water from sewerage overflow or failing septic tanks, active shooter and workplace violence, transportation of hazardous materials, and phosphorus and algal blooms in surface waters.

# SECTION V.
# PROGRESS ON THE 2012 MITIGATION PLAN STRATEGIES

This section reviews the progress on each of the strategy recommendations from the *Polk County Natural Hazards Mitigation Plan* adopted and approved by FEMA in 2012. As discussed in the 2012 plan, the availability of resources and changing priorities affect implementation. For instance, some strategies were contingent on grant funding. The 2012 strategy list was comprehensive, and there was not an expectation that all strategies would be fully addressed within five-year's time.

**Table 27** also includes a recommendation on how each strategy may be addressed in this plan update based on the input of the responsible parties identified in the 2012 plan and the Steering Committee. Later in this report, the recommendations in Table 27 are further considered and analyzed for feasibility by the Steering Committee.

**Table 27. Progress on 2012 Plan Strategies**

| 2012 Plan Strategy | Progress | Recommendation for Plan Update |
|---|---|---|
| **Physical Infrastructure Strategies** | | |
| 1. Continue to address stormwater and flash flooding hotspots in the County. Two of the higher priorities are the re-building of the Atlas Bridge (CTH "B") and stormwater management activities in the growing area immediately east of St. Croix Falls. **(High Priority)** ***related to continued NFIP compliance*** | County Highway Dept has been fairly aggressive in addressing hotspots, but problem areas remain, including Atlas bridge. No concerns noted east of SCF. | Keep in plan and specify any priority projects. Remove east of SCF reference. |
| 2. Pursue the installation of weather warning sirens in unincorporated areas of high residential growth. Coordinate with those cities and villages who are in need of siren replacement, battery back-up, or additional siren coverage. **(High Priority)** | No new sirens installed in unincorporated areas. See city and village actions in Appendix H. | Consider as a multi-jurisdictional alternative strategy in plan update. |
| 3. Pursue grant funds for dry hydrants for fire protection in areas of concentrated development where other water sources are not readily available. | Still a need in some areas per Fire Departments and towns. | Keep in plan. |
| 4. Pursue grant funding to make cost-sharing available for the installation of storm shelters at mobile home parks and campgrounds were no existing shelter alternatives exist. | A storm shelter built at Lakeview Park in Balsam Lake for the seasonal campground & RV Park and nearby senior mobile home park. | Keep in plan. |
| 5. Continue to work with local power providers to bury electrical lines in areas prone to outages due to falling trees/limbs or high winds. | Polk-Burnett Elec Coop has buried lines around 3-4 lakes in last 5 yrs and looking at more. | Keep in plan. |
| 6. Complete the connections of the County Highway fuel systems, garage doors, and communications systems to the back-up generator. | Small generator and hookups available for doors. New facility within 1-3 years. | Re-focus on emergency fuel supplies. |

| 2012 Plan Strategy | Progress | Recommendation for Plan Update |
|---|---|---|
| 7. Work with the State of Wisconsin and Minnesota agencies to establish a warning or queuing system for east-bound traffic on U.S. Highway 8 approaching the "St. Croix Falls" hill under icy or dangerous conditions. | Communication between counties is good, but no action on warning system. | Re-word to focus on communication and planning to explore options further. |
| 8. Work with the dam owner and the Town of Clam Falls to address the problems with over-the-road flooding on CTH "I" at the Clam Falls Dam. | Continuing concerns with dam condition. Failure analysis approved in 2016. | Keep in plan. Upgrades needed, if dam to be retained. |
| **Planning & Policy Strategies** | | |
| 9. Conduct a survey of emergency power generator capability and needs for EOCs and other critical facilities. Identify alternatives to address identified needs. **(High Priority)** | Informally discussed. No fueling stations have generators. | Encourage LTPO preparedness and continuity planning. |
| 10. Investigate the feasibility of centralized testing and triggering of sirens through County Dispatch. | Considered, but no plans to modify current approach. | Remove from plan. |
| 11. Revisit and expand the Polk County Continuity of Government Plan. | No action. | Consider as a strategy alternative. |
| 12. Every five years, Polk County will update its orthophotography to allow tracking of land-use trends and anticipate potential hazards, unless alternative photography exists. | 2014 LIDAR obtained. 2015 orthophotography collected. | Keep in plan. |
| 13. Continue to work with other county, regional, and state organizations to secure grant funding support for countywide LIDAR, then request an update to the D-FIRMS in the future. ***related to continued NFIP compliance*** | LIDAR obtained. Discussions underway at regional level to explore options for updating D-FIRMs | Refocus on D-FIRM updates, possibly as a LOMR or PMR |
| 14. Continue to monitor river and lake overbank flooding on the two Sand Lakes and along the Apple River. If repetitive problems begin to occur, investigate mitigation alternatives as a potential project. ***related to continued NFIP compliance*** | No issues noted since 2012. | Keep Sand Lake near Dresser, but remove Sand Hill Lake |
| 15. Continue to maintain or advocate for up-to-date emergency operating plans and dam failure analysis for County dams, high hazard dams, and dams with critical infrastructure within their shadows. **(High Priority)** | Dam Failure Analysis completed for Clam Falls Dam in 2016. No other significant action for other dams noted. | Keep in plan. |
| 16. Adopt County ordinance language which requires new mobile home parks to construct or identify per formal agreement a storm shelter for their residents. Provide model language to cities and villages for consideration. **(High Priority)** | No new parks opened or planned since 2012. Health code can address if certain size. | Remove from plan, but explore similar alternative for resorts, RV parks, & campgrounds. |
| 17. Continue the development of geographic informational systems (GIS) data for hazard mitigation and emergency management purposes, including completion of parcel mapping. Consider additional GIS coverages in the future, such as mapping of siren coverage areas, emergency shelters, dam shadows, dry hydrants/water sources, and building point files. **(High Priority)** | Parcel mapping completed along with building point data, Red Cross shelters, and some dam shadows. Development of GIS data and coverages is ongoing. | Revise with no specific coverages, but keep in plan. Explore pictometry for emergency services, planning, and damage assessment. |

| 2012 Plan Strategy | Progress | Recommendation for Plan Update |
|---|---|---|
| 18. Provide to municipalities a model agreement for use of non-municipal buildings as public storm shelters. | No action. | Consider as a strategy alternative. |
| 19. Encourage local communities in the Cooperative Fire Protection areas to administer burning permits in a manner consistent with WDNR approach for the Intensive Fire Protection areas. | Web-based permitting now available, but still inconsistencies in permit issuance and enforcement. | Education on risk factors and liabilities. |
| 20. Continue to work with communities and other service providers to expand awareness of and participation in the Polk County Special Needs Registry for times of emergency. | Special Needs Registry was terminated due to low participation. | Remove from plan. Explore alternatives. |
| 21. Encourage the County and municipalities to integrate hazard mitigation issues and strategies into their comprehensive plans. | Some progress, but many comp plans not yet updated. | Keep in plan. |
| 22. Discuss with the County's citizen planning committee the potential amendment of the County subdivision ordinance to require installation of dry hydrants in rural subdivisions without community water systems. | No action. Was a low priority in 2012. | Consider as a strategy alternative. |
| 23. Work with Town of Clam Falls to encourage dam shadow zoning for the Godfrey Lake Dam so that it may be re-classified from a HIGH hazard dam to a LOW hazard dam. | Downstream zoning adopted in 2013. EAP adopted December 2014. It is now a Low hazard dam. | Remove from plan. |
| **Communication and Coordination Strategies** | | |
| 24. Implement a NOAA All Hazard Radio project to include addressing the current gap in coverage area and distributing radios (or discount vouchers) to mobile home residents and/or critical facilities. **(High Priority)** | No action. Federal funding for tower maintenance to address gap is not available. With cell phones, less need. | Partner with interested communities on a radio distribution project. |
| 25. Explore the feasibility of establishing a Reverse 9-1-1 system. ***related to continued NFIP compliance*** | Bidding of system underway. | Re-focus on implementation, including sign-ups. |
| 26. Establish emergency procedures for contacting residents and facilities in the dam shadows of "HIGH" and "SIGNIFICANT" hazard dams. **(High Priority)** | Would be addressed as part of Reverse 9-1-1 system. | Keep in plan as part of #25 above. |
| 27. Continue to involve electric providers, County Land Information/G.I.S., County health and aging services, hospitals, ARES/RACES, and local non-profits (e.g., housing authorities, long-term care facilities) in exercises and discussions on their relationships with the incident command system. | Exercises continuing, but limited involved for non-profits that are not VOADs. | Keep in plan. |
| 28. As resources allow, continue to support the County Skywarn Spotter Program and ARES/RACES group, including the installation of informational signage, their efforts to attract new members, and their further implementation of the Automatic Packet Reporting System (APRS). | County Emergency Management continues to work with storm spotters and the local ARES/RACES group. Training every other year. | Keep in plan; revise slightly. |
| 29. Work with Fire Departments and municipalities to consider the development of a countywide fire mutual aid agreement. | Has been under discussion by fire departments. | Remove. But explore similar for public works. |

| 2012 Plan Strategy | Progress | Recommendation for Plan Update |
|---|---|---|
| 30. As grant opportunities allow, continue to assist local fire departments and emergency services agencies with communications equipment and pager upgrades for narrowbanding. | Most equipment needs addressed. | Remove from plan. Could be a related city/village strategy. |
| **Education and Outreach Strategies** | | |
| 31. Increase preparedness of campgrounds and resorts to severe weather by promoting use of weather radios and educational outreach to encourage the identification of storm shelters. | No significant action. Cell phone alerts provides alternative to weather radios. | Consider as a strategy alternative. |
| 32. Increase resident knowledge on flood insurance and the typical limitations of homeowner's policies to cover flood damage. ***related to continued NFIP compliance*** | No significant action. | Consider as a strategy alternative. |
| 33. Polk-Burnett Electric Cooperative will conduct periodic training for County and municipal officials and response providers using the high voltage emergency training unit. **(High Priority)** | Continuing. | Keep in plan to recognize these efforts. |
| 34. Polk County should continue to support WDNR and local wildfire awareness in the Towns of Sterling and West Sweden, such as continued public service announcements and increased signage. Work with WDNR, local fire departments, and the communities to determine interest in additional community wildfire protection planning or Firewise-style programming. **(High Priority)** | Primarily a Town and WDNR effort. County provides support as needed and upon request. | Keep in plan. May modify slightly. |
| 35. Polk County Emergency Management will continue to provide bi-annual presentation(s) to the Towns' Association on available resources, hazard event reporting, and current issues (e.g., access for emergency vehicles). Encourage towns to bring key staff to the presentation and maintain their emergency operating plans. Extend invitations to cities and villages, or provide a similar presentation for incorporated areas. | Continuing. | Keep in plan. Include periodic elected officials training workshop. |
| 36. Polk County Emergency Management will work with other pertinent county departments to host a meeting(s) with long-term care facilities and other health care service providers on emergency planning and roles during an event. | Coordinates with Northwest WI Health Care Coalition on training opportunities. | Re-focus. Partner with Coalition. |
| 37. Continue to expand educational efforts and partnerships regarding alternatives to mitigate stormwater and flash flooding run-off, such erosion controls, rain gardens, natural vegetation buffers, permeable pavement, shoreland practices, and forest management in areas with steep slopes. | Implemented primarily through County Land Information and Land & Water Resources Departments. | Consider as a strategy alternative to recognize the importance of such efforts. Integrate soil health. |
| 38. Polk County, municipalities, and fire departments in the Intensive Fire Protection areas should continue to advocate for and participate in WDNR wildland training exercises. | Continuing when offered. | Keep in plan. |

| 2012 Plan Strategy | Progress | Recommendation for Plan Update |
|---|---|---|
| 39. Work with local media on a concerted effort to increase public awareness of the volunteerism needs in the County for ARES/RACES, Red Cross, local fire departments, first responders, and other local emergency services. | Volunteer Fair conducted with AmeriCorps assistance. | Re-focus as a countywide strategy; County as a partner, but not the lead. |
| **Multi-Jurisdictional (City & Village) Strategies** | | |
| 1. **DRESSER, FREDERIC, LUCK, MILLTOWN, OSCEOLA, ST. CROIX FALLS** - Continue efforts to remedy the stormwater and flash flooding problems in each community, including any necessary studies and potential development of a community stormwater management plan. **(High Priority)** ***related to continued NFIP compliance*** | Flood and stormwater planning and improvements vary by community.<br><br>See Appendices G & H. | Keep in plan. Update as needed based on city and village interviews. |
| 2. **BALSAM LAKE, DRESSER, FREDERIC, MILLTOWN, OSCEOLA** - Identify storm shelters (or a second storm shelter site) for residents, execute formal agreements for shelter use, and use local media to educate residents on availability. If a shelter is not readily available, pursue grant funding to construct a public storm shelter as opportunities allow. **(High Priority)** | Limited progress varies by community.<br><br>See Appendices G & H. | Keep in plan. Update as needed based on city and village interviews. |
| 3. **CLEAR LAKE, DRESSER, LUCK, MILLTOWN, OSCEOLA, AMERY** - Pursue additional sirens for replacement of aging equipment or added geographic coverage as funding opportunities allow. Potentially coordinate through a multi-jurisdictional or countywide project. **(Medium-to-High Priority)** | Some improvements. Varies by community. See Appendix H. | Keep in plan. Update as needed based on city and village interviews. |
| 4. **ST. CROIX FALLS -** Work with the Polk County to encourage State of Wisconsin and Minnesota agencies establish a warning or queuing system for east-bound traffic on U.S. Highway 8 approaching the "St. Croix Falls" hill under icy or dangerous conditions *(see related County strategy)*. **(Medium-to-High Priority)** | No significant changes. Cross-county communications used when needed. | Integrate into a County-level strategy. |
| 5. **BALSAM LAKE, CENTURIA, FREDERIC, MILLTOWN** – Should funding opportunities arise, acquire additional electric power generators for emergency use. **(Medium Priority)** | Varies by community. Needs still exist.<br>See Appendices G & H. | Keep in plan. Update as needed based on city and village interviews. |
| 6. **LUCK** - Work with electric utilities to bury power lines along Highway 48 which is prone to falling trees and limbs. Coordinate such projects with municipal street and other utility improvements when opportunities arise. **(Low Priority)** | Improved pruning by electric provider has largely mitigated for now. | Not a pressing priority. Remove from plan. |
| 7. **CENTURIA, CLAYTON, LUCK, FREDERIC, MILLTOWN** - Pursue battery back-up or emergency generators for existing sirens as funding opportunities allow. Potentially coordinate through a multi-jurisdictional or countywide project. **(Low Priority)** | Limited progress varies by community.<br><br>See Appendix H. | Integrate with Multi-Juris. strategy #3 above. Grant funding unlikely. |

| 2012 Plan Strategy | Progress | Recommendation for Plan Update |
|---|---|---|
| 8. **ALL INCORPORATED AREAS** – If flooding or other emergency occurs, compile and document all damages and costs with pictures, testimony, invoices, etc., for potential future grant funding or reimbursement. **(High Priority)** ***related to continued NFIP compliance*** | Awareness on documentation of damages appears to be improving based on input received during city and village meetings. | Keep in plan. |
| 9. **ALL INCORPORATED AREAS** - Update, as needed, and maintain local emergency operating plans and continue to participate in mock event exercises and training sessions when opportunities arise. Develop and maintain siren use and testing policies as part of these plans. Consider development of continuity of operations plans for critical government services and records management. **(High Priority)** | During city and village interviews, improvement I keeping plans up to date was noted (See Appendix H). A new template is now available. | Keep in plan. Update plans using new template. Encourage integration of additional topics. |
| 10. **ALL INCORPORATED AREAS** - Continue to work with Polk County Emergency Management to ensure communications interoperability and to pursue funding support to replace and upgrade communications equipment for municipal utilities, street departments, and local emergency services providers in a cost-effective manner. **(High Priority)** | Most of the pressing communications interoperability and equipment needs have been addressed, but still some needs as reflected in Appendix H. | Keep in plan. Reference the equipment needs in Appendix H. |
| 11. **CLEAR LAKE** – Address "sanctioned status" under the National Flood Insurance Program (NFIP) as of January 13, 2012. **(High Priority)** ***related to continued NFIP compliance*** | On sanctioned list as of 8/23/16. Discussed as part of mitigation plan update. | Keep in plan. |
| 12. **ALL INCORPORATED AREAS –** Municipal staff and elected officials identified as having a first line, supervisory, or other key role during an emergency as identified in the community emergency operating plan should complete FEMA ICS 100, 200, and 700.A training which is available on-line. **(Medium-to-High Priority)** | Local officials workshop scheduled for Spring 2017. | Reword for periodic local officials workshops about once every 2-4 years. |
| 13. **ALL INCORPORATED AREAS** – If the community has not to date, adopt Wisconsin Department of Transportation third-party billing rates for equipment use, or its own equipment rate schedule, by resolution or other administrative policy. **(Medium-to-High Priority)** | Discussed with communities as part of this mitigation plan updated. | Keep in plan. |
| 14. **ALL INCORPORATED AREAS** - Incorporate hazard mitigation and emergency preparedness activities into community comprehensive plans and land use procedures (e.g., site plan review) as opportunities allow. Other planning efforts potentially related to mitigation include: continuity of government plans, stormwater management plans, and capital improvements plans. Consider the use of official mapping and subdivision standards to avoid the creation of long, dead-end streets. **(Medium Priority)** | Limited progress. Many comprehensive plans have yet to be updated. | Keep in plan, but modify so that. WCWRPC would provide guidance on how this might be achieved. |

| 2012 Plan Strategy | Progress | Recommendation for Plan Update |
|---|---|---|
| 15. **CLAYON, LUCK, AMERY -** Consider development of a public storm shelter agreement and policy with those entities currently providing facilities as a public storm shelter. **(Medium Priority)** | Clayton has agreement, but no change in Luck and Amery. Frederic and others may also not have formal agreements. | Keep in plan and address as part of a shelter/safe room strategy. |
| 16. **AMERY –** The City, response providers, housing authority, and other facilities should continue to cooperatively prepare for and exercise their emergency plans for multi-family housing complexes and long-term care facilities. **(Medium Priority)** | Ongoing. | To be considered by as mitigation alternative. |
| 17. **ALL INCORPORATED AREAS –** As deemed necessary, develop or modify public works mutual aid agreements to cover all levels of potential support (e.g., utilities, debris clean-up, generators, administrative) during or following an emergency. **(Medium-to-Low Priority)** | Some formalization of agreements; varies by community. See Appendix H. | Keep in plan. Also include periodic public works meetings as a county-level strategy. |

# SECTION VI.
# MITIGATION GOALS AND STRATEGIES

Polk County will continue to proactively protect the health, safety, and welfare of the community by mitigating the negative human, economic, and environmental impacts of natural hazard events. This vision will be accomplished through planning, evaluation, communicating with stakeholders, and maintaining a strong, reliable infrastructure. This plan reflects the County's past, current, and ongoing commitment to natural hazard mitigation.

## A. MITIGATION GOALS

The mitigation goals are intended to provide direction to achieve the desired outcome and are to be used as guidelines by which mitigation activities are identified and impact is evaluated. The goals provide Polk County further direction for determining the future and reflect the needs of the County as identified through the assessment of hazard conditions and community profile.

The mitigation goals for this plan update reflect, and are consistent with, the vision statements and goals found in the Polk County Comprehensive Plan adopted in 2009, including the following, in particular:

> **Transportation Vision Statement:** Safe, convenient transportation for residents and tourists; various transportation infrastructure modes to enhance the residential, commercial, industrial, agricultural, and recreational resources in Polk County.
>
> **Utilities and Community Facilities Vision Statement**: To provide for future growth while protecting public health and natural resources by maximizing the use of existing infrastructure and distributing facilities to ensure a consistent level of services.
>
> **Land Use Vision Statement**: Polk County will have the appropriate/minimal amount of restrictions to maintain land owners rights, and have high quality lakes, open spaces, parks, orderly growth with focus on commercial development within cities and villages and take into account the impacts to the environment, economy, agriculture, public use, health and commercial development.
>
> **Natural Resources Goal 1**: Recognize the environment as an integrated system of land, water, and air resources.
>
> **Natural Resources Goal 2**: Minimize the potential impacts on natural resources, environmental corridors water resources, and wildlife habitats when evaluating potential residence, communities, industrial/mining, and intensive agricultural uses
>
> **Intergovernmental Cooperation Vision**: Nurture an environment of divergent viewpoints and responsibilities so that governmental units may work in harmony and cooperation to reduce conflict and duplication of services and increasing efficiencies.
>
> **Intergovernmental Cooperation Goal 4**: Participate in effective intergovernmental agreements that deal with issues that cover more that one jurisdiction.

The following are the 2017 *Polk County Natural Hazards Mitigation Plan* goals, which the Steering Committee reviewed and are unchanged since the 2012 hazard mitigation plan:

### Goal One: Physical Infrastructure

**Maintain a safe, efficient physical infrastructure which is prepared for and mitigates the negative impacts of natural hazard events.**

### Goal Two: Planning and Policy

**Anticipate natural hazard vulnerabilities and identify appropriate, reasonable mitigation plans and policies that can be implemented in a cooperative, efficient manner.**

### Goal Three: Communication and Coordination

**Nurture cooperation and strategic partnerships to maintain efficient and effective emergency planning, response, and recovery systems.**

### Goal Four: Education and Outreach

**Increase the awareness of our natural hazard risks and the alternatives to mitigate these hazards in our homes, businesses, and communities.**

## B. EVALUATION OF ALTERNATIVE MITIGATION STRATEGIES

A comprehensive range of alternatives was considered when developing strategies to meet the plan's vision and goals. A description of many of these alternative mitigation strategies is included in the Mitigation Toolbox in **Appendix K** which was used to help identify potential mitigation options.

The strategy alternatives in **Appendix L** were evaluated based on community acceptance, administrative feasibility, costs, benefits, and other considerations. The strategies in Appendix L are organized by topic. Some strategies are also grouped by projects or policies (e.g., planning, policy, and outreach alternatives):

- ***Project Alternatives***: Projects typically have a focused, action-oriented outcome which is achievable within a certain time period. Since special funding or other resources are often needed for the implementation of projects, additional attention is given to these recommendations later in this report. Projects can also include major studies or planning efforts.
- ***Policy Alternative***: Policies tend to be ongoing, decision-making or programmatic guidance. Policies strategies can often be funded or performed as part of normal operating budgets and may not require the identification of new or special funding or other resources. However, policies can become projects due to changing conditions or if a policy necessitates action or additional resources.

Evaluating the alternatives and selecting the mitigation strategies for inclusion in this plan was a multi-step process:

#1 Potential mitigation strategies to address the hazard risks and vulnerabilities analyzed in Section III were identified during the key-stakeholder interview process, Steering Committee meetings, town surveys, and city and village meetings. The strategies with the most potential were integrated into Appendix L.

#2 During stakeholder interviews, the 2012 plan strategies listed in Section V were reviewed, which also yielded recommendations for this plan update. These strategies were also integrated into Appendix L, and a column was added which indicates whether the strategy appeared in the 2012 plan, was significantly revised, or if it is new to this update.

#3 A survey with the alternative county-level strategies shown in Appendix L was distributed via mail to Steering Committee members. Committee members gave each strategy a priority of "high," "medium," "low," or "exclude" based on costs vs. benefits, political acceptability, technical feasibility, etc. Average scores were then determined based on a 0-24 scale to provide a relative priority and exclude the lowest scoring strategies. Members were also encouraged to write-in comments, which were incorporated into Appendix L. The survey results were analyzed further during the fourth Steering Committee meeting, resulting in some additional changes.

**Note:**

**The priorities for the strategies in Appendix L were made in the context of this plan and the natural hazards facing Polk County.**

**A low priority should not necessarily be interpreted as having a lesser importance to Polk County overall.**

**A low priority or strategy not included in this plan should not be deferred if the need exists and resources are available.**

#4 For those strategies in Appendix L that are recommended for plan inclusion, key parties to be involved (or take a leadership role) in implementation were identified.

#5 Recommended multi-jurisdictional strategy alternatives for cities and villages were mailed to the cities and villages for review in April 2017. The input from the city and village meetings and follow-up mailing determined which multi-jurisdictional strategies should be recommended in the final plan.

#6 For priority projects recommended for implementation within the next five years, additional analysis and guidance was included in Section VI.C. The Steering Committee analysis and community input referenced in Steps #3 and #5 were used to help determine priority. This section allowed for additional analysis of the costs vs. benefits for the Steering Committee and communities, and it was further modified based on the additional input received.

#7 Additional changes and "fine-tuning" to the recommended strategies and draft plan were made based on review of the draft plan by communities, local officials, and key stakeholders.

# C. RECOMMENDED MITIGATION STRATEGIES (ACTION PLAN)

Strategies are specific mitigation policies and projects selected based on their feasibility to assist the Polk County in attaining the plan goals. Some strategies may also have a strong emergency-preparedness emphasis, but have been included for their importance in helping to mitigate the negative impacts of natural hazard events when they do occur. The last section (multi-jurisdictional strategies) identifies those recommended actions for the participating cities and villages.

As mentioned previously, Appendix L includes implementation guidance for each strategy, including relative priority and key parties likely involved during implementation. The relative priority (i.e., high, medium, low) is helpful in determining which projects to implement first from a mitigation perspective, but individual programs or communities may rate some of these strategies differently. As explained in Appendix L, the strategies were prioritized based on their importance to hazard mitigation, but some strategies have additional local benefits which may not have been considered. These priorities are also subject to change over time and new priorities may arise. To avoid too much emphasis on the prioritization, only the high priority strategies are noted here.

## i. Flood Mitigation Strategies

The following flood mitigation strategies are potentially related to continued NFIP compliance and support NFIP goals.

### Recommended Projects

1. Continue to monitor, study, and address stormwater and flash flooding hotspots in the county as identified in the Flood assessment section of this plan.
2. Pursue hazard mitigation grant funding to acquire, relocate, or floodproof structures and properties with a flood history, most at risk of flood damage, and/or following a flood event in which significant damage occurs, if the landowner agrees to participate.

### Recommended Planning, Policy, and Outreach Actions

3. Pursue opportunities to improve the accuracy of floodplain mapping (D-FIRMS) now that LIDAR data is available. **(High Priority)**
4. Continue to monitor river and lake overbank flooding at Sand Lake near Dresser and along the Apple River. If repetitive problems begin to occur, investigate mitigation alternatives.
5. Continue to maintain or advocate for up-to-date emergency operating plans and dam failure analysis for county dams, high hazard dams, and dams with critical infrastructure within their shadows.
6. Continue to enforce County floodplain regulations to: discourage future floodplain development and the storage of hazardous materials in floodplains; require dry land access for new structures; limit development in dam shadows; and maintain natural flood storage areas.

7. Continue to educate the public and elected officials of flood risks, including awareness that typical homeowner's insurance does not cover flood damage and that many structures outside the 100-year floodplain are vulnerable to flooding.
8. Stress the importance of culvert maintenance and sizing to municipalities. Encourage municipalities to work cooperatively to consider impacts downstream when making stormwater system improvements (e.g., resizing culverts, new drainageways).
9. Continue to expand educational efforts and partnerships regarding alternatives to mitigate stormwater and flash flooding run-off, such agricultural soil health best practices, erosion controls, rain gardens, natural vegetation buffers, permeable pavement, shoreland practices, and forest management in areas with steep slopes.
10. Support the efforts of County Land Conservation, NRCS, and UW-Extension to promote soil health practices that can help reduce flash flooding and make croplands more resilient to drought.

## ii. Severe Weather Strategies

### Recommended Projects

1. If sufficient funding resources become available, pursue a community safe room project at the Polk County Fairgrounds and, potentially, at the County campgrounds. **(High Priority)**
2. Pursue grant funding to make cost-sharing available for the installation of storm shelters at mobile home parks, campgrounds, RV parks, and recreational properties were no existing shelter alternatives exist. **(High Priority)**
3. Work with the State of Wisconsin Department of Transportation to install a digital sign board at the base of the U.S. Highway 8 hill for eastbound traffic so that messaging can provide warnings for icy conditions, accidents, alternative routes, etc. **(High Priority)**
4. Work with municipalities and businesses to explore grant funding for community safe rooms and hardening projects for community facilities, long-term care facilities, businesses, and manufacturers, especially if located in a slab-on-grade structure.

### Recommended Policies

5. Adopt County ordinance language which requires new or expanding campgrounds, RV parks, and resorts to construct or identify per formal agreement a storm shelter for visitors. Provide model language to cities and villages for consideration.
6. Provide to municipalities a model agreement for use of non-municipal buildings as public storm shelters.
7. Develop and post at each County campground and park recommended actions for visitors in cases of severe weather or weather warnings.
8. Increase public outreach via social media and media on severe weather warning systems, sirens, related smart phone apps, and appropriate actions as part of Severe Weather

Awareness Month. During the winter, use social media and the press to educate the public on winter-related risks and driver safety.

9. Increase preparedness of campgrounds, RV parks, and resorts to severe weather by promoting use of weather radios and educational outreach to encourage the identification of storm shelters.

10. Initiate a public outreach effort to encourage farmers to allow the installation of snow fencing or leave corn standing in areas prone to drifting. Along State and US Highways, make farmers aware that of the WisDOT Standing Corn Snow Fence Agreements and the potential for reimbursement.

11. Partner with interested communities to pursue mitigation grant dollars to distribute NOAA All Hazards (Weather) Radios, with a potential priority for seniors, mobile home residents, and/or critical facilities. Address the current gap in radio coverage should opportunities arise.

## iii. Long-Term Power Outage Strategies

1. If funding opportunities become available, work with communities to pursue grant dollars for emergency power generators for critical facilities and emergency operations centers in Polk County.

2. Continue to work with local power providers to bury electrical lines in areas prone to outages due to falling trees/limbs or high winds.

3. Encourage households with persons having special needs that may be uniquely at risk during a power outage or disaster (e.g., oxygen, dialysis, seniors living alone) to develop an emergency contact plan and notify the electric cooperative, neighbors, etc.

4. Work with area utilities to encourage public- and private-sector planning for long-term power loss and pursue other mitigating activities recommended during the 2010 regional long-term power outage planning effort, as deemed feasible. Encourage local governmental offices, businesses, emergency shelters, and critical facilities to develop a basic long-term power outage plan and continuity strategy that inventories and addresses power generation and emergency fuel needs and solutions.

5. Polk-Burnett Electric Cooperative will conduct periodic training for county and municipal officials and response providers using the high voltage emergency training unit.

## iv. Wildfire Mitigation & Emergency Access Strategies

1. Work with Towns and permitting agencies to adopt standards and increase public awareness of driveway access, grade, width/clearance, long-dead end roads, and turn-around issues for large emergency vehicles. **(High Priority)**

2. Continue to cooperate with the Wisconsin DNR, local Fire Departments, and school districts in the education of residents and local officials in the mitigation of wildfire risks, including high risk factors, fire-adapted communities, reducing hazard fuel loads, protecting the home ignition zone, emergency vehicle access, and general fire safety

through presentations, public service announcements, social media, and signage. Outreach should especially target the Towns of Sterling and West Sweden and other areas of high risk. Determine town interest in additional community wildfire protection planning or Firewise-style programming.

3. Educate local officials and local fire wardens on wildfire risk factors, burning permits requirements, and liabilities of burning without a permit.
4. Polk County, municipalities, and fire departments in the Intensive Fire Protection areas should continue to advocate for and participate in WDNR wildland training exercises.
5. Pursue grant funds for dry hydrants for fire protection in areas of concentrated development where other water sources are not readily available.
6. Discuss with the County's citizen planning committee the potential amendment of the County subdivision ordinance to require installation of dry hydrants in rural subdivisions without community water systems, if needed.
7. Discuss with the County's citizen planning committee the potential amendment of the County subdivision and/or zoning ordinance to request local fire department input on proposed streets or bridges, as well as certain land uses with high traffic or hazardous materials.

## v. Invasive Species Strategies

1. Continue working with lake groups and other partners to implement the County's Aquatic Invasive Species Strategic Plan, enforce the transport ordinance, and complete the AIS rapid response plan.
2. Work with the St. Croix-Red Cedar Cooperative Weed Management Area (SC-RC CWMA) to identify and promote actions that can be undertaken in Polk County based on the recommendations in the SC-RC CWMA Strategic Management Plan for terrestrial plant and animal species of highest concern.
3. Using various methods, prioritize target areas, treatment, and management efforts for terrestrial invasive species in Polk County.
4. Continue to maintain and implement the Polk County 15-Year Comprehensive Forest Land Use Plan to include best management practices to reduce risks related to wildfire, invasive species, and plant diseases.
5. Undertake an educational initiative regarding the cutting and movement of firewood, which can spread invasives and diseases/fungus such as Emerald Ash Borer, Gypsy Moth, and Oak Wilt.
6. Identify some basic strategies that can be taken by cities, villages, and towns to combat the spread of invasive species. Educate elected officials and the public to identify those invasive species of greatest concern and the potential economic and resource impacts of these species.

## vi. Other Public-Private Partnership Strategies

The following strategy alternatives will be pursued based on the interest and support of area businesses, utilities, municipalities, VOADs, and other non-profit organizations. While Polk County offices can provide some technical and coordination support, it is not the primarily responsibility of the County to be the lead or sole coordinating entity for the following.

1. Establish an agricultural disaster assessment team (e.g., Emergency Management, FSA, Land Conservation, NRCS, UW-Extension) that would meet periodically to discuss emergency procedures, plans, responsibilities, and trends. Explore opportunities to encourage continuity planning and long-term power outage preparedness for farmers.
2. As opportunities allow, partner with local responders and VOADs to engage the media and increase public awareness of the volunteerism needs in the county for ARES/RACES, Red Cross, local fire departments, first responders, and other local emergency services and volunteer organizations.
3. Continue to involve electric providers, County Land Information/G.I.S., County health and aging services, and local non-profits (e.g., housing authorities, long-term care facilities) in preparedness and training exercises, including discussions on their roles within the incident command system.
4. Work with the Chambers, Polk County Economic Development Corporation, Regional Indianhead Safety Council (RISC) and WCWRPC to promote continuity planning among Polk County businesses.
5. Partner with the Northwest Wisconsin Healthcare Coalition to encourage emergency preparedness and continuity planning by long-term care facilities and other health care service providers, including sharing information with public-sector emergency responders.

## vii. Other Planning & Policy Strategies

1. Provide information to the communities and public on the importance of having address/fire number signs that are clear and not faded and house numbers that are easy to see from the road. Encourage replacement with "flag style" signs. Provide signage guidelines to address situations where multiple properties may share a common driveway or entrance road, as well as the naming and signing of private roads if serving multiple homes.
2. Revisit and expand the Polk County Continuity of Government Plan. Ensure that the recovery site(s) is adequately staged for anticipated equipment and connections (e.g., electrical, broadband) to minimize downtime of operations.
3. Every five years, Polk County will update its orthophotography to allow tracking of land-use trends and anticipate potential hazards, unless alternative photography exists.
4. Explore the acquisition and use of pictometry (oblique aerial imagery) for emergency services, planning, and damage assessment.
5. Discuss and establish basic evacuation policies, including available resources, islands, and handling of pets.

6. County Emergency Management should continue to maintain an up-to-date list of the status of local Emergency Response Plans and work with local communities to revisit and update these plans regularly. Municipalities are encouraged to incorporate continuity planning, data backup, debris management, and public works mutual aid into their plans and to notify the County when plan changes or updates are completed.
7. Continue the development of geographic informational systems (GIS) data for hazard mitigation and emergency management purposes.
8. Encourage the county and municipalities to integrate hazard mitigation issues and strategies into their comprehensive plans.

## viii. Other Communication, Coordination, & Outreach Strategies

1. Develop and test procedures regarding the use of the proposed auto-dialer system to notify residents in higher hazard areas, such as dam shadows and near EHS sites. Obtain additional GIS-related data if needed. **(High Priority)**
2. Encourage Polk County residents, businesses, and organizations to sign-up their cell phone numbers for notifications under the County's auto-dialer system once implemented.
3. As resources allow, continue to support the County Skywarn Spotter Program and ARES/RACES group, including their efforts to attract new members.
4. Encourage public works, streets, and highway personnel from Polk County to meet annually to receive training, share experiences, and explore the development of a countywide public works mutual aid agreement.
5. Acquire additional portable scene lights for County use.
6. Polk County Emergency Management will continue to provide bi-annual presentation(s) to the Towns' Association on available resources and hazard event reporting and offer elected officials training every 2-4 years on NIMS/ICS, responsibilities, reporting, lessons learned, etc.
7. Use the County webpage and social media to keep the public informed of recovery status, recommended actions, etc. following an emergency or disaster event. For example, encourage well testing of private wells following flooding.
9. Undertake a small-scale initiative to encourage County employees to be prepared at home.

## ix. Multi-Jurisdictional Strategies

The priorities for multi-jurisdictional strategies vary by community. **Implementation of these strategy recommendations are at the discretion of each community.** In some cases, Polk County Emergency Management may be able to provide guidance, but the responsibility for putting these strategies into action lies with each community.

### Recommended Projects

1. **CLEAR LAKE, DRESSER, FREDERIC, LUCK**, **MILLTOWN, OSCEOLA, AMERY, ST. CROIX FALLS** - Continue efforts to remedy the stormwater and flash flooding problems discussed in the flood assessment and Appendix G for each community, including any necessary studies and potential development of a community stormwater management plan. **(High Priority)** ***related to continued NFIP compliance***

2. **BALSAM LAKE, CENTURIA, CLAYTON, DRESSER, FREDERIC, MILLTOWN, OSCEOLA, ST. CROIX FALLS** – Identify safe rooms/storm shelters (or additional safe room sites) and execute formal agreements for shelter use. In some communities, such as **Clayton**, a shelter is available but more efforts may be needed to educate residents on availability. Some communities, such as **Amery** and **Luck**, use non-municipal buildings as public shelters, but do not have formal agreements in place. If a shelter is not readily available, explore grant funding to construct a community safe room/storm shelters as opportunities allow. See Appendix H for additional discussion for each community. **(High Priority)**

3. **ALL INCORPORATED AREAS** – All cities and villages identified generator or generator connections needs for municipal buildings/EOCs, emergency services, emergency sirens, or for critical infrastructure and facilities as discussed in Appendix H. Should funding opportunities arise, acquire additional electric power generators for emergency use. **(Medium-to-High Priority)**

4. **ALL INCORPORATED AREAS** – As part of Severe Weather Awareness Week and as opportunities allow, work with Polk County Emergency Management and local media to educate residents, critical facilities, and businesses on severe weather warning systems, what sirens mean, and safe room/storm shelter availability; a number of communities noted such public education needs in Appendices G & H. **Clayton, Clear Lake, Dresser, Frederic, and Luck** expressed potential interest in a NOAA All Hazards Radio distribution project, potentially with a focus on manufactured home park residents, seniors, assisted living and care facilities, and other critical facilities. Additional education efforts on smart phone apps are also recommended, especially for the areas of Polk County with poor weather radio coverage. **(Medium-to-High Priority)**

5. **CENTURIA, CLEAR LAKE, LUCK, MILLTOWN, OSCEOLA, AMERY** – Continue efforts to address the emergency warning siren concerns noted in Appendix H. Some communities are interested in additional sirens for replacement of aging equipment or added geographic. Other communities had interest in repairs, battery back-up systems, or adding remote activation capability. Potentially coordinate through a multi-jurisdictional or countywide project should funding opportunities allow. **(Medium-to-High Priority)**

6. **ST. CROIX FALLS -** Work with the Polk County to address concerns with east-bound traffic on U.S. Highway 8 at the "St. Croix Falls" hill under icy or dangerous conditions *(see related County strategy)*. **(Medium-to-High Priority)**

7. **AMERY, OSCEOLA** – Work with the Fire Department to explore funding for the installation of dry hydrants. **(Medium Priority)**

## Recommended Policies

8. **ALL INCORPORATED AREAS** – If flooding or other emergency occurs, compile and document all damages and costs with pictures, testimony, invoices, etc., for potential future grant funding or reimbursement. **(High Priority)** ***related to continued NFIP compliance***

9. **ALL INCORPORATED AREAS** - Update, as needed, and maintain local emergency operating plans and continue to participate in mock event exercises and training sessions when opportunities arise. Develop and maintain siren activation and testing policies as part of these plans. Consider development of continuity of operations plans for critical government services and records management. See Appendix H for related discussion. **(High Priority)**

10. **ALL INCORPORATED AREAS** - Continue to work with Polk County Emergency Management to ensure communications interoperability and explore opportunities to address concerns with gaps in portable communications. **(High Priority)**

11. **CLEAR LAKE** – Address "sanctioned status" under the National Flood Insurance Program (NFIP). **(High Priority)** ***related to continued NFIP compliance***

12. **DRESSER** – Work with Polk County Emergency Management, emergency responders, and the business owner to encourage the sharing of emergency plans for large events at Trollhaugen. **(Medium-to-High Priority)**

13. **ALL INCORPORATED AREAS** – Work with Polk County Land & Water Resources to increase awareness of invasive species risks for the community, identify invasives, and explore potential actions that the community and landowners can take to address invasives and their impacts. **(Medium-to-High Priority)**

14. **ALL INCORPORATED AREAS –** Municipal staff and elected officials identified as having a first line, supervisory, or other key role during an emergency as identified in the community emergency operating plan should complete FEMA ICS 100, 200, and 700.A training which is available on-line. Encourage attendance at period local officials training efforts organized by Polk County Emergency Management. **(Medium-to-High Priority)**

15. **ALL INCORPORATED AREAS** - Incorporate hazard mitigation and emergency preparedness activities into community comprehensive plans and land use procedures (e.g., site plan review) as opportunities allow. Consider potential hazard risks and emergency planning/response for proposed growth areas. Explore the use of official mapping and subdivision standards to avoid the creation of long, dead-end streets. Other planning efforts potentially related to mitigation include: continuity of government plans, stormwater management plans, and capital improvements plans. **(Medium Priority)**

16. **AMERY –** The City, response providers, housing authority, and other facilities should continue to cooperatively prepare for and exercise their emergency plans for multi-family housing complexes and long-term care facilities. **(Medium Priority)**

17. **ALL INCORPORATED AREAS –** As deemed necessary, develop and maintain public works mutual aid agreements to cover all levels of potential support (e.g., utilities, debris clean-up, generators, equipment sharing, administrative) during or following an emergency. Encourage participation in periodic meetings among public works and highway offices if organized by Polk County Emergency Management. **(Medium Priority)**

18. **ALL INCORPORATED AREAS** – If the community has not to date, adopt Wisconsin Department of Transportation third-party billing rates for equipment use, or its own equipment rate schedule, by resolution or other administrative policy. **(Medium Priority)**

19. **ALL INCORPORATED AREAS** – Cities and villages are encouraged to engage local internet service providers to evaluate and promote broadband redundancy, perhaps as part of the utilities & community facilities element of their comprehensive plan. **(Medium Priority)**

20. **BALSAM LAKE –** Work with Polk County Emergency Management, local emergency responders, and landowners to discuss emergency and evacuation planning for islands. Educate landowners on related risks, procedures, etc. **(Medium-to-Low Priority)**

# D. IMPLEMENTATION OF PRIORITY PROJECTS

As discussed previously, Appendix L included implementation guidance for all recommended plan strategies, including relative priority, key parties, and other notes regarding implementation. This section focuses on the high-priority project recommendations. Projects typically have a focused, action-oriented outcome which is achievable within a certain time period. Since special funding or other resources are often needed for the implementation of projects, special attention to these strategies is provided here.

Three general types of priority projects were included in the previous recommendations:

**1. Continue to address flooding problems.**

This was both a County-level and multi-jurisdictional (city and village) strategy, though it was deemed a higher priority among some of the cities and villages. Section III.B.iv. and Appendix G discuss the flooding history, problem areas, and concerns in Polk County and its communities. No specific structures were identified for potential acquisition or floodproofing during the planning process, though potential candidates may exist within certain cities and villages.

**Timelines:** Addressing flooding and stormwater management is an ongoing project as resources and need allow. Project timelines vary by community and specific project. Significant progress has been made.

**Lead Party:** Varies by jurisdiction and project. County Highway Department has responsibility for highway roads and culverts, while cities/villages/towns are responsible for local roads and stormwater improvements within their respective communities

**Potential Funding Sources:** There is significant history of damage or critical risks to safety, flooding projects may be eligible for FEMA mitigation grant dollars. Otherwise, CDBG, transportation/road aids, or local funding (e.g., capital improvement budget, impact assessments, stormwater utility) are typical funding sources. Certain water quality or wetland grant programs may also be available, depending on the nature of the project.

**Other Potential Barriers:** In addition to funding, changes in rainfall frequency or intensity, changes in land use (e.g., new development), and changes in drainage and storage systems (e.g., loss of wetlands) were identified as potential barriers to consider. New culverts or culvert resizing upstream can increasing flooding downstream.

**2. Improve the accuracy for floodplain mapping (D-FIRMs)**

This is a County-level strategy. There are significant inaccuracies with the 100-year floodplain boundaries on the D-FIRMs, which is a challenge for interpretation and enforcement. Polk County now has LIDAR topographical data that could significantly increase the accuracy of the D-FIRMs.

**Timelines:** This is an active project. Polk County is not the only area county with such concerns. WCWRPC commenced regional-level discussion on alternatives in March 2017.

**Lead Party:** County Land Information Department. WCWRPC, who is facilitating a regional discussion on this topic with Wisconsin DNR.

**Potential Funding Sources:** Options currently being explored with WDNR through the regional initiative. Given that map modernization was completed less than a decade ago, there is no FEMA funding available for wide-scale map updates. There may be some opportunities through the FEMA RiskMAP program, but these are typically targeted towards higher risk watersheds.

**Other Potential Barriers:** Correcting the maps countywide could be time intensive and expensive. Any changes must be done to FEMA standards and will require FEMA approval.

**3. Develop/explore storm shelter/safe room projects**

Two county-level project recommendations and one multi-jurisdictional recommendation suggest that there is a significant need for safe rooms at the Fairgrounds, in communities, and at campgrounds, RV parks, mobile home parks, and other highly vulnerable locations in Polk County.

**Timelines:** Project timelines vary by community and specific project. Discussion are underway evaluating the feasibility of one or more community safe rooms at the County Fairgrounds. The Village of Osceola has actively pursued mitigation grant dollars for a community safe room, though this initial request to FEMA was not funded.

**Lead Party:** Varies by jurisdiction and project. For privately owned facilities (e.g., RV parks, mobile home parks) subject to interest, approval, and a potential financial contribution of the land owner.

**Potential Funding Sources:** For the construction of community safe rooms, the FEMA Hazard Mitigation Grant Program or Pre-Disaster Mitigation Grant Program are the two primary sources, though CDBG and other funding may be available if part of a larger structure. Mitigation grant amounts available are partially dependent on population to be served and coverage area (normally 0.5 miles). Pre-fabricated shelters/safe rooms for less than 15 persons can be purchased for $5,000 to $10,000, plus installation. The Bayfield Fairgrounds shelter (500-person capacity) cost about $320,000.

**Other Potential Barriers:** Mitigation grant funding can be very competitive and a cost-benefits analysis is required. For FEMA grant dollars, safe rooms must be constructed to FEMA specifications. Identifying a reasonable, expected user base for determining the capacity of a safe room can be a challenge for public safe rooms, such as a campground. If funded through FEMA, the shelter owner must also develop and maintain policies and activities to alert visitors to storm conditions and shelter availability.

## E. ADDITIONAL IMPLEMENTATION GUIDANCE

As discussed previously, **Appendix L** includes implementation guidance for all recommended plan strategies, including relative priority, and the key parties likely to be involved. **Appendix M** includes a synopsis of some commonly used hazard mitigation grant funding sources, with a focus on natural hazards. Additional information on Federal grant funding can be found at www.cfda.gov. Some infrastructure improvements may also be funded locally through the establishment of a stormwater utility district or ordinance fee system, tax incremental financing

(TIF), general obligation bonds, and developer contributions or exactions. Capital improvements planning can be a valuable tool to assist communities in the planning and prioritizing of major infrastructure investments and identifying the best financing approach.

Additional sources of financial support are also often available following a disaster event, such as U.S. Small Business Administration (SBA) loans for the repair or replacement of property. The U.S. Department of Agriculture, through its local Farm Service agencies, provides disaster assistance for crop losses and livestock emergencies. Grant funding for additional emergency measures, such as the rehabilitation of flood control works, may be available through the U.S. Army Corps of Engineers. Non-natural hazards such as pandemics, school-based terrorism, nuclear accident, and hazardous materials spills typically have their own unique supportive services and funding resources, which are not included in Appendix M. In the event of an impending or recent disaster, municipalities and County Emergency Management offices are encouraged to contact WEM and the agencies identified in Appendix M for potential assistance, since available resources and related requirements frequently change, and this list is not all-inclusive.

The prioritization of the strategies offers guidance in the implementation of this plan based on available resources and changing conditions. Appendix L also suggests key parties to be involved and other implementation guidance for the county-wide strategies. But with such challenges also come opportunities to form or strengthen strategic partnerships to share and leverage existing resources, which is a primary theme within the plan goals.

Most policy strategies can utilize existing program budgets for implementation, though funding would be required for many of the recommended projects. Some of these policy strategies may involve the amendment of an ordinance or the adoption of new procedures. Examples and model language for some of these strategies were compiled by WCWRPC and are available from Polk County Emergency Management or WCWRPC. This reference information does not constitute legal advice, but provides insight into similar activities by other communities which can be used at the discretion of Polk County municipalities. Further, due to the involvement of key officials and county departments during the planning process, the strategy recommendations are known to these stakeholders and can be integrated into, or coordinated with, other work programs and planning efforts.

Like many municipalities, Polk County and its communities are facing fiscal challenges and resources are limited. **The recommended strategies will be implemented as resources (e.g., funding, staffing) and as other priorities allow.** Further, because of such limitations, there is not an expectation that all strategy recommendations will be fully implemented between now and the next update of this plan.

# SECTION VII.
# PLAN ADOPTION & MAINTENANCE

## A. PLAN COORDINATION

Many of the strategy recommendations in the previous section have relationships to other plans and policies for which coordination and consistency is vital. These related plans tend to fall within the following general categories:

- Local capital improvements plans and other budget documents. Most notable are infrastructure projects, such as those related to stormwater systems, water supplies, weather sirens, and communications equipment, which must be considered as part of local budgets.
- Regulations, agreements, and related procedures (e.g., subdivision ordinances, official mapping, shelter agreements, burning permits). These strategies are primarily identified in the policy strategies. Amendments can often be performed in concert with other ordinance updates. Some related actions, such as consistent administration of burning permits, may be accomplished procedurally without an ordinance amendment.
- Existing emergency operating or response plans. Many local municipalities need to update their emergency operating plans, and Polk County Emergency Management is taking the lead to encourage these updates. County Emergency Management and other county offices will also work cooperatively with stakeholders regarding plans, procedures, and grant applications related to long-term power outage, storm shelters and sirens, highway closures, communications systems, incident command, etc.

To date, integrating the strategies and recommendations found in the past hazard mitigation plans into local comprehensive plans has been inconsistent. Some planning consultants working with local communities are unfamiliar with the details of the hazard mitigation plan, and the state comprehensive planning law includes no specific reference to mitigation or resiliency planning. Further, mitigation planning is on a different schedule than comprehensive planning, with most comprehensive plans likely to be updated no more frequently than once per decade.

Even so, past hazard mitigation plans and strategies have been considered or integrated into the County plan and many local planning efforts. And during this mitigation plan update, comprehensive plans were considered by local participants for potential issues and other guidance.

While the mitigation plan was not specifically referenced in most participant comprehensive plans, many of the mitigation recommendations are related to policies and strategies found in local comprehensive plans. For example, most communities with 100-year floodplains included strategies in their comprehensive plans to discourage or not allow floodplain development. Stormwater management is another common theme in many local comprehensive plans. Even so, greater effort is needed to ensure that the hazard mitigation plan is considered during other local planning efforts, and vice versa.

As the mitigation plan strategies reflect, WCWRPC and Polk County Emergency Management will continue to work with the Polk County Land Information (Planning) Department and local municipalities to encourage coordination and consistency between comprehensive planning and the hazard mitigation plan, and provide guidance on how to incorporate mitigation strategies into their comprehensive plans and other planning mechanisms. And when made aware of local comprehensive planning efforts and updates, WCWRPC will contact to municipalities to encourage them to consider the strategies found within the *Polk County Natural Hazards Mitigation Plan*, with periodic reminders through the WCWRPC newsletters e-mailed to every jurisdiction in the region.

As Sections IV and V showed, the hazard mitigation plan strategies have been integrated into additional local planning mechanisms. Many of the stormwater and flash flooding hotspots in the previous mitigation plans were addressed by including these projects in the road improvement or capital improvement and stormwater management plans at the County or local level. As part of its work plan, Polk County Emergency Management continues to encourage and assist local jurisdictions in the update of their emergency operating plans; these plans often address mitigation policies or issues. And Section IV demonstrated that many mitigation strategies were integrated into other work plans, ordinances, and project budgets, such as the adoption of a County stormwater ordinance.

Since key County staff were actively involved in the development and update of the County mitigation plan, many of the mitigation strategies are based on staff recommendations and provides confidence that a high level of coordination between such planning efforts will continue.

**Continued, active involvement of key county staff, local jurisdictions, and other stakeholders during hazard mitigation plan updates is critical to ensuring incorporation of mitigation strategies into other planning mechanisms.**

## B. PLAN MAINTENANCE

Since the adoption of the 2012 plan, reviews of the existing plan were primarily limited to a periodic internal review by the Emergency Management Coordinator. No special plan reviews or plan amendments were needed.

### i. Plan Monitoring and Annual Plan Reviews

The *Polk County Natural Hazards Mitigation Plan* will be monitored by the Emergency Management Coordinator, including a quarterly review of the progress on plan implementation. These reviews will be part of the County's semi-annual Plan of Work to be provided to the Wisconsin Emergency Management Regional Director.

Each year, starting in the first quarter of 2019, Polk County, through its Emergency Management Coordinator, will complete an annual review of plan progress unless a plan update is already in progress. The annual plan review should consider the following:

1. Any changing conditions impacting hazard risk or vulnerability.

2. Review of any new mandates, rules, etc. as well as any input from Wisconsin Emergency Management (WEM) and the Department of Homeland Security--Federal Emergency Management Agency (FEMA) regarding plan implementation.
3. Review of the plan's recommended strategies, emphasizing completed priority projects and their effectiveness as well as priority projects yet to be completed and funding sources.
4. Coordination of plan strategies with other County or local planning mechanisms.
5. Potential new projects.
6. Any public or community input received on the plan and activities.

After this review, the Emergency Management Coordinator will provide a brief report to the Hazard Mitigation Plan Steering Committee or the Local Emergency Management Committee on the progress towards the plan's strategies, as well as any critical changes or amendments being proposed. These meetings will be subject to the Wisconsin Open Meeting Law and properly noticed to allow for public involvement and comment. The Emergency Management Coordinator will have primary responsibility for establishing meeting dates, distributing related materials, and facilitating the meetings.

After completion of each annual review, the Committee will recommend any revisions or amendments to the plan if necessary. The revisions will be forwarded to the County Board for its consideration and action. The Emergency Management Coordinator may also need to follow-up with participating jurisdictions and various County offices during this process.

## ii. Special Plan Reviews (Post-Disaster or New Project)

Within three to six months following a significant natural disaster event as determined by the Emergency Management Coordinator, a special post-disaster review will occur. A municipality or the County may also request a special plan review for the consideration of a plan amendment to incorporate a new project that was not included in the original plan, perhaps due to unforeseen circumstances or an increased hazard risk.

Information regarding the recent disaster or new project will be collected by the Emergency Management Coordinator from local law enforcement personnel, fire department personnel, Polk County disaster response personnel, involved municipality(s), DNR, WEM and FEMA personnel, affected citizens, and any other relevant entity. If a mitigation plan amendment is potentially needed, this information will be provided to the Hazard Mitigation Plan Steering Committee for their review.

At a duly called and posted public meeting, the Committee will analyze factors which contributed to any impacts of the hazard risk, the likelihood of the event reoccurring, and any strategy alternatives. The Emergency Management Coordinator will have primary responsibility for establishing special plan review meeting dates, distributing related materials, and facilitating the meetings. The Emergency Management Coordinator will also advertise these special meetings to affected department heads, citizens, or community groups, so additional input and

comment can be received. Special plan review meetings will be subject to the Wisconsin Open Meeting Law and properly noticed to allow for public involvement and comment.

The Committee may recommend revising or amending the existing plan. As appropriate, recommended changes to the plan will be forwarded to the County Board and the municipal contacts of the participating incorporated municipalities for their action and consideration.

### iii. Plan Updates

Every five years, the Hazards Mitigation Plan will be comprehensively reviewed, current data collected, and fully updated. This planning effort should be robust and incorporate opportunities for public involvement to meet all requirements of 44 CFR Part 201.6 and/or any applicable requirements or regulations developed in the interim.

At that time, the Emergency Management Coordinator will propose a plan update Steering Committee and process for County Board approval, and will include representation on behalf of participating jurisdictions. Plan update Steering Committee meetings will be subject to the Wisconsin Open Meeting Law and properly noticed to allow for public involvement and comment. In the interim, efforts should continue address data weaknesses in the vulnerability assessment, most notably for the flood assessment as described in **Appendix B**.

## C. PLAN ADOPTION

Each participating municipality, including Polk County, considered and adopted this mitigation plan update in a duly posted and held public meeting.

| *Jurisdiction* | *Adoption Date* |
|---|---|
| Polk County (encompasses all unincorporated areas) | November 17, 2017 |
| Village of Balsam Lake | November 6, 2017 |
| Village of Centuria | December 11, 2017 |
| Village of Clayton | March 5, 2018 |
| Village of Clear Lake | April 10, 2018 |
| Village of Dresser | November 6, 2017 |
| Village of Frederic | November 13, 2017 |
| Village of Luck | March 21, 2018 |
| Village of Milltown | November 15, 2017 |
| Village of Osceola | March 13, 2018 |
| City of Amery | February 7, 2018 |
| City of St. Croix Falls | October 23, 2017 |

Copies of the adopting resolutions are attached (see **Appendix A**). The approval process is described in detail in Section I.B at the beginning of this plan.