Monroe County Climate Readiness and Rural Economic Opportunity Assessment – Summary Report

April 4, 2022

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Monroe County Climate Change Task Force

Acknowledgements

The Monroe County Climate Readiness and Rural Economic Opportunity Assessment (CRREOA) has been a collaborative effort supported by the following partner organizations:

Monroe County Climate Change Task Force
The Nature Conservancy in Wisconsin
Northern Institute of Applied Climate Science
U.S. Army, Fort McCoy
University of Wisconsin-Madison, Division of Extension
Wisconsin Dept. of Agriculture, Trade and Consumer Protection
Wisconsin Dept. of Natural Resources
Wisconsin Initiative on Climate Change Impacts
Wisconsin Land and Water
Wisconsin's Green Fire

Report Contributors

This report and its conclusions include contributions from the more than 40 members of technical teams that supported the CRREOA project. For a complete list of technical team members see Appendix II.

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Monroe County lies within the ancestral homelands of the Ho-Chunk peoples, and we gratefully acknowledge that history, as well as the diverse and vibrant Native communities who make their home here today.

Funding for this project came in part from The Nature Conservancy in Wisconsin, and from the Wisconsin Department of Agriculture Trade and Consumer Protection, Soil and Water Resource Management grant program.

Recommended Citation

Monroe County Climate Readiness and Rural Economic Opportunity Assessment - Final Summary Report

Wisconsin's Green Fire, 2022

Photos provided by Monroe County Land Conservation Department, Wisconsin DNR, Federal Emergency Management Agency, and Wisconsin's Green Fire.

1 INTRODUCTION

Project Purpose

The Monroe County Climate Readiness and Rural Economic Opportunity Assessment (CRREOA) is a first of its kind effort to conduct a rapid, comprehensive assessment that brings together climate readiness and conservation-based economic opportunities at a county level. This collaborative effort was initiated as a pilot project in Monroe County, Wisconsin using an approach that can be rapidly replicated at a similar scale in other locations.

The CRREOA project utilized a team of specialists working with county leaders to conduct a multi-faceted assessment with emphasis on community climate resiliency, built and natural infrastructure, and rural economic development through conservation. This work is intended to be a foundation for Monroe County to take the most effective actions and make the best investments to improve climate resiliency, while identifying productive land uses that protect soil, water, and ecosystem services, and address the needs of vulnerable populations and communities.

Recent Climate Events

Similar to other areas in the Upper Midwest, Monroe County has experienced severe flash flood events in recent decades. Some of these events have included unprecedented rainfall intensities. On August 28, 2018, during one of the most damaging flash flooding events, rain amounts approached 20 inches in a 24-hour period causing extensive damage and devastation.

Severe flooding is now a regular fact of life for many Monroe County residents that puts public and private property, lives, and livelihoods at risk.

The CRREOA Project

Following several months of planning, the Monroe County Climate Readiness and Rural Economic Opportunity Assessment was launched in May 2021. The project is the result of the combined efforts of a coalition of conservation agencies and Non-Governmental Organizations working together with Monroe County leaders, with coordination provided by Wisconsin's Green Fire and the Monroe County Land Conservation Department.

Objectives

1) Conduct a comprehensive climate change vulnerability assessment based on current conditions.

2) Project future climate-related risks.

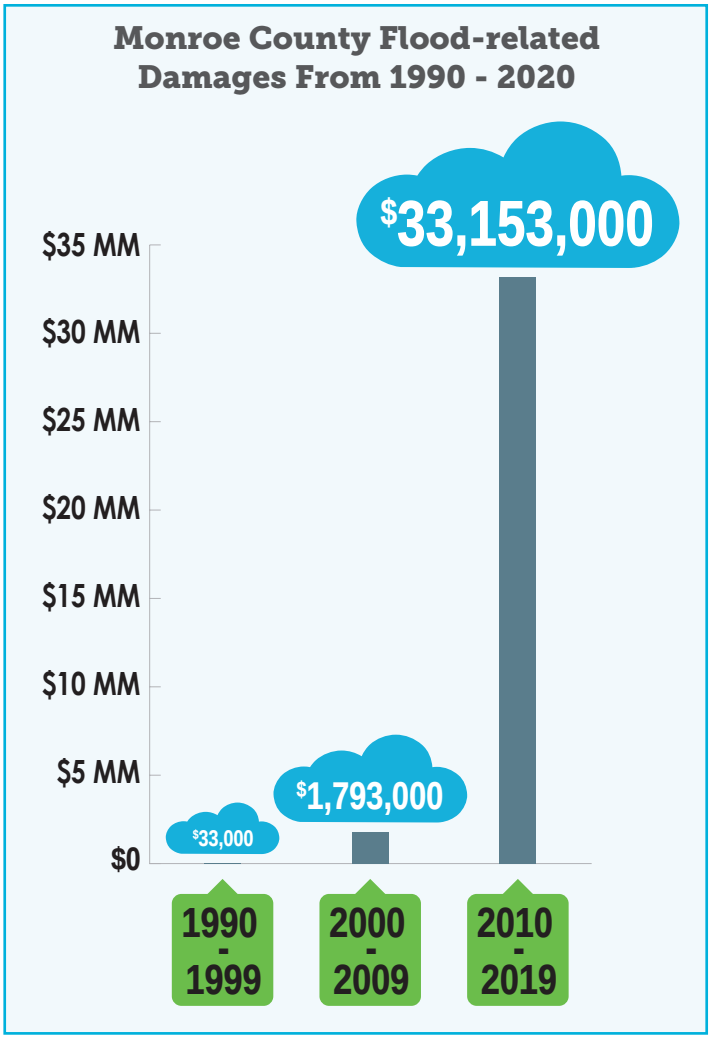
3) Provide expert recommendations for increasing resilience and mitigating current and projected climate impacts.

4) Identify conservation practices and land uses that increase resiliency and help conserve soil and water.

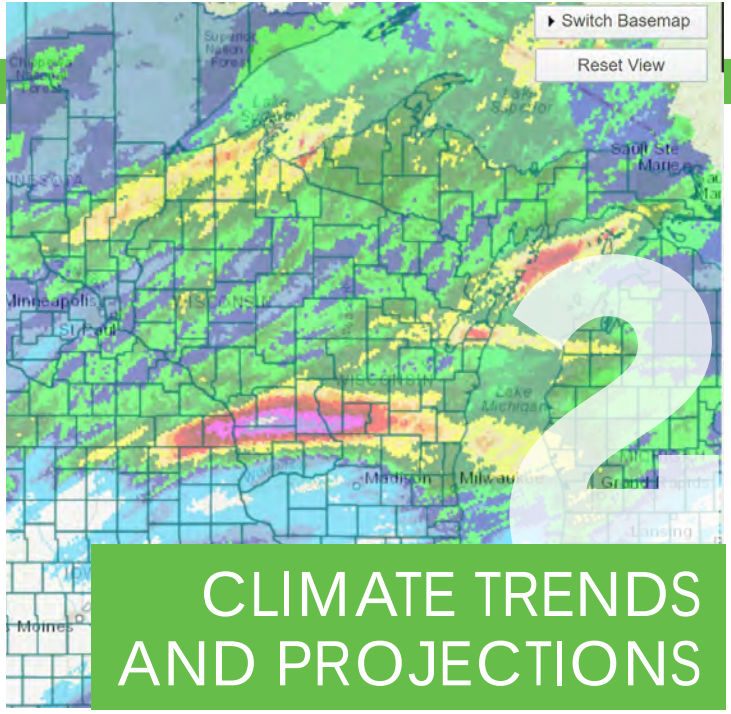
5) Help grow economic opportunities in rural communities through conservation action.

Summary Report

This summary report includes an overview of the CRREOA project and is intended for community members, policy makers, and interested citizens. The complete report and appendix material referenced here can be found at https://wigreenfire.org/community-climate-resiliency/



Between 2007 and 2020 more than 20 flash flood events have occurred in Monroe County, which destroyed homes and infrastructure, caused the failure of multiple dams, and resulted in significant economic losses to agricultural producers.



2 CLIMATE TRENDS AND PROJECTIONS

Monroe County Context and Setting

Monroe County, Wisconsin is located in the picturesque Driftless Area of southwestern Wisconsin, USA. The population in 2017 was an estimated 46,109 people. The cities of Tomah and Sparta, tribal land holdings of the Ho Chunk Nation, as well as the Fort McCoy military base are located within the county.

The county straddles two ecoregions, with southern and western portions comprised of steep ridges and valleys known as the **Western Coulee and Ridges (also known as the Driftless Area)**, and northeast portions characterized by sandy plains known as the **Central Sands**.

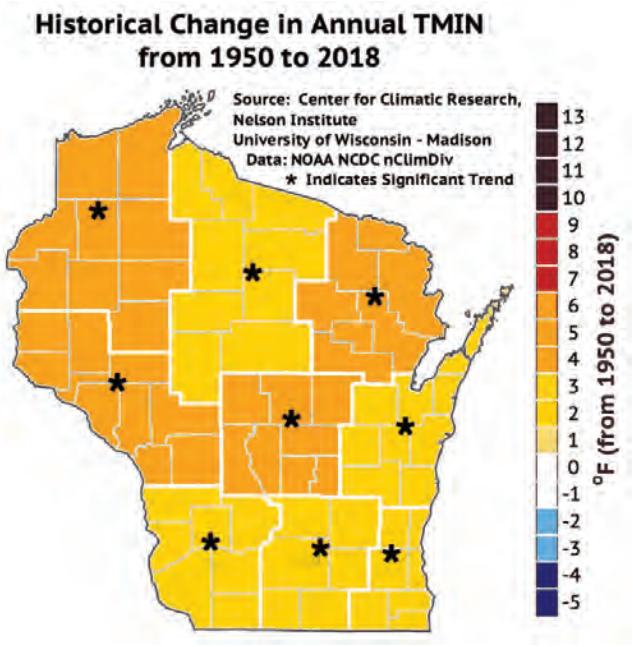
The ridges and valley landscape of the Driftless Area makes up a majority of the county.

Overview

Our analysis focused on climate conditions that will affect agriculture, forestry, water resources, and biodiversity in Monroe County. This work included collecting historic as well as future climate model data, review, and analysis, and summarizing county-specific climate data. Results are summarized in this section.

Changing Temperature

One of the clearest signs of climate change is the increase in temperature being experienced worldwide. Since 1880, average global temperatures have increased by about 1.8°F. This global warming trend has also been apparent in Monroe County.



Historical change in annual minimum temperature (TMIN) in Wisconsin 1950-2018.

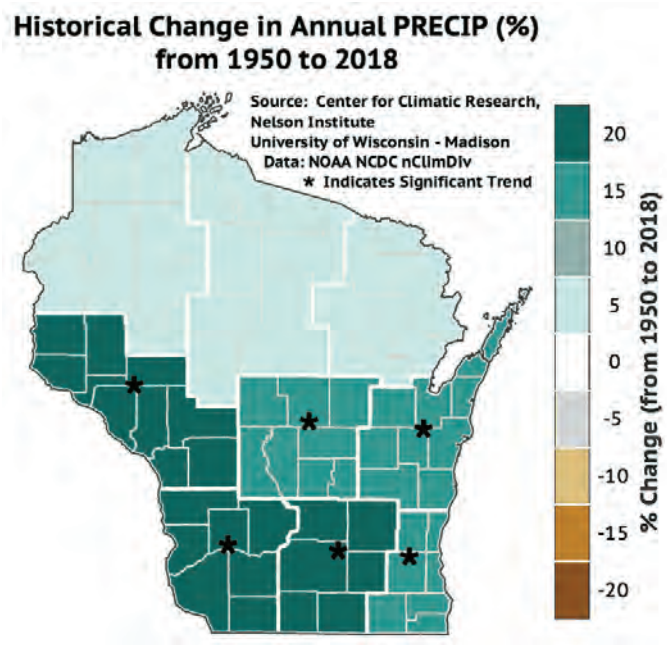
Findings

Historic Temperature Trends

- Annual average temperatures and minimum temperatures (TMIN) have increased by approximately 2.5°F since 1950. The largest monthly temperature increases, approximately 4°F, have been in the winter months of December, January, and February.
- Due to warmer conditions, the growing season is more than two weeks longer than it was at the beginning of the 20th Century.

Future Temperature Projections

- Temperatures in 2050 will continue the warming trend seen in recent decades, but at an accelerated pace. Average annual temperatures are projected to increase above current conditions by approximately 4°F. Average winter and fall temperatures will likely increase by approximately 5°F.
- The number of days with summer low temperatures over 70 F will increase from approximately 5 days currently to 15 in 2050.
- No recent summer or autumn in Monroe County has been as warm as the future predicted temperature averages.
- By 2050, the typical number of heat wave days in Wisconsin is projected to increase from around 10 to nearly 60 days per year.
- The overall increase in winter temperatures will be most notable as a reduction in the number of very cold nights.



Historical change in annual precipitation in Wisconsin 1950-2018.

Changing Precipitation

Wisconsin has been getting wetter for decades. Since 1950, Wisconsin has experienced significantly increased annual precipitation in most areas, including Monroe County. As in most of the Upper Midwest, precipitation increases are believed to be driven in part by increasing temperatures that result in storm systems with greater potential energy and greater likelihood of causing extreme precipitation events.

Precipitation Analysis for Monroe County

Historic Trends

- Annual precipitation in Monroe County is up approximately 20% (more than 7") from 1950. This increase has occurred mainly in fall, winter, and spring. Summer precipitation has increased approximately 10%.
- The August 28, 2018 storm rainfall depth of approximately 11.8 inches was between a 500-year and 1000-year storm using the latest Wisconsin Rainfall Project statistics. An August 8, 2021, storm which also caused significant damage in southwestern Monroe County had a total rainfall depth of between 4 and 5 inches, which if over 24 hours would fall between a 10-year and 25-year storm.
- As destructive as it was, the August 2018 storm was not as severe as several very large storms that have occurred elsewhere in Wisconsin in recent decades (see Appendix III).
- Both the 2018 and 2021 storms that struck Monroe County tracked east-west along the south line of the County. Analysis of severe storms and their tracks throughout Wisconsin suggests that extreme storms such as these, though rare, could occur anywhere in the county.

Future Projections

- Annual precipitation in 2050 will further increase above current amounts by about 5%, with a 10% increase projected for the winter. Current climate models do not provide a clear indication of changed summer precipitation.
- The 24-hour 100-year rainfall depth is projected to increase approximately 10%, with a similar increase in the maximum rainfall intensity.
- Extraordinarily large storms like August 2018, although still rare, will be more likely in the future.
- Peak rainfall intensities for future conditions of extremely large storms are expected to be similar to or slightly more intense than the record rainfall rates recently observed.
- More winter precipitation will occur as rain rather than as snow.

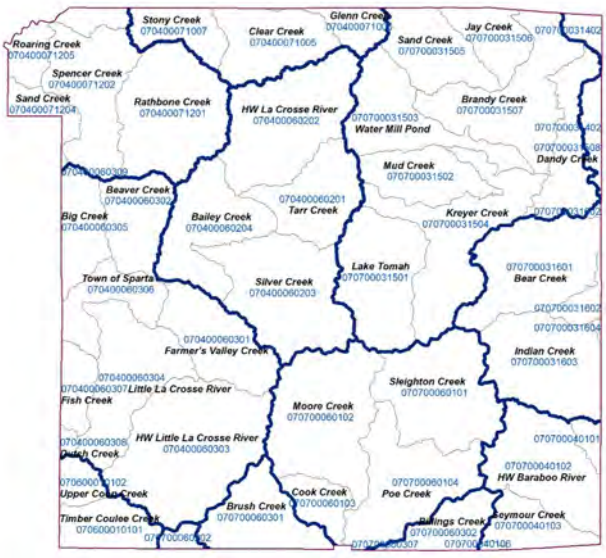
3 UNDERSTANDING RAINFALL, RUNOFF, AND FLOODING

As in much of the Upper Midwest, severe precipitation events and associated flash flooding have been the most profound and consistent impacts resulting from a changing climate. In southern Monroe County, flash flood events have repeated along similar storm tracks since at least 2007, including events with rainfall intensities of 2-6" per hour. **Given the extensive damage to property and the disruption to people and communities resulting from flooding, an assessment and modeling to understand the factors that affect flood events has been a particular focus of the CRREOA project.**

Runoff Modeling

Understanding how different land uses affect water on the landscape during severe storms is critical to informing effective strategies that increase watershed resiliency. Our project used modeling methods developed by faculty at the University of Wisconsin Madison to understand the effect of changes in land use on runoff from flood events.

Monroe County Watersheds



Map of Monroe County HUC-10 (dark blue) and HUC-12 (gray) watersheds.

Runoff Modeling Results

Model Results

- In rural watersheds, most of the runoff for both current and future conditions is generated from agricultural lands in annual cropping. Wooded areas produced much less runoff, indicating the importance of woodland areas in promoting interception and infiltration while reducing runoff.
- The runoff effects of future land use change were larger than those of increased future rainfall, especially for storms that occur relatively frequently such as the 2-year storm and were somewhat less significant for the larger 100-year storms.
- Changing all agricultural land use to row cropping without conservation practices increased runoff volume from existing conditions approximately 25%.
- Changing existing agricultural land cover to all permanent cover (e.g. meadow) reduced runoff by more than 20%.
- Increasing the woodland area by approximately 20% reduced runoff volume by approximately 13% for the 2-year storm and somewhat less than 10% for the 100-year storm.

Key Conclusions

- **Changes in land use that may occur by the year 2050 could have more impact on watershed hydrologic response than changes in storm rainfall.**
- **Improved land use can help substantially offset the impact of increased storm rainfall.** The watershed hydrology study led by Professor Eric Booth at UW-Madison highlighted this finding and our study reinforced that conclusion.
- **The August 2018 storm was extraordinarily large - approximately a 1,000-year storm by National Weather Service definitions.** Storms of this size are anticipated to be more likely in 2050 than at present. The 2018 storm produced flooding similar in magnitude to the types of future storm conditions projected to occur in 2050.
- The runoff produced from an extreme storm such as the August 2018 storm is so large that significant flooding will occur regardless of changes in watershed land use, or other non-structural measures. **This suggests that although land use strategies are an important part of a resilience solution, land use cannot be the only strategy.**
- **Runoff generation is significantly influenced by the pre-storm soil moisture and water-holding capacity.** In recent years, calculated soil moisture levels have been high due to heavy precipitation, however drought conditions could become more frequent in the future given the substantial increases in temperature and evapotranspiration likely to occur by 2050. Quantifying this possibility will be a complex effort.

4 CLIMATE VULNERABILITY ASSESSMENTS

Our climate vulnerability assessments consider the current conditions and vulnerabilities of Monroe County's built and natural assets, as well as how well the landscape may be able to respond to future climate conditions. We also consider the role of natural systems in supporting communities that are climate resilient, economically prosperous, and that enjoy the benefits of clean water and healthy soil.

Floodplain Infrastructure Vulnerability

Monroe County residents have seen first-hand how large storms and changes in land cover have affected private property, public infrastructure, and watershed health. Homes are damaged by floodwaters, public roads become impassable and are costly to repair, and culvert damage and failure can hamper fish and wildlife movement to the habitats they depend upon.

Farm structures such as this stream crossing are some of the most frequently damaged assets during storm events.

Floodplains and Floodplain Zoning

A floodplain is any land area susceptible to being inundated by floodwaters from any source. Much of this area has regulated statewide floodplain zoning to protect people and property. These laws prevent or limit building and development in certain flood zones. **Current floodplain maps for Monroe County were developed before 2010 and consequently have lower accuracy than what is possible with today's technology and updated weather event data.**

Flooding can occur anywhere, not just within mapped floodplains of the 1% storm where floodplain zoning applies. All waterways have floodplains, but many are not mapped. Large storms and intense rainfall can cause flooding well beyond the 1% floodplain, particularly under future climate conditions that are anticipated to bring greater rainfall amounts.

Structures in the Floodplain

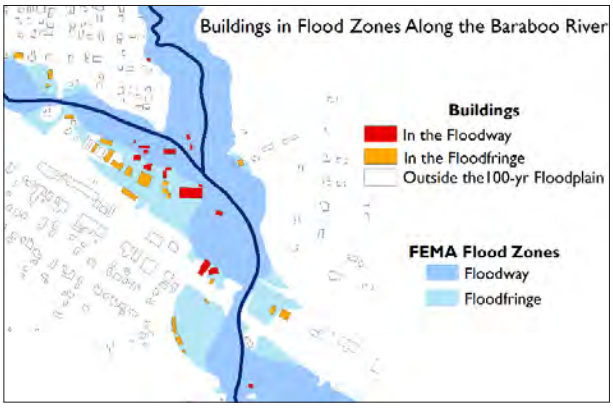
Many existing structures in Monroe County are in flood-risk zones. Based on preliminary building footprint data, and current FEMA maps, over 200 structures occur in a floodway, over 500 in a flood fringe zone, and over 600 in an unstudied floodplain.

Village of LaFarge, Kickapoo River at STH 82, Vernon County, 8 July 2008

FEMA floodplain likely underestimate the spatial extent and degree of flood risk, meaning that our estimate above is likely conservative. FEMA maps that assign flood risk do not include all streams with flood potential. While FEMA floodplains are frequently used in regulatory zoning, other flood risk frameworks are being developed.

The non-governmental site Flood Factor estimates that there are 6,895 properties in Monroe County that have greater than a 26% chance of being severely affected by flooding over the next 30 years.

Example Floodplain Zoning Map



The map is an example of structures in mapped flood hazard zones along the Baraboo River.

Marty Severson - "If You Live By the Water"

Sparta resident Marty Severson has experienced the impacts of five flood events in the course of two years at his home on the Little La Crosse River. He had just completed clean up and rebuilding following the first flood in 2017, when the August 28th, 2018 flood hit, filling his house with 7.5 feet of floodwater and causing him to lose everything from family heirlooms to the brand new cabinets and appliances that had been installed just months before.

Severson was inside his home during the 2018 flood, while floodwaters rose high enough to float his refrigerator through the kitchen ceiling. Beyond the appliances, losses that can never be replaced included an extensive tool collection, a complete set of Japanese dinnerware, and pictures and collections of letters from family.

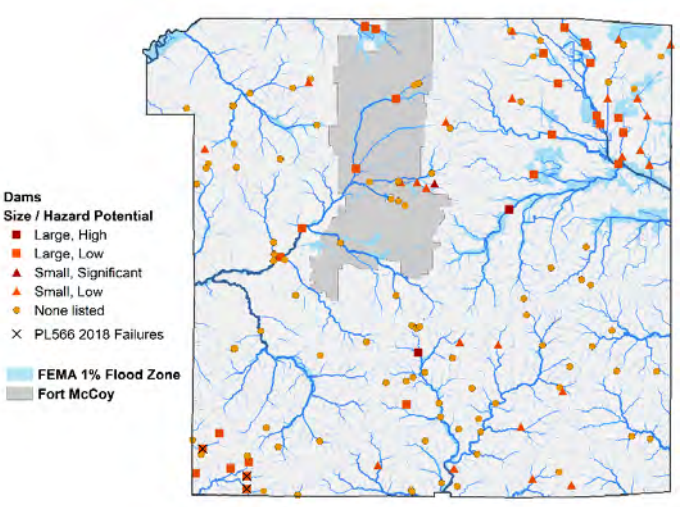
Following damage from the fifth and last flood event, it became clear that his home was no longer inhabitable. Beginning in 2019, staff from the Monroe County Planning and Zoning and Land Conservation Departments began managing a series of property buyouts for residents in hardest hit areas in the Little La Crosse and Coon Creek watersheds using combined funding from FEMA, WDNR, and Community Development Block Grants. For Marty, the buyouts helped cover his financial losses and allowed him to relocate and rebuild on a nearby home on high ground.

While nothing will replace some of what he has lost, Marty remains grateful for the help he has received from neighbors, from Monroe County staff, and from the FEMA Flood Insurance Program.

"If you live by water, you have to have flood insurance," Marty emphasized. "It's cheap – it only costs me a few hundred bucks per year, but if I hadn't had it then, I would have nothing today."

Dams

Dams in the county provide flood storage and serve other purposes that benefit business, agriculture, and recreation. WDNR, collaboratively with county officials, is responsible for regulating dams. WDNR maintains a dam database with information on each of the 143 approved dams in the County, such as its size, hazard rating, and inspection reports. Dam requirements and inspection schedules vary by the size class of the dam and the degree of potential hazard to life or property should it fail.



Monroe County dam locations and hazard potential.

Monroe County has 29 large, low hazard dams. Of these, five are under federal jurisdiction, fourteen are for cranberry operations in the northeast, and the remaining are owned by a municipality, the Land Conservation District, or a private landowner. The county has operation and maintenance responsibility on eight PL566 dams that are authorized and supported by the NRCS. These include seven dams in the Coon Creek watershed, three of which breached in the 2018 storm, and one in the Kickapoo River Watershed upstream from the village of Norwalk on Moore Creek. The map above shows the dams listed in the database in 2021.

Stream Crossings

An estimated 1,700 road-stream crossings occur in the county, each involving a culvert or bridge in the waterway.

The Monroe County Land Conservation Department began conducting a stream crossing inventory and assessment project in 2021 with support from Trout Unlimited, Monroe County Highway Department, WDNR, and involved townships. The survey was designed to assess the condition of each culvert or bridge and whether it was in need of repair, and whether the culvert or bridge was a barrier to fish and other aquatic life moving up or downstream.

One-third of the structures surveyed had at least moderate deterioration, and more than half of the structures were identified as barriers to migration under some flow conditions. These barriers will become increasingly limiting as the climate changes, making aquatic organisms more vulnerable.

Results for each road-stream crossing survey are available online: Great Lakes Stream Crossing Inventory (arcgis.com).

Background on the survey methods and the crossing assessment: Assessing Fish Passage | NAACC (streamcontinuity.org); Great Lakes Road Stream Crossing Inventory Instructions (michigan.gov)

Findings

Key Findings on Floodplain Infrastructure

- **Many existing structures are in flood-risk zones.** Based on preliminary building footprint data and current FEMA maps, over 200 structures occur in a floodway, over 500 in a flood fringe zone, and over 600 in an unstudied floodplain. Many of these occur in the cities of Sparta and Tomah.
- **Current FEMA maps likely underestimate the spatial extent and degree of flood risk**. FEMA maps are being updated using current technology, but they won't be available for several years. Even updated maps won't show where structures occur in the floodplain, whether a structure complies with floodplain zoning standards, or whether a structure is associated with other flood-related documents. When damage occurs after a flood event, the absence of geospatial data delays the response time needed to provide aid. This information is also not readily available for current or prospective landowners, or for the county to review future projects and zoning compliance.
- **An estimated 1,700 road-stream crossings occur in the county and some culverts and bridges at these crossings are in need of repair.** The 2021 survey of 204 crossings indicated 58 (32%) culverts or bridges with at least moderate deterioration and 5 (3%) with major to severe deterioration. Road crossings in need of repair, or improperly sized or placed, are at a higher risk of failure, pose a risk to public safety and downstream property, and can cause environmental damage. About half of the culverts impede fish migration up and downstream. Road crossings in need of repair, or that are improperly sized or placed, are at a higher risk of failure, pose a risk to public safety and downstream property, and can cause environmental damage.
- **WDNR dam information is incomplete and inspection reports are limited**. Absence of status and condition data on some dams impedes flood risk assessment and makes it difficult to evaluate the role dams play in flood abatement. Recognized safety issues can persist at some large dams because there is no automatic means to address them. Some dams limit fish and other aquatic organisms in the habitat they can reach as river and stream conditions change.
- **Land use conversion and land use practices have increased stormwater runoff rate and volume especially for smaller storms.** Some landowners have adopted practices that reduce runoff, but more of these practices are needed on farmed, forested, and developed lands. Runoff increases with conversion of wetlands to agricultural land, conversion of agricultural land to non-metallic mining, and development. Runoff also increases where land use practices compact the soil, reduce the amount of soil carbon, and allow seasonal bare soil, gully erosion, and unbuffered streams. Increased runoff results in greater water volumes, higher peak flows, transport of excess nutrients and sediment to waterways, and increased streambank erosion.

2018 flooding made many state trunk highways impassable, such as at this location on State Highway 131 at State Highway 33 outside Ontario.

Spring rains create increased risk for runoff and soil loss on lands without conservation cover.

Agricultural Vulnerability

Farming defines life for many Monroe County residents, and agriculture is a critical component of Monroe County's economy and culture. Maintaining a productive and prosperous farming sector is an essential outcome for any efforts aimed at climate resiliency. The agricultural producers who have been part of our project teams, and many of their neighbors, have contributed valuable insights to inform this part of our assessment.

Farmers in the Midwest have been experiencing the impacts of extreme weather events, especially flooding, for the last 14 years. More extreme weather events and other climate-driven impacts are projected to increase and may affect farm operations in the future.

Agriculture provides jobs for more than 4,500 Monroe County residents and contributes more than $279 million to the county's total income (UW-Ex 2014). The increased interest in local foods and agritourism has contributed to an increase in small farms, where some small acreage owners decided to enter specialty markets of apple orchards, pumpkin patches, and other specialty crops. The Amish communities have numerous outlets in the county selling produce, bakery goods, lumber, and other goods.

Farming and Climate Change

Agriculture is extremely vulnerable to climate change. Higher temperatures eventually reduce yields of desirable crops while encouraging weed and pest proliferation. Changes in precipitation and temperature patterns increase the likelihood of short-run crop failures and long-run production declines.

Continued heavy rain events and associated flooding will continue to disrupt farm operations, and in some cases may affect yield for agricultural products.

While preparing for extreme rain events has been a primary focus, warming temperatures and longer growing seasons may also affect farm production and could ultimately impact County goals and the wellness of farmers.

Farming and Carbon

Overall, agricultural activities are estimated to contribute approximately 19-20% of Wisconsin's annual greenhouse gas emissions. Greenhouse gas emissions on any individual farm are highly variable and are affected by farm systems and application of conservation practices.

Agriculture has the potential to shift from a net source to a net sink of greenhouse gases.

A wide variety of farm conservation practices are known to generate measurable carbon storage and reduced greenhouse gas emissions. Increasing soil carbon also increases infiltration of precipitation and soil moisture holding capability.

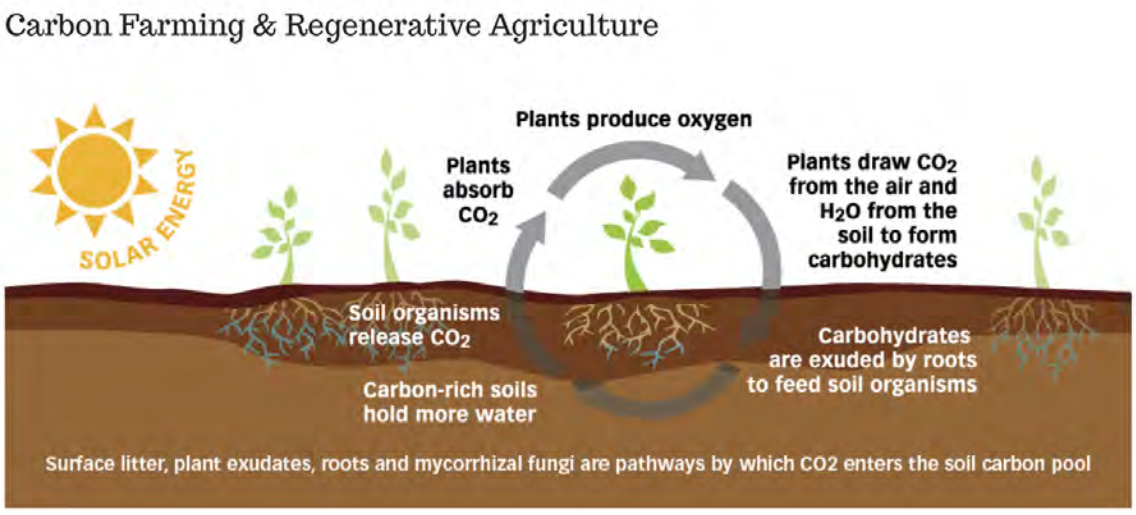
Managed grazing, cover crops, crop rotations, no-till farming, filter strips, prairie strips, windbreaks and shelterbelts, alley cropping, riparian buffers, and reforestation for forest products are all practices that can be carbon positive.

Application of any of these practices can contribute to a "triple win" of 1) generating income from farm products, 2) Protecting soil and reducing climate risks for producers, and 3) Contributing to watershed resilience.

Impacts of a Changing Climate

Findings

- **Continued heavy rain events and associated flooding will impact production and yield, as well as contribute to soil erosion and the creation of gullies through cropland.**
- **Increased nighttime temperatures, coupled with humidity, causes stress to crops and livestock.** Temperatures are expected to move above optimum conditions for many crops and closer to the reproductive failure temperature, particularly impacting corn in the Midwest. Elevated temperatures, humidity, and prolonged moisture can impact planting times, annual yields, and losses due to pests, pathogens, and rot.
- **Climate change may have unpredictable results on crop yields**; while increased temperatures and growing season lengths may provide benefits to crops, yield weights may be reduced and pollination rates may be more unpredictable.
- **Severe precipitation will continue to contribute to higher rates of soil erosion** and effects such as the creation of gullies through croplands. Runoff from unprotected fields will increasingly lead to higher runoff and soil and nutrient deposition in waterbodies.
- **Dairy livestock are vulnerable to increased summer temperatures.** Higher temperatures during both day and night may bring added stress to livestock that may cause reduced feed intake, reduced milk production, more susceptibility to disease, and potentially shorter productive lifespans.
- **Erratic weather patterns have health and well-being impacts on growers.**
- **Agriculture has the potential to shift from a net source to a net sink of greenhouse gases.**
- **Understanding barriers in implementing and maintaining conservation practices is needed to protect agricultural lands from extreme weather.**



Forest Vulnerability

Monroe County forests are a resource facing significant threats. Assuring resilient and productive forests for the future will require increased investment in good forest management that addresses existing stressors such as invasive species and forest pests and reduces risks from future climate impacts.

Overall, climate risks to forests are numerous, and these risks are compounded by other long-term stressors that are not directly related to climate.

Background

Monroe County forests cover about 297,000 acres, which is approximately 50% of the county's land base. Private family forest owners own about 219,000 acres (73%), of which, 53,673 acres (24% of private forests) are enrolled in Wisconsin's Managed Forest Law. The remainder of forest lands are owned by the Department of Defense at Fort McCoy (14%), Monroe County (4%), U.S. Fish and Wildlife Service (4%), and the State of Wisconsin (2%).

Forest cover provides important infiltration for precipitation and runoff in watersheds, however in landscapes such as southern Monroe County where forests and agricultural lands intersect, heavy rains on ridgetop fields in row crops without conservation practices routinely create erosion and gullying on adjacent side-slope forests.

Regnerating jack pine on County Forest lands near Cataract

Red pine plantations are particularly good habitats for invasive species such as common or glossy buckthorn, which are both common, especially in Northern Monroe County.

Findings

Direct Climate Impacts to Forests

- **Forest logging operations, especially in the county's southern ridge and coulee region, are increasingly limited by shorter winters and less frozen/firm ground conditions, as well as by longer periods of wet conditions**. This trend is expected to continue, as some studies we have cited project that frost-free growing seasons across southern Wisconsin could increase by as much as 20 days by the middle of the century.
- **Forests will be increasingly vulnerable to severe precipitation events, potentially causing gully erosion and damage to forest roads and infrastructure**. Forest cover provides important infiltration for precipitation and runoff, however heavy rain on ridgetop fields in row crops without conservation practices creates erosion and gullying in side-slope forests.
- **Tree species loss due to climate change is a future risk**. The variable nature of climate impacts in our region makes it difficult to predict with accuracy which species may be most threatened. However, conditions such as sustained periods of saturated soils, or conversely, periods of sustained drought, could create conditions causing failure of species regeneration or outright loss of sensitive species on some sites.
- **Forest diseases and insects are an increasing threat to productive forests**. Forest health threats cause significant economic losses to forest owners and damage may be more pronounced under future climate conditions, especially conditions that put trees under stress. For example, the insect pest emerald ash borer has caused widespread mortality of both green and white ash trees in recent years. Oak wilt, a fungal disease of oaks, thrives especially after storms create damaged trees which invite disease.

Waterways and Wetlands Vulnerabilities

Background

Extensive wetlands and slow, meandering streams are common in the glaciated northeast of of Monroe County, while waterways in the Driftless Area of the southwest portion of the county are typically fast-moving streams in narrow valleys with wetlands only along the stream corridor. Groundwater is a major source of stream flow and its stable supply of cooler water moderates stream temperatures year-round. The constant groundwater supply, steep topography, and the abundance of natural habitat in stream corridors lead to many miles of trout streams in the Driftless Area.

Fisheries

With increased temperatures and an increase in extreme weather, Wisconsin's cold-water fishery resource is at risk of decline. In the County's Driftless Area, a productive warm water fishery is not likely to replace the cold-water fishery because the conditions required for warm water sport fish – slower, larger streams -- aren't common. WDNR estimates a 75% decline in brook trout habitat in the Driftless Area by 2,050, from 9176 to 2,302 stream miles, and a 32% decline in brown trout habitat statewide.

Flood runoff in valley bottoms damages infrastructure and degrades habitat quality for fish and aquatic organisms.

Parts of Monroe County, however, have features that increase its potential to sustain a cold-water fishery even as climate changes.

Wetlands

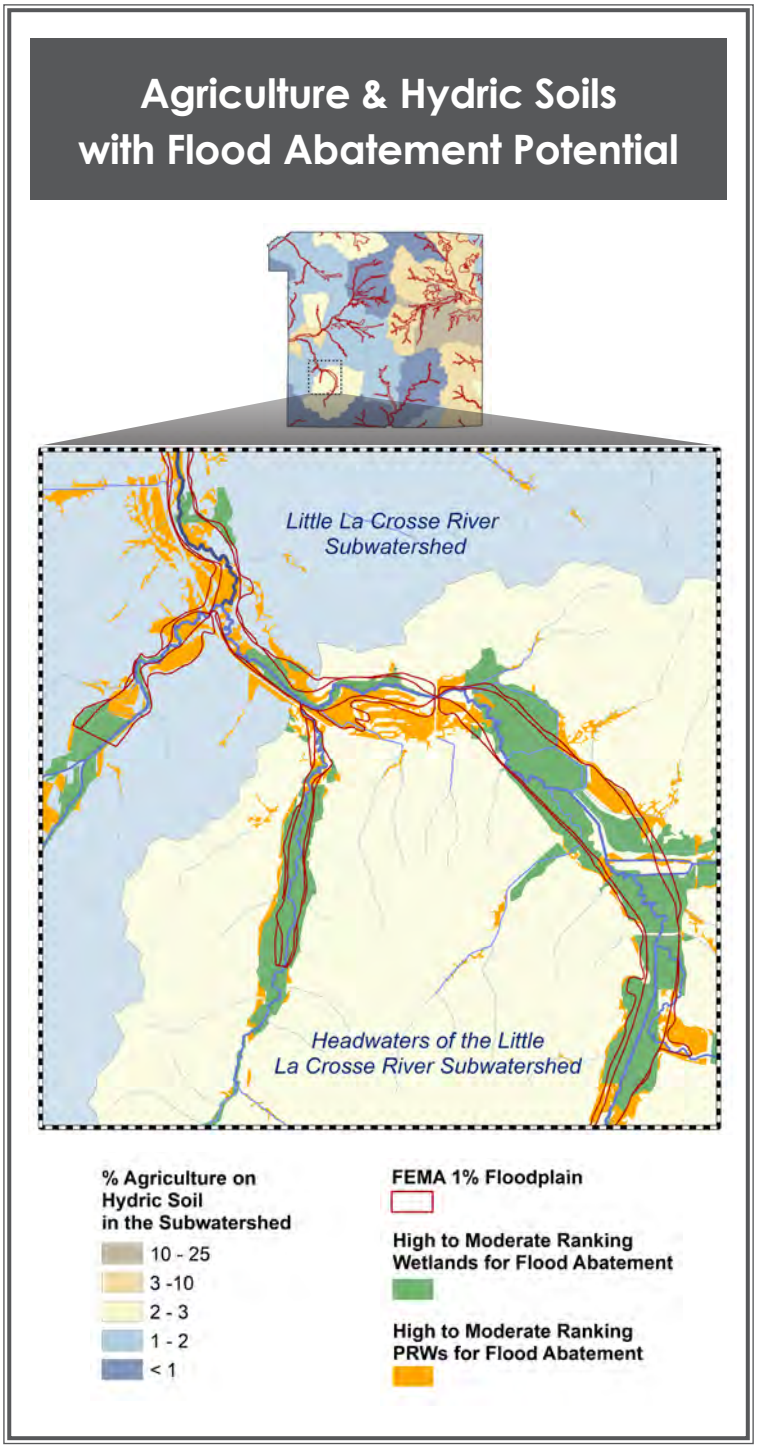
Wetlands act as water reservoirs during dry periods, slow stormwater runoff, and store floodwater after storms. Their contribution to multiple aspects of watershed health increases landscape resilience to a changing climate and to temperature and precipitation extremes.

Wetlands in Monroe County are minor features in all but the northeastern watersheds, but they play an outsized role in the benefits they provide.

Many of the original wetlands in the county have been lost over the decades. However there are many potentially restorable wetlands (PRWs) in the county where soil conditions still exist for these wetlands to be restored. Often these PRWs can be restored along with some of the former wetland benefits. For example, watersheds with PRWs along stream corridors have opportunities for wetland restoration that will store flood water and moderate flooding downstream.

The map below shows an example of both existing wetlands and PRWs along the Little La Crosse River that could provide floodwater storage,as identified by Wetlands by Design. invest in protecting existing wetlands and restoring former wetlands to meet different watershed needs.

Link to Wetlands by Design: https://freshwaternetwork.org/projects/wetlands-by-design/



Key Findings

- **Trout and other fish populations that depend on the County's cold-water streams are expected to decrease as the climate changes.** With increased temperatures and an increase in extreme weather, Wisconsin's cold water fishery resource overall is likely to decline. Waterways in Monroe County are mainly small, cold, fast-running streams that support trout. Lakes and slow, large rivers that support cool water sport fish, like walleye, or warm water sport fish, like bass and crappie are less common. The lack of habitat limits the opportunity for other climate-adapted species to increase as the trout fishery declines.
- **Parts of Monroe County have features that increase its potential to sustain a cold-water fishery even as climate changes.** WDNR's Brook Trout Reserve Program has identified places in Wisconsin where brook trout have the best chance of enduring the effects of climate change and other environmental perturbations if the stream habitat is improved. Monroe County contains much of the largest Reserve in southern Wisconsin.
- **Dams and road-stream crossings are often barriers to aquatic connectivity.** The County's recent road-stream crossing inventory indicated 55% of the bridges and culverts surveyed are barriers to fish and aquatic life moving up and downstream. The ability to move to different habitats is essential to complete life cycles. The effects of these barriers will increase as climate changes and will make populations of aquatic organisms more vulnerable.
- **Wetlands may be minor features in the Driftless Area of Monroe County but protecting existing wetlands and restoring former wetlands increases resilience**. Wetlands along streams abate floods, feed streams in dry periods, improve water quality, and provide habitat for fish and wildlife.

Habitat restoration and recreational uses are both compatible activities that can contribute to climate resilience.

Watershed Vulnerability Assessment

Maintenance of healthy, functioning natural ecosystems helps to ensure sustained, long-term provision of ecosystem services to local people. Functioning ecosystems help to buffer against the impacts of more frequent extreme weather events, and therefore help to create a more resilient landscape in the face of climate change, protecting both natural and built systems.

Watersheds are important because the amount and velocity of streamflow, as well as water quality, of a river or stream are affected by the things happening in the land area "above" the outflow point. A watershed is an interconnected landscape, in which both ecological processes and flood water movement are driven by interacting land and water features.

Our Watershed Vulnerability Assessment used available data to rate watersheds throughout the county against measures of climate resilience and measures of stress (vulnerability).

Watersheds that are more ecologically intact, with fewer stressors, are more resilient under extreme conditions, and enable plants and animals to move and adapt. Watersheds that are less intact and with more stressors are also more vulnerable.

Findings

- 19 of the 47 HUC-12 watersheds (40%) in the county are generally in good baseline condition and have conditions of relatively high resilience.
- 11 watersheds have relatively high stress and low ecological indices, indicating a need for improvement in land and water quality measures.
- The watersheds in the northern part of the county (generally north of I-90) had higher ecological indices and lower stress indices. This is likely primarily due to the protected status of lands located within the boundaries of Fort McCoy and the wildlife refuge areas of the northeast, where levels of industrialization, development, and agricultural practices are generally lower.
- Despite higher baseline conditions in the northern half of the county, some of these watersheds still have a moderately high vulnerability rating, due to low forest diversity, low levels of natural wetlands, and high numbers of stream/road crossings.
- Watersheds along the I-90 corridor (particularly those with larger urban centers) and watersheds in the southern half of the county are at the greatest climate change risk (relative to other watersheds in the county).

5 CREATING A RESILIENT FUTURE

Strategies to increase resiliency can include a wide variety of actions that help communities ***thrive in the context of change***.

Our recommendations throughout this report are intended to bring triple win benefits of increasing climate resiliency, protecting soil, water and air, and improving rural prosperity and economic opportunities.

Findings

- **There are ample opportunities to make investments in improved climate resiliency that will bring multiple benefits for people and the economy.**
- **Healthy, functioning forests, fields, soils, waters, and wetlands serve as "natural capital," ensuring that crucial ecological and economic activities—like agriculture, forestry, and recreational fishing—can continue to thrive, even in the face of change.**
- **The investments in conservation practices that increase climate resiliency and reduce future risks can also have economic benefits for landowners and communities.**

Monroe County has installed monitoring stations at stream crossings with flood histories. Data generated is fed to the National Weather Service to support flood alerts, and also generates stream data for researchers.

We describe concepts and strategies to achieve those benefits in this section, along with our analysis of where some of the best opportunities for targeted conservation investments to increase climate resiliency can occur.

In our recommendations, we provide detailed, actionable recommendations to support the concepts and opportunities presented here.

Increasing Resilience in Infrastructure

Climate change impacts, particularly flooding, have long been a concern in Monroe County, causing damage to homes, bridges, dams, and roadways. In many cases federal disaster recovery programs require rebuilding infrastructure in a manner identical to its pre-damage state. Recent events have made it clear that replacements of infrastructure cannot simply be brought back to pre-disaster conditions, but instead will need to incorporate designs that provide multiple benefits and that include adaptation for a wetter future.

Future infrastructure can include updated standards reflecting the likely size of future events, and incorporating both "gray" and "green" design features.

Restoring resilient watersheds can include re-shaping stream banks to accommodate more natural flow patterns.

Many paths to a resilient landscape

INFRASTRUCTURE

STRUCTURED EVALUATION

Review the condition of existing dams, culverts, and bridges and prioritize their repair or removal.

REDUCE RISK TO PEOPLE

such as

Remove homes in high flood risk area through the county buy-out program and anticipate for future conditions.

Consider early warning or automatic road closures where frequent flooding occurs.

CONSERVATION

INCREASED CARBON and WATER STORAGE

NO-TILL and COVER CROP PRACTICES

MANAGED GRAZING with silvopasture and composting

through

PRESERVATION of natural systems

RESTORATION

RESTORE WETLANDS in floodplains and on marginally productive land

RESTORE NATURAL or PERMANENT VEGETATION to stream banks and slopes

RESTORE FORESTS particularly to slopes and streambanks

together

These actions prevent erosion, absorb floodwaters, break down pollutants, provide habitat, and more.

Increasing Resilience Through Conservation and Restoration

Creating resilient landscapes that can withstand extreme weather will take a multi-layered approach to conservation. In some cases, land and water restoration activities can ensure increased infiltration, controlled runoff, and restored hydrology throughout all landscapes and new development.

Findings

- **Protecting and conserving existing natural assets is always more cost-effective than restoring new ones.** Strategies that keep forest in forest, keep farmland productive, and keep wetlands wet should be priority strategies for land managers.
- **Restoring wetlands, forests, and grasslands is an especially important strategy** where it can be employed to reduce flood risk and increase resiliency. Given the extensive loss of natural habitats and concurrent trends of increased flooding in regions of the Upper Midwest, habitat restoration will have special benefits where it can be targeted to areas of highest priority.
- **Conservation lands can remain working lands.** While increasing conservation land uses is a critical strategy, in most cases there are many conservation options available that generate income and meet landowners' goals while increasing climate resiliency.

Forests

Keeping forests in forest by keeping them productive is an essential strategy in protecting this critically valuable resource. Forest management that helps forests adapt to climate change is also highly important in order to maintain productivity.

Forest conservation can include measures such as invasive pest management, fire management (including controlled burns), and restocking degraded forests with more native, climate-adapted species (see the Climate Change Field Guide for Southern Wisconsin Forests).

For more details on increasing resilience through conservation practices see Appendix VI.

Members of the CRREOA Forestry Sub-team at the Steve and Patty Harelson Tree Farm.

Steve and Patty Harelson Tree Farm

The Steve and Patty Harelson Tree Farm, also known as Whitetail Ridge, includes 155 certified tree farm acres, planted with oak and pine, primarily on former agricultural fields and steep hillsides. Steve and Patty have owned the property since 1988, and they first started planting trees on it in 1992. They have pine plantations they planted in 1995 and 1996 that have just been thinned for the first time. There are oak trees that were planted on the property that are now producing acorns. This afforestation has simultaneously decreased erosion as well as increase carbon sequestration on the property.

The trees also serve as an important crop on the Harelson farm, contributing to a diversity of products and income sources on the family's land. They completed an oak harvest on the property in 2020 and planted oak and spruce in 2021.

Steve and Patty were also nominated for the American Tree Farmers of the Year for Monroe County in 1998 and went on to be chosen as Area Tree Farmers of the Year for District 14 which included Monroe, Vernon, Crawford, and Juneau Counties. All of the Harelson's work on the property will produce quality trees and wildlife habitat well into the future.

Grass cover can serve multiple purposes - in pastures, with native grasses for wildlife habitat, and as a component of flood control structures.

Wetland restoration contributes multiple benefits in capturing and storing flood waters, filtering and capturing sediments, and providing habitat for fish and wildlife.

Cover crops increase soil protection and rainfall infiltration in spring and fall.

Grasslands and Prairies

Grasslands of the Midwest hold great potential for increasing climate resiliency, with added benefits for biodiversity, wildlife habitat, and carbon storage. Grasslands include both managed pastures that may be dominated by cool season grasses and used for livestock, and native prairies (native grasslands) dominated by warm season grasses as well as native wildflowers.

Grasslands can be part of a broad spectrum of working lands options that generate income from pasture, agro-forestry, or from grass-based biofuels. Native wet prairie plantings can also be used in bioswales, detention basins, and rain gardens in urban and suburban areas.

Waterways and Wetlands

Protecting and restoring waterways and wetlands in targeted locations can be one of the most effective strategies for reducing flood risks and increasing resiliency.

Monroe County has some of the best conditions in southern Wisconsin to become a trout fishing destination, even as the climate warms. Spring-fed streams help keep water temperatures cool despite rising ambient temperatures, and topographic features help to provide natural shade. Despite this, without good stewardship, even the highest quality coldwater fisheries will be at risk.

Reconnecting streams to their floodplains and restoring ditches to natural channels will help divert and disperse surface flows to reduce flood severity and associated impacts.

Restoring wetlands or other natural land cover along streams, especially on marginally productive land (see Appendix VII) and in watersheds with high restoration potential is one of the most effective strategies for increasing resiliency.

Agricultural Lands

While many farm practices and conservation programs were intended to meet soil and water quality goals, they may be equally robust and effective in adapting to a changing climate.

Climate-smart farming can help farms remain productive, maintain a strong agricultural economy, and generate carbon credits that can be sold in carbon offset markets.

Climate-smart farming practices can include (but are not limited to):

- Cover crops for soil conservation
- Buffer strips at field edges
- Prairie strips within row crops
- Agro-forestry or silvopasture practices blending tree and grassland elements
- Producing bio-fuels from switchgrass

Re-thinking the landscape through an integrated carbon lens will promote farms as the solution to complex conservation problems, much like the county did 90 years ago when the Soil Conservation Service started in the Coon Creek Watershed.

Organic farmer Tucker Gretebeck discusses conservation practices on his farm in Monroe County.

Tucker and Becky Gretebeck Farm: A "Rural Renaissance"

Tucker and Becky Gretebeck own and operate a dairy farm with 50 grass-fed cows in Monroe County. The couple have been implementing sustainable practices, including permanent cover crops and tree plantings to increase the resilience of their land, which has been passed down over generations.

Alongside the dairy operation, the Gretebecks also own 10 acres of land in the valley below the farm on which they have spent the last several years growing an agri-tourism business based on a pick-your-own pumpkin patch. The Gretebecks were growing this portion of their business, using a 150-year-old tobacco shed, which they had restored and commissioned area artists who painted the shed with murals of original artwork. Their annual pumpkin event was drawing in more than 4,000 people annually and a sense of community around the farm was growing.

Then, the August 28th, 2018 storm came through the valley.

During this historic storm, an NCRS dam, located above the pumpkin patch, gave way, destroying and washing away everything in its path, including the Gretebeck's tobacco shed and pumpkin patch. Despite all the work the Gretebecks have done to improve their land, the storm proved to be too much for the historic shed and other buildings in their valley. Despite setbacks, the community came together to help the Gretebeck's rebuild, and Tucker and Becky continue to look for more ways to improve the resiliency of their land.

Learn more about Tucker and Becky's story here: https://www.organicvalley.coop/blog/farm-art-cooperative-spirit/

Mapping Conservation Opportunities

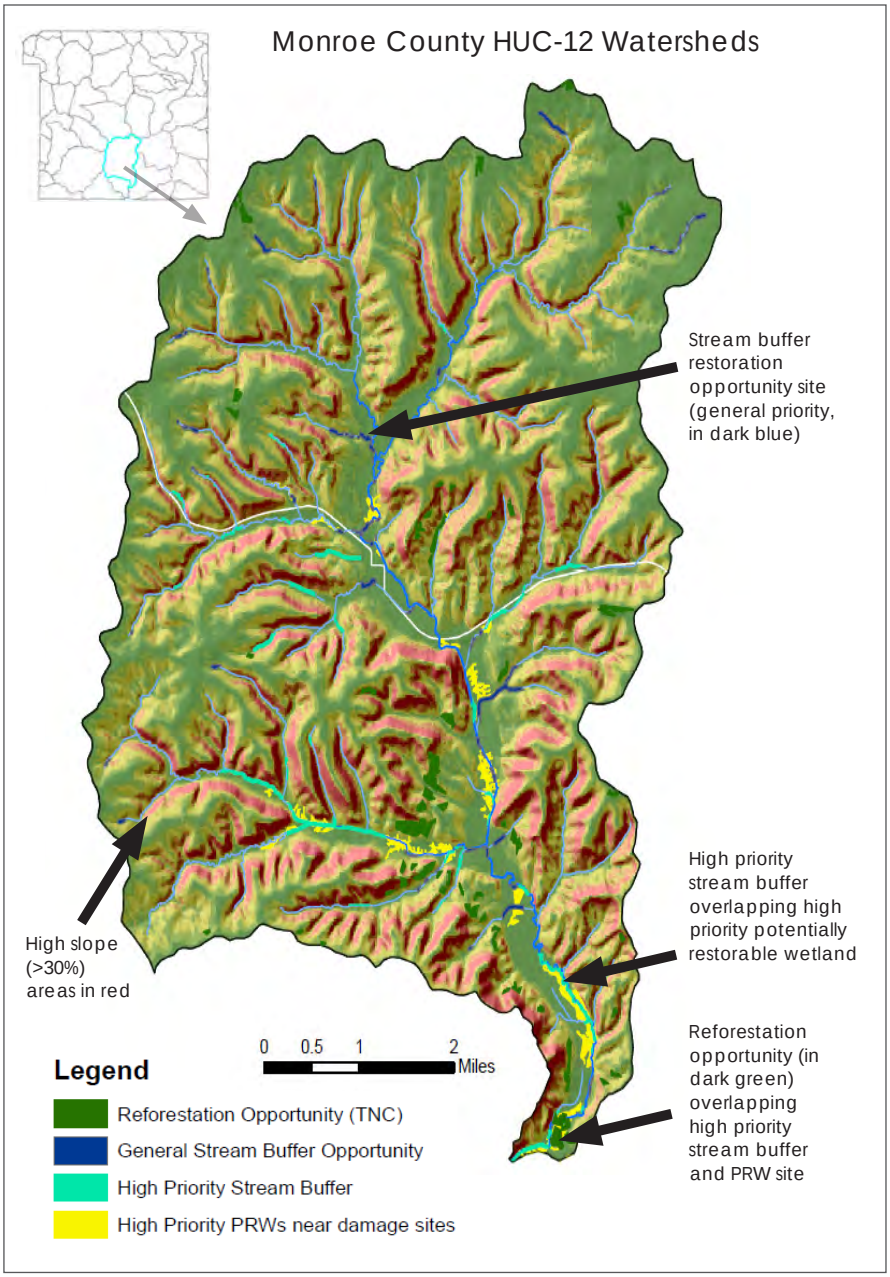
Our analysis of conservation opportunities focused on three priorities for improving climate resiliency through targeted restoration of lands and waters in watersheds throughout Monroe County.

1). Establishing forest cover on marginal and highly erodible soils

2). Restoring potentially restorable wetlands (PRWs)

3). Restoring riparian buffers

For a detailed description of methods and results for mapping conservation opportunities see our Full Report and Appendix VII. https://wigreenfire.org/community-climate-resiliency/.



Restoration opportunities identified in the Moore Creek watershed showing reforestation opportunity, general and high priority stream buffer needs, and high priority potentially restorable wetlands.

RECOMMENDATIONS AND NEXT STEPS

Teams made a series of 80 recommendations as part of the assessment. These recommendations are grouped by subject area: **Resilient Infrastructure; Resilient Watersheds; Resilient Agriculture**; and **Resilient Forests,** and a final section on **State and Federal Policy**.

For a complete listing of Recommendations see https://wigreenfire.org/community-climate-resiliency/

This assessment is not a plan, and any actions taken to implement any of the recommendations we have provided will be based on decisions made by county leaders and by interested citizens.

Monroe County must play a lead role in implementing actions around these recommendations; many other state and federal agencies and private partners will also need to be involved. **Most importantly, private farm and forest owners and private citizens will need to be actively involved in all stages of implementation**.

Additional Analysis

Several of the areas touched on in the CRREOA project will require additional assessment to support effective actions. Some areas of additional assessment called for in our recommendations include:

- Better understanding of the particular needs of underserved and at-risk communities and ways they may be especially affected by climate change.
- Detailed analysis of structures in floodplains and structures at risk of flooding.
- Analysis of Superfund and Brownfield sites to determine level of risks and need for remedial actions.
- Detailed estimates of carbon offset potential from individual forest and agricultural practices.
- More refined analysis of Opportunity Areas within Monroe County Watersheds to identify areas where conservation priorities can be achieved and where existing conservation programs can be prioritized.
- Continued development of information on agriculture, forestry, and watershed restoration activities that are both economically viable and climate resilient.
- Analysis of renewable energy opportunities and planning needs.

Planning and Implementation

The findings and recommendations provided in this report were developed to build on current and past work around climate and support effective actions by leaders in Monroe County. A series of steps to move toward implementation would include the following activities:

- Selection of priority recommendations by county leadership and the Monroe County Climate Change Task Force.
- Group selected strategies based on outcomes and development of action plans and sequences for each strategy group with lead roles and partners identified.
- Identify and work to secure funding for planning and implementation of recommendations.
- Continue to engage with members of the public and key stakeholders in building support for and expanding community support for climate resilience activities.

Mainstreaming Climate Resilience

Climate resilience efforts began in Monroe County long before this assessment started and they will continue long afterwards. Especially with the advent of targeted, and mostly one-time, federal funding, there is an opportunity to move decisively on actions now that will help prepare the county for future climate changes while maintaining a productive and prosperous rural economy.

If successful, climate resilience will become a routine aspect of day-to-day work throughout Monroe County in activities ranging from conservation to public health, bringing multiple benefits for quality of life.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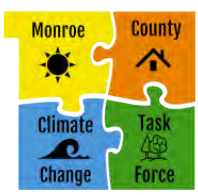
VOICES FOR CONSERVATION


Monroe
County
Climate
Change
Task
Force