

Murray County All Hazard Mitigation Plan

August
2019

This multi-jurisdictional hazard mitigation plan includes Murray County and the Cities of Avoca, Chandler, Currie, Dovray, Fulda, Hadley, Iona, Lake Wilson, and Slayton. This project was supported by a grant awarded by the Federal Emergency Management Agency (FEMA).

Prepared by
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MURRAY COUNTY

ALL HAZARD MITIGATION PLAN

August 2019

Executive Summary

The purpose of the Murray County All Hazard Mitigation Plan (AHMP) is to determine how to reduce property damage and loss of life resulting from natural and other hazards. The Murray County AHMP includes resources and information to assist county residents, public and private sector organizations, and others interested in participating in planning for both natural and other hazards. This mitigation plan identifies hazards that pose a threat to Murray County, as well as what is currently being done to mitigate their impacts. The plan also provides a list of actions and programs that may enable Murray County to further reduce negative impacts caused by disasters. The implementation strategies address both natural and other hazards that include but are not limited to flooding, drought, severe summer and winter storms, fires, and tornadoes.

“The overall benefit-cost ratio for FEMA mitigation grants is about 4:1, though the ratio varies from 1.5 for earthquake mitigation to 5.1 for flood mitigation.”¹

The Murray County AHMP Planning Team identified the following natural and other hazard as the highest rank hazards for Murray County:

- Winter Storm
- Tornado
- Hail
- Lightning
- Windstorm

This planning process has been conducted by the Southwest Regional Development Commission (SRDC) and Murray County Emergency Management in accordance with current guidance provided by the State of Minnesota Department of Homeland Security and Emergency Management (HSEM) and the US Federal Emergency Management Agency (FEMA). This hazard mitigation plan documents the multi-jurisdictional, multi-hazard mitigation planning process in Murray County, Minnesota, which is intended to meet the requirements of the Federal Emergency Management Agency (FEMA) Regulation 44 CFR 201.6 Local Mitigation Plans.

All participating jurisdictions in Murray County have agreed to a joint administration and operation of the AHMP to help mitigate the effects of natural and other hazards. The project was undertaken so that all

¹ FEMA. Benefits-Cost Analysis of FEMA Hazard Mitigation Grants. Accessed: 3/4/16. Available: <http://earthmind.org/files/risk/Nat-Haz-Review-2007-CBA-of-FEMA-Grants.pdf>

local units of government in Murray County, that wished to participate, could participate and remain eligible for FEMA funding.

The previous Murray County AHMP was adopted in 2012. The current update reviewed and updated the original plan. The update utilized a great deal of data from many different sources and also relied on input and expertise from the Murray County AHMP Planning Team. The plan resides with the Office of Emergency Management in Murray County, who is responsible for maintenance and updates.

Murray County's All Hazard Mitigation Mission:

"The Murray County All-Hazard Mitigation Plan is intended to enhance public safety for the County's citizens and infrastructure by effectively planning for potential disaster related outcomes and reducing that potential through mitigation efforts."

Participation in Plan Development

The Murray County All Hazard Mitigation Plan is a multiparty effort among Murray County, Murray County Emergency Management, Murray County citizens, local public agencies, people in the private sector, and many people in regional and state organizations. Public participation plays a key role in the planning process. We also rely on the experience of elected and appointed volunteers. The Murray County AHMP Planning Team (here after referred to as planning team) members comprised a broad representation of the county and their feedback was immensely useful in the development of the plan update.

Murray County AHMP Planning Team:

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- Rick Leebens – Nobles Cooperative Electric
- Jennifer Kirchner – Murray County Ambulance
- Glenn Kluis – Murray County Commissioner
- Adam Tromblay – Nobles Cooperative Electric
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- Jim Brown – City of Fulda Council Member
- Jeb Malone – City of Currie Mayor
- Marcy Barritt – Murray County Assessor
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Federal Emergency Management Agency

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Section 1 – Introduction

1.1 Mitigation Planning

Natural and other hazards present risks throughout Minnesota. Murray County has to be ready at all times to respond to a number of natural and other disasters. Local units of government, first responders, and emergency managers have worked together to create the Murray County All Hazard Mitigation Plan (AHMP). This plan helps Murray County protect its population and infrastructure by planning for natural and other hazards before the disaster strikes.

What is Hazard Mitigation Planning? According to the U.S. Federal Emergency Management Agency (FEMA) State and Local Mitigation Planning Fact Sheet:

Hazard mitigation planning is the process State, local, and tribal governments use to identify risks and vulnerabilities associated with natural disasters, and develop long-term strategies for protecting people, resources, and property in future hazard events. This planning process involves Tribal members and other affected stakeholders, and results in a mitigation plan with a strategy for breaking the cycle of disaster damage, reconstruction, and repeated damage. The mitigation plan also identifies mitigation actions and projects to implement the mitigation strategy. Under the Disaster Mitigation Act of 2000 (Public Law 106-390), State, local and tribal governments are required to develop a hazard mitigation plan as a condition for receiving certain types of non-emergency disaster assistance and FEMA grants to implement mitigation projects.

A simpler description comes from James Schwab:

“Hazard mitigation essentially is the art and science of reducing risks of future losses.”²

1.2 Purpose

- *Save lives, reduce injuries, sustain public health*

Identify properties that are in obvious need of protection and establish policies and practical actions that fortify these properties from the effects of natural and human caused hazards.

Reduce both economic and physical losses from repetitive damages caused from constant hazard events. Encourage county communities to participate in the National Flood Insurance Program (NFIP).

Improve hazard assessment information to make recommendations for discouraging new development and encouraging preventative measures for existing development in areas vulnerable to natural hazards.

- *Minimize social dislocation and stress*

²Planning Magazine. James Schwab. Accessed: 5/29/13. Available: <http://allhazards.wordpress.com/2010/03/02/mitigation-planning/>

Where appropriate, develop and implement education and outreach programs to increase public awareness of the risks associated with natural hazards and the potential danger for human caused hazards.

Provide assistance in locating tools, partnership opportunities, and funding resources to assist in implementing mitigation activities.

- *Minimize agricultural losses*

Balance land use planning and natural resource management with hazard mitigation in order to protect life, property, and natural environment.

Preserve, rehabilitate, and enhance the county's natural infrastructure systems to serve hazard mitigation functions.

- *Protect critical infrastructure from damage*

Establish policy through the planning process to ensure mitigation projects for critical facilities and services.

Strengthen emergency operations by increasing collaboration and coordination among public agencies, non-profit organizations, businesses, and industries.

Coordinate and integrate hazard mitigation activities, where appropriate, with emergency operations plans and procedures.

1.3 Justification & Legal Authority

The rising costs of natural and human-caused disasters at the end of the 20th century led many leaders to consider how to better protect people and their communities. Congress passed the Disaster Mitigation Act of 2000 (DMA2K) (PL 106-390) to establish a unified national hazard mitigation program. DMA2K amended the Robert T. Stafford Disaster Relief and Emergency Assistance Act of 1988 (Stafford Act), which in turn had amended the Disaster Relief Act of 1974. DMA2K placed new emphasis on hazard mitigation planning in state and local units of government, requiring adoption of mitigation plans as a prerequisite for certain assistance programs.

A multi-hazard or "All-Hazards" approaches to mitigation planning encompasses both natural and other hazards. Following the 2001 attacks on New York City and Washington, DC, and the subsequent reorganization of FEMA and the nation's homeland security structure, many mitigation planning efforts explicitly incorporated technological hazards arising from human activities in the hazard mitigation plans. While local hazard mitigation plans are only required to address natural hazards, the All-Hazards approach considers a comprehensive array of both risks and potential mitigation actions.

FEMA has implemented hazard mitigation planning requirements through federal regulations (44 CFR 201.6). In Minnesota, the Homeland Security and Emergency Management (HSEM) division of the Department of Public Safety (DPS) works with FEMA to implement disaster mitigation efforts. The Minnesota Department of Natural Resources (DNR) is also involved with mitigation as the agency

responsible for implementation of FEMA's National Flood Insurance Program (NFIP) and floodplain management in the state.

Minnesota Governor's Executive Order 07 – 14 assigns responsibility for the creation and maintenance of the Minnesota Emergency Operation Plan, the State All Hazard Mitigation Plan and such other duties as may be requested by the HSEM.³ The order also directs other state agencies to assist with the planning process.

Under 44 CFR 201.6, local governments must have a FEMA-approved Local All Hazard Mitigation Plan to be eligible for and receive project grants under the following hazard mitigation assistance programs: Hazard Mitigation Grant program (HMGP), Pre-Disaster Mitigation (PDM), Flood Mitigation Assistance (FMA), and Severe Repetitive Loss (SRL).

1.4 Mitigation Funding Programs

FEMA administers several different programs that provide hazard mitigation funding. Typically grants allow a cost-share of 75 to 90 percent federal funding for eligible projects. FEMA offers four hazard mitigation assistance programs which are described in detail at www.fema.gov/hazard-mitigation-assistance. Any projects funded by these programs must demonstrate a positive benefit-cost ratio. The four hazard mitigation assistance programs include: the Hazard Mitigation Grant Program (HMGP), Pre-Disaster Mitigation (PDM), Flood Mitigation Assistance (FMA), and Repetitive Flood Claims (RFC).

1.4.1 Hazard Mitigation Grant Program (HMGP)

HMGP provides funds in accordance with priorities identified in hazard mitigation plans to implement mitigation measures during disaster recovery. State and local governments, certain private non-profit organizations, and tribes are eligible sub-applicants through HSEM. Examples of eligible projects include:

- Acquiring and relocating structures from hazard-prone areas
- Retrofitting structures to protect them from floods, high winds, earthquakes, or other natural hazards
- Constructing certain types of minor and localized flood control projects
- Constructing safe rooms inside schools or other buildings in tornado-prone areas
- Hazard mitigation planning

1.4.2 Pre-Disaster Mitigation (PDM)

PDM provides funds for hazard mitigation planning and implementation prior to a disaster event. State-level agencies, tribes, local government, and public colleges are eligible sub-applicants through HSEM. Examples of eligible projects include:

- Voluntary acquisition of real property for open space
- Elevation of existing public or private structures
- Retrofitting existing structures to meet building codes
- Construction of safe rooms for public or private structures that meet certain FEMA requirements

³ State of Minnesota Executive Order 07-14. Accessed 5/29/13. Available: <http://www.leg.mn/archive/execorders/07-14.pdf>

- Hydrologic and hydraulic studies/analyses, engineering and drainage studies for project design and feasibility
- Vegetation management
- Protective measures for utilities, water, sewer, roads and bridges
- Storm water management to reduce/eliminate long-term flood risk

1.4.3 Flood Mitigation Assistance (FMA)

FMA implements cost-effective measures to reduce or eliminate long-term risk of flood damage to NFIP structures. State-level agencies, tribes, and local government are eligible sub-applicants through HSEM. Eligible projects include:

- Acquisition, structure demolition, or structure relocation with the property deed restricted for open space uses in perpetuity
- Elevation of structures
- Dry flood proofing of non-residential structures
- Minor structural flood control activities

1.4.4 Other Federal Disaster-related Funding Programs

FEMA is probably more well-known for providing response and recovery assistance. Other programs such as FEMA's Public Assistance (PA) Grant Program provide assistance to State, Tribal and local governments, and certain Private-Nonprofit organizations, so that communities can quickly respond to and recover from major disasters or emergencies. Through the PA Program, FEMA provides supplemental Federal disaster grant assistance for debris removal, emergency protective measures, and the repair, replacement, or restoration of disaster-damaged, publicly owned facilities and the facilities of certain Private Non-Profit (PNP) organizations. The PA Program also encourages protection of these damaged facilities from future events by providing assistance for hazard mitigation measures during the recovery process.

1.5 FEMA Guidance

FEMA has created the *Local Multi-Hazard Mitigation Planning Guidance* (the "Blue Book") to provide guidance to local governments to meet the requirements of 44 CFR §201.6 *Local Mitigation Plans*. There are three main objectives of the Blue Book. First, the Blue Book is intended to help local jurisdictions develop new mitigation plans or update existing plans in accordance with the requirements of the regulations. Second, the Blue Book is designed to help Federal and State Reviewers evaluate mitigation plans from local jurisdictions in a fair and consistent manner. Third, the Blue Book is designed to help jurisdictions conduct comprehensive reviews and prepare updates to their plans to meet the requirements of 44 CFR Part 201.6.

The Murray County All Hazard Mitigation Plan is going to follow the planning process outlined in the Blue Book. The Murray County plan will also use the Local Mitigation Plan Review Tool in the Local Mitigation Planning Handbook (March 2013) to specify where in the plan and how the specific regulation requirements were met.

FEMA requires that ALL participating jurisdictions meet the requirements for mitigation planning in 44CFR§201.6. The Blue Book specifically requires that each participating jurisdiction address:

- Risks, where they differ from the county
- Mitigation actions (actions must be identified for each jurisdiction)
- Participation in the planning process (attending meetings, contributing research, data, or other information, commenting on drafts of the plan); and
- Adoption (each jurisdiction must formally adopt the plan).

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Section 2 – Public Planning Process

2.1 Description of the Planning Process

2.1.1 Preplanning

Since the previous Murray County AHMP was approved and adopted in 2012, the Murray County Emergency Manager and the Southwest Regional Development Commission (SRDC) have collected information on hazards that occurred in Murray County. This information gathering helped in updating the risk assessment section of the plan. It also helped to initiate conversations during the planning process regarding strategies to mitigate the effects caused from hazards over the five year update cycle.

In the summer of 2017, the planning process began for the update of the Murray County AHMP. Every five years the Murray County AHMP has a planned update. “A local jurisdiction must review and revise its plan to reflect changes in development, progress in local mitigation efforts, and changes in priorities, and resubmit it for approval within five years in order to continue to be eligible for mitigation project grant funding.”⁴ The Murray County Emergency Manager initiated the planning process by applying for a planning grant from FEMA and contacting the Southwest Regional Development Commission (SRDC) to assist with the grant and update to the plan.

The Murray County AHMP Planning Team was reformed to assist with the update. The planning team consisted of a number of elected officials, county staff, city staff, and emergency personnel (refer to the planning team list in the executive summary).

The SRDC contacted all of the cities within Murray County that the update to the Murray County AHMP was taking place. This original outreach also asked the cities to participate in the planning process to update the plan. Outreach was also done to the townships in Murray County and multiple planning team members also represent townships in Murray County.

2.1.2 Planning Meetings

Planning Meeting #1

The first All Hazard Mitigation Plan Meeting was held on December 11, 2017. This meeting was an introduction to the Murray County AHMP Planning Team. The SRDC presented on the AHMP planning process, the purpose of the plan, the benefits of having a plan, and the participation in the development of the plan. Team members filled out CPRI worksheets and those who did not attend the meeting were sent CPRI and mitigation strategies update sheets via email and mail. Agendas for the meetings immediately follow this section, and copies of all of the meeting sign-in sheets are located after the copies of the resolutions of participation.

⁴ FEMA. 44 CFR 201.6 - Local Mitigation Plans. Accessed: 9/25/15. Available: <http://www.law.cornell.edu/cfr/text/44/201.6>

The planning process started with a review of the timeline and the information that needed to be gathered as part of the update and included in the plan. There were a total of two planning meetings: the first meeting, to refresh the county on the benefits of hazard mitigation planning, gather information, and analyze the natural and other hazards that pose a risk in Murray County; and the second to outline mitigation strategies to mitigate the risk of the hazards that were identified.

In lieu of subcommittee meetings (and due to the length of the plan), the entire planning team was invited to review the plan in detail online. This was done to further refine the plan and gather additional information, analyze potential hazards, and identify mitigation measures.

The CPRI was also discussed during the presentation regarding the planning process. The CPRI worksheet was distributed to the planning team via email so they could complete it prior to meeting in order to expedite the process and gain input from others in their jurisdiction. The CPRI is an important part of the planning process and helps the planning team rank and quantify the natural and other hazards in Murray County. Vulnerability is the critical component to the planning meetings. The planning team and city involvement is needed to help identify hazards and provide feedback in regard to potential frequency, spatial extent, potential severity, warning time, risk level, and hazard rank.

The CPRI outlined the natural and other hazards that were included in the original Murray County AHMP. SRDC staff presented other hazards that are typical to Minnesota and were included in the Minnesota AHMP and other county AHMPs. After thoroughly discussing each statewide hazard, the planning team updated the list of hazards that will be included in the plan. The planning team identified the following hazards (not in a specific order):

Natural Hazards affecting the jurisdiction include:

- Drought
- Extreme Temperatures
- Flood
- Lightning & Hail
- Severe Wind & Tornadoes
- Severe Winter Weather
- Wildfire

Other hazards affecting the jurisdiction include:

- Agricultural Disease
- Cyber Attack
- Civil Disturbance
- Hazardous Materials
- Invasive Species
- Public Health Infectious Disease
- Transportation Infrastructure

- Utility Failure
- Structure Fire
- Water Supply Availability & Water Supply Contamination

Certain statewide hazards were eliminated from the discussion since the planning team thought the risk of the hazard was minimal or non-existent in Murray County. These hazards included:

- Erosion/Landslide — Murray County's lakes and lakeshore are typically stable, so the team decided to remove it from the mitigation actions discussion.
- Sinkholes and Land Subsidence — Maps of Karst topography show this is not an issue in Murray County. This is an issue in counties in eastern Minnesota.
- Earthquake — Given the sparse history of earthquakes in Minnesota, the team felt that while it should be included, it was not a priority; other risks warranted much greater thought and analysis.
- Sea Level Rise, Storm Surge, Tsunami — These hazards concern coastal ocean areas, which Murray County is not.

Public participation is a critical component in the development of the Murray County AHMP. The planning team is critical in helping to engage the public and to garner feedback in regards to the plan. The planning team recognizes the importance of public involvement during the planning process. Participation in the development of the Murray County AHMP came from county staff, township and city representatives, and the general public. Efforts were made to actively include these groups in the update of the Murray County AHMP, including posting notices as well as draft copies of the plan on the Murray County Emergency Management website.

Planning Meeting #2

The second All Hazard Mitigation Plan Meeting was held on May 14, 2018. The second meeting was centered on reviewing the flood hazard analysis and updating the mitigation actions. This helped to outline existing plans and programs, gaps and deficiencies, and existing mitigation measures. The profile also included: locations affected by the hazard, extent of the hazard, previous occurrences of the hazard, and the probability of future events of this hazard. This also allowed the planning team members to draw on personal expertise and the hazard profile that was discussed during the risk assessment meetings.

The risk assessment meeting helped to educate the planning team, local government representatives, and other meeting attendees. Profiling the hazards also helped to facilitate conversation regarding the hazards. The conversations helped to fill in gaps in the research related to the hazards. There was also a chance for meeting attendees to discuss gaps that they identified.

Flood Mitigation Meeting

After the flooding of the summer of 2018, the planning team decided to meet specifically for the purpose of discussing flood mitigation strategies. This meeting was held on September 6, 2018 and included members of the planning team as well as new representatives from the Heron Lake Watershed District, Murray County Soil and Water Conservation District, and Murray County Planning and Zoning Office. At this meeting, the team discussed various potential flood mitigation strategies, some of which have been

incorporated into the plan. See section 5.4.3: Flooding for more information on the included flood mitigation strategies.

Mitigation Strategies & STAPLEE Process – Online Review

The team finalized and prioritized the goals, objectives, and strategies through the STAPLEE Process. STAPLEE stands for Social, Technical, Administrative, Political, Legal, Economic, and Environmental. The STAPLEE Process takes all seven criteria into consideration when finalizing and prioritizing the mitigation goals, objectives, and strategies.

A qualitative approach was used by the team in prioritizing the mitigation goals. The qualitative approach judged and prioritized the mitigation goals, objectives, and strategies based on perceived costs and benefits. All of the goals, objectives, and strategies were discussed during this subcommittee meeting. Upon completion, the Subcommittee reviewed the draft of the goals and strategies electronically.

Plan Review Meeting

The finished plan was sent to the Murray County Emergency Management Director for review at the beginning of March 2019.

The Draft Plan was disseminated to all of the Team Members for review in April 2019. The Murray County AHMP Planning Team reviewed the entirety of the Murray County AHMP. Modifications were made via email and phone to the SRDC.

The Public Review Meeting was held on May 6, 2019. The event was intended as an opportunity for local residents as well as neighboring communities, agencies, businesses, academia, nonprofits, and other interested parties to be involved in the planning process. Entities had the opportunity to ask questions and discuss specific goals with Planning Team members and SRDC staff. The Murray County AHMP was available online on Murray County's website for two weeks prior to the Public Review Meeting.

Interested entities could prepare feedback and recommendations before the public review meeting. Attendees were also able to come and go at their convenience, review the material sections of the plan, provide feedback, and make recommendations. A press release for the Public Review Meeting was advertised in the Murray County newspaper of record. A flyer was also provided to local units of government and a press release was distributed to other local media in the region. The open comment period provided a great opportunity for gathering feedback in regards to the Murray County AHMP.

2.2 Public Involvement

Intergovernmental coordination was essential in the development of the Murray County AHMP. The SRDC and Murray County Emergency Manager provided information to all local units of government in the county regarding the Murray County AHMP planning process and opportunities for participation. Meeting participation was solicited, but some local units of government opted for participating via phone, email, mail, or separate meeting with the Emergency Management Director. Email notices were also sent to local units of government, local organizations, and other entities involved in hazard mitigation. Subcommittee Meetings were not publicized.

All local units of government in Murray County were invited to review and comment on mitigation goals, objectives and strategies. Public and private entities were sent the mitigation strategies that their representing entity was listed in. Feedback and recommendations were requested regarding the mitigation goals, objectives, and strategies. Refer to the Figure #1 for more information regarding participating jurisdictions (including emergency response departments, schools, and organizations) that reviewed and approved the goals section of the Murray County AHMP.

2.3 Other Opportunity for Involvement

Hazard mitigation has been a regional effort in Southwest Minnesota, with many opportunities for involvement provided for neighboring communities, agencies involved in hazard mitigation, and businesses, academia, and other relevant private and non-profit interests. SRDC has worked with the following Minnesota counties on their hazard mitigation plans:

- Cottonwood County (2011; update 2019)
- Jackson County (2008; update 2016)
- Lincoln County (2010; update 2019)
- Lyon County (2010; update 2017)
- Murray County (2005; update 2012; update 2019)
- Nobles County (2005; update 2011; update 2018)
- Pipestone County (2010; update 2019)
- Redwood County (2005; update 2012; update 2019)
- Rock County (2007; update 2014)

2.4 Existing Plans, Studies, Reports, and Technical Information

Many sources of local, state, federal, and private information were used during the AHMP update. Various plans, programs, and policies were reviewed by SRDC staff. The literature review was a critical step in updating the Murray County AHMP. The coordinated use and consideration of these diverse data sources provided a sound basis for this plan and implementation activities. The following references were specifically consulted during the planning process.

- Murray County Emergency Operations Plan
- Murray County Comprehensive Plan
- The Murray County Water Management Plan
- Murray County Land Use Map
- Murray County Zoning Ordinances
- Local Water Plans
- Minnesota Department of Health water systems data
- The National Flood Insurance Program
- FIRM maps identifying flood hazard areas
- Fire District and Ambulance District Maps
- Mutual Aid Agreements between police forces, fire districts and ambulance districts
- Response Plans: HAZMAT

- MNDOT's Towards Zero Deaths (TZD) Program
- The Minnesota DNR dam safety program
- The Minnesota DNR drafts Emergency Action Plan
- FEMA Planning Aids and Tools
- County All Hazard Mitigation Plans

The above documents are incorporated into this planning document by reference. The maps selected and included in this plan have been created by Murray County and the SRDC utilizing data from Murray County GIS and the State of Minnesota's **Land Management Information Center (LMIC)**.

The University of Minnesota Duluth **Geospatial Analysis Center (GAC)** performed a hazard risk assessment for 100-year floods using the HAZUS-MH GIS tool. In recognition of the importance of planning in mitigation activities, FEMA created **Hazards USA Multi-Hazard (HAZUS-MH)**, a powerful geographic information system (GIS)-based disaster risk assessment tool. This tool enables communities of all sizes to predict estimated losses from floods, hurricanes, earthquakes, and other related phenomena and to measure the impact of various mitigation practices that might help reduce those losses. The Minnesota **Homeland Security and Emergency Management (HSEM)** office has determined that HAZUS-MH should play a critical role in Minnesota's risk assessments, and therefore the 100-year flood event hazard analysis is introduced in this plan.

The list of final mitigation actions was divided into jurisdiction-specific mitigation action charts so that each could see and address those actions that applied specifically to their cities (see *Appendix H: Mitigation Actions by Jurisdiction*).

Public input was sought through meetings and direct conversations (see *Appendix F: Public Hearing Notices and Meeting Notes/Comments*).

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SECTION 3: PREREQUISITES

This Chapter covers prerequisites for eligibility to adopt this multi-hazard mitigation plan in multiple jurisdictions. Section II describes the plan adoption process. Section III describes participation provisions post-approval of the all hazard mitigation plan by HSEM and FEMA.

3.1 Jurisdictions Represented in this Plan

For the purpose of hazard mitigation, FEMA considers a Local Government having jurisdiction as “any county, municipality, city, town, township, public authority, school district, special district, intrastate district, council of governments..., regional or interstate government entity, or agency or instrumentality of a local government.” (44CFR§201.2) Special considerations are given by FEMA for school districts, private nonprofit organizations, and multi-jurisdictional private nonprofit utilities (such as rural electric cooperatives).

Murray County has the land use authority over the townships, so Murray County will represent the townships in the All Hazard Mitigation Plan (AHMP). The Murray County AHMP will cover all the townships in the county. Land use authority within city limits is controlled by the local jurisdiction. Representatives from the townships were asked to participate in the planning process. Murray County and all of its cities previously passed resolutions of intent to participate in the hazard mitigation process and to be covered by the Murray County All Hazard Mitigation plan.

Murray County is a rural county. A number of resources and responsibilities are shared throughout the county. The Murray County Sheriff’s Office provides law enforcement throughout the county. The Cities of Fulda and Slayton also have separate police departments. Additional resources and responsibilities are shared regionally. Murray County is part of the Southwest Health and Human Services (SWHHS) service area, which includes the following counties: Lincoln, Lyon, Murray, Pipestone, Redwood, and Rock. A representative from the Murray County Sheriff’s office and SWHHS were members of the planning team. This ensured a regional prospective was taken when analyzing natural and other hazards.

Invitations were sent via email to representatives of all of the local jurisdictions to participate in the development of the plan either through filling out the worksheets, attendance at the meetings or participating in the plan review process. As in most rural areas, many of the participants wore multiple hats during the development process. For example, Emergency Management Director Heath Landsman represented Murray County Emergency Management as well as the Murray County Sheriff’s Department as he acts in the capacity as deputy sheriff for all services on behalf of the county.

Resolutions of Participation from each participating jurisdiction can be found in Appendix D. The Resolutions of Adoption will be added after FEMA approval.

Figure #1

Participating Jurisdictions

Local Units of Government
Murray County
City of Avoca

City of Chandler
City of Currie
City of Dovray
City of Fulda
City of Hadley
City of Iona
City of Lake Wilson
City of Slayton
Other Participating Organizations
Murray County Assessor's Office
Murray County Zoning Office
Murray County Ag & Solid Waste
Nobles Cooperative Electric
Murray County Medical Center
Southwest Health and Human Services

3.2 Adoption Procedure

Each jurisdiction participating in the plan must formally adopt the plan after FEMA provisionally approves the document (Section 1.B.1). This plan must be adopted within one year of provisional FEMA approval, or else be updated and re-submitted to FEMA again. Minnesota Statutes §375.51 Subd.1 requires that a “public hearing shall be held before the enactment of any ordinance adopting or amending a comprehensive plan or official control...”

Once the planning team finalized the draft All Hazard Mitigation Plan (AHMP), copies were made available to the public, local governments, and county departments for comment. The feedback period for the plan was 31 days. The planning team reviewed comments, modifications were made, and the draft was sent to Murray County Board of Commissioners for their review.

As part of the planning team's review, a public hearing was held to obtain any additional comments that the public or others wished to make. This final public review was conducted on May 6, 2019. 11 members of the public attended. When satisfied with the plan, the planning team recommended the Murray County Board of Commissioners forward the plan to the State of Minnesota Division of Homeland Security & Emergency Management (HSEM) for review. Federal rules require that this plan be submitted to HSEM for initial review and coordination, with the State then forwarding the plan to FEMA's Regional Office in Chicago for formal review and approval. Upon approval by FEMA, the Murray County Board of Commissioners will consider a Resolution of Adoption. After County approval, staff will work with each participating local unit of government to facilitate the local adoption of the plan.

Local jurisdictions with Comprehensive Plans and Land Use Plans are encouraged to incorporate applicable strategies, goals, and policies from the Murray County AHMP into their local plans upon next adoption. Local jurisdictions should utilize applicable zoning, subdivision control, and other ordinances to

enforce the policies described in this plan. The Murray County Emergency Management Department will work with local jurisdictions to help incorporate the applicable strategies, goals, and policies from the Murray County AHMP into their local plans. The SRDC sent all entities the goals, objectives, and strategies that their entity was named in. These entities had the opportunity to provide feedback and acknowledged the goals, objectives, and strategies that they were named in. Documentation of responses from those that responded can be found at the end of this plan.

3.3 Participation Provisions Post-Approval

FEMA guidance explains a process that jurisdictions can follow to become part of the planning process, or “join” the mitigation plan, after FEMA approval. Any jurisdiction wishing to join the plan at a later date should contact Murray County Emergency Management.

3.4 Planning Committee Worksheets

All planning meeting agendas, notes, and attendance (sign in sheets, emails) can be found in [Appendix F](#) for the meetings stated in Figure #1 below.

Figure #1 **Planning Team and Public Meetings**

Meeting Type	Date	Location
1 st Planning Team Meeting	September 7, 2017	Slayton, Minnesota
2 nd Planning Team Meeting	May 14, 2018	Slayton, Minnesota
Plan & Mitigation Strategies Review	April-May 2019	<i>Online</i>
Public Hearing	May 6, 2019	Slayton, Minnesota

Section 4 – Murray County Profile

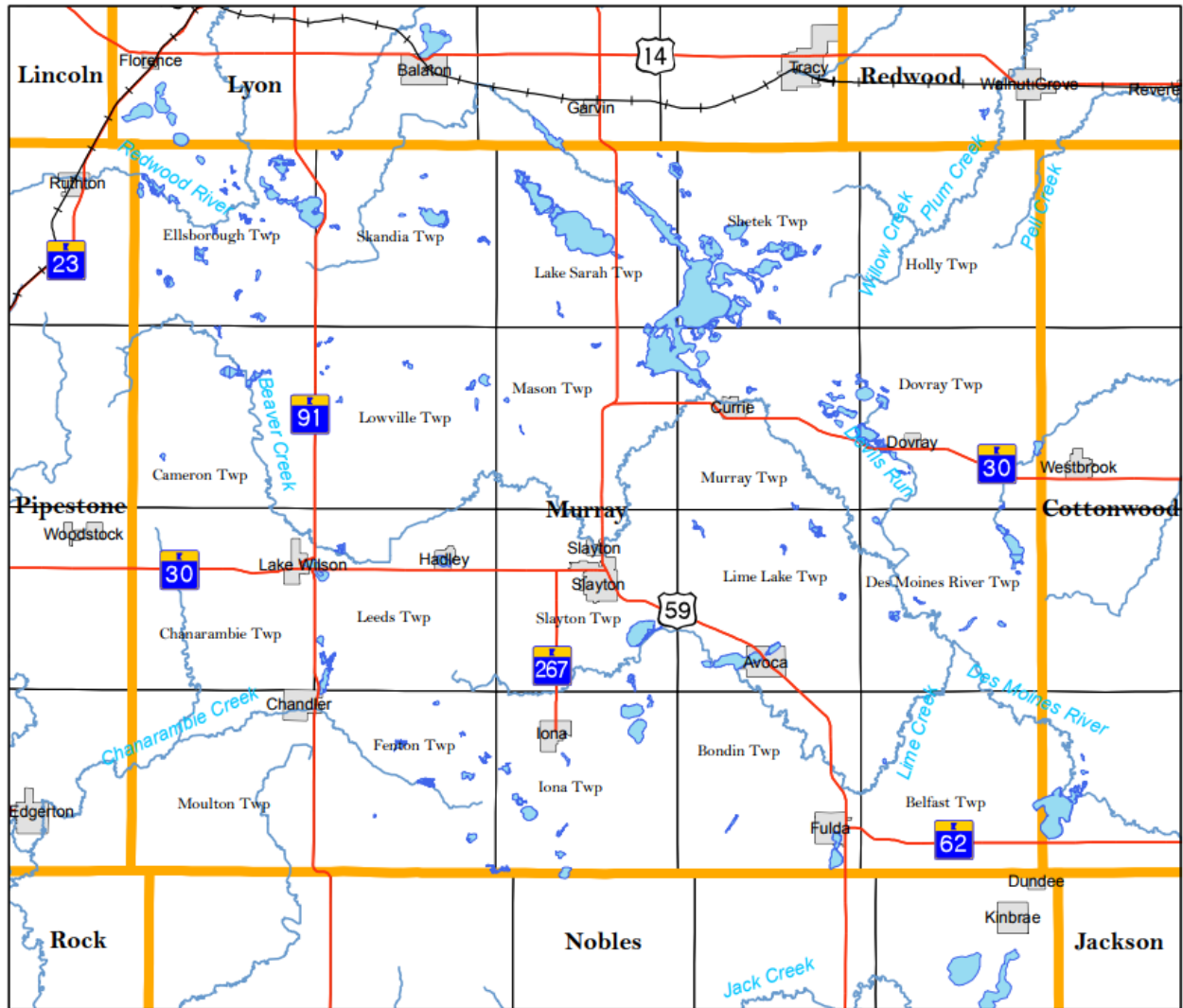
This section offers a general overview of Murray County to provide a basic understanding of the characteristics of the community, such as the physical environment, population, and the location and distribution of services.

4.1 Location and Area

Murray County is located in southwest Minnesota and has a total area of 720 square miles, 15 square miles of which is water. The county is bordered on the north by Lyon County, on the south by Nobles County, on the east by Cottonwood County, and on the west by Pipestone County. Cities within Murray County include Avoca, Chandler, Currie, Dovray, Fulda, Hadley, Iona, Lake Wilson, and Slayton.

The City of Slayton is the largest city in Murray County and serves as the Murray County seat. The city is along U.S. Highway 59 and Minnesota State Highway 30. US Highway 59 and Minnesota Highways 30, 62, and 91 provide thoroughfares into and out of the county from the north/south, east/west, east/west, and north/south respectively. US Highway 59 runs north-south through The Lakes Census-Designated Place, Slayton, Avoca, and Fulda, connecting to I-90 at Worthington and to I-94 near Fergus Falls. MN TH 30 runs east-west through the county – first through Dovray and Currie where it then meets US Highway 59 and runs north/south along the same roadway between The Lakes Census-Designated Place and Slayton where it then goes west through Hadley and Lake Wilson. Minnesota Highway 62 originates in Fulda at US Highway 59 and exits Murray County near the southeast corner, running east to Windom, MN where it terminates. Minnesota Highway 91 enters Murray County near its northwest corner and passes through Lake Wilson and Chandler, exiting near the southwest corner of the county. Additionally, Minnesota Highway 267 lies completely within Murray County, originating near Slayton along Minnesota Highway 30 and terminating in Iona. There are currently no railroads in Murray County.

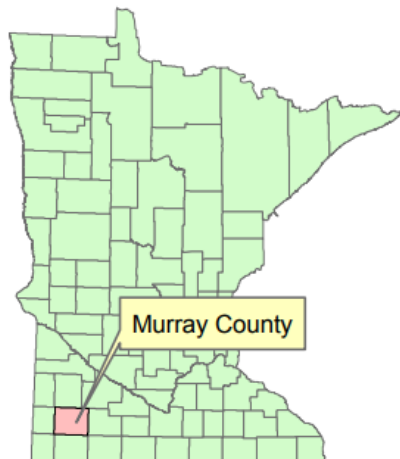
Figure #2
Minor Civil Divisions – Murray County



Murray County

- Trunk Highways
- Lakes
- Named Streams and Rivers
- County
- City
- Township

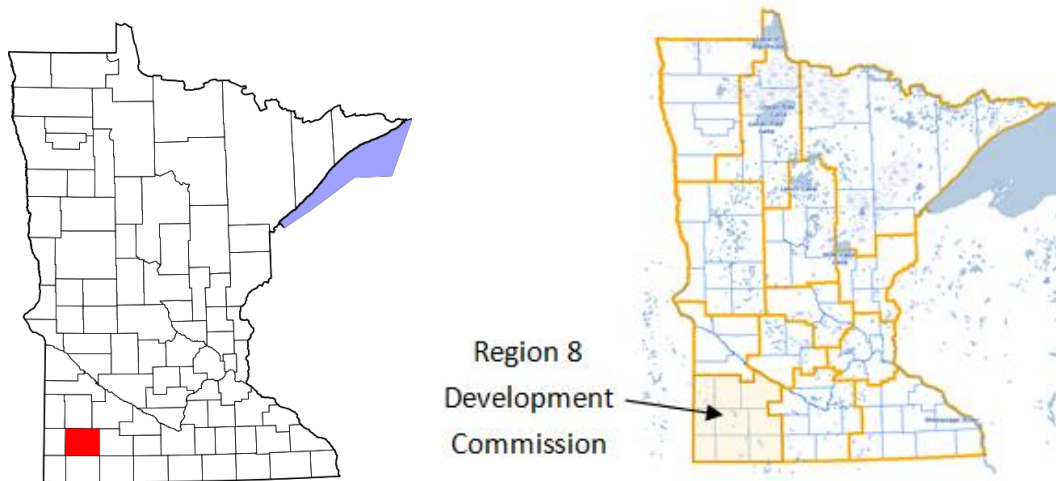
0 1 2 4 6 8
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Prepared by SRDC 4.08

Source: ESRI, MnDOT, DNR

Figure #3
Location of Murray County & Region 8 Development Commission



4.2 History

For generations, the Sisseton and Wahpeton bands of Dakota inhabited Southwest Minnesota. Under the Treaty of Traverse De Sioux (1851), the US Government acquired what is now Murray County. Murray County was created in 1857 from Brown County, and was officially organized in 1872.

Like many cities in Southwest Minnesota, the settlement of Murray County was aided by railroad commerce. The population in 1870 was 209 and just ten years later in 1880 it ballooned to 3,604. In 1890 the population reached 6,692 and 11,911 in 1900. The population of Murray County reached its peak at 15,060 in 1940. The population has continued to decline since then. By 2016, the Minnesota Demographic Center estimated the population of Murray County at 8,332.⁵

4.3 Physical Features

According to the Soil Survey of Murray County, land within Murray County is part of the Coteau des Prairies and is mostly a nearly level to undulating glacial moraine that is dissected by two nearly parallel, northwest- to southeast-trending moraines that form a rolling to steep topography. Murray County is characterized by some marked relief caused by the Coteau des Prairies plateau. Elevation ranges from more than 1,900 feet on the crest of the Coteau in Chanarambie Township to 1,250 on the Coteau slope in Holly Township – a 650 foot descent. This “Bemis Moraine” is known locally as “Buffalo Ridge.”⁶

The bedrock in Murray County is Sioux quartzite, crystalline, and cretaceous bedrock. Glacial drift also covers the county’s bedrock. The thickness of the glacial till ranges from over 500 feet near Chandler to about 150 feet in the northeast area of the county. There is little to no exposed bedrock in the county.

⁵ Minnesota State Demographic Center. Accessed: 7/18/17. Available: <https://mn.gov/admin/demography/data-by-topic/population-data/our-estimates/>

⁶ Soil Survey of Murray County, Minnesota. Accessed: 7/18/2017. Available: https://www.nrcs.usda.gov/Internet/FSE_MANUSCRIPTS/minnesota/MN101/0/Murray_MN.pdf

A study by the University of Minnesota’s Remote Sensing and Geospatial Analysis Laboratory found that 79% of the county is used for active agriculture.” About 12% is grass/shrub/wetland, 5.2% is classified as “urban,” and only 1.2% considered “impervious” (developed such that water will run off rather than soak into the ground).⁷ Most commercial and industrial development has taken place within incorporated cities. The future land use in Murray County will likely remain predominately in agriculture production.

4.3.1 Open Water Sources

There are approximately 15 square miles of open water in Murray County. The open water is characterized in three categories: lakes, marshes, and rivers and streams.

Lakes

Murray County has several lakes that provide recreational and natural resources. The lakes include: Currant Lake, Iron Lake, Lake Maria, Lake Sarah, Lake Shetek, Lake Louisa, Lake Wilson, Summit Lake, Badger Lake, Corabelle Lake, Lime Lake, and Fulda Lake.

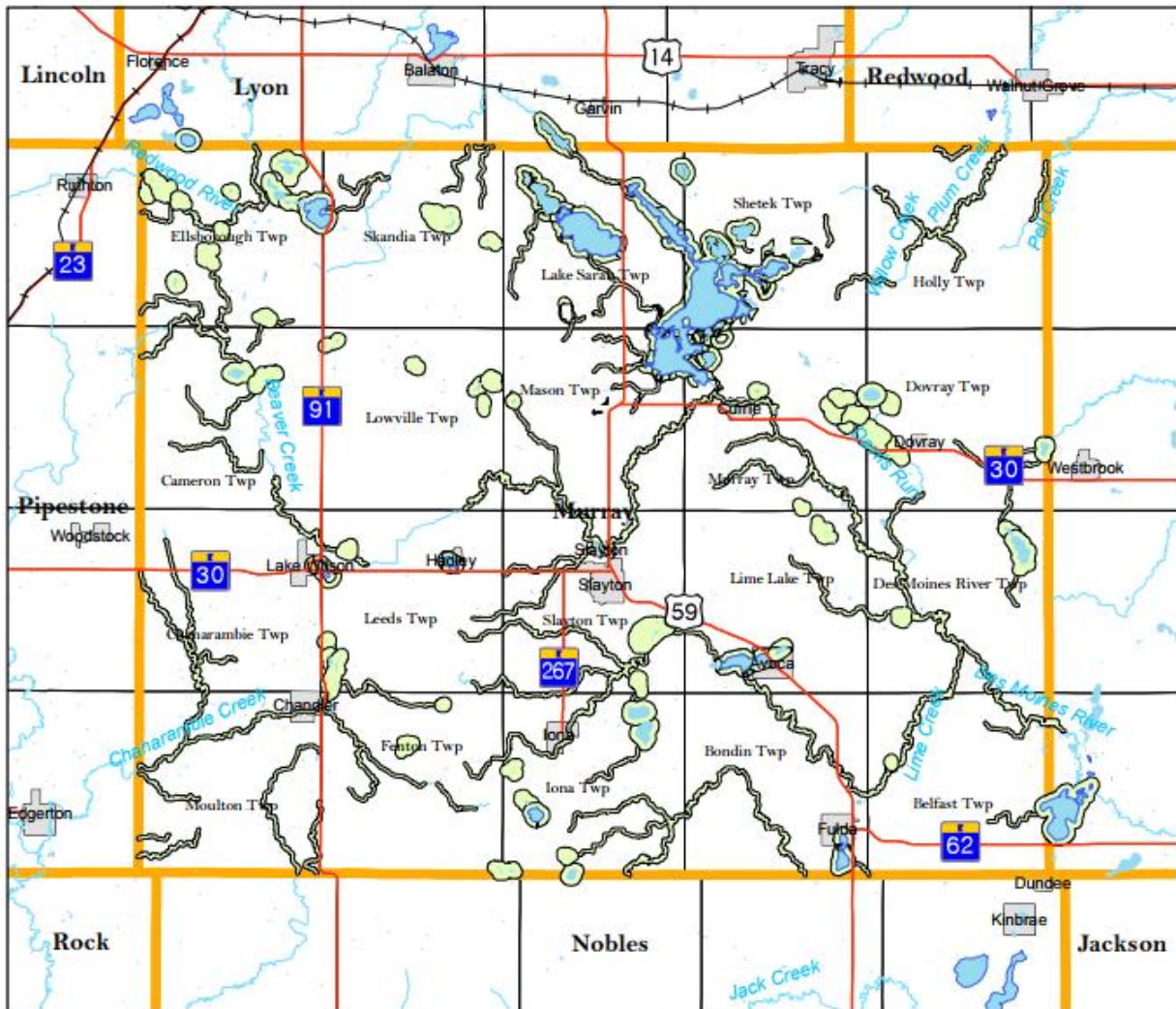
Lake Shetek is the largest lake and is located in the north-central portion of Murray County, just north of the City of Currie. Lake Sarah, located just northwest of Lake Shetek, is the second largest lake in the county. Many people have taken up year-round and seasonal residence at Lake Shetek, Lake Sarah, and the immediately surrounding lakes and sloughs – thus the area is known to the US Census Bureau as “The Lakes” Census Designated Place. Most of the lakes provide the opportunity to catch game fish and are also used for other water recreation.

Rivers

The only major river of Murray County is the Des Moines River. The West Fork (main branch) of the Des Moines River originates at Lake Shetek. It flows to the southeast, where it leaves Murray County toward Cottonwood and Jackson Counties.

⁷ Murray County All-Hazard Mitigation Plan 2012

Figure #4
Shoreland, Lakes, & Streams– Murray County



Murray County Shorelands

- Trunk Highways
- ~ Lakes
- Shoreland for basins
- Shoreland for courses
- ~ Named Streams and Rivers
- County
- City
- Township

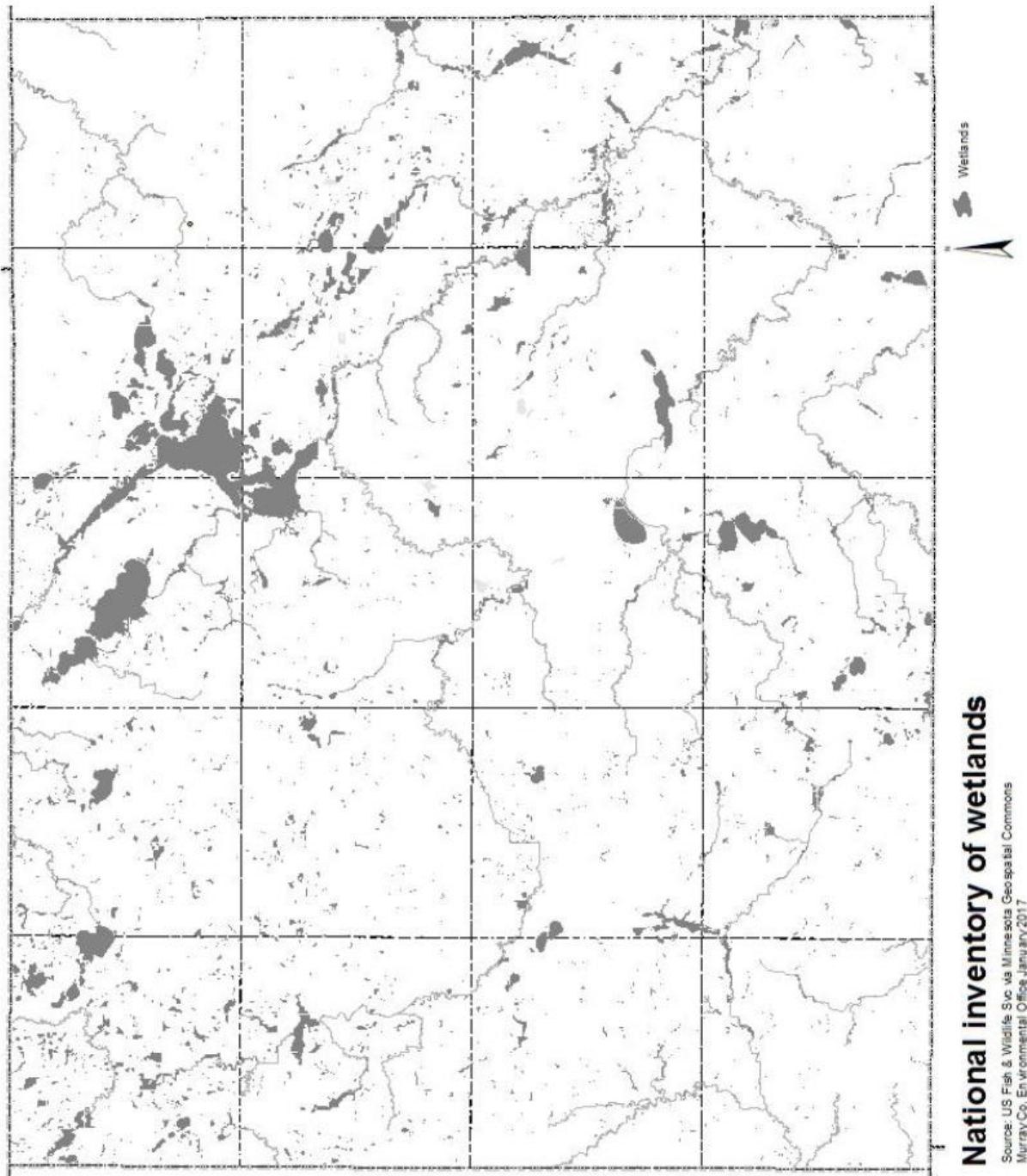
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 Miles



Prepared by SRDC 4.08

Projection: NAD83 HARN Adj Murray Co
 Source: ESRI, MnDOT, MPCA, DNR
 Murray County Environmental Services

Figure #5
Wetlands in Murray County



Watersheds

There are four watersheds in Murray County that help drain surface water. The main watersheds are the Redwood River Watershed, the Cottonwood River Watershed, the Des Moines River Headwaters Watershed, and the Rock River Watershed. The Des Moines River Headwaters drains into the Mississippi

basin and the Cottonwood and Redwood Rivers drain to the Mississippi by way of the Minnesota River. The Rock River watershed flows to the Missouri River basin. There are also a number of small streams that flow into these waterways.

Wetlands

Murray County is situated with a relatively large number of lakes. Recreational lakes are concentrated in the northeast and north central portions of the county. The streams and rivers in the county are, for the most part, utilized as drainage channels. Spring flooding is mainly confined to the Des Moines River watershed, particularly along Beaver Creek. While none of these lakes are as large as the resort lakes of northern Minnesota, shore lands in the region have attracted seasonal and year-round use which may lead to long-term pressure for development.

There are also many wetlands scattered across the region. According to MN DNR, “a wetland has mostly wet soil, is saturated with water either above or just below the surface and is covered with plants that have adapted to wet conditions” Wetlands provide many benefits to humans including the reduction of flooding by means of storage during high flows, filtration of pollutants and sediment, groundwater and aquifer recharge, wildlife habitat and aesthetic appeal. Much of the drainage of wetlands within the county occurred prior to the 1980s, when policies were enacted to prevent future wetland loss.

Heron Lake Watershed District (HLWD) was established in 1970 for a portion of the West Fork Des Moines River watershed, covering parts of Cottonwood, Jackson, Murray and Nobles counties. While HLWD currently focuses on water quality and wildlife habitat, their latest draft management plan (2011) includes flood control.

Wetlands store runoff and allow for a natural filtration of the water before it enters the ground water. The benefits of a healthy wetland vary from improved water quality to economic development generated from increased hunting, fishing, and recreation spending. Overall, wetlands provide many benefits to humans including the reduction of flooding by means of storage during high flows, filtration of pollutants and sediment, groundwater and aquifer recharge, wildlife habitat and aesthetic appeal.

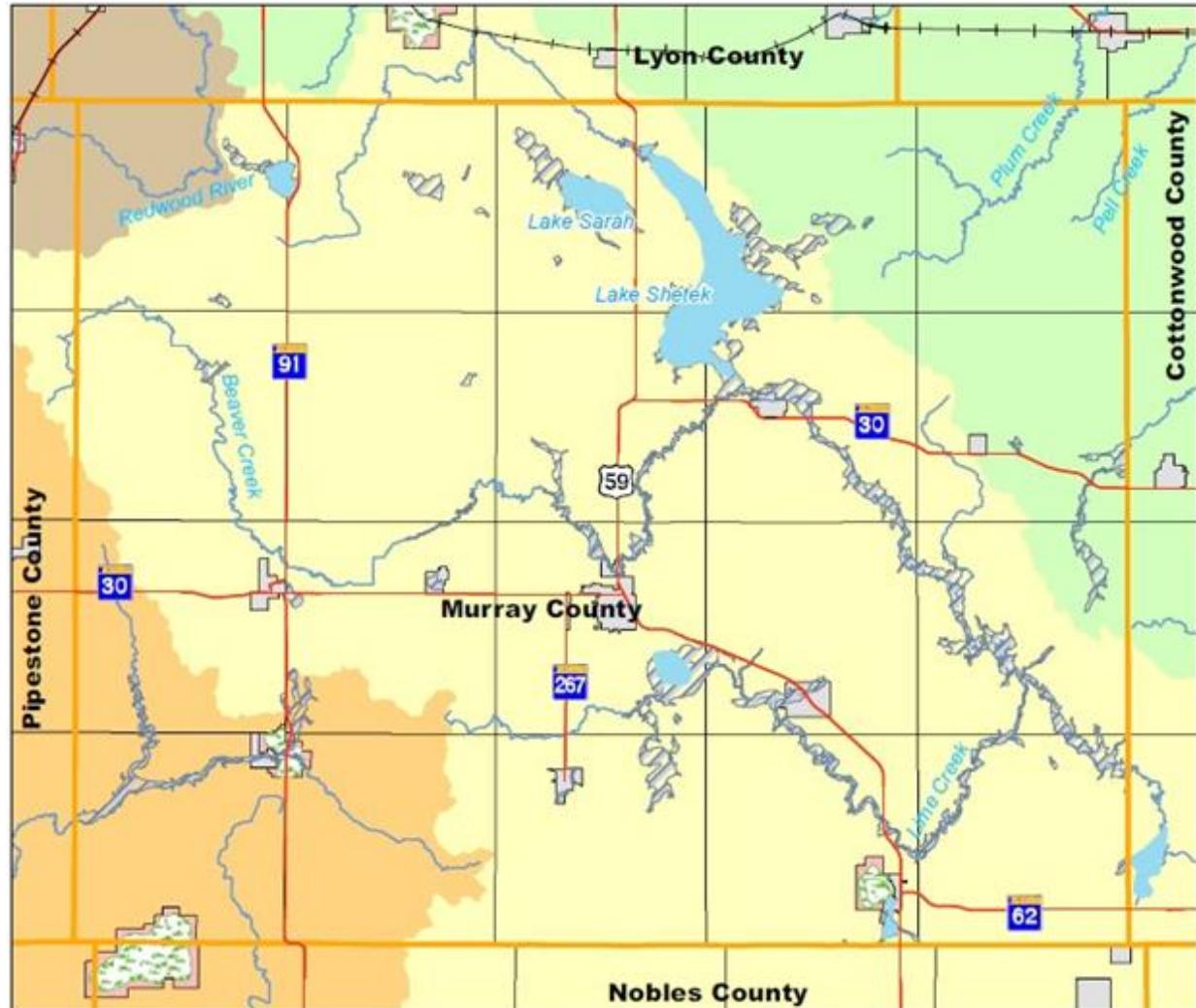
In addition, the wetlands in Murray County provide the following benefits:

- | | |
|--------------------------------------|--|
| ➤ Floodwater Storage and Detention | ➤ Aesthetics and Recreation |
| ➤ Nutrient Assimilation | ➤ Shore land Anchoring and Erosion Control |
| ➤ Sediment Entrapment | ➤ Wildlife Habitat |
| ➤ Groundwater Recharge and Discharge | ➤ Fisheries Habitat |
| ➤ Low-Flow Augmentation | |

Per the 2018 impaired waters list from the Minnesota Pollution Control Agency, the following waters of Murray County are impaired:

- 1 Unnamed wetland
- 11 Unnamed creeks
- Redwood River
- Currant Lake
- Lake Shetek Inlet
- County Ditch 20
- Beaver Creek
- Chanarambie Creek, North Branch
- Chanarambie Creek
- Champepadan Creek
- Lake Shetek
- Lake Sarah
- Upper Lake Sarah Outlet
- Fox Lake
- Bloody Lake
- Des Moines River
- Devils Run Creek
- Lime Lake
- Lime Creek
- Lake Corabelle
- Plum Creek (Judicial Ditch 20A)
- Dutch Charley Creek
- Jack Creek, North Branch
- Judicial Ditch 26
- Talcot Lake

Figure #6
Watersheds Map – Murray County



Murray County, MN

- | | |
|--|---|
| —+— Railroad | DWSMA |
| — Trunk Highways | WHPA |
| — Lakes | Major Watersheds |
| FEMA Floodplain | Cottonwood |
| ~ Named Rivers | Redwood |
| County | Rock |
| City | W. Fork Des Moines |
| Township | |

0 1 2 4 6 8 Miles



SRDC 06.11

Note: Floodplain is a rough estimation of the FEMA 100-year flood hazard area as shown on the Flood Insurance Rate Map. Not to be used for other than planning purposes. Additional hazard areas do exist. Actual location is only accurate by field elevation.

Source: Murray Co, MN DNR, MDH, MPCA, MnDOT, ESRI

This project was supported by Grant Award Number FEMA-DR-1717-MN awarded by the Federal Emergency Management Agency (FEMA). Points of View or opinions in this document are those of the author and do not represent endorsement by FEMA or reflect FEMA's views.

As the landscape in Murray County has changed over the years due to increased agricultural activities, the wetlands have also changed. Changes in the wetlands are due in part to tiling, changes in vegetation, and impervious surfaces. The exact amount of wetlands drained in Murray County since increased agricultural activities is unknown. Most of the remaining wetlands in Murray County have been identified in the National Wetlands Inventory. The inventory classifies all wetlands into eight different wetland types based on the depth of water and type of vegetation. Identifying and classifying wetlands along with regulations protecting wetlands help to preserve our wetlands into the future.

Land use and management practices that have occurred in Murray County have caused water quality degradation in the lakes and other water bodies (as mentioned above in the list of impaired waters). Due to the increase of nutrients, the county's lakes have seen an increase in algae blooms and other suspended sediments. With this decrease in water clarity, sunlight is not able to reach all areas of the lakes and this restricts many different kinds of plant growth. This not only eliminates a food supply for many game fish, but it also favors the growth of less desirable species like carp and black bullhead. Those fish then cause greater destruction to the lakes by uprooting other vegetation types and sending more debris into the water column. At least one lake in Murray County, Fulda Second Lake, has seen success in improving water quality and was recently delisted from the impaired waters list.

4.3.2 Surficial Geology

Sioux Quartzite aquifers lie in the upper 100 to 300 feet of bedrock, although few wells in Murray County draw water from them. Cretaceous aquifers—thin layers of sandstone concentrated near the base of Cretaceous deposits—range from 50 to 500 feet with moderate yields of water high in dissolved solids and minerals. Glacial aquifers are the most common source of drinking water in the county. Buried deposits of glacial sand and gravel are generally thin and discontinuous, typically 80 to 350 feet deep. Surficial glacial aquifers lie along glacial meltwater channels or small outwash plains. Wells in this layer are shallow, typically 30 to 55 feet deep. Surficial aquifers are often vulnerable to sources of pollution such as fuel storage tanks, feedlots and failing septic systems.

The bedrock of Murray County consists of three types of rock:

- Sioux quartzite: Stretching in a strip from northwest Murray County to the southeast corner of the county.
- Cretaceous rocks, undivided: Covering the northeast sections of the county as well as the southwest portions and a small part of the northwest corner.
- Migmatitic gneiss, amphibolite, and granite: In a strip from the northwest corner of the county to the central part of the county and a small section of the southwest.

4.3.3 Bedrock Geology

According to the soil survey of Murray County, the bedrock in Murray County is Sioux quartzite, crystalline, and cretaceous bedrock. Glacial drift also covers the county's bedrock. The thickness of the glacial till ranges from over 500 feet near Chandler to about 150 feet in the northeast area of the county. There is little to no exposed bedrock in the county.

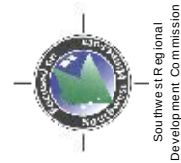
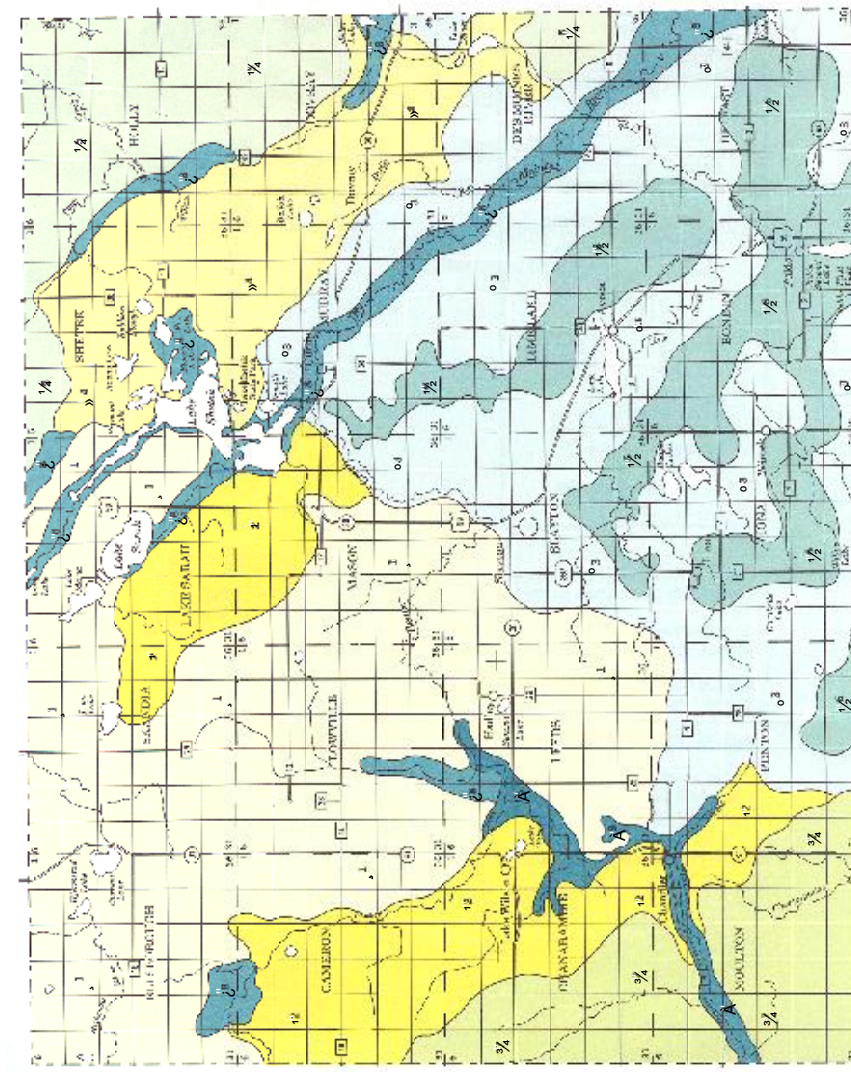
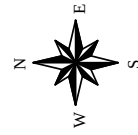
4.3.4 Soils

There are nine soil associations within Murray County according to the Soil Survey of Murray County.⁸ Four of the soil associations make up about 69 percent of the county. The first, Barnes-Flom-Vallers Association, which is nearly level to moderately steep, makes up 26 percent of the county. The second, Clarion-Webster-Nicollet Association, which is nearly level to hilly, makes up about 21 percent of the county. The third, Collinwood-Clarion-Waldorf Association, which is nearly level to sloping, makes up 12 percent of the county, and the fourth, Barnes-Buse Association, which is gently undulating to very steep and well-drained, makes up 10 percent of the county. The remaining five soil associations are Clarion-Storden (8 percent), Everly-Letri-Wilmonton (7 percent), Vienna-Hidewood-Lismore (8 percent), Arvilla-Egeland-Marysland (7 percent), Lamoure-La Prairie (1 percent).

⁸ Soil Survey of Murray County, Minnesota. Accessed: 7/18/2017. Available: https://www.nrcs.usda.gov/Internet/FSE_MANUSCRIPTS/minnesota/MN101/0/Murray_MN.pdf

Murray County General Soils Map

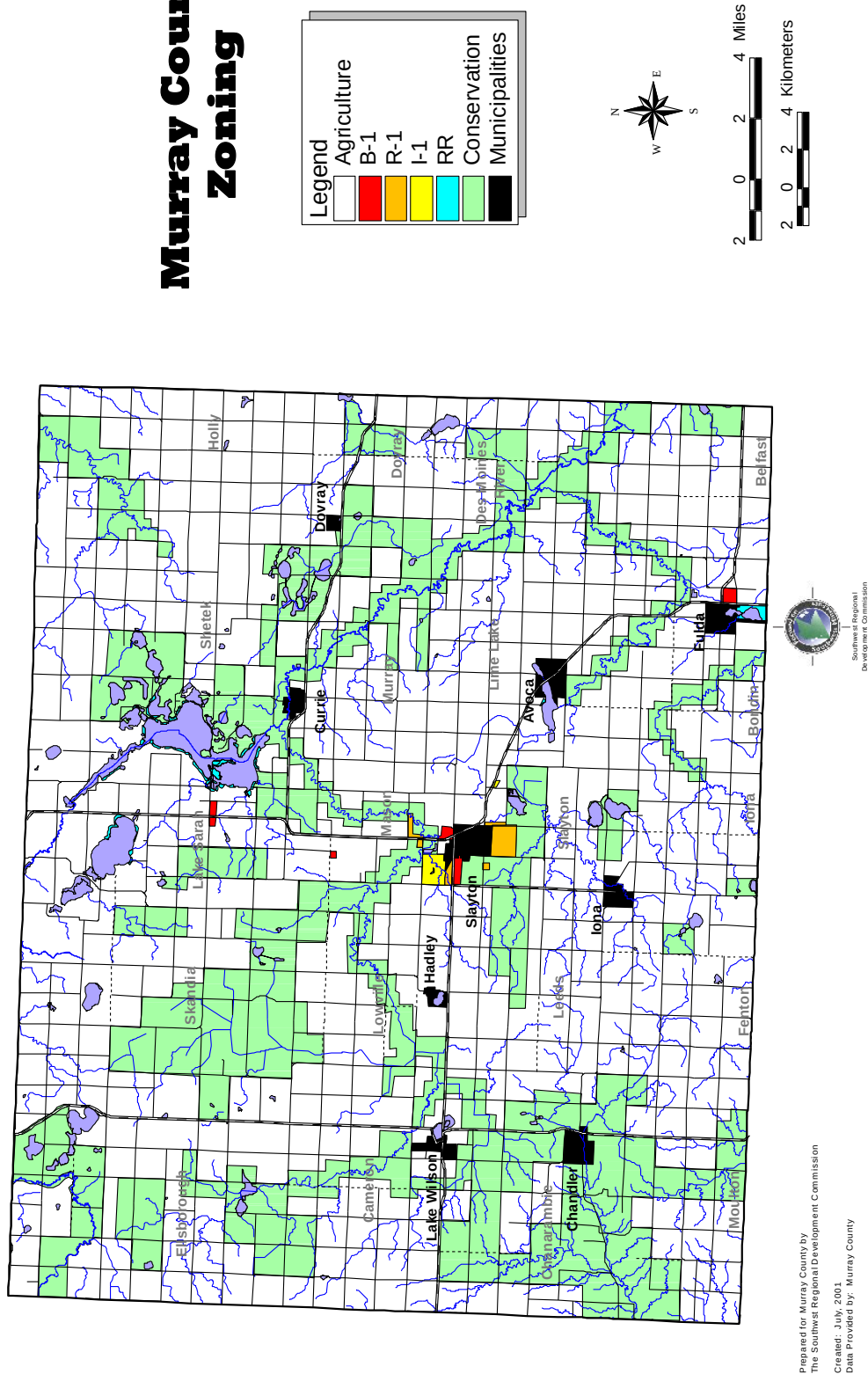
- 1 Barnes-Floim-Valliers: Well drained and poorly drained, nearly level to moderately steep soils that formed in loamy glacial till
- 2 Barnes-Buse: Well drained, gently undulating to very steep soils that formed in loamy glacial till
- 3 Carion-Webster-Nicollet: Well drained, poorly drained, and moderately well drained, nearly level to hilly soils that formed in loamy glacial till
- 4 Clarion-Storden: Well drained, undulating to very steep soils that formed in loamy glacial till
- 5 AREAS DOMINATED BY SOILS THAT FORMED IN FRIABLE AND FIRM GLACIAL TILL
Everly-Letri-Wilmonton: Well drained, poorly drained, and moderately well drained, nearly level to moderately steep soils that formed in loamy glacial till
- 6 Collinwood-Clarion-Waldorf: Moderately well drained, well drained, and poorly drained, nearly level to sloping soils that formed in clayey lacustrine sediments or loamy glacial till
- 7 AREAS DOMINATED BY SOILS THAT FORMED IN LOESS AND GLACIAL TILL
Vienna-Hidewood-Lismore: Well drained, poorly drained, and moderately well drained, nearly level to hilly soils that formed in silty loess and in glacial till
- 8 AREAS DOMINATED BY SOILS THAT FORMED IN GLACIAL OUTWASH AND ALLUVIUM
Arvilla-Egeland-Marysland: Somewhat excessively drained, well drained, and poorly drained, nearly level to moderately steep soils that formed in loamy material over sandy and gravelly deposits
- 9 Lamoure-La Prairie: Poorly drained and moderately well drained, nearly level soils that formed in silty and loamy alluvial material



Prepared for Murray County by
The Southwest Regional Development Commission
Created: January, 2001
Data Provided by: Soil Conservation Service, 1989

Murray County Zoning

Figure #8
Zoning Map – Murray County



4.4 Climate

Southwest Minnesota has a humid, mid-continental climate. Winters are characterized by cold, dry continental polar air. Summers are characterized by hot, dry tropical air masses from the Southwest meeting warm, moist maritime air masses from the Gulf of Mexico in the summer.

The weather is extremely variable during the year. During the winter months, precipitation is in the form of snowstorms, some of which may be severe. During the summer months, precipitation is in the form of showers (occasionally heavy) when warm moist air leaves the Gulf region and meets cooler air over Murray County. Weather patterns circulate counter-clockwise and generally enter Murray County from the west to southwest and sometimes from the south.

4.4.1 Precipitation

Average precipitation in Murray County from 1981 to 2010 was 28.82 inches. Average precipitation ranged from 18.35 inches to 51.1 inches from 1981 to 2010. From 1981 to 2010, the average seasonal snow fall in the City of Lake Wilson, which is in the west central portion of Murray County, was 46.1 inches.

Figure #9
Precipitation: 1981 – 2010 Average

Month	Precipitation in Inches – Lake Wilson	Snowfall in Inches – Lake Wilson
January	0.57	7.9
February	0.70	6.8
March	1.94	11.1
April	3.30	4.6
May	3.27	0.0
June	4.47	0.0
July	3.24	0.0
August	3.32	0.0
September	3.21	0.0
October	2.13	0.6
November	1.83	6.5
December	0.84	8.6
Annual Average	28.82	46.1

Source: National Climatic Data Center (<http://ggweather.com/normals/>)

4.4.2 Temperature

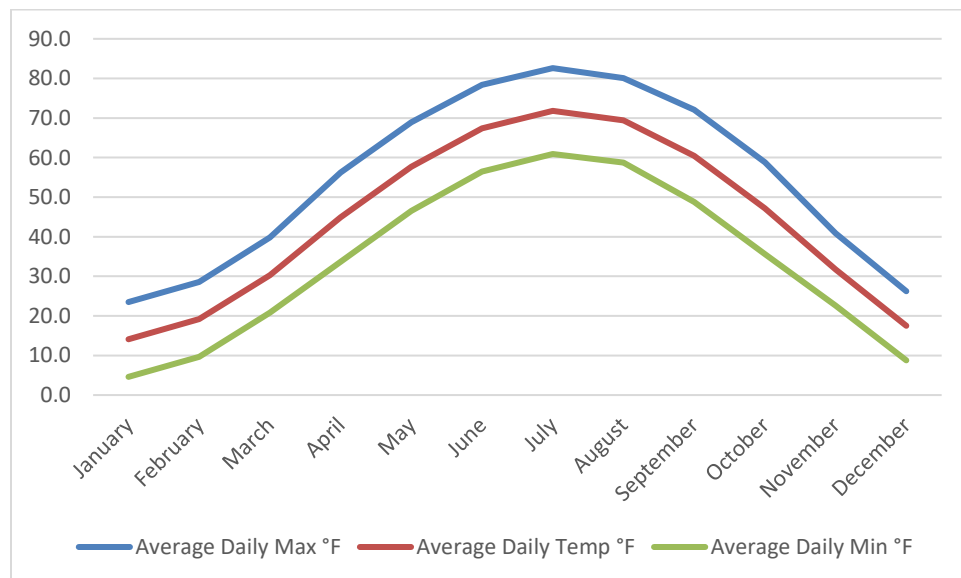
Average temperature in Murray County from 1981 to 2010 was 44.3 degrees Fahrenheit. The hottest month on average in Murray County is July with an annual average temperature of 71.8°F. The coolest month on average is January with an annual average temperature of 14.1°F. Temperatures were taken in the City of Lake Wilson.

Figure #10
Average Temperature: 1981 – 2010 – Lake Wilson

Month	Average Daily Max °F	Average Daily Temp °F	Average Daily Min °F
January	23.5	14.1	4.6
February	28.6	19.2	9.7
March	39.8	30.3	20.8
April	56.2	44.9	33.7
May	68.9	57.7	46.5
June	78.4	67.4	56.5
July	82.6	71.8	60.9
August	80.1	69.4	58.7
September	72.1	60.4	48.8
October	58.8	47.2	35.6
November	40.9	31.7	22.6
December	26.2	17.5	8.8
Annual Average	54.7	44.3	33.9

Source: National Climatic Data Center (<http://ggweather.com/normals/>)

Figure #11
Average Temperature: 1981 – 2010 – Lake Wilson



4.5 Population

Murray County is the 75th most populous county in the State of Minnesota (out of 87).⁹ Population growth trends have an effect on the needs and demands of services such as transportation, law enforcement, and emergency response personnel. It is important to analyze past population trends to attempt to make valid projections. However, it should be recognized that population projections are dependent upon a number of factors, a number of which are beyond county control.

4.5.1 Population Trends

The 2010 Census shows that Murray County has a population of 8,725. The MN State Demographic Center's most recent 2016 estimate places the population at 8,332. The two largest communities are Slayton with a population of 2,153 in 2010 and Fulda with a population of 1,318 in 2010. From 2000 to 2010, Slayton's population increased by 3.9 percent and Fulda's population increased by 2.7 percent. As a whole, Murray County experienced a decrease in population of 4.8 percent from 2000 to 2010. Murray County shares many of the demographic opportunities and challenges common in rural Minnesota and the Midwest overall.

Figure #12
Population Trends – Region 8

County	1970	1980	1990	2000	2010
Cottonwood	14,887	14,854	12,694	12,167	11,687
Jackson	14,352	13,690	11,677	11,268	10,266
Lincoln	8,143	8,207	6,890	6,429	5,896
Lyon	24,273	25,207	24,789	25,425	25,857
Murray	12,508	11,507	9,660	9,165	8,725
Nobles	23,208	21,840	20,098	20,832	21,378
Pipestone	12,791	11,690	10,491	9,895	9,596
Redwood	20,024	19,341	17,254	16,815	16,059
Rock	11,346	10,703	9,806	9,721	9,687
Region 8	141,532	137,039	123,359	121,717	119,151

Source: U.S. Census 1970, 1980, 1990, 2000, 2010

Figure #13
Distribution of Population – Murray County

	1970	1980	1990	2000	2010
Cities	5,328	5,484	4,759	4,593	4,627
Townships	7,180	6,023	4,901	4,572	4,098
Murray County	12,508	11,507	9,660	9,165	8,725

Source: U.S. Census 2000, 2010

⁹ MN State Demographic Center. Accessed: 7/19/2017. Available: <https://mn.gov/admin/demography/data-by-topic/population-data/our-estimates/>

While 57.4 percent of the county's population lived in the rural areas in 1970, only 47 percent lived in those same rural townships in 2010. The loss in population numbers from the rural areas and increasing proportion of urban population is not unique to Murray County, which is seen in the decline of the number of farmers. Populations in rural farming communities, like Murray County, are interconnected to the agricultural economy.

The agricultural economy is a competitive industry and is often used in economics as an example of a perfectly competitive market. Competition in the agriculture industry has lead agricultural businesses to specialize and exploit economies of scale to stay competitive in the market place. Innovation, specialization, and economies of scale have resulted in an agriculture industry that has been able to supply agriculture demand with fewer workers. In addition, the migration of young people from the rural areas to more urban areas, and the elderly persons moving to warming states have contributed to the decline of the rural population and the growth of urban centers.

Population by County Subdivision

The overwhelming majority of county subdivisions saw a decline in population from 2000 to 2010. The six county subdivisions that saw an increase in population between 2000 and 2010 were the City of Avoca (0.7 percent), the City of Currie (3.6 percent), the City of Fulda (2.7 percent), Lake Sarah Township (12.9 percent), Mason Township (5.3 percent), and the City of Slayton (3.9 percent). The two largest population declines were in Des Moines River Township (26.9 percent decrease) and Ellsborough Township (26.8 percent decrease).

Figure #14
Distribution of Population by County Subdivision – Murray County

County Subdivision	2000	2010	Percent Change 2000 - 2010
Avoca city	146	147	0.7%
Belfast township	195	192	-1.5%
Bondin township	335	268	-20.0%
Cameron township	151	137	-9.3%
Chanarambie township	223	206	-7.6%
Chandler city	276	270	-2.2%
Currie city	225	233	3.6%
Des Moines River township	182	133	-26.9%
Dovray city	67	57	-14.9%
Dovray township	167	152	-9.0%
Ellsborough township	198	145	-26.8%
Fenton township	209	177	-15.3%
Fulda city	1,283	1,318	2.7%
Hadley city	81	61	-24.7%
Holly township	172	127	-26.2%
Iona city	173	137	-20.8%
Iona township	195	163	-16.4%
Lake Sarah township	348	393	12.9%
Lake Wilson city	270	251	-7.0%
Leeds township	238	210	-11.8%
Lime Lake township	225	181	-19.6%
Lowville township	175	169	-3.4%
Mason township	284	299	5.3%
Moulton township	242	206	-14.9%
Murray township	204	177	-13.2%
Shetek township	313	296	-5.4%
Skandia township	173	172	-0.6%
Slayton city	2,072	2,153	3.9%
Slayton township	343	295	-14.0%
Total	9,165	8,725	-4.8%

Source: U.S. Census 2000, 2010

Population by Age Cohort

Population by age cohort can help planners identify trends and make predictions based on these trends. Changes in age cohorts can also help government plan for changes in demand for services. If the childbearing cohorts decline, government can make predictions that student enrollments may decline in the near future. The largest gain in population by age cohort was the age group 55 to 64 with 31.8 percent. The largest loss in population by age cohort was 35 to 44 with -31.6 percent.

Figure #15
Population by Age Cohort – Murray County

Age Group	2000	Percent of Total	2010	Percent of Total	Percent Change 2000 - 2010
0-9	1,094	11.9%	1,033	11.8%	-5.6%
10-19	1,384	15.0%	1,073	12.3%	-22.5%
20-24	348	3.8%	345	4.0%	-0.9%
25-34	846	9.2%	829	9.5%	-2.0%
35-44	1,285	14.0%	879	10.1%	-31.6%
45-54	1,279	13.9%	1,321	15.1%	3.3%
55-64	982	10.7%	1,294	14.8%	31.8%
65-74	984	10.7%	911	10.4%	-7.4%
75-84	700	7.6%	694	8.0%	-0.9%
85+	299	3.2%	346	4.0%	15.7%
Total	9201	100.0%	8725	100.00%	-5.2%

Source: U.S. Census 2000, 2010

Median Age

Cities in Murray County had small to moderate changes in median age from 2000 to 2010. The largest two increases in the median age were in the City of Iona with 18.6 percent, and in the City of Hadley with 17.3 percent. The largest decrease in the median age was in the City of Chandler with -4.0 percent. The City of Avoca had the smallest change in median age, which was a 0.2 percent increase.

Figure #16
Median Age by City – Murray County

City	2000	2010	Percent Change 2000-2010
Avoca	44.0	44.1	0.2%
Chandler	42.7	41.0	-4.0%
Currie	49.3	53.3	8.1%
Dovray	54.5	59.5	9.2%
Fulda	43.8	46.8	6.8%
Hadley	47.9	56.2	17.3%
Iona	43.5	51.6	18.6%
Lake Wilson	44.4	51.2	15.3%
Slayton	44.9	43.5	-3.1%

Source: U.S. Census 2000, 2010

In 18 of the 20 townships in Murray County, the median age increased between 2000 and 2010. The largest increase in the median age was in Lime Lake Township with an increase of 29.1 percent. The two

decreases in the median age were in Dovray Township, with a 2.6 percent decrease, and in Skandia Township, with a 9.4 percent decrease.

Figure #17
Median Age by Township – Murray County

Township	2000	2010	Percent Change 2000-2010
Belfast	36.1	45.4	25.8%
Bondin	38.7	45.9	18.6%
Cameron	35.3	38.4	8.8%
Chanarambie	35.8	42.3	18.2%
Des Moines River	44.0	52.5	19.3%
Dovray	46.5	45.3	-2.6%
Ellsborough	36.8	46.4	26.1%
Fenton	39.6	45.8	15.7%
Holly	38.0	48.5	27.6%
Iona	34.1	40.5	18.8%
Lake Sarah	47.7	53.9	13.0%
Leeds	34.8	44.2	27.0%
Lime Lake	38.2	49.3	29.1%
Lowville	37.2	39.3	5.6%
Mason	46.0	49.3	7.2%
Moulton	34.0	35.5	4.4%
Murray	45.5	47.3	4.0%
Shetek	46.1	55.1	19.5%
Skandia	40.3	36.5	-9.4%
Slayton	42.1	51.1	21.4%

Source: U.S. Census 2000, 2010

In Murray County the median age had a moderate increase from 42.4 to 46.8 from 2000 to 2010. The median age in Murray County is 6.3 years higher than Region 8 and is 9.4 years higher than the State of Minnesota, while Region 8 has a median age that is 3.1 years higher than the State of Minnesota.

Figure #18
Median Age by County/Region/State

Jurisdiction	2000	2010	Percent Change 2000-2010
Murray County	42.4	46.8	10.4%
Region 8	38.7	40.5	4.6%
Minnesota	35.4	37.4	5.6%

Source: U.S. Census 2000, 2010

Population by Race

From 2000 to 2010, the White population had a decrease of 1.66 percent in their proportion of the county-wide population and a 6.4 percent decrease in number. There has been a shift towards a more diverse population as seen in the data in Figure #19. The populations of Black/African-Americans and “Some Other Race” more than doubled and the Asian population increased by 310.5 percent. The Two or More Races group increased by 16.4 percent. The American Indian and Alaska Native population decreased by 45.0 percent.

Figure #19
Population by Race – Murray County

Race	2000	Percent	2010	Percent	Percent Change 2000-2010
White	9,013	98.34%	8,435	96.68%	-6.4%
Black or African-American	9	0.10%	25	0.29%	177.8%
American Indian and Alaska Native	20	0.22%	11	0.13%	-45.0%
Asian	19	0.21%	78	0.89%	310.5%
Native Hawaiian and other Pacific Islander	2	0.02%	2	0.02%	0.0%
Some Other Race	41	0.45%	103	1.18%	151.2%
Two or More Races	61	0.67%	71	0.81%	16.4%
Total Race Responses	9,165		8,725		

Source: U.S. Census 2000, 2010

About 95.9 percent of residents in Murray County only speak English. There are a number of other languages that are spoken in Murray County, that include: Spanish, German, other West Germanic Languages, Karen, and Arabic.

Figure #20
Language Spoken At Home – Murray County

Subject	Percent	Margin of Error
Speak only English	95.9%	+/-0.7
Speak a language other than English	4.1%	+/-0.7
Spanish	2.5%	+/-0.4
Other Indo-European	0.8%	+/-0.3
Asian and Pacific Island Languages	0.3%	+/-0.2
Other Languages	0.5%	+/-0.5

Source: 2010-2014 American Community Survey 5-Year Estimates

4.5.2 Population Projections

Population projections from the MN Department of Administration show that the population in Murray County is projected to decrease by 14.1 percent from 2015 to 2050. The projections show a dramatic

increase in the age cohorts 80+ from 2015 to 2050. The population for the age cohorts 35-49 are also projected to increase by percentages ranging from 3.3 percent to 22.3 percent. All other population cohorts are expected to have small to significant decreases – the highest of which is a decline of about 46.1 percent in the 60-64 cohort. Murray County communities will undoubtedly be impacted by the changing age structure of their communities. The county must ensure that services and needs are met as the population gradually becomes older and the demands for public services change. In the next three decades of years, local governments throughout the State will find themselves dealing with an aging population and attempting to improve the safety and welfare of an older and a more diverse community.

Figure #21
Population Projections – Murray County

	2015		2020		2025		2030	
Age Group	Male	Female	Male	Female	Male	Female	Male	Female
00 to 04	245	214	182	159	187	163	204	178
05 to 09	265	246	232	215	172	160	178	165
10 to 14	262	248	256	242	224	212	167	159
15 to 19	245	250	246	251	241	244	212	216
20 to 24	214	201	249	234	250	235	246	230
25 to 29	196	176	212	192	247	223	250	225
30 to 34	212	199	186	175	203	191	238	223
35 to 39	214	214	200	200	177	177	193	193
40 to 44	202	200	209	207	196	194	174	172
45 to 49	246	214	209	181	217	188	204	177
50 to 54	303	285	230	217	195	184	204	192
55 to 59	317	346	273	297	207	226	177	193
60 to 64	341	312	335	307	289	265	220	202
65 to 69	296	276	326	304	321	300	279	260
70 to 74	237	244	271	279	299	307	296	304
75 to 79	182	194	221	236	252	270	280	300
80 to 84	135	167	143	176	174	213	200	246
85+	115	216	101	192	100	190	115	216
Gender Totals	4227	4202	4081	4064	3951	3942	3837	3851
Total Population	8429		8145		7893		7688	

2035		2040		2045		2050		Percent Change 2015-2045	
Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
213	186	214	187	200	174	178	156	-27.3%	-27.1%
196	182	208	193	210	195	199	184	-24.9%	-25.2%
175	166	195	184	210	198	213	202	-18.7%	-18.5%
160	163	170	172	191	194	207	211	-15.5%	-15.6%
219	205	167	157	179	168	203	191	-5.1%	-5.0%
248	224	224	202	173	156	187	168	-4.6%	-4.5%
242	228	244	229	222	209	173	163	-18.4%	-18.1%
229	229	236	236	240	240	221	221	3.3%	3.3%
192	190	230	228	241	239	247	244	22.3%	22.0%
184	159	206	178	249	215	262	228	6.5%	6.5%
195	183	176	166	200	188	244	230	-19.5%	-19.3%
187	204	180	196	166	180	190	206	-40.1%	-40.5%
191	175	203	187	199	182	184	168	-46.0%	-46.2%
215	200	188	175	203	190	200	186	-32.4%	-32.6%
260	266	203	208	180	184	196	201	-17.3%	-17.6%
280	300	249	266	197	210	175	188	-3.8%	-3.1%
224	275	227	279	204	250	162	200	20.0%	19.8%
133	251	154	287	164	308	157	297	36.5%	37.5%
3743	3786	3674	3730	3628	3680	3598	3644	-14.9%	-13.3%
7529		7404		7308		7242		-14.1%	

Source: Minnesota Department of Administration

4.6 Housing

Household characteristics have a direct impact on land use, demand for housing, government services, and public education. Changes in demographics are part of the driving forces that contribute to changes in housing characteristics and demand for housing. Planning and consideration needs to take place at the local levels to ensure the supply of housing is adequate to meet the demand.

The 80+ are projected to increase significantly from 2015 to 2045. This aging population change requires different housing needs than younger cohorts. Assisted living facilities and nursing homes are two types of facilities that will help to accommodate this population change. The 60 plus age cohorts also have to be considered in emergency planning, since a number of persons in this cohort may have trouble evacuating a building and performing other safety protocol. This cohort and youth cohorts have to have special considerations when it comes to emergency planning.

There are a number of other considerations that have to be made when it comes to emergency planning. The age of a structure is one variable that impacts how well a structure will withstand a disaster. The age of a structure is also one variable that impacts the ability to repair a structure after a disaster. The building

materials used to construct the structure and the maintenance of the structure are two other variables in whether a structure can withstand a disaster. There are a number of other variables that impact the ability of a structure to withstand the stresses of a disaster.

4.6.1 Housing Units

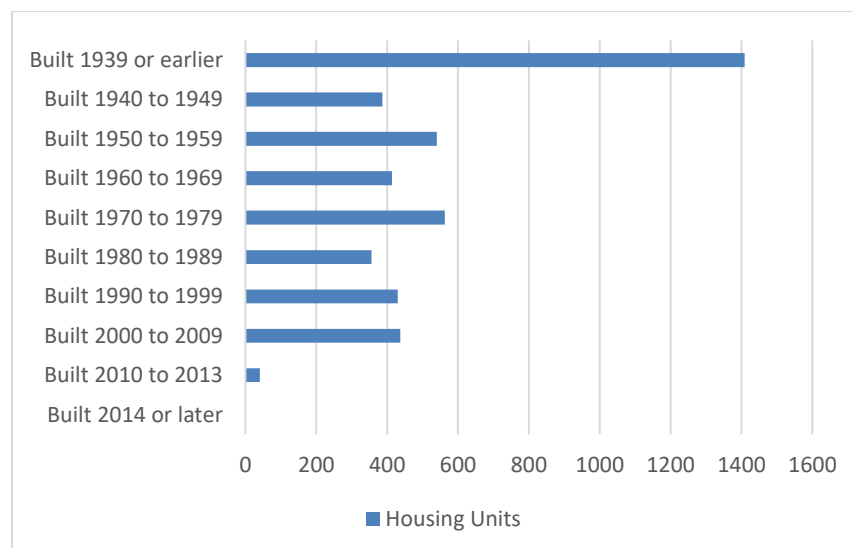
In Murray County 34.4 percent of housing units were built in 1939 or earlier. 62.6 percent of the housing units in Murray County were built prior to 1970, while 29.9 percent of housing units were built before 1950. Murray County still has an older housing stock which impacts the county's ability to withstand a disaster.

Figure #22
Build Year of Housing Units, 2015 Estimates – Murray County

Year Built	Housing Units	Percent
<i>Built 2014 or later</i>	1	0.0%
<i>Built 2010 to 2013</i>	41	0.7%
<i>Built 2000 to 2009</i>	437	6.5%
<i>Built 1990 to 1999</i>	430	6.1%
<i>Built 1980 to 1989</i>	356	5.7%
<i>Built 1970 to 1979</i>	563	18.4%
<i>Built 1960 to 1969</i>	414	8.1%
<i>Built 1950 to 1959</i>	540	10.1%
<i>Built 1940 to 1949</i>	387	10.0%
<i>Built 1939 or earlier</i>	1,409	34.4%
Total Housing Units	4,578	100.00%

Source: U.S. Census Bureau, 2015 ACS

Figure #23
Building Year of Housing Units – Murray County



There were a total of 46,762 housing units in Region 8 in 1970. Region 8 experienced a 12.98 percent increase in housing units from 1970 to 1980. From 1970 to 2000, there was a 12.13 percent increase in housing units for Region 8. From 2000 to 2010, there was a 1.73 percent increase in housing units for Region 8. In total, there was a 14.9 percent increase in housing units from 1970 through 2010.

For Murray County, the total number of housing units increased in 1980, decreased in 1990, decreased again in 2000 and then again increased in 2010. The overall change in housing units over the 40 years was a 7.6 percent increase (320 actual units).

Figure #24
Housing Unit Trends – Region 8

County	1970	1980	1990	2000	2010	Percent Change 1970 - 2010
Cottonwood	5,130	5,804	5,495	5,376	5,419	5.6%
Jackson	4,918	5,525	5,121	5,092	4,990	1.5%
Lincoln	2,882	3,298	3,050	3,043	3,108	7.8%
Lyon	7,526	9,196	9,675	10,298	11,098	47.5%
Murray	4,236	4,679	4,611	4,357	4,556	7.6%
Nobles	7,386	8,212	8,094	8,465	8,535	15.6%
Pipestone	4,286	4,636	4,387	4,434	4,483	4.6%
Redwood	6,718	7,388	7,144	7,230	7,272	8.2%
Rock	3,680	4,095	3,963	4,137	4,262	15.8%
Region 8	46,762	52,833	51,540	52,432	53,723	14.9%

Source: U.S. Census 1970, 1980, 1990, 2000, 2010

Population by Household

Murray County's population in households decreased somewhat by 4.9 percent from 2000 to 2010. The U.S. Census defines households as the total number of occupied housing units, and household units as the total number of livable dwellings that are available. The number of households, however, decreased by only 0.1 percent during the same period.

As the result of the relatively stable number of households, but declining population, the persons per household decreased from 2.42 in 2000 to 2.30 in 2010. The decrease over that time period was 4.9 percent. This might be partially due to the number of elderly living alone, which poses a number of concerns in regards to emergency preparedness.

The Housing Summary Table (Figure #32) shows the number of householders living alone and the number of householders 65 years and over living alone. There are 1,095 householders living alone and 557 householders 65 years and over living alone.

Figure #25
Population by Household – Murray County

	2000	2010	Percent Change 1990 - 2010
<i>Population in Households</i>	9,004	8,562	-4.9%
<i>Households</i>	3,722	3,717	-0.1%
<i>Persons Per Household</i>	2.42	2.30	-4.9%

Source: U.S. Census 2000, 2010

In Murray County 82.6 percent of occupied housing units are owner-occupied. From census to census, Murray County has seen fluctuations in the number of owner-occupied housing units over the past four decades. From 1970 to 2010, Murray County saw an overall 8.8 percent increase in owner-occupied housing units. During that same time period, Region 8 saw a 4.6 percent decrease in owner-occupied housing units.

Figure #26
Housing Occupancy – Region 8

	Total Occupied	Owner -Occupied
County	2010	2010 (%)
Cottonwood	4,912	79.6%
Jackson	4,429	78.3%
Lincoln	2,574	80.2%
Lyon	10,227	66.5%
Murray	3,717	82.6%
Nobles	7,946	72.8%
Pipestone	4,054	74.9%
Redwood	6,580	78.0%
Rock	3,918	77.4%
Region 8	48,357	74.9%

Source: U.S. Census 2010

The trend of renter-occupied units in Murray County was very different from the owner-occupied units. From 1970 to 2010, the percentage change in renter-occupied housing units was a decrease of 27.9 percent (250 actual units). The demand for renter-occupied housing units may increase as the population ages and moves from owner-occupied housing units to assisted living facilities and other rental facilities.

Figure #27
Owner- Occupied Housing Occupancy – Region 8

County	1970	1980	1990	2000	2010	Percent Change 1970 – 2010
Cottonwood	3,760	4,243	3,925	3,955	3,757	-0.1%
Jackson	3,356	3,781	3,477	3,601	3,466	3.3%
Lincoln	2,131	2,323	2,161	2,130	2,063	-3.2%
Lyon	5,107	6,203	6,207	6,643	6,799	33.1%
Murray	2,821	3,181	2,982	3,135	3,070	8.8%
Nobles	5,161	5,928	5,791	5,955	5,783	12.1%
Pipestone	3,066	3,358	3,129	3,173	3,035	-1.0%
Redwood	4,587	5,252	5,055	5,328	5,135	11.9%
Rock	2,519	2,868	2,826	2,994	3,031	20.3%
Region 8	32,508	37,137	35,553	36,914	31,009	-4.6%

Source: U.S. Census 1970, 1980, 1990, 2000, 2010

Figure #28
Renter – Occupied Housing Occupancy – Region 8

County	1970	1980	1990	2000	2010	Percent Change 1970 - 2010
Cottonwood	1,053	1,233	1,134	962	1,003	-4.7%
Jackson	1,193	1,207	1,083	955	963	-19.3%
Lincoln	448	605	543	523	511	14.1%
Lyon	1,930	2,476	2,866	3,072	3,428	77.6%
Murray	897	855	776	587	647	-27.9%
Nobles	1,864	1,886	1,892	1,984	2,163	16.0%
Pipestone	996	999	949	896	1,019	2.3%
Redwood	1,579	1,600	1,499	1,346	1,445	-8.5%
Rock	975	987	928	849	887	-9.0%
Region 8	10,935	11,848	11,670	11,174	10,622	-2.9%

Source: U.S. Census 1970, 1980, 1990, 2000, 2010

4.6.2 Vacant Housing Units

The 1970 U.S. Census reported that Murray County had 463 vacant housing units. This number decreased by 18, to 445 units from 1970 to 1980. The number of vacant housing units almost doubled from 1980 to 1990 by 408 units to 853 total. The number of vacant housing units then dropped by 218 units between 1990 and 2000. Again, between 2000 and 2010, the number rose to 839 units. The overall increase within this 40 year span was 81.2 percent.

In 1990, the Census Bureau began to separate owner and renter vacant housing units. The combined percentages of the new data are higher than the actual vacant units year round. The numbers include unoccupied units for sale and housing used for seasonal, recreational, or occasional use. The rise of vacant

housing units from 1970 to 1990 is mainly contributed to the decrease in rural population in Murray County and other rural counties.

Figure #29
Vacant Housing – Region 8

County	1970	1980	1990	2000	2010	Percent Change 1970 - 2010
Cottonwood	317	318	435	459	507	59.9%
Jackson	322	379	561	536	561	74.2%
Lincoln	280	324	346	390	534	90.7%
Lyon	484	512	602	583	871	80.0%
Murray	463	445	853	635	839	81.2%
Nobles	350	383	411	526	589	68.3%
Pipestone	224	278	309	365	429	91.5%
Redwood	520	523	590	556	692	33.1%
Rock	182	239	209	294	344	89.0%
Region 8	3,142	3,401	4,316	4,344	5,366	70.8%

Source: U.S. Census 1970, 1980, 1990, 2000, 2010

In 2010, 18.4 percent of the housing units in Murray County were vacant, which was the highest percentage in Region 8. The percentage of a county's housing units being vacant adversely affects preparing for and cleaning up after a disaster.

Figure #30
Percent Vacant – Region 8

County	1970	1980	1990	2000	2010
Cottonwood	6.6%	5.8%	8.6%	8.5%	9.4%
Jackson	7.1%	7.6%	12.3%	10.5%	11.2%
Lincoln	10.9%	11.1%	12.8%	12.8%	17.2%
Lyon	6.9%	5.9%	6.6%	5.7%	7.8%
Murray	12.5%	11.0%	22.7%	14.6%	18.4%
Nobles	5.0%	4.9%	5.3%	6.2%	6.9%
Pipestone	5.5%	6.4%	7.6%	8.2%	9.6%
Redwood	8.4%	7.6%	9.0%	7.7%	9.5%
Rock	5.2%	6.2%	5.6%	7.1%	8.1%
Region 8	7.1%	6.8%	8.9%	8.1%	9.7%

Source: U.S. Census 1970, 1980, 1990, 2000, 2010

Housing Unit Value

Among Region 8 counties, Murray County in the middle of the housing unit value – higher than four counties and lower than four counties. The median rent is only \$521 – the third lowest among Region 8 counties. The cost of a disaster is about average in comparison to other Region 8 counties.

Figure #31
Median Housing Unit Value – Region 8

County	Median Housing Unit Value	Median Rent
Cottonwood	\$81,800	\$454
Jackson	\$100,300	\$543
Lincoln	\$76,300	\$477
Lyon	\$136,300	\$543
Murray	\$90,000	\$521
Nobles	\$97,200	\$554
Pipestone	\$85,100	\$576
Redwood	\$88,300	\$557
Rock	\$99,200	\$567
Region 8	\$100,904	\$538

Source: U.S. Census 2010

Figure #32
US Census 2010 Housing Summary: Murray County

Subject	Number	Percent
Total Population		
In Households	8,562	98.1%
In Group Quarters	163	1.9%
Total Households		
Family Households	2,480	66.7%
Non Family Households	1,237	33.3%
Householder Living Alone	1,095	29.5%
Households 65 years and over living Alone	557	15.0%
Households with Individuals under 18	946	25.5%
Households with Individuals 65 and over	1,297	34.9%
Average Household Size	2.30	(X)
Units in Structure		
1 unit, detached	4,088	89.3%
1 unit, attached	28	0.6%
2 units	35	0.8%
3 or 4 units	37	0.8%
5 to 9 units	23	0.5%
10 to 19 units	126	2.8%
20 or more units	95	2.1%
Mobile Home	146	3.2%

Vehicles Available		
None	144	3.9%
1 Vehicle	1,074	28.7%
2 Vehicles	1,335	35.7%
3 or more	1,184	31.7%
House Heating Fuel		
Utility Gas	869	23.3%
Bottled, tank, or LP gas	1,602	42.9%
Electricity	502	13.4%
Fuel oil, kerosene, etc.	618	16.5%
Coal or coke	0	0.0%
Wood	70	1.9%
Solar Energy	0	0.0%
Other fuel	59	1.6%
No fuel used	17	0.5%
Selected Characteristics		
Lacking complete plumbing facilities	8	0.2%
Lacking complete kitchen facilities	9	0.2%
No telephone service	77	2.1%

Source: U.S. Census 2010 and 2015 ACS

4.7 Employment

Murray County had an estimated employment of 2,953 persons in 2016, including 2,377 employments by private ownership and 575 employments by government ownership. The two largest employers by industry were the Trade, Transportation and Utilities Industry and the Education and Health Services Industry, followed by the Manufacturing Industry. The industry cohort Natural Resources and Mining including Agricultural, Forestry, Fishing, Hunting and Mining, is estimated to be higher, but self-employed farms workers are not reported in Department of Employment and Economic Development figures.¹⁰

¹⁰ MN Department of Employment and Economic Development. Accessed 7/20/17. Available: <https://apps.deed.state.mn.us/lmi/qcew/AreaSel.aspx>

Figure #33
Employment by Industry – Murray County

Industry	2000	2010	2016
Natural Resources and Mining	105	81	114
Construction	219	176	194
Manufacturing	146	359	531
Trade, Transportation and Utilities	580	770	754
Information	36	NA	19
Financial Activities	148	155	123
Professional and Business Services	117	84	87
Education and Health Services	682	774	682
Leisure and Hospitality	185	179	188
Other Services	71	79	77
Public Administration	217	183	181
All Industries	2,508	2,868	2,953

Source: Department of Employment and Economic Development

Agriculture is a significant driving force in Murray County. The USDA 2012 Census of Agriculture showed that there were 895 farms in Murray County in 2012, 13 percent fewer than in 2007. In 2012, the average farm size was 456 acres, and the average farm reported sales of \$408,347. There were 407,919 acres of farm land in production in Murray County.¹¹ In 2012, the market value of agricultural products sold in Murray County was \$365,471,000. Between 2007 and 2012, the market value of agricultural products sold increased by 54 percent and the average per farm increased by 76 percent.

4.7.1 Unemployment Trends

The unemployment rate in Murray County was 4.8 percent in 2016, while the State of Minnesota had an unemployment rate of 3.9 percent. From 2000 through 2016, the average unemployment rate was 4.8 percent for Murray County, 4.2 percent for Region 8, 4.9 percent for Minnesota, and 6.2 percent for the United States. The average unemployment rate for Murray County was slightly higher than Region 8, almost equal to the State, and moderately lower than the national rate.

During the economic recession of 2008-2012, the average unemployment rate was 5.8 percent for Murray County, 5.3 percent for Region 8, 6.5 percent for the State of Minnesota, and 8.3 percent for the United States. Murray County fared significantly better during the recession than the State of Minnesota and the United States.

One explanation for Murray County seeing significantly lower unemployment rates was the agriculture industry. Murray County is part of a strong agricultural region in Southwest Minnesota. About 2/3 of farmers list farming as their primary occupation. Murray County has a significant amount of livestock,

¹¹ USDA Census 2012, Murray County Profile. Accessed: 7/21/17. Available: https://www.agcensus.usda.gov/Publications/2012/Online_Resources/County_Profiles/Minnesota/cp27101.pdf

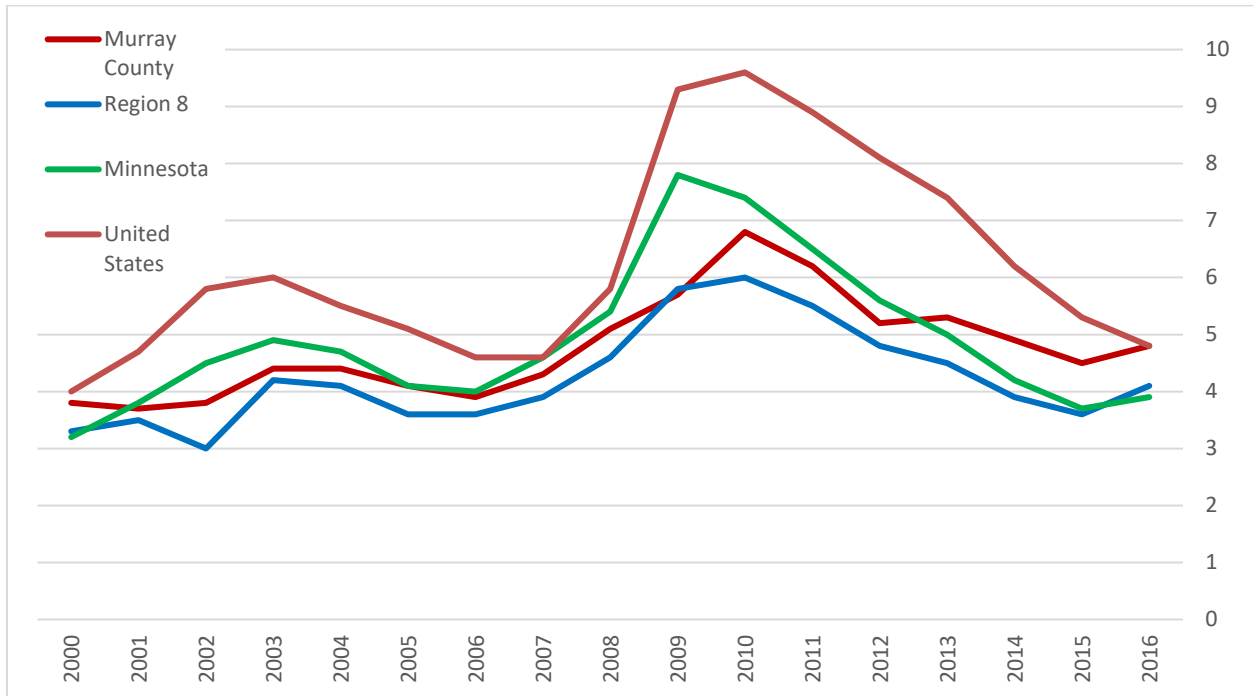
including hogs and pigs, cattle, and sheep. The largest employer in the county is Monogram Food Solutions, and there are other large health employers such as the Murray County Medical Center, Maple Lawn Nursing Home, and Golden Living Center.

Figure #34
Unemployment Trends

Year	Murray County	Region 8	Minnesota	United States
2016	4.8	4.1	3.9	4.8
2015	4.5	3.6	3.7	5.3
2014	4.9	3.9	4.2	6.2
2013	5.3	4.5	5.0	7.4
2012	5.2	4.8	5.6	8.1
2011	6.2	5.5	6.5	8.9
2010	6.8	6.0	7.4	9.6
2009	5.7	5.8	7.8	9.3
2008	5.1	4.6	5.4	5.8
2007	4.3	3.9	4.6	4.6
2006	3.9	3.6	4.0	4.6
2005	4.1	3.6	4.1	5.1
2004	4.4	4.1	4.7	5.5
2003	4.4	4.2	4.9	6.0
2002	3.8	3.0	4.5	5.8
2001	3.7	3.5	3.8	4.7
2000	3.8	3.3	3.2	4.0
Average	4.8	4.2	4.9	6.2

Department of Employment and Economic Development & Bureau of Labor Statistics

Figure #35
Unemployment Trends



4.7.2 Household Income Levels

Changes in income are an indicator of the county's economic condition. Per Capita income is the mean income computed for every person in a specified geographic area. For household income, the median is based on the distribution of the total number of housing units, including those occupants with no income. According to the 2010 Census information, the median household income for Murray County was \$45,657, while the Region 8 average was \$44,361. Per capita income in Murray County was \$24,045, while Region 8 was \$23,192. The median family income was \$54,647, while Region 8 was \$57,072. In household and per capita income, Murray County ranked higher than the Region 8 average, though it was lower in terms of family income.

Figure #36
Comparative County Income Levels – Region 8

County	2000 Median Household Income	2010 Median Household Income	2000 Per Capita Income	2010 Per Capita Income	2000 Median Family Income	2010 Median Family Income
Cottonwood	31,943	40,292	16,647	23,162	40,237	51,705
Jackson	36,746	46,869	17,499	25,144	43,426	59,238
Lincoln	31,607	44,672	16,009	24,922	38,605	58,953
Lyon	38,996	46,872	18,013	23,755	48,512	63,793
Murray	34,966	45,657	17,936	24,045	40,893	54,647
Nobles	35,684	43,040	16,987	20,953	43,076	52,356
Pipestone	31,909	40,589	16,450	22,289	40,133	55,609
Redwood	37,352	44,181	18,903	23,548	46,250	55,829
Rock	38,102	45,411	17,411	23,079	44,296	58,147
Region 8	\$35,998	\$44,361	\$17,493	\$23,192	\$43,923	\$57,072

Source: U.S. Census 2000, 2010

4.8 EMERGENCY RESPONSE PROFILE

4.8.1 Introduction

A county's ability to respond to an emergency situation is based on service areas, facilities, equipment, and staff. An understanding of response times and abilities is critical for providing protection to Murray County residents. The existing facilities, equipment, and staff in Murray County are here to respond to local hazard events and provide regional support. These investments are critical in mitigating the effects of natural and other hazards and protecting lives, property, and other assets. Murray County is considered a mutual aid county because they provide and receive support from neighboring counties. The following summary and description serves as an inventory of the response facilities for Murray County. This Chapter profiles the emergency response capabilities of Murray County. Facilities included in the profile include:

- Law Enforcement
- Regional Assets
- Public Health
- Medical Facilities
- Ambulance Service
- Fire Department
- Red Cross Shelter
- Sirens and other Emergency Notification Devices

4.8.2 Murray County Emergency Management

The Murray County Emergency Management Director administers the county-wide emergency management program in Murray County. The Director coordinates the emergency management functions of county and city governmental units. The Director's and department's duties also include the following:

- Coordinating emergency preparedness throughout the county
- Writing and coordination of emergency operation plans
- Public education
- Assistance to local jurisdictions and county agencies before, during, and after disasters strike
- Collaborate with local, state, and federal officials, and partner with neighboring jurisdictions, to facilitate better preparedness, response, and recovery from natural and human-made disasters.

4.9 Profiling Emergency Response Capabilities

Emergency Operations Center

The Murray County Emergency Management Office and the Emergency Operations Center (EOC) are located in the Sheriff's Office at the Law Enforcement Center in Slayton.

4.9.1 Law Enforcement

In Murray County, the Cities of Fulda and Slayton have independent police departments. The rest of the county is served by the Murray County Sheriff's Office. The Sheriff's deputies patrol all townships in Murray County, and contract police services to the cities of Avoca, Chandler, Currie, Dovray, Hadley, Iona, and Lake Wilson. One Murray County Sheriff Deputy is affiliated with the Buffalo Ridge Drug Task Force.

The Murray County Sheriff's Office partners with Lyon County to house inmates. The Murray County Sheriff's Office currently has 12 full-time licensed officers and 1 part-time licensed officer along with 2 civilian employees. The patrol deputies provide law enforcement and other sheriff's services to the citizens of Murray County.

The Murray County 911 Emergency Dispatch and Communications Center is comprised of 5 dispatchers (4 full-time, 1 part-time) who work 7 days a week, 24 hours a day, on a variety of shifts and are responsible for the dispatching of Law Enforcement, Fire, and EMS countywide.

Fulda Police Department

The Fulda Police Department is comprised of 2 full-time officers and 2 part-time officers.

Slayton Police Department

The Slayton Police Department is comprised of 4 full-time officers and 5 part-time officers. The department also has 1 full-time civilian employee.

Law enforcement agencies in Murray County are also supported by state and federal law enforcement agencies. Law enforcement can contact the MN Bureau of Criminal Apprehension (BCA) for felony crimes that have occurred in the county or for internal investigations. There are a number of other specialized law enforcement agencies that can provide assistance to Murray County.

4.9.2 Regional Assets

There are a number of regional assets that are shared throughout southwest Minnesota in Emergency Management Region Five. These assets include: light towers, generators, cameras, livestock trailers, APX radios, computers, go kits, video tele-conferencing systems, cots, blankets, privacy screens, identification equipment, pet shelter equipment, and presentation equipment.

- Radio communications trucks – There are five radio communications trucks available.¹²
- Portable ARMER Tower

¹² Minnesota Southwest ARES District. Accessed: 1/1/16. Available: <http://www.minnesotaares.org/ares/index.php/mn-ares-districts/2014-02-15-22-14-39>

4.9.3 Public Health

Murray County is part of the Southwest Health and Human Services (SWHHS) group. SWHHS provides services across six counties, serving Lincoln, Lyon, Murray, Pipestone, Redwood, and Rock Counties. Southwest Health and Human Services is a multi-county agency that is committed to strengthening individuals, families and communities by providing quality services in a respectful, caring and cost effective manner. SWHHS provides a number of services in regards to public health and welfare that include: social services, child support, financial assistance, and public health services.

- Social Services include: special needs adoption, adult and children's mental health, adult and child protection, chemical health, developmental disabilities, foster care, child care assistance, individuals with disabilities/chronic illness, licensing of foster and child care providers, family services, and senior services.
- Child support assisting in establishing parentage, establishing court orders for child support, enforcing those orders, providing medical, dental and child care support, collecting and processing payments.
- Financial assistance services that determine eligibility for services ranging from cash assistance, food support, health care and emergency assistance.
- Public Health Services that assure a strong public health system, promote healthy families and communities, prevent the spread of infectious disease, make environments safe and healthy, prepare for disasters and emergencies, and help all people get quality health services.

4.9.4 Medical Facilities

Medical facilities inventoried in Murray County consist of one hospital, three medical clinics, two nursing homes, three assisted living facilities, and three chiropractic clinics.

Hospitals

There is one hospital in Murray County – the Murray County Medical Center in Slayton. The Murray County Medical Center is a Level IV trauma center.

Patients in Murray County are also transferred to hospitals in the region. Other hospitals in the region include Avera Marshall Regional Medical Center, Sanford Worthington Medical Center, Sanford USD Medical Center in Sioux Falls, and Avera McKennan Hospital of Sioux Falls.

Clinics

There are three health clinics within Murray County that specialize in a variety of areas. Both the Avera Medical Group and Murray County Medical Center have clinics located in Fulda and Southwestern Mental Health Center is located in Slayton.

Nursing Homes

There are two nursing homes in Murray County. The nursing homes in Murray County include: Maple Lawn Nursing Home in Fulda and Slayton Rehabilitation and Healthcare Center (closed in June, 2019).

Assisted Living Facilities

There are three assisted living facilities in Murray County – Lindenwood Assisted Living in Slayton, Maplewood Court in Fulda, and Sunrise Terrace in Slayton.

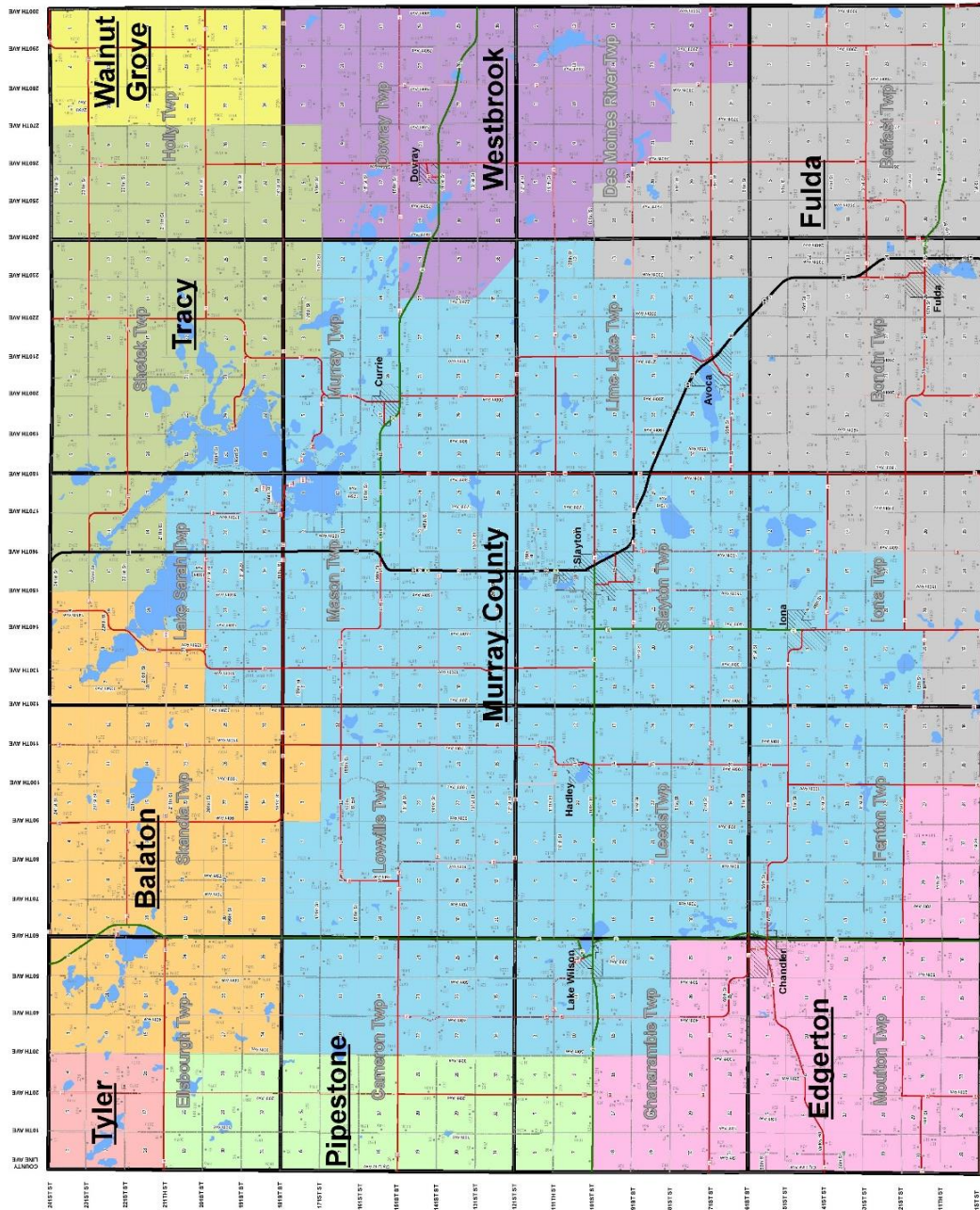
Chiropractic Clinics

There are three chiropractic clinics in Murray County. The chiropractic clinics in Murray County include: Fulda Family Chiropractic, Fixen Chiropractic in Slayton, and Slayton Chiropractic Clinic.

4.9.5 Ambulance Services

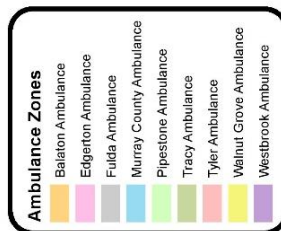
There are two Ambulance Districts headquartered in Murray County. Those Ambulance Districts are Fulda Ambulance District and Murray County Ambulance District. Other ambulance districts that serve the cities and rural areas of Murray County include: Balaton Ambulance District, Edgerton Ambulance District, Pipestone Ambulance District, Tracy Ambulance District, Tyler Ambulance District, Walnut Grove Ambulance District, and Westbrook Ambulance District. Additional ambulances can be called from neighboring counties.

Figure #37
Ambulance Districts – Murray County



Ambulance Coverage

Murray County
 Minnesota
 2012



Source: Murray County GIS Data
 Prepared by Murray County Planning Services, 2012
 Displayed using ArcView County Coordinate System

Balaton Ambulance Service (Balaton EMS)

The Balaton Ambulance Service covers the Cities of Balaton, Garvin and Russell, as well as surrounding rural areas including northern Murray County. The Balaton Ambulance Service is comprised of eight Emergency Medical Technicians-B (EMT-B) and eight first responders (EMR). The Balaton Ambulance Service averages roughly 135 calls per year. The majority of calls tend to be medical transports from the Colonial Manor of Balaton Nursing Home to the emergency room (ER) in Marshall or Tracy.

For assistance the Balaton Ambulance Service more frequently calls upon neighboring ambulance service that includes: Tracy Ambulance service, North Memorial, Murray County ambulance as well as Tyler Ambulance. The Balaton Ambulance Service does have mutual aid agreements with these neighboring ambulance services. The Balaton Ambulance Service has one operational ambulance.

Chandler First Responders

The Chandler First Responders cover the City of Chandler and the immediate surrounding area. The Chandler First Responders are composed of 15 first responders.

Edgerton Ambulance

The Edgerton Ambulance Service covers the Cities of Edgerton, Hatfield, and Trosky, all of Osborne Township, and portions of Burke, Elmer, and Gray Townships (as well as the City of Chandler and Leota CDP and surrounding areas outside of Pipestone County). The Edgerton Ambulance Service is comprised of 22 EMTs. The Edgerton Ambulance Service went on 171 calls in 2015 and 137 calls in 2016. The majority of calls were medical followed by trauma.

For assistance, the Edgerton Ambulance Service relies on mutual aid. The Edgerton Ambulance Service has mutual aid agreements with Pipestone Ambulance, Jasper Ambulance, Murray County Ambulance, and Rock County Ambulance Services.

Fulda Ambulance

The Fulda Ambulance Service covers the City of Fulda, as well as surrounding rural areas (including the unincorporated communities of Lime Creek and Wirock) in southeast and southern Murray County. The Fulda Ambulance Service is comprised of 18 EMTs and First Responders. The Fulda Ambulance Service went on 78 calls in 2017.

Lake Shetek First Responders

The Lake Shetek First Responders cover The Lakes CDP area and the immediate surrounding area. The Lake Shetek First Responders are composed of 11 first responders. The Lake Shetek First Responders went on 17 calls in 2017.

Lake Wilson First Responders

The Lake Wilson First Responders cover the City of Lake Wilson and the immediate surrounding area. The Lake Wilson First Responders are composed of 8 first responders. The Lake Wilson First Responders went on 4 calls in 2017.

Murray County Ambulance

The Murray County Ambulance Service covers the Cities of Avoca, Currie, Hadley, Iona, Lake Wilson, and Slayton and the surrounding rural areas. The Murray County Ambulance Service is comprised of 24 EMTs and First Responders. The Murray County Ambulance Service went on 213 calls in 2017.

Pipestone Ambulance

The Pipestone Ambulance Service covers the Cities of Holland, Pipestone, and Woodstock; all of Troy and Sweet Townships; and portions of Grange, Gray, Eden, and Elmer Townships. The Pipestone Ambulance Service is comprised of 22 EMTs and 5 Paramedics. The Pipestone Ambulance Service went on 925 calls in 2015 and 884 calls in 2016. The majority of calls were medical follow by trauma and interfacility transfers.

For assistance, the Pipestone Ambulance Service relies on mutual aid. The Pipestone Ambulance Service has mutual aid agreements with Edgerton Ambulance, Jasper Ambulance, Tyler Ambulance, Murray County Ambulance, and Rock County Ambulance Services.

Tracy Ambulance Service (Tracy EMS)

The Tracy Ambulance Service covers the City of Tracy, as well as surrounding rural areas. The Tracy Ambulance Service is composed of three paramedics and 20 Emergency Medical Technicians (EMT). The Tracy Ambulance Service went on 315 calls in 2013 and 305 calls in 2014. The majority of the calls were to transfer patients to Sanford in Sioux Falls, South Dakota.

For assistance the Tracy Ambulance Service most frequently calls upon neighboring ambulance service that includes: North Memorial Ambulance in Marshall, Balaton Ambulance, Murray County Ambulance in Slayton, Westbrook Ambulance, and Walnut Grove Ambulance. The Tracy Ambulance Service does have mutual aid agreements with these neighboring ambulance services. The Tracy Ambulance Service has three operational ambulances.

Tyler Ambulance Service (Tyler EMS)

The Tyler Ambulance Service covers the Cities of Tyler, Lake Benton, Verdi, Florence and Ruthton, as well as surrounding rural areas in Lincoln, Lyon, Pipestone and Murray Counties. The Tyler Ambulance Service is comprised of 11 Emergency Medical Technicians (EMT). The Tyler Ambulance Service averages roughly 220 calls per year. The majority of calls tend to be 911 calls where the patient is transported from their home or the scene to the closest hospital or hospital of their choice. Approximately 30% of the calls are medical transports to other facilities including Marshall, Sioux Falls and Rochester.

For assistance the Tyler Ambulance Service calls upon neighboring ambulance services that includes: Balaton, Hendricks, Ivanhoe, Marshall, Minneota, Pipestone, and Tracy. The Tyler Ambulance Service does have mutual aid agreements with these neighboring ambulance services. Tyler Ambulance also works with the Lake Benton, Holland, Ruthton and Russell First Responder Units. The Tyler Ambulance Service has two operational ambulances.

Walnut Grove Ambulance

The Walnut Grove Ambulance Service covers portions of Holly Township in the far northeastern corner of Murray County.

Westbrook Ambulance

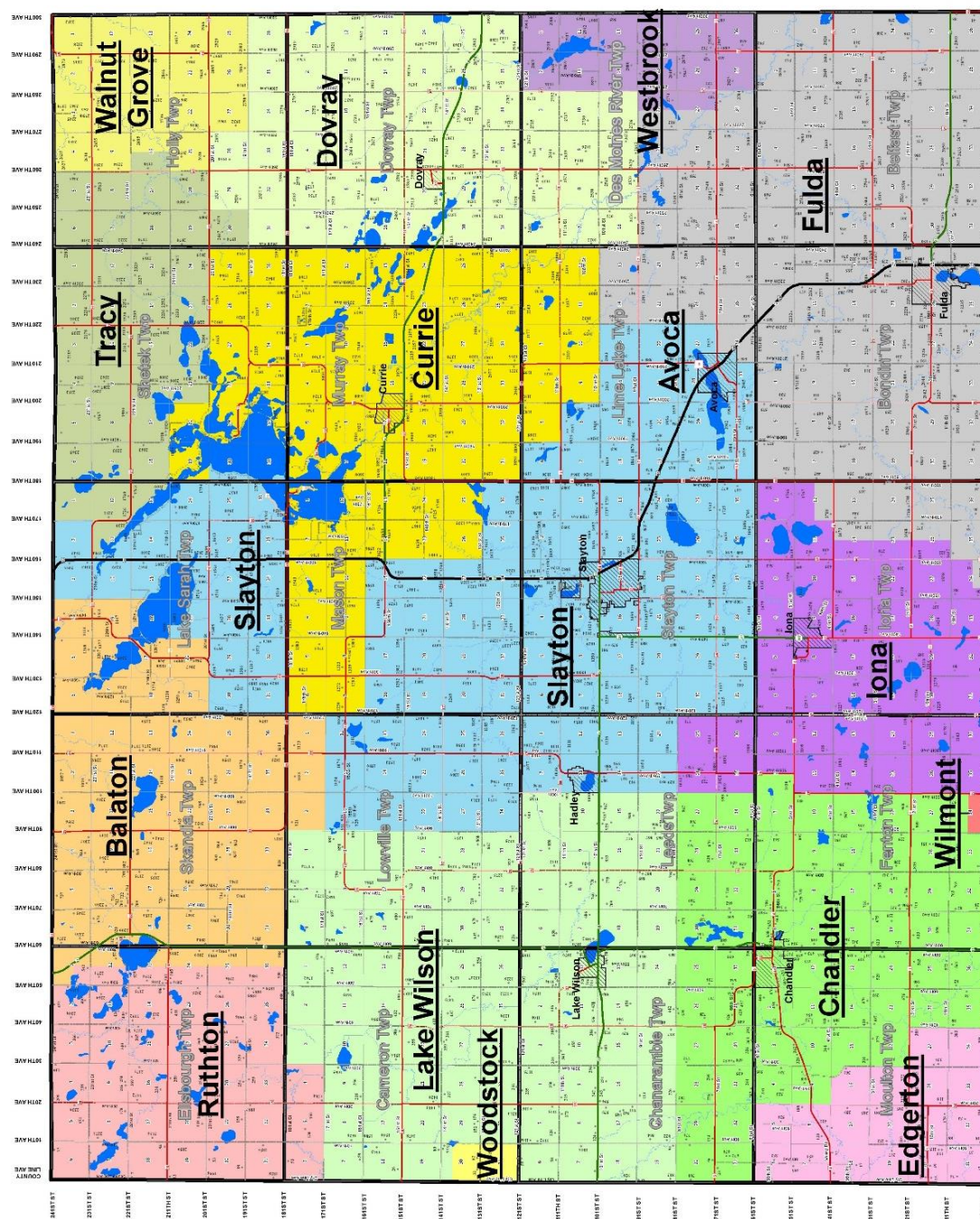
The Westbrook Ambulance Service covers the cities of Westbrook, Storden, and Jeffers. They serve all of Rose Hill and Westbrook Townships and parts of Amboy, Amo, Ann, Dale, Southbrook, and Storden Townships in Cottonwood County. The Westbrook Ambulance Service is composed of 14 volunteer staff members on call 24 hours a day and 7 days a week. The Westbrook has 1 type III ambulance and 1 type I four wheel drive ambulance and went on approximately 150 calls in 2016.

Westbrook Ambulance service has Mutual Aid agreements with Windom, Mountain Lake, Walnut Grove, Tracy, and Murray County.

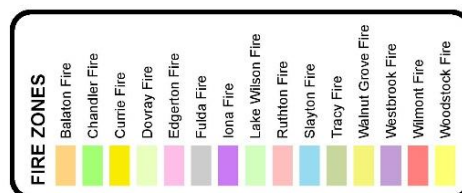
4.9.6 Fire/Emergency Services

There are 15 fire districts that serve Murray County – 7 of which are headquartered within the county. Those headquartered in Murray County are Chandler Fire, Currie Fire, Dovray Fire, Fulda Fire, Iona Fire, Lake Wilson Fire, and Slayton Fire. The other fire districts that read into Murray County are Balaton Fire, Edgerton Fire, Ruthton Fire, Tracy Fire, Walnut Grove Fire, Westbrook Fire, Wilmont Fire, and Woodstock Fire.

Fire District Map – Murray County



**Fire
Coverage**
Murray County
Minnesota
2016



Source: Murray County GIS Data
Prepared By: Murray County Emergency Management, 2016
Displayed Using: Murray County Coordinate System

There are no full time fire departments within Murray County. All fire departments are volunteer based with responsibilities being divided between the fire districts. The fifteen districts allow for response times to be reduced, but since Murray County is a rural county some areas are better served than others.

4.9.7 Primary Fire Districts

Chandler Fire Department (Chandler Fire District)

The Chandler Fire Department covers the City of Chandler and portions of surrounding townships including: Chanarambie, Leeds, Moulton, and Fenton. The Chandler Fire Department consists of 22 volunteer fire fighters. The Chandler Fire Department went on 12 calls in 2017. The Chandler Fire Department does have mutual aid agreements with Edgerton and Lake Wilson fire departments.

Currie Fire Department (Currie Fire District)

The Currie Fire Department covers the City of Currie, all of Murray Township and portions of surrounding townships including: Mason, Lime Lake, and Shetek. The Currie Fire Department consists of 21 volunteer fire fighters. The Currie Fire Department went on 2 calls in 2017.

Dovray Fire Department (Dovray Fire District)

The Dovray Fire Department covers the City of Dovray, all of Dovray Township and portions of surrounding townships including: Holly and Des Moines River. The Dovray Fire Department consists of 20 volunteer fire fighters. The Dovray Fire Department went on 4 calls in 2017. The Dovray Fire Department is planning on signing a Southwest Minnesota region-wide mutual aid agreement.

Fulda Fire Department (Fulda Fire District)

The Fulda Fire Department covers the City of Fulda, the unincorporated communities of Lime Creek and Wirock, all of Bondin and Belfast Townships, and portions of surrounding townships including: Lime Lake, Des Moines River, and Iona. The Fulda Fire Department consists of 21 volunteer fire fighters. The Fulda Fire Department went on 16 calls in 2017. The Fulda Fire Department does have mutual aid agreements with the fire departments of Worthington, Heron Lake, Brewster, Slayton, Wilmont, Westbrook, Dovray, Currie, and Iona.

Iona Fire Department/First Responders (Iona Fire District)

The Iona Fire Department/First Responders covers the City of Iona, and portions of surrounding townships including: Iona, Fenton, and Leeds. The Iona Fire Department consists of 16 volunteer fire fighters and first responders. The Iona Fire Department went on 7 calls in 2017. The Iona Fire Department has no current mutual aid agreements.

Lake Wilson Fire Department (Lake Wilson Fire District)

The Lake Wilson Fire Department covers the City of Lake Wilson and portions of surrounding townships including: Cameron, Lowville, Chanarambie, and Leeds. The Lake Wilson Fire Department consists of 23 volunteer fire fighters. The Lake Wilson Fire Department went on 14 calls in 2017. The Lake Wilson Fire Department is planning to sign a Southwest Minnesota region-wide mutual aid agreement.

Slayton Fire Department (Slayton Fire District)

The Slayton Fire Department covers the Cities of Avoca, Hadley, and Slayton; all of Slayton Township; and portions of surrounding townships including: Lowville, Mason, Lake Sarah, Leeds, Shetek, and Lime Lake. The Slayton Fire Department consists of 30 volunteer fire fighters. The Slayton Fire Department went on 21 calls in 2017. The Slayton Fire Department is planning to sign a Southwest Minnesota region-wide mutual aid agreement.

4.9.8 Secondary Fire Districts

Balaton Fire Department (Balaton Fire District)

The Balaton Fire Department covers the City of Balaton and surrounding townships in Murray County that include: Ellsborough, Skandia, Lake Sarah, and Lowville. The Balaton Fire Department consists of 22 volunteer fire fighters. The Balaton Fire Department went on approximately 35 calls in 2013 and 39 calls in 2014. The Balaton Fire Department does have mutual aid agreements with neighboring fire departments, including: Garvin, Tracy, Russell, Lynd, Marshall, Cottonwood, Minneota, and Ghent.

Edgerton Fire Department (Edgerton Fire District)

The Edgerton Fire Department covers the Cities of Edgerton, Hatfield, and Trosky; all of Osborne Township; and portions of surrounding townships including: Burke, Gray, and Elmer. The Edgerton Fire Department consists of 23 volunteer fire fighters. The Edgerton Fire Department went on 22 calls in 2017 and 20 calls in 2018. The Edgerton Fire Department does have mutual aid agreements with surrounding fire departments, though none are formal.

Ruthton Fire Department (Ruthton Fire District)

The Ruthton Fire Department covers the City of Ruthton and portions of Fountain Prairie, Aetna, and Rock Townships. The Ruthton Fire Department consists of 18 volunteer fire fighters. The Ruthton Fire Department went on 11 calls in both 2017 and 2018. The Ruthton Fire Department does have aid agreements with every Pipestone County fire department and the Balaton Fire Department.

Tracy Fire Department (Tracy Fire District)

The Tracy Fire Department covers the City of Tracy and the surrounding townships including: Amiret, Monroe, and part of Custer and Sodus. The Tracy Fire Department consists of 26 volunteer fire fighters. The Tracy Fire Department went on approximately 167 calls in 2013 and 2014. The Tracy Fire Department does have mutual aid agreements with neighboring fire departments, including: all fire departments in Lyon County and the Walnut Grove Fire Department.

Walnut Grove Fire Department (Walnut Grove Fire District)

The Walnut Grove Fire Department covers the City of Walnut Grove and portions of Holly Township in Murray County.

Westbrook Fire Department (Westbrook Fire District)

The Westbrook Fire Department covers the City of Westbrook and portions of Des Moines River Township in Murray County. The Westbrook Fire Department consists of 27 volunteer fire fighters. The Westbrook Fire Department went on 33 calls in 2016-2017.

Wilmont Fire Department (Wilmont Fire District)

The Wilmont Fire Department covers the City of Wilmont and a very small portion of Fenton Township in Murray County. The Wilmont Fire Department consists of 23 volunteer fire fighters. The Wilmont Fire Department went out on 24 calls in 2015 and 34 calls in 2016. The Wilmont Fire Department is part of a Mutual Aid Agreement that includes all Fire Departments/Fire Districts in Nobles County.

Woodstock Fire Department (Woodstock Fire District)

The Woodstock Fire Department covers the City of Woodstock and a small portion of Cameron Township in Murray County.

4.9.9 Red Cross Shelters

American Red Cross Southwest Minnesota Chapter serves communities across Yellow Medicine, Lincoln, Lyon, Redwood, Renville, McLeod, Sibley, Nicollet, Blue Earth, Watonwan, Brown, Cottonwood, Murray, Pipestone, Rock, Nobles, Martin and Faribault counties, covering the nine counties in Southwest Minnesota. There are three shelter trailers; one is in Marshall, one is in Worthington and one is in Pipestone. The American Red Cross Southwest Minnesota Chapter is an Emergency Support Function (ESF) #6 and #15.

ESF #6 is responsible for Mass Care, Emergency Assistance, Housing, and Human Services. ESF #6 coordinates the delivery of federal mass care, emergency assistance, housing, and human services when local, tribal, and state response and recovery needs exceed their capabilities.¹³

- *Mass Care* - Includes sheltering, feeding operations, emergency first aid, bulk distribution of emergency items, and collecting and providing information on victims to family members.
- *Emergency Assistance*: Assistance required by individuals, families, and their communities to ensure that immediate needs beyond the scope of the traditional “mass care” services provided at the local level are addressed. These services include: support to evacuations (including registration and tracking of evacuees); reunification of families; provision of aid and services to special needs populations; evacuation, sheltering, and other emergency services for household pets and service animals; support to specialized shelters; support to medical shelters; nonconventional shelter management; coordination of donated goods and services; and coordination of voluntary agency assistance.
- *Housing* - Includes housing options such as rental assistance, repair, loan assistance, replacement, factory-built housing, semi-permanent and permanent construction, referrals, identification and provision of accessible housing, and access to other sources of housing assistance. This assistance is guided by the National Disaster Housing Strategy.
- *Human Services* - Includes the implementation of disaster assistance programs to help disaster victims recover their non-housing losses, including programs to replace destroyed personal property, and help to obtain disaster loans, food stamps, crisis counseling, disaster unemployment, disaster legal services, support and services for special needs populations, and other Federal and State benefits.

Emergency Support Function (ESF) #15 ensures that sufficient federal assets are deployed to the field during incidents requiring a coordinated federal response to provide accurate, coordinated, timely, and

¹³ FEMA. Accessed: 4/16/14. Available: <http://www.fema.gov/pdf/emergency/nrf/nrf-esf-06.pdf>

accessible information to affected audiences, including governments, media, the private sector, and the local populace, including the special needs population. ESF #15 provides the resource support and mechanisms to implement the National Response Framework (NRF) Incident Communications Emergency Policy and Procedures (ICEPP) described in the Public Affairs Support Annex.¹⁴

4.9.10 Sirens and other Emergency Notification Devices

Outdoor warning sirens provide coverage in cities and other more densely populated areas within Murray County. The emergency sirens can be activated by the Murray County Dispatchers or city officials to warn residents in the event of severe weather. Murray County is a rural county, so large portions of the county are outside the range of severe weather warning sirens. Refer to Figure #77 through Figure #87 for outdoor warning siren coverage and needs throughout Murray County.

Since Murray County is a rural county, additional measures are in place to expand the notification system. Emergency warnings over the radio are still an effective medium to reach wide audiences. NOAA Weather Radio is used for broadcasting severe weather warnings. NOAA Weather Transmitters are located in Fulda (WNG702), Jeffers (KX131), Russell (KX150), and Sioux Falls (WXM28).

Murray County selected CodeRED Community Notification System as their emergency response system. CodeRED is an emergency notification service that allows emergency officials to notify residents and businesses by telephone, cell phone, text message, email and social media regarding time-sensitive general and emergency notifications.

Fulda Public School System uses JMC for their instant messaging system to be used in emergencies. It can provide emails, short text messages, and voice calls/voicemails. Murray County Central public school system uses Honeywell Instant Alert messaging software to communicate with the community. This service can provide voice calls, text, and emails.

¹⁴ FEMA. Accessed: 4/16/14. Available: <https://www.hsd1.org/?view&did=483049>

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Section 5 – Risk Assessment

The goal of mitigation is to reduce the future impacts of a hazard including loss of life, property damage, disruption to local and regional economies, and the expenditure of public and private funds for recovery. Sound mitigation practices must be based on sound risk assessment. A risk assessment involves quantifying the potential loss resulting from a disaster by assessing the vulnerability of buildings, infrastructure, and people.

Basing risk assessments on the best information available is important in developing effective mitigation actions that benefit communities. Geographic Information System (GIS) tools are not only helpful in producing maps, but they also show structures at risk and may determine damage estimates for potential hazard scenarios. MN Homeland Security and Emergency Management (HSEM) mitigation staff encourages the use of GIS tools in risk assessments because they produce good information to be used in the risk assessment process. In recognition of the importance of planning in mitigation activities, FEMA created **Hazards USA Multi-Hazard (Hazard-MH)**, a powerful GIS-based disaster risk assessment tool. This tool enables communities to predict estimated losses from floods, hurricanes and other related phenomena and to measure the impact of various mitigation practices that might help reduce those losses. Hazard-MH was used by University of Minnesota Duluth Geospatial Analysis Center staff in the flood hazard risk assessment.

This assessment identifies the characteristics and potential consequences of a disaster, how much of the community could be affected by a disaster, and the impact on community assets. A risk assessment consists of 3 components — hazard identification, risk profile, and vulnerability profile. The last step is the risk ranking for each jurisdiction.

5.1 Hazard Identification/Profile

5.1.1 Hazard Identification

The cornerstone of the risk assessment is identification of the hazards that affect jurisdictions. To facilitate the planning process, several sources were employed to ensure that the natural hazards are identified prior to assessment.

The County maintenance of the plan includes continual updates of the hazards identified in the initial plan. The mitigation planning team decided to compare the hazards in the initial plan to the current publications to determine if new hazards should be considered or if some should be deleted.

Natural hazards are identified in the FEMA publication “Multi-Hazard Identification and Risk Assessment – A Cornerstone of the National Mitigation Strategy” also known as MHIRA. FEMA Region V developed a list based on state mitigation plans in the region. The list was divided into natural (Figure #39) and other hazards (Figure #40) as was done in the 2014 Minnesota State Hazard Mitigation Plan.

Figure #39
FEMA MHIRA Natural Hazards in the 2014 Minnesota State Hazard Mitigation Plan

Flooding	Hail	Drought
Dam/Levee Failure	Lightning	Extreme Heat
Wildfire*	Winter Storms	Extreme Cold
Windstorms	Erosion	Earthquakes
Tornadoes	Land Subsidence (Sinkholes & Karst)	

**Addressed in the State Mitigation Plan because Minnesota is a heavily forested state compared to other states in Region V.*

For the purpose of this plan, FEMA defines other hazards or “man-made hazards” as technological hazards and terrorism. These are distinct from natural hazards primarily in that they originate from human activity. In contrast, while the risks presented by natural hazards may be increased or decreased as a result of human activity, they are not inherently human-induced. The term “technological hazards” refers to the origins of incidents that can arise from human activities such as the manufacture, transportation, storage, and use of hazardous materials. For the sake of simplicity, this guide assumes that technological emergencies are accidental and that their consequences are unintended. The term “terrorism” refers to intentional, criminal, and malicious acts. There is no single, universally accepted definition of terrorism, and it can be interpreted in many ways. For the purposes of this plan, FEMA refers to “terrorism” as the use of Weapons of Mass Destruction (WMD), including biological, chemical, nuclear, and radiological weapons; arson, incendiary, explosive, and armed attacks; industrial sabotage and intentional hazardous materials releases; and “cyber terrorism.”

Figure #40
FEMA MHIRA Other Hazards in the 2014 Minnesota State Hazard Mitigation Plan

Terrorism	Nuclear Generating Plant Incidents	Ground and Surface Water Supply Contamination*
Infectious Disease Outbreak	Hazardous Materials Incidents	
Fires (Structures and Vehicles)	Transportation Incidents	

**Addressed in the State Hazard Mitigation Plan because Minnesota has made a high investment in its prized resource, water.*

5.1.2 Vulnerability Assessment by Jurisdiction

The planning team met multiple times to review and update the hazards faced by residents of Murray County, update the existing mitigation actions published in the 2012 All Hazard Mitigation Plan, and propose new mitigation actions.

To engage in this process the planning team drew on a number of data sources. First, the planning team examined the hazards identified in the 2010 Murray County Hazard Mitigation Plan (Figure #41). The existing mitigation actions were discussed and adjusted to reflect the definitions of natural hazards used in the State of Minnesota 2014 Multi-Hazard Identification and Risk Assessment list of natural hazards. This was done in order to assure that the risks faced by Murray County were categorized the same way as the priority hazards established by the State of Minnesota.

Figure #41
Hazards identified in the 2010 Murray County All Hazard Mitigation Plan

Natural Hazards	Technological Hazards
Tornado / Straight-Line Winds	Structure Fires
Flooding / Dam Failure	Hazardous Materials / Water Supply
Drought	Civil Unrest / Terrorism
Wildfires	Agricultural Diseases
Severe Winter / Ice Storms / Extreme Cold	Public Health / Infectious Disease
Severe Summer Storms / Hail / Lightning / Extreme Heat	

While the AHMP mainly deals with natural hazards, this planning took place with the understanding that many non-natural hazards could occur as a result of natural disasters (i.e. disruption in electrical service due to freezing rain causing problems for both utility corporations and vulnerable populations dependent on electricity for heat).

This plan draws on a variety of data sources including the State of Minnesota and Homeland Security Emergency Management Critical Infrastructure Strategy for the State of Minnesota (2010), FEMA's Local Mitigation Planning How-to Guide Integrating Manmade Hazards into Mitigation Planning (2003), and the State of Minnesota Multi Hazards Identification Risk Assessment.

Based on the planning team's comparison of these sets of hazards, the planning team developed a list of hazards faced by Murray County to address in the 2019 plan update (Figure #42).

Figure #42
Hazards Included in the 2019 Murray County All Hazard Mitigation Plan Update

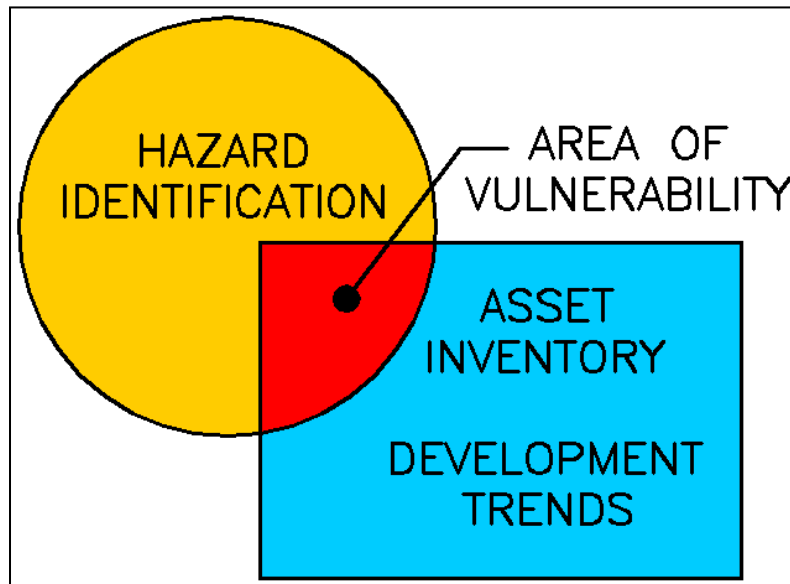
Natural Hazards		
Agricultural Disease (animal/crop)	Blizzards & Winter Storms	Drought
Extreme Temperatures	Fire/Wildfire	Flooding
Hail	Severe Summer Storms & Lightning	Tornado & Straight-Line Winds
Man-made Hazards		
Civil Unrest & Terrorism	Dam Failure [combined with flooding]	Hazardous Materials
Public Health & Infectious Disease	Structure & Vehicle Fires	

The committee drew on the 2017 Murray County Calculated Priority Risk Index (CPRI) rankings to prioritize each hazard for inclusion in the plan. The methodology of the CPRI is outlined below.

5.1.3 Calculated Priority Risk Index

The vulnerability assessment builds upon the previously developed hazard information by identifying the community assets and development trends and intersecting them with the hazard profiles to assess the potential amount of damage that could be caused by each hazard event. This concept is generally illustrated in Figure #43. A summary of Calculated Priority Risk Index (CPRI) Categories and Risk Levels is shown in Figure #44.

Figure #43
Conceptual Depiction of a Vulnerability Analysis



Definitions of CPRI Categories in Figure #44

Probability – a guide to predict how often a random event will occur. Annual probabilities are expressed between 0.001 or less (low) up to 1 (high). An annual probability of 1 predicts that a natural hazard will occur at least once per year.

Magnitude/Severity – indicates the impact to a community through potential fatalities, injuries, property losses, and/or losses of services. The vulnerability assessment gives information that is helpful in making this determination for each community.

Warning Time – plays a factor in the ability to prepare for a potential disaster and to warn the public. The assumption is that more warning time allows for more emergency preparations and public information.

Duration – relates to the span of time local, state, and/or federal assistance will be necessary to prepare, respond, and recover from a potential disaster event.

Figure #44
Summary of Calculated Priority Risk Index (CPRI) Categories and Risk Levels

CPRI Category	DEGREE OF RISK			Assigned Weighting Factor
	Level ID	Description	Index Value	
Probability	Unlikely	Extremely rare with no documented history of occurrences or events. Annual probability of less than 0.001	1	45%
	Possible	Rare occurrences with at least one documented or anecdotal historic event. Annual probability that is between 0.01 and 0.001.	2	
	Likely	Occasional occurrences with at least two or more documented historic events. Annual probability that is between 0.1 and 0.01.	3	
	Highly Likely	Frequent events with a well-documented history of occurrence. Annual probability that is greater than 0.1.	4	
Magnitude/Severity	Negligible	Negligible property damages (less than 5% of critical and non-critical facilities and infrastructure). Injuries or illnesses are treatable with first aid and there are no deaths. Negligible quality of life lost. Shutdown of critical facilities for less than 24 hours.	1	30%
	Limited	Slight property damages (greater than 5% and less than 25% of critical and non-critical facilities and infrastructure). Injuries or illnesses do not result in permanent disability and there are no deaths. Moderate quality of life lost. Shut down of critical facilities for more than 1 day and less than 1 week.	2	
	Critical	Moderate property damages (greater than 25% and less than 50% of critical and non-critical facilities and infrastructure). Injuries or illnesses result in permanent disability and at least one death. Shut down of critical facilities for more than 1 week and less than 1 month.	3	
	Catastrophic	Severe property damages (greater than 50% of critical and non-critical facilities and infrastructure). Injuries or illnesses result in permanent disability and multiple deaths. Shut down of critical facilities for more than 1 month.	4	
Warning Time	Less than 6 hours	Self-explanatory.	4	15%
	6 to 12 hours	Self-explanatory.	3	
	12 to 24 hours	Self-explanatory.	2	
	More than 24 hours	Self-explanatory.	1	
Duration	Less than 6 hours	Self-explanatory.	1	10%
	Less than 24 hours	Self-explanatory.	2	
	Less than one week	Self-explanatory.	3	
	More than one week	Self-explanatory	4	

The prioritized list of hazards is presented in Figure #45 and is based on the ranking of hazards in the 2017 Murray County CPRI and the planning team’s determination at the planning team meetings.

Figure #45
Priorities of Risks Faced by Murray County

Hazard	Probability	Magnitude/ Severity	Warning Time	Duration	Risk Index	Risk Severity
Winter Storm	3.48	2.06	1.97	2.50	2.73	Medium
Tornado	2.33	2.90	3.33	1.90	2.61	Medium
Hail	3.10	1.60	2.80	1.10	2.41	Medium
Lightning	3.10	1.49	2.62	1.25	2.36	Medium
Windstorm	2.75	2.00	2.25	1.70	2.35	Medium
Extreme Cold	2.81	1.62	1.48	2.80	2.25	Medium
Drought	2.24	1.76	1.24	3.40	2.06	Medium
Extreme Heat	2.33	1.62	1.48	2.75	2.03	Medium
Flash Flood	1.80	1.70	2.38	2.00	1.88	Low
Erosion	1.84	1.37	1.95	2.21	1.75	Low
Flood (Riverine)	1.85	1.40	1.75	2.38	1.75	Low
Wildfire	1.29	1.62	2.81	1.75	1.66	Low
Dam Failure	1.25	1.40	2.55	1.90	1.56	Low
Earthquake	1.00	1.73	2.62	1.37	1.50	Low
Landslide/Mudslide	1.05	1.30	2.25	1.53	1.35	Low
Subsidence	1.00	1.28	2.22	1.72	1.34	Low

Hazard Profiling Concept of Planning

The risk assessments identify the characteristics and potential consequences of a disaster, how much of the community could be affected by a disaster, and the impact on community assets. A risk assessment consists of 3 components—hazard identification, risk profile, and vulnerability profile. The last step is the risk ranking for each jurisdiction.

5.1.4 GIS and Hazus-MH

The risk analysis step in this assessment quantifies the risk to the population, infrastructure, and economy of the community. Hazards that can be geographically identified (wildland fires, windstorms, tornadoes, hail, floods) were mapped.

Hazus-MH was used to estimate the damages incurred for a 100-year flood event and for general asset assessment. Hazus-MH also generates a combination of site-specific and aggregated loss estimates for the entire county due to a 100-year flood event. Aggregate inventory loss estimates, which include building stock analyses, are based upon the assumption that building stock is evenly distributed across each census block. Therefore, it is possible that overestimates of damage will occur in some parts of areas while underestimates will occur in other areas. With this in mind, total loss estimates tend to be more reliable over larger geographic areas (groups of many blocks) than for individual census blocks. It is

important to note that Hazus-MH is not intended to be a substitute for detailed engineering studies. Rather, it is intended to serve as a planning aid for communities interested in assessing their risk to flood-, earthquake-, and hurricane-related hazards. This documentation does not provide full details on the processes and procedures completed in the development of this project. It is only intended to highlight the major steps that were followed during the project.

Site-specific analysis is based upon loss estimations for individual structures. For flooding, analysis of site-specific structures takes into account the depth of water in relation to the structure. Hazus-MH also takes into account the actual dollar exposure to the structure for the costs of building reconstruction, content, and inventory. However, damages are based upon the assumption that each structure will fall into a structural class, and structures in each class will respond in a similar fashion to a specific depth of flooding. Site-specific analysis is also based upon a point location rather than a polygon, therefore the model does not account for the percentage of a building that is inundated. These assumptions suggest that the loss estimates for site-specific structures as well as for aggregate structural losses need to be viewed as approximations of losses that are subject to considerable variability rather than as exact engineering estimates of losses to individual structures.

5.1.5 National Centers for Environmental Information (NCEI) Records

Historical storm event data was compiled from the National Centers for Environmental Information (NCEI). NCEI records are estimates of damage reported to the National Weather Service (NWS) from various local, state, and federal sources. However, these estimates are often preliminary in nature and may not match the final assessment of economic and property losses related to given weather events.

The NCEI data included 284 reported events in Murray County between 1950 and October 2017. No records before 1950 were available. A summary table of events related to each hazard type is included in the hazard profile sections that follow. A full table listing all events, including additional details, is included in Appendix C. NCDC hazard categories used in this plan are listed in Figure #46.

Figure #46
National Climatic Data Center Historical Hazards

Hazard	
Tornado	Hail Storm
Thunderstorm Wind	Flood/Flash Flood
Severe Snow Events	Ice Storms
Extreme Cold/Wind Chill	Excessive Heat
Wildfire	Drought

5.1.6 FEMA Declared Disasters

Another historical perspective is derived from FEMA-declared disasters. These major disasters are events which the President of the United States determines warrants federal aid to supplement state and local recovery efforts. Twelve federal disaster declarations in Murray County have been made between 1965 and 2016 (Figure #47).

Figure #47
FEMA-Declared Disasters in Minnesota (1953-2016)

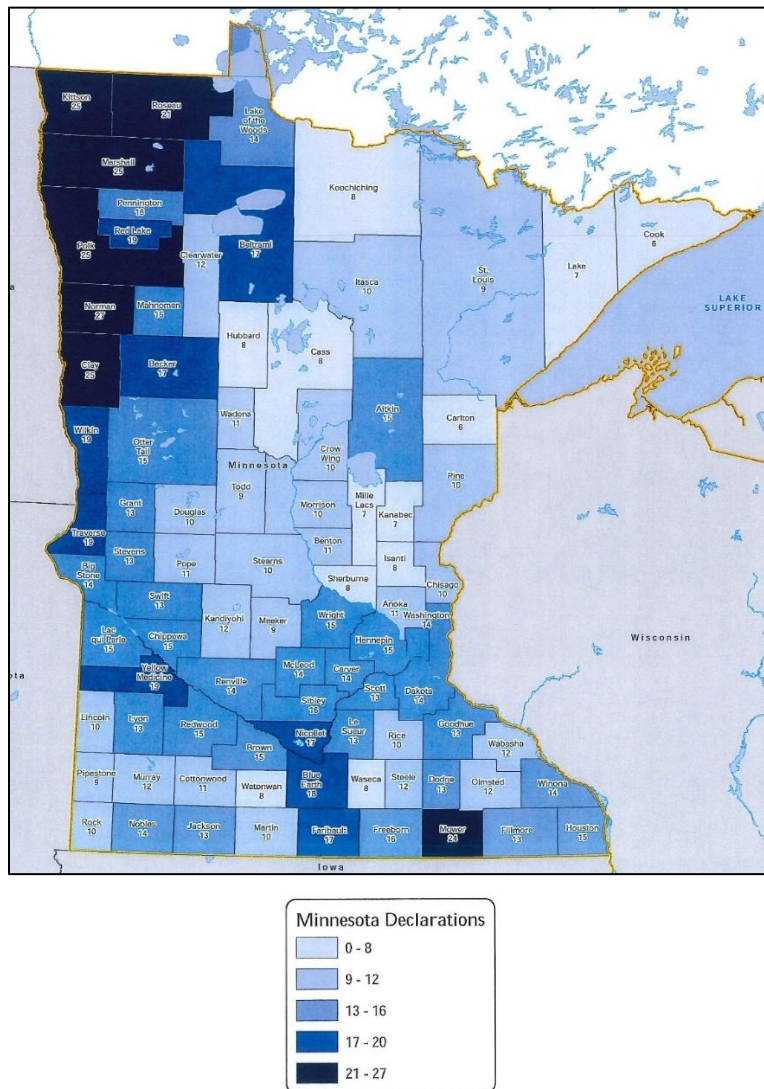


Figure #48 and Figure #49 show the details of the disasters including payments for Public Assistance (PA) and Individual Assistance (IA), listed under the flooding and severe storms profiles. No declarations were made for the other storms listed in the NCDC database. Reviewing the federal payments for damages from the declared disasters is a way of correlating the impact from the NCDC report.

Figure #48
FEMA-Declared Major Disasters in Murray County (1953-2016)

Incident	Declaration Date and Disaster Number	Incident Period	Total PA Obligated by FEMA for Disaster in Minnesota	Total PA Obligated by FEMA for Disaster in Murray County	Individual Assistance in Minnesota	Individual Assistance in Murray County
Flooding	DR-255 4/18/1969	4/18/1969- 4/18/1969	Yes – Unknown Amount	Unknown	Yes – Unknown Amount	Unknown
Heavy Rains & Flooding	DR-268 8/5/1969	8/5/1969- 8/5/1969	Yes – Unknown Amount	Unknown	Yes – Unknown Amount	Unknown
Severe Storms, Tornadoes & Flooding	DR-946 6/26/1992	6/16/1992- 6/20/1992	Yes – Unknown Amount	Unknown	Yes – Unknown Amount	Unknown
Severe Storms, Tornadoes & Flooding	DR-993 6/11/1993	5/6/1993- 8/25/1993	Yes – Unknown Amount	Unknown	Yes – Unknown Amount	Unknown
Severe Ice Storm	DR-1151 1/7/1997	11/14/1996- 11/30/1996	Yes – Unknown Amount	Unknown	\$0	\$0
Severe Winter Storms	DR-1158 1/16/1997	1/3/1997- 2/3/1997	Yes – Unknown Amount	Unknown	\$0	\$0
Severe Flooding, High Winds, Severe Storms	DR-1175 4/8/1997	3/21/1997- 5/24/1997	Yes – Unknown Amount	Unknown	Yes – Unknown Amount	Unknown
Severe Storms and Flooding	DR-1941 10/13/2010	9/22/2010- 10/14/2010	\$25,963,422.37	\$190,966.29	\$0	\$0
Severe Storms, Straight-Line Winds, Flooding, Landslides, and Mudslides	DR-4182 7/21/2014	6/11/2014- 7/11/2014	\$41,013,709.98	\$299,641.67	\$0	\$0
Severe Winter Storm	DR-4113 5/3/2013	4/9/2013- 4/11/2013	\$11,090,674.37	\$164,526.76	\$0	\$0

* Data provided by FEMA, accessed July 26, 2017: <https://www.fema.gov/media-library/assets/documents/28331>. Values are estimates collected at the time of the disaster.

Figure #49
FEMA-Declared Emergencies in Murray County (1953-2016)

Incident	Declaration Date and Disaster Number	Incident Period	Individual Assistance in Minnesota	Public Assistance (all affected areas)
Drought	EM-3013 6/17/1976	6/17/1976- 6/17/1976	\$0	\$0
Hurricane Katrina Evacuation	EM-3242 9/13/2005	8/29/2010- 10/14/2010	\$0	\$0

**Note the Public Assistance totals are for ALL counties affected in the disaster. Data accessed July 26, 2017 at https://www.fema.gov/disasters/grid/state-tribal-government/57?field_disaster_type_term_tid_1=All*

Figure #50 depicts the historical projects in Murray County resulting from hazard mitigation funding.

Figure #50
Historical Hazard Mitigation Funding in Murray County

Year	Project Description	Sub-Grantee	Federal Share
1998	Installation of three NOAA Weather Radio Transmitters on existing towers in Murray County. This is a 5% state initiative project.	Murray County	\$149,120
2007	The Murray County All-Hazard Mitigation Plan was approved by FEMA on 11/5/2007. It is due to be updated and approved by 11/5/2012.-JMCCLOSK-01/07/2009 17:15 GMT The Southwest Regional Development Commission (SRDC) will be the subgrantee to update the plan for Murray County. The SRDC will work with the Murray County mitigation team and the emergency manager during all phases of the update process. Murray County will provide the local match with work in-kind. A HAZUS-MH river flood risk analysis will be performed by the SRDC. -JMCCLOSK-01/07/2009 17:21 GMT Increase in the amount of non-fed share matching funds along with project closeout in letter request by State dated 4/20/12-EHARDIMO-04/23/2012 19:13 GMT.	Southwest Regional Development Commission	\$16,831.00

5.2 Vulnerability Assessment

5.2.1 Asset Inventory

The HAZUS-MH defaults, critical facilities, and essential facilities have been updated based on the most recent available data sources. The essential facility updates (schools, medical care facilities, fire stations, and police stations) were integrated into the HAZUS-MH input database. Other critical facilities identified by the county were geocoded and overlaid with the HAZUS-MH flood model output. Critical facilities are defined by the Department of Homeland Security in the Automated Critical Asset Management System (ACAMS).

FEMA's Hazus 4.2 and ArcGIS 10.5.1 were used to estimate potential losses incurred in a 100-year flood event in Murray County. A Q3 floodplain obtained from the MN DNR was used to determine the flood extent because no updated National Flood Insurance Program (NFIP) map is available. The Q3 Flood Data are derived from the Flood Insurance Rate Maps (FIRMS), published by FEMA, and follow standards required for mapping at a scale of 1:24000; these maps are often outdated. A 10-meter digital elevation model (DEM) was used to create a flood depth grid for the county. The 100-year floodplain boundary is shown in Figure #65.

5.2.2 Facility Replacement Costs

According to the Murray County general building stock (derived from the county's parcel data and imported to the Hazus model), the Hazus model estimates there are 4,590 parcels with buildings in the region with a total replacement value (excluding contents) of \$463 million. Approximately 71.76 % of the buildings (and 57.40 % of the building value) are associated with residential housing. The Hazus model estimated 18 parcel's buildings will be at least moderately damaged (>10% damage). Zero buildings are estimated to be completely destroyed.

Facility replacement costs and total building exposure are identified in Figure #51, which also includes the estimated number of buildings within each occupancy class as calculated by Hazus general building stock.

Census blocks of concern should be reviewed in more detail to determine the actual location and proximity of facilities with respect to the flood hazard areas. The aggregate losses reported in this study may be overstated due to the fact that values are distributed evenly across a census block. The 3 census blocks with the greatest estimated loss values, which have parcels with buildings located within the floodplain, are shown in Figure #52. These potentially high loss census blocks, used for the loss estimation, and the Hazus-MH output floodplain, are shown in Appendix A. In some cases, the assets of value may not fall in the floodplain in the same proportion that the floodplain covers the entire census block. For this reason, some potential losses may be overstated.

Figure #51
Total Economic Loss from 100-Year Flood

General Occupancy	Estimated Total Buildings	Total Damaged Buildings	Total Building Exposure (in \$1000s)	Total Economic Loss (in \$1000s)	Building Loss (In \$1000s)
Agricultural	741	0	\$109,073,000	\$1,465,000	\$324,000
Commercial	347	0	\$31,134,000	\$479,000	\$31,000
Education	6	0	\$12,046,000	\$150,000	\$14,000
Government	114	0	\$17,084,000	\$3,746,000	\$19,000
Industrial	25	0	\$9,261,000	\$17,000	\$4,000
Religious /Non-Profit	61	0	\$18,552,000	\$17,494,000	\$105,000
Residential	3,294	21	\$265,631,000	\$3,562,000	\$1,960,000
Total	4,590	21	\$462,781,000	\$26,913,000	\$2,457,000

Source: Flood Hazard Analysis for Murray County, April 2018, Geospatial Analysis Center, Swenson College of Science and Engineering

Figure #52
Murray County Census Blocks with the Greatest Estimated Losses in the 100-Year Floodplain

Census Block Number	Total Estimated Loss	Location
271019001001179	\$16,309,000	3 miles northwest of Currie
271019002001130	\$2,145,000	Chandler
271019003002135	\$1,958,000	Slayton

An additional analysis was performed to identify the 10 parcels with the highest values (building + contents) that intersect the 100-year floodplain. Some of the parcels are located in one of the 3 census blocks with the greatest estimated loss; these parcels are labeled accordingly. The results of this analysis (and total building values) are shown in Figure #53.

Figure #53
Murray County Properties with Highest Building/Contents Value Intersecting 100-Year Floodplain

Parcel ID	Parcel Building + Contents Total Value	Class Description	Building Area (ft ²)
22-006-0090	\$1,440,000	Churches & other Non-profit Org.	95,569
17-007-0010	\$733,800	Government – General Services	15,192
18-030-0011	\$661,050	Single Family Dwelling	3,202
11-011-0040	\$646,600	Agriculture	2,246
15-001-0210	\$642,300	Single Family Dwelling	3,091
15-012-0011	\$640,600	Agriculture	2,132
11-160-0240	\$587,850	Single Family Dwelling	2,797
11-160-0250	\$570,300	Single Family Dwelling	2,747
11-160-0210	\$558,300	Single Family Dwelling	2,677
11-150-0110	\$557,700	Single Family Dwelling	2,650
Total	\$7,038,500		

5.3 Future Development

Because Murray County is vulnerable to a variety of natural and technological hazards, the county government—in partnership with state government—must make a commitment to prepare for the management of these types of events. Murray County is committed to ensuring that county elected and appointed officials become informed leaders regarding community hazards so that they are better prepared to set and direct policies for emergency management and county response.

Currently, Murray County actively discourages development within floodplains and sound construction within flood fringe areas. They are also developing a program to acquire, relocate, or elevate at-risk structures.

The Murray County Emergency Management Director will work to keep the jurisdictions covered by the AHMP engaged and informed during the plan's 5-year planning cycle. By keeping jurisdictional leaders actively involved in the monitoring, evaluation and update of the AHMP, they will keep their local governments aware of the hazards that face their communities and how to mitigate those hazards through planning and project implementation. Each jurisdiction has identified mitigation strategies that they will seek to implement in their communities (see *Appendix H: Mitigation Actions by Jurisdiction*). Jurisdictions will include considerations for hazard mitigation in relation to future development when updating local comprehensive plans or other plans that may influence such development.

5.4 Hazard Profiles

Hazards were ranked by the planning team. The Calculated Priority Risk Index is listed in this section from high to low priority (Figure #54).

Figure #54
Ranking of Natural Hazards in Murray County 2019 AHMP Update

Hazard	Risk Severity
Winter Storm	Medium
Tornado	Medium
Hail	Medium
Lightning	Medium
Windstorm	Medium
Extreme Cold	Medium
Drought	Medium
Extreme Heat	Medium
Flash Flood	Low
Erosion	Low
Flood (Riverine)	Low
Wildfire	Low
Dam Failure	Low
Earthquake	Low
Landslide/Mudslide	Low
Subsidence	Low

Included Natural Hazards

Drought
Extreme Temperatures
Flood
Hail
Lightning
Severe Wind
Severe Winter Weather
Tornado
Wildfire

Included Other Hazards

Agricultural Disease
Civil Disturbance
Cyber Attack
Hazardous Materials
Invasive Species
Public Health Infectious Disease

Structure Fire
Transportation Infrastructure
Utility Failure
Water Supply Availability & Contamination

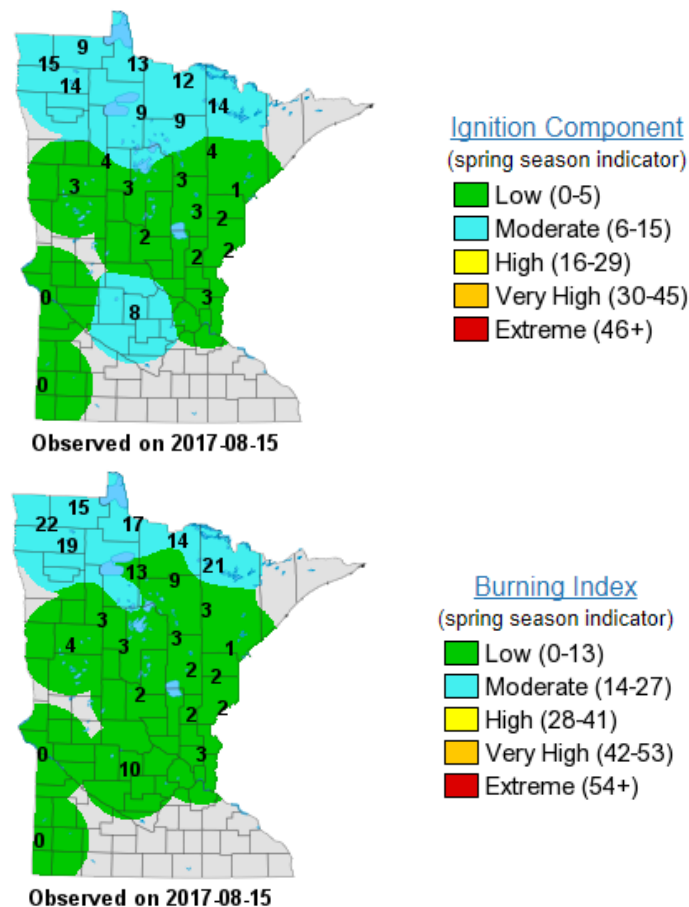
5.4.1 Fire (Wildfires and Structure Fires)

According to FEMA, each year in the United States more than 2,500 people die and 12,600 are injured in home fires, many of which could have been prevented.¹⁵ A home fire is reported every 85 seconds in the United States.¹⁶ Fires can occur in any community and pose a year-round threat.

Locations Affected by the Hazard

All locations in Murray County are at risk to be exposed to this hazard. Incidents of wildfire tend to be localized in southwest Minnesota due to the low burning index in this area. The planning team identified the spatial extent of a wildfire as local. "Burning Index relates the potential amount of effort needed to contain a single fire in a particular fuel type."¹⁷ Wildfires can start in grasslands or in crops if the conditions are dry.

Figure #55
Ignition Component & Burning Index Map – Minnesota



¹⁵ FEMA. Accessed: 6/2/14. Available: <http://www.ready.gov/fires>

¹⁶ Karter Michael Jr. Fire Loss in the United States During 2011. Accessed: 6/20/14. Available: <http://www.nfpa.org/assets/files/pdf/os.fireloss.pdf>

¹⁷ MN Department of Natural Resources. Accessed: 5/20/13. Available: http://www.dnr.state.mn.us/forestry/fire/maps/fdi_grass.html

Incidents of structure fires tend to be contained to one or two buildings, rather than spreading widely. Isolated rural structures can be at risk due to long response times and limited water supplies. The planning team identified the spatial extent of a structure fire as local. However, there are many risks in town, such as one structure fire spreading to adjacent properties.

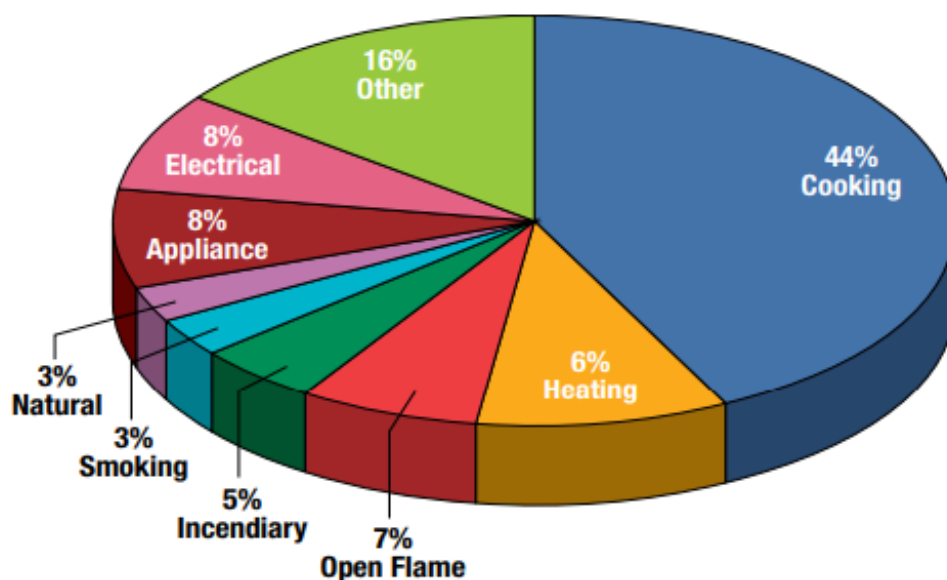
Extent of the Hazard

Structure fires are classified into three categories:

- Residential Structures
- Public and Mercantile Structures
- Industrial Structures

In Minnesota, there was over 119 million dollars in losses due to residential structure fires in 2014. Almost half of structure fires are caused by cooking accidents (mostly from unattended cooking equipment), 14 percent by other causes, and 10 percent by heating sources.¹⁸ Refer to Figure #56 for a complete breakdown of structure fire causes.

Figure #56
Structure Fire Causes – Minnesota (2015)



“While careless smoking accounts for only two percent of structure fires, it caused 35 percent of known fire fatalities and 27 percent of residential fire deaths.”¹⁹ The most deadly time for a fire is during the

¹⁸ Minnesota Fire Marshall. Fire in Minnesota Report. Accessed: 1/8/16. Available: <https://dps.mn.gov/divisions/sfm/Documents/2014-Fire-Minnesota-Report.pdf>

¹⁹ Minnesota Fire Marshall. Fire in Minnesota Report. Accessed: 1/8/16. Available: <https://dps.mn.gov/divisions/sfm/Documents/2014-Fire-Minnesota-Report.pdf>

night when people are sleeping. There have been no civilian deaths related to fires in Murray County, since 1990.²⁰

The State Fire Marshal reports that there was \$142,078 in fire related losses reported in Murray County in 2015.

Wildfire occurs when an uncontrolled fire spreads through vegetation, posing danger and destruction of property. Wildfires often begin unnoticed, spread quickly, and can be highly unpredictable. Prairie fires are less common than forest fires in the rugged Northern or Western forested area, but prairie fires can pose a serious threat. The State hazard plan categorizes wildfires into three types:

- Wild land fires in grasslands, brush and forests;
- Interface fires where natural landscapes meet urbanized areas
- Prescribed burns, intentionally set or natural fires that are allowed to burn for beneficial purposes

Factors such as topography, fuel and weather affect wildfire behavior. Fire intensity tends to increase during daytime heating. Large parcels of land left fallow in conservation and natural areas may be susceptible to grass fire even when properly managed. Gusty winds and low relative humidity create conditions for wildfire to spread rapidly in dry grasses and crops. Farm fields with row crops, and ditches are also vulnerable, in particular to the errant spark or carelessly discarded cigarette. Prolonged periods of high temperatures and/or high winds increase the risk of wildfires.

Relationship to Other Hazards—Cascading Effects

- Flooding and erosion. Major wildfires can completely destroy ground cover, which causes heavy erosion and vegetation loss. If heavy rains follow a major fire, flash floods, landslides, and mudflows might occur since vegetation is essential in deterring flooding during heavy rainfalls or spring runoff.
- Hazardous Material. The potential for hazardous materials to catch on fire is an added risk to wildfires. Any leaking or explosion of hazardous materials adds to the potential destruction caused by a wildfire.
- Service disruptions. Major fires can completely destroy structures, utility infrastructure, and essential public facilities that provide basic services to the community.
- Health risks. Destruction or damage to essential infrastructure like water or wastewater facilities might cause public health risk.
- Hazardous materials. If certain buildings or storage areas are ruptured or caused to explode because of fire, dangerous hazardous materials could be unleashed into surrounding areas. For example, many farms have anhydrous ammonia and other agricultural chemicals, which can cause serious difficulties for emergency response.
- Public Health - Air quality is adversely affected by wildfires

Previous Occurrences of the Hazard

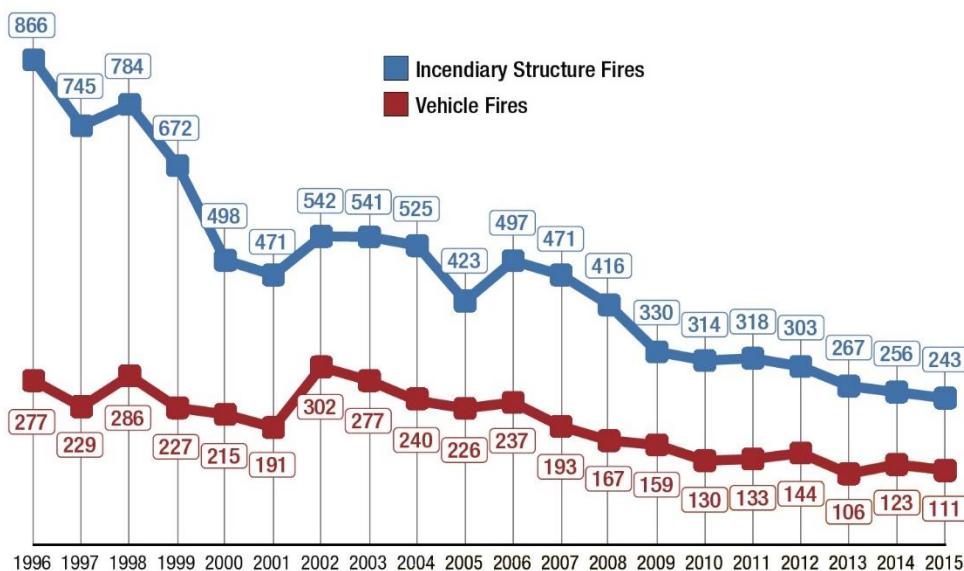
²⁰ Minnesota Fire Marshall. Fire in Minnesota Report. Accessed: 1/8/16. Available: <https://dps.mn.gov/divisions/sfm/Documents/2014-Fire-Minnesota-Report.pdf>

Structure Fires occur periodically throughout Murray County. From 1990 through 2016, there were zero civilian deaths related to fires in Murray County.²¹

Approximately 1,300 wildfires occur in Minnesota each year.²² However, according to data from the National Centers for Environmental Information, Minnesota experienced fourteen reportable wildfires between 2003 and 2017. Wildfires occur throughout the spring, summer and autumn. During the spring and autumn periods, much of the existing vegetation has been killed due to winter temperatures and is dead, brown and combustible. Also, there is little green vegetation to serve as a barrier for a moving wildfire.

Wildfires in western Minnesota most often occur in grasslands. Grasslands typically include lands in conservation programs such as Reinvest In Minnesota (RIM), Conservation Reserve Program (CRP), Wetland Reserve Program (WRP) and Conservation Reserve Enhancement Program (CREP); “rough ground” that has been hayed, pastured or left wild; and public lands (such as wildlife management areas (WMAs), state parks, waterfowl production areas (WPAs), etc.). Fire danger grows when cedar trees encroach into grasslands. These trees can add a considerable amount of fuel load.

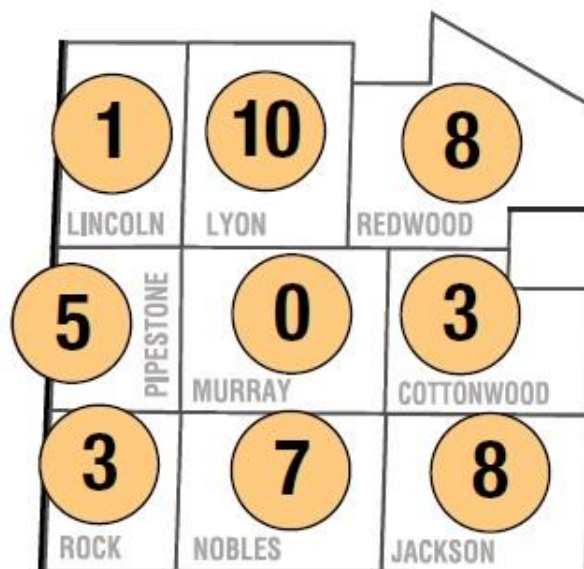
Figure #57
Structure & Vehicle Incendiary Fires – Minnesota



²¹ Minnesota Fire Marshall. 2016 Fire in Minnesota Report. Accessed: 01/19/2018. Available: <https://dps.mn.gov/divisions/sfm/mfirs/Documents/Fire%20in%20Minnesota/Fire-in-Minnesota-2016.pdf>

²² Minnesota DNR website. Accessed 7/31/17. Available: <http://www.dnr.state.mn.us/forestry/anniversary/beginning-now.html>

Figure #58
Civilian Fire Deaths by County: 1990 – 2015



Minnesota Department of Public Safety²³

Figure #59
Runs & Dollar Losses by County – 2016

County	Fire Runs	Other Runs	Total County Dollar Loss	Fire Rate	Avg. Dollar Loss/Fire
Cottonwood	26	70	\$1,671,500	498	\$69,646
Jackson	21	91	\$167,450	661	\$9,850
Lincoln	20	20	\$1,078,100	363	\$63,418
Lyon	92	281	\$764,250	348	\$10,764
Murray	31	40	\$684,531	428	\$32,597
Nobles	54	281	\$1,066,375	499	\$24,236
Pipestone	28	83	\$94,600	416	\$4,113
Redwood	68	80	\$1,046,878	295	\$19,034
Rock	33	125	\$496,000	63	\$17,103

Minnesota Department of Public Safety²⁴

There were zero wildfires in Murray County from January 1950 through April 2017.²⁵ The National Weather Service issues Grassland Fire Danger statements from April 1st to November 15th each year. The

²³ Minnesota Fire Marshall. 2016 Fire in Minnesota Report. Accessed: 01/19/2018. Available: <https://dps.mn.gov/divisions/sfm/mfirs/Documents/Fire%20in%20Minnesota/Fire-in-Minnesota-2016.pdf>

²⁴ Minnesota Fire Marshall. 2016 Fire in Minnesota Report. Accessed: 01/19/2018. Available: <https://dps.mn.gov/divisions/sfm/mfirs/Documents/Fire%20in%20Minnesota/Fire-in-Minnesota-2016.pdf>

²⁵ NOAA. Storm Events Database. Accessed 8/9/17. Available: <http://www.ncdc.noaa.gov/stormevents/>

DNR is the lead state agency for wildfire response and prevention across the state, and offers training and other resources for local fire departments. DNR conducts controlled burns annually to help manage grasslands.

Wildfire and Climate Change

Temperatures are predicted to rise in the state, which could lead to more extreme heat events and associated wildfire risks. As Minnesota's climate changes, weather fluctuations between drought and extreme rain events and increasing temperatures will result in changes to forest composition and/or distribution. These fluctuations can lead to dry conditions that may cause increased fire risk in both grassland and forest environments.

Vulnerability

Fire is a serious risk that is not always understood. There are structure fires every year in Murray County, though wildfires are rare. It only takes 30 seconds for a small flame to get completely out of control.²⁶ There is often only enough time to get out of the house safely, before the entire house is engulfed with smoke and flames.

Plans and Programs

- Local fire departments – Local fire departments within the districts extinguish structure fires. Each department is responsible for fires within their boundaries. However, they often work together on larger fires through mutual aid agreements.
- State training – Local firefighters participate in mandatory firefighting training classes offered by the state. Firefighters are also offered the opportunity to participate in wildfire training classes offered by the Minnesota Department of Natural Resources-Forestry Department.
- Zoning – The Murray County Zoning Ordinance controls development of new construction, including the enforcement of safety restrictions like setbacks, coverage, depth, and structure height requirements. The county Environmental Services Office issues permits for all new construction in the county outside incorporated municipalities, as well as within the City of Hadley.
- Burning Bans – Currently, in times of extreme heat and drought, the county will enact burning bans. Residents are alerted through social media when a burning ban is enacted.
- Burn Permits – Murray County Sheriff's Office issues burn permits free of charge. Burning permits are good for a lifetime and law enforcement will be checking and calling if they see smoke. Emergency responders respond to reported fires, so you should alert the authorities when you are going to burn.
- Burn barrels – "In Minnesota, open burning of household garbage is banned, with the exception of farms where regularly scheduled pick up of waste is not "reasonably available to the resident" (Minn. Stat. §§ 17.135 and 88.171). In Minnesota, 32 counties have formally banned garbage burning at the local level, passing a county board resolution stating garbage service is reasonably available to all residents and making onsite disposal illegal for county residents. It is illegal to burn garbage in Murray County.

²⁶ FEMA. Learn About Fire: The Nature of Fire. Accessed: 1/6/16. Available: http://www.usfa.fema.gov/citizens/about_fire.shtml

- Property management – Many properties that are owned by Murray County are used for recreation or conservation. Management plans providing maintenance of these properties (including cutting tall grass, thinning trees, prescribed burning, and removal of low-hanging branches around structures) are in place.
- Wind tower fires – Plans are in place for fires involving wind towers. Firefighters are instructed to contain the fire from a distance and let the turbine burn.
- Solar farm fires – Plans are in place for fires involving solar farms. Firefighters are instructed to follow emergency shutdown procedure and to contain the fire from a distance.
- Electrical fires – The state electrical inspectors inspect commercial and residential structures for potential fire hazards.
- Prescribed burns – The DNR conducts prescribed (or controlled) burns annually in Murray County. Controlled burns help to reduce fuel load, while also benefiting native prairie restoration. Controlled burns have to be conducted in the right locations and in the right weather conditions. Coordination between the DNR and local fire departments is done to ensure the controlled burns are contained.
- Ditch maintenance – Road ditches are maintained to help decrease the chance of a wildfire spreading. MN Stat. 160.232 states: “To provide enhanced roadside habitat for nesting birds and other small wildlife, road authorities may not mow or till the right-of-way of a highway... Exception is from July 31 to August 31, where the entire right of way may be mowed. Statute also states “When feasible, road authorities are encouraged to utilize low maintenance, native vegetation that reduces the need to mow, provides wildlife habitat, and maintains public safety.”
- Water source capacity – Water storage is also analyzed by fire departments in Murray County to understand water source capacity to fight fires.
- Road closures – Fire departments in Murray County keep up to date on road closures so efficient routes can be used to reduce response times.
- Development Policy – New developments in Murray County are required to have streets and alleys wide enough to sufficiently handle the size of a modern fire truck.
- Mutual Aid Agreements – Mutual Aid Agreements are in place between police forces, fire districts and ambulance districts to ensure adequate emergency services in Murray County. Mutual Aid Agreements create agreement among emergency responders to lend assistance across jurisdictional boundaries. Mutual Aid Agreements are updated every five years in Murray County, and they are currently in the process of updating them.
- Quarterly Fire Protection Meeting – Murray County holds quarterly mutual aid meetings.
- Right-of-way maintenance – Road Authorities maintain the right-of-way of roadways in Murray County. This helps to limit tree growth and farm fields from approaching onto public right-of-way of roadways.
- Fire education – Murray County Fire Departments participate in fire awareness training.
- Ordinances – Snow removal ordinances are in place to keep fire hydrants accessible.
- Building codes – Public buildings are constructed to include fire/smoke alarms and sprinkler systems.

Gaps and Deficiencies

- Lack of fire breaks – Murray County needs a program that places fire breaks in between the continuous CRP (Conservation Reserve Program) tracts of land or other state wildlife areas during times of severe drought.

- Wildfire risk assessment – Murray County does not undertake a systematic assessment of wildfire risk and associated prevention measures.
- Fire department/EMS equipment – Regulations, compliance, and training issues are costing rural fire departments more and more. This is causing deficiencies in equipment availability. Not having proper equipment is a safety concern. Older equipment is better than no equipment.
- Specialized trainings – Homes with chimneys pose a larger threat for fires. Specialized training classes, like chimney cleaning, safe cooking in the kitchen, and holiday hazards could be offered to residents.
- Evacuation plans – Murray County has evacuation routes, but these should be checked to ensure they are also for fire.
- Street capacity – Currently, some local streets and alleys are not adequate to handle fire trucks. Those roads should be identified and widened in the future to provide adequate protection.
- Property maintenance – An increasing number of properties are used for recreation or conservation. These properties may not be monitored frequently, which can result in overgrowth and an increased fire risk. Managing properties effectively can reduce the risk of structure and wildfires. Effective property maintenance can include cutting tall grass, thinning trees, prescribed burning, and removal of low-hanging branches around structures as needed.
- Emergency response staffing levels – Keeping local fire departments staffed is becoming an issue. Local fire departments are getting older, and there are less young residents volunteering for the departments. Availability is also a concern for the local fire departments. A number of Murray County residents work outside the county, so availability is an issue.
- Burn barrel compliance – Compliance with burn barrel regulation is an issue. An educational campaign may be necessary to increase compliance.
- Water availability – Murray County is a rural county, so water availability during a rural fire can be an issue. Barn fires require between 5 and 15 tankers of water, each 2,000 gallons. This requires firefighters to pull water from multiple locations depending on the location of the fire. Pulling water from multiple sources affects response times and the ability to contain the fire.
- Dry hydrants – There are multiple dry hydrants in Murray County (Lake Wilson, Currant Lake, Summit Lake, Lake Sarah, Lake Shetek) and the Mutual Aid Association is looking at adding one at Buffalo Lake. More dry hydrants spread throughout Murray County would help to ensure timely refill capabilities of tanker trucks. Maintenance is an issue regarding dry hydrants. The dry hydrant has to be blown out once a year. One of the closest dry hydrants is at Currant Lake in Murray County.
- Transformer and meter fires – corn dryers and other heavy equipment can overload and overheat a transformer or meter. This is a concern in the fall during harvest.
- Household electrical fires – Electrical improvements in homes in greater Minnesota are often not inspected. The homeowner has an incentive to ensure the work is done properly, but some people may not be able to ensure proper electrical work.
- Rural fire hydrants – There are no fire hydrants located by water storage towers in rural Murray County.
- Prairies in southwest corner of county near Chandler (includes Lost Timber Bible Camp). The distance and accessibility to this area of the county and other very rural areas means response times are slower.

- Wind towers also pose a risk for fire. Main Streets and lakes area where buildings are very close together poses a structure fire risk. One solution might be to encourage ATVs or trucks for fire departments to take to very rural areas – the downside is the low amount of water that can be brought.

5.4.2 Severe Winter Storms – Blizzards, Ice Storms

Between the years of 1975 and 1991, there were 49 deaths associated with blizzards statewide, or an average of 3 deaths per year. Deaths attributable to blizzards have dropped in recent years (seven since 1992), primarily due to increased weather awareness and warning capabilities across the state. The economic costs of winter storms since 1992 has resulted in property damage of over \$26,000,000.

Ice storms are described as occasions when damaging accumulations of ice occur due to freezing rain. The terms freezing rain and freezing drizzle warn the public that a coating of ice is expected on the ground and on other exposed surfaces. Heavy accumulations of ice can bring down trees, electrical wires, telephone poles and lines, and communication towers.

Minnesota experiences winter weather from mid-autumn through the winter season into spring. Heavy snowfall can immobilize large regions at the same time. All types of winter storms can also be accompanied by extreme cold—both absolute temperatures and wind chill.

Locations Affected by the Hazard

All locations in Murray County are equally likely to be exposed to this hazard. Rural areas are more likely to be severely impacted by the hazard. Rural homes and farms face the threat of isolation and utility failure during winter storms. Roads throughout the county are at risk from ice or blowing and drifting snow. Roads closed due to hazardous winter weather also make it difficult for emergency responders to access individuals located in remote rural areas.

Given the rural nature of Murray County, residents of smaller communities may face similar isolation issues as rural residents. City residents are also at risk. Attempting to travel between communities would expose city dwellers to higher levels of risk corresponding with their rural counterparts. The planning team identified the spatial extent of blizzards and winter storms events as countywide.

Extent of the Hazard

There are several types of winter storm events that are typical for this area including: heavy snow events, ice storms, and blizzards.

Heavy snow events in Minnesota are considered to be 6 or more inches of snow in a 12-hour period, or 8 or more inches in a 24-hour period. Snow is considered heavy when visibilities drop below one-quarter mile regardless of wind speed. Heavy snows can lead to building collapse as well as creating a hazard to residents and travelers.

Ice storms include freezing rain, freezing drizzle and sleet (see Section 5.4.4 Severe Summer Storms below for information on hail storms, which more typically occur in the spring and summer seasons). Freezing rain, probably the most serious of the ice storms, occurs during a precipitation event when warm air aloft exceeds 32 degrees Fahrenheit while the surface remains below the freezing point. When precipitation originating as rain or drizzle contacts physical structures on the surface, ice forms on all surfaces creating problems for traffic, utility lines, and tree limbs.

Sleet forms when precipitation originating as rain falls through a rather large layer of the atmosphere with below freezing temperatures allowing the raindrops to freeze before reaching the ground. Sleet is also

referred to as ice pellets. Freezing rain freezes when it hits the ground, creating a coating of ice on roads, trees and power lines. Sleet storms are usually of shorter duration than freezing rain and generally create fewer problems.

Ice storms combined with high winds often threaten the electrical power grid. Typical power outages are due to localized storm events and utility crews can respond and restore power within hours. A complete power outage, however, has the potential to be a catastrophic event, due to the extensive systems that rely on remote power generation. Water and sewer service rely on electrical pumping stations. Individual home furnaces may be able to run on natural gas or propane, but usually need electricity to circulate warm air or hot water throughout a building.

Blizzards are the most violent type of winter storm. A blizzard occurs with sustained or frequent gusts to 35 miles per hour or greater and considerable amounts of falling and/or blowing snow (reducing visibility to less than a quarter mile) for three hours or longer. While blizzards in Murray County can occur from October through April, they are most likely from November through the end of March. Temperature is not taken into consideration when the National Weather Service issues a Blizzard Warning; however, the nature of these storms typically leads to extreme cold.

Relationship to Other Hazards—Cascading Effects

- **Flooding.** Heavy snows and rapid snow melt are primary contributors to seasonal spring flooding. Areas along rivers and streams in Murray County can be impacted by spring flooding.
- **Transportation Crashes.** Winter storms often lead to hazardous conditions for transportation infrastructure. Icy roads can make travel difficult and poorly designed roads can result in large drifts that make travel impossible. Poor driving conditions and poorly designed transportation infrastructure can contribute to motor vehicle crashes.
- **Utility Failure.** Winter storms can impact the power grid. Utility interruption can be severe in Murray County due to the rural nature of the county. A winter storm can isolate rural residents and can leave them without power for extended periods of time. These residents are at risk of hypothermia or even death.
- **Wildland or Structural Fire -** Heavy storms that result in large amounts of downed timber can result in an increase of dead or dying trees left standing, thus providing an increased fuel load for a wildfire. There is an additional risk of increased frequency of structural fires during heavy snow events, primarily due to utility disruptions and the use of alternative heating methods by residents.
- **Public Safety -** Drivers stranded in snowstorms may make uninformed decisions that can put them at risk; residents who are unprepared or vulnerable may not be able to obtain goods or reach their destinations. EMS providers may be slowed by road conditions while responding to emergencies. Ice storms may result in power outages due to downed power lines, putting people at risk for cold temperature exposure and reducing the ability to spread emergency messages to the public via television, radio or computer.

Previous Occurrences of the Hazard

From January 2000 through April 2017, there have been 28 documented winter storms in Murray County. These winter storms are often not confined to Murray County but affect all of southwest Minnesota. In the table below are winter storm occurrences that occurred from January 2015 through April 2017.

Figure #60
Winter Storms – Murray County

Date	Location	Event Narrative
1/5/2015	Lyon, Lincoln, Rock, Pipestone, Nobles, Cottonwood, Murray, Jackson	Snow accumulated 3 to 6 inches. The snow was accompanied by southeast winds gusting to over 30 mph, reducing visibility to a quarter mile or less in a few areas. The storm forced some schools to close early for the day.
11/30/2015	Lyon, Lincoln, Jackson, Pipestone, Nobles, Murray, Rock, Cottonwood	Freezing drizzle was quickly followed by snow. The snow accumulated 5 to 9 inches over a 24 to 30 hour period, including 8.0 inches 4 miles north of Currie. The storm resulted in cancellations or cutbacks of school classes.
12/01/2015	Lyon, Lincoln, Jackson, Pipestone, Nobles, Murray, Rock, Cottonwood	Freezing drizzle was quickly followed by snow. The snow accumulated 5 to 9 inches over a 24 to 30 hour period that began on November 30th, including 8.0 inches 4 miles north of Currie. The storm resulted in cancellations or cutbacks of school classes.
12/25/2015	Murray, Pipestone, Lyon, Lincoln, Rock, Cottonwood, Jackson, Nobles	Snow accumulated 5 to 8 inches, including 8.0 inches 4 miles north of Currie. North to northwest winds gusted to around 30 mph on December 26th, causing areas of blowing snow with visibilities below a half mile in places. The storm affected mainly Christmas weekend travel.
03/23/2016	Lincoln, Lyon, Rock, Nobles, Pipestone, Murray, Cottonwood, Jackson	Snowfall ranging from 3 to 8 inches, including 8 inches at Lake Wilson, was accompanied by north to northeast winds gusting to over 40 mph. Despite the wet nature of the snow, the winds caused blowing and drifting snow while the snow was falling. The snow made travel difficult at times.
12/16/2016	Lyon, Nobles, Rock, Lincoln, Murray, Pipestone, Jackson, Cottonwood	Snow accumulated 5 to 7 inches. Northerly winds increased to around 20 mph sustained with gusts around 30 mph, causing drifting snow and areas of blowing snow. The winds and falling temperatures caused wind chills to drop to 20 to 25 below zero during the storm. Some schools were dismissed early on December 16th.

National Climatic Data Center (NCDC) Storm Events database

From January 2000 through April 2017, there have been 17 documented Blizzards in Murray County. In the table below are blizzard occurrences that occurred from January 2014 through April 2017.

Figure #61
Blizzards – Murray County

Date	Location	Event Narrative
1/16/2014	Pipestone, Lyon, Rock, Nobles, Lincoln, Murray, Jackson, Cottonwood	Northwest winds gusting to over 50 mph combined with existing snow cover and new snowfall of up to 2 inches to cause widespread frequent visibilities below a quarter mile in blowing snow. Schools and some businesses closed as travel temporarily became difficult to impossible.
1/8/2015	Lyon, Lincoln, Murray, Cottonwood, Nobles, Jackson, Pipestone	Northwest winds gusting up to 50 mph combined with existing snow cover to cause blowing snow, reducing visibilities to a quarter mile or less over much of the area. Some schools ended classes early.
02/02/2016	Nobles, Jackson, Rock, Pipestone, Lincoln, Murray Cottonwood, Lyon	Heavy snow combined with north to northwest winds 20 to 35 mph, with gusts over 40 mph, to produce near zero visibilities in falling and blowing snow. Accumulations ranged from 6 to 9 inches with 6 inches near Currie. Travel was brought to a halt and numerous vehicles slid off roads due to the combination of snowy roads and low visibility. Schools and numerous businesses were closed.
02/07/2016	Lyon, Pipestone, Murray, Lincoln, Cottonwood, Nobles, Jackson	Northerly winds gusting to over 50 mph combined with existing heavy snow cover and around one inch of new snowfall to produce widespread blizzard conditions, with visibilities lowering to below a quarter mile in blowing snow. Some vehicles became stuck or drove off roads in zero visibilities. Some schools and businesses closed on Monday February 8th.
11/18/2016	Lyon, Lincoln, Murray, Pipestone	Wet snow accumulated 4 to 7 inches, including 5 inches north of Currie. The snow was accompanied by northwest winds gusting to 55 mph, which caused widespread visibilities of less than a quarter mile while the snow was falling. Travel was difficult because of the low visibility and snow covered surfaces. Wind chills were driven down into the teens after an immediately preceding period of much above normal temperatures. Classes were cancelled at many schools.
02/23/2017	Rock, Pipestone, Cottonwood, Nobles, Jackson, Murray	Snowfall of 2 to 4 inches combined with strong winds of 30 to 40 mph created localized blizzard conditions with widespread visibilities below a half mile. Highway crews were reporting localized white-out conditions.

National Climatic Data Center (NCDC) Storm Events database

Severe Winter Storms and Climate Change

Historically, winter storms have had a large impact on public safety in Minnesota. This will continue, with a possible increase in snowstorm frequency and annual total snowfall. Winter weather is often a cause of power outages. Pressures on energy use, reduced reliability of services, potential outages and potential rise in household costs for energy are major climate change risks to public health.

The number of heavy snowfall years for the Midwest has fluctuated throughout the 1900-2006 time period. The periods of 1900-1920 and 1960-1985 had numerous years with snowfall totals over the 90th percentile. In the recent 3 decades, the number of heavy seasonal snowfall totals has been much lower. Despite these generally lower seasonal snowfall totals, some areas of the Midwest have still experienced significant snow totals in the most recent decade. The 100-year linear trends based on decadal values show that the upper Midwest had statistically significant (1% level) upward linear trends in snowstorm frequency from 1901 to 2000 (Kunkel, et al., Regional Climate Trends and Scenarios for the U.S. National Climate Assessment., 2013).

Vulnerability

Winter storms are highly likely in the area, and they occur annually.

Winter storms have major impacts on local communities. The effects of a winter storm can include: closures, need to clear snow and ice from public streets, recover from utility failure, possibly provide emergency shelters for travelers and dislocated residents, and potential injuries and death. Winter storms can also cause lost productivity and disruptions in the local workforce, with public and private employees unable to work regular hours.

A number of facilities in Murray County have emergency generators that help keep emergency services available during a winter storm.

Figure #62
Locations with Emergency Generators & Needs, Murray County

City	Location / Description
Avoca	Unknown
Chandler	Unknown
Currie	Yes – City Hall/Water Treatment
Dovray	No
Fulda	No
Hadley	No
Iona	No
Lake Wilson	Yes – City Office/Water System
Slayton	Yes – Fire Hall/Water Treatment

Information request to city and county representatives

The accumulated effects of winter storms and blizzard conditions also pose a risk to structures from snow load on roofs. Vulnerable structures can easily collapse under the weight of heavy snow and/or high winds. The Minnesota building code has requirements for snow loads.

Analysis of specific infrastructure and structure dollar-cost vulnerability is not possible since winter storms can (and do) impact large portions of the study area. Based on current available data, modeling future losses would only be possible for total losses with excessive margins of error. Future storm events could

be tracked specifically as they occur and could be used to model local vulnerability to winter storms in future updates.

Plans and Programs

- Real-time weather monitoring – The City of Slayton has a real-time weather monitoring station at the municipal airport that provides current temperatures, dew point, wind speed, wind direction, and barometric pressure.
- Travel Assistance – “511 is a public service of the Minnesota Department of Transportation (MnDOT) to help traveler’s access information about road conditions, traffic incidents, commercial vehicle restrictions, and weather information via the phone or the Web, 24 hours a day, seven days a week.”
- Regional Forecasts – Murray County is in the Sioux Falls broadcasting region. Weather forecasts in the Sioux Falls region tend to be a good predictor of weather in Murray County. Murray County uses this information in regards to school closures and other weather related announcements.
- School closings – Murray County’s school districts have a policy of closing schools when wind chills exceed certain thresholds, low visibilities create unsafe driving conditions, or when heavy snow has fallen making travel difficult. Local radio stations partner with the school districts to make sure the announcements are out by 6:00 am or earlier if possible.
- Snow Removal Problem Areas – Murray County has in the past cut back some groves in snow removal problem areas.
- Road closures – Murray County Public Works and local cities are working closely with MnDOT to improve transportation safety in all weather conditions. Road closures are enacted when conditions become too hazardous. MnDOT uses the 511MN.org, or 511 for mobile phones. This system does not send out alerts, but posts weather related road information online for public access.
- Emergency generators – Emergency generators help keep emergency services available during winter storms. Refer to Figure #62 for public entities with emergency generators in Murray County.
- City Policies – Cities have snow removal and winter parking policies in place to ensure access throughout the city.
- Backup generators – Some critical public facilities have emergency electrical generation on-site. Refer to Figure #62 for locations with emergency generators. A number of private residents also have backup generators.
- Hardening of the electrical grid – Much work has already been completed to harden electric utilities against winter storms. Redundancies in utility systems can further reduce outages resulting from storms.
- Set up operations at Nobles Coop in the case of a storm like the Rock/Nobles one this past winter.

Gaps and Deficiencies

- Automated weather stations at schools – Automated weather stations at schools throughout Murray County would provide more current information and quicker response to dangerous and changing weather conditions.
- 511 System – The 511 system does not incorporate local knowledge as well as it could. County staff has little involvement in providing updates to the 511 system. Including snowplow drivers and other county staff could help to improve the accuracy of the system. County staff has local knowledge

regarding the road network and can provide accurate information into the system. Road Closures Coordination – MnDOT closes state highways and does not talk to local emergency managers. There needs to be a direct line of communications between MnDOT and local emergency managers. This is an issue for emergency response and mass sheltering.

- Minnesota Building Code – The Minnesota Building Code helps to ensure buildings are built with minimum snow load requirements and other requirements to ensure the building is safe and will be safe for years to come. Murray County has not adopted the Minnesota Building Code.
- Loss of power. Backup generation is lacking in some areas.

Below are a few non-site specific projects that could be pursued if mitigation funding from FEMA was available:

- Looping/tying substation feeds together so if one substation fails, the load can be picked up by other substations.
- Putting ties between substations underground.
- Replacing overhead lines with underground lines for key member loads. These loads would include rural water pumping stations and other emergency loads that rely on electricity to maintain service.
- Tree Maintenance – Cities help to increase the reliability of the utility grid by cutting down and maintaining trees that are close to power lines and in the public right-of-way.
- Road design – Transportation engineers use road design to substantially reduce hazards from blowing and drifting snow. Living snow fences have been used to mitigate the effects of blowing and drifting snow, which affect road conditions. Living snow fences are designed plantings of trees and/or shrubs and native grasses located along roads or around buildings, which create a vegetative trap to control blowing and drifting snow.

5.4.3 Flooding

Flooding is one of the most common hazards across the United States and “floods are among the most frequent and costly natural disasters.”²⁷ Flooding can occur anytime, anywhere. Seemingly benign streams can overflow their banks from a sudden rainstorm, quick snowmelt, or blockage of a channel. Lakes or reservoirs can retain water and quietly creep up the shorelines. City sewers can back up and pour into private basements and onto public streets. Dams can break causing flooding down river.

The **National Flood Insurance Program (NFIP)** was created by Congress to help property owners to protect themselves financially. NFIP offers flood insurance in communities that agree to adopt and enforce ordinances to reduce the risk of flooding. In Minnesota, the DNR administers floodplain management programs.²⁸

As of 6/30/2018, there are 25 flood insurance policies in Murray County.²⁹ Each policy covers a single building, but all single family home policies include detached garages. The table below details the policies.

Figure #63
Flood Insurance Policies – Murray County

Area	Number of NFIP Policies in-force	Insurance in-force
Murray County (Unincorporated)	25	\$3,992,700

FEMA Data, 04/30/2017

The Federal Emergency Management Agency (FEMA) has mapped the probability of flood waters inundating floodplains. FEMA works with local communities to map the Special Flood Hazard Area (SFHA), commonly known as the 100-year floodplain (one percent floodplain), where they calculate a one percent chance of a flood event any given year. Within the SFHA lie the floodway, in which water can be expected at any time, and the flood fringe which is vulnerable to flood events.

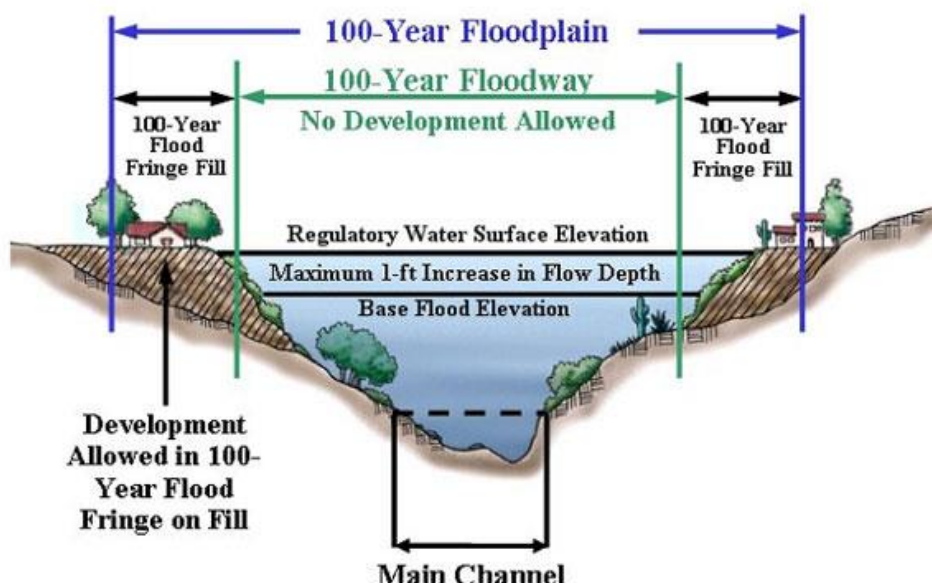
FEMA has developed Flood Insurance Rate Maps (FIRMs) for many communities across the United States. FEMA now posts these online, along with “FIRMettes” —a “a full-scale portion of a FEMA Flood Insurance Rate Map (FIRM) that you create yourself online by selecting the desired area from an image of a Flood Insurance Rate Map.”

²⁷ American Red Cross. Accessed: 8/8/17. Available: <http://www.redcross.org/prepare/disaster/flood>

²⁸ Flood Smart. Accessed 5/21/13. Available: http://www.floodsmart.gov/floodsmart/pages/about/nfip_overview.jsp

²⁹ FEMA Data. Accessed 8/24/2018. Available: <https://bsa.nfipstat.fema.gov/reports/1011.htm>

Figure #64
100-Year Floodplain (1 percent Floodplain)



Locations Affected by the Hazard

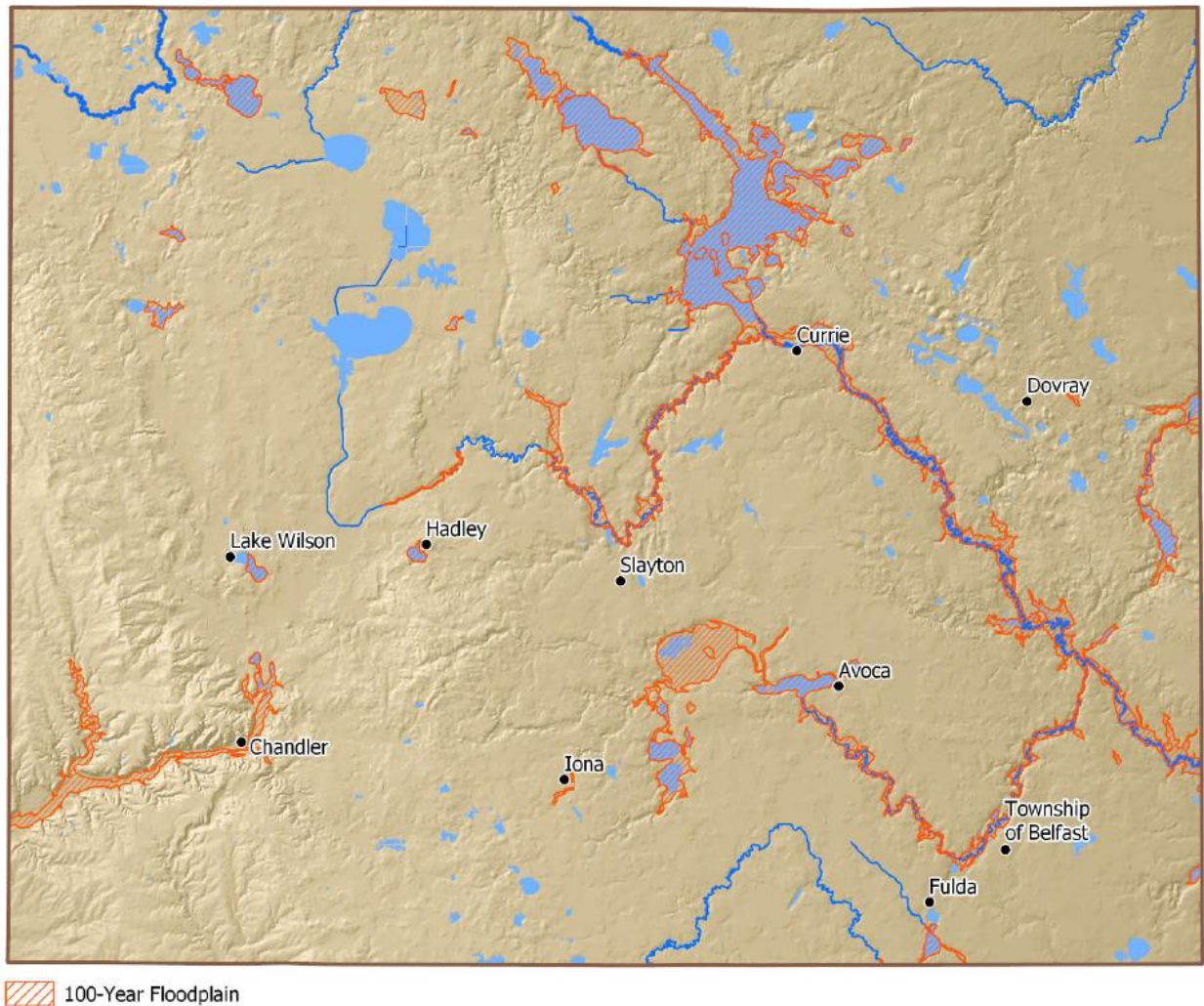
Flooding can occur anytime, anywhere. The areas of minimal flooding include most of the intermittent streams throughout the county. These streams contain surface water runoff at various times throughout the year and high water levels may extend beyond the established drainage channel and onto adjacent lands.

Flash flooding events tend to be localized, not countywide, but the risk is countywide. Flash flooding can occur rapidly and cause substantial damage. Flash flooding can cause a rapid rise in the water level of a stream or creek above a predetermined flood level.

One percent floodplain areas do exist in Murray County. The Des Moines River runs through Murray County and one percent floodplains exist along it. Additionally one percent floodplains exist within or directly adjacent to the cities of Avoca, Chandler, Currie, Hadley, Iona, and Fulda. Very high losses are estimated to occur in the Lake Shetek area in the event of a one-hundred year flood, due to the density and value of residential and commercial infrastructure around the lake and on islands in the lake. See Figure #65 for a map of Murray County's one-hundred year floodplain.

Flood Insurance Rate Maps (FIRMs) are available for the Cities of Avoca, Chandler, Dovray, Hadley, and Iona and all townships. The Flood Insurance Rate Maps (FIRM) for these public entities can be found by contacting the Murray County Emergency Manager. These maps have not been updated since 1990.

Figure #65
100-Year Flood Plain Map – Murray County



Source: HAZUS Flood Hazard Analysis for Murray County, 2018, Geospatial Analysis Center

City of Avoca

The City of Avoca does not have a FIRM, though the surrounding areas show vulnerability along the shore of Lime Lake and immediately surrounding areas that likely extend through the northwest portion of the City of Avoca. These are classified as Zone A (most volatile of Special Flood Hazard Areas). According to the HAZUS Analysis, there is one Census Block in Avoca with over \$500,000 of losses in the event of a 100-year-flood.

City of Chandler

The HAZUS Flood Hazard Analysis for Murray County shows that a significant portion of southern, eastern, and northeastern Chandler is vulnerable to losses in a 100-year flood as it lies along Chanarambie Creek. Census Block is estimated to see over \$16 million in losses in the event of a 100-year-flood. See Appendix A for a map of the 100-year flood loss estimates in Chandler.

City of Currie

The City of Currie is not listed in the NFIP Community Status Book. The Hazus Flood Hazard Analysis for Murray County shows minor losses in northeast Currie in the event of a 100-year flood.

City of Dovray

The City of Dovray is not mapped in the FIRM. The HAZUS Analysis shows Dovray completely outside the 100-year-floodplain.

City of Fulda

The City of Fulda does not participate in the NFIP and was not mapped in the FIRM in the latest maps (1990), but portions of Bondin Township that have since been annexed by Fulda were mapped. The portions of Fulda directly around Fulda First and Second Lakes are within Zone AE where flood insurance is mandatory for properties with federally-backed mortgages. The HAZUS Analysis confirms the flooding risk with all Census Blocks surrounding Fulda First and Second Lake at risk of between \$142,000-\$549,999 in losses. See Appendix A for a map of the 100-year flood loss estimates in Fulda.

City of Hadley

The City of Hadley does not participate in the NFIP and has no more recent FIRM than 1975. The HAZUS Analysis shows 100-year flood losses of under \$142,000 in the Census Block surrounding Summit Lake in Hadley.

City of Iona

The City of Iona does not participate in the NFIP and has no more recent FIRM than 1974. The HAZUS Analysis shows 100-year flood losses of under \$142,000 in the Census Block that includes Iona.

City of Lake Wilson

The City of Lake Wilson participates in the NFIP, but has no FIRM available. The area immediately surrounding the lake of Lake Wilson is a Zone A flood hazard area. The HAZUS Analysis shows no potential 100-year flood losses in the city.

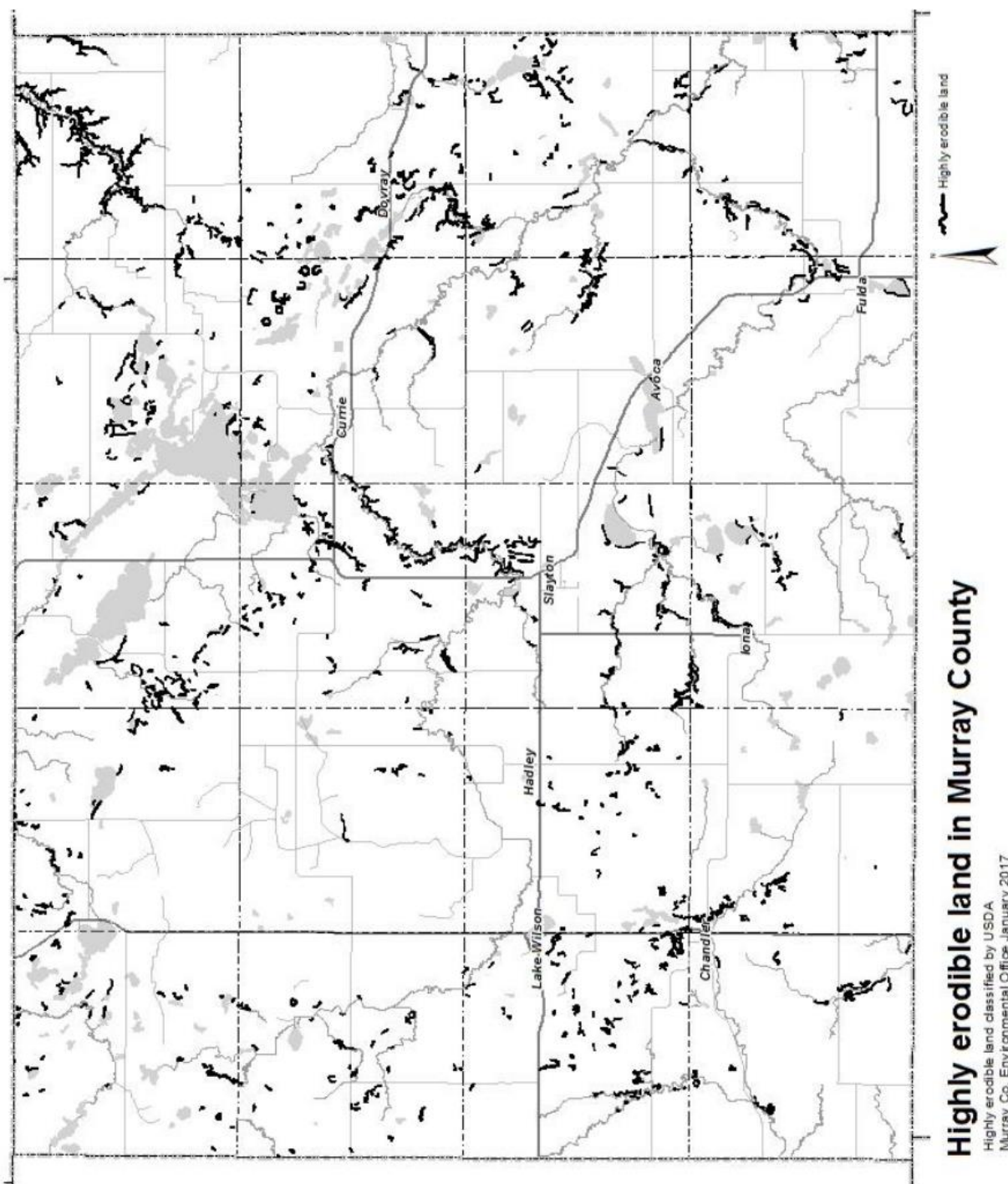
City of Slayton

The City of Slayton does not participate in the NFIP and has no FIRM available. The HAZUS Analysis shows losses of under \$142,000 in the census block bordering the northeastern portion of Slayton. See Appendix A for a map of the 100-year flood loss estimates in Slayton.

The Lakes CDP

The Lakes Census-Designated Place is an area that spans areas of Lake Sarah, Mason, Murray, and Shetek Townships, encircling the major lakes area within those townships. The shoreline areas of these lakes and islands within the lakes are classified as Zone AE. These areas participate in the NFIP under the unincorporated areas of Murray County. The HAZUS Analysis shows losses of over \$142,000 on multiple Census Blocks bordering all of Lake Sarah and Maria and some of Lake Shetek as well as losses of over \$923,000 on many Census Blocks surrounding and within (islands) Lake Shetek. Additionally losses of over \$16,309,000 are estimated to occur on the Census Block that encompasses Keeley Island in Lake Shetek.

Figure #66
Highly Erodible Soils – Murray County



“A highly erodible soil, or soil map unit, has a maximum potential for erosion that equals, or exceeds, eight times the tolerable erosion rate. The maximum erosion potential is calculated without consideration to crop management or conservation practices, which can markedly lower the actual erosion rate on a given

field. The maximum potential erosion rate is determined using the formula: $RKLS/R$ (where R = the rainfall factor, K = erodibility value of the soil, and LS = the slope factor). If $RKLS/T$ is > 8 then the soil meets the criteria for a highly erodible soil.”³⁰

Highly erodible soils can result in landslides and sinkholes. Both of these phenomenon can occur in Murray County.

Extent of the Hazard

“Floods are among the most frequent and costly natural disasters.”³¹

Critical Facilities

There are no critical facilities in Murray County that are within the one percent floodplain.

Effect on Housing

The majority of Murray County’s population lives safe from flooding, although some housing units have been identified within the one percent floodplain and flooding can occur anywhere. County staff has identified residential and commercial structures within the floodplain using GIS, FIRM Maps, and the State of Minnesota DOQ flyovers.

Development has occurred along and near water bodies in Murray County due to the aesthetics they create. The median housing unit value in Murray County was \$105,000 in 2010.³² The HAZUS model estimates there are 4,590 parcels with buildings on them with a total replacement value (excluding contents) of \$463 million. Approximately 71.76% of the buildings (and 57.40% of the building value) are associated with residential housing. Since flooding could theoretically occur in any of the communities within Murray County and in the rural areas, the potential damage of a flood could be relatively high.

Commercial Structures

There are some commercial structures currently located within the one percent floodplain in Murray County. Future construction of commercial buildings in the floodplain has been prohibited under Murray County’s zoning regulations.

Public Infrastructure

Within Murray County there are some roads that are prone to flooding or washing out during a hazard event. Those most noted are roads in low-lying areas that are vulnerable to intermittent flooding.

There are 208 bridges on county, municipal, and township roadways within Murray County.³³ Most are made of steel or steel reinforced concrete, which can withstand annual spring flooding. To date, none of the bridges within Murray County have been destroyed as a result of flooding.

³⁰ National Resources Conservation Service. Accessed: 11/24/14. Available: http://www.nrcs.usda.gov/wps/portal/nrcs/detail/ri/soils/?cid=nrcs144p2_016637

³¹ American Red Cross. Accessed: 10/30/13. Available: <http://www.redcross.org/prepare/disaster/flood>

³² ³² Census 2010. Accessed: 8/24/18. Available: https://factfinder.census.gov/faces/nav/jsf/pages/community_facts.xhtml

³³ MnDOT. Accessed: 8/14/2017. Available: <http://www.dot.state.mn.us/bridge/pdf/minnesota-bridges-2016-report.pdf>

The majority of roadway damages from flooding occur on township roads and county roads. Many other locations can experience damage from flooding depending on the location, amount, and duration of the rainfall event. A one percent flood event would result in a number of roadways sustaining damage and wider spread road closures.

Roads, bridges, and culverts are susceptible to damage from flooding. Figures 67 and 68 identify areas where drainage may be a contributing factor in roadway flooding. This may be the result of an undersized culvert, poor drainage, inadequate holding basin, or other issues.

There are no communities in Murray County that have wastewater treatment plants close to the one percent floodplain. To date, extensive damage to wastewater treatment ponds within the county due to flooding has not occurred. The City of Chandler's well is within the 100-year flood plain; however, the cost-effectiveness of moving this well is low.

Relationship to Other Hazards—Cascading Effects

- Numerous. Flooding can have a number of secondary effects that can create additional hazards related to fire, public health, utility failure, insect and pest infestation, and infrastructure damage. Flooding can interfere with emergency response to fires, as seen in Grand Forks, North Dakota, during the Red River Flood of 1997. The after effects of a flood can be a contaminated water supply and mold which affect public health. It can take up to a week or two to get the power back on after a flood. Not having reliable power makes day to day life more difficult. Insect and pest infestation can take place after the flood has receded. Damage to infrastructure can takes weeks to repair. This can cause increased emergency response times and put residents at risk.

Previous Occurrences of the Hazard

From January 2000 through April 2017, there have been 4 documented floods and 4 documented flash floods in Murray County. During the writing of this plan (summer 2018), extensive flooding occurred in Murray County that resulted in widespread damage to residential infrastructure. Statistics for this flood are not yet available.

NOAA defines a flood as “an overflow of water onto normally dry land. The inundation of a normally dry area caused by rising water in an existing waterway, such as a river, stream, or drainage ditch. Ponding of water at or near the point where the rain fell. Flooding is a longer term event than flash flooding: it may last days or weeks.”³⁴

NOAA defines a flash flood as “a flood caused by heavy or excessive rainfall in a short period of time, generally less than 6 hours. Flash floods are usually characterized by raging torrents after heavy rains that rip through river beds, urban streets, or mountain canyons sweeping everything before them. They can occur within minutes or a few hours of excessive rainfall. They can also occur even if no rain has fallen, for instance after a levee or dam has failed, or after a sudden release of water by a debris or ice jam.”³⁵

³⁴ NOAA. Accessed: 11/24/14. Available: <http://www.srh.noaa.gov/mrx/hydro/flooddef.php>

³⁵ NOAA. Accessed: 11/24/14. Available: <http://www.srh.noaa.gov/mrx/hydro/flooddef.php>

Figure #67
Floods – Murray County

Date	Location	Event Narrative
03/16/2011	7NW Currant Lake to 8SW Chandler	Melting of a heavy winter snow cover caused flooding of lowlands, lakes, and streams. There was considerable flooding of farmland. Numerous roads in the county were flooded. Some of the roads were closed, and some were washed out in spots. The flooding onset was rapid for a snow melt flood due to high water and groundwater levels from record precipitation in the year 2010.
04/01/2011	7NW Currant Lake to 8SW Chandler	Flooding of lakes, streams, and lowlands, including some farmland, continued in the county through April. While flooding of small streams abated, lake and lowland flooding continued with very slow improvement. Several roads remained flooded. High water and groundwater levels resulting from record precipitation in the previous year was the main reason that the flooding either grew worse or improved so slowly.
06/15/2014	8NW Currant Lake to 2ENE Woodstock	Persistent moderate to heavy rain caused flooding of some fields and other lowlands, including several roads. This flooding lasted well into the daytime hours after the rain subsided.
06/16/2014	7NW Currant Lake to 7SW Chandler	Persistent moderate to heavy rain caused flooding of fields and other lowlands, including several roads, homes, and businesses. This flooding lasted for two days, and was aggravated locally by additional storms during that time. Some roads were damaged or washed out.

National Climatic Data Center (NCDC) Storm Events database

Figure #68
Flash Floods – Murray County

Date	Location	Event Narrative
05/29/2004	Countywide	Rainfall of 2 to 5 inches caused flooding of basements, fields, and many roads. Several roads were blocked by high water, including state highway 30 and U.S. highway 59. The basement flooding was most noted in Slayton and in the Lake Shetek area.
06/15/2004	Countywide	Rainfall of 2 to 6 inches over the northern and eastern parts of Murray County flooded numerous roads, and washed out some township roads. Residents in the Lake Shetek area were especially affected, with high water flooding roads to many homes. At least 50 thousand acres of cropland were flooded, with some crops washed away completely. The amount of crop damage was not known, due to the uncertainties in both crop recovery and in the ability to replant. Other lowlands were flooded, including a golf course in Slayton.

06/20/2005	5NW Lake Wilson to 4SW Chandler	Heavy rain caused flooding of roads and fields.
09/22/2010	5S Lake Wilson to 2ESE Fulda	Heavy rain caused flash flooding in much of southern Murray County. Numerous roads were flooded, including Minnesota Highway 30 in several areas. Numerous basements were flooded, especially in Fulda.

National Climatic Data Center (NCDC) Storm Events database

Vulnerability

Flooding is highly likely to occur each year and forecasting technology and models can help predict yearly spring flooding. Even with weather forecasting technology floods can occur rapidly and poses a risk throughout the county.

Flooding can occur anytime anywhere, so the potential damage of a flood could be higher than the total value of residential structures within the floodplain. The value of residential structures does not take into consideration outbuildings, machine sheds, and agricultural production. The potential damage of a flood could be relatively high. Flash flooding could result in sewer systems being overloaded and flooding to occur in basements. Basement flooding could be isolated to low lying areas, or could be citywide in an event of an extreme rain event.

Improvements have been made along the flood plain. Pumps have been purchased by cities to assist with bypassing the sewer system during an extreme rain event.

Plans and Programs

- Zoning – The floodplain section of the Murray County Zoning Ordinance addresses the placement of structures within the floodplain. Murray County’s zoning regulations regulates any further development within the floodplains; and existing structures may continue to exist as “grandfathered” structures.
- The Redwood-Cottonwood Rivers Control Area, a non-regulatory, joint-powers organization that includes eight counties in the Redwood and Cottonwood river basins, focuses mostly on water quality but also works to keep water on the landscape longer, reducing potential flood impacts.
- Currently under development, The Missouri River Watershed One Watershed, One Plan, a joint planning effort with neighboring counties for the Missouri River Basin, identifies loss of natural storage and loss of functioning wetlands as high priority issues. The Missouri River Watershed encompasses all of Rock County and portions of Pipestone, Lincoln, Murray, Nobles, and Jackson counties.
- Area II River Basin – The Area II River Basin works to alleviate recurrent flood problems in southwest Minnesota. Member counties include: Brown, Cottonwood, Lac qui Parle, Lincoln, Lyon, Murray, Pipestone, Redwood, and Yellow Medicine.
- County flood area maps – Murray County has FIRM maps identifying the 100-year, dated May 3, 1990. The cities of Chandler, Currie, Fulda, Hadley, Lake Wilson and Slayton have all annexed land within the county FIRMs, so they, too, would have FIRM Maps. The county zoning ordinance controls permitted land uses in areas outside municipalities, for what can be built, and how.
- Murray County Emergency Operations Plan – A response plan to a flood emergency has been developed and local resources and personnel have been committed to it:

- Response Plan – A response plan to a flood emergency has been developed and local resources and personnel have been committed to it. Part of the response plan is an evacuation plan that is in the EOP.
- National Flood Insurance Program (NFIP) – Murray County and the following cities participate in the NFIP: Avoca (Emergency Program), Chandler, and Lake Wilson (Emergency Program). The NFIP has three basic aspects that include: floodplain identification and mapping, floodplain management, and flood insurance.
- Zoning restrictions – Murray County has zoning restrictions that limit new structures and land uses within the Floodway, Flood Fringe, and General Flood Plain District.
- Local Water Management Plan – The water plan identifies priorities regarding drainage, which includes flooding. The Plan also identifies water retention as very important and sets an objective to encourage their installation.
- Emergency response planning – Road closures are taken into account in planning and training. Local fire departments, emergency medical services, and other emergency responders plan for having to use alternative routes in case of flooding.
- Ditch system / drainage – Murray County continues to make improvements to the ditch system. With increased tiling, it is important to reevaluate the ditch system and drainage.
- Road mitigation projects – Road retention projects were pursued to reduce the impact of flooding along roadways. These projects included: analyzing runoff and the capacity of county ditches, the installation of smaller culverts, and adding water retention ponds. Downsizing culverts is a reversal in the trend of replacing culverts with larger sized culverts, which only transfer additional water downstream.
- NFIP Participation and Floodplain Ordinance Development – Murray County has hosted DNR Floodplain trainings to encourage cities to work with the DNR to enroll in the NFIP and to adopt floodplain regulations in their ordinances.

Gaps and Deficiencies

- Wastewater treatment vulnerability to flooding – Wastewater treatment plants are vulnerable to flooding. Pumps may not be capable to keep up with flood events. This would result in sewer water being combined with clean water and entering the various watersheds. Pond systems are the most vulnerable.
- Grandfathered in structures in the floodplain – At-risk uses and structures remain in identified 100-year floodplains, because they are “grandfathered” in.
- Severe flooding – Local resources are not adequate for a severe and prolonged flood. State and federal resources are required when responding to severe flooding. There may be a time delay to receive assistance.
- Development in the floodplain – Some residents are resistant to leaving their property, even if it is located in a designated floodplain. The area may be seen as scenic, so the resident may want to continue living in the floodplain.
- Local assistance – Local match for mitigation projects (such as acquisition of property) is often difficult to acquire, due to limited local budgets.

- Limitations of models – Models are increasingly being used by engineers and scientists in flood management. Models are only as accurate as the data that is used in the analysis. Outdated maps and not including all the impacting variables can cause forecasting errors to occur. Ground saturation is one variable that is not included in the models for estimating yearly flood levels. Ground saturation affects the amount of moisture that can be soaked in during a precipitation event. Forecasters are working on ways to include ground saturation into their flood models.
- Pumps – There are always a number of requests for pumps and generators when there are flood events. The MN Warn System helps to coordinate the supply of pumps, generators, and other equipment to affected communities. Through the MN Warn System communities can share local and regional assets.
- Aging drainage systems – Public drainage systems are aging and maintenance costs are increasing. Culverts are rusting out and replacement costs are substantial. Townships and local units of government need outside funding to help update public drainage systems. Not updating the system will lead to culvert failures, roads washing out, and erosion.
- Flood Maps – FIRM Maps are outdated and need to be replaced with newer, more accurate floodplain boundaries, for not only Murray County, but also all of the cities prone to flooding. Murray County's FIRM Maps are dated May 3, 1990, and for the following cities, their maps are even older: Avoca – May 10, 1975; Chandler – August 9, 1974; Hadley – April 11, 1975; and Iona – December 20, 1974.
- Fulda Lagoons could be an area that is a problem, but doesn't show on the floodplain maps or flood hazard analysis. The lagoons already pumping regularly and are at capacity when there is a heavy rain. If there were a 100-year flood, they wouldn't be able to handle it. This is public infrastructure so it would be eligible for funding. One idea would be more cells to the lagoons, but funding is limited.
- Four cities with flood issues do not participate in the NFIP.
- No generator for lift station in Avoca.

Strategies

After the summer 2018 flooding, the planning team convened to discuss strategies for flood mitigation. Out of this meeting came multiple strategies including:

- Raise and repair flood-prone grinder stations. Sleeve grinders in flood-prone areas.
- Identify areas for flood retention, including with private landowners.
- Work with Soil & Water and area watershed districts to identify areas where flood mitigation and retention initiatives are feasible, including the Fulda Lagoons.
- Build structures to meter water at roads susceptible to flooding, such as (but not limited to) roadway retention basins and risers on culverts.
- Build structures to hold water sources feeding to Lake Shetek and Beaver Creek that are unconnected to Lake Sarah.
- Build identified water retention structures where feasible.
- Work with the DNR to repair the Avoca Dam.

5.4.4 Severe Summer Storms (Severe Thunderstorms, Lightning, and Hail)

During the spring, summer and autumn, severe thunderstorms, lightning, and hail can occur. (Windstorm and tornado events are addressed in the next section.)

Locations Affected by the Hazard

All locations in Murray County are at risk to be affected by this hazard. Severe summer storm events will be more widespread. These weather events can generate lightning and hail that tend to be more isolated.

Extent of the Hazard

Thunderstorms, which occur most frequently from mid-May through mid-July, are the most common type of severe summer storm. Thunderstorms are usually localized, produced by cumulonimbus clouds, accompanied by lightning, and have strong wind gusts, heavy rains, and sometimes hail or tornadoes. Thunderstorms are produced by air masses that become unstable and that overturn violently. Unstable air masses are usually the result of warm humid air at lower elevations and colder air at higher elevations.

Lightning is often associated with thunderstorms and can be deadly. Lightning occurs to balance the difference between positive and negative discharges within a cloud, between two clouds, and between the cloud and ground. For example, a negative charge at the base of the cloud is attracted to a positive charge on the ground. A lightning bolt happens when the difference between the charges is great enough. The charge is usually strongest on tall buildings, trees, and other objects protruding from the surface. Consequently, these objects are more likely to be struck than lower objects.

While cloud-to-ground lightning poses the greatest threat to people and objects on the ground, it accounts for only 20 percent of all lightning strikes. The remaining lightning occurs within the cloud, from cloud to cloud, or from the ground to the cloud. The most common type of lightning is lightning occurring within a cloud.

Hail is an ice product produced in severe thunderstorms. It is formed when strong updrafts within the cumulonimbus cloud carry water droplets above the freezing level or when ice pellets in the cloud collide with water droplets. The water droplets freeze or attach themselves to the ice pellets and begin to freeze as strong updraft winds toss the pellets and droplets back up into colder regions of the cloud. Both gravity and downdrafts in the cloud pull the pellets down, where they encounter more droplets that attach and freeze and are tossed once again to higher levels in the cloud. This process continues until the hail becomes too heavy to be supported by the updrafts and falls to the ground.

In Minnesota, most hail ranges in size from pea-size (1/4 inch) to golf-ball size (1-3/4 inch). Larger hailstones have been reported, but occur less frequently. Strong updrafts are necessary within the cloud to form hail, and are usually associated with severe thunderstorms. Coverage areas for individual hailstorms are highly variable and spotty due to the changing nature of the cumulonimbus cloud.

Figure #69
Estimating Hail Size

Description	Diameter (inches)
Pea	0.25
Plain M&M	0.5
Penny	0.75
Nickel	0.88
Quarter	1
Half Dollar	1.25
Walnut or Ping Pong Ball	1.5
Golf ball	1.75
Hen's Egg or Lime	2
Tennis Ball	2.5
Baseball	2.75
Tea Cup	3
Grapefruit	4
Softball	4.5
CD-DVD	4.75 – 5

National Weather Service (NWS)

Given the rural agricultural nature of the county, the likelihood is greatest that crops would experience the most damage from a hail event; however, hail can also do a great amount of damage to vehicles and roofs of individual structures. The chance of significant building damage is likely to be higher within the cities as there are simply more buildings clustered in a small area to be potentially damaged.

Relationship to Other Hazards—Cascading Effects

- **Utility Failure.** Severe Summer Storms often occur during times of extreme heat that can place a heavy burden on the power grid, making it especially vulnerable to service interruptions caused by lightning.
- **Transportation Infrastructure.** Heavy rain can cause flash flood events, and may threaten transportation infrastructure.
- **Fire.** Lightning can cause both structure fires and wildfires.

Previous Occurrences of the Hazard

Thunderstorms are not documented by the NOAA as a separate event. There was one documented lightning event in Murray County from January 2000 through April 2017.³⁶ There were most likely a number of other lightning events, but they went unreported. “Tall objects such as trees and skyscrapers are commonly struck by lightning... Lightning can strike the ground in an open field even if the tree line is close by.”³⁷

³⁶ NOAA. Accessed: 11/24/15. Available: <http://www.ncdc.noaa.gov/stormevents/>

³⁷ NOAA. Accessed: 11/24/15. Available: <http://www.nssl.noaa.gov/education/svrwx101/lightning/>

Figure #70
Lightning Events – Murray County

Date	Location	Event Narrative
06/13/2001	Slayton	Lightning struck a house, causing damage to the side of the house and burning off cable television wires.

National Climatic Data Center (NCDC) Storm Events database

The lightning activity level (LAL) is a common parameter that is part of fire weather forecasts nationwide. LAL is a measure of the amount of lightning activity using values 1 to 6 where:

Figure #71
Lightning Activity Level

LAL	Cloud & Storm Development	Lightning Strikes / 15 min
1	No thunderstorms.	-
2	Cumulus clouds are common but only a few reach the towering cumulus stage. A single thunderstorm must be confirmed in the observation area. The clouds produce mainly virga, but light rain will occasionally reach the ground. Lightning is very infrequent.	1-8
3	Towering cumulus covers less than two-tenths of the sky. Thunderstorms are few, but two to three must occur within the observation area. Light to moderate rain will reach the ground, and lightning is infrequent.	9-15
4	Towering cumulus covers two to three-tenths of the sky. Thunderstorms are scattered and more than three must occur within the observation area. Moderate rain is common and lightning is frequent.	16-25
5	Towering cumulus and thunderstorms are numerous. They cover more than three-tenths and occasionally obscure the sky. Rain is moderate to heavy and lightning is frequent and intense.	>25
6	Similar to LAL 3 except thunderstorms are dry.	

Hail events are separate events recorded by NOAA. Hail is often part of a thunderstorm and is not always reported due to the varying size and the rural nature of Murray County. From January 2000 through April 2017, there have been 36 documented hail events in Murray County. Some of these hail events are only minutes apart, but a hail event is a separate event if the storm stops hailing and starts hailing a few minutes later. The events between 2012 and 2017 are listed in Figure #72.

Figure #72
Hail Events, Murray County

Date	Location	Event Narrative
5/1/2012	4WSW Curren Lake	Thunderstorms produced large hail, up to half dollar size, at several locations in southwest Minnesota, during the late afternoon and early evening of May 1st.
5/1/2012	2NW Curren Lake	Thunderstorms produced large hail, up to half dollar size, at several locations in southwest Minnesota, during the late afternoon and early evening of May 1st.
5/1/2012	4ENE Currie	Thunderstorms produced large hail, up to half dollar size, at several locations in southwest Minnesota, during the late afternoon and early evening of May 1st.
5/23/2012	3ENE Lake Wilson	Thunderstorms produced large hail in three counties of southwest Minnesota during the late afternoon and early evening of May 23rd.
5/23/2012	4N Currie	Large hail was accompanied by heavy rain.
8/1/2012	4N Currie	Thunderstorms produced large hail and damaging winds in Lincoln, Lyon, and Murray Counties of southwest Minnesota during the late afternoon and early evening of August 1st.
8/4/2013	4N Currie	Thunderstorms produced marginally large hail in Murray and Cottonwood Counties in southwest Minnesota near midnight on August 4th/5th, 2013.
5/8/2014	5NW Lake Wilson	Thunderstorms produced large hail and damaging winds in Pipestone and Murray Counties in southwest Minnesota shortly after midnight on May 8th.
5/8/2014	1SE Lake Wilson	Thunderstorms produced marginally large hail at a few places in southwest Minnesota on the afternoon of May 8th.
5/8/2014	1E Lake Wilson	Thunderstorms produced marginally large hail at a few places in southwest Minnesota on the afternoon of May 8th.
7/7/2014	0N Chandler	A thunderstorm produced up to nickel size hail near Chandler in southwest Minnesota on the afternoon of July 7th.
7/7/2014	1NNE Chandler	A thunderstorm produced up to nickel size hail near Chandler in southwest Minnesota on the afternoon of July 7th.

National Climatic Data Center (NCDC) Storm Events database

Hail and Climate Change

According to the Federal Advisory Committee Draft National Climate Assessment (NCA), winter storms have increased slightly in frequency and intensity, and their tracks have shifted northward over the U.S. Other trends in severe storms, including the numbers of hurricanes and the intensity and frequency of tornadoes, hail, and damaging thunderstorm winds are uncertain. Since the impact of more frequent or intense storms can be larger than the impact of average temperature, climate scientists are actively researching the connections between climate change and severe storms (National Climate Assessment Development Advisory Committee, 2013).

The occurrence of very heavy precipitation has increased in Minnesota in recent decades and future projections also indicate this will continue (International Climate Adaptation Team, 2013). While it is unknown if this precipitation will occur during severe storms that produce hail, the possibility has not been ruled out.

Vulnerability

Severe summer storms are highly likely to take place every year, including lightning, and hail. People do not always recognize their limitations. Summer storms can pose a serious risk to all populations, especially the young and elderly population. Informing the public about summer storms is important in preventing accidents.

Plans and Programs

- Emergency alert system – Murray County has the CodeRED emergency notification system. CodeRED allows emergency officials to notify residents and businesses by telephone, cell phone, text message, email and social media regarding time-sensitive general and emergency notifications.
- Weather Ready Nation Ambassador – Murray County is a Weather Ready Nation Ambassador. “The Weather-Ready Nation Ambassador™ initiative is the National Oceanic and Atmospheric Administration’s (NOAA) effort to formally recognize NOAA partners who are improving the nation’s readiness, responsiveness, and overall resilience against extreme weather, water, and climate events. As a WRN Ambassador, partners commit to working with NOAA and other Ambassadors to strengthen national resilience against extreme weather.”
- Public Education – During times of extreme heat, The Sheriff’s Office and Emergency Management put out ads on Facebook pages with heat exhaustion warning signs.
- Severe Weather Awareness – Each spring, Murray County Emergency Management personnel will educate local schools, nursing homes, hospitals, etc. on the importance of doing a “Severe Weather Awareness Week” workshop for their staff. This workshop identifies evacuation routes and emergency shelters, along with other important information. Entities that participate include Fulda Public Schools and Murray County Central Public Schools.
- Local media – Severe weather warnings are broadcasted via local media, social media, and Code Red.
- Severe weather spotter training – an annual training is provided at Murray County Central High School in Slayton. The National Weather Service (Sioux Falls) conducts the training.

Gaps and Deficiencies

- Lightning detectors – Lightning detectors detect lightning produced by thunderstorms. Lightning detectors would improve safety at outdoor sporting events by providing better information when delaying or cancelling a sporting event. Not all outdoor sporting events have a lightning detector. Currently, the National Federation of State High School Associations (NFHS) “30-30 Rule” is used. The 30-30 Rule states that when you see lightning, count the time until you hear thunder. If this time is 30 seconds or less, go immediately to a safer place. Some smart phones are able to download a lightning detector app.
- Lightning detectors – None in the county. This is something to talk about with school districts.
- Sirens at Lake Shetek – These have no battery backup.

5.4.5 Tornado & Straight-line Wind Events

Tornadoes are the most violent of all storm types experienced in Minnesota.³⁸ A tornado is a rapidly rotating column of air that is spawned from a cumulonimbus cloud. When it drops to the ground, it can create significant property damage and loss of life.

Straight-line winds are also damaging but not to the extent of more powerful tornadoes. Straight-line winds can and do produce substantial damage over wider areas at one time. NOAA documents straight-line wind events as thunderstorm wind events and defines them as winds equal to or greater than 40 mph (35 knots).

Locations Affected by the Hazard

All of Murray County is at risk of a tornado. FEMA places Southern Minnesota in Wind Zone IV, subject to winds of up to 250 mph.³⁹

Extent of the Hazard

Minnesota lies along the north edge of the region of maximum tornado occurrence in the United States, known as tornado alley. Tornado Alley encompasses part of the central United States that extends across parts of Texas, Oklahoma, Kansas, Missouri, East Nebraska, and West Iowa. Tornadoes have been reported in Minnesota in every month from March through November.⁴⁰

The severity of tornado damage is measured by the Fujita Tornado Scale, with a sliding scale from F0 to F5 depending on wind speed. A tornado's path typically ranges from 250 feet to a quarter of a mile in width. The speed a tornado travels varies but commonly is between 20 mph and 30 mph. Most tornadoes stay on the ground for less than five minutes. Tornadoes frequently move from southwest to northeast but this also varies and cannot be counted on in all instances.⁴¹

Tornado damage can vary from limited damage to trees and buildings to complete destruction of a community. Along with monetary damages, loss of life is a real concern. However, due to the rural nature of Murray County, many funnel clouds have only caused damages to crops and unpopulated area.

The most severe windstorms usually occur (and do the most damage) during severe thunderstorms in the spring and summer months. These include tornadoes, downbursts, or straight line winds. Straight-line winds have similar effects to tornadoes without the rotational damage pattern.

Downbursts are created by a column of sinking air, capable of producing straight-line winds in excess of 150 mph. Winds of greater than 60 mph are also associated with intense spring and fall low-pressure systems. These winds can inflict damage to buildings and overturn high profile vehicles.

³⁸ MN All Hazard Mitigation Plan. Accessed: 5/29/13. Available: https://dps.mn.gov/divisions/hsem/hazard-mitigation/Documents/2011_MinnesotaAllHazardMitigationPlanDraft.pdf

³⁹ FEMA. Accessed: 5/29/13. Available: <http://www.fema.gov/safe-rooms/wind-zones-united-states>

⁴⁰ MN All Hazard Mitigation Plan. Accessed: 5/29/13. Available: https://dps.mn.gov/divisions/hsem/hazard-mitigation/Documents/2011_MinnesotaAllHazardMitigationPlanDraft.pdf

⁴¹ MN All Hazard Mitigation Plan. Accessed: 5/29/13. Available: https://dps.mn.gov/divisions/hsem/hazard-mitigation/Documents/2011_MinnesotaAllHazardMitigationPlanDraft.pdf

Figure #73
Derived Enhanced F-Scale for Tornado Damage

Scale	Wind Estimate	Typical Damage
EF0	65-85 mph	Light damage. Some damage to chimneys; branches broken off trees; shallow-rooted trees pushed over; sign boards damaged.
EF1	86-109 mph	Moderate damage. Peels surface off roofs; mobile homes pushed off foundations or overturned; moving autos blown off roads.
EF2	110-137 mph	Considerable damage. Roofs torn off frame houses; mobile homes demolished; boxcars overturned; large trees snapped or uprooted; light-object missiles generated; cars lifted off ground.
EF3	138-167 mph	Severe damage. Roofs and some walls torn off well-constructed houses; trains overturned; most trees in forest uprooted; heavy cars lifted off the ground and thrown.
EF4	168-199 mph	Devastating damage. Well-constructed houses leveled; structures with weak foundations blown away some distance; cars thrown and large missiles generated.
EF5	200-234 mph	Incredible damage. Strong frame houses leveled off foundations and swept away; automobile-sized missiles fly through the air in excess of 100 meters (109 yards); trees debarked; incredible phenomena will occur.

National Climatic Data Center (NCDC) Storm Events database

Figure #74
Straight-line Wind Damage Estimates

Wind Speed	Effects
25 – 31 mph	Large branches in motion, whistling in telephone wires
32 – 38 mph	Whole trees in motion
39 – 54 mph	Twigs break off of trees, wind impedes walking
55 – 72 mph	Damage to chimneys and TV antennas, pushes over shallow rooted trees
73 – 112 mph	Peels surface off roofs, windows broken, trailer houses overturned
113+ mph	Roofs torn off houses, weak buildings and trailer houses destroyed, large trees uprooted

The National Weather Service

The Minnesota AHMP calculated an annual probability of 0.84 of a windstorm event causing \$54,167 worth of damages per event.⁴² This average damage per event is based on wind damages from 1950 through 2007. During that timeframe there were 48 reported incidences of damages from windstorms.

⁴² MN All Hazard Mitigation Plan. Accessed 9/11/13. Available: http://www.rrbdin.org/wp-content/uploads/2011/08/MN_state_mitigation_plan.pdf

Relationship to Other Hazards—Cascading Effects

- Numerous. A tornado or straight-line wind storm, can lead to total destruction of buildings and wide-scale casualties. There can be fires, disruptions to transportation infrastructure and other infrastructure, and potential public health emergencies. Catastrophic events such as these may also create the potential for civil unrest.
- Emergency Response. Emergency response times can also be affected by infrastructure being damaged. Cell phone towers and telephone lines can be downed delaying calls for help.

Previous Occurrences of the Hazard

There were 5 documented tornadoes in Murray County from January 2000 through April 2017. There were 29 thunderstorm wind events documented during this same time period. Straight-line winds are classified by NOAA as thunderstorm wind events. The tornadoes that took place between 2000 and 2017 are listed below. The thunderstorm wind events that recorded wind speeds of 60 kts and greater and listed in Figure #76.

Figure #75
Tornadoes – Murray County

Date	Mag.	Location	Event Narrative
05/16/2004	F0	1W Hadley	A tornado destroyed a 48 foot grain bin. The tornado also caused widespread tree damage, including several trees blown down.
06/11/2008	EF1	2SSW Wirock to ONE Wirock	A tornado, after crossing into Murray County from Nobles County, destroyed a garage and a barn, blew down a grain bin, damaged several sheds, and caused tree damage.
06/11/2008	EF1	2NW Lime Creek to 4N Lime Creek	A tornado blew the roof off a house, collapsed a wall in the house, and shifted the house off its foundation. A woman taking shelter in a closet was injured. On the same farmstead, the tornado also destroyed two sheds and caused minor damage to another house and two outbuildings. The tornado carried some debris from the farm over a mile. The tornado also caused extensive tree damage.
7/17/2010	EF0	5SSW Currant Lake	A brief tornado caused no reported damage.
6/5/2014	EF0	1SE Chandler	A brief tornado caused no reported damage.

National Climatic Data Center (NCDC) Storm Events database

Figure #76
Thunderstorm Wind Events – Murray County

Date	Mag.	Location	Event Narrative
06/12/2001	61 kts.	2E Slayton	Thunderstorm winds destroyed a granary building.
06/13/2001	74 kts.	1W Fulda	Thunderstorm winds lifted an anchored metal building and rolled it into a house.
04/16/2002	61 kts.	Slayton	Thunderstorm winds blew the roof off a building, damaged trees and road signs, and blew a semi-trailer on its side.
05/16/2004	61 kts.	7NE Dovray	Thunderstorm winds caused tree damage, including 8 inch diameter branches blown down. The winds also blew shingles off roofs, and blew the back door from a barn.
05/29/2004	61 kts.	6E Avoca	Thunderstorm winds destroyed a small building.
06/29/2005	61 kts.	4SW Chandler	Thunderstorm winds caused tree damage, including up to 8 inch diameter branches blown down.
08/03/2005	69 kts.	Avoca	Thunderstorm winds caused widespread tree damage, including several trees blown down. The winds also flattened corn fields. The amount of damage was not known.
07/17/2010	61 kts.	2NNW Currie	Thunderstorm winds caused widespread tree damage near Lake Shetek, including up to 3 foot diameter trees blown down. Several vehicles, a dock, and a trampoline near the lake were damaged by falling trees or tree debris. Falling trees trapped 4 people in a restaurant.
07/23/2010	72 kts.	1E Dovray	Thunderstorms produced damaging winds across several counties in southwest Minnesota during the late evening of July 23rd.
06/16/2014	70 kts.	3W Dovray	Thunderstorms produced numerous events of large hail, damaging winds, flash flooding, and areal flooding across most of southwest Minnesota during the afternoon and evening of June 16th. The areal flooding was a longer term event and persisted through much of June 18th.
09/24/2016	61 kts.	1E Currie	Thunderstorm winds caused tree damage and created huge waves on Lake Sarah.

National Climatic Data Center (NCDC) Storm Events database

Often the right conditions exist to produce a tornado, but a tornado will not be produced. Also, an unknown number of tornadoes are not reported because they do not touch down or cause any damages.

Straight-line winds can also cause property damage, but there is less risk of loss of life associated with straight-line winds. Tornadoes and straight-line winds can be most devastating to those living in mobile

homes, boats, or RVs. The 2015 American Community Survey identified 146 mobile home units in Murray County.⁴³

Windstorms and Climate Change

Lack of high-quality long-term data sets make assessment of changes in wind speeds very difficult (Kunkel, et al., Regional Climate Trends and Scenarios for the U.S. National Climate Assessment, 2013). One analysis generally found no evidence of significant changes in wind speed distribution. Other trends in severe storms, including the numbers of hurricanes and the intensity and frequency of tornadoes, hail, and damaging thunderstorm winds are uncertain. Since the impact of more frequent or intense storms can be larger than the impact of average temperature, climate scientists are actively researching the connections between climate change and severe storms (National Climate Assessment Development Advisory Committee, 2013).

Tornadoes and Climate Change

Tornadoes and other severe thunderstorm phenomena frequently cause as much annual property damage in the U.S. as do hurricanes, and often cause more deaths. Although recent research has yielded insights into the connections between global warming and the factors that cause tornados and severe thunderstorms, such as atmospheric instability and increases in wind speed with altitude (Del Genio, Yao, & Jonas, 2007), these relationships remain mostly unexplored, largely because of the challenges in observing thunderstorms and tornadoes and simulating them with computer models (National Climate Assessment Development Advisory Committee, 2013).

According to Harold Brooks of NOAA's National Severe Weather Laboratory, there is increasing variability in the "start" of tornado season. The number of days with more than 30 EF1 or greater tornadoes is increasing, while the number of days with at least 1 EF1 or greater tornadoes is decreasing. Thus, tornadoes are occurring on fewer days, but *more* are occurring on outbreak days.

Tornadoes have not been recorded in Minnesota in the winter months of December, January and February (MN DNR, 2014). However, the state of Wisconsin has recorded 3 tornadoes in January and 6 in December during the period of 1844-2013 (National Weather Service Weather Forecast Office, 2014) including a recent January tornado in 2008.

Vulnerability

Tornado and Straight-line Wind events are likely to take place in any year. Tornadoes are less common than straight-line wind events, but communities need to be prepared since loss of life is a risk associated with these two hazards.

Severe wind events can cause minor damage to structural failure and full-scale devastation. Residents and travelers must be warned of impending danger immediately before and during a tornado or severe straight-line wind event.

Plans and Programs

⁴³ FactFinder. Accessed 8/9/17. Available: <http://factfinder.census.gov>

- Severe Weather Spotter Network – The severe storm spotter network, sponsored by the National Weather Services (NWS), enlists the help of trained volunteers to spot severe storm conditions and report this information to the NWS. No tornado warnings are given unless the storm has been spotted by someone or is confirmed by NWS radar reports. Murray County annually trains severe weather spotters who report directly to the NWS when severe weather is observed.
- Severe Weather Shelters – The Minnesota State Zoning Ordinance regarding severe weather shelters has been adopted by Murray County. This ordinance requires on-site shelter for mobile home park residents or provides information on evacuation routes to safe shelters elsewhere.
- Campgrounds: Valhalla Mobile Home Park is located on Valhalla Island - Lake Shetek and has a storm shelter. Other campgrounds (including children's summer camps) do not have storm shelters.
- NOAA Weather Radio – NWR broadcasts official warnings, watches, forecasts, and other hazard information 24 hours a day, seven days a week. The nationwide network of radio stations broadcast continuous weather information from the nearest National Weather Service office. The NWR is your primary source of comprehensive weather and emergency information regarding all hazards.
- Outdoor warning sirens – Outdoor warning sirens offer last minute warnings to take shelter. The primary purpose of the outdoor warning siren is to alert people *who are outside* to severe weather, chemical hazard, or other emergency. If you hear an outdoor warning siren you should seek shelter immediately. All cities in Murray County as well as The Lakes CDP have good coverage by emergency sirens that can be activated to warn residents in the event of a severe weather event or other emergency. All of the sirens in Murray County have been converted to narrow band frequency.
- Minnesota State Parks and Trails Severe Weather Policy –Minnesota State Parks have a severe weather policy to help inform visitors on how to respond during severe weather events. Lake Shetek State Park is covered by the Keeley Island siren. State park, state recreation area and forest recreation area visitors are ultimately responsible for their own safety during severe weather.
- Text Alert – Murray County and Fulda Schools have a text alert system for emergencies and school closings.
- Tornado drills – Murray County Central Public Schools and Fulda Public Schools participate in severe weather awareness week. The schools have a plan in place for tornadoes and other severe weather events.
- Emergency shelters – Local units of government in Murray County provide emergency shelters.

Figure #77
Outdoor Warning Sirens – Murray County

Cities	Number	Have backup battery
Avoca	1	Yes
Chandler	1	Yes
Currie	1	Yes
Dovray	1	Yes
Fulda	1	Yes
Hadley	1	Yes
Iona	1	Yes
Lake Wilson	1	Yes
Slayton	1	Yes
The Lakes CDP	3	No
County Parks	0	-

Figure #78
Outdoor Warning Sirens – Avoca

AVOCA SIREN COVERAGE

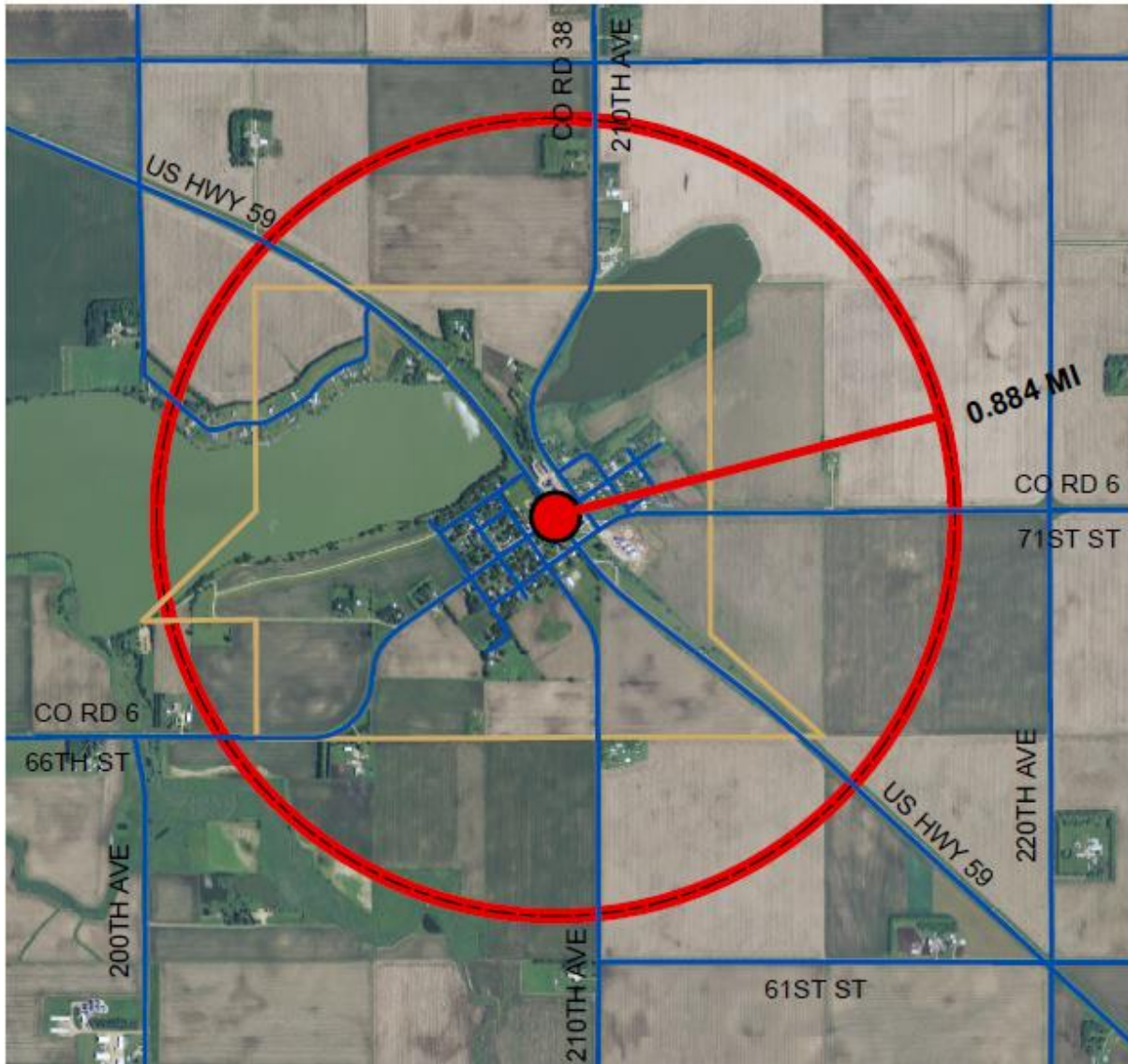


Figure #79
Outdoor Warning Sirens – Chandler

CHANDLER SIREN COVERAGE

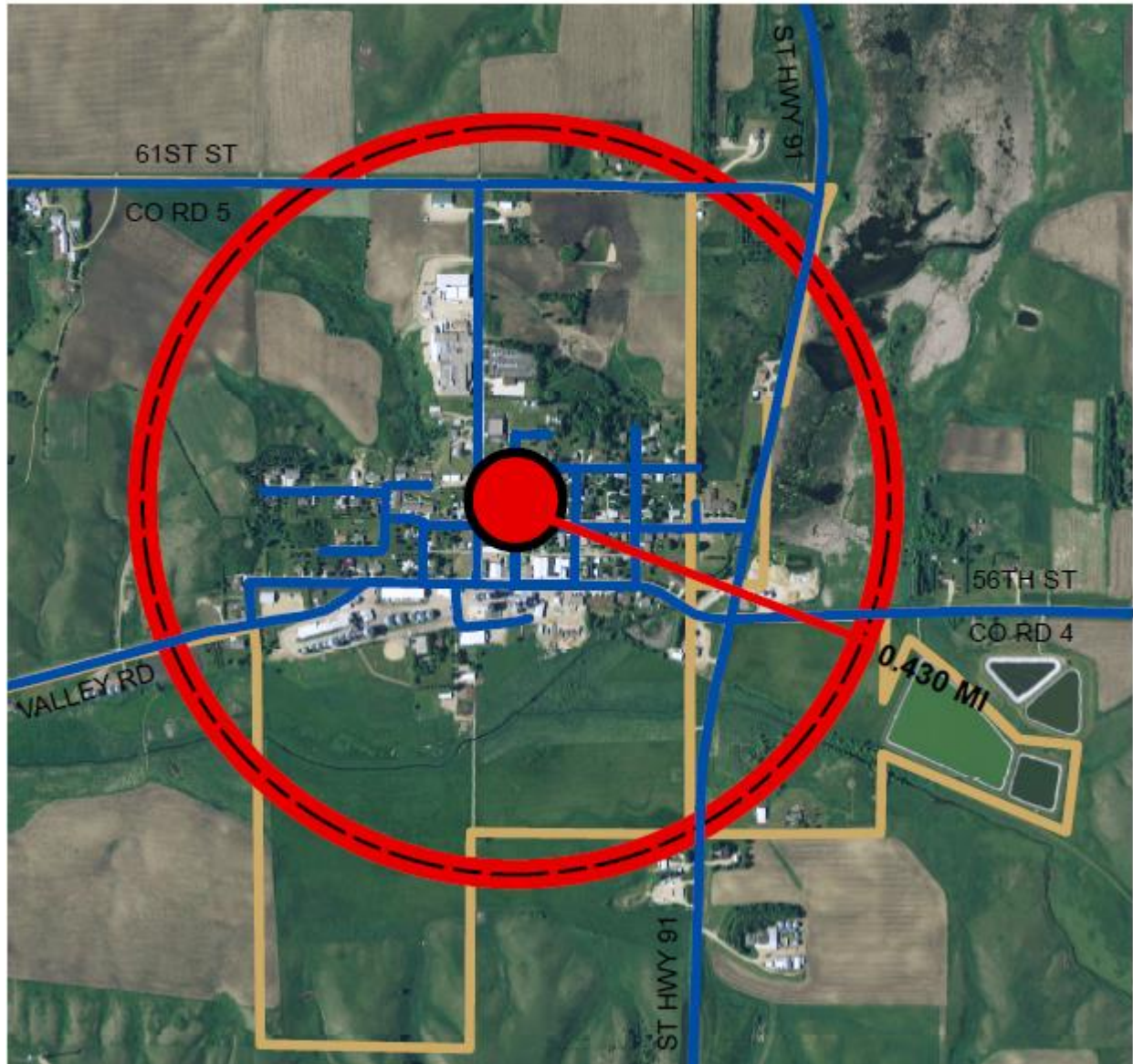


Figure #80
Outdoor Warning Sirens – Currie

CURRIE SIREN COVERAGE



Figure #81
Outdoor Warning Sirens – Dovray

DOVRAY SIREN COVERAGE

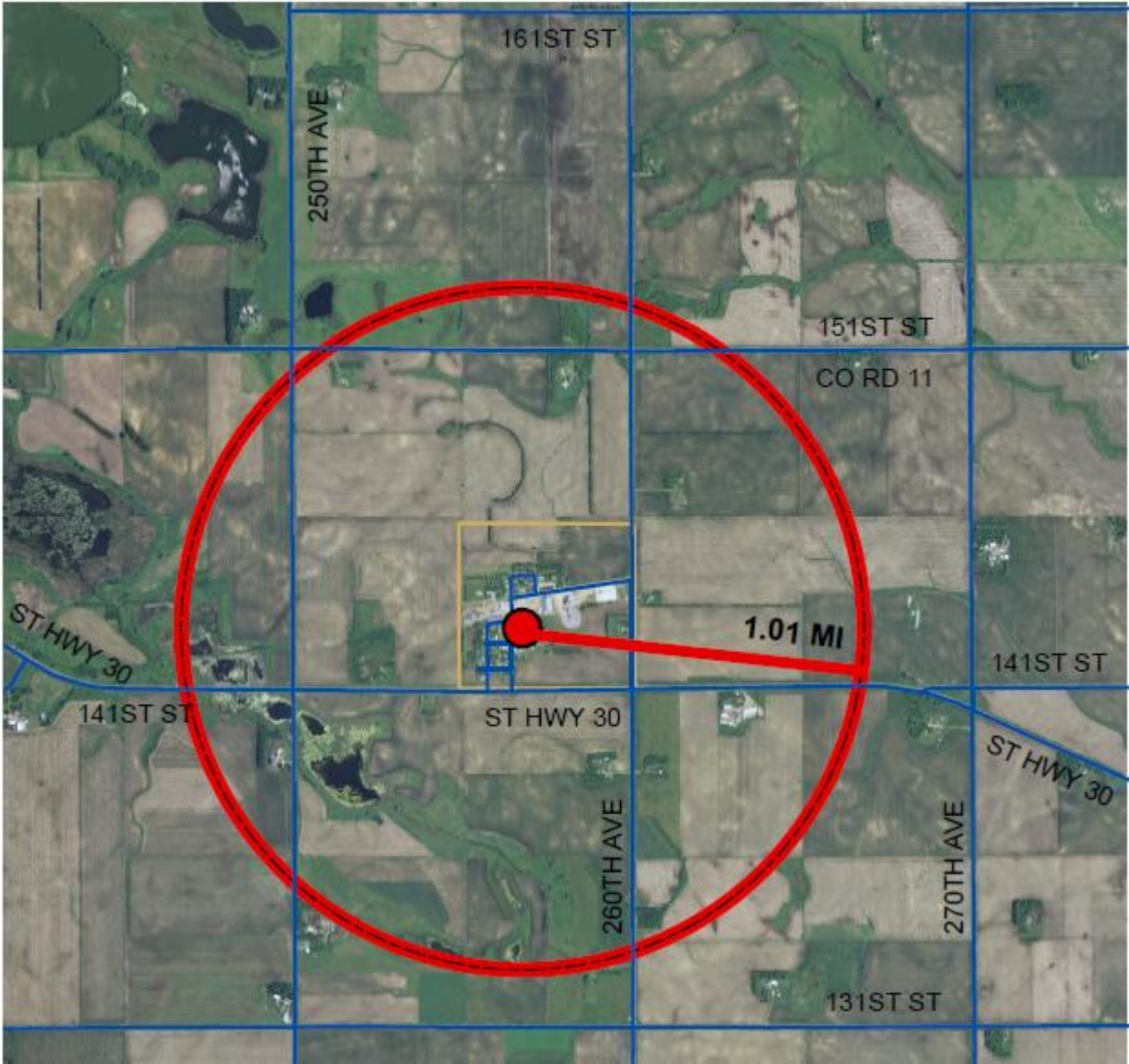


Figure #82
Outdoor Warning Sirens – Fulda

FULDA SIREN COVERAGE



Figure #83
Outdoor Warning Sirens – Hadley

HADLEY SIREN COVERAGE

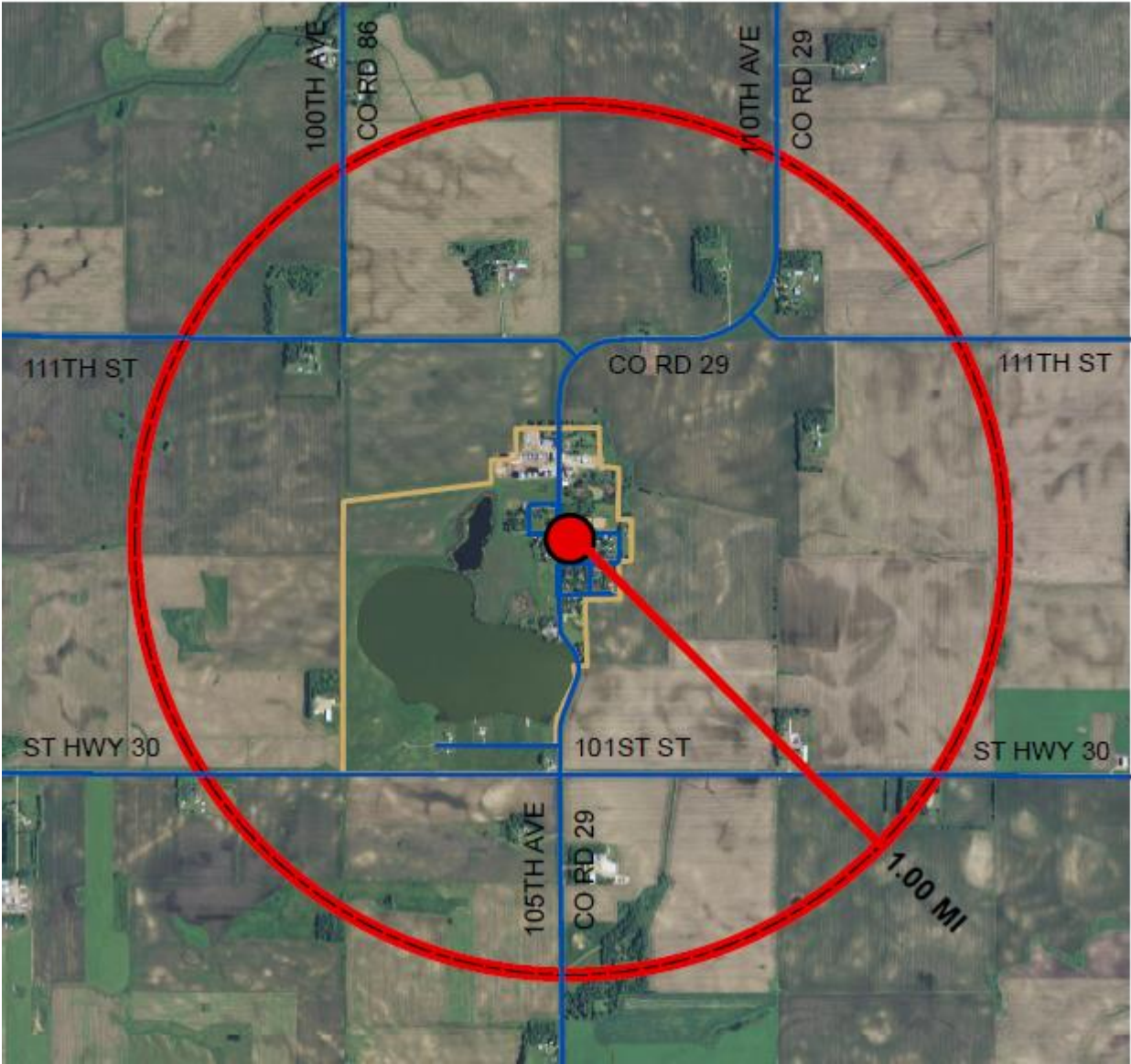


Figure #84
Outdoor Warning Sirens – Iona

IONA SIREN COVERAGE

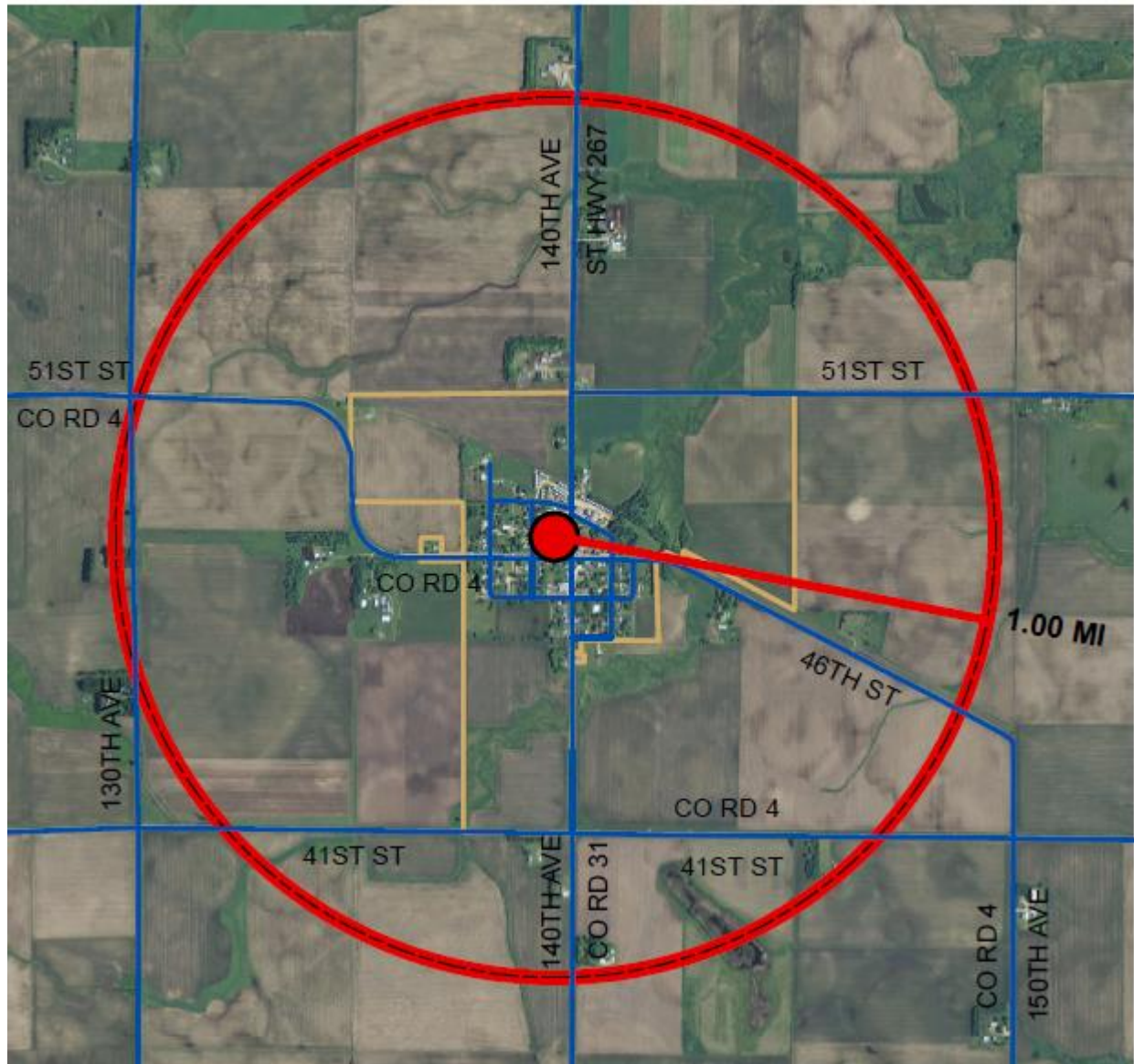


Figure #85
Outdoor Warning Sirens – Lake Wilson

LAKE WILSON SIREN COVERAGE

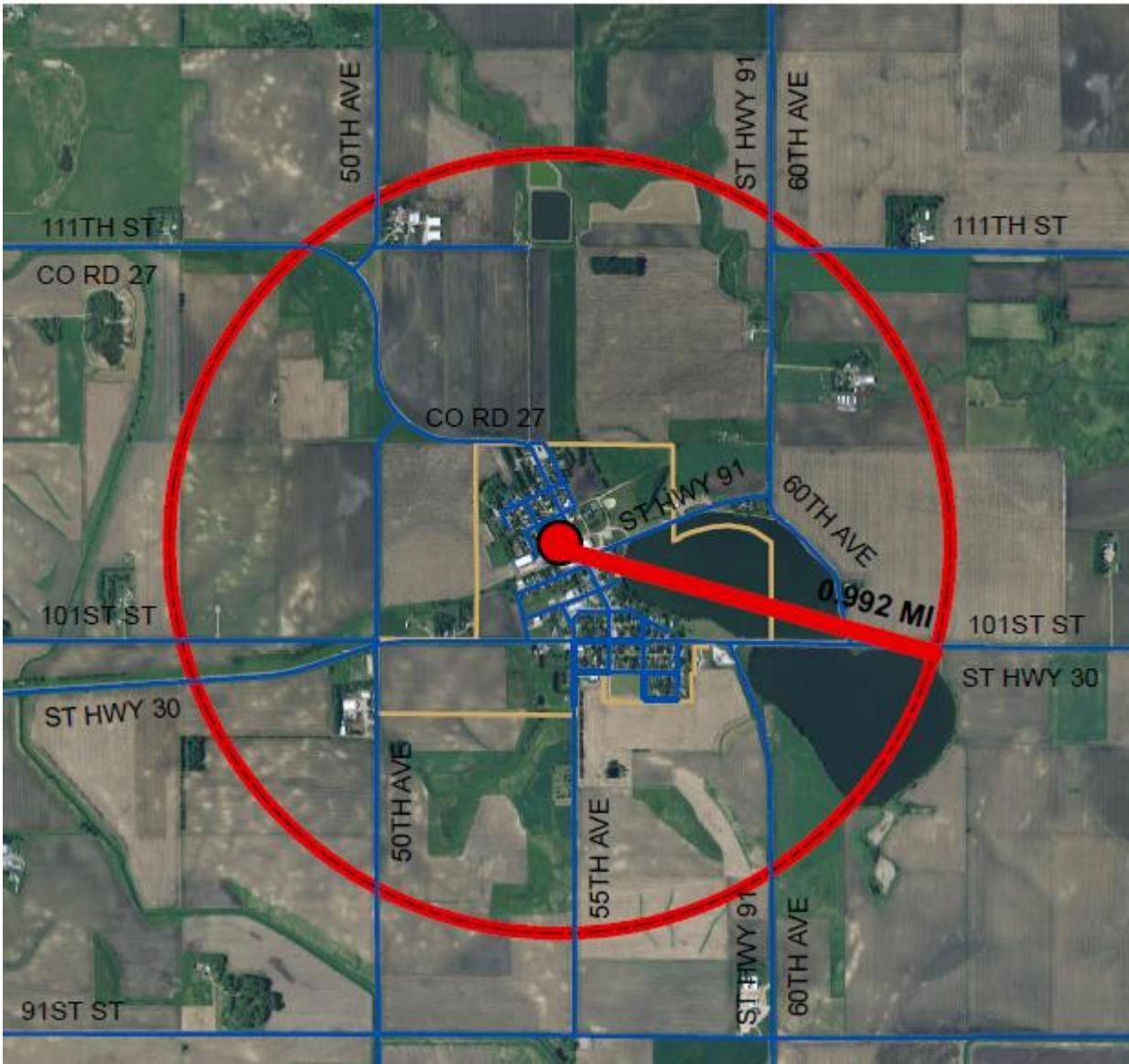


Figure #86
Outdoor Warning Sirens – Slayton

SLAYTON SIREN COVERAGE

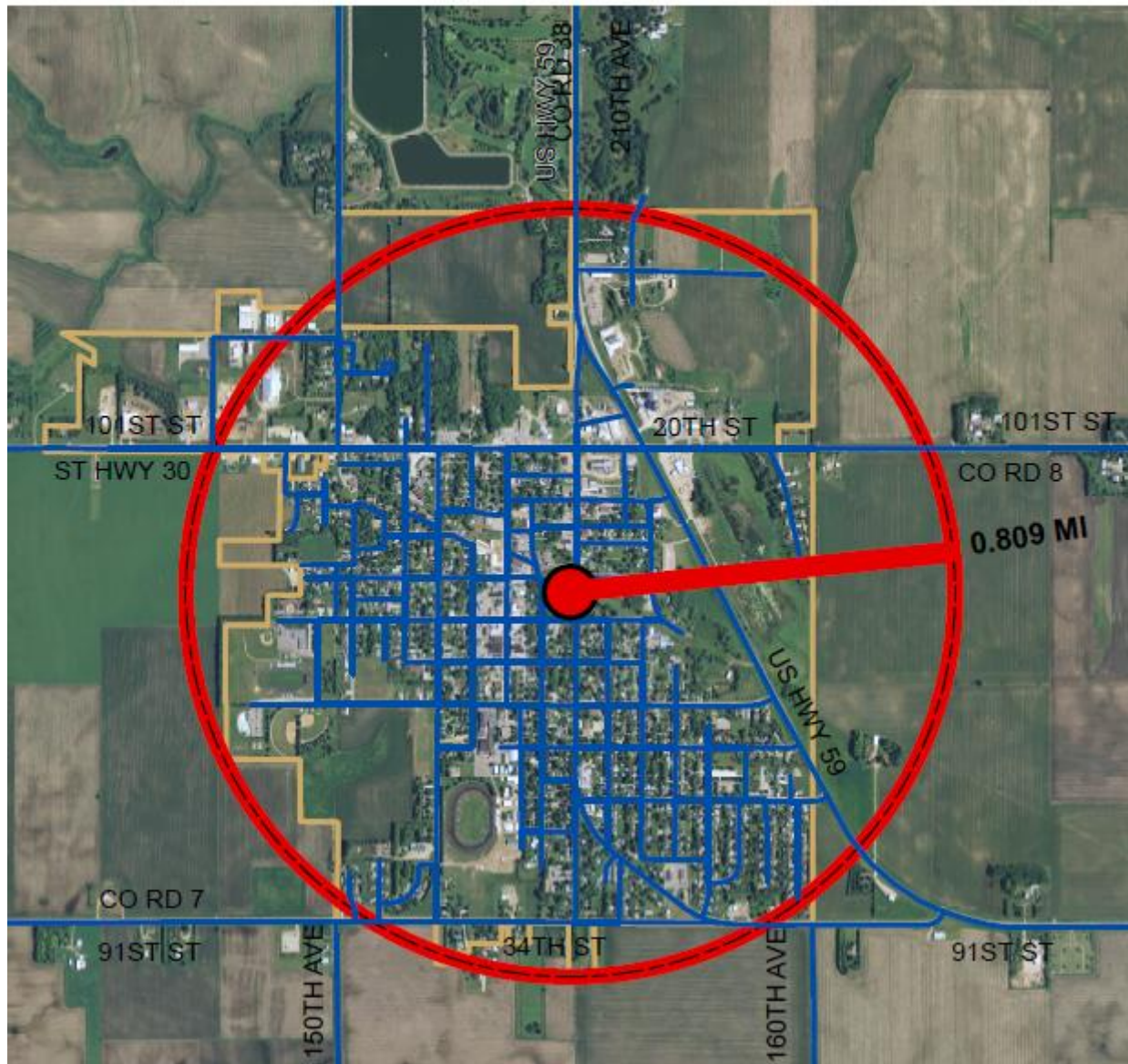
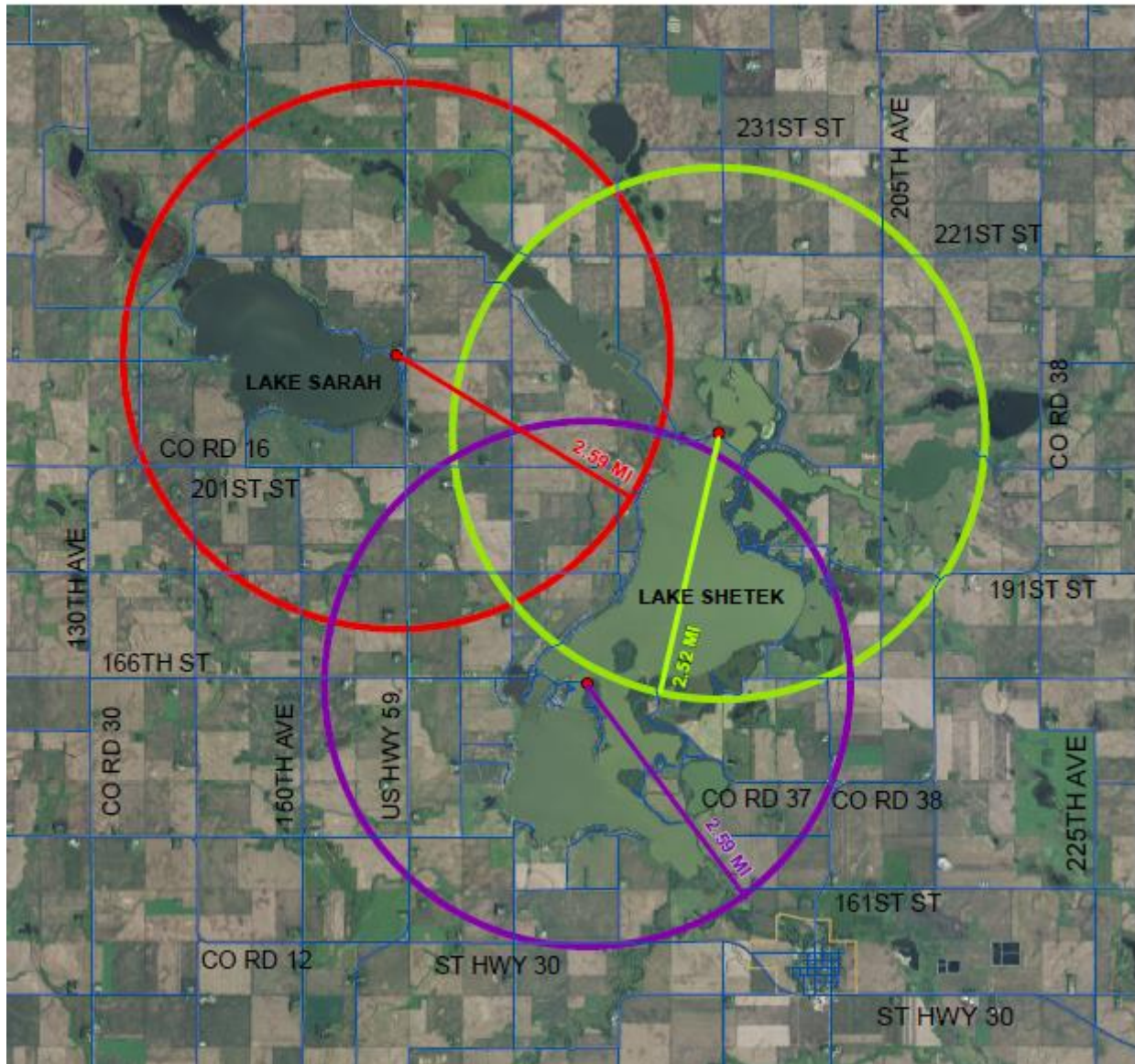


Figure #87
Outdoor Warning Sirens – Lake Shetek & Lake Sarah Area

LAKES AREA SIREN COVERAGE



Gaps and Deficiencies

- Emergency shelters in nursing homes and assisted living facilities – None
- Emergency shelters in mobile home parks – Only Valhalla Mobile Home Park in The Lakes CDP has an emergency shelter. All others are still in need.
- Warning siren range – The effective range of warning sirens is limited. Rural areas are outside the range of the severe weather warning system areas.
- Local radio and television warnings – Local radio and television stations do provide warnings, but they are effective only if tuned to the local channel. Satellite and internet based mediums are widely used, so local emergency broadcasts are limited. Language barriers can also be an issue regarding severe weather warnings.
- Tornado preparedness training – Training should be given to educate residents as to where to go in their own homes during a tornado.
- Countywide basement study – A small number of homes in the county lack basements that would provide shelter in the event of a tornado or damaging winds from a severe thunderstorm. The county needs to better assess how many actual homes do not have basements, and then develop a plan to provide shelter to those residents.
- Emergency shelter and safe rooms – Not all parks in Murray County have emergency shelters. There are no safe rooms in Murray County. Funding is an obstacle for the construction of safe rooms.
- Warning sirens in county parks – None of the county parks in Murray County have a warning siren.
- Warning siren backup batteries – Not all sirens are equipped with a backup battery. If the power goes off as a result of the storm, the siren is useless if it does not have a backup generator. See Table Figure #77 for warning sirens in Murray County that do and do not have backup batteries (backup power generation).
- Diversity and language barriers – There are a number of ethnicities and languages spoken in Murray County. This makes it difficult to send out emergency broadcast. Having to translate emergency broadcasts into multiple languages takes time and money.

Figure #88
Emergency Shelters & Safe Rooms – Murray County

Cities	Emergency Shelter	Safe Room
Avoca	N/A	N/A
Chandler	N/A	N/A
Currie	N/A	N/A
Dovray	N/A	N/A
Fulda	N/A	Fulda Elementary School
Hadley	N/A	Community Center
Iona	N/A	N/A
Lake Wilson	N/A	N/A
Slayton	N/A	N/A
The Lakes CDP	N/A	Valhalla mobile home park

- The warning siren in Avoca goes off twice a day (12:00 PM and 6:00 PM) every day. If severe weather occurs around these times, residents may ignore the siren thinking it is just the routine siren. Non-residents, who are not familiar with the routine sounding of the siren, on the other hand, may be falsely alarmed by the routine sounding of the siren.

5.4.6 Extreme Cold

Minnesota experiences winter weather from mid-autumn through the winter season into spring. Extreme cold can immobilize large regions at the same time. All types of winter storms can be accompanied by extreme cold—both absolute temperatures and wind chill.

Locations Affected by the Hazard

All locations in Murray County are equally likely to be exposed to this hazard. Rural areas are more likely to be severely impacted by the hazard. Rural homes and farms face the threat of isolation and utility failure during winter storms.

Given the rural nature of Murray County, residents of smaller communities may face similar isolation issues as rural residents. City residents are also at risk. Attempting to travel between communities would expose city dwellers to higher levels of risk corresponding with their rural counterparts.

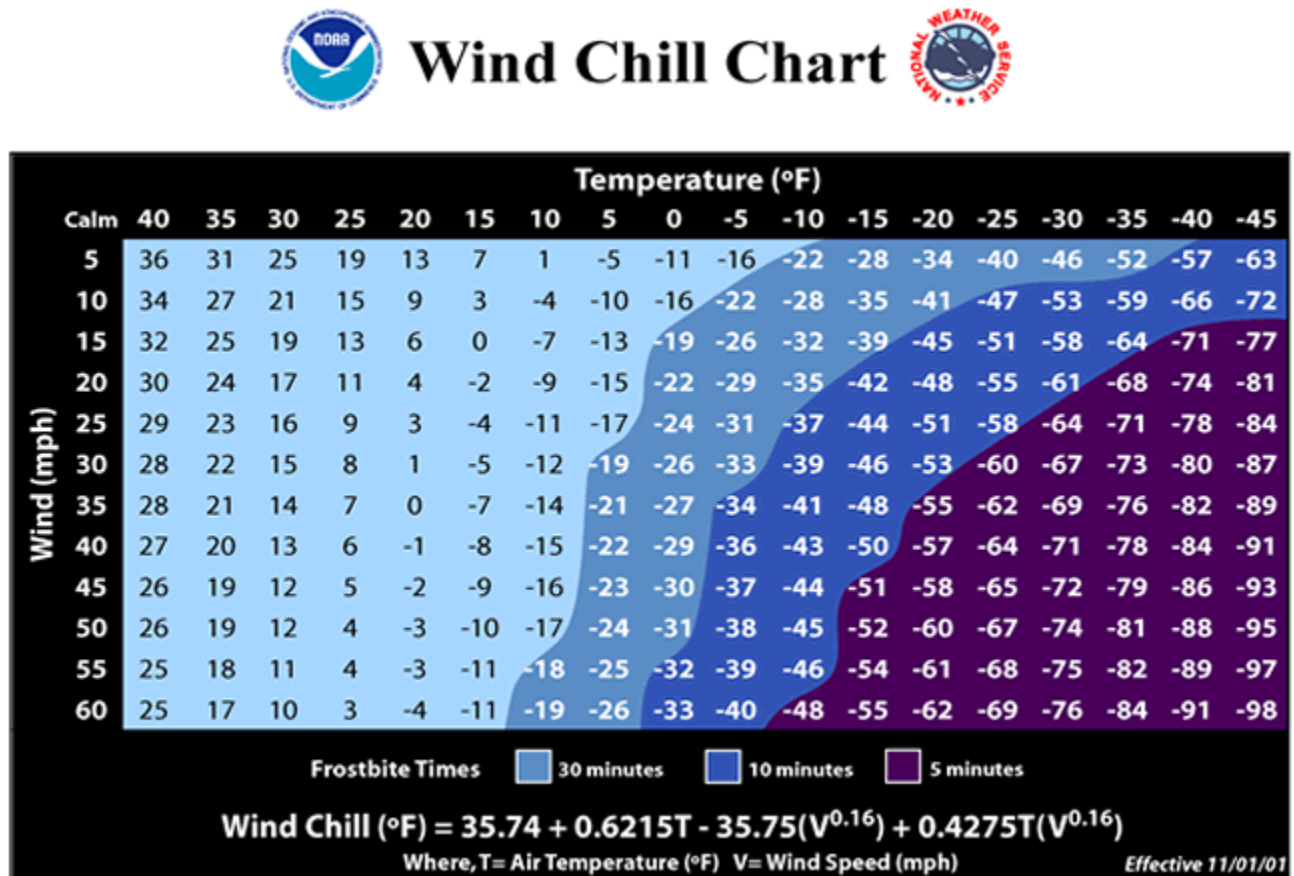
Extent of the Hazard

Extreme cold events are when temperatures lead to direct dangers to people and animals. Infants and the elderly are most susceptible to prolonged exposure to the cold. Wind and cold weather can combine to cause wind chill temperatures as low as 70 degrees below zero.⁴⁴ Prolonged exposure can cause frostbite or hypothermia and can be life-threatening.

Below freezing temperatures can also damage vegetation and cause pipes to freeze and burst inside homes. More deaths are attributed to winter storms than to extreme cold weather events, but some populations are at more risk than others. The best advice is to stay inside. Over half of winter-weather deaths occurred in a vehicle, and 30 percent occurred outdoors.

⁴⁴ National Oceanic and Atmospheric Administration. Accessed 8/9/17. Available: http://www.nws.noaa.gov/om/cold/wind_chill.shtml

Figure #89
Wind Chill Table



Relationship to Other Hazards—Cascading Effects

- **Transportation Crashes.** Winter storms often lead to hazardous conditions for transportation infrastructure. Icy roads can make travel difficult. Poor driving conditions and poorly designed transportation infrastructure can contribute to motor vehicle crashes.
- **Wildfire.** Extreme cold directly impacts firefighting, making fire suppression more difficult and increasing the likelihood of equipment damage.
- **Public Health.** Frozen septic systems can lead to the release of increased levels of untreated wastewater into the environment.
- **Public Safety.** Anyone exposed to extremely cold temperatures can develop frostbite and hypothermia. The elderly, children and those who engage in outdoor work or recreation may be most susceptible to the danger of extremely cold temperatures.

Previous Occurrences of the Hazard

From January 2000 through April 2017, there have been 10 documented extreme cold events in Murray County. In the table below are extreme cold events that occurred from January 2014 through April 2017.

Figure #90
Extreme Cold Events – Murray County

Date	Location(s)	Event Narrative
01/14/2009	Jackson, Nobles, Rock, Lincoln, Murray, Pipestone, Lyon, Cottonwood	Moderate to strong northwest winds and very cold air combined to lower wind chills to 35 to 45 below zero at times. The coldest winds chills were during the morning of January 14th with strong winds, and the night of January 14th to daybreak of January 15th when temperatures were falling and winds were slowly decreasing. The actual temperature dropped to 24 below zero at Slayton on the morning of January 15th after the wind had subsided.
01/07/2010	Jackson, Nobles, Rock, Lincoln, Murray, Pipestone, Lyon, Cottonwood	Persistent north to northwest winds combined with very cold air to produce wind chill values the frequently dropped to 35 below zero or a little colder. These extremely dangerous wind chills added to the hazards produced by the preceding winter storm. As winds slowly subsided during the night of January 7th, temperatures continued to drop to well below zero, keeping the wind chills at the very dangerous level through the morning of January 8th.
02/01/2011	Jackson, Nobles, Rock, Lincoln, Murray, Pipestone, Lyon, Cottonwood	North to northwest winds averaging 15 to 30 mph combined with temperatures dropping below zero to produce wind chills of 20 to 35 below zero on February 1st. On the night of February 1st and the early morning of February 2nd, wind chills reached the 35 to 40 below zero range at times despite slowly decreasing winds, as temperatures fell further below zero.
01/20/2013	Jackson, Nobles, Rock, Lincoln, Murray, Pipestone, Lyon, Cottonwood	Northwest winds 15 to 30 mph combined with temperatures well below zero to lower wind chills to 35 to 40 degrees below zero.
12/23/2013	Jackson, Nobles, Rock, Lincoln, Murray, Pipestone, Lyon, Cottonwood	Temperatures of 15 to 28 below zero and winds reaching 10 to 15 mph at times combined to produce wind chills of 35 to 45 below zero.
1/23/2014	Jackson, Nobles, Rock, Lincoln, Murray, Pipestone, Lyon, Cottonwood	Temperatures reaching double digits below zero and northwest winds of 10 to 15 mph combined to produce wind chill readings of 35 to 40 below zero in southwest Minnesota.
2/27/2014	Jackson, Nobles, Lincoln, Murray, Lyon, Cottonwood	Temperatures dropping to double digits below zero, combined with winds of 10 to 20 mph, produced wind chill readings around 35 below zero for several hours ending a little after sunrise on February 27th.
3/2/2014	Jackson, Nobles, Rock, Lincoln, Murray, Pipestone, Lyon, Cottonwood	Temperatures dropping to around 15 below zero, combined with northwest winds of 5 to 15 mph, produced wind chill readings around 35 below zero for several hours ending a little after sunrise on March 2nd.

01/16/2016	Lyon, Pipestone, Lincoln, Murray, Nobles, Jackson, Cottonwood, Rock	Wind chills dropped to the 35 to 45 below zero range for much of the night and morning hours on January 16-17. Northwest winds gusted to around 20 mph early in the event, but generally averaged 10 to 15 mph when the coldest wind chills were reached, during which time actual temperatures were 15 to 20 degrees below zero.
12/17/2016	Jackson, Nobles, Rock, Lincoln, Murray, Pipestone, Lyon, Cottonwood	Strong northwest winds on December 17th, decreasing to around 10 mph during the night of the 17th, combined with falling temperatures to lower wind chill readings to 40 to 55 below zero. Actual temperatures dropped to colder than 20 below zero, including a record 26 below zero at Lake Wilson.

- National Climatic Data Center (NCDC) Storm Events database

Extreme Cold and Climate Change

There is not yet any observable trend related to extreme cold events and climate change in Minnesota. Cold temperatures have always been a part of Minnesota's climate and extreme cold events will continue. However, an increase in extreme precipitation or storm events such as ice storms as the climate changes could lead to a higher risk of residents being exposed to cold temperatures during power outages or other storm-related hazards during extreme cold.

Probability of Future Events of this Hazard & Vulnerability

Extreme cold temperatures affect the county nearly every year. The amount of snow and ice, number of blizzard conditions, and days of sub-zero temperatures each year are unpredictable.

Citizens living in climates such as these must always be prepared for situations that put their lives or property at risk. It is not always the depth of the cold, but an unprepared individual with a vehicle breakdown or unmaintained garage that are at risk. Rural citizens not connected to city gas lines are more vulnerable to issues with extreme cold. The vulnerability of each jurisdiction to extreme cold has not changed due to any development in the last five years.

Plans and Programs

- Travel Assistance – "511 is a public service of the Minnesota Department of Transportation (MnDOT) to help traveler's access information about road conditions, traffic incidents, commercial vehicle restrictions, and weather information via the phone or the Web, 24 hours a day, seven days a week."⁴⁵
- Regional Forecasts – Murray County is in the Sioux Falls broadcasting region. Weather forecasts in the Sioux Falls region tend to be a good predictor of weather in Murray County. Murray County uses this information in regards to school closures and other weather related announcements.
- School closings – Murray County's school districts have a policy of closing schools when wind chills exceed certain thresholds, low visibilities create unsafe driving conditions, or when heavy snow has fallen making travel difficult. Local radio stations partner with the school districts to make sure the announcements are out by 6:00 am or earlier if possible.
- Wind chill warnings – The local radio and television media partner with the National Weather Service to issue a wind chill warning when temperatures are -30 degrees Fahrenheit or lower. Severe wind chill warnings are provided when conditions warrant and when safety is a factor. Wind chills of -40

⁴⁵ MnDOT. 511. Accessed: 12-2-14. Available: <http://hb.511mn.org/About.html>

degrees Fahrenheit or lower frequently prompt the closing of schools to protect children, particularly in rural areas.

- Emergency generators – Emergency generators help keep emergency services available during winter storms. Refer to Figure #62 for public entities with emergency generators in Murray County.

Gaps and Deficiencies

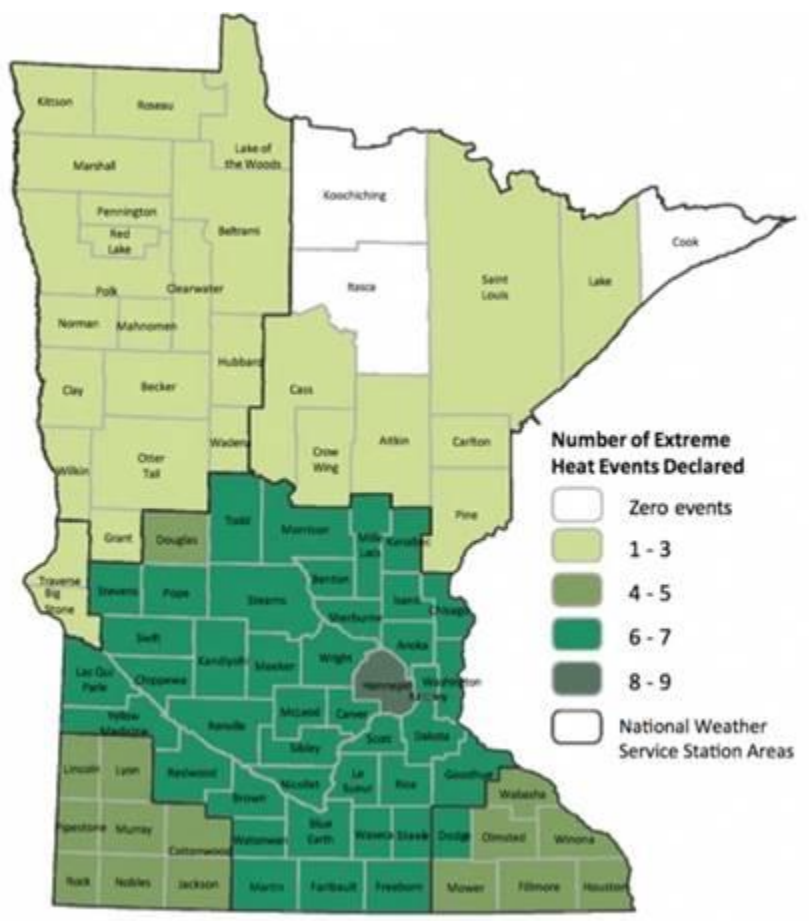
- Automated weather stations at schools – Automated weather stations at schools throughout Murray County would provide more current information and quicker response to dangerous and changing weather conditions.
- 511 System – The 511 system does not incorporate local knowledge as well as it could. County staff has little involvement in providing updates to the 511 system. Including snowplow drivers and other county staff could help to improve the accuracy of the system. County staff has local knowledge regarding the road network and can provide accurate information into the system.
- Road Closures Coordination – MnDOT closes state highways and does not talk to local emergency managers. There needs to be a direct line of communications between MnDOT and local emergency managers. This is an issue for emergency response and mass sheltering.
- Language barriers – Language barriers can be an issue regarding severe weather warnings. There are a number of languages spoken in Murray County. This makes it difficult to send out emergency broadcast. Having to translate emergency broadcasts into multiple languages takes time and money.
- No listing of cell phone numbers in the event of needing to check on people.

5.4.7 Extreme Heat

During the spring, summer and autumn excessive heat can occur. Excessive heat temperatures and temperature change is one of the variables that impact summer storms.

Extreme heat helps to contribute to the magnitude of a thunderstorm and often accompanies severe summer storms. The combination of high temperatures and exceptionally humid conditions can lead to overheating, heat stress, and a severe strain on the system. Heat stress can lead to heat cramps, heat exhaustion, heatstroke, and even death. According to the Centers for Disease Control and Prevention (CDC), more than 300 Americans die annually from excessive heat exposure from 1979-2003. Extreme heat events, or heat waves, are a leading cause of extreme weather-related deaths in the United States. The number of heat-related deaths is rising.⁴⁶

Figure #91
Number of Extreme Heat Events by County 1995-2012



Locations and Extent of the Hazard

⁴⁶ Centers for Disease Control and Prevention (CDC). Accessed 8/10/17. Available: <https://ephtracking.cdc.gov/showClimateChangeExtremeHeat.action>

All locations in Murray County are at risk to be affected by this hazard. Severe summer storms and extreme heat events will be more widespread. These weather events can generate lightning and hail that tend to be more isolated.

Previous Occurrences of the Hazard

Extreme heat events are documented as a separate event by NOAA. There were 6 documented extreme heat events in Murray County from January 2000 through April 2017. Excessive heat occurs from a combination of high temperatures and high humidity index. From 1979 to 2003, more people in the U.S. died from extreme heat than from hurricanes, lightning, tornadoes, floods, and earthquakes combined.⁴⁷

NOAA Definitions

Excessive Heat Outlook

A combination of temperature and humidity over a certain number of days are designed to provide an indication of areas of the country where people and animals may need to take precautions against the heat during the months of May through November.

Excessive Heat Warning

Issued within 12 hours of the onset of the following criteria: heat index of at least 105°F for more than 3 hours per day for 2 consecutive days, or heat index more than 115°F for any period of time.

Excessive Heat Watch

Issued by the National Weather Service when heat indices are in excess of 105°F (41°C) during the day combined with nighttime low temperatures of 80°F (27°C) or higher are forecast to occur for two consecutive days.

Relationship to other Hazards

- *Drought and Wildfire* - Dry, hot conditions can reduce the protective moisture of woodlands and increase the risk of wildfire.
- *Public Safety* - Anyone exposed to extreme heat can develop heat exhaustion and heat stroke. The elderly, children and those who engage in outdoor work or recreation may be most susceptible to the danger of extreme heat.
- *Agricultural Disease* - Extreme Heat can have a major effect on the county's crops and livestock. During prolonged heat events, crops grow weak and are more susceptible to plant pests and diseases. In times of extreme heat, it is important that confinement buildings are properly ventilated and outside livestock are provided with places to get into the shade. Heat stroke can pose a serious threat to livestock.

Extreme Heat and Climate Change

Minnesota's average temperature has increased more than 1.5°F since recordkeeping began in 1895, with increased warming happening in recent decades (International Climate Adaptation Team, 2013). Annual temperatures in the Midwest have generally been well above the 1901-1960 average since the late 1990s, with the decade of the 2000s being the warmest on record (Kunkel, et al., Regional Climate Trends and

⁴⁷ Minnesota Department of Health. Assessed: 11/24/15. Available:
http://www.health.state.mn.us/divs/climatechange/docs/toolkit_chapter1.pdf

Scenarios for the U.S. National Climate Assessment, 2013). 7 of Minnesota's 10 warmest years occurred in the last 15 years. Projected increases are 2°F to 6°F more by 2050 and 5°F to 10°F by 2100 (MN Environmental Quality Board, 2014). The Midwest has experienced major heat waves and their frequency has increased over the last 6 decades (Perera, et al., 2012). For the U.S., mortality increases 4% during heat waves compared with non-heat wave days (Anderson & Bell, 2011). During July 2011, 132 million people across the U.S. were under a heat alert – and on July 20 the majority of the Midwest experienced temperatures in excess of 100°F. Heat stress is projected to increase as a result of climbing summer temperatures and humidity (Schoof, 2012). On July 19, 2011, Moorhead Minnesota set a new state record for the hottest heat index ever, at 134°F. That same day, Moorhead also recorded a new state record for the highest dew point at 88. It was the hottest, most humid spot on the planet that day (Douglas, 2011)

Figure #92
Excessive Heat – Murray County

Date	Location	Event Narrative
7/15/2011	Jackson, Nobles, Rock, Lincoln, Murray, Pipestone, Lyon Cottonwood	An extended period of excessive heat produced daytime temperatures reaching the 90s and dew points in the 70s to lower 80s, with heat indices often reaching or exceeding 115 degrees. Nighttime temperatures often in the mid-70s to lower 80s with continued high humidity provided little if any relief. The heat and humidity caused prolonged stress on people and livestock. At least 15 livestock deaths were reported in the county.
6/27/2012	Jackson, Nobles, Rock, Lincoln, Murray, Pipestone, Lyon, Cottonwood	Temperatures reaching the 90s and high humidity with dew points in the 70s caused excessive heat, with the heat index peaking between 100 and 105 degrees.
7/2/2012	Rock, Pipestone, Nobles, Cottonwood, Lyon, Lincoln, Jackson, Murray	Temperatures reaching the 90s to just above 100, and high humidity with dew points in the 70s, caused an extended period of excessive heat. The heat index peaked at 100 to 110 degrees each day, and did not fall enough at night to provide much relief to indoor locations that were not otherwise cooled.
7/16/2012	Rock, Pipestone, Nobles, Cottonwood, Lyon, Lincoln, Jackson, Murray	Temperatures reaching the 90s, and high humidity with dew points in the 70s, caused excessive heat. The heat index peaked at 100 to 105 degrees.
6/10/2016	Rock, Nobles, Jackson, Cottonwood, Murray, Lincoln, Lyon, Pipestone	Temperatures reaching daytime highs in the mid to upper 90s after a period of cool weather were accompanied by humid conditions, with the heat index rising to 100 degrees or a little hotter. An unknown number of people suffered from heat stress, heat exhaustion, or dehydration, as reported by hospital emergency rooms.

7/20/2016	Jackson, Nobles, Rock, Lincoln, Murray, Pipestone, Lyon, Cottonwood	Temperatures reaching daytime highs in the 90s were accompanied by very humid conditions, with the heat index rising to 100 to 110 degrees. An unknown number of people suffered from heat stress, heat exhaustion, or dehydration, as reported by hospital emergency rooms.
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National Climatic Data Center (NCDC) Storm Events database

Increasing temperatures impacts Minnesota's agricultural industry. Agriculture is highly dependent on specific climate conditions. As a result of increasing temperature, crop production areas may shift to new regions of the state where the temperature range for growth and yield of those crops is optimal. According to the National Climate Assessment, the Midwest growing season has lengthened by almost 2 weeks since 1950 due in large part to earlier timing of the last spring freeze. This trend is expected to continue. While a longer growing season may increase total crop production, other climate changes, such as increased crop losses and soil erosion from more frequent and intense storms, and increases in pests and invasive species, could outweigh this benefit. There may also be higher livestock losses during periods of extreme heat and humidity. Losses of livestock from extreme heat lead to a challenge in disposal of animal carcasses. Currently there are only 2 rendering facilities in Minnesota available for livestock disposal. If a rendering facility is not available, lost livestock must be composted on an impervious surface. If losses are high, finding an impervious surface large enough is a challenge. In an attempt to adapt to increased temperatures, livestock areas in Minnesota may shift farther north. As a result of new livestock areas and the resulting manure production, farmers may transition to manure-based fertilizer applications in areas where traditionally only commercial fertilizers have been used, with accompanying environmental advantages and disadvantages (Adapting to Climate Change in Minnesota: 2013 Report of the Interagency Climate Adaptation Team, 2013).

Vulnerability

Severe summer storms are highly likely to take place every year, including excessive heat, lightning, and hail.

People do not always recognize their limitations. Summer heat can pose a serious risk to all populations, especially the young and elderly population. Informing the public about extreme heat events and other summer storms is important in preventing accidents.

Plans and Programs

- Heat advisories – The local radio and television media are in contact with the National Weather Service to issue a heat advisory when the combination of temperature and humidity create risks for people and animals. A heat index of 105 to 114 warrants a heat advisory. This occurs when air temperature reaches 95 degrees and the relative humidity is 50 percent. An excessive heat warning is issued when the heat index reaches 115. This occurs with an air temperature of 95 degrees and relative humidity of 60 percent. A heat index of 115 or higher puts both humans and animals at risk.
- Emergency alert system – Murray County has the CodeRED emergency notification system. CodeRED allows emergency officials to notify residents and businesses by telephone, cell phone, text message, email and social media regarding time-sensitive general and emergency notifications.

- Weather Ready Nation Ambassador – Murray County is a Weather Ready Nation Ambassador. “The Weather-Ready Nation Ambassador™ initiative is the National Oceanic and Atmospheric Administration’s (NOAA) effort to formally recognize NOAA partners who are improving the nation’s readiness, responsiveness, and overall resilience against extreme weather, water, and climate events. As a WRN Ambassador, partners commit to working with NOAA and other Ambassadors to strengthen national resilience against extreme weather.”⁴⁸
- Local media – Severe weather warnings are broadcasted via local media. Public service announcements are one of the ways to warn the public of severe weather.
- Severe weather spotter training – an annual training is provided at Murray County Central High School in Murray County. The National Weather Service (Sioux Falls) conducts the training.

Gaps and Deficiencies

- Public education – The public may not be aware of the real risks associated with heat exhaustion, extreme heat events, and other severe summer storms.
- No listing of cell phone numbers in the event of needing to check on people.

⁴⁸ NOAA. Weather Ready Nation Ambassadors. Accessed: 3/24/16. Available: <http://www.nws.noaa.gov/com/weatherreadynation/ambassadors.html>

5.4.8 Drought

Drought is defined as a prolonged period of dry weather with very little or no precipitation. There are four types of drought: meteorological drought (departure from average), hydrological drought (shortfall of stream flows or groundwater), agricultural drought (soil moisture deficiencies), and socioeconomic or water management drought. Droughts can have lasting effects and can cause a serious depletion of surface and ground waters.

Locations Affected by the Hazard

The entire county is equally at risk for drought; however, areas within the county may react differently to drought conditions. Areas with well-drained soils may be more likely to experience adverse impacts to crops. Areas that rely on individual wells for drinking water supplies are more likely to experience shortages than areas with access to municipal and rural water suppliers.

Different areas in Murray County may be impacted differently by a drought, but the small size of the county and interdependence of the residents will result in any drought event having a significant impact on the entire county.

Extent of the Hazard

Murray County's economy is based heavily on agriculture. A severe drought could cause economic hardship within the county.

Corn and soybeans yields can be dramatically decreased by drought conditions. Livestock operations are affected by loss of feedstock, pasture and general forage, as well as drinking water. Reduced yields due to a drought event will not only have an economic impact on individual farmers, but on secondary suppliers who buy and sell crops and livestock, agricultural retailers, and local governments that rely on sales taxes. Drought insurance for crops does help compensate for losses, but there can still be economic hardship as the result of a drought.

A drought will not only produce a hardship for the farmers growing the crops, but overall supply can decrease causing food prices to rise. The U.S. Department of Agriculture estimates that the drought during the summer of 2012 will push retail food prices up by between 3% and 4% in 2013.⁴⁹

Relationship to Other Hazards—Cascading Effects

Drought can increase the risk of a number of natural and other hazards.

- Wildfires. Drought stressing woods, brush land, and non-cultivated fields significantly increases the risk of wildfires and lightning strikes onto dry fields have the potential to cause wildfires as well. In addition, moving equipment within Murray County like trains or combines during fall harvest have the potential to cause wildfires.
- Insect Infestation. An increase in the amount of insects and other pests are often caused or impacted by severe drought conditions.

⁴⁹ Time. The Cost and Consequences of the U.S. Drought. Oct. 26 2012. Access: 6/20/14. Available: <http://business.time.com/2012/10/26/the-cost-and-consequences-of-the-u-s-drought/#ixzz2Tqswe7kB>

- **Tree Loss.** Due to the lack of moisture, tree loss or decline can be experienced resulting in several problems including: loss of shade for homes requires increased power consumption, and loss of windbreaks provided by trees allows for an increase in soil erosion.
- **Wells/Aquifers.** The absence of rain for a long period of time is insufficient to recharge aquifers and eventually, the loss of water in underground wells results.
- **Business interruption.** A drought can result in watering bans. Businesses that are heavier water users will be impacted. Golf courses, processing facilities, car washes, and a number other businesses will be impacted.
- **Utility/Infrastructure.** Limited groundwater resources, provided by surficial aquifers, can be easily negatively impacted by drought.
- **Dust Storms.** As surface soils dry out and the winds blow, an increased amount of soil erosion occurs.
- **Civil Disturbance.** A long lasting drought can cripple the economic opportunity in greater Minnesota and other areas that have an agricultural based economy. This loss in economic opportunity can cause social unrest.

Previous Occurrences of the Hazard

From January 2000 through April 2017, there were 14 documented droughts in Murray County. In the table below are documented droughts that occurred from January 2010 through April 2017.

Figure #93
Droughts – Murray County

Date	Location	Event Narrative
07/01/2012	Lyon, Lincoln, Jackson, Cottonwood, Pipestone, Nobles, Murray, Rock	Much below normal rainfall aggravated existing long term dry soil conditions, and also resulted in a lack of even short term relief. This produced stress on crops with the stress becoming increasingly visible. Damage in the form of reduced yields became certain, but the amount of yield reduction was still highly unknown because of the long time remaining before harvest, and the unknown future weather during that time. At the end of the month, corn crops were judged to be the most susceptible to the reduced yields, due to the lack of moisture during the tasseling period, while soybeans had more recovery potential if significant rain were to fall in the near future.
08/01/2012	Lyon, Lincoln, Jackson, Cottonwood, Pipestone, Nobles, Murray, Rock	Below normal rainfall continued to aggravate existing long term dry soil conditions, and stress on crops continued despite less hot weather than in July. Crop damage including certain reduced crop yields was very apparent, although the amount of yield reduction and other damage was still highly uncertain before harvest. Corn continued to be the crop suspected of enduring the most damage, with some recovery potential for soybeans in the less hot weather. The drought was also leading to local water use restrictions.

09/01/2012	Lyon, Lincoln, Jackson, Cottonwood, Pipestone, Nobles, Murray, Rock	Well below normal rainfall continued to aggravate existing long term dry soil conditions. Stress on crops which was observed during most of the summer became more evident with the beginning of harvest, although the amount of yield reduction and other damage was still uncertain. Corn, soybeans, and other crops were known to be severely affected, although corn continued to be the crop suspected of suffering the most damage. The drought continued to result in local water use restrictions.
10/01/2012	Lyon, Lincoln, Jackson, Cottonwood, Pipestone, Nobles, Murray, Rock	Below normal rainfall continued to aggravate existing long term dry soil conditions. The fall harvest was generally completed with definitely reduced yields, but no estimation on how much the reduction in yields was. The dryness hampered the germination of winter wheat which was planted. The effect of local water use restrictions eased with the dropping off of water usage.
11/01/2012	Lyon, Lincoln, Jackson, Cottonwood, Pipestone, Nobles, Murray, Rock	Well below normal rainfall continued to aggravate existing long term dry soil conditions. The effect of the dryness on winter wheat germination was more strongly confirmed, and the future effect of the lack of soil moisture on next spring and summer's farming was feared if the dryness were to continue. Otherwise, few new effects of the drought were noted during the month due to the seasonal decrease in water usage and need.
12/01/2013	Lyon, Lincoln, Jackson, Cottonwood, Pipestone, Nobles, Murray, Rock	Long term dry soil conditions continued, despite normal to above normal precipitation, as the excess over the low winter normals was not enough to relieve the dry conditions. Aside from the effects on winter wheat and available winter livestock feed, hunting was hampered due to reduced pheasant population and disease in the deer population. The future effect of the lack of soil moisture on next spring and summer's farming was feared if the dryness were to continue. Otherwise, few new effects of the drought were noted during the month due to the seasonally low water usage and need.
1/1/2013	Lyon, Lincoln, Jackson, Cottonwood, Pipestone, Nobles, Murray, Rock	Drought conditions continued over all of southwest Minnesota in January. Precipitation was below to well below normal, although with the low midwinter normals, even greater precipitation would have been unlikely to change the dry soil conditions. There was little noted in the way of new effects of the drought, with the dry conditions giving a poor outlook for the Spring and Summer, including poor germination of the winter wheat crop during the dry fall. Water restrictions continued to be few during the winter because of the low water usage, but the area was becoming more vulnerable to even marginally weather if it developed in the spring and summer. Drought was generally listed as continued severe to extreme for the area.

2/1/2013	Lyon, Lincoln, Jackson, Cottonwood, Pipestone, Nobles, Murray, Rock	Drought conditions continued over all of southwest Minnesota in February, despite precipitation which was a little above normal. The excess of a few tenths of an inch in the driest month of the year did little to relieve the long term dry soil conditions. There was little noted in the way of new effects of the drought, with the dry conditions giving a poor outlook for the Spring and Summer, including the poor germination of the winter wheat crop during the dry fall. Water restrictions continued to be few during the winter because of the low water usage, but the area was deemed vulnerable to even marginally dry weather if it developed in the spring and summer. Drought was generally listed as continued severe to exceptional for the area, with the northern edge of the area, from Ivanhoe to Marshall, making a slight improvement to severe because of greater snowfall and snow cover during the month.
3/1/2013	Lyon, Lincoln, Jackson, Cottonwood, Pipestone, Nobles, Murray, Rock	Drought conditions continued over all of southwest Minnesota in March. Precipitation was normal to half of normal, with drought rated severe to extreme over all of the area. There continued to be a lack of soil moisture as winter approached its end, since even normal winter precipitation is low compared to the warmer seasons. Also, the frozen ground forced runoff of what precipitation and snowmelt there was. There was little noted in the way of new effects of the drought, with the dry conditions giving a poor outlook for the Spring and Summer, including the winter wheat crop, which was also affected by poor germination conditions in the dry fall. Water restrictions continued to be few because of the low water usage, but the area was deemed vulnerable to even marginally dry weather if it developed in the spring and summer. Some effect was noted on livestock, although the majority of the livestock was in good condition despite persistent feed shortages.
4/1/2013	Lyon, Lincoln, Jackson, Cottonwood, Pipestone, Nobles, Murray, Rock	Extreme to exceptional drought abated slowly to the moderate to severe category over southwest Minnesota during April. Near to a little above normal precipitation was not enough to end the long standing drought entirely, given the long term dry soil conditions that carried over into the month. Accordingly, the area was still deemed very sensitive to the potential of below normal rainfall during the planting and growing seasons. However, the severity of the drought generally decreased. No new effects of the drought were noted during the month.

National Climatic Data Center (NCDC) Storm Events database

Figure #94
US Drought Monitor Map – August 2017

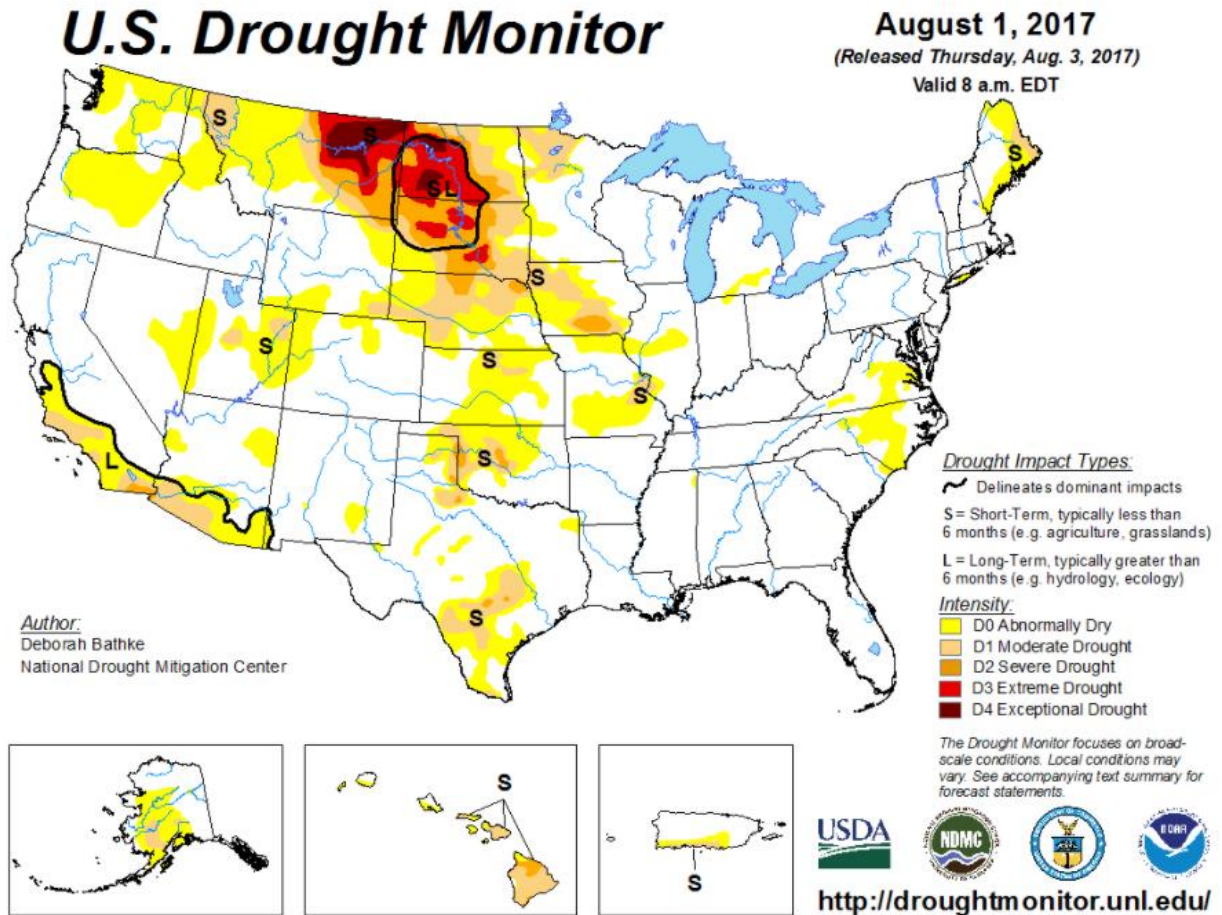
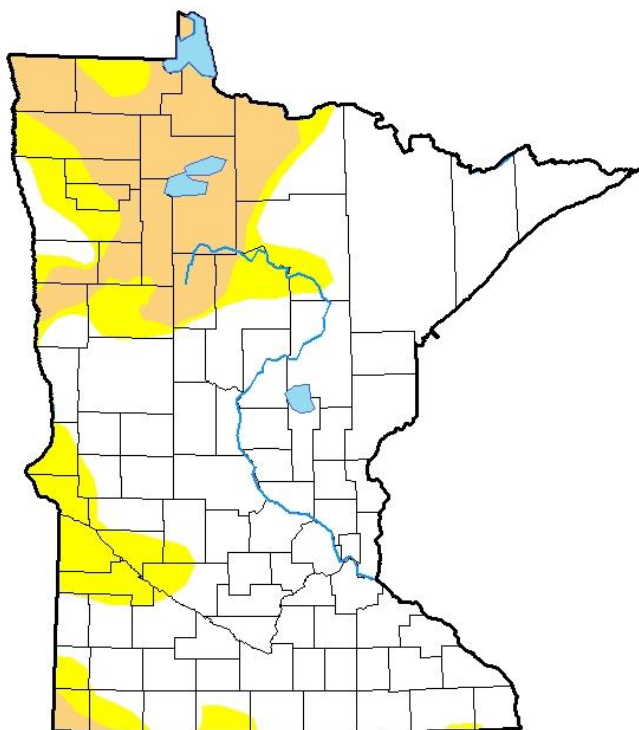


Figure #95
US Drought Monitor Map of Minnesota – August 2017

U.S. Drought Monitor Minnesota



August 1, 2017

(Released Thursday, Aug. 3, 2017)

Valid 8 a.m. EDT

Drought Conditions (Percent Area)

	None	D0	D1	D2	D3	D4
Current	68.22	14.37	17.41	0.00	0.00	0.00
Last Week 07-25-2017	67.95	24.02	8.02	0.00	0.00	0.00
3 Months Ago 05-02-2017	100.00	0.00	0.00	0.00	0.00	0.00
Start of Calendar Year 01-03-2017	100.00	0.00	0.00	0.00	0.00	0.00
Start of Water Year 09-27-2016	100.00	0.00	0.00	0.00	0.00	0.00
One Year Ago 08-02-2016	98.54	1.44	0.02	0.00	0.00	0.00

Intensity:

D0 Abnormally Dry	D3 Extreme Drought
D1 Moderate Drought	D4 Exceptional Drought
D2 Severe Drought	

The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.

Author:

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National Drought Mitigation Center



<http://droughtmonitor.unl.edu/>

Drought and Climate Change

Droughts have been happening throughout Minnesota's history and it is not yet clear how climate change may impact this.⁵⁰ While there was no apparent change in drought duration in the Midwest over the past century (Dai, 2011), the average number of days without precipitation is projected to increase in the future.⁵¹

Even in areas where precipitation does not decrease, projected higher air temperatures will cause increased surface evaporation and plant water loss, leading to drier soils. As soil dries out, a larger proportion of the incoming heat from the sun goes into heating the soil and adjacent air rather than evaporating its moisture, resulting in hotter summers under drier climatic conditions.⁵² Temperature has risen in Minnesota about 2°F since the early 20th century. Under a higher emissions pathway, historically unprecedented warming is projected by the end of the 21st Century. While warmer temperatures will

⁵⁰ Adapting to Climate. Change in Minnesota. 2013 Report of the Interagency Climate Adaptation Team. November 2013.

⁵¹ Adapting to Climate. Change in Minnesota. 2013 Report of the Interagency Climate Adaptation Team. November 2013.

⁵² Mueller and Seneviratne. PNAS, July 31, 2012, vol. 109, no. 31

reduce the heating energy demand and lengthen the growing season, it will also increase the intensity of naturally occurring droughts.⁵³ In 2007, 24 Minnesota counties received drought designation, while 7 counties were declared flood disasters. In 2012, 55 Minnesota counties received federal drought designation at the same time 11 counties declared flood emergencies (MN Environmental Quality Board, 2014).

Vulnerability

Droughts do occur throughout Murray County.

Plans and Programs

- Watering Ban Ordinance – Cities in Murray County have not issued a watering ban in recent memory, though they have the ability to do so.
- Burning ban – Murray County can issue a burning ban during a drought event.
- Murray County Water Management Plan – The Murray County Comprehensive Water Management Plan serves as the ten year ‘Work Plan’ for the Murray Soil and Water Conservation District (SWCD), Murray County Environmental Services Office, and other associated entities. The Water Plan identifies the importance of wetland restoration and water retention practices that promote groundwater recharge. The Murray County Comprehensive Water Management Plan can be found on the Murray County SWCD website, was last updated in 2018.
- Shoreline zoning – Murray County has adopted the Department of Natural Resources (DNR) statutory shoreline zoning classifications and minimum standards.
- Aquifer inventories – Recharge rates and capacities of the county’s aquifers are recorded and inventoried by United States Geological Survey (USGS). These studies help to determine the capacities and recharge rates of the county’s aquifers in order to better assess use restrictions and provisions during times of drought.
- Usage rates – The Department of Natural Resources (DNR) regulates withdrawal and usage rates. There has to be a draw down study before irrigation permits can be issued.
- Public outreach – Educational campaigns regarding water conservation by the Murray Soil and Water Conservation District and rural water systems. This helps to ensure Murray County’s ground water supplies are sufficient to meet demands.
- Crop insurance covers most concerns for droughts.

Gaps and Deficiencies

- Water conservation outreach – Water conservation programs need to be established to educate residents on the need and ways to conserve water usage. This can also be used in response to flooding. Water usage increases sewage (wastewater) going into ponds and higher pond levels leave ponds unable to discharge.
- Water supply – A number of communities are dependent on or rely on rural water as a backup. Water supply could be an issue in Murray County.
- Lack of Fire Breaks – The County needs a program that places fire breaks in between the continuous CRP tracts of land or other state wildlife areas during times of severe drought.

⁵³ NCICS State Summaries. Accessed: 8/10/17. Available: <https://statesummaries.ncics.org/mn>

- Rural Water Suppliers – Lincoln Pipestone Rural Water and Red Rock Rural Water currently serve a portion of the residents in not only the rural areas of Murray County, but also some municipalities.
- Large water users – Food processors are large water users. The City of Chandler is a large water user, since one of the city's main industries is food processing. An adequate water supply is critical to the food processing industry in Chandler and Murray County.
- Drought Contingency in Minnesota – The Minnesota DNR wrote a Water Supply Statewide Drought Management Plan in 2012 (http://lprw.com/documents/325/Water_Supply_Statewide_Drought_Management_Plan.pdf) and provide additional information on Drought in Minnesota on their website: <http://www.dnr.state.mn.us/climate/drought/index.html>.

5.4.9 Earthquakes

“An earthquake is a sudden motion or trembling caused by an abrupt release of accumulated strain in the tectonic plates that comprise the earth’s crust.”⁵⁴

Locations Affected by the Hazard

All of Murray County is at equal risk of an earthquake according to the United States Geological Survey (USGS) seismic map of Minnesota.⁵⁵ It is important to acknowledge that earthquakes are a possibility in Murray County and plan accordingly.

Extent of the Hazard

The average magnitude for an earthquake in Minnesota is 3.2. The effects of an earthquake with a magnitude of 3.0 – 3.9 range from a few persons feeling the vibration, especially on upper floors of a building to many people noticing the vibration. Standing motor cars may rock slightly. The Uniform Building Code of the International Conference of Building Officials assigns every location in the United States to a five-grade Seismic Risk Zone (0 = least risk; 4 = greatest risk); Minnesota rates in Seismic Risk Zone 0.

Relationship to Other Hazards—Cascading Effects

An earthquake can be the catalyst to a number of other natural and other hazards.

- Flooding. An earthquake could result in dam failure and flooding downstream.
- Transportation Infrastructure. An earthquake could damage transportation infrastructure and make emergency response difficult.
- Civil Disturbance. An earthquake could cause countywide distress. Emergency responders may not be able to handle everything, so as people grow desperate, distress can take over and cause civil unrest.

Previous Occurrences of the Hazard

Murray County has not had any significant earthquake events. “Minnesota has one of the lowest occurrence levels of earthquakes in the United States, but a total of 21 small to moderate earthquakes have been documented since 1860.”⁵⁶ There was, however, a small earthquake of 3.4 magnitude in Pipestone County in 1964. This is the nearest recorded earthquake to Murray County.

⁵⁴ MN All Hazard Mitigation Plan. Accessed: 5/29/13. Available: https://dps.mn.gov/divisions/hsem/hazard-mitigation/Documents/2011_MinnesotaAllHazardMitigationPlanDraft.pdf

⁵⁵ USGS Earthquake Hazards Program. Information by Region – Minnesota, 2014 Seismic Hazard Map. Accessed 8/27/2018. Available: <https://earthquake.usgs.gov/earthquakes/byregion/minnesota-haz.php>

⁵⁶ MN All Hazard Mitigation Plan. Accessed: 5/29/13. Available: https://dps.mn.gov/divisions/hsem/hazard-mitigation/Documents/2011_MinnesotaAllHazardMitigationPlanDraft.pdf

Figure #96
Richter Scale

Magnitude	Description	Average earthquake effects	Average global frequency of occurrence (estimated)
1.0–1.9	Micro	Microearthquakes, not felt, or felt rarely. Recorded by seismographs.	Continual/several million per year
2.0–2.9	Minor	Felt slightly by some people. No damage to buildings.	Over one million per year
3.0–3.9		Often felt by people, but very rarely causes damage. Shaking of indoor objects can be noticeable.	Over 100,000 per year
4.0–4.9	Light	Noticeable shaking of indoor objects and rattling noises. Felt by most people in the affected area. Slightly felt outside. Generally causes none to minimal damage. Moderate to significant damage very unlikely. Some objects may fall off shelves or be knocked over.	10,000 to 15,000 per year
5.0–5.9	Moderate	Can cause damage of varying severity to poorly constructed buildings. At most, none to slight damage to all other buildings. Felt by everyone.	1,000 to 1,500 per year
6.0–6.9	Strong	Damage to a moderate number of well-built structures in populated areas. Earthquake-resistant structures survive with slight to moderate damage. Poorly designed structures receive moderate to severe damage. Felt in wider areas; up to hundreds of miles/kilometers from the epicenter. Strong to violent shaking in epicenter area.	100 to 150 per year

7.0–7.9	Major	Causes damage to most buildings, some to partially or completely collapse or receive severe damage. Well-designed structures are likely to receive damage. Felt across great distances with major damage mostly limited to 250 km from epicenter.	10 to 20 per year
8.0–8.9	Great	Major damage to buildings, structures likely to be destroyed. Will cause moderate to heavy damage to sturdy or earthquake-resistant buildings. Damaging in large areas. Felt in extremely large regions.	One per year
9.0 and greater		At or near total destruction – severe damage or collapse to all buildings. Heavy damage and shaking extends to distant locations. Permanent changes in ground topography.	One per 10 to 50 years

Figure #97
Earthquakes, Minnesota

Epicenter (nearest Town)	Date	Magnitude
Rosholt	10/20/1995	3.7
Granite Falls	2/9/1994	3.1
Dumont	6/4/1993	4.1
Walker	9/27/1982	2.0
Cottage Grove	4/24/1981	3.6
Nisswa	7/26/1979	1.0
Rush City	5/14/1979	0.1
Evergreen	4/16/1979	3.1
Milaca	3/5/1979	1.0
Pipestone	9/28/1964	3.4
Alexandria	2/15/1950	3.6
Detroit Lakes	1/28/1939	3.9
Bowstring	12/23/1928	3.8
Staples	9/3/1917	4.3
Red Lake	2/6/1917	3.8
New Ulm	02/12/1881	3.0-4.0
St Vincent	12/28/1880	3.6
New Prague	12/16/1860	4.7
Long Prairie	Date unknown (1860-61)	5.0

National Climatic Data Center (NCDC) Storm Events database

Earthquakes and Climate Change

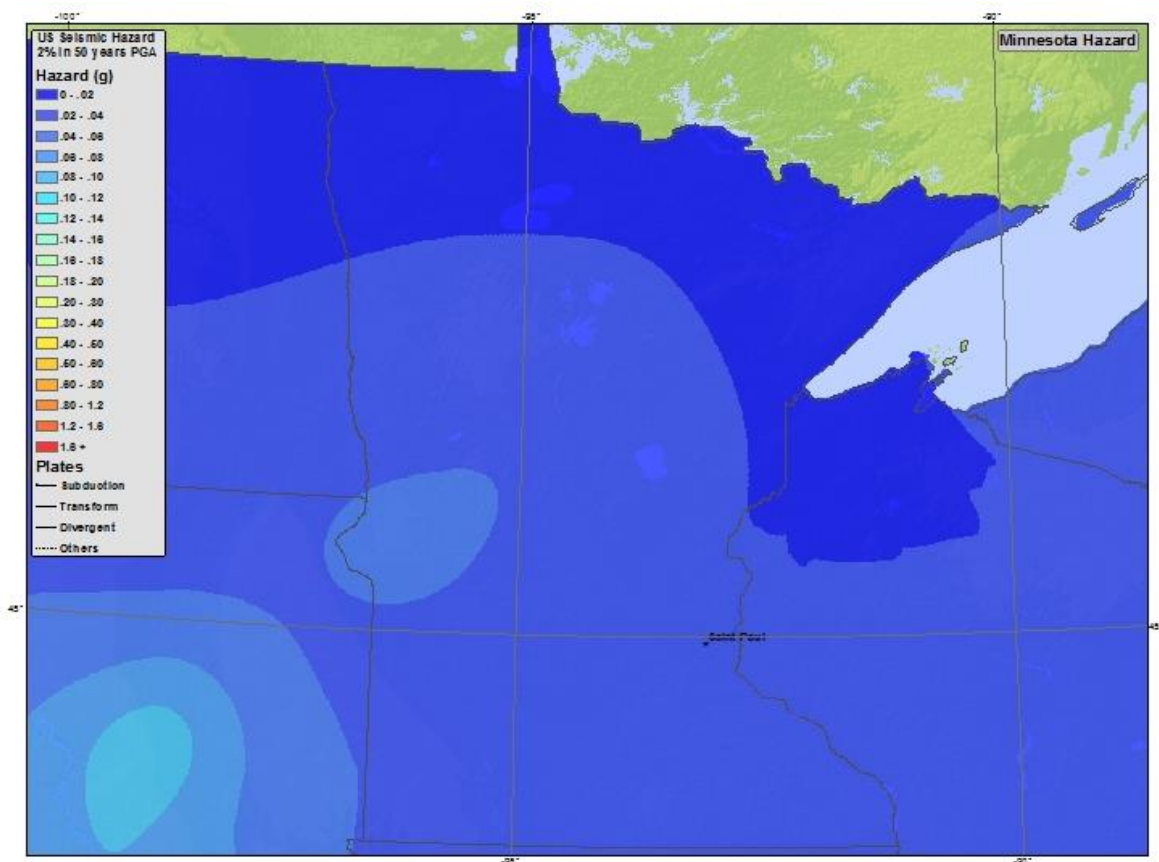
There is no evidence that climate change will increase the risk of earthquakes in Minnesota.

Probability of Future Events of this Hazard

The USGS Seismic Map shows the seismic activity in the United States, the potential for an earthquake of any significant magnitude happening in Murray County is very minimal.

Since it is unlikely for an earthquake to occur in Murray County, little or no preparation has occurred. There have been multiple earthquakes in Minnesota with a magnitude of 4.0 – 5.0. An earthquake registering a 5.0 on the Richter Scale could occur and cause major damage to poorly constructed buildings.

Figure #98
Seismic Hazard Map – Minnesota



Source: USGS Minnesota Seismic Hazard Map

Plans and Programs

- Murray County does recognize that there is some risk associated with earthquakes, but there are not extensive plans and programs to address the risk.
- Well defined response – Emergency responders have a well-defined response protocol outlined in the Emergency Operations Plan. The response protocol is in regards to all hazards. An earthquake would result in a large hazard event with a number of smaller events that include the risk of fire, transportation infrastructure damage, utility damage, civil disturbance, and water supply contamination. The response protocols would generally be applied to an earthquake and the resulting hazard events.

Gaps and Deficiencies

- The risk associated with an Earthquake in Murray County is perceived as very minimal, so extensive planning does not take place. This lack of preparation could result in an earthquake causing large damages and disorganization in the aftermath of the hazard.

5.5 Other Hazards

5.5.1 Agricultural Disease & Invasive Species (animal or crop)

Agriculture is a major economic driver in Murray County and Southwest Minnesota. Animal and crop related diseases have the potential to inflict both large economic losses and logistical hazards on the community.

Locations Affected by the Hazard

Agricultural disease is often difficult to contain. The majority of incidents related to agricultural disease are likely to occur countywide rather than in localized areas, given the small size and the difficulty to contain a disease. The planning team identified the spatial extent of agricultural disease as countywide.

One of the most current threats is emerald ash borer, which is an exotic beetle from Asia that is devastating ash trees in a number of states. Emerald ash borer is a small green beetle that kills ash trees. It has been difficult to contain this threat, and there are a number of other similar examples of how it is difficult to contain an agricultural disease. Foot & mouth disease also poses some risk to the county. The decision to relate agricultural disease to a countywide area instead of a localized area is also based on the planning teams experience within the county, the prevalence of crop agriculture, and the relative ease with which plant diseases spread. It is likely that any outbreak will likely affect all trees, crops, and animal agriculture within the county.

Extent of the Hazard

The majority of the land in Murray County is used for agriculture. An agricultural disease causing crop failure could cause millions of dollars in lost production. Murray County is ranked 14 in crop production and 27 in livestock production among counties in Minnesota with a total of \$373,533,000 in 2011.⁵⁷ Animal transmitted diseases pose the greatest threat to animal confinement buildings, feeding lots, and pastures. Insects and pests pose the largest risk to both agriculture crops and tree-cover.

Animal Transmitted Diseases and Invasive Species

Avian Influenza (HPAI) is a disease caused by infection with avian influenza and Type A viruses. These viruses occur naturally among wild aquatic birds worldwide and can infect domestic poultry and other bird and animal species. Avian Influenza viruses do not normally infect humans. However, sporadic human infections with Avian Influenza viruses have occurred.⁵⁸

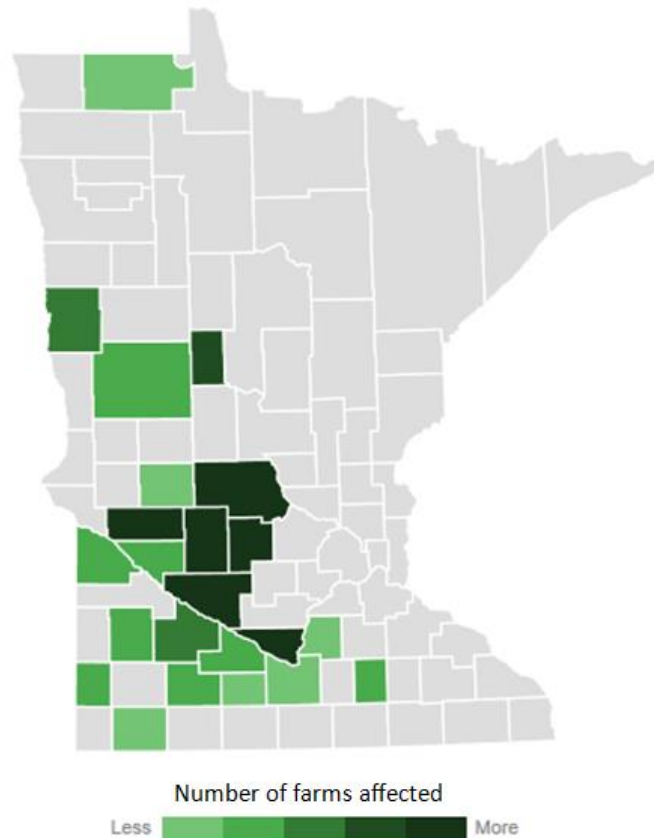
“Influenza in poultry falls into two groups: low pathogenic avian influenza (LPAI), or highly pathogenic avian influenza (HPAI). Similar to influenza symptoms in people, birds infected with LPAI usually experience only mild signs if any, including respiratory signs such as conjunctivitis and nasal discharge, ruffled feathers or a drop in egg production. Unlike LPAI, the first indication of HPAI in poultry is sudden

⁵⁷ Murray County Agricultural Profile. Accessed 01/22/2018. Available: <http://www.mda.state.mn.us/food/business/agmktg-research/~media/Files/food/business/countyprofiles/econrpt-murray.ashx>

⁵⁸ CDC. Information on Avian Influenza. Access: 11/24/15. Available: <http://www.cdc.gov/flu/avianflu/>

death, often without signs of illness. In the last 40 years, there have been introductions of LPAI in Minnesota poultry all of which have been successfully eliminated.”⁵⁹

Figure #99
Avian Influenza Outbreak Map – Minnesota June 2015



The threat of bovine tuberculosis (TB) has impacted agriculture in Minnesota recently. In April, 2008, USDA downgraded Minnesota’s status, requiring Minnesota cattle producers to do additional testing when shipping animals out of state. According to the Board of Animal Health website, bovine TB can be difficult to diagnose. Infested animals can be infected for a long period of time before showing any outward signs of TB.⁶⁰

The United States has been free of Hoof and Mouth Disease Bovine Spongiform Encephalopathy (BSE- Mad Cow Disease) since 1929.⁶¹ This was possible through effective collaborative prevention programs between private producers, veterinarians, researchers, and government organizations. Education and

⁵⁹ Minnesota Board of Animal Health. Avian Influenza. Accessed: 11/24/15. Available: <https://www.bah.state.mn.us/avian-influenza>

⁶⁰ Minnesota Board of Animal Health. Accessed 5-17-13. Available: <http://mn.gov/bah/diseases/bovine-tb/tb-testing.html>

⁶¹ University of California Cooperative Extension. Accessed: 9/10/13. Available: http://cesanbernardino.ucanr.edu/Dairy511/FACT_SHEET_No-1_Foot_and_Mouth_Disease/

early symptom identification were critical in the success. When an infection of foot and mouth disease or BSE is confirmed, the only effective way to control the disease is isolation and culling of an entire herd.

Early detection can be difficult since symptoms can be the same for multiple diseases. Later detection can result in a large percentage of a herd having the disease. Having to dispose of a large percentage of a herd would result in substantial financial loss to the producer.

Animals are also susceptible to the flu and common colds. “Respiratory diseases are common and costly to livestock producers.”⁶² The common cold along with other animal diseases like avian Influenza (bird flu), Chronic Wasting Disease, and Lyme Disease, just to name a few, pose risks to producers and cost thousands of dollars to producers to treat annually.

In 2018 the Minnesota Department of Natural Resources confirmed the presence of zebra mussels in Lake Sarah in Murray County. The DNR found the zebra mussels on docks removed for the winter season, confirming their presence in six locations around the lake. The DNR instructed residents near lakes with no known presence to take photos of newly discovered invasive species and to save the specimens or leave them in place until the DNR could investigate.

Plant Pests and Diseases

Plant diseases can cause a loss of yield or damage to the infected plants. Certain tree diseases may weaken their structure and create a hazardous situation where property damage or serious bodily injury may result from falling limbs or the entire tree toppling. Root decay and the loss of trees may also lead to erosion.

In many cases, fungi are involved in tree diseases that result in a tree becoming a hazard. A tree with slowed growth, branch dieback, smaller than normal leaves or needles, excessive cone or seed set, premature autumn leaf coloration, or severe winter twig kill may be exhibiting early symptoms of a disease. Nothing can be done for a tree once it is infected nor is it likely that fungus can be completely eliminated from the soil or general area around the tree once the tree is removed.

A tree with fungal fruiting structures on several limbs, trunk, butt, or roots should be removed promptly if it is in a location where property damage might occur or where falling limbs or tree could strike people or animals. If most of the tree appears healthy, any single branch with fungal fruiting structures should be removed promptly, regardless of the identity of the fungus present.

Some of the more notable pests infest corn fields. Corn rootworm and European corn borer are two major pests that pose serious potential loss of income to farmers. Goss’s Bacterial Wilt and Leaf Blight are two other damaging diseases that have caused problems over the past few growing seasons in Minnesota. In 2010, Wilt and Leaf Blight developed in many fields across southern Minnesota. Wilt and Leaf Blight can

⁶² The Cattle Site. Accessed: 9/11/13. Available:
<http://www.thecattlesite.com/diseaseinfo/#sthash.KWvGHoRq.dpuf>

be a significant disease problem, with yield losses reported as high as 70 to 80 bushels per acre in Minnesota.⁶³

In the past few decades technological progress has been made, and seed companies have been able to genetically enhance corn varieties to provide a higher level of protection against pests and diseases. Advances in Soybean seed modifications have also been able to overcome a number of plant pests and diseases that include soybean cyst nematode and soybean aphids. These hybrids have resistance to certain types of cyst nematode, but not all. Soybean aphids can be addressed with commercial spray, but Mother Nature is often one step ahead. Other plant diseases include: Asian Soybean Rust, European Corn Borer, elongate hemlock scale, and a number of insects.

Relationship to Other Hazards—Cascading Effects

- **Public Health.** Agricultural disease can have a major impact on public health. A shortage of food can cause poor development among youth that will have lifelong consequences.
- **Civil Disturbance.** A shortage of food could also result in civil disturbance. When the supply of a necessity becomes drastically low, distress can take over and cause civil unrest.

Previous Occurrences of the Hazard

There have not been any recent large scale occurrences of agricultural disease in Murray County.

Not having any large scale occurrences of agricultural disease is largely due to the economic incentives farmers have to stay ahead of new diseases and taking precautionary actions. Large operations have specialized staff to monitor livestock and enforce sterilization of equipment and employees before entering facilities. Ag businesses also work with Minnesota Department of Agriculture (MDA) and University of Minnesota Extension Service to stay ahead of and combat agricultural disease.

Minnesota Department of Agriculture (MDA) and University of Minnesota Extension Service provide information on a variety of insects and pests that help prevent occurrences of agricultural disease. Seed producers and other agricultural businesses use this information to modify crops to be resistant to more pests and diseases. The agricultural sector studies past seed modifications and make adjustments to combat the next year's hazards. It is important to study past plant pests and diseases, so we can prepare for future hazards. Understanding the past is an important variable in mitigating future hazard events.

During the spring and summer of 2015, Highly Pathogenic Avian Influenza hit turkey and chicken farmers in Minnesota and neighboring states. As of June 5, 2015, 9 million birds were affected and humanely put down in Minnesota.⁶⁴ Murray County had no turkey farms affected.⁶⁵ However, neighboring Lyon and Redwood Counties saw significant impacts with 66,000 and 126,900 birds affected, respectively. Losses in poultry production and related businesses due to avian influenza are estimated at \$309.9 million in

⁶³ University of Minnesota Extension. Accessed 5-17-13. Available:

<http://blog.lib.umn.edu/efans/cropnews/2011/08/watch-for-gosss-leaf-blight-an.html>

⁶⁴ CDC. Information on Avian Influenza. Accessed: 7/23/15. Available: <http://www.cdc.gov/flu/avianflu/>

⁶⁵ USDA APHIS HPAI Response Final Report, 2014-2015 HPAI Outbreak. Accessed 8/27/2018. Available: https://www.aphis.usda.gov/animal_health/emergency_management/downloads/hpai/2015-hpai-final-report.pdf

Greater Minnesota, according to University of Minnesota Extension. “Using economic modeling, analysts determined that for every million dollars in direct losses, the estimated ripple effect leads to \$1.8 million in overall economic losses, including \$450,000 in wages. Ripple effect losses stem from factors including reduced wage-earner and business-to-business spending.”⁶⁶

Vulnerability

Large scale animal outbreaks are rare. The Minnesota Board of Animal Health works with producers to educate, monitor, report, and respond to outbreaks. This coordinated effort has worked to reduce the frequency and scale of occurrences.

Some occurrence of crop pests and diseases happens each year. Researchers try to stay ahead of the hazards by giving livestock vaccinations and supplements and by genetically modifying crops.

Emerald Ash Borer (EAB) is one pest that has the potential for a large amount of damage in Murray County. There are statewide efforts being made to slow the spread, but the outcome is unknown at this time. According to a story in *Planning Magazine* (“Diversifying the Urban Forest, February 2010), Minnesota could lose all of its ash trees within 10 years.

Ash trees became a preferred quick-growing street tree and shade tree across the USA after elm trees succumbed to Dutch Elm Disease. According to the MDA, the EAB is an insect that attacks and kills ash trees. The adults are small, iridescent green beetles that live outside of trees during the summer months. The larvae are grub or worm-like and live underneath the bark of ash trees. Trees are killed by the tunneling of the larvae under the tree's bark.

“On May 14, 2009, emerald ash borer was confirmed as present in the South Saint Anthony Park neighborhood in St. Paul. EAB is a serious invasive tree pest. Quarantine has been placed on Ramsey, Hennepin, Houston, and Winona counties to help slow the spread of Emerald Ash Borer to other areas.”⁶⁷

Agricultural disease is difficult to contain and can spread quickly. Emerald Ash Borer is an example of how a plant disease can spread and how it is difficult to contain. The City of Minneapolis has removed 879 unhealthy ash trees in 2012.⁶⁸ It was recommended by the Minneapolis Tree Advisory Commission to remove and replace another 5,000 ash trees in 2013 to help prevent the widespread infestation of the bug.

⁶⁶ University of Minnesota. Extension analysis: Economic impact of avian flu at nearly \$310 million as of May 11. Accessed: 7/23/15. Available: <http://discover.umn.edu/news/food-agriculture/extension-analysis-economic-impact-avian-flu-nearly-310-million-may-11>

⁶⁷ Minnesota Department of Agriculture. Accessed 5-17-13. Available: <http://www.mda.state.mn.us/plants/pestmanagement/eab.aspx>

⁶⁸ City of Minneapolis. Accessed: 9/17/13. Available: <http://www.minneapolismn.gov/sustainability/indicators/WCMS1P-081056>

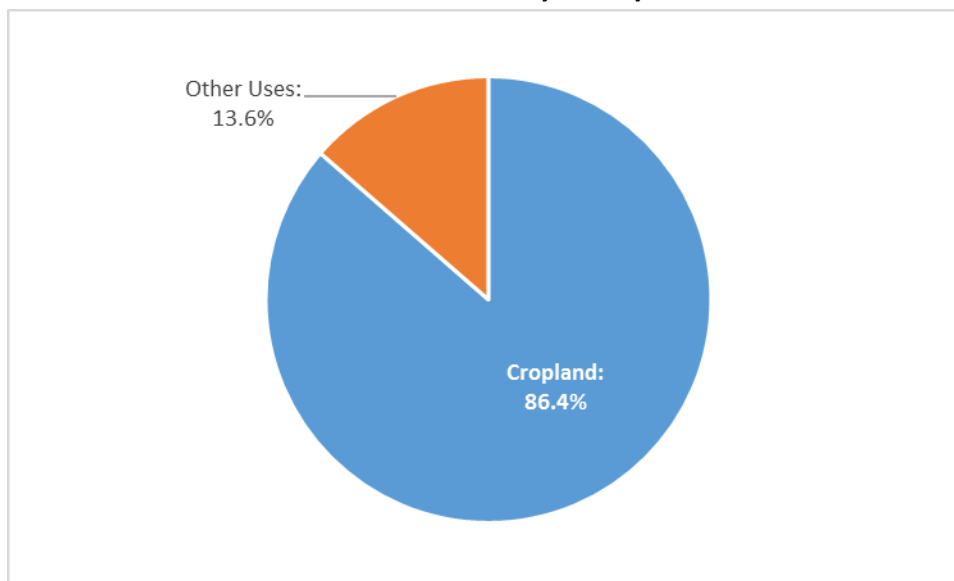
Figure #100
Farm Summary – Murray County

	1987	1992	1997	2002	2007	2012	Change 2007- 2012
Land in Farm (acres)	372,454	375,628	383,725	407,488	428,869	407,919	-5.10%
Number of Farms	995	903	836	911	1,023	895	-12.50%
Average Size (acres)	374	416	459	447	419	456	8.10%
Harvested Crops (acres)	242,041	308,321	334,326	353,805	360,347	352,407	-2.20%
Corn (acres)	114,705	146,668	149,288	167,617	191,694	173,711	-9.38%
Soybean (acres)	128,556	143,273	166,425	162,626	148,675	162,114	9.04%

Source: Census of Agriculture 1987, 1992, 1997, 2002, 2007, 2012

(<http://agcensus.mannlib.cornell.edu/AgCensus/homepage.do?sessionId=2AFCEF7241026635E4A4466B27A437AD>)

Figure #101
Land in Farms – Murray County 2012



Feedlots

The Minnesota Pollution Control Agency (MPCA) regulates collection, transportation, storage, processing and disposal of animal manure. As of July 2016, there were 462 registered feedlots within Murray County.⁶⁹ Management of feedlots and manure is a priority for Soil and Water Conservation Districts in southwest Minnesota. Murray County participates in the MPCA County Feedlot Program.

⁶⁹ Murray County Planning and Zoning Department Information request. Received: 3/24/16.

Feedlots – Murray County



Plans and Programs

- Combined mitigation approach – Department of Agriculture, Minnesota Board of Animal Health, Minnesota Department of Health, University of Minnesota Extension Service, and Homeland Security and Emergency Management (HSEM) are working with local agencies and farmers to effectively mitigate any and all effects of hazards on animal agriculture and plant agriculture.
- Emergency Operations Plan – The Murray County Emergency Operations Plan outlines procedures for county and local governments for contacting appropriate state and federal agencies and provides guidelines and strategies for dealing with animal and plant diseases and command structures with the Murray County Emergency Manager.
- The Minnesota Board of Animal Health continues to work together with agricultural industries and other state and federal agencies to prepare for and respond to introductions of animal disease outbreaks. The state's voluntary cooperative control plan includes education, monitoring, reporting, and response. For the Avian Influenza outbreak, testing for influenza in poultry is conducted at the Minnesota Poultry Testing Laboratory in Willmar. Commercial and non-commercial poultry flocks are routinely monitored for influenza. Livestock and other agricultural operations are also monitored for animal disease outbreaks.
- Catastrophic animal loss – In the event of a catastrophic animal loss the Minnesota State Duty Officer, the Board of Animal Health (BAH), the Department of Agriculture, and your local feedlot officer should be contacted. The primary responsibility for regulating carcass disposal in Minnesota lies with the BAH. The 7020 feedlot rule addresses site selection for composting animal carcasses. MPCA is in charge of carcass disposal in Minnesota.
- Catastrophic animal loss preparation – the Board of Animal Health conducted a catastrophic animal loss training exercise that helped dramatically with the response to Avian Influenza. Foaming and composting was part of the training, which was used during the response to Avian Influenza.
- The private sector has done a good job of policing itself in regards to animal disease outbreaks and the spread of plant diseases. Private agricultural businesses have an economic interest in maintaining a healthy field and healthy animal stock. Research and development plays a big role in trying to stay ahead of the animal and plants diseases and pests.
- Private / public partnerships – Press releases from the Minnesota Board of Animal Health were a critical part of getting the word out regarding Avian Influenza. Murray County has promoted private and public partnership to help educate the agricultural community regarding potential insects/pests and diseases. These partnerships utilize research provided by public entities like the University of Minnesota Extension, and by private entities like Cargill. Creating private and public partnerships is important in mitigating the effects of agricultural disease. A number of issues impact geographical areas, so combining resources and taking advantage of economies of scale can help to make the mitigation efforts more effective.
- Aquatic Invasive Species Prevention Plan for Murray County – The prevention plan outlines the efforts of Murray County to help prevent the spread of aquatic invasive species (AIS) within Minnesota. Its goal is to prevent AIS from entering Murray County waters. Currently, there are no infestations. The plan was last amended December 19, 2017.
- Public education/outreach – Murray County has many activities to educate the public on AIS. There are radio newspaper ads, education displays at the Murray County Fair, and promotional items

distributed with fishing license sales from licensing agents. While conducting water patrols, Murray County's Sheriff's Department will discuss AIS laws with boaters. The Prairie Ecology Bus also presents AIS classes to students at Murray County Central and Fulda public schools.

- Major hog facilities are working on communication – University of Minnesota had a conference in Worthington regarding this.
- Subsidies exist for reporting issues.

Gaps and Deficiencies

- Livestock / Poultry Disposal – Disposal of dead livestock and poultry was an issue identified in many rural counties since the 2015 Avian Influenza Outbreak. This is in regards to catastrophic animal loss. The catastrophic animal loss issue pertains to on the farm animal loss and while the livestock or poultry is being transported. Refer to the section of Transportation accidents for more information related to catastrophic animal loss while livestock and poultry are being transported. There are mitigation efforts in place, but the planning team was unsure of how effective the plans would be in regards to a catastrophic animal loss. There were not extensive poultry losses in Murray County, but there were catastrophic poultry losses in Minnesota, and Iowa.
- Animal Disease Containment – Isolation and containment was and is a concern regarding Avian Influenza. It is difficult to quickly identify infected flocks. Once an infected flock is identified containment protocols can be established.
- Manure Plans and Disposal – During the Avian Influenza outbreak in 2015, manure from infested farms from Iowa was being transported to Murray County. Feed was then taken back to Iowa. There is an economic incentive for truckers to have loads both ways, but this should have been caught earlier. Wash sites and decontamination for trucks need to be more accessible.
- Avian Influenza Cause – Unsure why Avian Influenza occurred and other questions related to how it was transmitted.
- Local Coordination – The relationship between Emergency Management, Southwest Health and Human Services (SWHHS), and local veterinarians needs to be strengthened in order to respond to the potential of actual animal disease that would pose a public health threat.
- Lag in Response – The response for Foreign Disease Outbreak is controlled at the State level. There may be a lag in response, since organizations have to be informed about the outbreak before a response is coordinated. Time is critical in responding to an outbreak, so additional local assets may be needed. Additional training between local assets and state level staff could also help to decrease response times.
- Coordination with State and Federal Agencies – Coordination with local emergency managers was not effective during the Avian Influenza outbreak. The Minnesota response to Avian Influenza on the Minnesota Board of Animal Health's website has a section titled Collaborative Effect. One key partner was overlooked and was not utilized to the full extent. The Avian Influenza Emergency Operations Center in the vicinity of Murray County was in Wilmar. Communication did not go through the normal channels. Local emergency managers were not asked to be heavily involved. Local resources could have been better utilized if local emergency managers were more involved.
- Disposal of contaminated materials – During the Avian Influenza there was a lack of coordination regarding the transportation and disposal of contaminated supplies and equipment. Wash in and

wash out was used for larger equipment, but disposal of contaminated supplies and equipment needed additional coordination.

- Availability of PPE suits (Personal Protection Equipment – Contamination Suits) – Contamination suits were not always available for workers when entering a contaminated site during the Avian Influenza outbreak.
- Early detection/monitoring – Murray County relies on outside entities to find new infestations. This could cause issues down the road on how quickly new infestations are found. Early detection is critical to containing and minimizing the effects of new infestations of AIS.
- Watercraft inspection/decontamination – Currently, Murray County does not hire watercraft inspectors or have a decontamination site for boat decontamination.
- AIS Boater Compliance – A very small number of boaters can comply with aquatic invasive species regulations intended to slow the spread of invasive species. The “DNR recommends that boaters either: spray boat with high-pressure water; rinse boat with hot water (120 degrees for two minutes, or 140 degrees for 10 seconds); or dry boat and equipment for at least five days.” More can be done here.
- Emergency Response plan/protocol – There is no plan in place for quick response to new infestations of AIS. As AIS moves closer to Murray County every year, it is important to be able to take quick action to contain or minimize the effects of a new infestation.
- Communications with County: Top-down communication comes in too late.
- Foot & Mouth Disease poses a risk.

5.5.2 Civil Disturbance

Civil disturbance is violence that includes actions meant to undermine law and order. This can include riots, generalized violence, unlawful obstructions, and others.⁷⁰

U.S. Code 18 U.S.C. § 2331 defines Domestic Terrorism activities as acts that:

- Involve acts dangerous to human life that violate federal or state law;
- Appear intended
 - i. to intimidate or coerce a civilian population;
 - ii. to influence the policy of a government by intimidation or coercion; or
 - iii. to affect the conduct of a government by mass destruction, assassination, or kidnapping;
- Occur primarily within the territorial jurisdiction of the U.S

Locations Affected by the Hazard

Public buildings and facilities, such as the Courthouse, schools and utilities, are potential targets for civil disturbance. Agricultural chemical depots may also be targets for terrorism. Isolated rural farmsteads may also be inviting staging grounds for violent groups or individuals, away from watchful eye of law enforcement.

Relationship to Other Hazards—Cascading Effects

The nature of civil disturbance is inherently unpredictable. Cascading effects depend on the specifics of the event. For example, release of anthrax or other biological agents could lead to animal and crop disaster, destruction of a dam could lead to flooding, destruction of an industrial or farm chemical site could lead to a hazardous material crisis, or destruction of any structure could likely lead to fires.

Previous Occurrences of the Hazard

There have been no events of this type in Murray County. An active shooter or an intentional effort to contaminate food or water sources may be the most significant localized threats to be considered.

Vulnerability

Given the unpredictable nature of civil disturbance, the vulnerability of Murray County to this threat is difficult to determine. .

Plans and Programs

- Fulda Public Schools, Murray County Central Public Schools, and Chandler Christian School have cameras in their schools.

Gaps and Deficiencies

- Manpower – Law enforcement in Murray County would not have the manpower required for a large-scale civil disturbance.
- Training –Training for a civil disturbance would require mutual aid response with National Guard units to better understand and work with military personnel.

⁷⁰ 2014 Minnesota State Hazard Mitigation Plan pg. 182, retrieved 2/3/2016
(<https://dps.mn.gov/divisions/hsem/hazardmitigation/Documents/State%20Plan%20Final%202014.pdf>)

- Equipment - Protective gear for crowd control as well as higher level response gear (Class A HazMat suits for possible chemical incidents; crowd control devices - gas launchers, etc.) for terrorism or a civil disturbance.
- There is no response plan for a large-scale crisis.

5.5.3 Cyberattack

A cyberattack is the deliberate hacking or use of malicious code to compromise digital data, leading to crimes such as financial or identity theft.

Cyberattacks may include, but are not limited to the following:⁷¹

- Identity theft, fraud, extortion
- Malware, pharming, phishing, spamming, spoofing, spyware, Trojan horses, and viruses
- Stolen hardware
- Denial-of-service
- Breach of access
- Password sniffing
- System infiltration
- Website defacement
- Private and public web browser exploits
- Instant messaging abuse
- Intellectual property theft or unauthorized access

Prevention of cyberattacks can include user behavior analytics and security information and event management (SEIM).

Relationship to Other Hazards—Cascading Effects

Depending on the nature of the cyberattack, it may be related to civil disturbance or exacerbate the effects of a civil disturbance event. As technology advances and more of the government's duties are conducted online (elections, for example), there is increased risk of that data being compromised and/or manipulated.

Previous Occurrences of the Hazard

At least one cyberattack has occurred in Southwest Minnesota when the computer systems of Jackson County Central Schools were compromised by an outside entity.

Plans and Programs

- Public entities in Murray County currently use the available technological tools (firewalls, etc.) to prevent cyberattacks.

Gaps and Deficiencies

- Funding to upgrade technology is often limited.
- Response communications haven't always been effective (e.g. previous hepatitis outbreak in Murray County).

⁷¹ Technopedia: Cyberattack. Accessed: 8/28/2018. Available: <https://www.techopedia.com/definition/24748/cyberattack>

5.5.4 Dam, Impoundment, & Culvert Failure

Dams and impoundments maintain lake levels and help control flooding and the destructive power of water. Dams and impoundments are a critical part in minimizing erosion. “There are more than 1,250 dams in Minnesota; 800 are public dams, and the state owns over 430 of the public dams. Most of the public dams are more than 50 years old and require ongoing emergency repairs and reconstruction to maintain their structural integrity.”⁷²

Dam failure is defined as a collapse or failure of an impoundment resulting in downstream flooding. Failure may occur for one or a combination of the following reasons:

- Prolonged periods of rainfall and flooding;
- Inadequate spillway capacity, resulting in excess overtopping flows;
- Internal erosion caused by embankment or foundation leakage or piping;
- Improper maintenance, including failure to remove trees, repair internal seepage problems, replace lost material from the cross section of the dam and abutments, or maintain gates, valves, and other operational components;
- Improper design, including the use of improper construction materials and construction practices;
- Improper operation, including the failure to remove or open gates or valves during high flow periods;
- Failure of upstream dams on the same waterway that release water to a downstream dam;
- Earthquakes, which typically cause longitudinal cracks at the tops of the embankments that can weaken entire structures

The Department of Natural Resources (DNR) has a dam safety program that inspects the structural integrity of dams and impoundments. The DNR classifies dam structures in three categories:

- Class 1: High Hazard: any loss of life or serious hazard to public;
- Class 2: Significant Hazard: possible health hazard or probable loss of high-value property;
- Class 3: Low Hazard: property loss restricted to rural outbuildings and local roads.

Locations Affected by the Hazard

There are 6 dams in Murray County. All six are class 3, the lowest risk. Below is a dam inventory table for Murray County. Select areas along other streams and water ways in Murray County where impoundments were constructed to hold back water are also susceptible to flooding from impoundments washing out or dam failure upriver.

Murray County Emergency Management does not currently have an Emergency Action Plan (EAP) for dam failures in neighboring counties, the downstream risk for Murray County is very low.

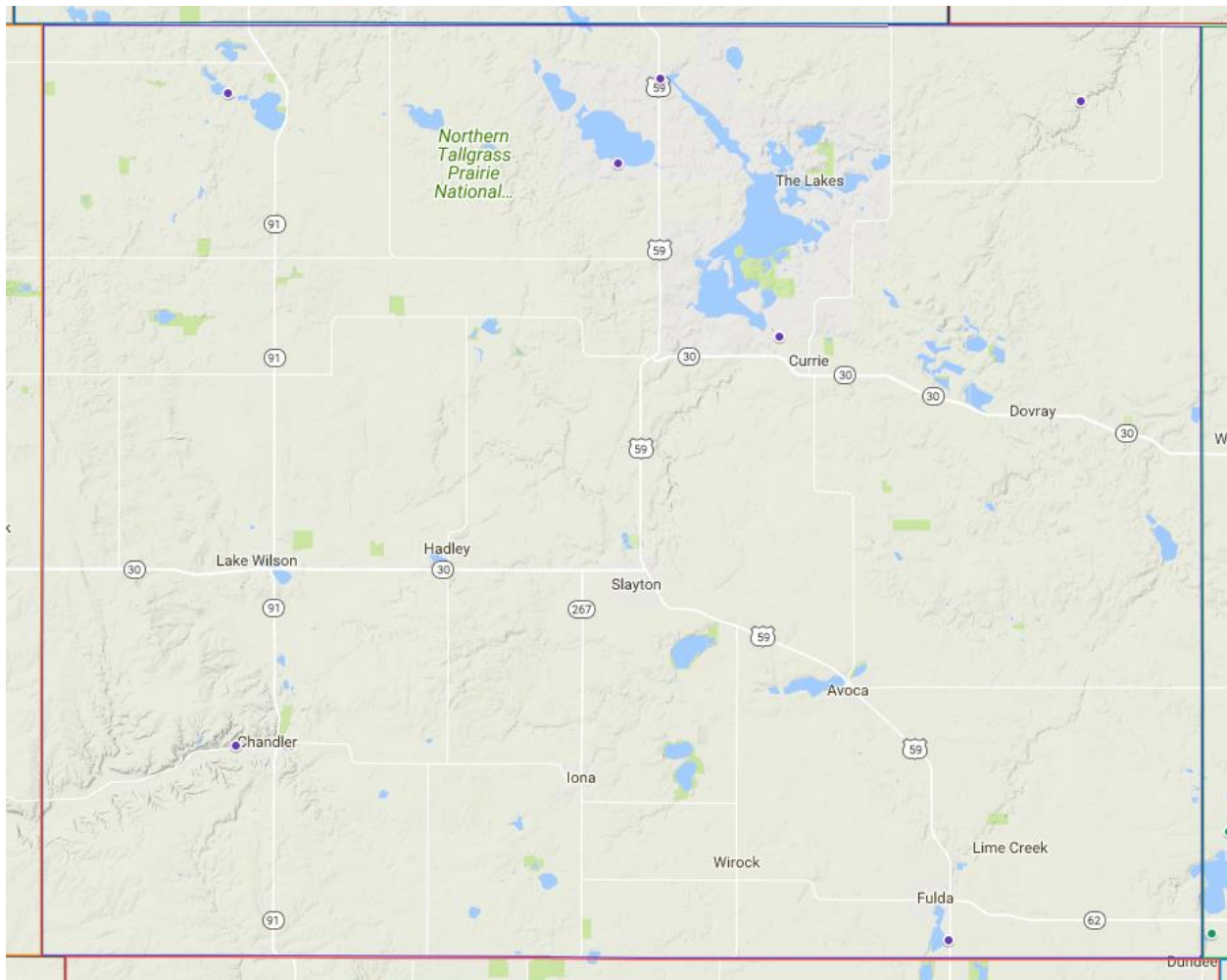
⁷² Minnesota Department of Natural Resources. Accessed: 11/14/13. Available: http://www.dnr.state.mn.us/waters/surfacewater_section/damsafety/index.html

Figure #103
Dam Inventory – Murray County

Dam Name	ID	Next Inspection Year	Last Inspection Date	Dam Class
HOLLY 9	MN01427	2016	5/13/2008	3
POST GROUP DETENTION	MN00852	2018	4/26/2010	3
SHETEK LAKE INLET	MN01192	2018	4/26/2010	3
HJERMSTAD SLOUGH WMA	MN01438	2018	4/15/2010	3
FULDA LAKE	MN00073	2018	4/23/2010	3
SARAH LAKE	MN00118	2016	4/24/2008	3
SHETEK LAKE OUTLET	MN00119	2018	7/26/2011	3

DNR Dam Safety Engineer

Figure #104
Dams – Murray County



Extent of the Hazard

Dam failure, although the risk is minimal, has the potential to be devastating to the areas within the floodplain and around the streams directly below impoundments and dams. Dam failure may result in flash flooding, extensive property damage, and erosion, destruction of infrastructure including road and culvert, and loss of life.

It is more likely to have an impoundment or culvert fail. A failure of an impoundment or culvert has a potential of devastating downstream property damage, erosion, and destruction of infrastructure, including roads and other culverts.

Relationship to Other Hazards—Cascading Effects

- **Flash Flooding.** Dam failure has the potential to cause damage to the areas directly below the dam. Dam failure would cause immediate flash flooding, destruction of property, erosion of crops, infrastructure damage, and possibility of lives being lost. Damage to public infrastructure could also occur in areas of heavy water movement.

Previous Occurrences of the Hazard

Murray County has not experienced a major dam, impoundment, or culvert failure.

Relationship to other Hazards

- **Flooding** - In the event of dam failure, flooding of communities and transportation corridors can occur.

Dam Failure and Climate Change

Dams are designed based on assumptions about a river's annual flow behavior that will determine the volume of water behind the dam and flowing through the dam at any one time. Changes in weather patterns due to climate change may alter the expected flow pattern. It is conceivable that bigger rainfalls at earlier times in the year could threaten a dam's designed margin of safety, causing dam operators to release greater volumes of water earlier in a storm cycle in order to maintain the required margins of safety. Such early releases of increased volumes can increase flood potential downstream.

While climate change will not increase the probability of catastrophic dam failure, it may increase the probability of design failures. Minnesota had a dam failure due to a large storm event in June 2012. The Forebay canal had operated as designed for nearly 100 years. The intensity of the 2012 rain event caused a failure of the canal wall which caused significant damage.

Climate change is adding a new level of uncertainty that needs to be considered with respect to assumptions made during dam construction.

Probability of Future Events of this Hazard & Vulnerability

Free flowing water has tremendous power. It can move boulders, carve out rock, and erode an impoundment or dam. It is important to slow the runoff of water, so groundwater supplies can be replenished and the volume of free flowing water in streams and rivers is reduced. Reducing the free

flowing water in streams and rivers will help to preserve impoundments and dams, but over time impoundments and dams will require maintenance and replacement.

There are 7 dams in Murray County. All of the dams are classified a Class 3, which is the lowest risk classification.

Plans and Programs

- Minnesota Dam Safety Program – The Minnesota Department of Natural Resources (DNR) regulates nearly 900 dams in the State of Minnesota. The DNR and U.S. Army Corps of Engineers regularly inspect dam and reservoir capabilities for flooding and dam failure. The Minnesota DNR dam safety program inspects the structural integrity of dams and impoundments in Murray County. The classification of the dam depends on how often the dam is inspected. A dam classified as High Hazard is inspected annually. A dam classified as Significant Hazard is inspected every three to four years. A dam classified as Low Hazard is inspected every eight years.
- Dam Emergency Action Plan – The Minnesota DNR drafts an Emergency Action Plan (EAP) for all High Hazard dams and strongly recommends that Significant Hazard dams be included as well. An EAP is a formal document that identifies potential emergency conditions at a dam and specifies preplanned actions to be followed in order to minimize property damage and loss of life in the event of a dam failure.
- Emergency Operations Plan – Explains the standard operating guidelines for countywide notification in the event of an emergency and the procedures of evacuation during an emergency.
- Impoundment dams and other water control systems.
- U.S. Army Corps of Engineers - The U.S. Army Corps of Engineers has plans in place for terroristic acts against the dams and flood control projects in the county.

Gaps and Deficiencies

- Registry of dams – Not all dams and impoundments are identified by the DNR. If the dam is not on the registry, the dam does not get inspected by the DNR. Non-identified dams could be at risk of failing, since they are not inspected.
- Infrequency of dam inspection – Dams in Murray County that are all classified by the Minnesota DNR as Low Hazard dams and therefore only get inspected every eight years. The infrequency of inspection may result in maintenance being deferred for a number of years or structural deficiencies not being identified. Inadequate maintenance could result in dam failure.
- Utility failure in the event of dam failure.
- Lake Sarah dam is old.
- The Avoca Dam is in need of repairs. The concrete walk way is undermined. Concerns are that the cement will give way and there won't be a safe way for pedestrians to get to the bridge. The dam is starting to show its age as well. There is quite a bit of rebar that is now exposed and there are cracks in the wing walls where water can run through when the lake is high. The DNR has this dam listed as #10 in the state for need of repair. County staff is currently working with DNR staff on possible solutions. The county board needs to decide what they want to do with it in the near future.

5.5.5 Hazardous Materials

Hazardous materials are found everywhere, from farm to home. A hazardous material is any item which has the potential to cause harm to humans, animals, or the environment, by itself or through interaction with other factors. Spilled material can be costly to clean up and may render the area of the spill unusable for an extended period of time. Water supplies may become contaminated by the introduction of point and non-point source pollutants into public ground water and/or surface water supplies.

Locations Affected by the Hazard

Murray County there are a number of manufacturers who use and or produce a number of potentially hazardous materials. US 59 runs through the county and this major transportation corridor has a high volume of semi-truck traffic. The loads coming to the county and through the county varies, but some of these loads could pose a serious chemical hazard if a crash would take place. Oil tankers are one example.

Many chemicals are also used daily in agriculture, putting farms and rural communities at risk. Anhydrous ammonia is one dangerous chemical used in agriculture that if not handled properly can be very dangerous. Methamphetamine (commonly referred to as “meth”) manufacturers have targeted isolated rural homes and abandoned farm sites for illegal drug labs. However, these individuals also have been known to set up labs in their car or basement in town, so populations in town are equally at risk of a meth lab explosion and other hazards.

Extent of the Hazard

Federal law defines certain hazardous chemicals, and requirements for emergency planning for facilities at which hazardous substances are present. According to the Minnesota AHMP, approximately 6,000 facilities across the state report their storage of hazardous chemicals to the Minnesota Department of Public Safety’s Emergency Planning and Community Right-To-Know Act (EPCRA) Program, US Environmental Protection Agency (EPA), and their local fire department. Within Murray County there are no facilities that report hazardous material storage to state and local authorities.⁷³ These types of facilities are known as 302 facilities after EPCRA Section 302(c) that require state and local authorities to develop chemical emergency preparedness and response capabilities through better coordination and planning with local businesses.

Chemicals

Land use activities and farming practices can have significant impacts on vulnerable aquifers. Aquifers in the region are often shallow and have a high potential of contamination from nitrate leaching. Deeper aquifers may not be suitable for water supplies due to naturally occurring contaminants, such as sulfur, or because of slow well recharge. Nitrates have been identified as a specific problem in the region.

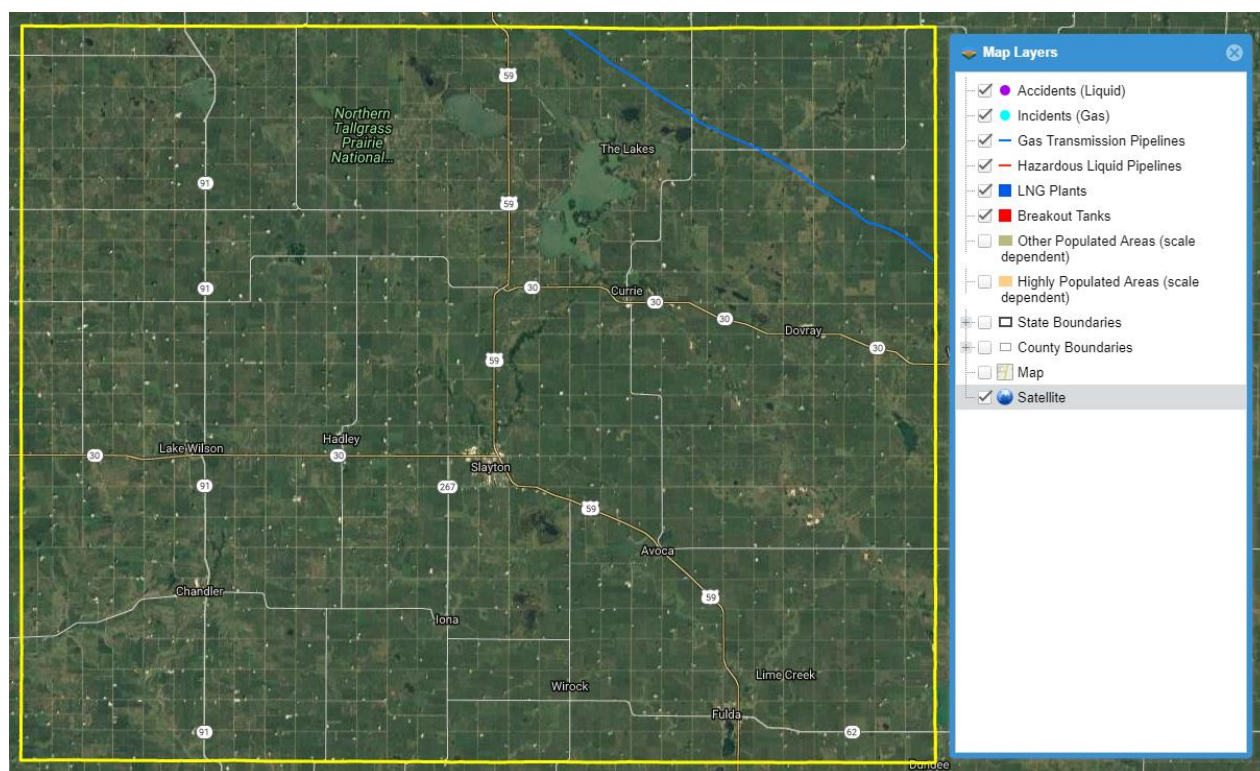
Pipelines

The State Fire Marshal’s Pipeline Safety Team (SFMPST) oversees pipeline operations in Minnesota. The National Pipeline Mapping System identifies no hazardous liquid pipelines traversing Murray County. There is one gas transmission pipeline in Murray County that travels across the northeast corner of the

⁷³ Toxic Release Inventory Program. 2016 Preliminary Dataset. Accessed 8/14/17. Available: <https://www.epa.gov/toxics-release-inventory-tri-program/2016-preliminary-dataset-basic-data-files>

county. This pipeline is in blue on the map below. Pipelines are pressurized and monitored, so pipelines can be quickly shut off in case of an accident. Pipelines are a safer way to transport hazardous liquids than by trucks or rail. “The evidence is clear: transporting oil and natural gas by pipeline is safe. Furthermore, pipeline transportation is safer than transportation by road, rail, or barge, as measured by incidents, injuries, and fatalities—even though more road and rail incidents go unreported.”⁷⁴

Figure #105
Hazardous Liquid and Gas Transmission Pipelines – Murray County



Source: National Pipeline Mapping System - <https://www.npms.phmsa.dot.gov/PublicViewer/>

Meth

Meth is a powerful stimulant drug that is similar to a family of drugs called amphetamines. During the production process there are a number of dangerous chemicals that are mixed that can cause dangerous fires and explosions. According to the Rand Drug Policy Research Center, amphetamines are the most widely used illicit drug worldwide, after marijuana.⁷⁵ Information in regional data systems and feedback from law-enforcement agencies and elected officials indicate that meth is still a problem facing the populations they serve, though its production is generally no longer taking place locally.

Meth labs are a concern in the region and an incident at a lab could result in a major hazard material incident. A number of hazardous chemicals are used in the production process. An explosion and fire

⁷⁴ Manhattan Institute for Policy Research. Issue Brief – Pipelines are Safer for Transportation of Oil and Gas. Accessed: 7/23/15. Available: http://www.manhattan-institute.org/html/ib_23.htm#.VbFOi6_bK70

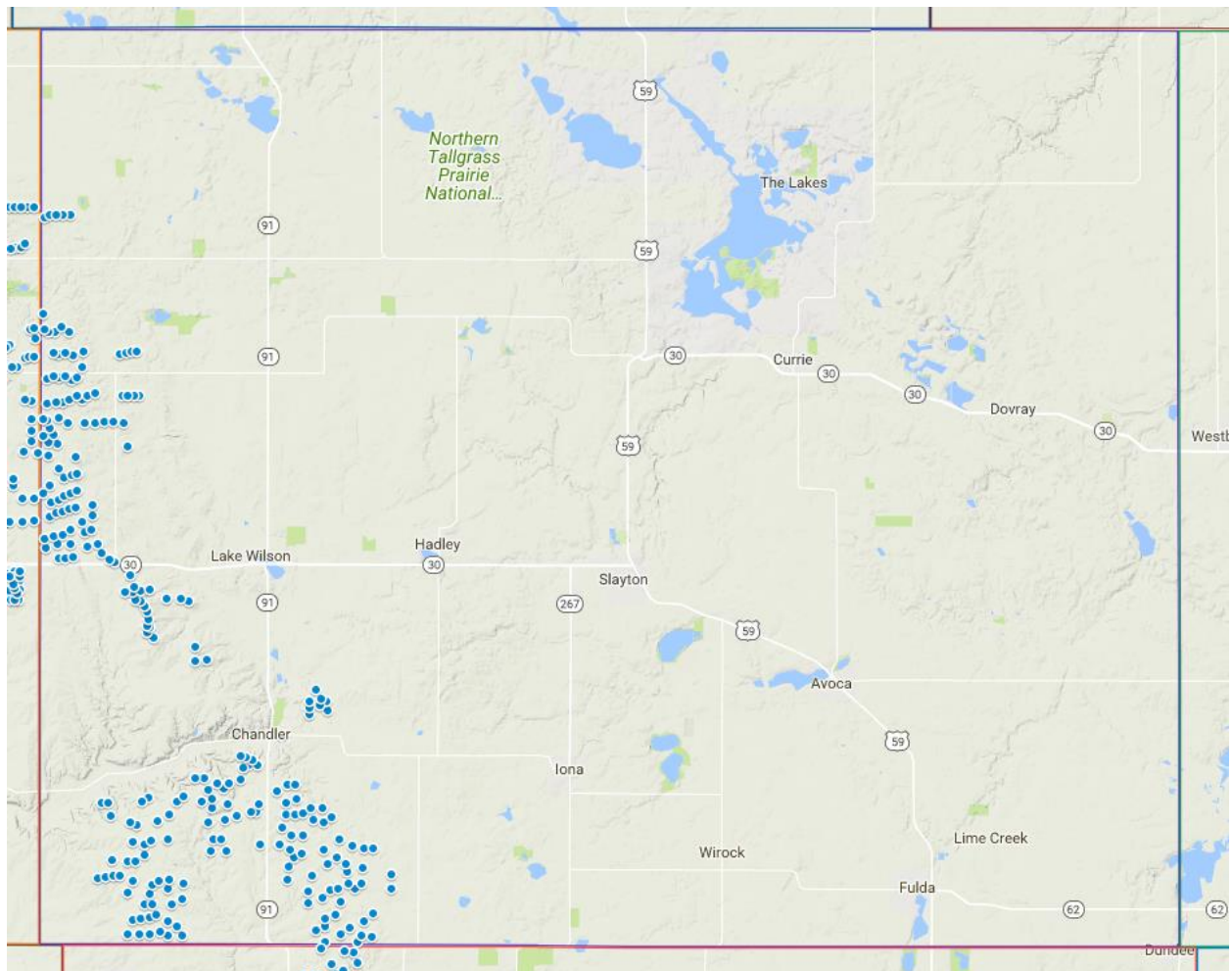
⁷⁵ Rand. Accessed: 5/29/13. Available: http://www.rand.org/pubs/research_briefs/RB9438/index1.html

could result in a number of chemicals being emitted into the air and the ground water. There is also chemical byproduct from cooking meth that is often discarded. This chemical byproduct could infiltrate the ground water and cause ground water contamination.

Decommissioning of Wind Towers

There are a number of wind towers in Murray County and more are being built. They are located predominantly along the edge of the Coteau des Prairies – locally known as Buffalo Ridge – in the western portion of the county. There is a concern of wind towers being abandoned and property owners left with removal and cleanup. There are removal and cleanup guarantees in the majority of the contracts with the wind farms, but if the wind farm files bankruptcy or closes all together, there may not be funding for removal and cleanup. There would be a substantial cost associated with decommissioning wind towers.

Figure #106
Wind Towers in Murray County⁷⁶



⁷⁶ Source: USGS. Accessed 8/23/2017. Available: <https://eerscmap.usgs.gov/windfarm/>

Relationship to Other Hazards—Cascading Effects

- Fire. Hazardous materials incidents may cause or occur in conjunction with a fire. This could result in the fire spreading at a fast rate and can make containing and fighting the fire more difficult. Specialized equipment may be required to combat the fire caused or in conjunction with a hazard material.
- Water Supply Contamination. An incident involving hazardous materials on the roads, rail, or in the air can lead to a water contamination issue. Wellhead Protection Plans discuss the infiltration of chemicals leaking into ground water aquifers. The issue of infiltration could be multiplied by a load of hazardous materials being transported on any of the main highways being in a crash and causing contamination to the ground water.
- Terrorist activity. Most hazardous materials in transit are marked, but there is an unknown volume of government materials being shipped that are not marked due to security reasons. Since MN HWY 23 passes through Lincoln County, there is an increased risk of a semi-truck being stolen and used in a terrorist activity.
- Public Health Emergency. Hazardous materials being proceeded in or shipped through Lincoln County could be involved in a crash. The exposure of radiological substances by unprotected humans might result in the negative effects caused by such an exposure. It can be life threatening depending upon how much exposure and the length of the exposure time.

Previous Occurrences of the Hazard

Hazardous material incidents can occur in different locations:

- Fixed site facilities
- Highway and rail transportation
- Air transportation
- Pipeline transportation

There have been 6 hazardous materials incidents in Murray County since 2000.⁷⁷ The incidents are listed in the table below. It is unknown how many hazard materials are buried in Murray County.

Vulnerability

With US 59 and MN 30 and 62 passing through the county, there is some risk that there will be a crash involving hazardous materials.

As traditional drugs, like cocaine, become more scarce and expensive due to the War on Drugs, it is likely demand for synthetic drugs, like meth, will increase. This increase in demand will entice more people to supply the drug. Meth can be produced locally and is relatively inexpensive to manufacture, so as the number of meth labs increase due to the increase in demand, the probability of a hazardous event involving a meth lab increases.

⁷⁷ USCG National Response Center – EPA Hazardous Incidents Reports. Accessed 8/14/17. Available: <http://nrc.uscg.mil/>

Figure #107
Hazardous Materials Incidents – Murray County

Date/Time	Type	Cause	Nearest City	Description
6/8/2017 9:00	MOBILE	OTHER	CHANDLER	CALLER IS REPORTING THAT A WATER TRUCK WAS INVOLVED IN A DUAL ACCIDENT AND SPILLED MATERIALS ON THE ASPHALT AND ROAD DITCH.
10/6/2011 16:00	PIPELINE	OPERATOR ERROR	GARVIN	CALLER STATED THAT THERE WAS A RELEASE OF 1000 GALLONS OF SEWAGE FROM A SEWAR FORCE MAIN. THE CAUSE WAS DUE TO DIGGING TO CLOSE TO THE LINE.
11/1/2011 16:00	STORAGE TANK	EQUIPMENT FAILURE	SLAYTON	CALLER STATED ANHYDROUS AMMONIA RELEASED FROM A NURSE TANK IN A FIELD DUE TO A BROKE VALVE FITTING.
11/11/2010 17:15	STORAGE TANK	EQUIPMENT FAILURE	CURRIE/ SLAYTON	A PIN BROKE ON A HITCH CAUSING A RELEASE OF ANHYDROUS AMMONIA FROM A NURSE TANK.
2/21/2006 6:14	PIPELINE	UNKNOWN	SLAYTON	CALLER STATED THERE WAS A 6" CARBON STEEL PIPELINE BREAK DUE TO UNKNOWN CAUSES AT THE FACILITY. CALLER ALSO STATED THE WATER AND POT ASH MIXTURE IS CONTAINED INSIDE OF THE BUILDING BUT THE RELEASE OUTSIDE OF THE BUILDING IS JUST WATER.
7/31/2000 8:00	FIXED	UNKNOWN	CHANDLER	THE CALLER IS REPORTING A RELEASE DUE TO ROUTINE MAINTENANCE ON A REFRIGERATION SYSTEM.

With US Hwy 59 and MN 30 and 62 running through the county, hazardous materials may be traveling through the area at any time. This volume of hazardous materials traversing Murray County poses a serious risk of a hazardous material incident occurring. Precautionary measures are in place to prevent an all traffic accidents from occurring, but a crash on a highway involving a tanker of hazardous materials could result in a major hazardous material incident. A major incident could have large cascading effects since almost all water for public consumption in Southwest Minnesota is sourced from underground aquifers, rather than surface waters.

Plans and Programs

- State agency cooperation – Murray County works directly with the appropriate state agencies to address needs for responding to and mitigating the impacts of a hazardous materials event.
- Emergency Operations Plan – The EOP discusses Radiological/Hazardous Materials and outlines procedures for dealing with hazardous material accidents, spills, and releases. EOP identifies the 302/312 facilities within Murray County that maintain a supply of hazardous chemicals.
- Environmental health regulations – Murray County has worked to develop environmental health regulations and a County Safety Procedures and Policy Guide. These documents are cross-departmental plans that deal with hazardous material, infectious disease, and food-borne illnesses. They serve to provide guidelines to protect the citizens of the county.
- Training of emergency personnel – All emergency personnel are trained to at least the minimum Hazardous Materials Awareness level and all first responder groups conduct the required Occupational Health and Safety Administration training on a yearly basis.
- Ordinance – Murray County has a meth lab ordinance describing the policies and procedures for cleaning up such a site. The cost of the cleanup is billed to the property owner.
- Murray County Solid Waste Plan – In 2014, Murray County updated its ten year Solid Waste Plan. The plan identifies the policies and programs regarding Hazardous Waste Management for the county. The plan also identifies the large waste generators within the county.
- Hazardous chemicals collection – Murray County’s Emergency Manager works with the Department of Public Safety, Emergency Response Commission to assist in the statewide collection of hazardous chemicals existing at facilities throughout Murray County so that local emergency officials can prepare for incidents.
- Mobile Household Hazardous Waste Unit – In 1992, Murray County purchased a Household Hazardous Waste Mobile Unit to provide a service to the smaller communities within Murray County. The unit provides an opportunity for residents to dispose of their HHW correctly and safely.
- Regional hazardous waste facility. Murray County works with the regional office in Marshall, MN, in providing a way for Very Small Quantity Generators (VSQG) to dispose of their hazardous waste.
- Hazardous Materials Response Team – Murray County does not have a HAZMAT Team. Murray County coordinates with the HAZMAT Team out of Mankato and Marshall. Marshall has a CAT Team out of their MERIT Center. Sioux Falls could potentially be added as a HAZMAT Team, but state lines can make coordination more difficult.
- SW MN is served by the Marshall Chemical Assessment Team (CAT), but they only tell you what kind of chemical has been spilled, they don’t do cleanup.
- Monitoring program – A number of store owners currently report to the sheriff’s office when products are sold that are used in making meth.
- Avera Marshall Regional Medical Center and Sanford Tracy Medical Center both have a portable decontamination shower. The facility has access to other decontamination assets, personal protective equipment (PPE), and other resources through the System and Regional partners which can be deployed with a phone call (through SWEPT).

- MnDOT – MnDOT has several departments to address hazardous materials, freight, emergency management and disaster preparedness. The District State Aid Engineer is a good contact for access to those resources.
- Regional and State assistance – Plans are in place specifying hazardous material cleanup and protocol for who should be contacted for regional and state assistance.

Gaps and Deficiencies

- Specialized equipment – Murray County fire departments are in need of specialized equipment to deal with hazardous materials. This equipment is often a single use item and is a high cost item. Maintaining this equipment is expensive, so this equipment is often not purchased, available, or dies on the shelf.
- Public education regarding drug ingredients – Public outreach to business owners needs to occur more frequently regarding substances used in making meth and other controlled substances.
- Hazard material / Meth lab cleanup -The sheriff's office and local fire departments are trained to handle a number of hazardous materials, but for meth labs and other hazard materials a HAZMAT certified cleanup team is required. The Murray County sheriff's office does not have a HAZMAT Team. Meth lab clean up can be very costly. If a fire fighter goes into a fire and sees that it is a meth lab, the equipment the fire fighter is wearing is no longer good. The chemicals in the fire contaminate the suit, so there are other costs that can be associated with a meth lab fire and clean up.
- Hazardous material training for first responders – First responders are trained to recognize hazardous materials and establish a perimeter. Hazardous material training only happens every three years for emergency responders. A refresher course would be helpful for emergency responders.
- 302 Facilities portable database – It may be time consuming to look up what hazardous materials a 302 facility is storing. A more usable database could assist with emergency response and increasing the safety of emergency responders.
- Proper hazardous waste disposal – Although the Murray County Household Hazardous Waste Facility is open, there is still a need to educate the public and businesses on how to dispose of their waste properly.
- Drug Drop Box outreach and marketing – There is a prescription and over the counter medication disposal drop box in Slayton. The Murray County Sheriff's office set up the drug drop box. Additional outreach and marketing to the public is needed to increase use of the drug drop box.
- No firemen are trained for this beyond awareness. There is no ability to do cleanup. Need for chemical storage disaster training.

5.5.6 Public Health Emergencies

As technology developed people started to demand sewer systems, running water, and waste disposal. This helped to prevent the spread of disease and helped to maintain a healthier public. As building technology also developed people started to demand safe and well-built buildings. This made it safer for people to live and work. Local government saw these demands and has tried to create uniformity through regulation. Through this government regulation the public health service evolved.

Public health services today face new challenges to counter ever-evolving disease. The Minnesota Department of Health (MDH) works with Department of Public Safety (DPS) and other agencies to prepare for large-scale emergencies of many types. Infectious diseases can present wide threats to many people, or very narrow threats to highly susceptible populations.

- An “epidemic” is a disease that occurs suddenly in numbers clearly in excess of normally expected rates.
- A “pandemic” is an epidemic that spreads across a large region.

Figure #108
Cases of Selected Communicable Diseases Reported to the Minnesota Department of Health by District of Residence, 2015

Disease	District (population per U.S. Census 2014 estimates)								Unknown Residence	Total (5,372,030)
	Metropolitan (2,919,177)	Northwestern (157,393)	Northeastern (326,026)	Central (732,492)	West Central (235,563)	South Central (290,521)	Southeastern (498,011)	Southwestern (212,847)		
Anaplasmosis	145	104	96	186	49	5	23	5	0	613
Arboviral disease										
La Crosse	0	0	0	0	0	1	0	0	0	1
West Nile	5	0	0	2	1	0	0	1	0	9
Babesiosis	9	14	3	12	5	1	1	0	0	45
Blastomycosis	16	3	5	7	1	0	2	0	0	34
Botulism (Infant)	0	0	0	0	0	0	1	0	0	1
Brucellosis	3	0	0	0	0	0	1	0	0	4
Campylobacteriosis	469	15	29	152	42	47	91	79	0	924
Cryptosporidiosis	72	7	8	58	44	30	60	37	0	316
Escherichia coli O157 infection	49	2	1	22	4	6	11	20	0	115
Hemolytic uremic syndrome	2	0	0	4	1	1	2	1	0	11
Giardiasis	316	15	42	105	23	25	49	45	0	620
Haemophilus influenzae disease	37	6	8	17	3	9	10	14	0	104
HIV (non-AIDS)	200	1	3	7	3	2	6	2	4	228

Disease	District (population per U.S. Census 2014 estimates)								Unknown Residence	Total (5,372,030)
	Metropolitan (2,919,177)	Northwestern (157,393)	Northeastern (326,026)	Central (732,492)	West Central (235,563)	South Central (290,521)	Southeastern (498,011)	Southwestern (212,847)		
AIDS (diagnosed in 2015)	93	3	3	6	4	3	7	2	20	141
Legionellosis	31	0	5	6	1	2	6	0	0	51
Listeriosis	1	0	0	1	0	0	1	0	0	3
Lyme disease	555	44	120	288	49	18	92	10	0	1176
Measles (rubeola)	2	0	0	0	0	0	0	0	0	2
Meningococcal disease	2	0	1	2	0	0	2	0	0	7
Mumps	6	0	0	0	0	0	0	0	0	6
Pertussis	343	23	30	88	13	6	75	14	2	594
Q Fever (acute)	0	0	1	1	0	0	0	0	0	2
Salmonellosis	578	18	36	135	31	48	70	59	0	975
Sexually transmitted diseases										
Chlamydia trachomatis -genital infections	13534	461	992	1901	576	823	1470	370	1111	21238
Gonorrhea	3166	50	130	263	87	54	185	23	139	4097
Syphilis, total	569	3	13	29	1	10	19	10	0	654
Primary/secondary	220	0	2	10	2	4	5	4	0	246
Early latent*	162	3	1	10	0	3	4	2	0	185
Late latent**	184	0	10	9	1	3	9	4	0	220
Congenital	3	0	0	0	0	0	0	0	0	3
Other***	0	0	0	0	0	0	0	0	0	0
Shigellosis	244	1	6	12	8	8	8	5	0	292
Streptococcal invasive disease - Group A	124	10	27	32	8	8	20	7	0	236
Streptococcal invasive disease - Group B	275	13	39	76	15	30	62	17	0	527
Streptococcus pneumoniae disease	238	16	50	81	32	44	51	22	0	534
Toxic shock syndrome (Staphylococcal)	10	0	0	1	0	0	0	0	0	11
Tuberculosis	111	1	0	9	3	4	18	4	0	150
Varicella	167	4	10	75	9	35	33	28	0	361
Viral hepatitis, type A	15	0	2	0	1	2	1	0	0	21

Disease	District (population per U.S. Census 2014 estimates)								Unknown Residence	Total (5,372,030)
	Metropolitan (2,919,177)	Northwestern (157,393)	Northeastern (326,026)	Central (732,492)	West Central (235,563)	South Central (290,521)	Southeastern (498,011)	Southwestern (212,847)		
Viral hepatitis, type B (acute infections only, not perinatal)	15	0	0	2	0	0	2	0	0	19
Viral hepatitis, type C (acute infections only)	13	2	10	4	4	1	2	1	0	37

* Duration ≤1 year

** Duration >1 year

*** Includes unstaged neurosyphilis, latent syphilis of unknown duration, and latent syphilis with clinical manifestations

County Distribution within Districts

Metropolitan - Anoka, Carver, Dakota, Hennepin, Ramsey, Scott, Washington

Northwestern - Beltrami, Clearwater, Hubbard, Kittson, Lake of the Woods, Marshall, Pennington, Polk, Red Lake, Roseau

Northeastern - Aitkin, Carlton, Cook, Itasca, Koochiching, Lake, St. Louis

Central - Benton, Cass, Chisago, Crow Wing, Isanti, Kanabec, Mille Lacs, Morrison, Pine, Sherburne, Stearns, Todd, Wadena, Wright

West Central - Becker, Clay, Douglas, Grant, Mahnommen, Norman, Otter Tail, Pope, Stevens, Traverse, Wilkin

South Central - Blue Earth, Brown, Faribault, LeSueur, McLeod, Martin, Meeker, Nicollet, Sibley, Waseca, Watonwan

Southeastern - Dodge, Fillmore, Freeborn, Goodhue, Houston, Mower, Olmsted, Rice, Steele, Wabasha, Winona

Southwestern - Big Stone, Chippewa, Cottonwood, Jackson, Kandiyohi, Lac Qui Parle, Lincoln, Lyon, Murray, Nobles, Pipestone, Redwood, Renville, Rock, Swift, Yellow Medicine

Source: <http://www.health.state.mn.us/divs/idepc/newsletters/dcn/sum15/2015dcn.pdf>

Locations Affected by the Hazard

People throughout Murray County are equally affected by this hazard.

Extent of the Hazard

“Infectious diseases have the potential to affect any form of life.”⁷⁸ Some infectious diseases that were thought to have been eradicated have re-emerged and new strains present threats to the populations and require monitoring. Different strains of the influenza virus emerge seasonally and require modifications to antibiotics and vaccinations.

⁷⁸ MN All Hazard Mitigation Plan. Accessed: 5/29/13. Available: https://dps.mn.gov/divisions/hsem/hazard-mitigation/Documents/2011_MinnesotaAllHazardMitigationPlanDraft.pdf

Infectious diseases in livestock also pose a significant risk. Food supplies could be affected and the livelihood of the owners of livestock will be impacted. Certain infectious diseases are considered more likely to present a public health emergency hazard in rural Minnesota.

Many infectious diseases are preventable and controllable. Measles, Rubella, Polio, and Pertussis are all vaccine preventable diseases. These diseases are no longer common, but a single case can cause a public health emergency. Doctors are often not looking for these diseases, so they may be overlooked which can cause the disease to spread. Also, more parents are electing not to vaccinate which puts the entire population at greater risk.

Arboviral Encephalitis commonly known as West Nile Virus is a mosquito transmitted disease that can cause encephalitis in people and horses. This virus was usually found in mosquitos and birds in Africa and Europe. However, West Nile encephalitis was reported in New York City in 1999.⁷⁹ In 2012, there was one death in Minnesota associated with West Nile Virus. In Murray County there were three cases of West Nile Virus.⁸⁰

In 2009, the Centers for Disease Control and Prevention (CDC) started taking larger steps to combat H1N1 (sometimes called “swine flu”). H1N1 was first detected in people in the United States in April 2009. This virus has the potential to spread fast and can cause severe illness in people. The virus can spread person to person, much in the same way the seasonal influenza is spread.⁸¹

Smallpox has not been an issue in the United States for more than 50 years. Due to the threat of terrorism, this disease has been thrust to the forefront of public concern and fear. Smallpox is a serious, contagious, and sometimes fatal infectious disease. There is no specific treatment for smallpox. The only prevention for small pox is vaccination.

“Ebola is a rare and deadly disease caused by infection with a strain of Ebola virus. The 2014 Ebola epidemic is the largest in history, affecting multiple countries in West Africa. The risk of an Ebola outbreak affecting multiple people in the U.S. is very low.”⁸²

Relationship to Other Hazards—Cascading Effects

- Emergency Response. A public health emergency will affect the ability to respond and recover from any other natural or other hazard. If an epidemic event were to occur, deaths could be in the many hundreds of thousands across the nation.
- Civil Disturbance. If the health of the general public is perceived to be threatened on a large scale, riots or states of lawlessness are a possibility.

⁷⁹ Minnesota Department of health. Accessed: 8/19/13. Available:

<http://www.health.state.mn.us/divs/idepc/diseases/westnile/>

⁸⁰ Minnesota Department of health. Accessed: 8/19/13. Available:

<http://www.health.state.mn.us/divs/idepc/diseases/westnile/wnvmap12.pdf>

⁸¹ Center for Disease Control and Prevention. Accessed: 5/29/13. Available: <http://www.cdc.gov/h1n1flu/qa.htm>

⁸² Center for Disease Control and Prevention. Accessed 11/5/14. Available:

<http://www.cdc.gov/vhf/ebola/outbreaks/2014-west-africa/index.html>

Previous Occurrences of the Hazard

Standard procedures involve collection of accurate assessment data, outbreak detection and investigation, and development of appropriate control strategies based on specific epidemiological data. These activities require close collaboration between health care providers, clinical laboratories, state and local health departments, and federal agencies.

There have been no major outbreaks of a disease in Murray County in recent years.⁸³

Influenza is a common seasonal occurrence in Murray County, but (according to Southwest Health and Human Services) no major outbreak has occurred. Seasonal influenza is planned for every year. The annual seasonal influenza usually peaks in February.

There are strains of influenza that can be more devastating. Influenza Type A virus has caused three pandemics in the past century worldwide with significant loss of life. Pandemics are caused by the unstable nature of Influenza Type A, and new subtypes that appear through genetic drifts or shifting.

Probability of Future Events of this Hazard & Vulnerability

People contract seasonal influenza every year. Other diseases occur regularly.

If an outbreak occurs that is contagious it is critical to quarantine the population affected by the disease. This is often difficult since the outbreak may go unnoticed for a period of time. Certain mutations of a disease are also becoming more resistant to antibiotics. This is particularly true regarding Influenza Type A. Younger and older population cohorts are at a higher risk for acquiring a disease.

Currently there are measles outbreaks across the United States largely tied to individuals who decline to vaccinate their children. If a certain threshold of Southwest Minnesota's population falls below the threshold needed for herd immunity, a measles outbreak is also possible in Murray County. Complications from measles range from diarrhea to pneumonia to brain inflammation (sometimes causing permanent brain damage).

Plans and Programs

- Emergency Operations Plan – County Emergency Management is working closely with Public Health and local healthcare facilities to mitigate and effectively respond to potential Public Health Emergencies. The Murray County Emergency Operations Plan outlines procedures for county and local governments for contacting appropriate state and federal agencies and provides guidelines and strategies for dealing with infectious diseases. A command structure between local public health and the Emergency Manager is also outlined in the Emergency Operations Plan.
- Southwest Health and Human Services (SWHHS) – SWHHS works with the Minnesota Department of Health (MDH) to address infectious diseases that are listed in MN Rule #4605.7040 (such as Encephalitis, Hepatitis, Influenza, Lyme's Disease, Tuberculosis, and Syphilis). If any of these or other listed diseases should appear in Murray County, SWHHS works with MDH and local medical providers to limit the spread of the disease. SWHHS routinely receives information from MDH via Health Alert

⁸³ Southwest Health and Human Services Data Request. Received: 01/26/2018

Network (HAN) for outbreaks occurring in Minnesota or outbreaks that could impact the state and issues appropriate information based on the most current alerts. SWHHS provides information to public and private employers, schools and hospitals about potential infectious disease threats and prevention measures.

- Area Strategic Stockpile Plan – SWHHS has a Strategic National Stockpile (SNS) plan in place. SWHHS and working with the Minnesota Department of Health and other regional and local partners for the mass distribution of needed medicines and supplies for a Public Health Emergency. SWHHS will continue to coordinate with regional partners for mass distribution of needed medical supplies for a public health emergency.
- Response capabilities (facilities) – SWHHS have designated buildings for the Strategic National Stockpile and Medical Countermeasure Dispensing Sites.
- Medical Countermeasure Dispensing Plan – SWHHS has a Medical Countermeasure Dispensing Plan in place. The plan covers mass dispensing of medicines and supplies/Medical Countermeasure Dispensing (MDS). In the event of a naturally occurring outbreak, bioterrorism incident or mass vaccination, dispensing of medication may be needed within a short period of time to prevent morbidity and mortality due to the incident. SWHHS has four designated medical countermeasure dispensing sites (MDS) which are utilized as an emergency, temporary, public health clinic to provide immunizations or medications to a large number of residents. SWHHS follows guidance from the Minnesota Department of Health (MDH) and works with other local, state, federal, and non-governmental agencies, as necessary.
- Isolation/Quarantine (I/Q) Plan – SWHHS has developed an Isolation & Quarantine plan to prevent the spread of diseases. The I/Q will be event specific. The plan will address measures to protect the public and prevent spread of disease. Isolation measures are directed towards people already ill, who are usually within a health care facility or off site care. Quarantine is a tool used to hold & limit contact between persons who have been exposed to a disease in their own home. Both measures are effective tools in preventing spread of disease. SWHHS does not monitor individuals once they are placed in I/Q. This monitoring will come down from MDH.
- Media outreach – County Emergency Management works with SWHHS and other local media throughout the county in the event of an infectious disease outbreak.
- Vaccination program – SWHHS conducts outreach programs to educate residents on the benefits of routine vaccinations. Part of this outreach is to assure that children and adults have access to recommended vaccines. Targeted groups include children, people with high deductibles, or people with no insurance. People in these groups can receive immunizations through the agency. Flu immunizations are also targeted to some adults within the county. Immunizations are designed to assist families of need in protecting their children and themselves from infectious diseases. SWHHS also participates in the South Central/Southwest Minnesota Immunization Information Connection (MIIC), which is a confidential, computerized network of shared immunizations records. It provides clinics, schools, and parents/adults with accurate, complete, and up-to-date immunization records. This system can assist in alerting participating families if there is any disease outbreak that may put them at risk in their area.

- Environmental health regulations and policies – SWHHS in cooperation with MDH has worked to develop environmental health regulations, a policy guide, and procedures to address infectious disease and food borne illness. Murray County relies on the State for inspections.
- Outbreaks – Murray County Medical Center has written plans for Investigation of Suspected Outbreaks, Significant Epidemiologic Occurrence or Sentinel Events, Pandemic Influenza, Flu Center, and Reporting of Communicable Diseases.
- Southwest Healthcare Preparedness Coalition Team – The coalition represents 23 hospitals, 43 primary care clinics, 50 Nursing Homes, 103 EMS groups and two tribal governments in our 16-county region in southwest Minnesota. Additional coalition members include: State and local representatives from Public Health, Homeland Security and Emergency Management, the Minnesota Department of Health, and the Emergency Medical Services Regulatory Board. The coalition is working together toward enhancing our response to local, regional, statewide, and national emergencies.
- MDH FluSafe Program – Avera Marshall Regional Medical Center has performed staff vaccination and tracked percentage vaccinated each year participating in the MDH FluSafe Program with vaccination efforts of greater than 90% for several years.
- Public education – Southwest Health and Human Services, the agency responsible for the delivery of public health and social services in Murray County, has various campaigns to educate the public on the importance of active living and healthy eating, vaccinations, tobacco, and other public health issues.
- Senior LinkAge Line® – The Senior LinkAge Line® is the Minnesota Board on Aging's free statewide information and assistance service. This service helps to connect Minnesotans to local services.
- ACT on Alzheimer's Marshall – A group dedicated to helping build awareness about dementia. Programs and activities regarding Alzheimer's began as early as 1980. For more information visit: <http://www.actonalz.org/marshall>.

Gaps and Deficiencies

- Strategic National Stockpile vulnerable to power outages – Southwest Health and Human Services (SWHHS) and the Minnesota Department of Health maintain a Strategic National Stockpile (SNS) of needed medicines and supplies for Public Health Emergencies. The medication/vaccinations are vulnerable to power outages. A power outage could result in medicines and supplies not being kept cold and spoiling.
- Response capabilities (facilities) – SWHHS needs to work with Emergency Management, various units of government, and health care facilities to clarify and determine the use of buildings needed to respond to a public health emergency or respond to a hazard.
- Aging population – An aging population puts the county at greater risk of Public Health Emergencies. The population cohort 85 plus has increased by 22.4 percent from 2000 to 2010. As more of the population is dependent on the younger population cohorts to help them, it puts a greater need on the rest of the population to stay healthy. The older population is dependent and requires services the rest of the population provides. If healthcare staff becomes sick that will put a strain on the care capacity of assisted living facilities, other elderly care facilities, and general care facilities.
- Lack of Alzheimer's treatment – There is a lack of treatment facilities for Alzheimer's in southwest Minnesota.

- Lack of mental health treatment – There is a lack of treatment facilities for mental health issues in southwest Minnesota. Mental health issues go undiagnosed and too many people are not getting treatment. The biggest issue is finding a facility to take patients to. Jail space is being used to house people with mental health issues.

5.5.7 Transportation Infrastructure & Transportation Crashes

Infrastructure is a critical need for the operation and competitiveness of a city, county, or region. Infrastructure is the skeleton and nervous system of a community. Infrastructure includes roads and bridges, rail, air and transit.

Minnesotans move goods and people on a variety of transportation networks. In the wake of the Interstate 35W bridge collapse, the 2008 update of the Minnesota AHMP focused attention on the status of bridges across Minnesota.

Locations Affected by the Hazard

Roads, bridges, rails, landing strips, and other transportation infrastructure wear out. Transportation infrastructure is characterized by long-term, capital-intensive investments that are interdependent and vulnerable to both natural and other hazards. Transportation infrastructure continually needs to be inspected and upgraded. Numerous locations in Murray County have the potential to be affected by transportation infrastructure hazards.

Murray County's transportation network is comprised of highways, railways, airports and trails. The system is designed to serve local residents, agriculture and industry, as well as travelers and regional commerce. The Minnesota Department of Transportation (MnDOT) works with the county engineer and municipal authorities to construct, maintain, and regulate a comprehensive system of roads, rail and airports for public and private use.

Roads

There are hundreds of miles of roadway to be monitored and maintained in Murray County. There are city highways, county roads, township roads, and city streets traversing Murray County that all require different monitoring and upkeep. It is critical to keep the system in a good state of repair, so people and goods can travel safely.

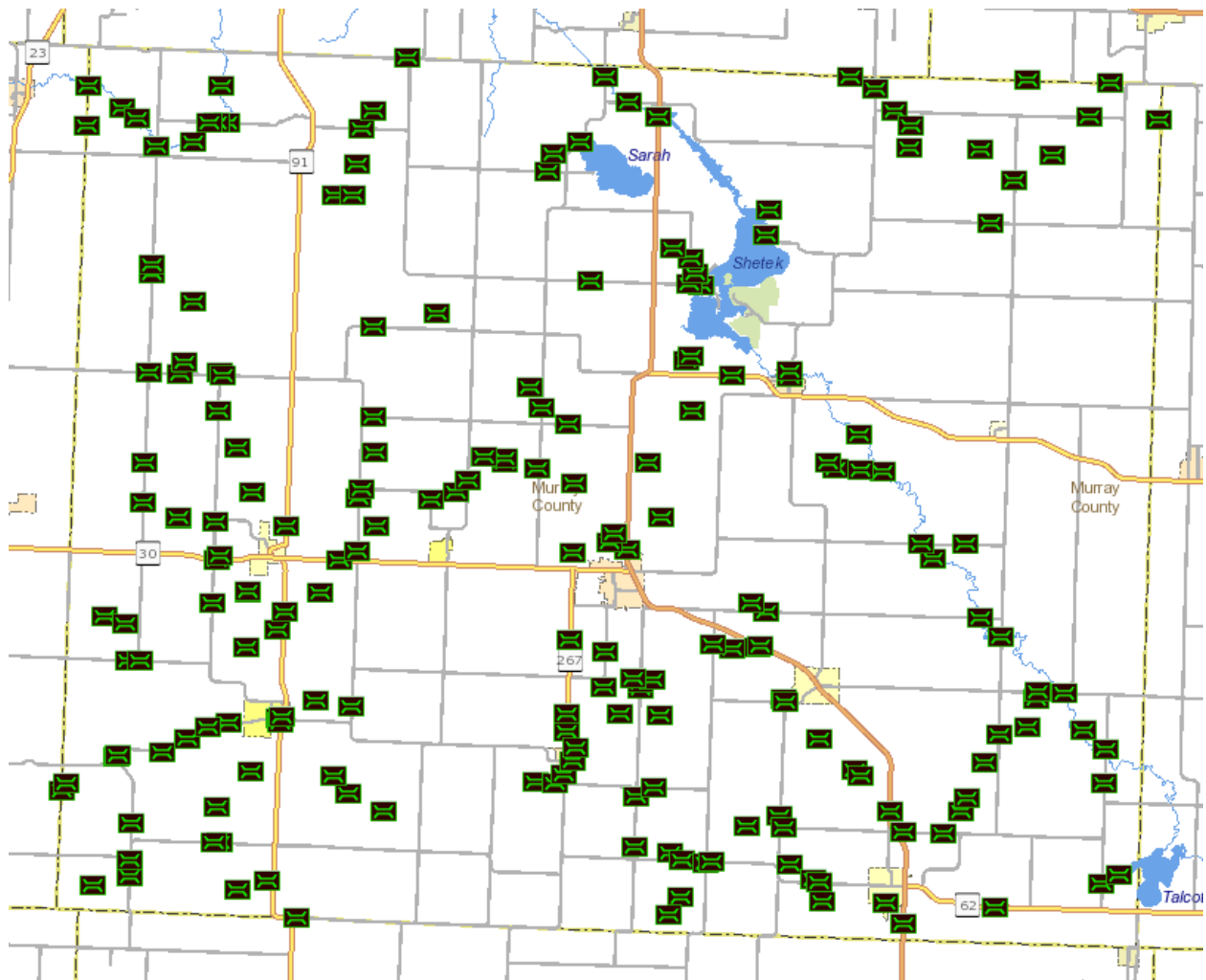
Murray County has roads and bridges in state, county, and local jurisdictions with each entity having primary responsibility for construction and maintenance over their segments. The road network is designated by jurisdiction:

- **Trunk Highway System.** Statewide routes originally established under a 1920 constitutional amendment. The routes are the responsibility of MnDOT. Murray County is located in MnDOT's District 8, which has its primary office in Willmar. U.S. Highway 59, and State Highways 30, 62, 91, and are 267 Trunk Highways (TH routes).
- **County State Aid Highways (CSAH).** Roads or streets established and designated under county jurisdiction in accordance with Minnesota Statutes Chapter 162. The State provides funding assistance to maintain the CSAH system.
- **County Roads (CR).** Roads established and maintained by the county under the sole authority of the county board.
- **Township Roads.** Roads established and maintained by township boards or reverted back to township jurisdiction by the county board.
- **City Streets.** Any street/road in a municipality not otherwise designated.

Bridges

There are approximately 208 bridges on county, municipal, and township roadways within Murray County.⁸⁴ MnDOT lists 131 bridges in Murray County on their inventory of bridges over 20 feet. Many of those bridges intersect with the HAZUS analysis mapped floodplain.

Figure #109
Bridge Map – Murray County⁸⁵



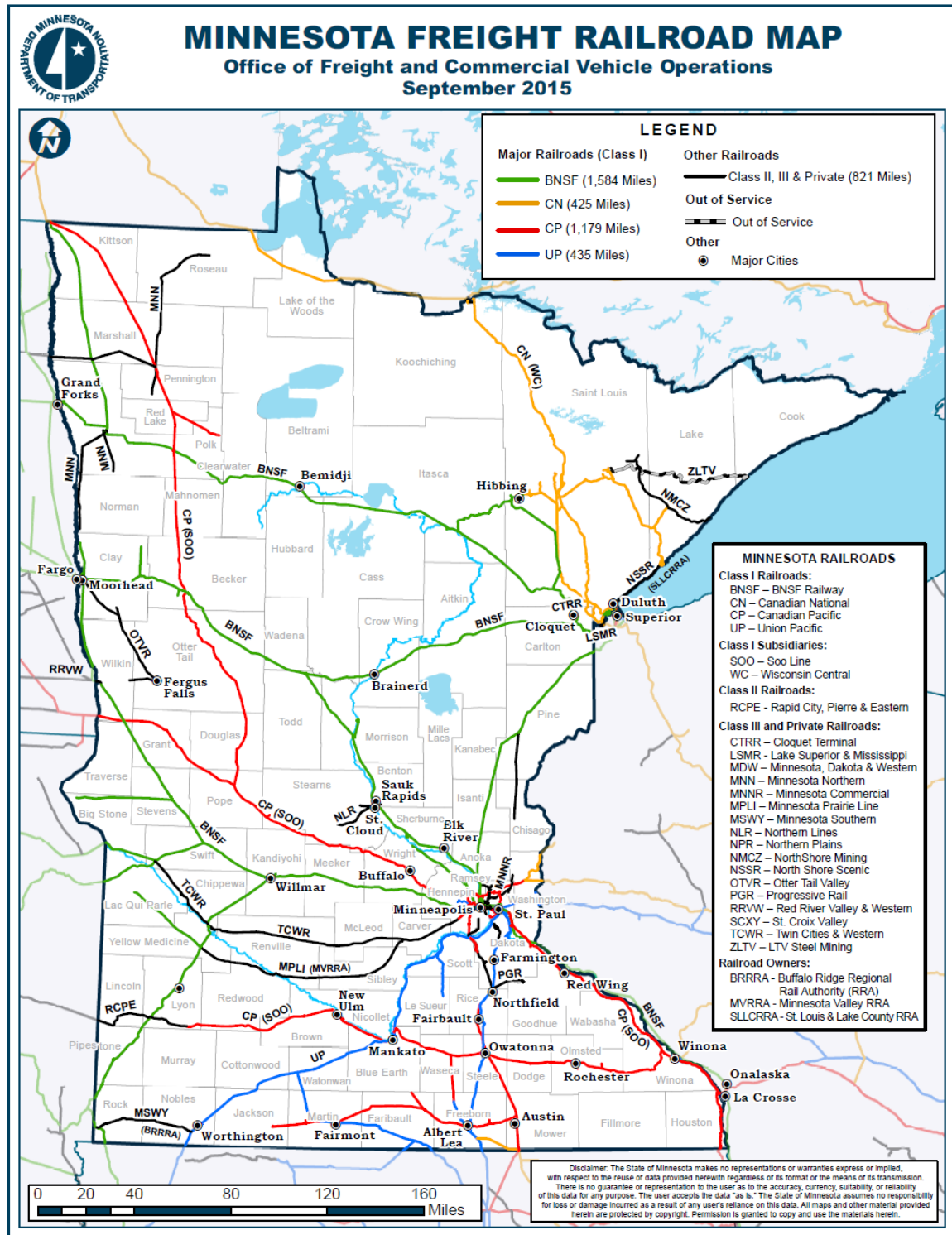
Railroads

There are no railroads serving Murray County. Murray County is one of four counties in Minnesota with no active railroads. See Figure #110 for a statewide map of freight railroads.

⁸⁴ MnDOT. Minnesota Bridges, December 2017. Accessed: 11/6/18. Available: <http://www.dot.state.mn.us/bridge/pdf/minnesota-bridges-2017-report.pdf>

⁸⁵ BridgeInfo3 by State Aid and Bridge of MnDOT. Accessed: 8/15/2017. Available: <http://dotapp9.dot.state.mn.us/bridgeinfo3/>

Figure #110
Railroads – Minnesota



Air Transportation

There is one municipal airport in Murray County, the Slayton Municipal Airport. The Slayton Municipal Airport features a 3,005' asphalt surface runway. The airport averages 63 aircraft operations per week.⁸⁶ The Slayton Municipal Airport is located west of Slayton along MN Highway 267 at its intersection with MN Highway 30.

The city of Slayton have adopted Airport Zoning regulations to protect adjacent land use from conflicts with airport traffic. MnDOT also reviews applications within a certain distance of an airport to reduce the chance of future use conflicts.

Extent of the Hazard

Rails, landing strips, and other transportation infrastructure are monitored, inspected, and maintained to ensure people and goods are transported safely. There are a number of variables that impact safety that vary from current weather condition and design to age and upkeep. Driving and planning for the conditions are important to ensure safety.

One issue that affects road conditions is winter weather. Ice and snow can build up on the road and can cause hazardous driving conditions. Due to the prevailing wind patterns in the area, east-west roads are more susceptible to ice and snow affecting the road surface. Road crews are responsible for maintaining the roadway, clearing snow, and salting for ice. It is also the responsibility of the driver to take the road conditions into consideration and drive appropriately. Winter weather is just one variable that impacts road conditions. There are a number of other variables that impact road conditions.

Traffic crashes are the primary hazard to people and property related to transportation infrastructure. The Minnesota Department of Transportation (MnDOT) and Minnesota Department of Public Safety (DPS) developed the Strategic Highway Safety Plan covering years 2014-2019. The plan was intended to examine the underlying causes of traffic deaths and serious injuries, determine strategies to mitigate those causes, and implement the most promising strategies in the "Toward Zero Deaths" program. The Toward Zero Death program continues today.

The Minnesota Strategic Highway Safety Plan (SHSP) study for the entire state of Minnesota found the most frequent crash types and contributing factors included:⁸⁷

- Lane Departure
- Intersection
- Unbelted Occupants
- Impaired Roadway Users
- Younger Drivers
- Inattentive Drivers
- Speed
- Motorcyclists

These variables along with transportation infrastructure conditions and design can impact the severity of crash or incident. The condition can be a variable that is assumed to be safe, as in the 35W bridge collapse. Bridges are classified as "structurally deficient" if they have a general (poor) condition rating for the deck, superstructure, substructure, or culvert or if the road approaches regularly overtop due to flooding. The

⁸⁶ AirNav. Accessed 8/15/2017. Available: <http://www.airnav.com/airport/KDVP>

⁸⁷ MNDOT. Accessed: 5/29/17. Available: <http://www.dot.state.mn.us/trafficeng/safety/shsp/>

fact that a bridge is structurally deficient does not imply that it is unsafe. If a bridge has been identified as unsafe during a physical inspection, the structure will be closed.

There are approximately 208 bridges on county, municipal, and township roadways within Murray County. These bridges are inspected and a grade of the bridge is given. This helps to ensure the safety of crossing using a bridge. There are 16 bridges in Murray County that have been identified as structurally deficient as of 2016.⁸⁸ In Minnesota, 9.1 percent of bridges are structurally deficient in 2012.⁸⁹

Relationship to Other Hazards—Cascading Effects

- Hazardous Materials. Dangerous roadways can lead to an accident and hazardous materials being spilt. This spill can result in ground water contamination, dangerous chemicals going into the air, and dangerous fire scenarios. If a fuel tanker is involved in the crash, the fire would be extremely hot and the fire would burn until the right equipment can be brought in to control the fire.
- Emergency Response. Dangerous roadways can make emergency response difficult.

Previous Occurrences of the Hazard

From 2006-2015, there were 781 recorded vehicle crashes in Murray County. Eleven of those crashes were fatal (totaling 12 fatalities) and thirty-one crashes caused severe injury. The crashes were geographically dispersed and the causes of the crashes vary.

Aviation Accidents

Since 2010, there have been no recorded aviation incidents in Murray County.⁹⁰

Vehicle Crashes

Fatal crashes per million vehicle miles traveled have been on a steady decline since 1966 in Minnesota. According to Minnesota Department of Public Safety, there were 15 traffic deaths in Murray County from 2004 through 2015. The MN Department of Public Safety's 2015 Crash Facts report states that the top four contributing factors in road fatalities statewide were: speed, distraction, impaired driving, and failure to use a seat belt.⁹¹

⁸⁸ MnDOT. Minnesota Bridges, December 2017. Accessed: 11/6/18. Available:

<http://www.dot.state.mn.us/bridge/pdf/minnesota-bridges-2017-report.pdf>

⁸⁹ Governing. Local Bridges in Bad Shape. Accessed: 2/18/16. Available:

<http://www.governing.com/topics/transportation-infrastructure/gov-local-state-government-owned-bridge-condition-disparity.html>

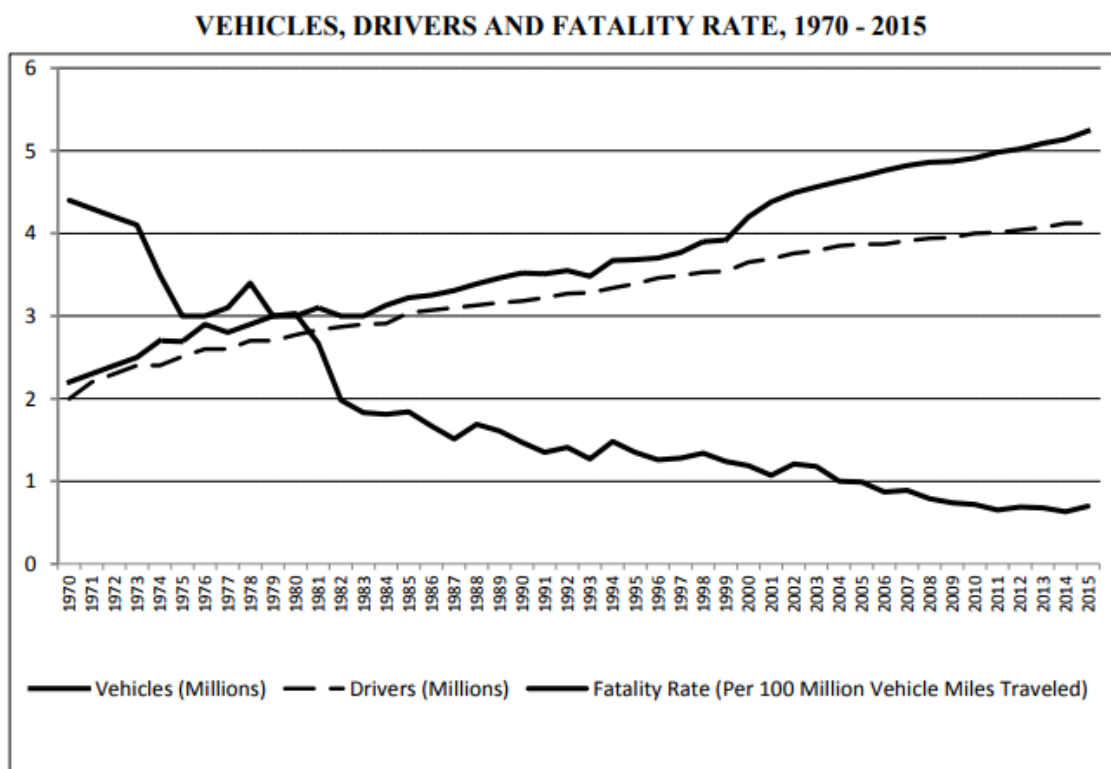
⁹⁰ National Transportation Safety Board. Accessed: 8/15/2017. Available:

https://www.nts.gov/_layouts/nts.gov/Results.aspx?queryId=be5f147f-735a-41e7-a6d8-97e31800d845

⁹¹ Minnesota Department of Public Safety Crash Facts 2015. Accessed: 8/14/17. Available:

<https://dps.mn.gov/divisions/ots/reports-statistics/Documents/2015-crash-facts.pdf>

Figure #111
Driver Fatality Rate – Minnesota



Source: Minnesota Department of Public Safety

Figure #112
Motor Vehicle Crashes & Fatalities – Murray County

Year	Number of Crashes	Number of Fatal Crashes	Number of Fatalities
2015	54	1	1
2014	64	1	2
2013	63	0	0
2012	76	2	2
2011	85	1	1
2010	90	1	1
2009	93	0	0
2008	70	0	0
2007	74	3	3
2006	109	1	1
2005	87	2	2
2004	93	2	2

Source: MN Department of Public Safety

Figure #113
Fatal & Serious Crashes – Murray County

Murray County

Fatal and Serious Injury Crashes, 2012-2016

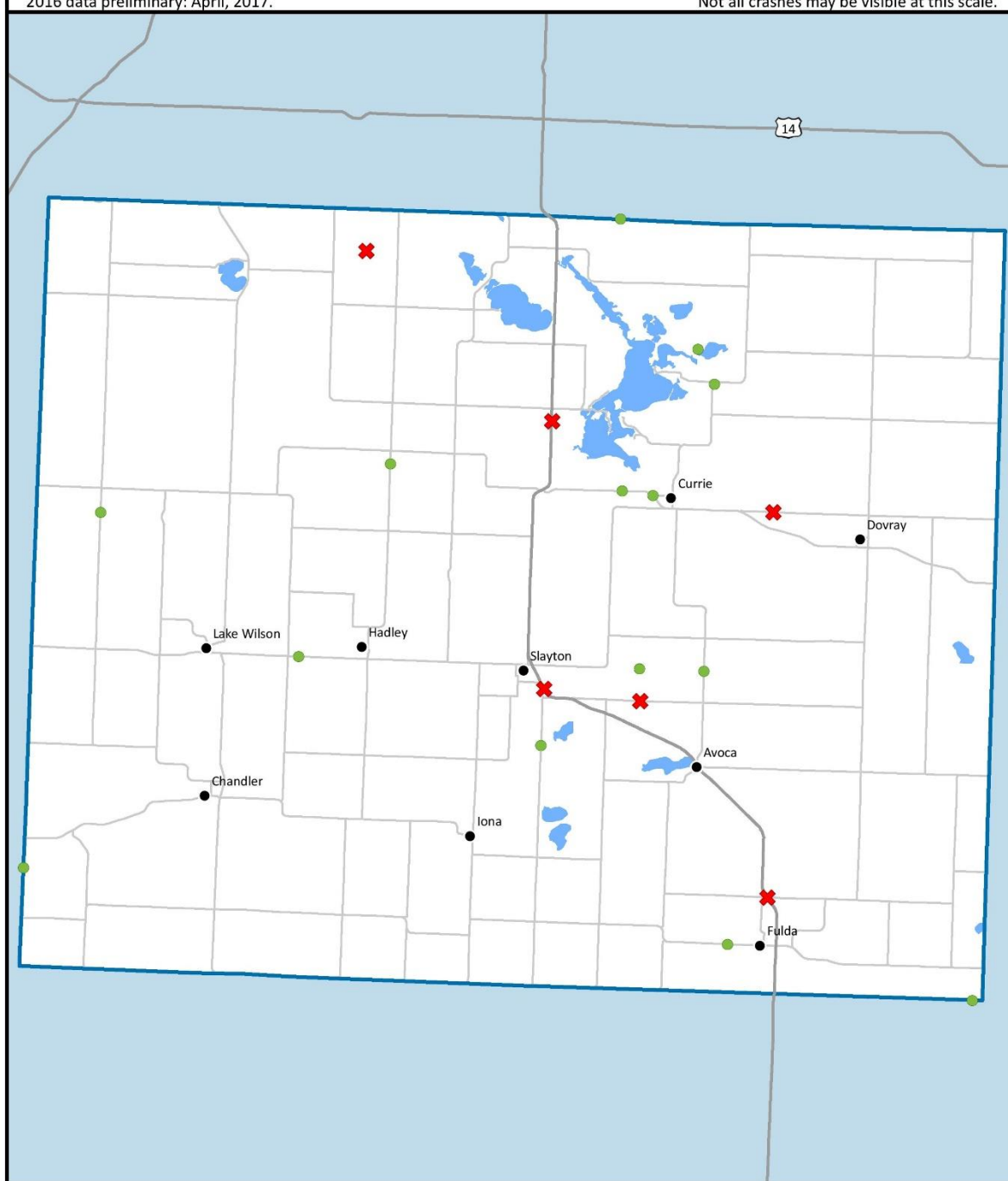
- ✖ Fatal Crash
- Serious Injury Crash



0 5 10 Miles

2016 data preliminary: April, 2017.

Not all crashes may be visible at this scale.



Bridges

There have been no recent bridge related incidents in Murray County.

Railroads

Because there are no railroads in Murray County, there have been no recent incidents nor are there foreseeable future derailments, spills, etc.

Vulnerability

Fatal crashes are more likely to occur in rural areas, which are defined as having a population of less than 5,000 people. In 2015, 70 percent of all fatal crashes in Minnesota occurred in rural areas.⁹²

There are a number of variables that impact the likelihood of a crash from driver distraction to infrastructure failure. Distracted drivers are a definite threat to safety regarding other drivers, pedestrians, and bicyclists. Infrastructure failure, like a bridge collapsing, can also cause transportation crashes, but are less common.

Transportation infrastructure is a basic component of government. Funding for transportation infrastructure should be maintained in every budget cycle, but funding previously allocated for transportation infrastructure has been used for other programs, like subsidizing ethanol and other programs in the general fund. This has resulted in less funding to maintain our transportation infrastructure. This decrease in funding makes maintaining and improving our transportation infrastructure more difficult.

Plans and Programs

- Emergency Operations Plan – The Murray County Emergency Operations Plan explains the procedures of evacuation during an emergency evacuation.
- Road authorities – The Murray County High Department works closely with MnDOT to improve local transportation infrastructure. MnDOT encourages discussions to identify and improve locations where higher risk areas of conflict may exist and is interested in suggestions to improve safety. Public Roadways and other transportation infrastructure are inspected, monitored, and maintained to ensure safety.
- Safe Routes to School (SRTS) – Transportation projects around schools may be eligible for SRTS funding. These projects can be related to education, encouragement, enforcement, evaluation, and engineering. During the 2016-2017 academic year, the Murray County Central School District along with the City of Slayton completed the SRTS planning process. The Fulda School District completed the SRTS planning process the following academic year. Southwest Regional Development Commission staff and MnDOT can discuss potential SRTS projects on request.
- Towards Zero Deaths (TZD) – Strategies for promoting safe driving are important facets to MnDOT's TZD program. Many counties are forming local TZD coalitions involving schools, law enforcement, and other agencies. Representatives from Murray County formed a TZD/Safe Roads Coalition in late 2016.

⁹² Minnesotans for Safe Driving. Accessed: 8/15/2017. Available: <http://mnsafedriving.com/just-the-facts/minnesota-statistics-and-laws.html>

Besides Education, the TZD program includes Engineering, Enforcement, and Emergency Services as the “4 E’s” that the TZD program focuses on.

- Murray County Area Safe Committee – The committee is the Towards Zero Deaths committee in Murray County.
- Safe and Sober – A Minnesota campaign under the umbrella of the Minnesota Department of Public Safety and the Office of Traffic Safety. The program is dedicated to reducing traffic related deaths and injuries.
- Traffic safety resources – Several publications, such as the National Cooperative Highway Research Program (NCHRP), are available to MnDOT to suggest options for improved safety for all users. Other technical guides exist to improve pedestrian safety and include: MnDOT Road Design Manual, ADA Tool Kit, MnDOT Bikeways Facility Design Manual, Minnesota Manual on Uniform Traffic Control Devices, and multiple Safe Routes to School Resources.
- Snow management – According to MnDOT, “Drift-free roads are achievable through two mitigation strategies, proper road design and/or the use of snow fences. A suitably designed roadway will promote snow deposition in ditches rather than on the roadway and blowing snow that does reach the road will move across without drifting. Snow fences can also help maintain clear roadways by capturing blowing snow upwind of a problem area and storing that snow over the winter season.”
- National Bridge Inventory System – Bridges or culverts that carry vehicular traffic and are longer than 20 feet are part of the National Bridge Inventory System. In Minnesota, bridges 10 feet or longer are inspected and inventoried. The general condition rating ranges from 0 (failed condition) to 9 (excellent) based on the physical condition of the deck (riding surface), the superstructure (load carrying members such as beams or trusses that support the driving surface), and substructures (abutments and piers).
- Murray County Transportation Safety Plan – the Murray County Highway Department develops a transportation safety plan to identify higher risk intersections and other transportation related safety concerns. Higher risk intersections are identified by the number of crashes and local knowledge by the Murray County Highway Department and local law enforcement. The plan was last updated in 2011.
- Comprehensive Plan – The City of Slayton has a Comprehensive Plan, which contains a chapter on transportation. Transportation goals are outlined in the plan to mitigate transportation related issues.
- ADA Accessibility – Murray County enforces ADA compliance on all public facilities outside of municipalities.
- There are a number of regional assets that are shared throughout southwest Minnesota in Emergency Management Region Five. This is an under-utilized facility at responders’ disposal. Primary among these shared assets is the Minnesota Emergency Response and Industrial Training (MERIT) Center located in Marshall. The MERIT Center provides training opportunities for local and regional emergency responders for a wide variety of situations, including hazardous materials spills, tanker spills and renewable energy related disasters.

Gaps and Deficiencies

- Transportation Funding – As funding has declined the condition of the transportation infrastructure has also declined

- High commuting numbers – Many people in Murray County commute to work, which increases exposure to transportation hazards.
- Road width limitations – A narrow road can cause difficulties when trying to improve safety. If a road is too narrow there is not room to add rumble strips and a safe place to pull over in case of an emergency. Rumble strips alert drivers that they are leaving the travel lane.
- Hazard materials transport – Hazard materials may be shipped via highways.
- Tile remains under Highway 30.

5.5.8 Utility Failure

Utility failure consists of power outages, water treatment system failure, and waste water treatment system failure. Citizens have come to expect these services on a 24/7 basis. When these services fail there can be a social, economic, and public health impact.

Locations Affected by the Hazard

The majority of Murray County residents are connected to and rely on one or more of these systems: power grid, water treatment system, and waste water treatment system. A small percentage of residents have personal backup generator, personal wells, and septic tanks. In the event of a major utility failure, the majority of Murray County residents will be affected by the event.

There are five electric utilities that operative within Murray County. These are: Nobles Cooperative Electric, Xcel Energy, Sioux Valley Southwestern Electric, South Central Electric Association, and Federated Rural Electric Association. Refer to Figure #114 for electric utility service area map.

Nobles Cooperative Electric provides electric service to the vast majority of rural townships and to the Cities of Avoca, Dovray, and Fulda as well as the unincorporated communities of Lime Creek and Wirock and the western portion of The Lakes CDP. Xcel Energy provides electric service to the Cities of Chandler, Currie, Hadley, Iona, Lake Wilson, and Slayton as well as to the eastern portion of The Lakes CDP. A small area along the western border of the county is covered by Sioux Valley Southwestern Electric. Similarly, very small portions of the eastern edge of Murray County are served by South Central Electric Association and Federated Rural Electric Association.

Extent of the Hazard

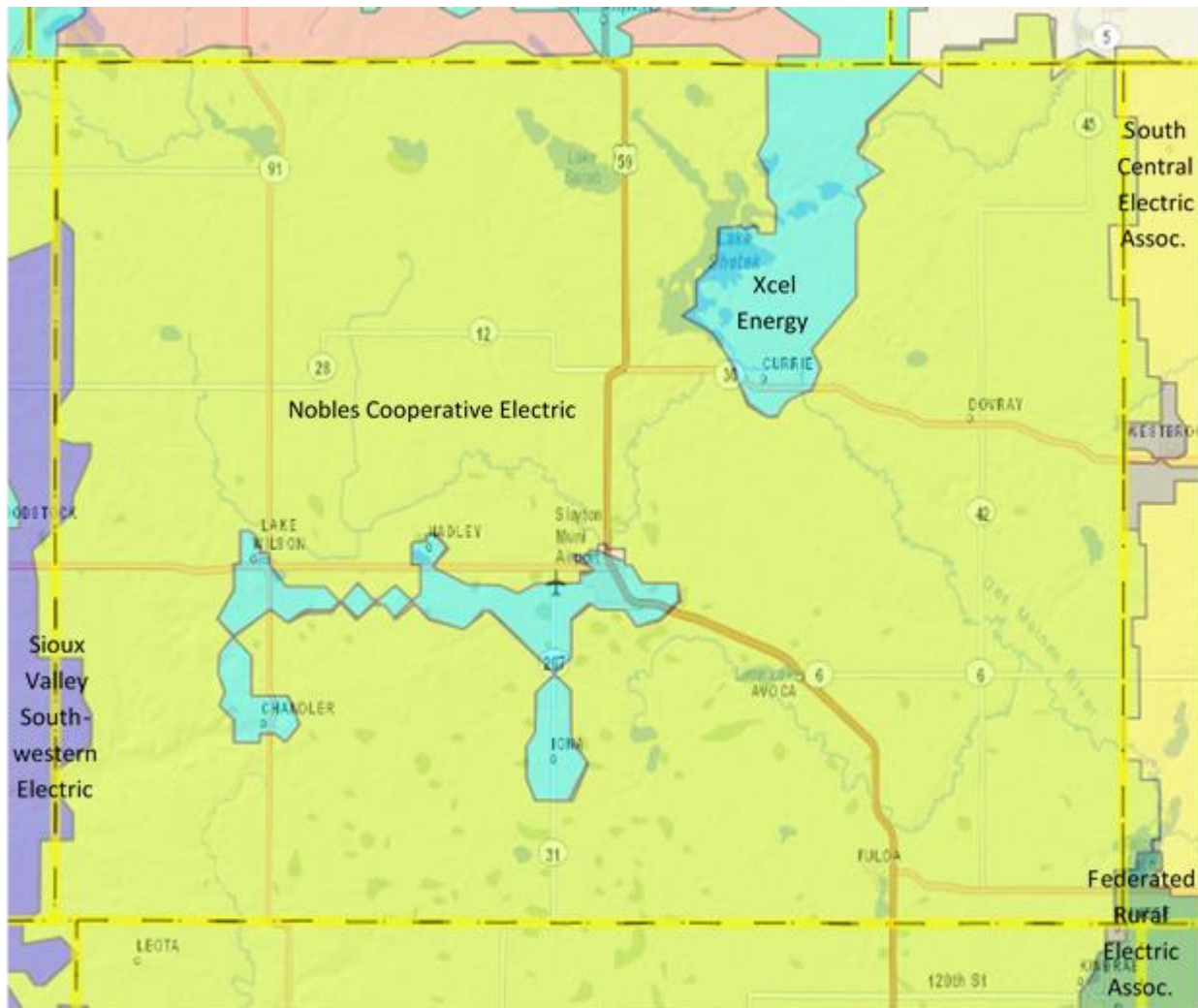
Utility failure can cause hardship and economic loss. The loss of power can have a cascading effect. A loss of power can result in water supply pumps not being able to replenish the water supply for a city or rural water system and water treatment facilities not being able to process waste water. Power interruption can also result in food spoiling, adequate drinking water supplies being diminished, and extreme cold and warm temperatures causing hardship and can be potentially life threatening for both people and livestock. The majority of all feedlots operating within the county rely on electricity for their livestock's water. In terms of animal production, a loss of power could result in large livestock losses. Routine daily activities can also become difficult and overwhelming at times.

Relationship to Other Hazards—Cascading Effects

- **Civil Disturbance.** Food and water are basic necessities and if power is out for multiple days, supplies could be diminished to critical levels. When the supply of a necessity becomes drastic low distress can take over and cause civil unrest. Scarce resources could cause the public to loot and cause civil disorder.
- **Public Health Emergency.** The failure of septic treatment facilities and systems can have immediate adverse impacts on human health due to communicable diseases and epidemics. A water treatment failure could also result in contamination of the water supply.
- **Fire.** Utility failures caused by downed power lines can cause wildfires and structure fires. Fighting a fire would be more challenging since electric pumps are not able to replenish the water supply and

refueling may have to take place a number of miles from the fire. These variables will affect the response time, and will make it more difficult to stay ahead of the fire.

Figure #114
Electric Utilities – Murray County⁹³



Previous Occurrences of the Hazard

Typically, when the power is down it is confined to certain localities and crews can respond immediately and have power restored within hours. However, a severe daylong blizzard can keep crews from getting to the problem. The initial storm and piled up snow left behind can cause the power outage to last for multiple days. Ice storms can also cause power outages that last for multiple days.

⁹³ <http://www.mngeo.state.mn.us/eusa/index.html>

Figure #115
Downed Powerlines



Associated Press

Vulnerability

Natural hazards will continue to cause power outages. Hardening of the utility grid will help to prevent large outages, but the costs of redundancy and hardening of the utility grid will limit the extent of the project.

Though some power lines have been buried, there are miles of power lines in Murray County that are above ground on poles. This makes them vulnerable to winter storms, ice buildup, tornadoes and straight line winds, and other natural disasters.

Plans and Programs

- Tree maintenance – Electric utility providers identify and clean up areas of Murray County that are most likely to experience damage to power lines from falling tree limbs. Murray County works with each of its communities to ensure that these activities are conducted regularly.
- Utility grid upgrades – The utility grid is constantly being upgraded with new poles and technology to make the system more reliable.
- Water storage – There are planning recommendations to help mitigate the impact of utility failure. To help ensure adequate water storage capacity, cities consider two basic recommendations when analyzing water storage needs. First, Minimum storage should be at least 40 gallons/capita. Second, municipal water supply should have a minimum water storage capacity equal to the average daily water usage. During a power outage the water stored in water holding facilities can act as a reserve water supply until power can be regained.
- Underground gas lines – Most gas mains within the county have been placed underground. This makes the lines less susceptible to damage to the system.
- Federated Rural Electric – is working on a four year plan regarding redundancy. Part of this plan is also to bring their new territories into a plan for the future.

- MnWARN – “MnWARN is a formal emergency response program in Minnesota. MnWARN is a mutual aid agreement to provide a program whereby water, wastewater, and storm water utilities sustaining physical damage from natural or man-made disasters in the state of Minnesota can obtain emergency assistance, in the form of personnel, equipment, and materials and other associated services necessary to protect the health and welfare of the utilities' customers.” The following Murray County communities are members of MnWARN: Fulda and Shetek Area Water & Sewer District (Slayton).
- Utility grid hardening – Local electrical cooperatives are hardening the electrical grid through various building techniques. Rural electrics suffer from storm damage and interruptions mainly from ice, wind, and severe weather on its overhead lines, so additional mitigation funding could advance utility hardening projects at a faster rate.
- All wires and poles are inspected regularly.

Gaps and Deficiencies

- Above ground power lines – Many power lines in the county are above ground and subject to damage from ice storms, wind, and falling tree limbs.
- Backup generators – Not all communities have backup electrical generators to guarantee the operation of essential services in the event of a county wide utility failure. Water supplies could be diminished quickly, medical supplies that need to be cold may spoil, large amounts of food may spoil, and waste water could become an issue.
- Essential operating systems – Facilities that have backup generators learned, in the spring ice storm of 2013, that all essential operating systems were not hooked up to the generator. There are also key facilities that do not have backup generators. Refer to Figure #62 for a list of facilities that need new or additional backup generators.
- Cell phone coverage – Cell phone coverage is good in Murray County except for the areas around Lake Shetek and Lake Sarah.
- Public education – Public awareness should be increased for alerting the public of potential damage to gas mains and lines as these could be disrupted at many locations within the county.
- Natural gas lines and township road maintenance – there is a risk associated with snagging natural gas lines along township roads when work is being done. County roads require getting a permit. A permit should also be required along township roads.
- Hardening of the electrical grid – It is important to increase redundancy between the different electrical utilities in Murray County. There is redundancy within individual systems, but there should also be redundancy between systems and suppliers. This would increase the reliability of the grid within Murray County.
- Funding for hardening of the electrical grid – Local cooperatives will be able to harden the grid at a faster rate if rural electric funding could be supplemented with mitigation funding from FEMA and other sources.
- No fuel sources in towns in the event of utility failure. Propane shortage is a concern.

5.5.9 Water Supply Contamination & Availability

Water supply contamination is the introduction of point and non-point source pollutants into public ground water and/or surface water supplies.⁹⁴ Water supply contamination can be the result of mismanaged landfills and dumps, negative externalities of industrial activity, and agricultural run-off. The availability of water is always a concern, with water sources being consumed at high rates across the United States. Coupled with the risk for drought, water supply availability continues to be a concern for the planning team.

Surficial aquifers yield “young water”, with 10-12 year recharge cycles from precipitation. This makes them more susceptible to drought and contamination from both point and non-point sources. The highest quality water comes from these shallow aquifers. The deeper the aquifers the more iron and manganese there is in the water. The more shallow aquifers are preferred since they have better quality water, but are more susceptible to contamination.

Microbiological and chemical contaminants can enter the ground water through leaking underground storage tanks, feedlots, and waste disposal sites. Human wastes and pesticides can also be carried to lakes and streams during heavy rains or snow melt. Areas in Murray County have different risk factors in regards to certain contaminants, but there is equal risk throughout the county for water contamination.

Figure #116
Public Water Supplies – Murray County

Public Water Supplier	ID
Avoca	1510001
Chandler	1510002
Currie	1510003
Fulda	1510005
Hadley	1510006
Iona	1510007
Lake Wilson	1510008
Slayton	1510009
Dovray	1510010

Extent of the Hazard

A major contamination could cause massive disruption to Murray County’s economy and the health of surrounding communities. Removing contaminants from a water supply or relocating a well is an expensive process. Treating water for both human and animal consumption may result in people and farming operations relocating to new locations. This would leave areas of Murray County unused until contaminants are removed from the water supply.

⁹⁴ EPA. Accessed 6/3/13. Available: <http://www.epa.gov/agriculture/tsur.html>

Relationship to Other Hazards—Cascading Effects

- Civil Disturbance. A water supply shortage could also lead to public unrest and civil disturbances. When the supply of a necessity becomes drastically low distress can take over and cause civil unrest. Scarce resources could cause the public to loot and cause civil disorder.

Previous Occurrences of the Hazard

Murray County has not had a major groundwater contamination problem.

Vulnerability

Murray County has some risk of water supply contamination since the county is tapped into aquifers, but no major groundwater contamination has occurred. Water recharge in shallow wells can occur in a matter of hours, so wells that are drilled into the shallow aquifer are more vulnerable to pollutants infiltrating the water supply. A number of regulations and monitoring procedures are in place to help maintain a quality water supply. Refer to the Plans and Programs section under Vulnerability for more measures to keep ground water supplies safe.

Plans and Programs

- Murray County Local Water Management Plan – The Murray County Local Water Management Plan (which was recently updated) encourages water retention practices and identifies the importance of wetland restoration which would help with aquifer recharge. The plan identifies that efforts to protect groundwater should focus on Drinking Water Supply Management Areas (DWSMAs) and surficial aquifers, and it outlines Murray County’s enforcement of the state code for septic systems and floodplain ordinances. The county also does private well water testing through the well water testing program and conducts a free well water nitrate testing clinic at the Murray County Fair.
- Wellhead Protection Program – Several municipalities in Murray County have set up a wellhead protection program, as promoted by the Minnesota Department of Health. All incorporated communities in Murray County will eventually be developing wellhead protection plans. Since 1974, all water wells constructed in Minnesota must meet the location and construction requirements of the Minnesota Well Code. These requirements pertain to private wells, also. Refer to Appendix A for a handout regarding wellhead protection.
- Abandoned Well Sealing Program – Murray County has a cost share program for sealing abandoned wells. This program is part of the Local Water Management Plan.
- Feedlot pollution prevention – Murray County actively works to protect water sources from feedlot runoff. County ordinances require that all feedlots within the county participate in the state’s feedlot program. Also, county and county extension services promote best management practices to minimize runoff from feedlots. County zoning ordinances also limit feedlot locations.
- Subsurface Sewage Treatment Systems (SSTS) – SSTS are commonly known as septic systems and are regulated by Minnesota Statutes 115.55 and 115.56. Minnesota Pollution Control Agency (MPCA) enforces the statutes and Murray County continually works with MPCA towards updating failing septic systems.
- Septic System Code – Murray County enforces the state code for septic systems and floodplain ordinances.

- Household Hazardous Waste Program (HHW) – The Murray County’s HHW program, helps residents with the disposal of toxic household products and provides an exchange program for usable leftover products.
- Wastewater water monitoring – The MPCA requires routine inspection of all public wastewater systems. State staff, in the Water-Quality Point-Source Program, issue permits and monitors compliance through data review and inspections, and enforces permit conditions. Employees at the wastewater facilities are certified operators under state requirements. These operators are required to take state training to maintain their certified operator status.
- Public water system monitoring – The MDH requires routine inspection of all public water systems. State staff issues permits and monitors compliance through data review and inspections, and enforces permit conditions. Employees at the water facilities are certified operators under state requirements. These operators are required to take state training to maintain their certified operator status.
- Drinking water standards – The U.S. Environmental Protection Agency (EPA), as required by the Safe Drinking Water Act of 1974, sets uniform nationwide minimum standards for drinking water. State public health and environmental agencies have the primary responsibility for ensuring that each public water supplier meets the federal drinking water standards or more stringent ones established by the state. The EPA requires an ongoing water quality monitoring program to ensure public water systems are working properly. Local officials work together with the MDH and EPA to ensure that all public water supplies are safe. Also, the EPA requires all local suppliers to promptly inform the public should the supply become contaminated.
- Shoreline zoning – Murray County has adopted the state’s statutory shoreline riparian zoning classifications and minimum standards via ordinance.
- Clean Water, Land and Legacy Amendment – The Clean Water, Land and Legacy Amendment of 2008 increased the sales and use tax rate by three-eighths of one percent on taxable sales, starting July 1, 2009, continuing through 2034. Approximately 33 percent of this revenue is dedicated to the Clean Water Fund to protect, enhance, and restore water quality in lakes, rivers, streams, and groundwater.
- I & I – Cities in Murray County work to reduce Infiltration and Inflow in their sanitary sewer systems.
- County zoning – Several steps are being taken to protect ground water sources from feedlot runoff. County ordinances require that all feedlots within Murray County participate in the State’s feedlot programs. Also, county extension services promote best management practices to minimize runoff from feedlots. County zoning ordinances also limit feedlot locations.
- Inflow & Infiltration – All cities in Murray County work to reduce inflow and infiltration in their sanitary sewer systems.
- Sedimentation pond –Sedimentation ponds are being integrated into highway projects to help slow the flow of water and allow for a more natural water filtration process.

Gaps and Deficiencies

- Backup drinking water sources – The Murray County Emergency Management Plan should identify alternate sources of drinking water, including locations for acquiring adequate amounts of bottled water, in the event of well contamination.
- Public outreach for wellhead protection – Efforts to educate private well owners on the importance of wellhead protection plans are not well planned and coordinated with state and federal efforts.

- Septic system inspection – Murray County does not have an ordinance requiring periodic inspections of individual septic systems. The initial installation must meet MPCA requirements, and it has to be installed by a licensed contractor.
- Security around public water sources – Wells, water towers, groundwater storage tanks and water treatment plants should have additional security. This may include fencing around sites, alarm systems for break-ins and the addition of surveillance cameras. Rural water supplies may be more vulnerable, since security is less.
- Backup electrical generators – Not all communities have backup electrical generators to guarantee the operation of their water supply and/or wastewater treatment facilities.
- Sump pump public education – The general public may be unaware that sump pumps cannot drain into the city wastewater system.
- Wellhead protection plans - All cities do not have Wellhead Protection Plans. The Cities of Chandler, Iona, Fulda, and Lake Wilson have wellhead protection plans. The Cities of Avoca, Currie, Hadley, and Slayton do not have wellhead protection plans, but are encouraged to have one developed by the Minnesota Department of Health within the next five years. The city of Dovray is served by rural water.
- Rural Water Systems Wellhead protection plans – Lincoln Pipestone Rural Water has a water tower in Murray County, but their water source (well) is located outside the county. A new well for Red Rock Rural Water has been located in Murray County, and is currently in the wellhead protection delineation process.
- Wellhead protection plan funding – The Minnesota Department of Health lacks resources to work with every community to complete wellhead protection plans quickly.
- Nitrates – Aquifers in the region are often shallow and have a high potential of contamination from nitrate leaching. Deeper aquifers may not be suitable for water supplies due to naturally occurring contaminants, such as sulfur, or because of slow well recharge. Nitrates have found to be a specific problem in the region. Both cities, Chandler and Lake Wilson, have high aquifer sensitivity, but only Chandler’s well is susceptible.
- Aging infrastructure – The water supply infrastructure in the majority of cities in southwest Minnesota is past its useful life. The water supply infrastructure is old, in need of repair, and is extremely costly to replace. Repairs and replacement is occurring, but this process could be accelerated with state and federal funding. Accelerated funding would help to decrease costs, so cities could make larger updates. There are economies of scale in larger projects and having work done in multiple adjacent cities.
- Fulda pumping station is the only source of water and not sure if there’s a backup generator – this station is also next to Asmus and there is a risk of contamination.
- Towns without wellhead protection plans are a gap.
- Chandler’s well is in the flood plan, but there is likely low cost effectiveness in moving it.

5.6 Hazard Identification Worksheet

5.6.1 Methodology

The Hazard Identification Worksheet below, (Figure 117) is a tool to help profile the identified hazards. In Section II above the results of the Planning Team's Hazard Identification Worksheet were included in the profile of the identified natural and other hazards. The profile and the hazard identification worksheet helped the planning team assign priority to hazard mitigation strategies.

The Hazard Identification Worksheet was developed by the former Minnesota Planning Agency and expanded by the Southwest Regional Development Commission. It is used by assigning a Probability score, (from 1 to 4, with 1 being Unlikely, 2 Possible, 3 Likely and 4 Highly Likely) a Magnitude/Severity Score, (1 is Negligible, 2 is Moderate, 3 is Critical and 4 is Catastrophic) a Warning Time Score (1 is Optimal, 2 Limited, 3 Marginal and 4 Minimal), and a Duration score, (1 is Brief, 2 Intermediate, 3 Extended, 4 Prolonged.) The Probability score accounts for 45% of the total score, Magnitude/Severity accounts for 30% of the total, Warning Time for 15% of the total and Duration 10%. Each event is then scored and the end score is calculated to come up with the Risk Index listed in Figure 118. The Planning Team then looked at the totals and assigned a subjective ranking of Low, Medium or High.

Minnesota State Hazard/Threat Identification and Risk Assessment

Table 1: Modified Calculated Priority Risk Index

0.45 Probability	0.3 Magnitude / Severity	0.15 Warning Time	0.1 Duration
4 - Highly Likely ☐ Event is probable within the calendar year. ☐ Event has up to 1 in 1 year chance of occurring (1/1 = 100%). ☐ Chance of event is greater than 33% likely per year. ☐ Event is 'highly likely' to occur.	4 - Catastrophic ☐ Local jurisdiction is overwhelmed and unable to effectively respond to the hazard. Local resources are inadequate or non-existent. Complete loss of communications. Massive regional, state, EMAC and federal responses is required. Federal disaster declaration. ☐ Local and regional medical services are unable to manage the volume of injuries and fatalities. Mass evacuation, sheltering, and care of displaced residents, medical patients, high risk and vulnerable populations are required. ☐ Loss of public utilities, government and essential services for more than 1 month. Widespread destruction of critical infrastructure, public and private property. More than 50% of critical and non-critical facilities and infrastructure damaged or destroyed. Extended emergency response operations lasting more than 1 month may be required.	4 - Minimal ☐ No-notice up to 6 Hours	4 - Prolonged ☐ More Than 1 Week
3 - Likely ☐ Event is probable within the next three years. ☐ Event has up to 1 in 3 years chance of occurring (1/3 = 33%). ☐ Chance of event is greater than 20% but less than or equal to 33% per year. ☐ Event is 'likely' to occur.	3 - Critical ☐ Local jurisdiction is unable to effectively respond without District-level mutual aid support and significant state assistance. Local resources have been expended and local agencies have reached the limits of their capabilities. Communications seriously degraded with significant impact on operations. State disaster declaration. ☐ Local medical services are unable to manage number of injuries and fatalities. Patients require transportation to regional medical facilities outside of the affected areas. Local area evacuations, sheltering, and care of displaced residents, medical patients, high risk and vulnerable populations are required. ☐ Loss of public utilities, government and essential services for up to 1 month. Significant damage to critical infrastructure, public and private property over a large area. Up to 50% of critical and non-critical facilities and infrastructure damaged. Emergency response operations lasting up to 1 month may be required.	3 - Marginal ☐ 6 to 12 Hours	3 - Extended ☐ Up to 1 Week
2 - Possible ☐ Event is probable within the next five years. ☐ Event has up to 1 in 5 year chance of occurring (1/5 = 20%). ☐ Chance of event is greater than 10% but less than or equal to 20% per year. ☐ Event could 'possibly' occur.	2 - Moderate ☐ Local jurisdiction is able to effectively respond with significant inter-local mutual aid support and limited state assistance. Local and mutual aid resources are adequate to support response. Communications systems operating near capacity. Local medical services are able to manage volume of injuries and fatalities but are near the limits of their capabilities. Only critically injured patients are diverted to facilities outside of the affected areas. Limited evacuations and sheltering required. ☐ Loss of public utilities, government and essential services for up to 1 week. Significant damage to critical infrastructure, public and private property over a localized area. Up to 25% of critical and non-critical facilities and infrastructure damaged. Response operations lasting up to 1 week may be required.	2 - Limited ☐ 12-24 Hours	2 - Intermediate ☐ Up to 1 Day
1 - Unlikely ☐ Event is probable within the next 10 years. ☐ Event has an up to 1 to 10 years chance of occurring (1/10 = 10%). ☐ Chance of event occurrence is less than or equal to 10%. ☐ Event is 'unlikely' to occur.	1 - Negligible ☐ Local jurisdiction is able to manage incident with standard mutual aid and little or no state assistance. Local resources are adequate to support response. Communications system operating normally. Local emergency, local medical services are able to manage number of injuries and fatalities with on hand personnel and resources. ☐ Loss of public utilities, government and essential services for up to 24 hours. Damage contained to a single incident scene and immediate area. Up to 5% of critical and non-critical facilities and infrastructure damaged. Response operations lasting up to 72 hours may be required.	1 - Optimal ☐ 24+ Hours	1 - Brief ☐ Up to 6 Hours

Figure #117

The sorting criteria for categories in the Hazard Identification Worksheet are as follows:

Figure #117A
CPRI Sorting Criteria

Probability:	Unlikely (1) if <1% chance in the next 100 years, Occasional (2) = 1% and 10% chance in next year, Likely (3) = between 10% and 100% chance in next year, Highly Likely (4) = greater than 10% chance in next year.
Magnitude/Severity:	Negligible (1) =<10% area affected destroyed, Moderate (2) = 10% to 25% area affected, Critical (3) = 25% to 50% area affected, Catastrophic (4) = >50% area affected.
Warning Time:	Optimal (1) 24+ hours Minimal , 6 – 12 hours, 12– 24 hours,
Duration:	Prolonged, Extended, Intermediate, or Brief
Risk Level:	Combined ranking based on previous categories
Hazard Rank:	Subjective ranking by Planning Team based on previous categories

Figure #118
CPRI Worksheet – Planning Team Rankings

Hazard	Probability	Magnitude/Severity	Warning Time	Duration	Risk Index	Risk Severity
Winter Storm	3.48	2.06	1.97	2.50	2.73	Medium
Tornado	2.33	2.90	3.33	1.90	2.61	Medium
Hail	3.10	1.60	2.80	1.10	2.41	Medium
Lightning	3.10	1.49	2.62	1.25	2.36	Medium
Windstorm	2.75	2.00	2.25	1.70	2.35	Medium
Extreme Cold	2.81	1.62	1.48	2.80	2.25	Medium
Drought	2.24	1.76	1.24	3.40	2.06	Medium
Extreme Heat	2.33	1.62	1.48	2.75	2.03	Medium
Flash Flood	1.80	1.70	2.38	2.00	1.88	Low
Erosion	1.84	1.37	1.95	2.21	1.75	Low
Flood (Riverine)	1.85	1.40	1.75	2.38	1.75	Low
Wildfire	1.29	1.62	2.81	1.75	1.66	Low
Dam Failure	1.25	1.40	2.55	1.90	1.56	Low
Earthquake	1.00	1.73	2.62	1.37	1.50	Low
Landslide/Mudslide	1.05	1.30	2.25	1.53	1.35	Low
Subsidence	1.00	1.28	2.22	1.72	1.34	Low

5.6.2 Repetitive Flood Claim Properties and Severe Repetitive Loss Properties

Repetitive loss properties are defined by FEMA as having two or more losses of at least \$1,000 each paid under the National Flood Insurance Program (NFIP) within any 10-year period since 1978. A Severe Repetitive Loss (SRL) property is defined by FEMA as a residential property covered under NFIP that has at least four NFIP claim payments over \$5,000 each and the cumulative amount of such claims exceeds \$20,000. An SRL property may also be one for which at least two separate NFIP payments have been made with the cumulative amount of the building portion of these claims exceeding the market value of the building.

Repetitive Loss Properties

FEMA has a nonpublic database of all of the repetitive loss structures within the State. These structures are those which have sustained damages on two separate occasions within a ten-year time span for which the cost of repairs at the time of the flood meets or exceeds 25 percent of the market value of the structure before the damage occurred.

Based on this database, Murray County does not have any repetitive loss structures identified. From January 1, 1978, through December 31, 2015, 6 total losses were reported in Murray County; all 6 were reported in rural Murray County.⁹⁵

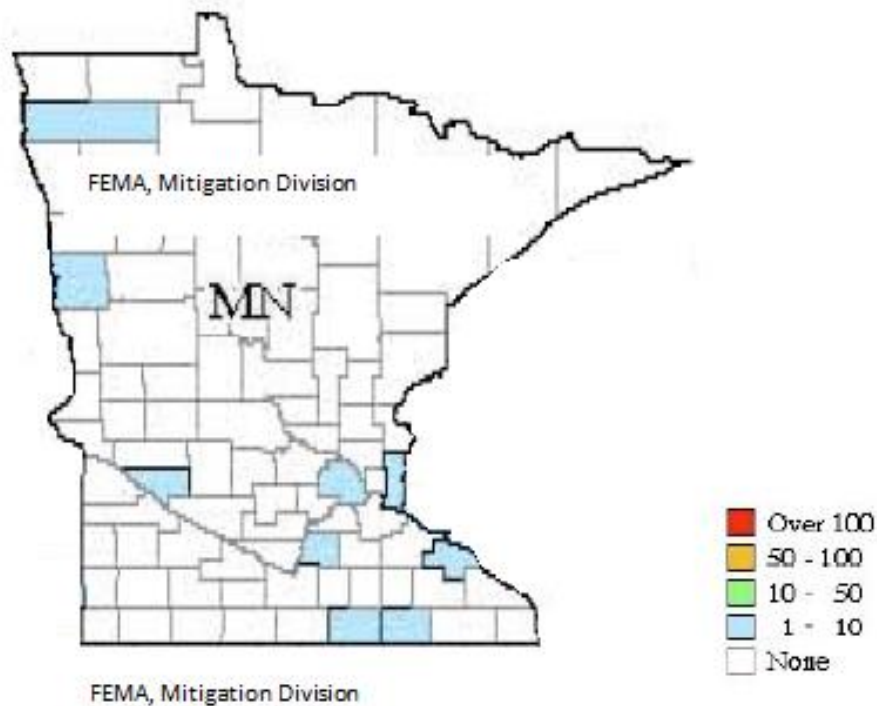
Figure #119
Loss Statistics Flooding – Murray County
January 1, 1978 – December 31, 2015

Community Name	Total Losses	Closed Losses	Open Losses	CWOP Losses	Total Payments
Murray County	6	4	0	2	\$11,290.71
Totals	6	4	0	2	\$11,290.71

FEMA: Loss Statistics

⁹⁵ FEMA. Loss Statistics. Accessed: 01/17/2018. Available: <http://bsa.nfipstat.fema.gov/reports/1040.htm>

Figure #120
Counties with Repetitive Loss Properties



Severe Repetitive Loss Properties

As of December 2017, there were no Severe Repetitive Loss properties in Murray County.⁹⁶

5.6.3 Analyzing Development Trends

Land Use and Development Trends

Murray County is a rural county with urban growth largely limited to small developments in the Cities of Fulda and Slayton. There are 407,919 acres in farm production in Murray County.⁹⁷

A large percentage of tillable land in Murray County is farmed. There are also lands in conservation programs, parks, and other more natural settings. Not having all of the tillable ground in production helps to maintain ground water quality, wetlands, and plants and wildlife.

Prohibiting development in floodplains also helps to mitigate the negative effects of flooding and runoff. Grasslands, shrubs, and other vegetation help to negate the negative effects that flooding and runoff can have. It is important to incorporate land conservation practices into local and county land use policy and development plans.

⁹⁶ FEMA, Data Request. Received 12/07/2017.

⁹⁷ USDA Census 2012. Accessed: 01/17/2018. Available:

http://www.agcensus.usda.gov/Publications/2012/Full_Report/Volume_1,_Chapter_2_County_Level/Minnesota/st27_2_001_001.pdf

One percent floodplain areas do exist in Murray County. The Des Moines River runs through Murray County and one percent floodplains exist along it. Additionally one percent floodplains exist within or directly adjacent to the cities of Avoca, Chandler, Currie, Hadley, Iona, and Fulda. Very high losses are estimated to occur in the Lake Shetek area in the event of a one-hundred year flood, due to the density and value of residential and commercial infrastructure around the lake and on islands in the lake. See Figure #65 for a map of Murray County's one-hundred year floodplain.

In southwest Minnesota there have also been a growing number of wind farms, solar farms, ethanol plants, and other biofuel plants. This development trend poses some unique challenges. In regards to roads and bridges, there is an increase of oversized loads, which can wear out the infrastructure faster and pose safety concerns to other motorists.

Firefighting also may be challenging. Specialized equipment is required to reach the top of the turbines, so firefighters have been instructed to sit back and let the wind turbine burn. Firefighters will monitor the fire to make sure the fire does not spread.

Ethanol plants and other biofuel plants have the potential to generate large and very hot fires. Plans are in place to address these new developments, but there is not extensive experience in mitigating hazards related to these development trends. Refer to 5.4.1 Fire (Wildfires and Structure Fires) for more information related to wind turbines ethanol plants, and biofuel fires.

A combination of conservation and planning has helped Murray County maintain safe and efficient development. Murray County is a rural county, so emergency response is impacted by distance and time and the availability of equipment and resources. Regional efforts help to mitigate the effects of natural and other hazards in Murray County.

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Section 6 – Mitigation Strategy

The goal of mitigation is to protect lives and reduce the future impacts of hazards including property damage, disruption to local and regional economies, the amount of public and private funds spent to assist with recovery, and to build disaster-resistant communities. Mitigation actions and projects should be based on well-constructed risk assessments, provided in Section 4 of this plan. Mitigation should be an ongoing process adapting over time to accommodate a community's needs.

6.1 Community Capability Assessment

The capability assessment identifies current activities used to mitigate hazards. The capability assessment identifies the policies, regulations, procedures, programs, and projects that contribute to the lessening of disaster damages. The assessment also provides an evaluation of these capabilities to determine whether the activities can be improved in order to more effectively reduce the impact of future hazards. The following sections identify existing plans and mitigation capabilities within all of the communities.

6.1.1 National Flood Insurance Program (NFIP)

The NFIP is a federal program created by Congress to mitigate future flood losses nationwide through sound, community-enforced building and zoning ordinances and to provide access to affordable, federally-backed flood insurance protection for property owners. The NFIP is designed to provide an insurance alternative to disaster assistance to meet the escalating costs of repairing damage to buildings and their contents caused by floods. Participation in the NFIP is based on an agreement between local communities and the federal government that states that if a community will adopt and enforce a floodplain management ordinance to reduce future flood risks to new construction in Special Flood Hazard Areas (SFHAs), the federal government will make flood insurance available within the community as a financial protection against flood losses.

As of 6/30/2018, there are 25 flood insurance policies in Murray County.⁹⁸ Each policy covers a single building, but all single family home policies include detached garages. There are no repetitive loss properties in Murray County. Figure #121 below shows which jurisdictions in Murray County participate in the National Flood Insurance Program (NFIP).

⁹⁸ FEMA Data. Accessed 8/24/2018. Available: <https://bsa.nfipstat.fema.gov/reports/1011.htm>

Figure #121
NFIP Participation in Murray County

Jurisdiction Name	NFIP y/n	Mapped High-Risk Areas
Murray County	Yes	Yes
Avoca	Yes	Yes
Chandler	Yes	Yes
Currie	No	Yes
Dovray	No	No
Fulda	No	No
Hadley	No	Yes
Iona	No	Yes
Lake Wilson	Yes	No
Slayton	No	Yes

Source: FEMA NFIP Community Status Book

6.1.2 Plans and Ordinances

Murray County and its incorporated communities have a number of plans and ordinances in place to ensure the safety of residents and the effective operation of communities, including a Zoning Ordinance, Floodplain Ordinance, Wellhead Protection Plan, Local Water Plan, Transportation Plan, Economic Development Plan, and Emergency Operations Plan. In Section 5.0 of this plan (*Risk Assessment*) a review of the plans and programs in place was included as related to each of the hazards addressed in the plan.

6.2 Mitigation Goals

In Section 5.0 of this plan, the risk assessment, identified Murray County as prone to a number of natural and technological hazards. Planning team members understand that although hazards cannot be eliminated altogether, Murray County can work toward building disaster-resistant communities.

Hazard mitigation is intended to protect our communities by reducing or eliminating long-term risk to people and property before a disaster strikes. Emergency management involves a cycle through which communities prepare, respond, and recover from emergencies and disasters. The planning team formulated goals, objectives, and strategies to mitigate the effects of natural and other hazards.

Goals are general guidelines that explain what Murray County wants to achieve. Objectives narrow the general guidelines and define in more detail what Murray County wants to achieve. Strategies are the actual steps to be taken to achieve the goals.

A qualitative approach was used by the planning team to judge and prioritize the mitigation strategies based on perceived costs and benefits. The process used to judge and prioritize the mitigation strategies was the STAPLEE Process. The prioritization results are found under the “priority” column of Figure #123.

Figure #122
STAPLE+E Planning Factors

S – Social	Mitigation actions are acceptable to the community if they do not adversely affect a particular segment of the population, do not cause relocation of lower income people, and if they are compatible with the community’s social and cultural values.
T – Technical	Mitigation actions are technically most effective if they provide a long-term reduction of losses and have minimal secondary adverse impacts.
A – Administrative	Mitigation actions are easier to implement if the jurisdiction has the necessary staffing and funding.
P – Political	Mitigation actions can truly be successful if all stakeholders have been offered an opportunity to participate in the planning process and if there is public support for the action.
L – Legal	It is critical that the jurisdiction or implementing agency have the legal authority to implement and enforce a mitigation action.
E – Economic	Budget constraints can significantly deter the implementation of mitigation actions. Hence, it is important to evaluate whether an action is cost-effective, as determined by a cost benefit review, and possible to fund.
E – Environmental	Sustainable mitigation actions that do not have an adverse effect on the environment, comply with federal, state, and local environmental regulations, and are consistent with the community’s environmental goals, have mitigation benefits while being environmentally sound.

Refer to the Planning Process Chapter for more information relating to the STAPLEE Process and the planning process.

It should be noted that not every hazard identified within the risk assessment has a goal outlined below. Goals were combined for certain hazards with similar mitigation measures. For example, severe summer storms and tornadoes both require similar awareness, prevention and structural measures. The main benefit of the actions listed is the improved health, safety and welfare of the community and residents. The highest ranking hazards are listed first, followed by moderate rank hazards and finally low rank hazards. An acronym list of entities listed in the strategies below can be found in Section 6.3.

6.2.1 Hazard Mitigation Actions

Murray County and its included municipalities share a common All Hazard Mitigation plan and worked closely to develop it. These people work together with their city councils and the Murray County Emergency Management Director to assure that the hazards and mitigation actions included in this plan are accurate and addressed in their jurisdictions. The jurisdictions responsible for each action are: Murray County, Avoca, Chandler, Currie, Dovray, Fulda, Hadley, Iona, Lake Wilson, and Slayton.

Figure #123 lists all mitigation actions for Murray County and its jurisdictions. Appendix H contains separate mitigation action tables for each jurisdiction. Each of these mitigation action charts detail the hazard, the mitigation action to address it, the priority ranking for implementation (High Priority; Moderate Priority; Low Priority), its current stage of implementation, the timeframe for implementation going forward, the jurisdictions who have identified they will work to implement the action, the

responsible parties to carry through with implementation, and comments on how the plan will be implemented through existing planning mechanisms and funding to make implementation happen.

In addition to ranking the hazard mitigation actions using STAPLE+E, the planning team also reports on the status of the mitigation action. Completed and deleted mitigation actions are denoted in Appendix G.

Status

Ongoing mitigation actions from the initial review were incorporated into annual reviews by the mitigation team. The status designations for the mitigation action chart are below. The status designations are broken into new and existing.

New Mitigation Strategy

- New – new action added to the AHMP

Existing Mitigation Strategy

- Ongoing – actions require continuing application
- In Progress – actions are currently being acted upon
- Complete – the action is complete
- Deferred – no progress has been made and the team has deferred working on it
- Carried Over – no progress has been made

Timeframe

The timeframe for implementing a mitigation strategy is divided into three categories:

- Short Term – 1 to 5 years
- Long Term – 5 + years
- Continuous

6.2.2 Strategy Implementation & Administration

Prioritization does not mean that all strategies with a priority ranking of five have to be accomplished before strategies with a four and so on can be implemented. The purpose of the prioritization is to show that the planning team talked about possible options and with unlimited resources, this is what they chose to accomplish first. Due to scarce resources, it may be necessary to start with a goal that has less upfront costs and is relatively easier to implement. The goals, objectives, and strategies being outlined in the Murray County AHMP are recommendations from the planning team, so during implementation modifications can take place.

Murray County Emergency Management is the primary agency responsible for implementation and administration of this plan. The County will implement mitigation strategies within the next five years, and will seek appropriate funding to do so.

Local jurisdictions with comprehensive plans and land use controls will be strongly encouraged to incorporate applicable goals, objectives, and strategies into their local plans upon their next update. Transmittal of the final plan will include a letter from the County Emergency Manager requesting that each participating jurisdiction 1) adopt this Hazard Mitigation Plan as a primary policy document, and 2)

review and incorporate all applicable policies of this document into the community's existing plans by inclusion or by reference.

6.3 Mitigation Strategies Acronym List

Cities

CiA	City of Avoca	CiI	City of Iona
CiCh	City of Chandler	CiLW	City of Lake Wilson
CiCu	City of Currie	CiS	City of Slayton
CiD	City of Dovray		
CiF	City of Fulda		
CiH	City of Hadley		

Priority

- 1 = High
- 2 = Medium
- 3 = Low

Status

- New = actions have not yet started
- Ongoing = actions require continuing application
- In Progress = actions are currently being acted upon
- Complete = the action is complete
- Deferred = no progress has been made
- Deleted = the action is no longer relevant

Townships

Twps = All Townships

Local Organizations

HAZ = HAZMAT Team
MCA = Murray County Administration
Utility = Nobles Cooperative Electric or Other Utility
SWHHS = Southwest Health & Human Services
MCEM = Murray County Emergency Management
MCEO = Murray County Environmental Services Office
MCGIS = Murray County GIS
MCHwy = Murray County Public Works & Highway
MCSO = Murray County Sheriff's Office
NRCS = Natural Resources Conversation Service
SWCD = Soil and Water Conservation District

Other Entities & Organizations

Air
BAH
BWSR
EMS
DNR
DPS
EXT
FEMA
Fire
FSA
Hosp
LE
LPRW
MDA
MDH
MnDOT
MPCA
PU
Rail
RC
RRRW
RWS
Sch
USDA
Local Airports (Slayton)
MN Board of Animal Health
MN Board of Water and Soil Resources
Medical Response Personnel
Department of Natural Resources
Department of Public Safety
University of Minnesota Extension
U.S. Federal Emergency Mgmt. Admin.
Fire Districts
USDA Farm Services Agency
Hospitals & Clinics
Law Enforcement
Lincoln-Pipestone Rural Water
MN Dept. of Agriculture
MNDept. of Health
MN Dept. of Transportation
MN Pollution Control Agency
Public Utilities
Local Railroads
American Red Cross
Red Rock Rural Water
Rural Water Systems
Local School districts
U.S. Department of Agriculture

Hazards in Plan

Ag Disease
Civil
Drought
Earthquakes
Erosion
E Cold
E Heat
Flood
Fire
HazMat
Public Health
S-Storms
Tornado
Trans Inf
Utility
Water
W-Storms
Agricultural Disease
Civil Disturbance / Terrorism
Drought
Earthquakes
Erosion, Landslide, and Subsidence
Extreme Cold
Extreme Heat
Flooding
Fire
Hazardous Materials
Public Health Emergencies
Severe Summer Storms
Tornado & Straight-line Wind Events
Transportation Infrastructure
Utility Failure
Water Supply Contamination
Severe Winter Storms

6.4 Mitigation Strategies

Figure #123. All Mitigation Actions for Murray County

Action Number	Hazard - Strategy	Mitigation Action	Priority	Status	Time-frame	Jurisdictions	Responsibility	Murray County Comments on Planning Mechanisms for Implementation	Est. Cost/ Source
1	Agricultural Disease – Awareness	Provide information on ag disease and prevention to producers & residents.	Moderate	Ongoing	2019-2024	Avoca, Chandler, Currie, Dovray, Fulda, Hadley, Iona, Lake Wilson, Slayton, Murray County	Murray County Emergency Management Director, MCEO, SWCD, Ext, FSA		Low
2	Agricultural Disease – Prevention	Monitor invasive insect species, such as emerald ash borer.	Moderate	In Progress	2019-2024	Avoca, Chandler, Currie, Dovray, Fulda, Hadley, Iona, Lake Wilson, Slayton, Murray County	Murray County Emergency Management Director, MCEO, SWCD, MDA, DNR, Ext.	MCEO does this on an on-call basis.	Low
3	Severe Summer Storms – Structural	Conduct a study to determine what places in the County and each city are deficient in safe rooms; Construct at least one new safe room or improve warning system in one community each year.	Moderate	Revised	2019-2029	Avoca, Chandler, Currie, Fulda, Iona, Lake Wilson, Slayton, Murray County	Murray County Emergency Management Director, MCSO, MCEO, City Clerks for Avoca, Chandler, Currie, Fulda, Iona, and Lake Wilson, City Administrator, City of Slayton	Hadley complete. Not applicable to Dovray.	High
4	Severe Summer Storms – Awareness	Educate local schools, nursing homes, hospitals, etc. on importance of doing a “Severe Weather Awareness Week” workshop for their staff, including identifying evacuation routes and safety shelters, etc.	Moderate	Ongoing	2019-2024	Chandler, Fulda, Slayton, Murray County	Murray County Emergency Management Director, Chandler City Clerk, Fulda City Clerk, Slayton City Administrator, Murray County Central Administration, Fulda Schools Administration	MCEM does this through ads and social media.	Low

Action Number	Hazard - Strategy	Mitigation Action	Priority	Status	Time-frame	Jurisdictions	Responsibility	Murray County Comments on Planning Mechanisms for Implementation	Est. Cost/ Source
5	Severe Summer Storms – Awareness	Make nursing home staff aware of the need/importance of providing shelter locations and evacuation routes for nursing home residents in case of severe weather.	Moderate	In Progress	2019-2024	Fulda, Slayton, Murray County	Murray County Emergency Management, Fulda City Clerk, Slayton City Administrator		Low
6	Severe Summer Storms – Awareness	Increase signage at public campgrounds warning campers of weather risks – i.e. those sites not covered by sirens.	Moderate	Revised	2019-2024	Currie, Fulda, Slayton, Murray County	Murray County Emergency Management, MCPF, SWHHS Food, Beverage, Lodging Staff, Currie City Clerk, Fulda City Clerk, Slayton City Administrator	Hadley has no public campgrounds.	Medium
7	Severe Summer Storms – Protection	Ensure that critical facilities have access to back-up power generators.	High	Revised & In Progress	2019-2029	Currie, Fulda, Slayton, Murray County	Murray County Emergency Management, Currie City Clerk, Fulda City Clerk, Slayton City Administrator	Murray County Medical Center has a generator. Hadley complete – has access to Slayton's.	Medium
8	Severe Summer Storms – Protection	Harden utilities, replace overhead with underground power lines.	Moderate	Ongoing	2019-2029	Murray County, Utility Providers	MCEM, MCEO, Utilities		High
9	Severe Summer Storms – Emergency Services	Make sure that county dispatchers and first responders are aware of any low/minimum maintenance roads or “closed roads” within respective townships.	Moderate	In Progress	2019-2024	Murray County	MCHwy, MCSO, MCEM, Twp, LE, EMS, Fire	Some townships do and others don't do this – they may have only been instructed to inform the sheriff.	Low

Action Number	Hazard - Strategy	Mitigation Action	Priority	Status	Time-frame	Jurisdictions	Responsibility	Murray County Comments on Planning Mechanisms for Implementation	Est. Cost/ Source
10	Severe Summer Storms – Prevention	Work with MnDOT/local road authorities to identify and improve hazardous intersections and bridges.	Moderate	New	2019-2034	Murray County	MCHwy, MCSO, MCEO, Twp		High
11	Severe Summer Storms – Prevention	Use road design and living snow fences to help control snow on roadways.	Moderate	New	2019-2024	Murray County	MCHwy, MCSO, MCEO, Twp		Medium
12	Wildfire – Prevention	Conduct wildfire risk assessments periodically.	Low	Revised	2019-2024	Avoca, Chandler, Currie, Fulda, Hadley, Murray County	Murray County Sheriff's Office, Fire Chiefs in Avoca, Chandler, Currie, Fulda and Hadley	Small hazard behind Hadley elevator.	Low
13	Wildfire – Prevention	Develop management plans that outline the scheduled maintenance of Conservation properties.	Low	Revised & Deferred	2019-2024	Avoca, Chandler, Currie, Fulda, Murray County	Murray County Environmental Office, Avoca, Chandler, Currie and Fulda Fire Departments	Hadley removed – none present.	Low
14	Wildfire – Awareness	Develop a program to educate property owners on need for firebreaks before they enroll land in CRP or CREP	Low	Deferred	2019-2024	Murray County	Murray County Emergency Management, SWCD, Ext, FSA		Low
15	Drought – Prevention	Work with the Minnesota Department of Health to develop & implement Wellhead Protection Plans	Moderate	Revised & In Progress	2019-2024	Slayton, Murray County	Murray County Environmental Office, SWCD, Slayton Public Works, MDH	Complete for Chandler, Currie, Fulda, Hadley, & Lake Wilson.	Medium

Action Number	Hazard - Strategy	Mitigation Action	Priority	Status	Time-frame	Jurisdictions	Responsibility	Murray County Comments on Planning Mechanisms for Implementation	Est. Cost/ Source
16	Drought – Prevention	Encourage development of ordinances that contain conservation provisions and use restrictions in times of severe drought	Low	Deferred	2019-2024	Chandler, Currie, Dovray, Fulda, Hadley, Lake Wilson, Slayton, Murray County	Murray County Environmental Office, Murray County Emergency Management, City Clerks in Chandler, Currie, Dovray, Fulda, Hadley and Lake Wilson. Slayton City Administrator, BWSR	In progress for Slayton and Dovray.	Medium
17	Drought – Prevention	Educate the public and private leaders of the importance of wellhead protection and water conservation	Moderate	In Progress	2019-2024	Murray County	SWCD, MDH, Ext, RWS		Low
18	Public Health – Awareness	Improve coordination and communication with the local media	Moderate	In Progress	2019-2024	Murray County, Currie, Fulda, Slayton	Murray County Emergency Management, SWHHS public health staff, Currie and Fulda City Clerks, Slayton City Administrator	Ongoing for Slayton.	Low
19	Public Health – Emergency Services	Work with Public Health Service and MDH on the mass distribution of needed medicines and supplies for public health emergencies	Moderate	In Progress	2019-2024	Murray County	Murray County Emergency Management, SWHHS public health staff		Low
20	Public Health – Emergency Services	Maintain a quarantine plan in coordination with local doctors and other health professionals	Moderate	Revised	2019-2024	Murray County	Murray County Emergency Management, Sheriff's Office, Slayton PD, Hospital Infectious Disease Control, Public Health		Low
21	Public Health – Prevention	Spray standing water areas for mosquito control	Moderate	Ongoing	2019-2029	Fulda, Hadley	Fulda and Hadley Public Works	Hadley sprays streets and parks. Dovray does this.	Medium

Action Number	Hazard - Strategy	Mitigation Action	Priority	Status	Time-frame	Jurisdictions	Responsibility	Murray County Comments on Planning Mechanisms for Implementation	Est. Cost/ Source
22	Public Health – Protection	Ensure that hospitals have access to backup power generators. Examine needs and costs for providing backup power generation where none currently exists	High	In Progress	2019-2024	Murray County	Murray County Emergency Management, SWHHS – Public Health	Generators are at Murray County Medical Center.	Medium
23	Water Supply – Prevention	Update the Emergency Response Plan to identify alternate sources of drinking water, including the location of adequate amounts of bottled water.	Moderate	Deferred	2019-2024	Murray County, Chandler, Currie, Fulda, Hadley, Lake Wilson, Slayton	Murray County Emergency Management, Chandler, Currie, Fulda, Hadley, Lake Wilson, and Slayton Public Works , Red Rock Rural Water System		Low
24	Water Supply – Prevention	Review the county water plan for potential groundwater contaminants within the county.	Moderate	<i>Complete, Carried Over</i>	2019-2029	Murray County, Currie, Hadley, Fulda, Lake Wilson, Slayton	Murray County Environmental Office, Currie, Hadley, Fulda, Lake Wilson, Slayton Public Works	This is complete for now, but <u>will need updating eventually</u> .	Medium
25	Hazardous Materials – Awareness	Continue to educate county residents, farmers and businesses on the potential impact of hazardous material spills	Moderate	In Progress	2019-2024	Murray County, Chandler, Dovray, Fulda, Lake Wilson, Slayton	MCPZA, Murray County Emergency Management, Chandler, Dovray, Fulda, Lake Wilson, Slayton Fire Departments, MDH, MPCA		Low
26	Hazardous Materials – Awareness	Increase awareness of the county household hazardous waste facility, its importance, and how to utilize its services	Moderate	In Progress	2019-2024	Murray County, Currie, Fulda, Hadley, Lake Wilson, Slayton	MCEO, MCEM, SWCD, Currie, Fulda, Hadley, Lake Wilson City Clerks, Slayton City Administrator	Murray County does a radio spot. Hadley maintains access to recycling facility.	Low

Action Number	Hazard - Strategy	Mitigation Action	Priority	Status	Time-frame	Jurisdictions	Responsibility	Murray County Comments on Planning Mechanisms for Implementation	Est. Cost/ Source
27	Hazardous Materials – Prevention	Develop Geographic Information Systems capability to map locations of fixed facilities using hazardous materials and associated transportation corridors	Moderate	In Progress	2019-2029	Murray County, Currie, Fulda, Hadley, Lake Wilson, Slayton	Murray County Environmental Office , SWCD, Currie, Fulda, Hadley, Lake Wilson City Clerks, Slayton City Administrator, MPCA	Fixed hazmat facilities have been mapped. Transportation corridors need mapping.	Medium
28	Hazardous Materials – Emergency Services	Train county emergency personnel so that all types of potential spills will be readily recognized upon arrival at the scene	Moderate	In Progress	2019-2029	Murray County	MCEM, MCSO, SWCD, EMS, Fire, LE, MDH, MPCA		Low
29	Hazardous Materials – Awareness	Encourage hazardous materials facilities to have properly trained staff and equipment	Moderate	In Progress	2019-2024	Murray County	MCEM, MCSO, Fire	Ongoing. Dovray relies on mutual aid.	Low
30	Hazardous Materials – Prevention	County, townships and cities with airports review airport improvement plans and zoning.	Low	In Progress	2019-2024	Murray County, Slayton	MCEO, Slayton City Administrator, Twp, MnDOT	County ordinances being updated to review this.	Medium
31	Structure Fires – Prevention	Ensure that snow removal ordinances are followed and encourage building construction to include fire/smoke alarms and sprinkler systems.	Moderate	In Progress	2019-2024	Murray County, Currie, Dovray, Fulda, Lake Wilson, Slayton	MCEM, MCEO, Currie, Dovray, Fulda, Lake Wilson, Slayton Fire Departments	Dovray is adding this to their ordinances.	Low

Action Number	Hazard - Strategy	Mitigation Action	Priority	Status	Time-frame	Jurisdictions	Responsibility	Murray County Comments on Planning Mechanisms for Implementation	Est. Cost/ Source
32	Structure Fires – Awareness	Work with community fire chiefs to educate and encourage residents on the need for having fire alarms and chimney inspections.	Moderate	Revised & In Progress	2019-2024	Murray County, Avoca, Chandler, Currie, Dovray, Fulda, Slayton	MCEM, Avoca, Chandler, Currie, Dovray, Fulda, Lake Wilson, Slayton Fire Departments	Hadley removed as it is within Slayton FD. Ongoing with Dovray.	Low
33	Civil Disturbance – Prevention	Increase security around critical facilities including the addition of fencing, alarm systems and surveillance cameras as appropriate	Moderate	In Progress	2019-2029	Chandler, Currie, Dovray, Hadley, Fulda, Slayton	LE, Sch, Chandler, Currie, Dovray, Hadley, Fulda, Slayton Public Works	All county buildings currently have cameras. Hadley has system in municipal building & looking at cameras for parks.	High
34	Civil Disturbance – Emergency Services	Complete and maintain thorough community risk and threat assessments.	Low	In Progress & Ongoing	2019-2024	Murray County, Currie, Hadley, Fulda, Slayton	Murray County Emergency Management, Fulda, and Slayton PDs		Low
35	Civil Disturbance – Prevention	Limit public access in high profile critical facilities in times of increased potential for terrorist activity. These times could follow the Federal Government (Department of Homeland Security) warning system.	Low	Revised	2019-2024	Murray County	MCEM, MCSO, LE		Medium
36	Plan Maintenance – Prevention	Budget to perform additional data collection and analysis to identify vulnerable structures in specific detail in next plan update.	Low	Carried Over	2019-2024	Murray County	MCEM, HSEM		Medium

Action Number	Hazard - Strategy	Mitigation Action	Priority	Status	Time-frame	Jurisdictions	Responsibility	Murray County Comments on Planning Mechanisms for Implementation	Est. Cost/ Source
37	Plan Maintenance – Prevention	Budget to perform estimates of potential monetary loses to structures, contents and functions in specific detail in next plan update.	Low	Carried Over	2019-2024	Murray County	MCEM, HSEM		Medium
38	Flooding / Dam Failure – Prevention	Discourage future development within floodplains	Moderate	Ongoing	2019-2029	Murray County, Avoca, Chandler, Currie, Iona, Lake Wilson	MCEO, MCHwy, SWCD, Avoca, Chandler, Currie, Iona, Lake Wilson City Clerks		Low
39	Flooding / Dam Failure – Protection	Encourage sound construction practices and agricultural Best Management Practices (BMPs) in flood fringe areas	Moderate	Ongoing	2019-2024	Murray County, Avoca, Currie, Fulda, Hadley, Iona, Lake Wilson	MCEO, Avoca, Currie, Fulda, Hadley, Iona, Lake Wilson City Clerks, HLWD, BWSR		Low
40	Flooding / Dam Failure – Prevention	Improve floodplain maps.	Moderate	In Progress	2019-2024	Murray County, Chandler, Currie, Fulda, Hadley, Iona, Slayton	MCEO, Chandler, Currie, Fulda, Hadley, Iona and Slayton City Clerks/Public Works, HLWD, DNR, FEMA	County is currently working with DNR to do so.	Medium
41	Flooding / Dam Failure – Prevention	Jurisdictions not currently participating in the National Flood Insurance Program (NFIP) will review their flood hazard areas and consider participation.	Moderate	In Progress	2019-2024	Currie, Fulda, Hadley, Slayton	DNR, Currie and Hadley City Councils	Currently working with Hadley and Currie. Fulda and Slayton have been annexed into County Maps.	Medium
42	Flooding / Dam Failure – Prevention	Develop a program to voluntarily acquire, relocate or elevate at-risk structures in floodplains	Low	In Progress	2019-2029	Murray County, Chandler	MCEO, Chandler City Clerk, MCEM, DNR, FEMA	Currently developing a program to acquire/ relocation/elevate at-risk structures. Inventory of structures in floodplain is needed.	High

Action Number	Hazard - Strategy	Mitigation Action	Priority	Status	Time-frame	Jurisdictions	Responsibility	Murray County Comments on Planning Mechanisms for Implementation	Est. Cost/ Source
43	Flooding / Dam Failure – Protection	Raise and repair flood-prone grinder stations. Sleeve grinders in flood-prone areas and install shroud extensions.	Moderate	New	2019-2024	Murray County	MCEO, MCEM, DNR, FEMA		High \$81,000
44	Flooding / Dam Failure – Prevention	Identify areas for flood retention, including with private landowners.	Moderate	New	2019-2024	Murray County	MCEO, MCEM		Low
45	Flooding / Dam Failure – Prevention	Work with Soil & Water and area watershed districts to identify areas where flood mitigation and retention initiatives are feasible, including the Fulda Lagoons.	Moderate	New	2019-2024	Murray County	MCEO, MCEM, SWCD, Watershed Districts		Low
46	Flooding / Dam Failure – Prevention	Build structures to meter water at roads susceptible to flooding, such as (but not limited to) roadway retention basins and risers on culverts.	Moderate	New	2019-2029	Murray County	MCEO, MCEM, SWCD, MCHwy		High
47	Flooding / Dam Failure – Prevention	Build structures to hold water sources feeding to Lake Shetek and Beaver Creek that are unconnected to Lake Sarah.	Moderate	New	2019-2029	Murray County	MCEO, MCEM, SWCD, Watershed Districts		High
48	Flooding / Dam Failure – Prevention	Build identified water retention structures where feasible.	Moderate	New	2019-2029	Murray County, Cities	MCEO, MCEM, SWCD, Watershed Districts, Avoca, Chandler, Currie, Dovray, Fulda, Hadley, Iona, Lake Wilson, and Slayton Public Works		High

Action Number	Hazard - Strategy	Mitigation Action	Priority	Status	Time-frame	Jurisdictions	Responsibility	Murray County Comments on Planning Mechanisms for Implementation	Est. Cost/ Source
49	Flooding / Dam Failure – Prevention	Work with the DNR to repair the Avoca Dam.	Moderate	New	2019-2029	Murray County, Avoca	MCEO, MCEM, SWCD, Watershed Districts, DNR, CiA		High
50	Utility Failure – Prevention	Acquire a portable substation to be used in the event of utility failure.	Moderate	New	2019-2029	Murray County	MCEM, Utility	Nobles Co-op. Electric has a portable substation.	High
51	Transportation Infrastructure – Prevention	Identify bridges, culverts, and roads that are problem areas and map the hazard areas. Include areas where tile lies under the roadway.	Moderate	New	2019-2024	Murray County, Dovray	MCEM, MCHwy, Dovray Public Works	Dovray has culvert improvements that are needed.	Low

6.4.1 Mitigation Actions by Community

Action items for Participating Jurisdictions

Murray County is a rural county with few full-time paid staff in the area of emergency management. Jurisdictions in Murray County rely on Murray County Emergency Management for services regarding emergency management and hazard mitigation. Murray County Emergency Management maintains regular communication with all local units of government in the county to facilitate intergovernmental cooperation.

Combining strategies between jurisdictions is due to the rural nature of the county, and that a number of jurisdictions are similar in regards to the natural or other hazard the strategy is trying to mitigate. A number of strategies in the Murray County AHMP have “All Cities” listed as who will be working to implement the strategy. Some strategies specifically outline a specific city or multiple specific cities to work together on implementing the strategy. The listed entities under each strategy have had the opportunity to provide input and recommendations in regards to the strategy and will work together to implement the strategy.

Implementation by Local Jurisdictions

Each local jurisdiction will implement and integrate the strategies identified in the hazard mitigation plan as they update their own comprehensive plans, zoning ordinances, and other plans that the community may from time to time need to update. When “All Cities” are identified within the strategies, it means that all jurisdictions mentioned in a strategy will take the strategy into consideration when updating planning processes and undergoing construction or development projects. In many of the smaller jurisdictions these strategies will be implemented as changes are made, but changes in the smaller jurisdictions do not occur as frequently as in the larger jurisdictions.

Mitigation actions by jurisdiction for the above cities are separated out in in Appendix G.

Section 7 – Plan Maintenance

7.1 Monitoring, Evaluation, and Updating the Plan

The Murray County All Hazard Mitigation Plan (AHMP) should be considered a living document. The plan should be reviewed at a minimum of every 5 years. The guidance in this section will function as the primary tool when reviewing progress on the implementation of the Murray County AHMP.

Plan Monitoring

It is the intent of the plan to serve as a guide for mitigating current and future hazards. Murray County Emergency Management Department maintains regular contact with all jurisdictions in Murray County. This will allow the Murray County Emergency Management Director and Department to monitor and implement strategies outlined in the AHMP. The Murray County Emergency Management Director will evaluate the goals that have been implemented by Murray County and jurisdictions within the county. The Murray County Emergency Management Director will also evaluate the Murray County AHMP on the number of strategies that have been implemented and the number of goals that were reached.

Public participation is critical in implementing strategies outlined in the plan. Local residents and representatives have a thorough understanding of local issues. Local residents and representatives can assist in gathering support and technical information to help ensure the project is successful. Maintaining regular contact with the jurisdictions in Murray County will help to ensure that the Murray County Emergency Management Director and Department are able to effectively implement the strategies outlined in the plan.

Evaluating the Plan

It is recommended that the County Emergency Management Director review and formally evaluate the plan within eighteen months of adoption, as well as after every disaster event, to adequately prepare for the plan update. When implementing strategies from the existing plan it is important to consider improvements that can be made to the planning process, implementation, and evaluation of the plan. AHMP are evolving documents that need to stay up to date. Information gathering and evaluation should be taking place throughout the five year cycle of updating the plan. This will help to insure existing risk assessments are accurate and that mitigation efforts are effective.

Updating the Plan

FEMA requires that plans be reviewed, updated and re-approved every five years or sooner. The planning process timeline for reviewing, updating, and approving an AHMP at Minnesota Homeland Security and Emergency Management (HSEM) and Federal Emergency Management Agency (FEMA) is around 15 months. Within three years of adoption, the Emergency Management Director will formulate a work plan and seek input from Murray County AHMP Planning Team members, local units of government, and local residents to start the process to update the Murray County AHMP. The Emergency Management Director will also extend an invitation to non-participating jurisdictions to join the planning process for the update.

7.2 Implementation

Murray County and its included municipalities share a common All Hazard Mitigation Plan and work together closely to develop, revise, and implement it. This AHMP provides a comprehensive chart of mitigation actions for Murray County and its jurisdictions (see *Figure #123*). Jurisdictions participated in the AHMP planning process and identified the specific mitigation strategies that they would seek to implement in their communities during the 5-year planning cycle. These mitigation actions are also provided in Appendix G: *Mitigation Actions by Jurisdiction*.

A number of implementation tools are available to address hazards. Many of these tools are below, however, in some cases additional discussion is needed in order to identify what strategies are most appropriate to use. This will be part of an ongoing discussion as Murray County looks for opportunities for plan implementation. The following tools should be considered:

Education: In many cases education of residents has been identified as one of the most effective mitigation strategies.

Capital Investments: Capital investments such as fire and ambulance equipment, sprinkler systems and dry hydrants are tools that can limit risks and impacts of natural and man-made hazards.

Data Collection and Needs Assessments: Data collection and needs assessments can aid in gaining a better understanding of threats and allow planning for mitigation strategies accordingly. As resources are limited for this part of the planning process, additional data collection is likely to be an ongoing activity as resources become available.

Coordination: Responsibilities for mitigation strategies run across various county departments, local fire and ambulance departments, city and township governments, and a host of state and federal agencies. Ongoing coordination is an important tool to ensure resources are used efficiently. Coordination can also avoid duplication of efforts or prevent gaps that are created because of unclear roles and responsibilities. The mitigation plan review process can function as a tool to have an ongoing discussion of roles, responsibilities, and opportunities for coordination.

Regional Cooperation: Counties and public safety services providers throughout the Northeastern Region of Minnesota often share similar challenges and concerns. In some cases a regional approach may be warranted as a mitigation strategy in order to save resources. Mutual aid agreements are a tool already in use for a number of services. Needs assessments for fire and ambulance services and development of assistance for volunteer recruiting, training, and retention could benefit from a regional approach. Cooperation among counties could also help in lobbying for certain funding priorities that address concerns relating to challenges in service delivery in rural areas. Organizations such as FEMA Region V and the MN Department of HSEM through the Regional Program Coordinator can offer tools and resources to assist in these cooperative efforts.

Regulation: Regulation is an important mitigation tool for Murray County. Regulation plays a particularly important role for land use, access to structures and the protection of water resources and public health.

7.3 Continued Public Involvement

Continued public involvement is critical to the successful implementation of the All Hazard Mitigation Plan (AHMP). The County and its participating jurisdictions should continue to engage new public stakeholders in planning discussions and project implementation during the 5-year cycle of this plan.

Murray County maintains a website that includes a page for Emergency Management. The SRDC also maintains a website that includes a page for hazard mitigation. Both of these websites will be the main point of access for the public regarding information about the Murray County AHMP. A PDF copy of the approved plan will be available on these pages along with other information related to the update and hazard mitigation. The public will have access to the plan and be able to provide input regarding progress on the mitigation strategies.

<https://murraycountymn.com/emergency-management/>

<http://www.swrdc.org/planning/hazard-mitigation/>

Other Opportunities for Involvement

Hazard mitigation has been a regional effort in Southwest Minnesota with services overlapping between counties. All Hazard Mitigation Plan (AHMP) development starts with reviewing the counties existing mitigation plan and comparing the plan with the neighboring counties. There are many opportunities during the development of a plan for involvement provided from neighboring communities, agencies involved in hazard mitigation, businesses, academia, and other relevant private and non-profit interests. SRDC has helped to develop mitigation plans for the following counties in southwest Minnesota:

- Cottonwood County
- Jackson County
- Lincoln County
- Lyon County
- Murray County
- Nobles County
- Pipestone County
- Redwood County
- Rock County

During the 5-year period before the plan is updated, planning team members will be responsible to keep their city councils, city departments, schools, and community members updated and engaged in the implementation of their respective mitigation action charts (see *Appendix G: Mitigation Actions by Jurisdiction*). Each respective jurisdiction will report their progress in this area to the Murray County Emergency Management Director. Jurisdictions will use numerous means of public outreach to engage new public stakeholders in providing input on mitigation efforts or concerns on hazards by sharing information at city council meetings, sharing information at special events, working with local schools and partner organizations, and posting information on relevant local or social media that their communities use to inform and engage the public. As local mitigation projects are implemented, jurisdictions will work to keep the public updated and engaged in those local efforts.

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Conclusion

Hazards can occur with little or no warning. The relatively unpredictable nature of some hazards makes mitigating the effects of an event more difficult, but history and probability says that natural and other hazards are going to occur. Since hazardous events are going to take place, hazard mitigation is here to minimize the damages to property and loss of life.

When planning mitigation projects and investing in the future, it is critical to consider all the costs, not just the construction costs. There are costs associated with the potential loss of life, public and private property damages, interruption to the economy, decreased connectivity, health outcomes, and loss of community. Decision makers need to consider health and include health related outcomes in the benefits and costs of a project.

Health benefits of a project could be related to increasing livability, connectivity, and creating an environment where people want to live. When people are there, people invest and create demand. Hazard mitigation can be the link between livability, economic vitality, and public safety.

Figure #123
Disaster Management Cycle



APPENDICES

MURRAY COUNTY ALL HAZARD MITIGATION PLAN, 2019

Appendix A – Murray County Maps & Hazus Analysis

Appendix B – Murray County Hazard Events

Appendix C – Adopting Resolutions

Appendix D – Planning Team Meetings, Sign-In Sheets, & Notes

Appendix E – Public Hearing Notices and Notes

Appendix F – Completed and Deleted Actions from the 2008 Plan

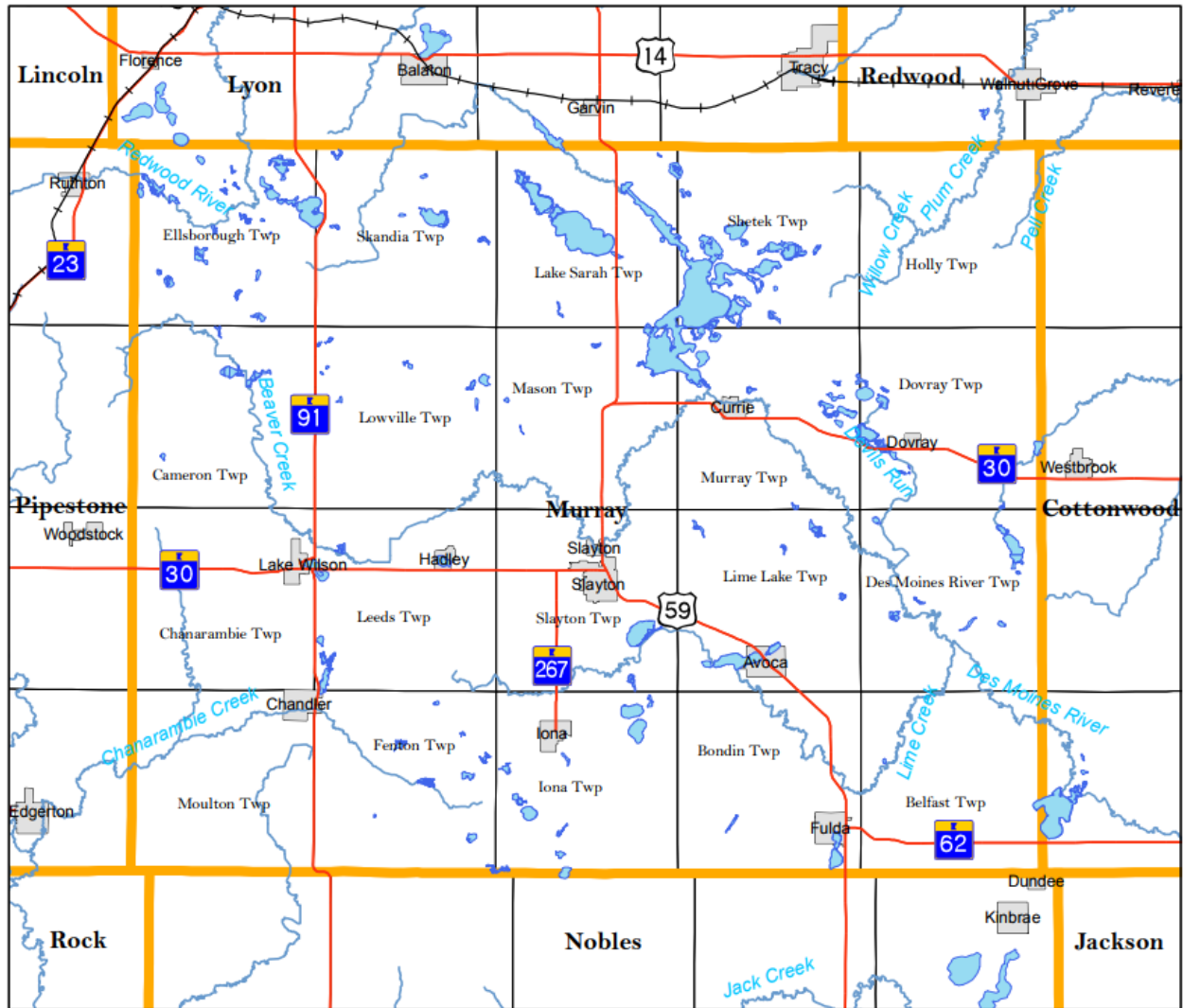
Appendix G – Mitigation Actions by Jurisdiction

Appendix H – Works Cited

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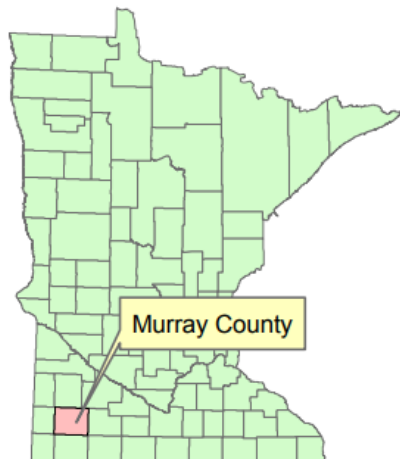
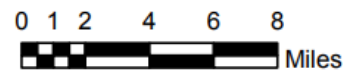
Appendix A - Murray County Maps & Hazus Analysis

Figure #2
Minor Civil Divisions – Murray County



Murray County

- Trunk Highways
- ~ Lakes
- ~ Named Streams and Rivers
- County
- City
- Township



Prepared by SRDC 4.08

Source: ESRI, MnDOT, DNR

[illegible]

- Trunk Highways
- Lakes
- Shoreland for basins
- Shoreland for courses
- Named Streams and Rivers
- County
- City
- Township



Projection: NAD83 HARN Adj Murray Co
Source: ESRI, MnDOT, MPCA, DNR
Murray County Environmental Services

Figure #5
Wetlands in Murray County

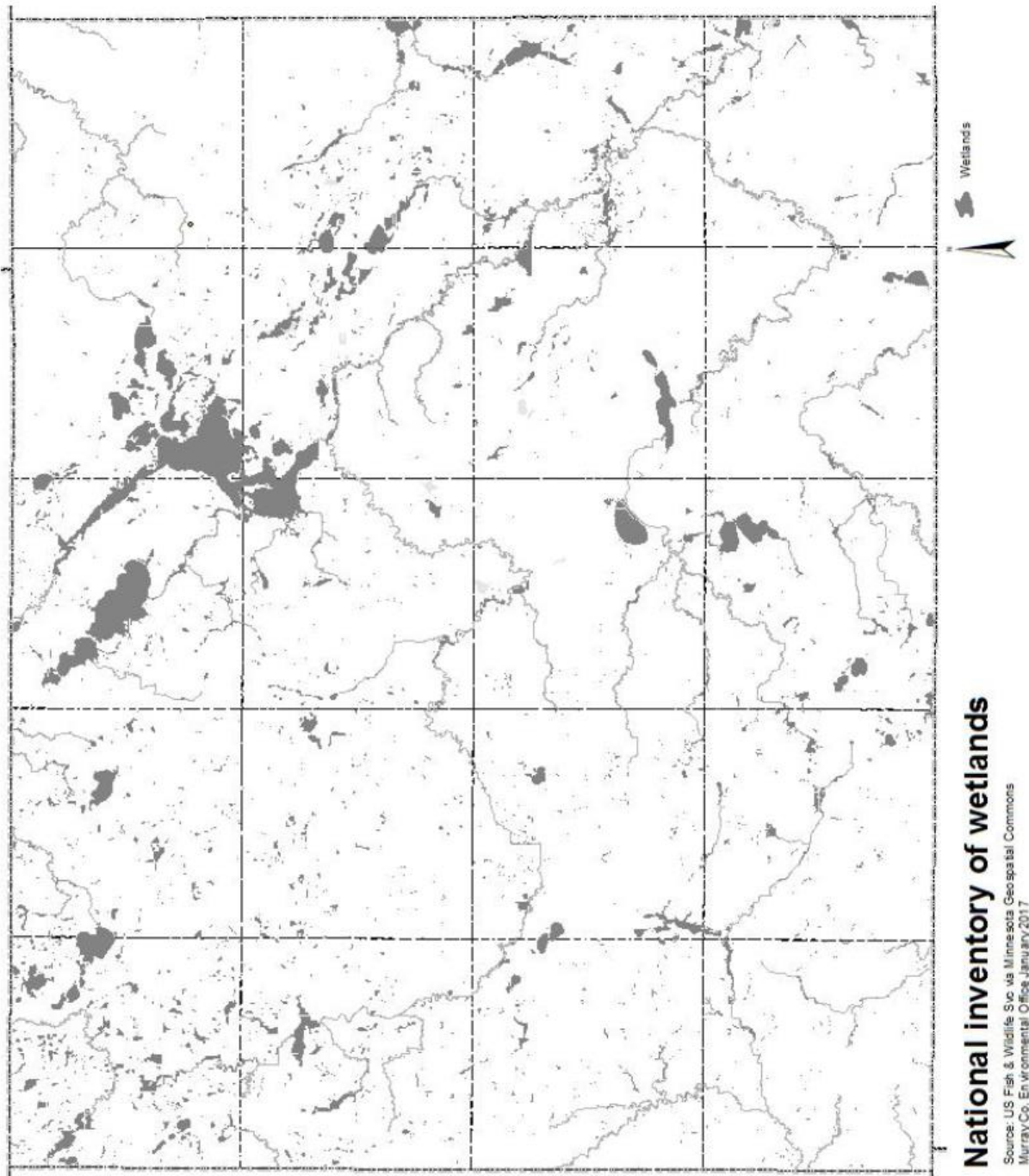
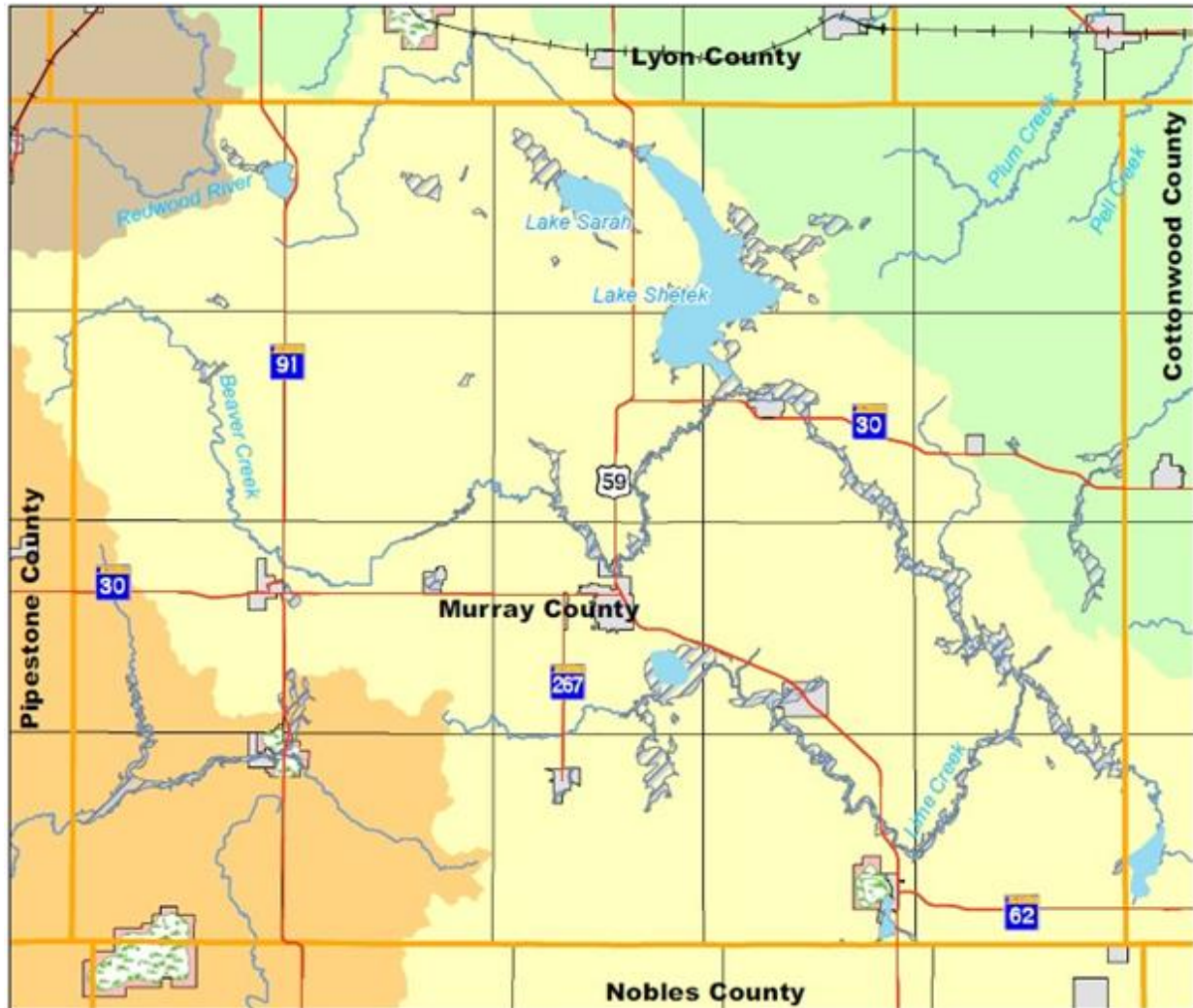
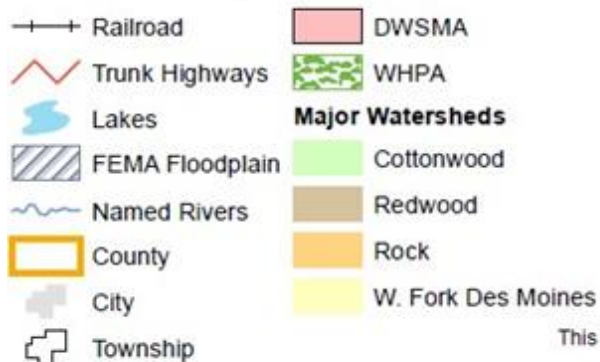


Figure #6
Watersheds Map – Murray County



Murray County, MN



0 1 2 4 6 8 Miles



SRDC 06.11

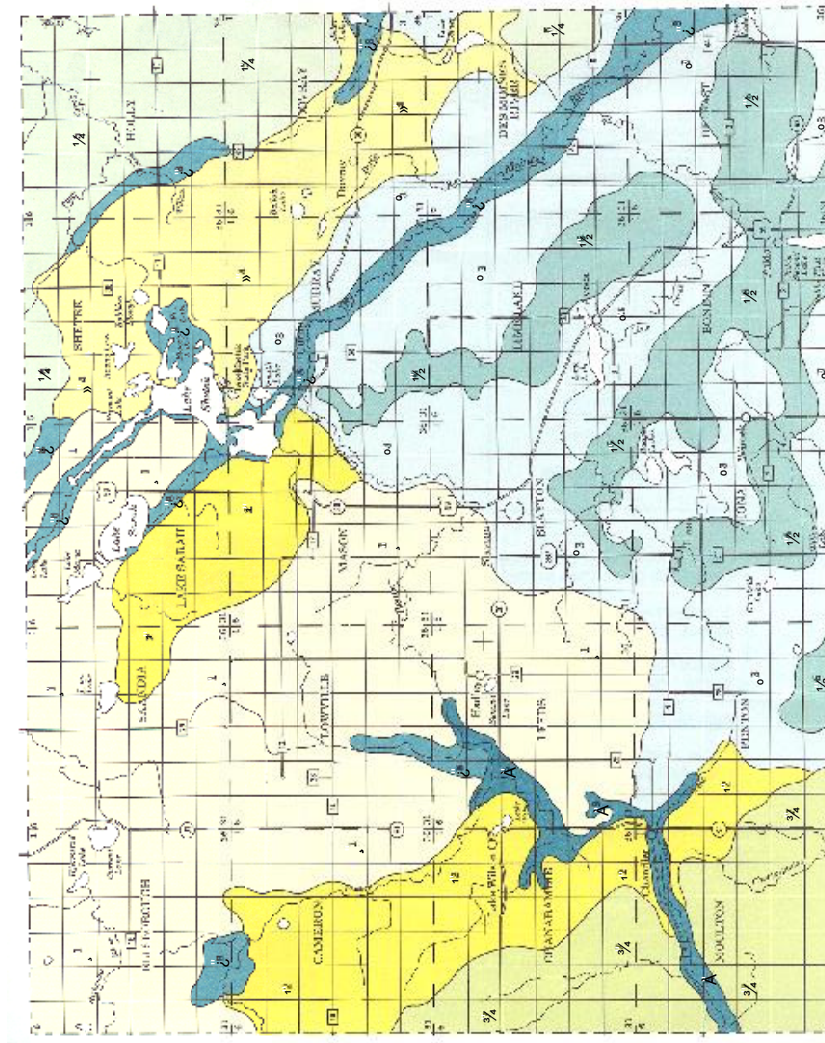
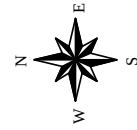
Note: Floodplain is a rough estimation of the FEMA 100-year flood hazard area as shown on the Flood Insurance Rate Map. Not to be used for other than planning purposes. Additional hazard areas do exist. Actual location is only accurate by field elevation.

Source: Murray Co, MN DNR, MDH, MPCA, MnDOT, ESRI

This project was supported by Grant Award Number FEMA-DR-1717-MN awarded by the Federal Emergency Management Agency (FEMA). Points of View or opinions in this document are those of the author and do not represent endorsement by FEMA or reflect FEMA's views.

Murray County General Soils Map

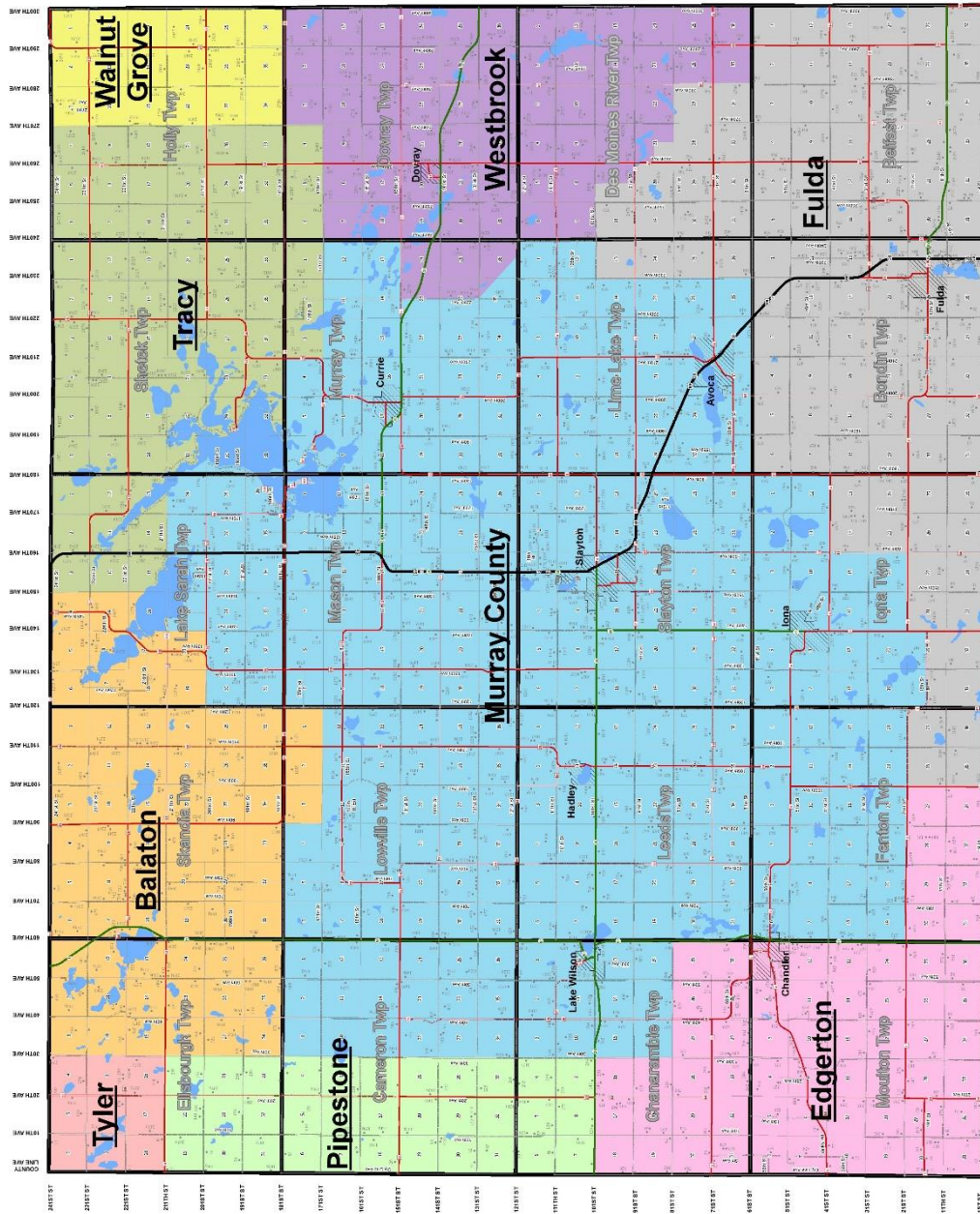
- 1 Barnes-Flom-Vallers: Well drained and poorly drained, nearly level to moderately steep soils that formed in loamy glacial till
- 2 Barnes-Buse: Well drained, gently undulating to very steep soils that formed in loamy glacial till
- 3 Carlon-Webster-Nicollet: Well drained, poorly drained, and moderately well drained, nearly level to hilly soils that formed in loamy glacial till
- 4 Carlon-Storden: Well drained, undulating to very steep soils that formed in loamy glacial till
- 5 AREAS DOMINATED BY SOILS THAT FORMED IN FRIABLE AND FIRM GLACIAL TILL
- 6 Every-Letri-Wilmonton: Well drained, poorly drained, and moderately well drained, nearly level to moderately steep soils that formed in loamy glacial till
- 7 Collinwood-Carlton-Waldorf: Moderately well drained, well drained, and poorly drained, nearly level to sloping soils that formed in clayey lacustrine sediments or loamy glacial till
- 8 AREAS DOMINATED BY SOILS THAT FORMED IN LOESS AND GLACIAL TILL
- 9 Vienna-Hidewood-Lismore: Well drained, poorly drained, and moderately well drained, nearly level to hilly soils that formed in silty loess and in glacial till
- 10 AREAS DOMINATED BY SOILS THAT FORMED IN GLACIAL OUTWASH AND ALLUVIUM
- 11 Arvilla-Egeland-Marysland: Somewhat excessively drained, well drained, and poorly drained, nearly level to moderately steep soils that formed in loamy material over sandy and gravelly deposits
- 12 Lamoure-La Prairie: Poorly drained and moderately well drained, nearly level soils that formed in silty and loamy alluvial material



Prepared for Murray County by
The Southwest Regional Development Commission
Created: January, 2001
Data Provided by: Soil Conservation Service, 1989

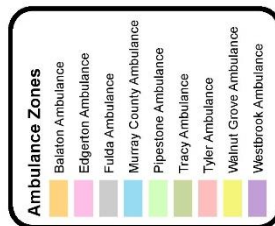
Figure #7
General Soils Map – Murray County

Figure #37
Ambulance Districts – Murray County



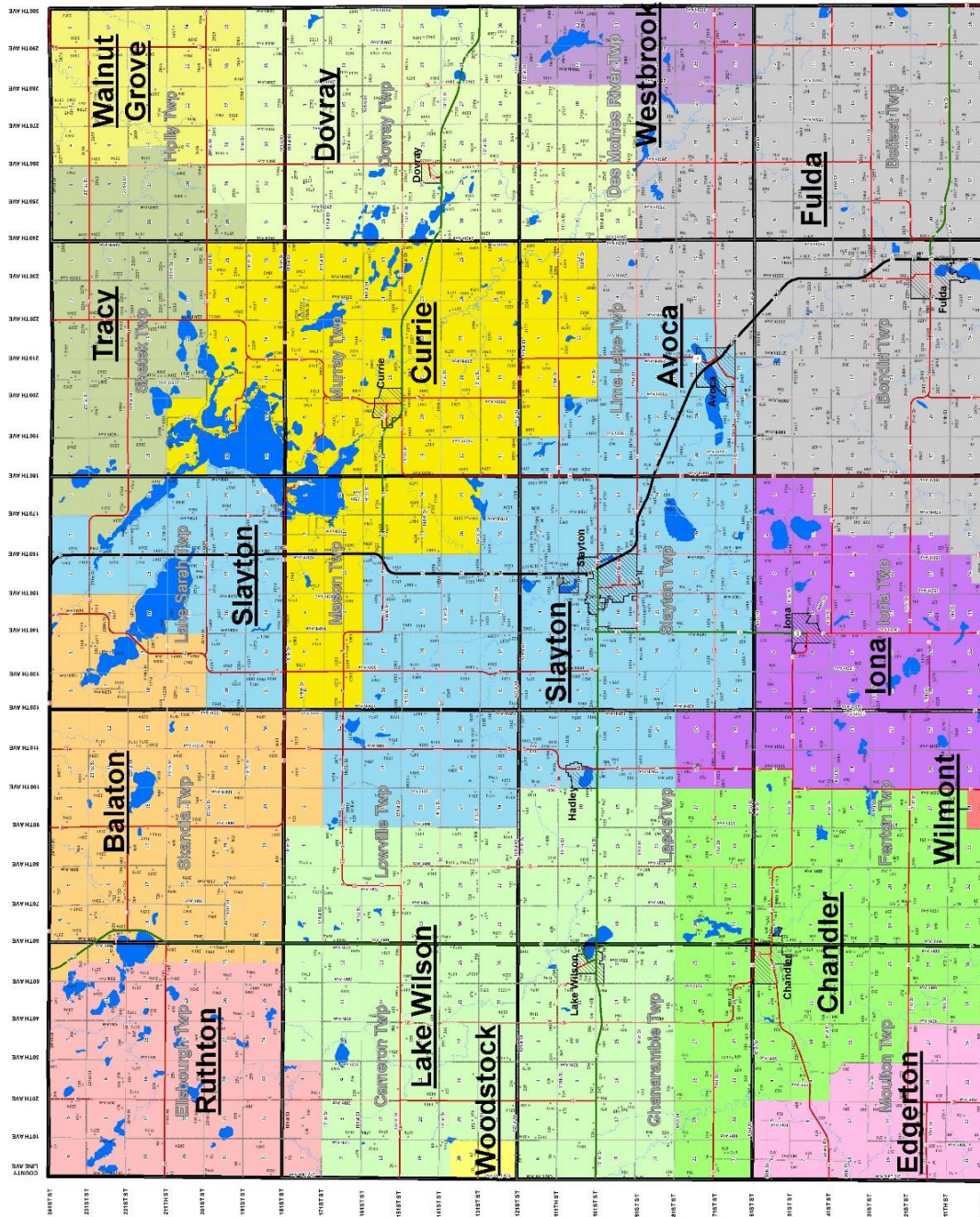
Ambulance Coverage

Murray County
 Minnesota
 2012



Source: Murray County GIS Data
 Prepared by: Murray County Emergency Services, 2012
 Displayed Using: Murray County Coordinate System

Figure #38
Fire District Map – Murray County



Fire Coverage

Murray County

Minnesota

2016

FIRE ZONES	
	Balaton Fire
	Chandler Fire
	Currie Fire
	Dovray Fire
	Edgerton Fire
	Fulda Fire
	Iona Fire
	Lake Wilson Fire
	Ruthton Fire
	Slayton Fire
	Tracy Fire
	Walnut Grove Fire
	Westbrook Fire
	Wilmont Fire
	Woodstock Fire



Source: Murray County GIS Data
Map Date: 10/1/2016
Map Scale: 1 inch = 10 miles
Displaying Using: Murray County Coordinate System

Figure #65
100-Year Flood Plain Map – Murray County

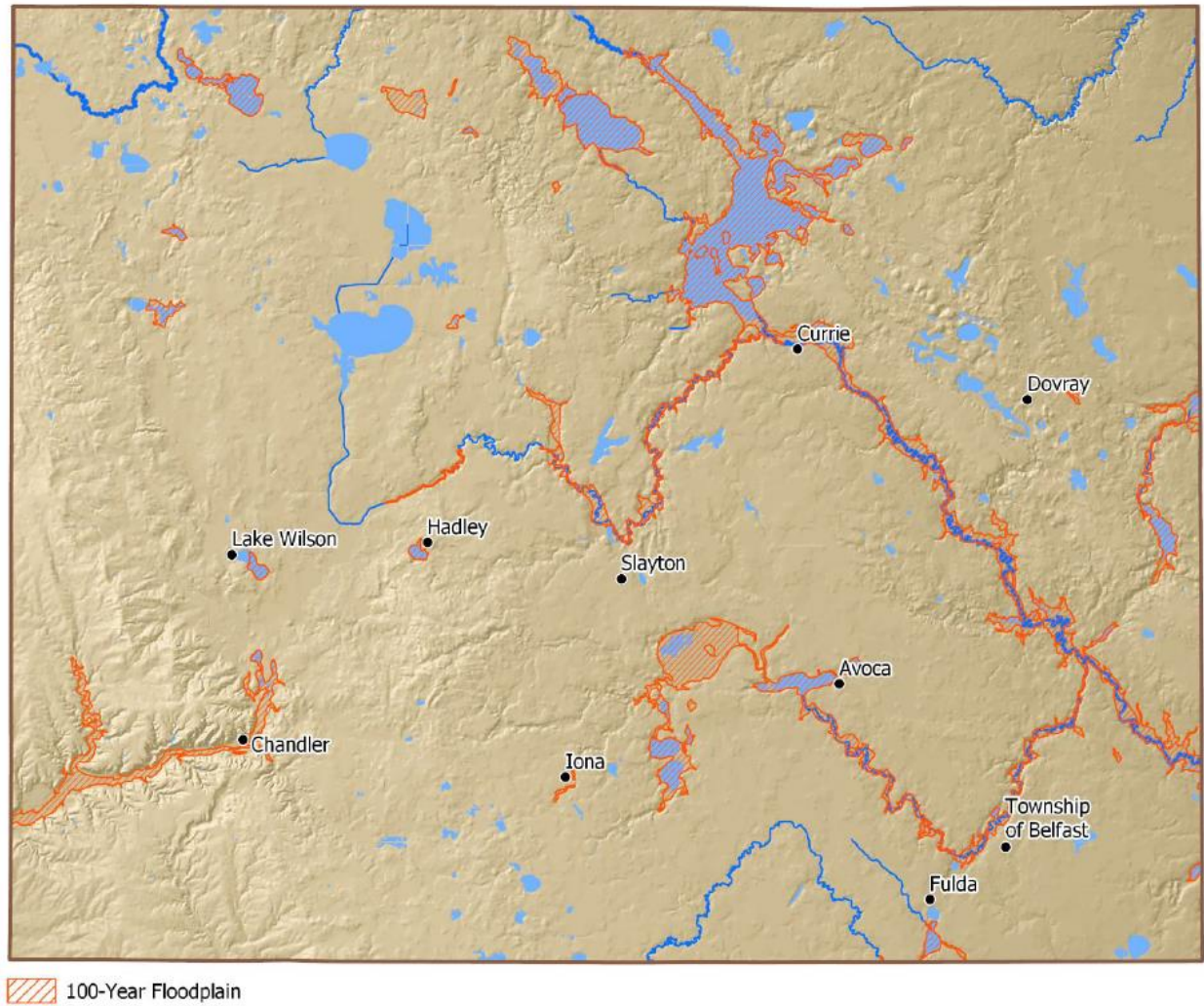
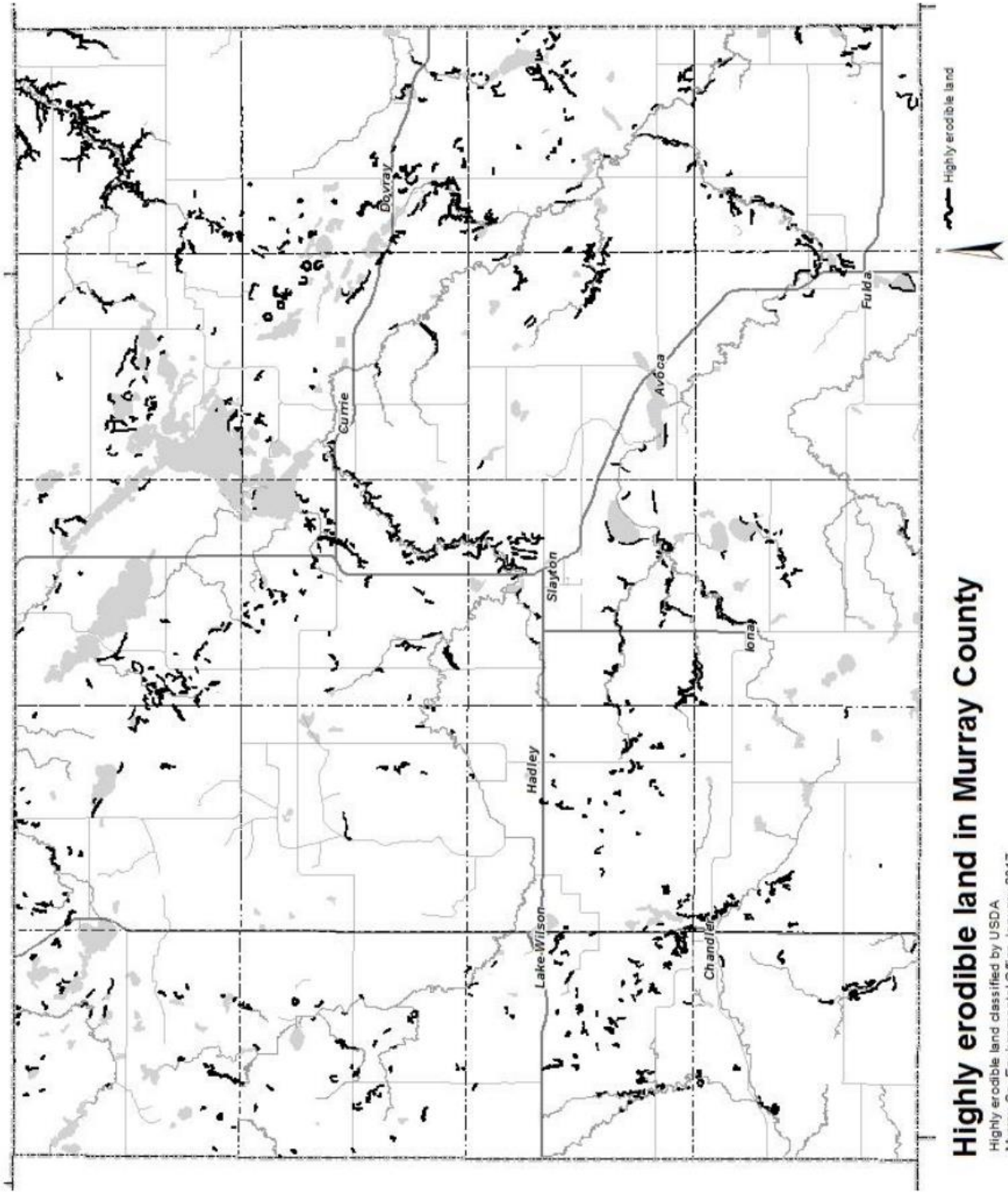


Figure #66
Highly Erodible Soils – Murray County



Highly erodible land in Murray County

Highly erodible land classified by USDA
Murray Co. Environmental Office January 2017

Figure #78
Outdoor Warning Sirens – Avoca

AVOCA SIREN COVERAGE

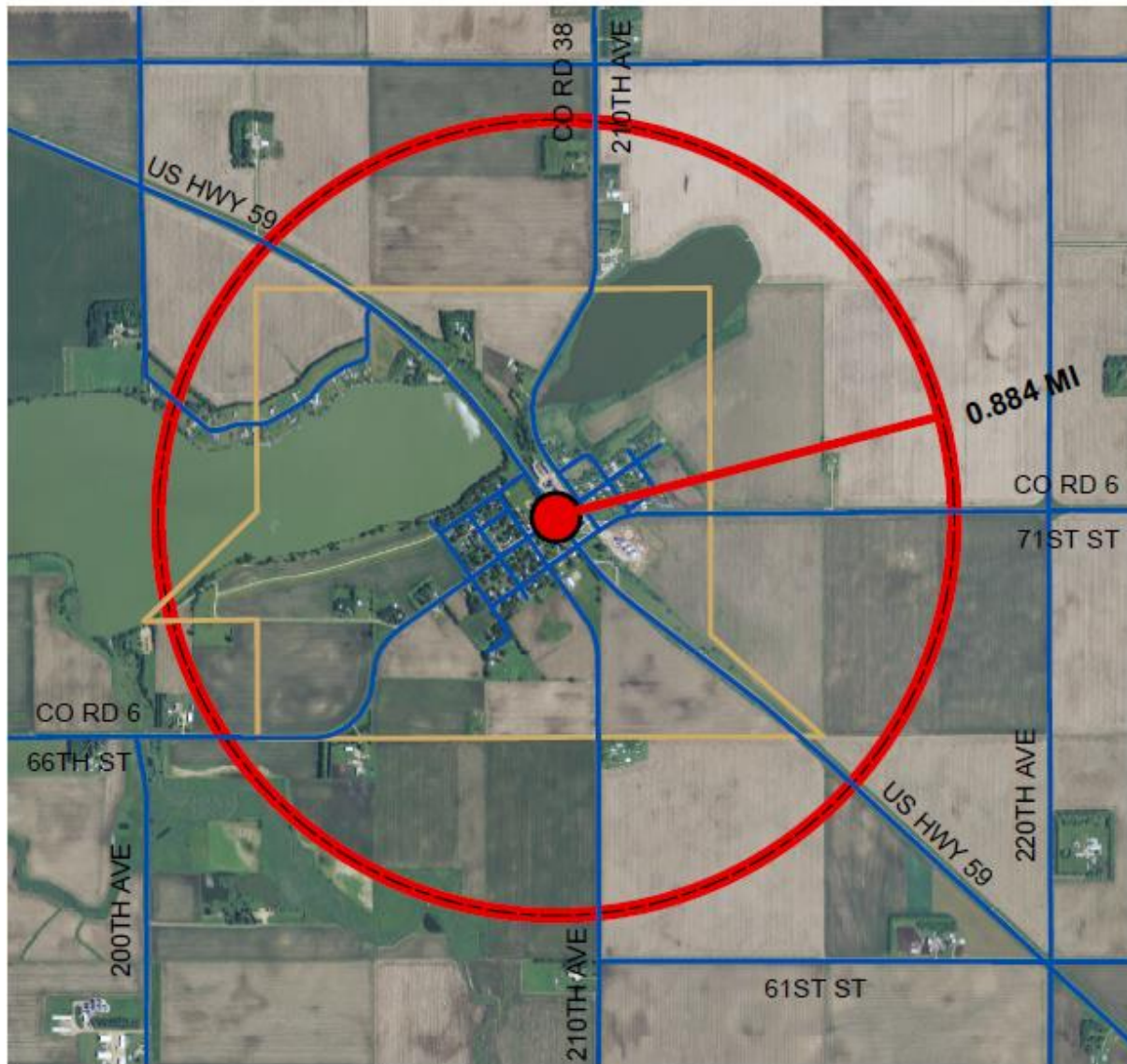


Figure #79
Outdoor Warning Sirens – Chandler

CHANDLER SIREN COVERAGE

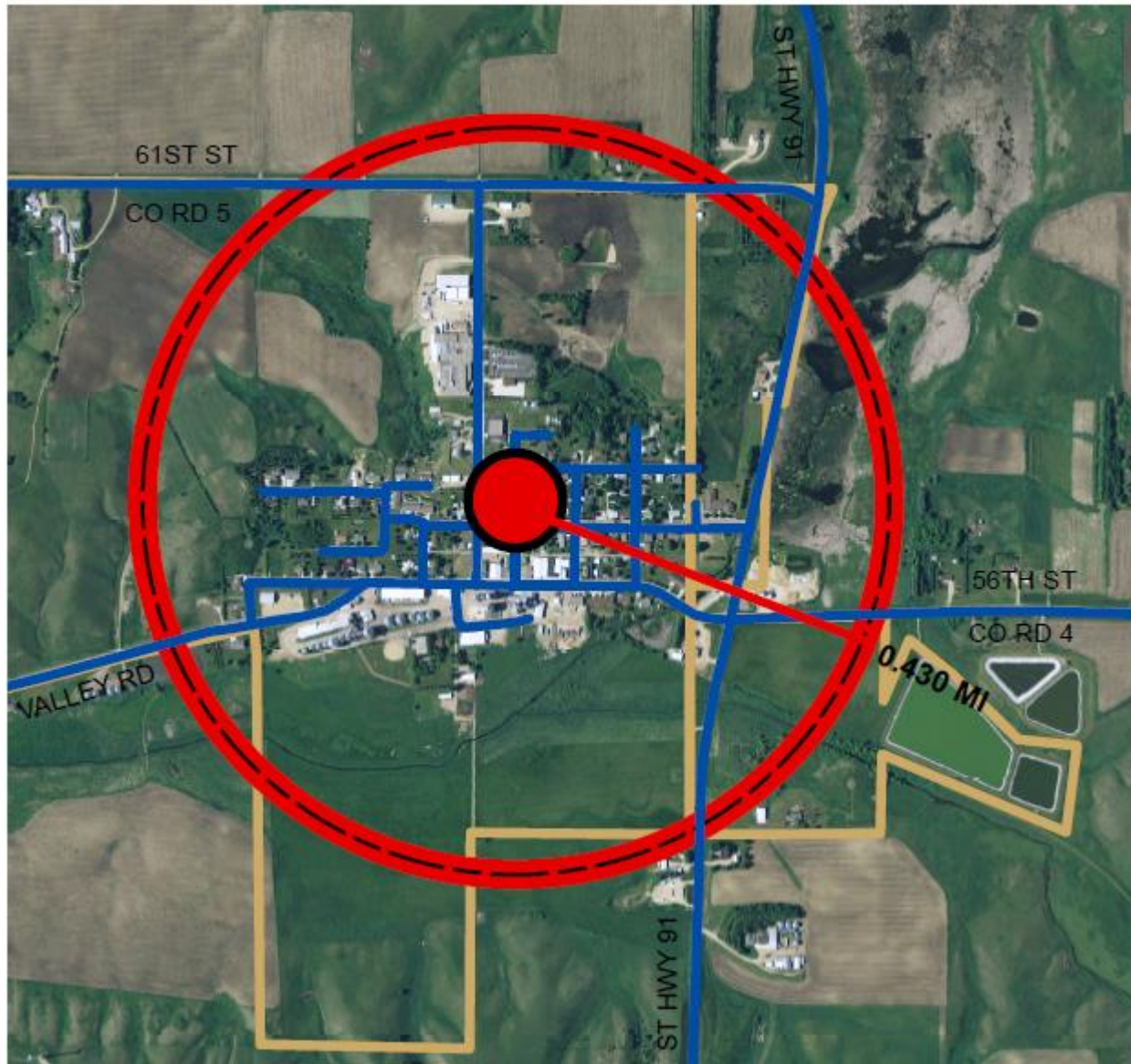


Figure #80
Outdoor Warning Sirens – Currie

CURRIE SIREN COVERAGE



Figure #81
Outdoor Warning Sirens – Dovray

DOVRA SIREN COVERAGE

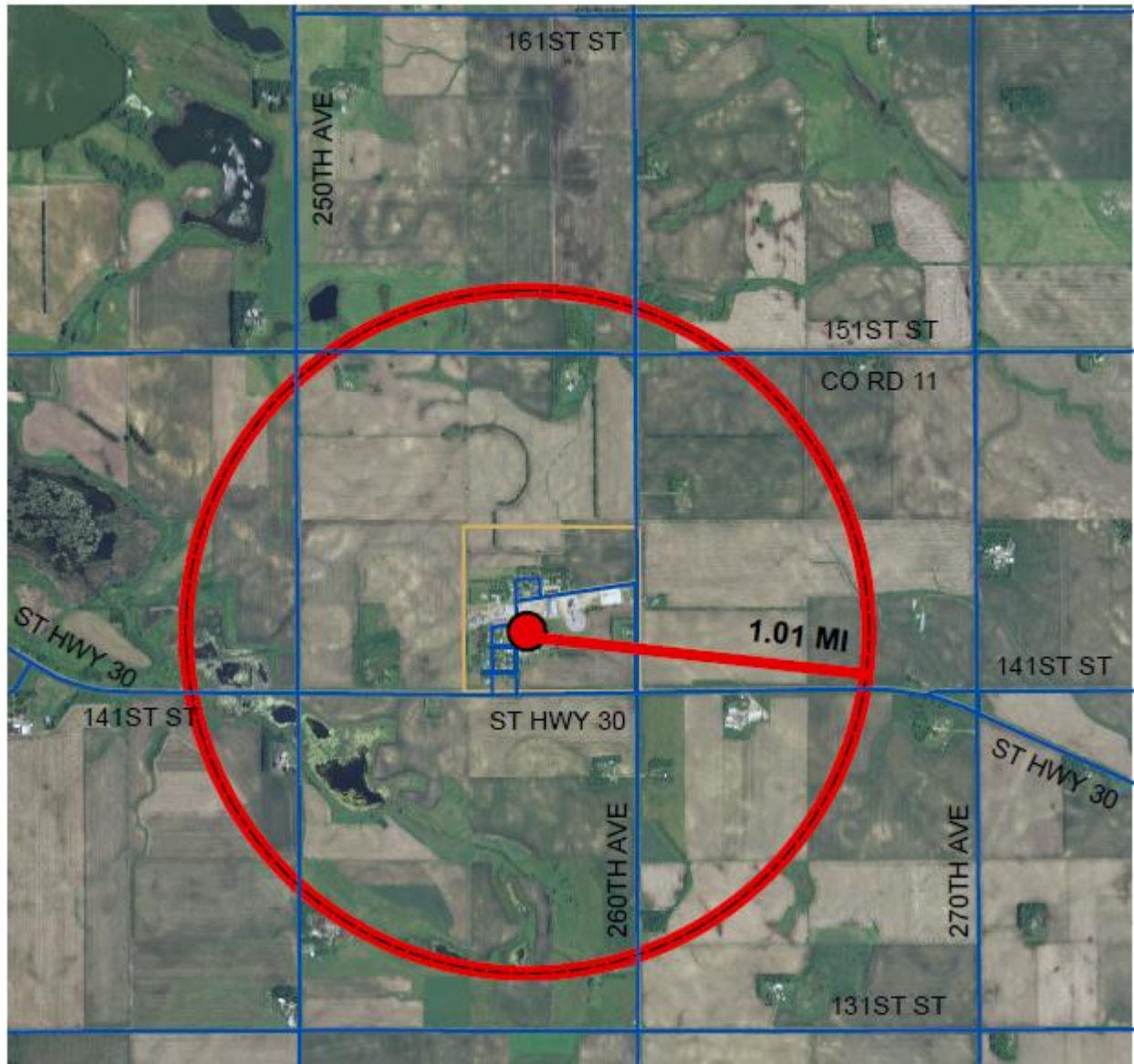


Figure #82
Outdoor Warning Sirens – Fulda

FULDA SIREN COVERAGE

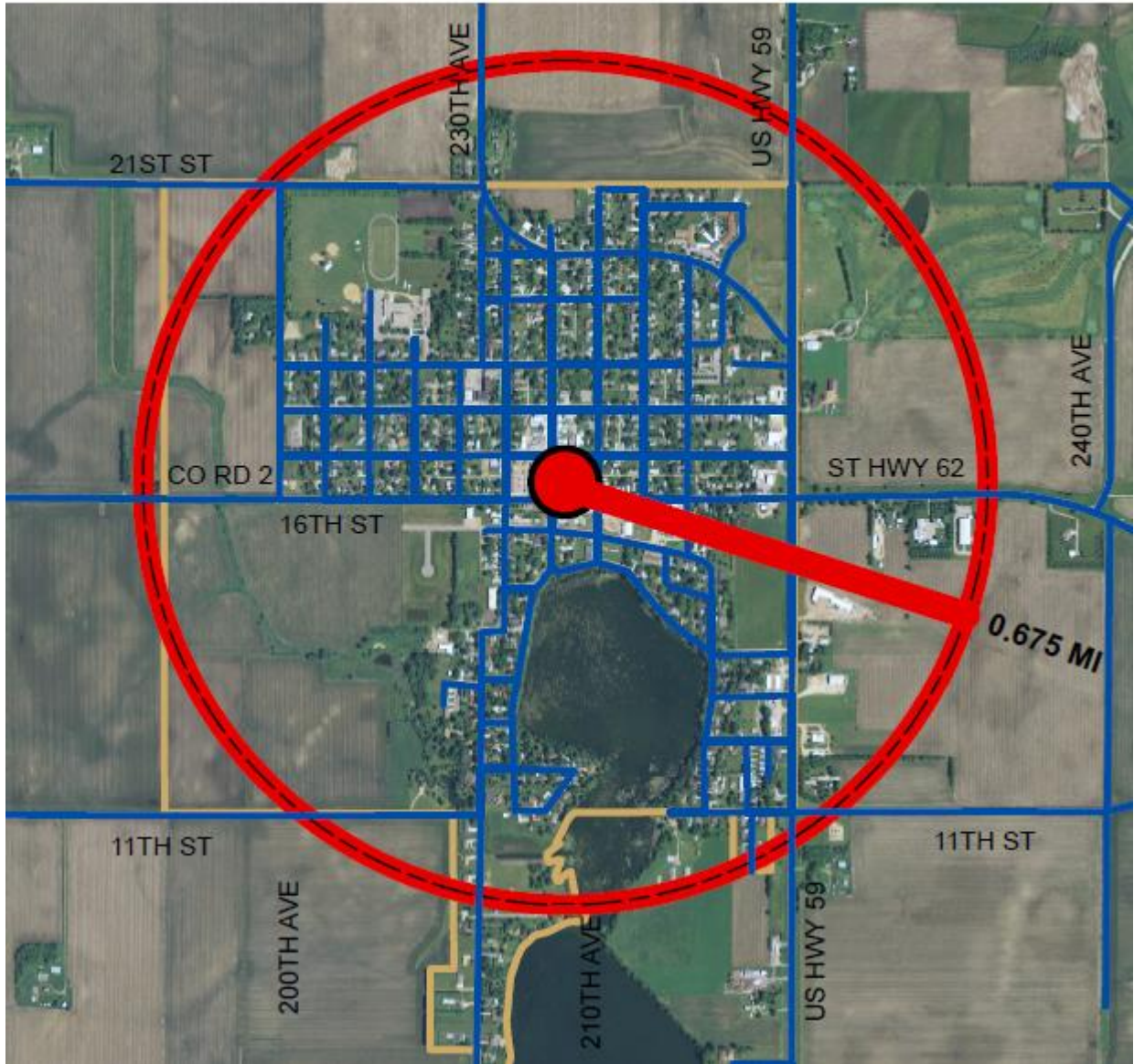


Figure #83
Outdoor Warning Sirens – Hadley

HADLEY SIREN COVERAGE

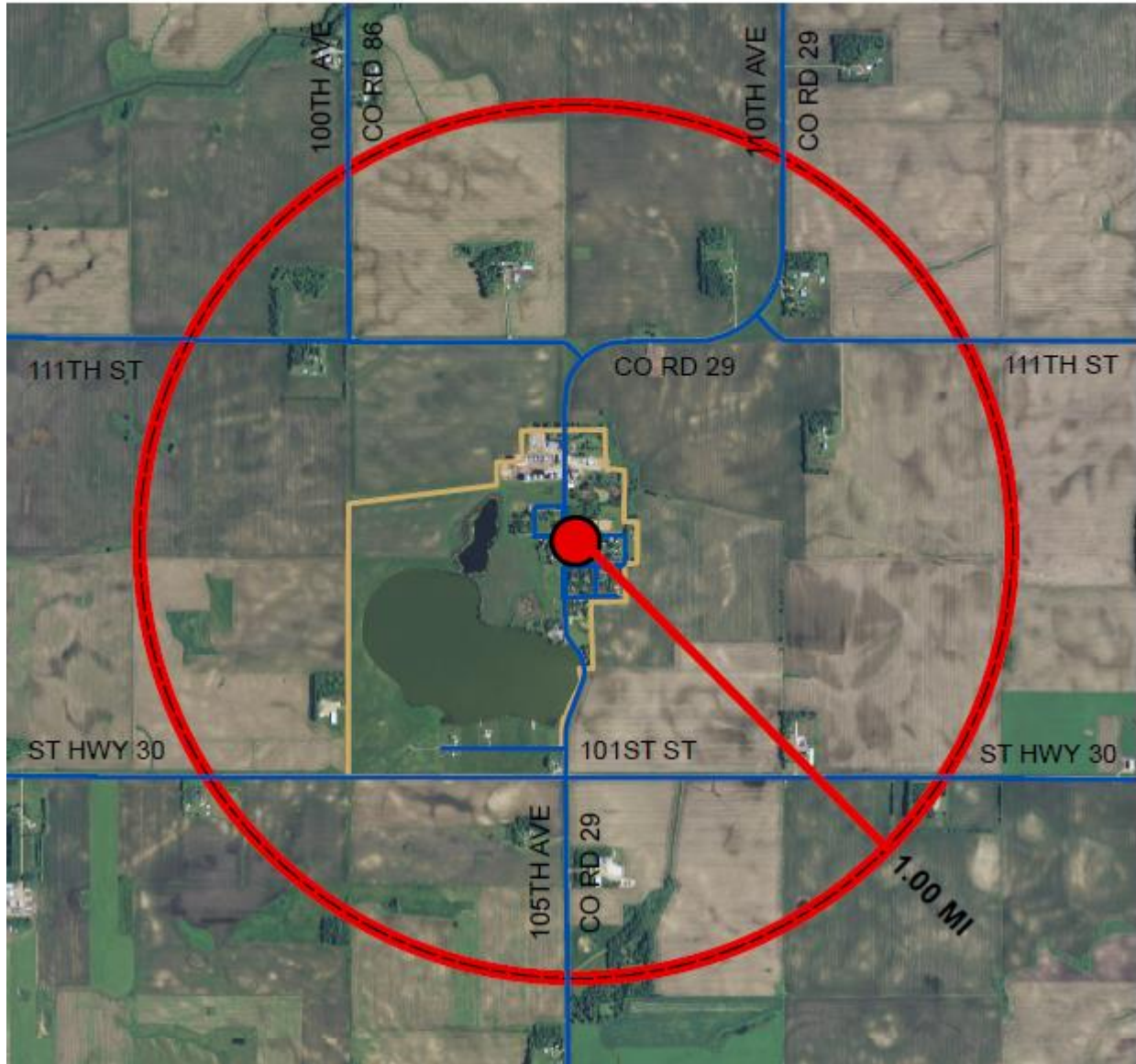


Figure #84
Outdoor Warning Sirens – Iona

IONA SIREN COVERAGE

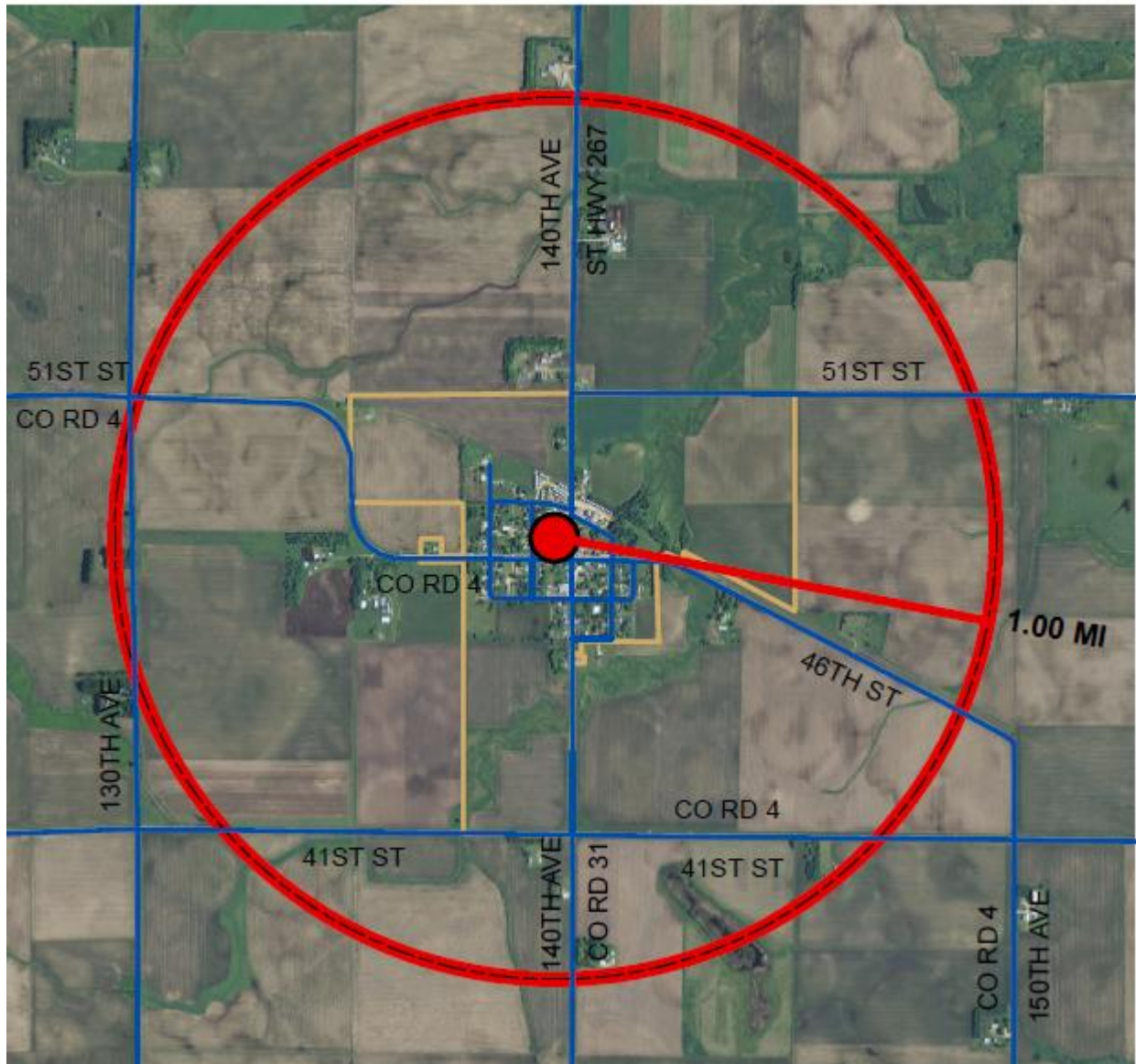


Figure #85
Outdoor Warning Sirens – Lake Wilson

LAKE WILSON SIREN COVERAGE

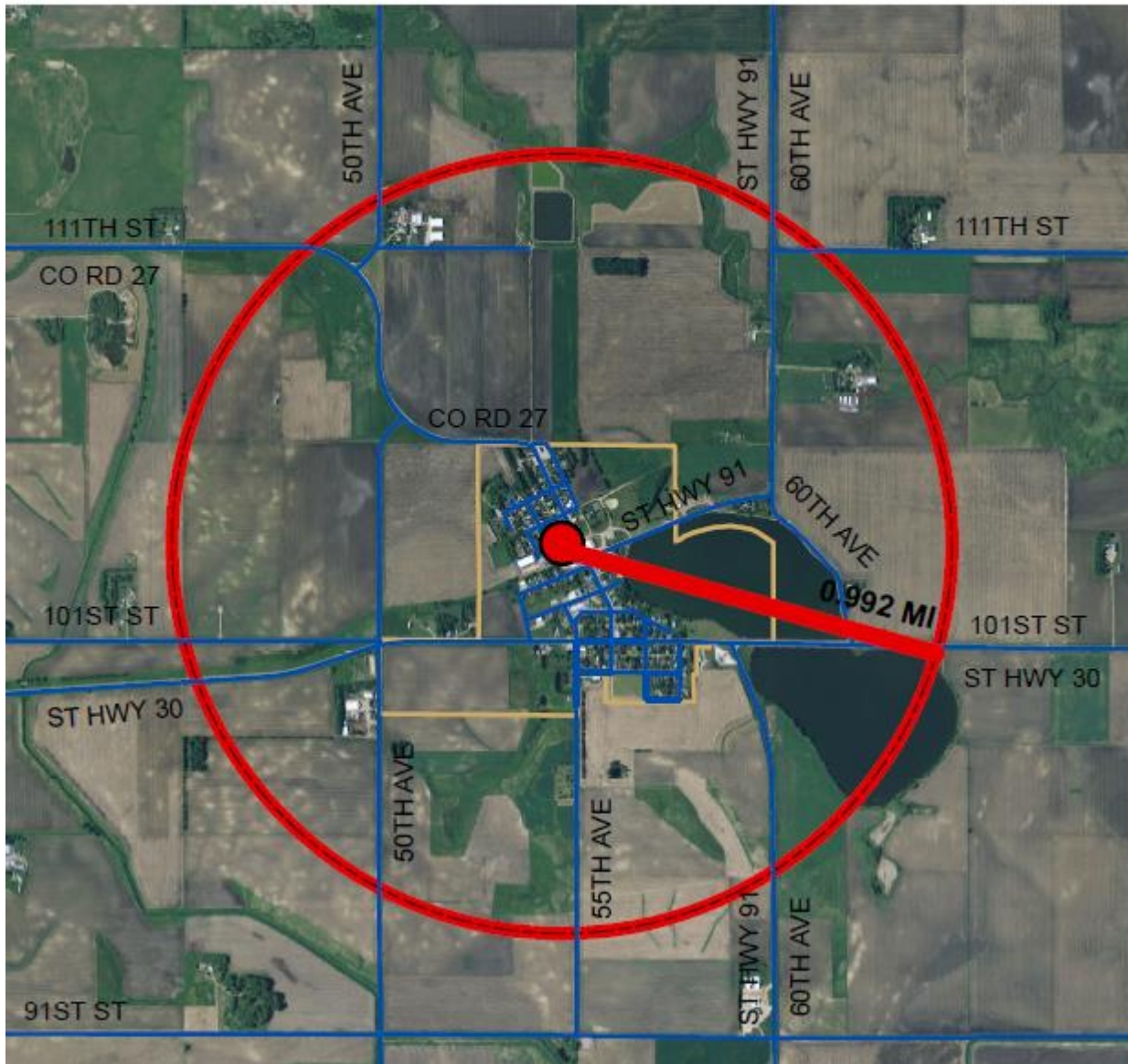


Figure #86
Outdoor Warning Sirens – Slayton

SLAYTON SIREN COVERAGE

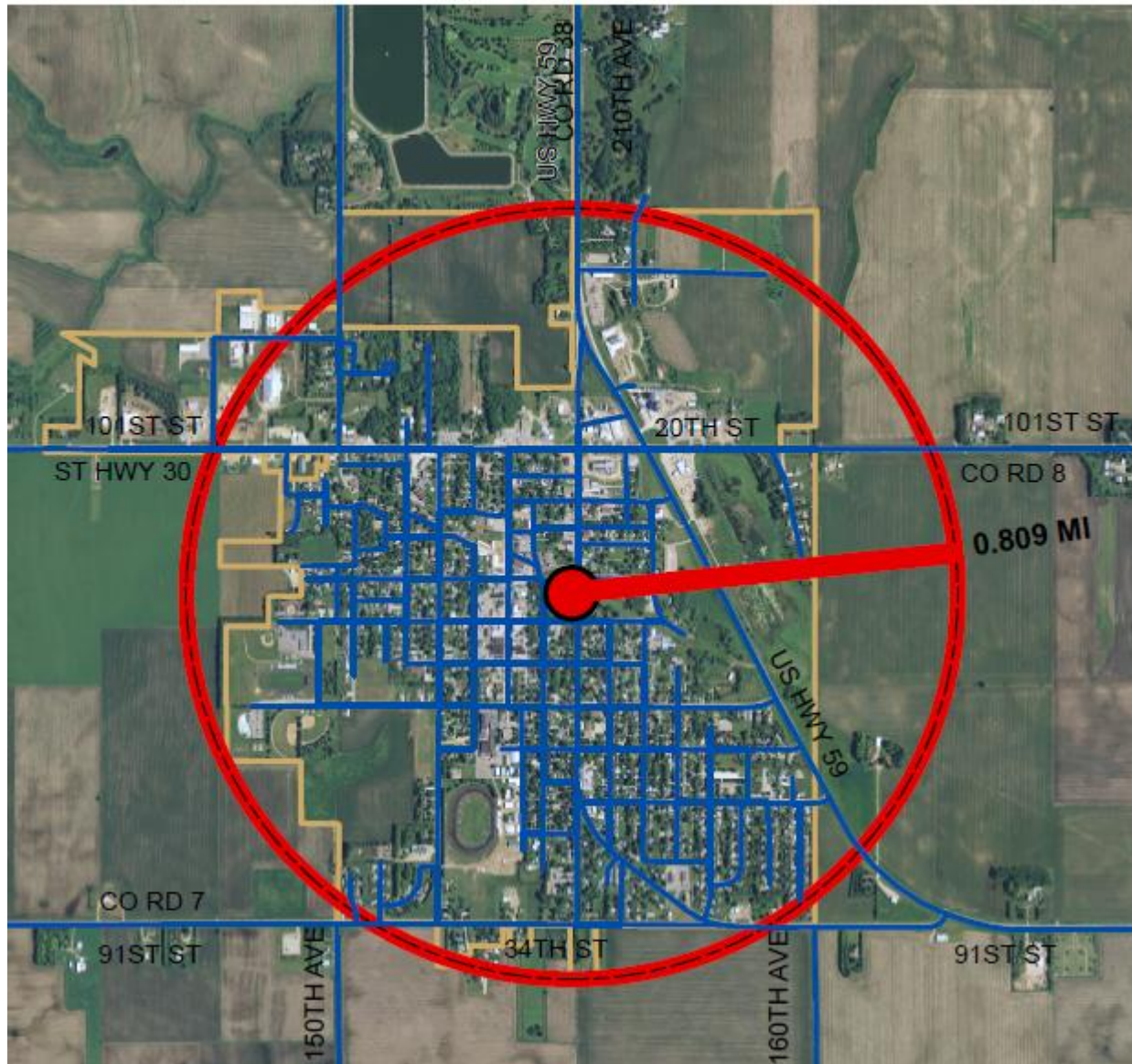


Figure #87
Outdoor Warning Sirens – Lake Shetek & Lake Sarah Area

LAKES AREA SIREN COVERAGE

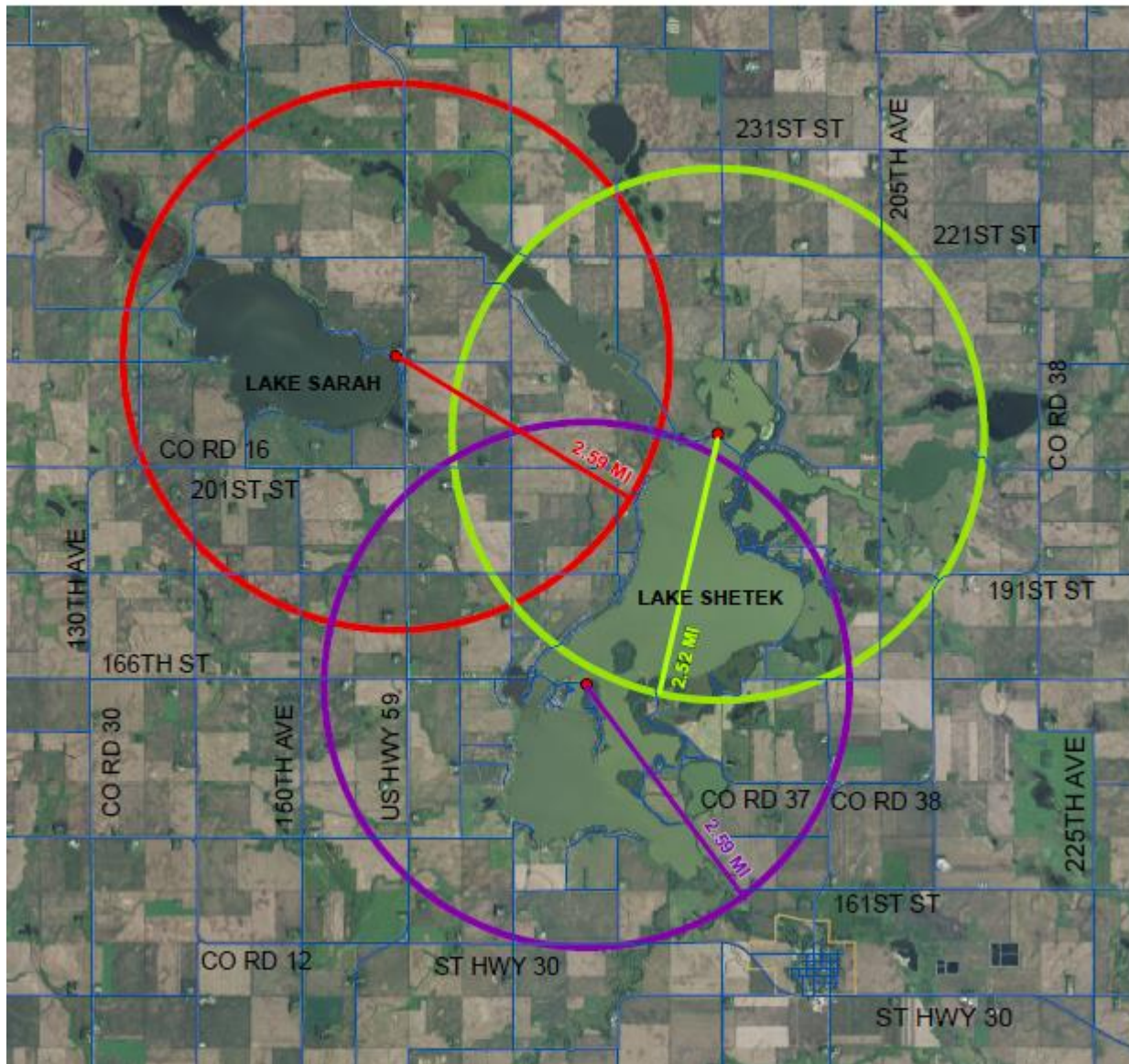


Figure #102
Feedlots – Murray County

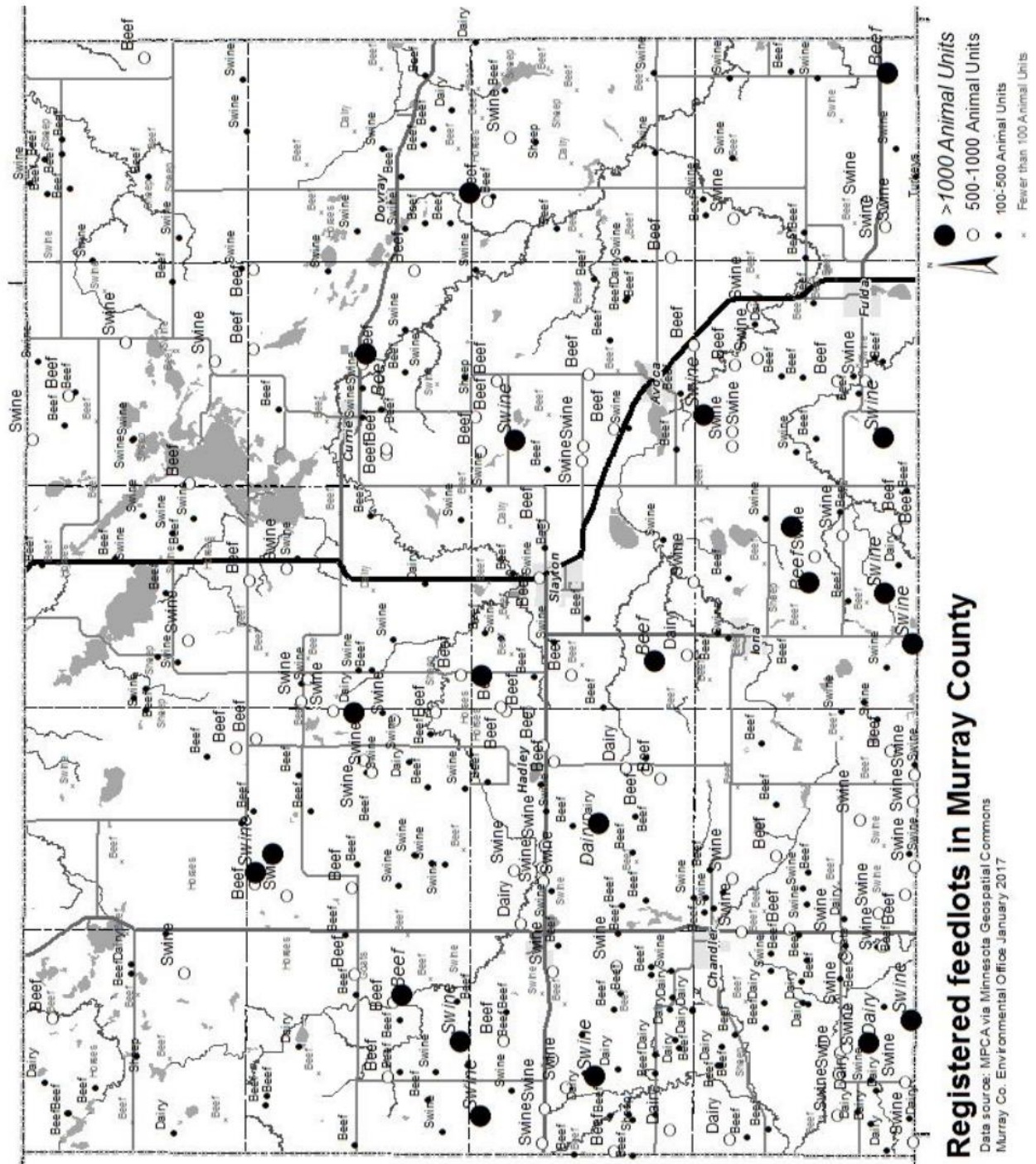


Figure #104
Dams – Murray County

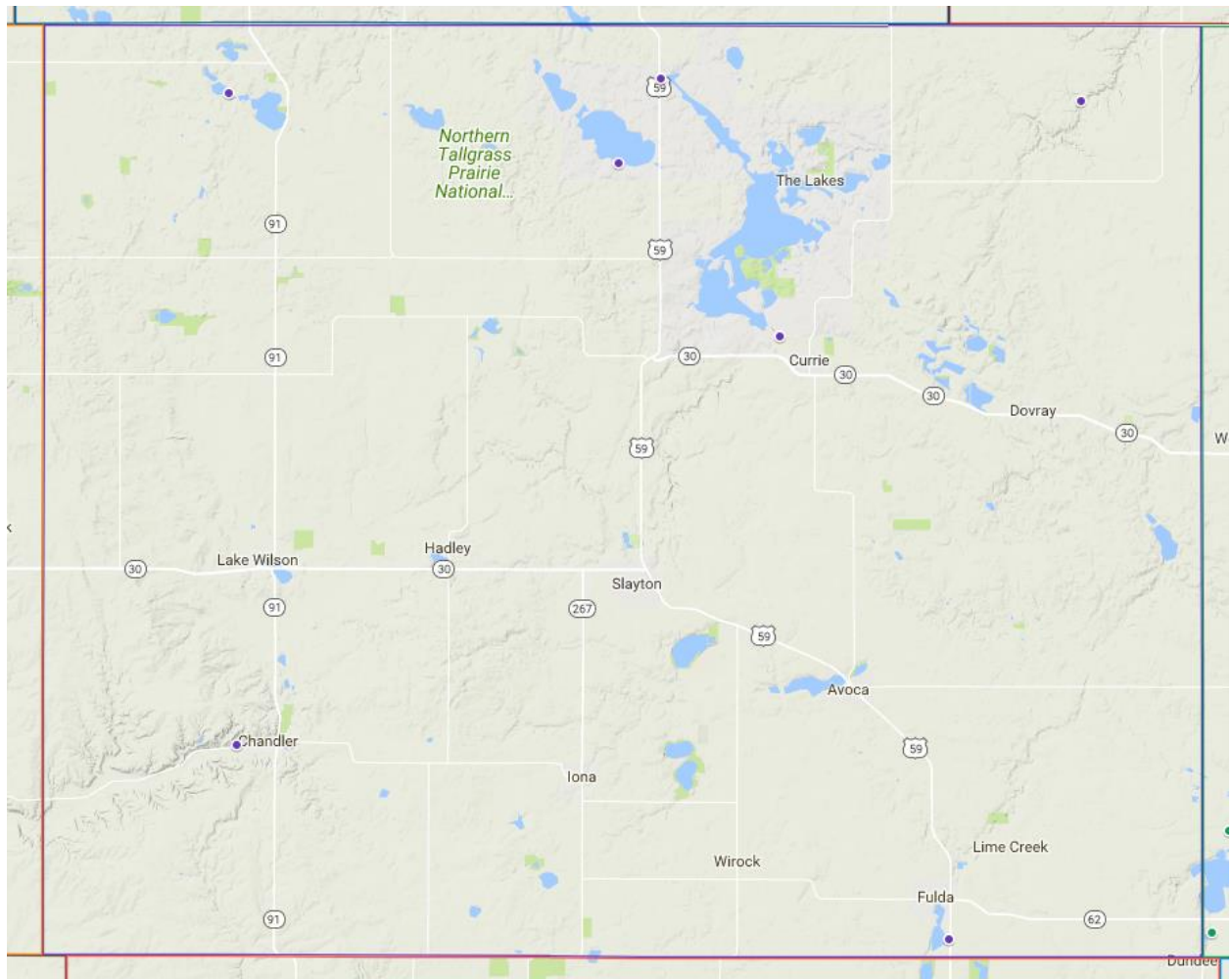


Figure #105
Hazardous Liquid and Gas Transmission Pipelines – Murray County

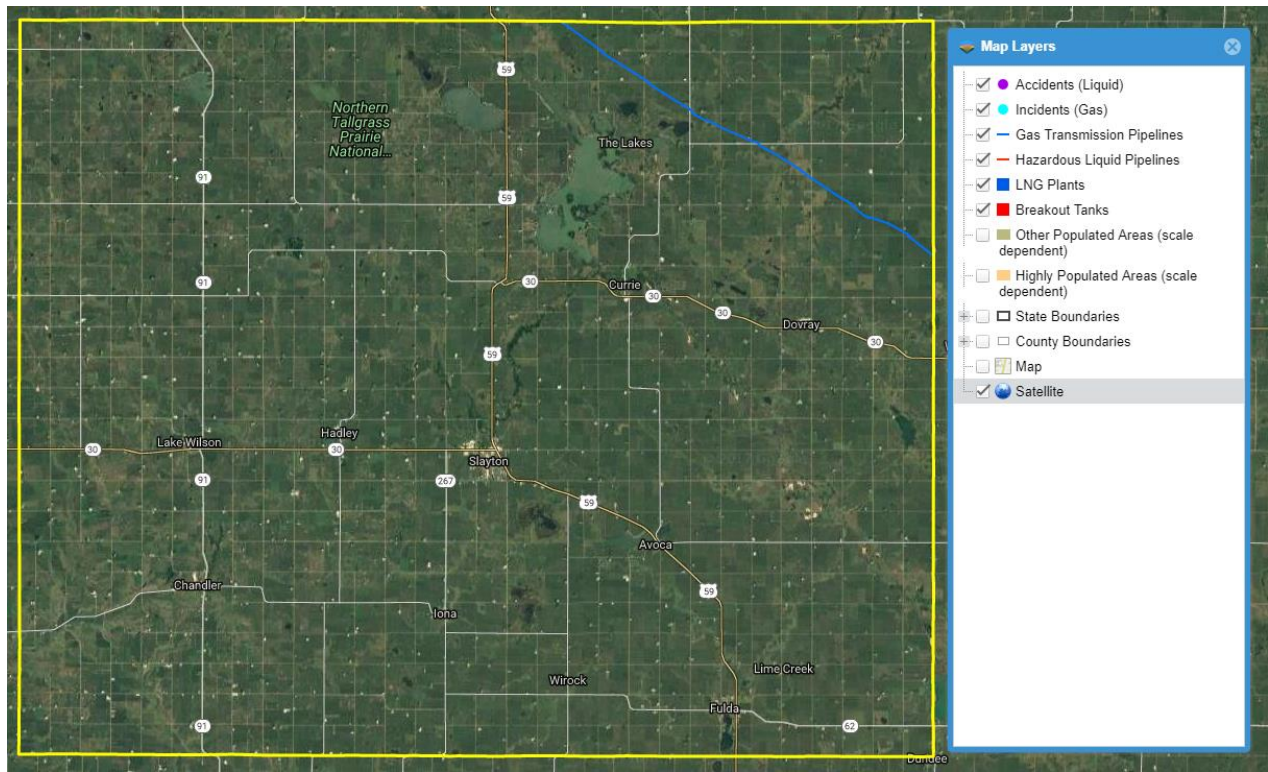


Figure #106
Wind Towers in Murray County

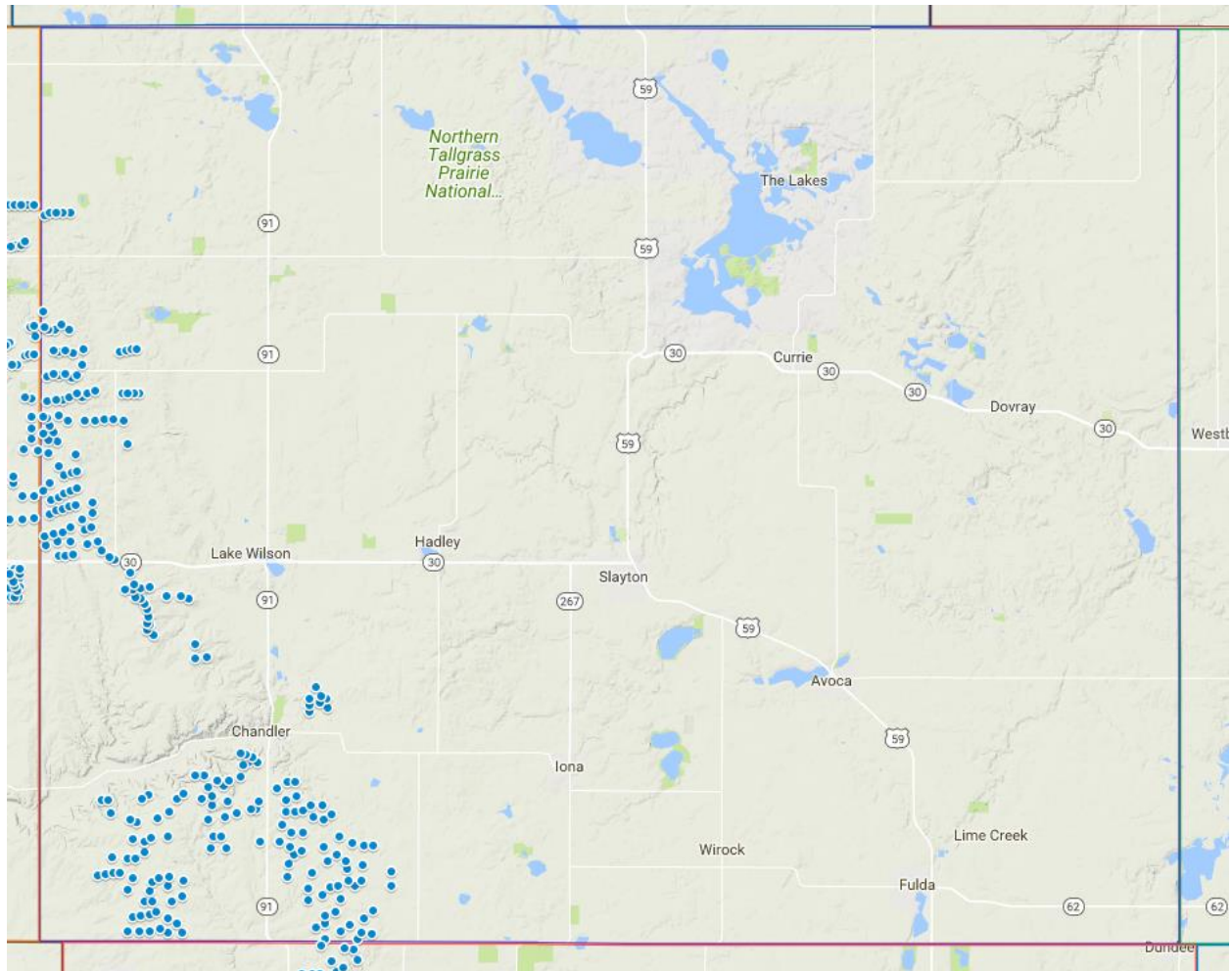


Figure #109
Bridge Map – Murray County

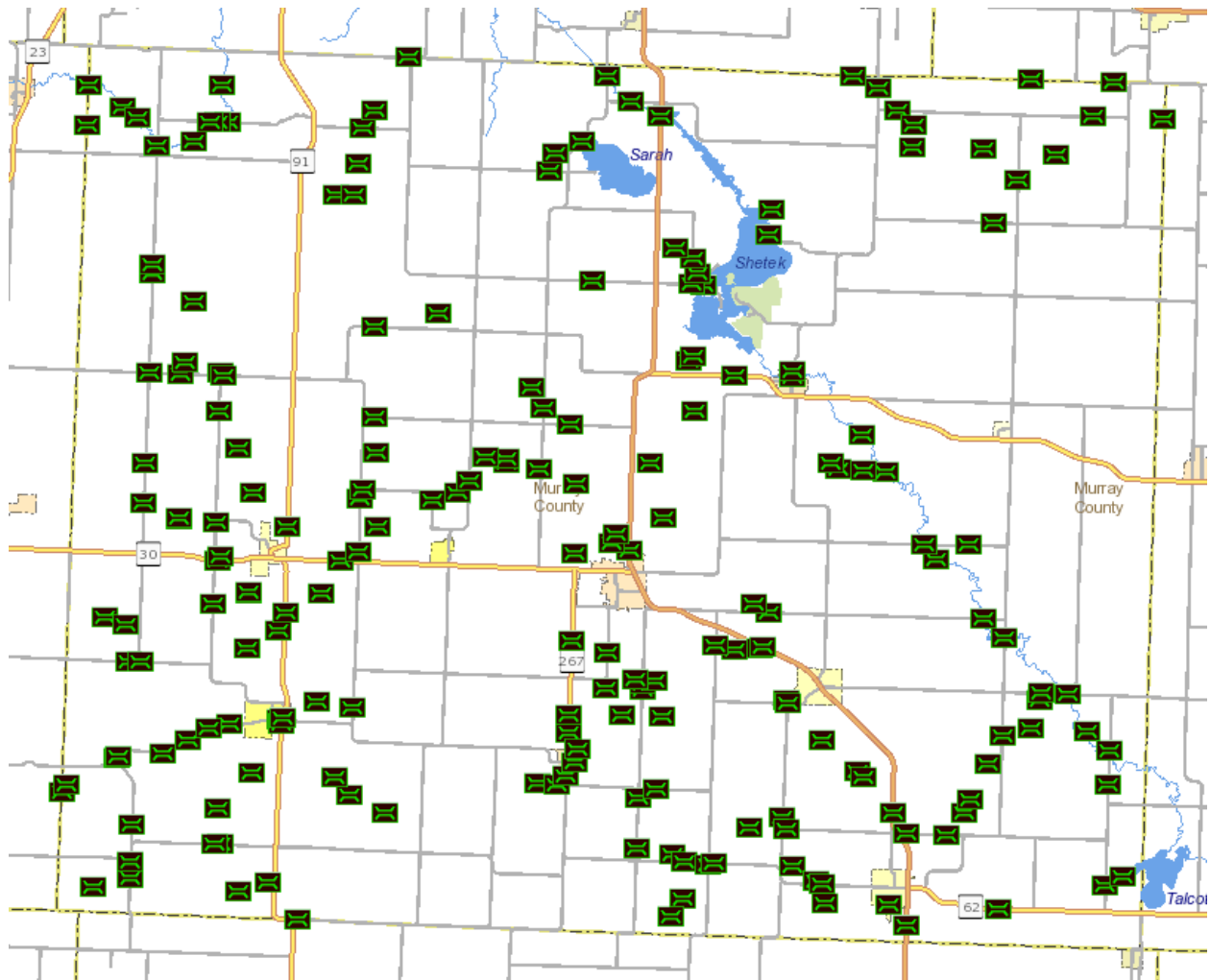
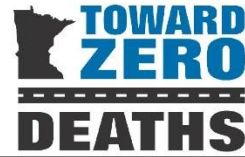


Figure #113
Fatal & Serious Crashes – Murray County

Murray County

Fatal and Serious Injury Crashes, 2012-2016

- ✖ Fatal Crash
- Serious Injury Crash



0 5 10 Miles

2016 data preliminary: April, 2017.

Not all crashes may be visible at this scale.

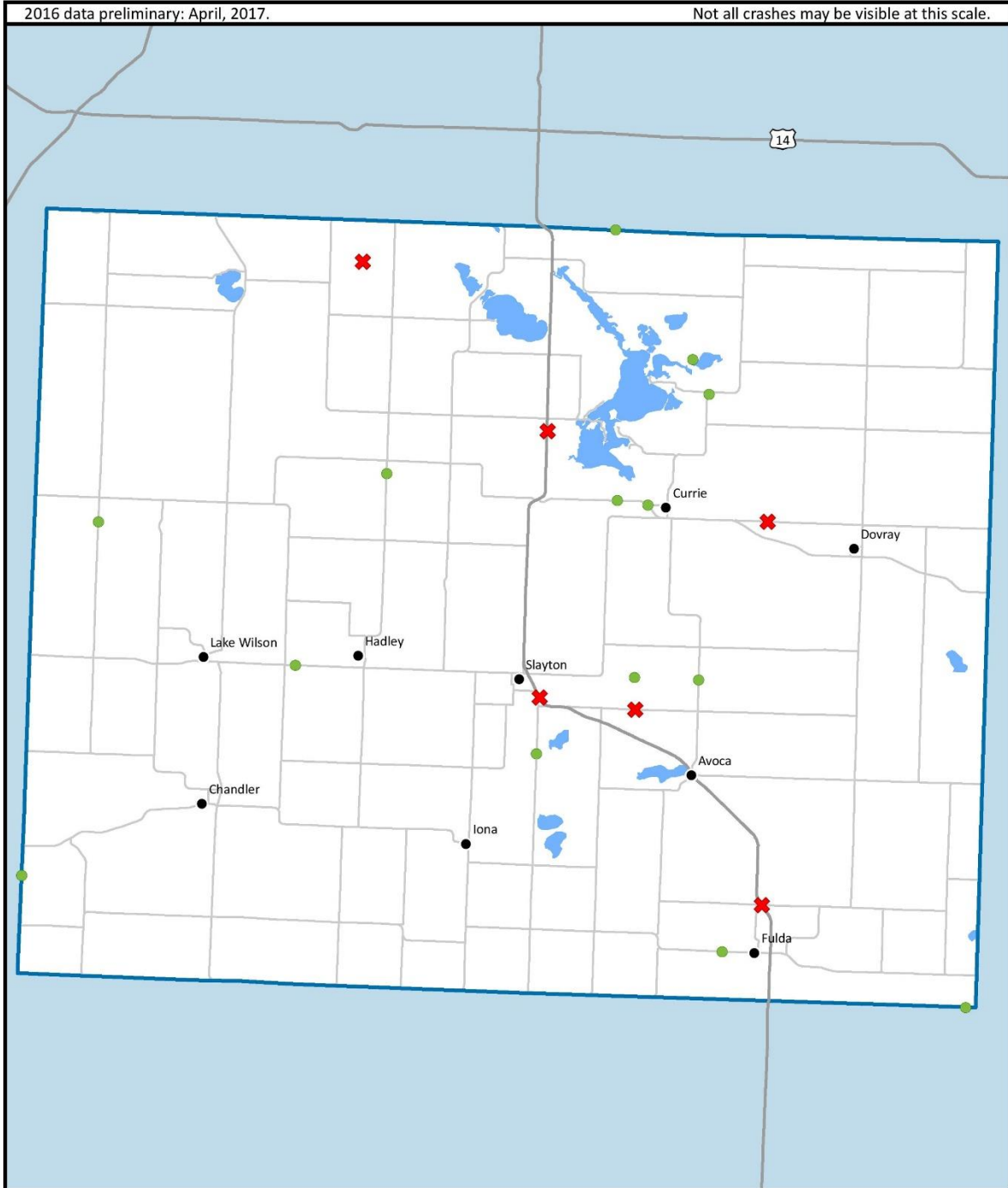
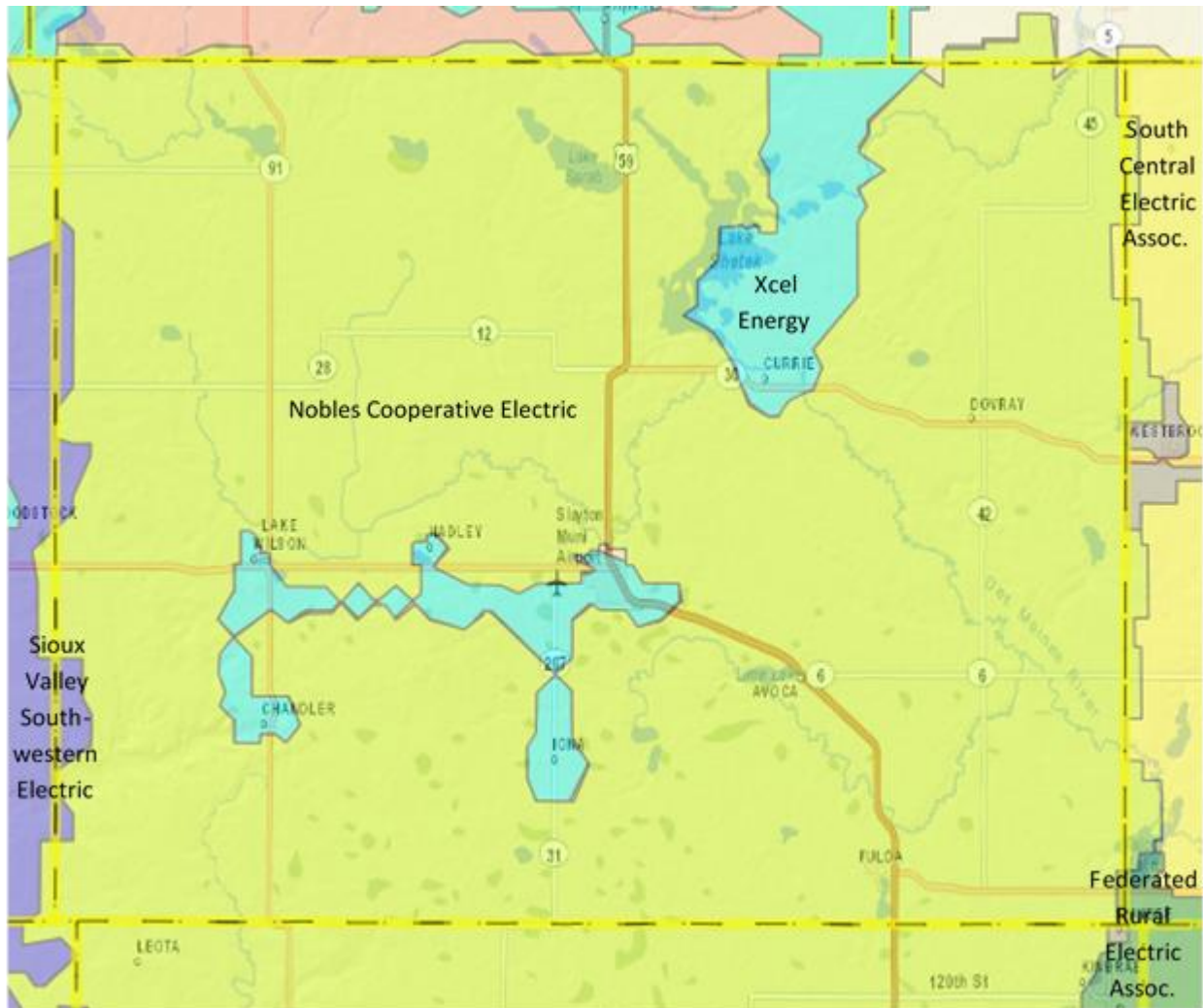


Figure #114
Electric Utilities – Murray County



Flood Hazard Analysis for Murray County

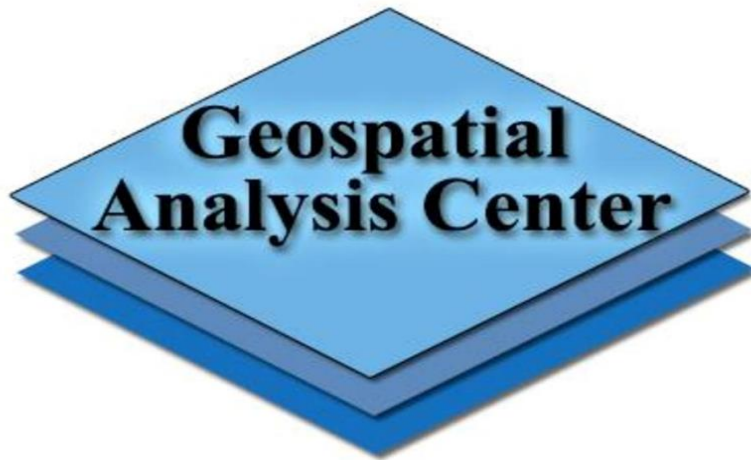
Flood Hazard Analysis for Murray County

*Prepared for Southwest Regional Development Commission
Level II Flood Hazard Analysis performed using FEMA Hazus*

April 2018

Contact Information:

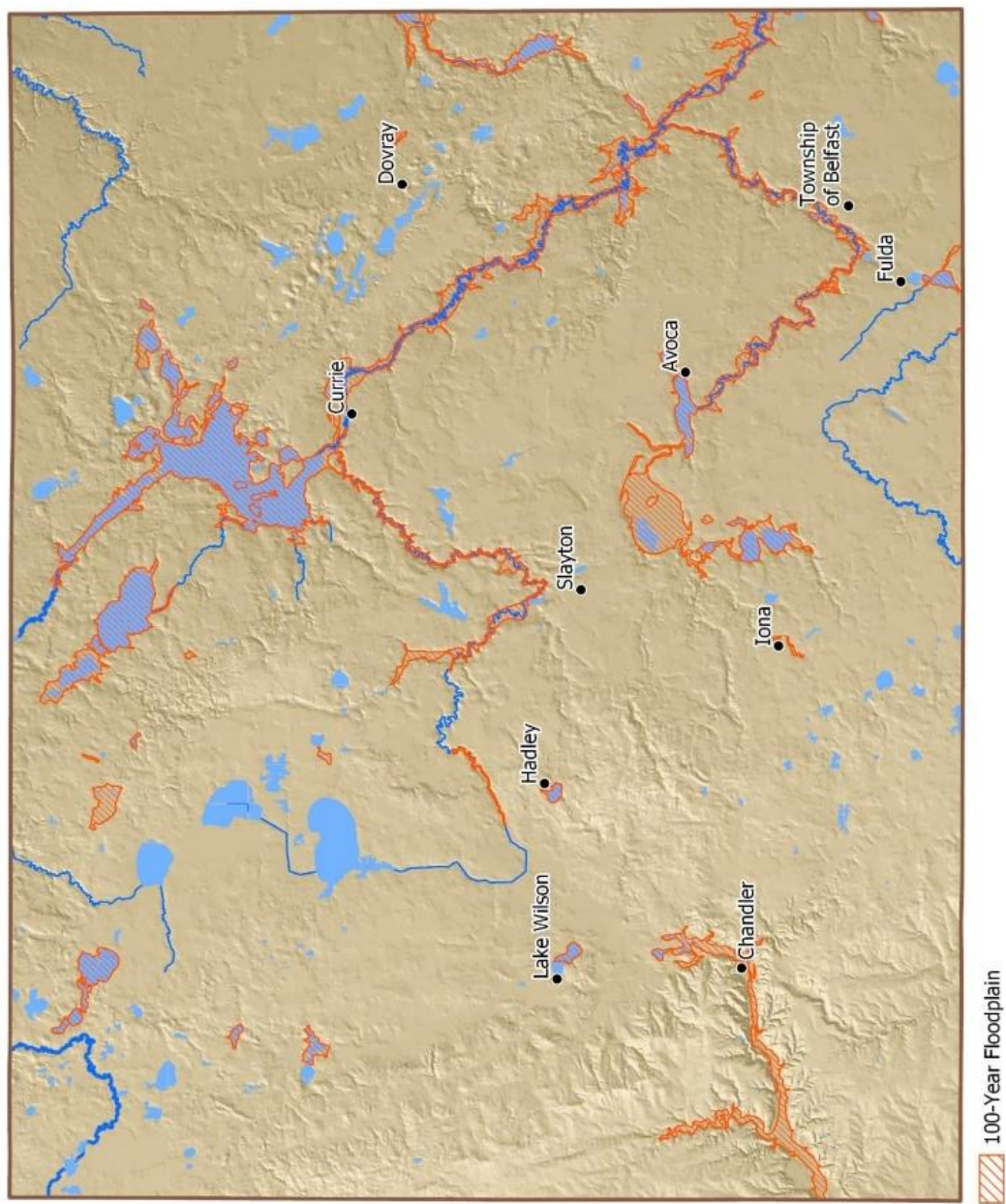
Stacey L. Stark, MS, GISP
Geospatial Analysis Center
Swenson College of Science and Engineering
140 Engr
1303 Ordean Court
Duluth, MN 55812
Email: slstark@d.umn.edu
Tel: 218-726-7438



Murray County Hazus-MH Hazard Analysis

The University of Minnesota Duluth Geospatial Analysis Center (GAC) performed the hazard risk assessment for 100-year floods using the Hazus-MH GIS tool. In recognition of the importance of planning in mitigation activities, FEMA created **Hazards USA Multi-Hazard** (Hazus-MH), a powerful geographic information system (GIS)-based disaster risk assessment tool. This tool enables communities of all sizes to predict estimated losses from floods, hurricanes, earthquakes, and other related phenomena and to measure the impact of various mitigation practices that might help reduce those losses. The Minnesota Homeland Security and Emergency Management (HSEM) office has determined that Hazus-MH should play a critical role in Minnesota's risk assessments.

FEMA's Hazus 4.2 and ArcGIS 10.5.1 were used to estimate potential losses incurred in a 100-year flood event in Murray County. A Q3 floodplain obtained from the MN DNR was used to determine the flood extent because no updated National Flood Insurance Program (NFIP) map is available. The Q3 Flood Data are derived from the Flood Insurance Rate Maps (FIRMS), published by FEMA, and follow standards required for mapping at a scale of 1:24000; these maps are often outdated. A 10-meter digital elevation model (DEM) was used to create a flood depth grid for the county. The 100-yr floodplain boundary is shown in Figure 1.



Data Sources: FEMA Q3 Flood Data, and Hazus-MH

Figure 1. 100-Year Floodplain in Murray County

Murray County specific building data was sourced from the parcel tax and spatial databases to include building valuations and occupancy class. A shapefile named MurrayParcels.shp was obtained from Murray County. File HazMitData2017x (structure value and occupancy class), was obtained from Murray County. Square footage, Number of stories, year built, and contents value were derived from this data and regional averages. The resulting spatial dataset included 4,607 parcel records with buildings.

In cases where building value, square footage, year built, or number of stories were missing, values were assigned based on best practices from values in the other 4 fields. The data were then assigned to one parcel centroid or LIDAR building centroid, which served as a surrogate for the each parcel's buildings to aggregate to the associated census block for use in the Hazus model.

According to the Murray County general building stock (derived from the county's parcel data and imported to the Hazus model), the Hazus model estimates there are 4,590 parcels with buildings in the region with a total replacement value (excluding contents) of \$463 million. Approximately 71.76 % of the buildings (and 57.40 % of the building value) are associated with residential housing. The Hazus model estimated 18 parcel's buildings will be at least moderately damaged (>10% damage). Zero buildings are estimated to be completely destroyed.

The total economic loss estimated for the flood is \$26.91 million, which represents 17.47% of the total replacement value of the scenario buildings. Building losses are broken into 2 categories: direct building losses and business interruption losses. The direct building losses are the estimated costs to repair or replace the damage caused to the building and its contents. The business interruption losses are associated with inability to operate a business because of the damage sustained during the flood. Business interruption losses also include the temporary living expenses for those people displaced from their homes because of the flood. The total building-related losses were \$4.96 million. 82% of the estimated losses were related to the business interruption of the region. Residential occupancies made up 13.24% of the total loss.

The reported building counts should be interpreted as degrees of loss rather than an exact number of buildings exposed to flooding. These numbers were derived from aggregate building inventories which are assumed to be dispersed evenly across census blocks. Hazus requires that a predetermined amount of square footage of a typical building sustain damage in order to produce a damaged building count. If only a minimal amount of damage to buildings is predicted, it is possible to see zero damaged building counts while also seeing economic losses.

The total estimated number of damaged buildings (parcels as a surrogate), total building losses, and estimated total economic losses for the countywide 100-year flood are shown in Table 1. The distribution of economic losses for Murray County is depicted in Figure 2.

General Occupancy	Estimated Total Buildings	Total Damaged Buildings	Total Building Exposure	Total Economic Loss	Building Loss
Agriculture	741	0	\$109,073,000	\$1,465,000	\$324,000
Commercial	347	0	\$31,134,000	\$479,000	\$31,000
Education	6	0	\$12,046,000	\$150,000	\$14,000
Government	114	0	\$17,084,000	\$3,746,000	\$19,000
Industrial	25	0	\$9,261,000	\$17,000	\$4,000
Religious/Non-Profit	61	0	\$18,552,000	\$17,494,000	\$105,000
Residential	3,294	21	\$265,631,000	\$3,562,000	\$1,960,000
Total	4,590	21	\$462,781,000	\$26,913,000	\$2,457,000

Table 1. Murray County Total Economic Loss from 100-Year Flood

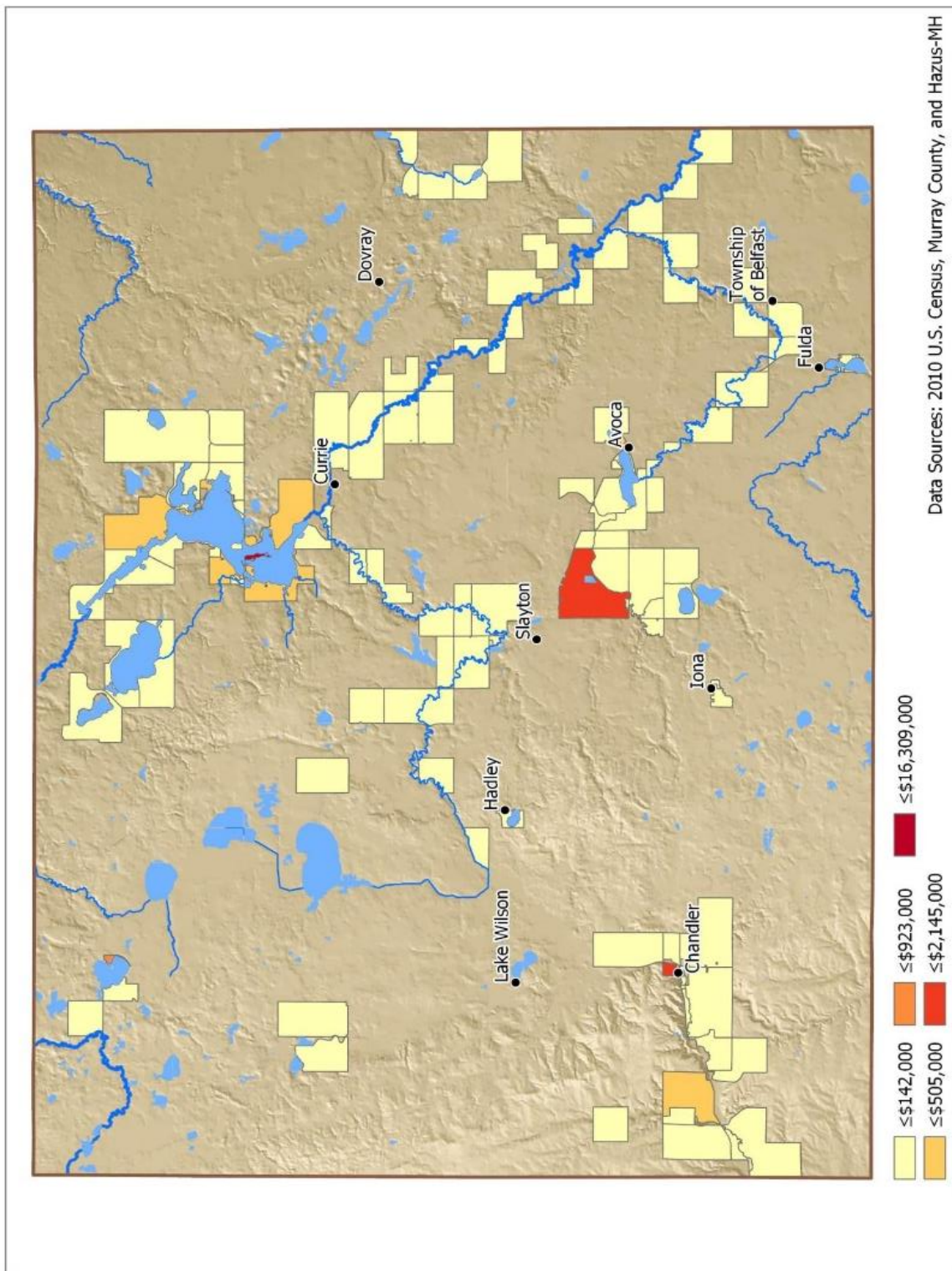


Figure 2. Estimated Economic Loss by Census Block within the 100-Year Floodplain

The three most populated cities with a potential economic loss are displayed in Figure 3, Figure 4, and Figure 5.



Figure 3. 100-Year Flood Loss Estimates in Slayton

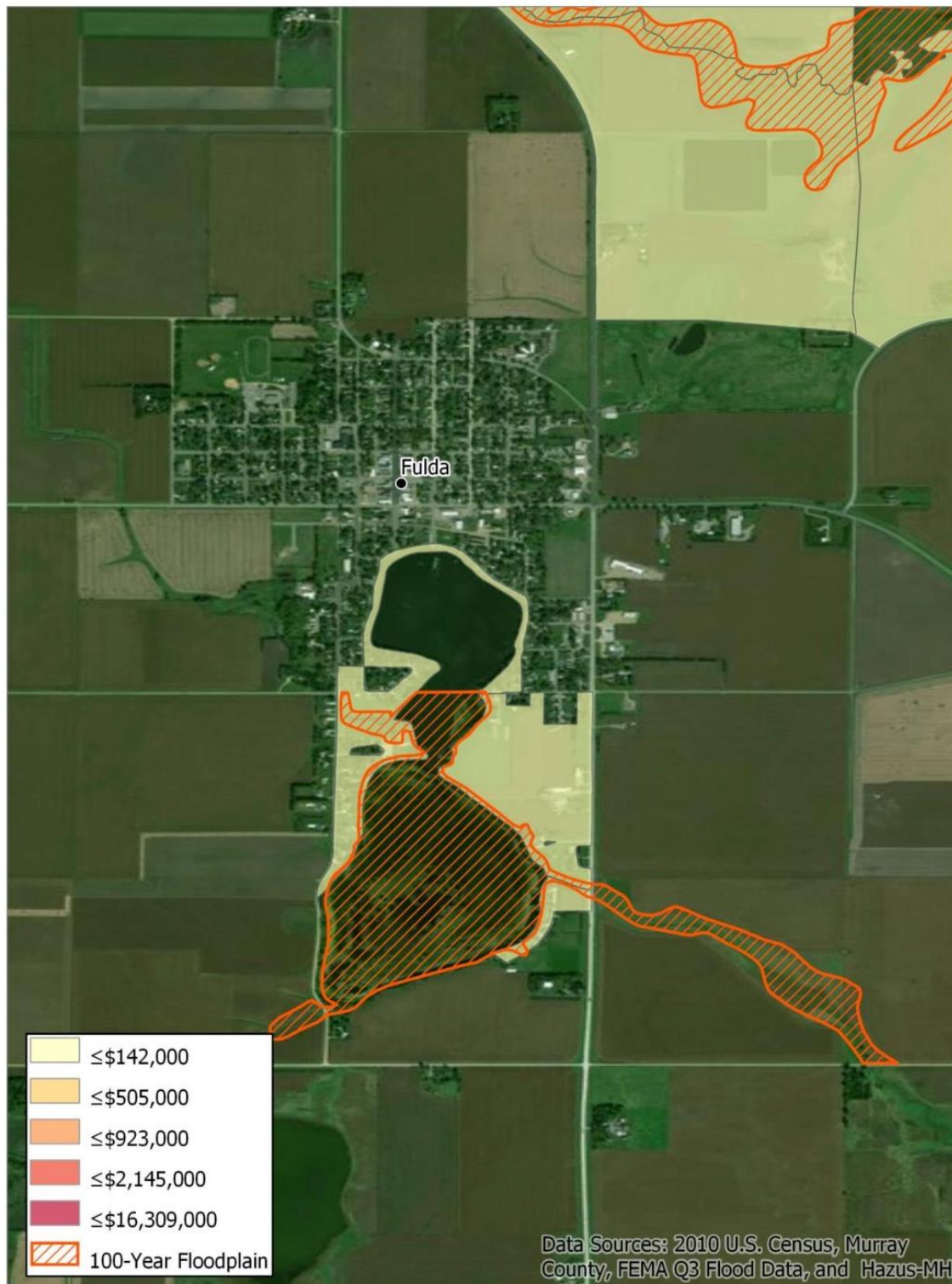


Figure 4. 100-Year Flood Loss Estimates in Fulda

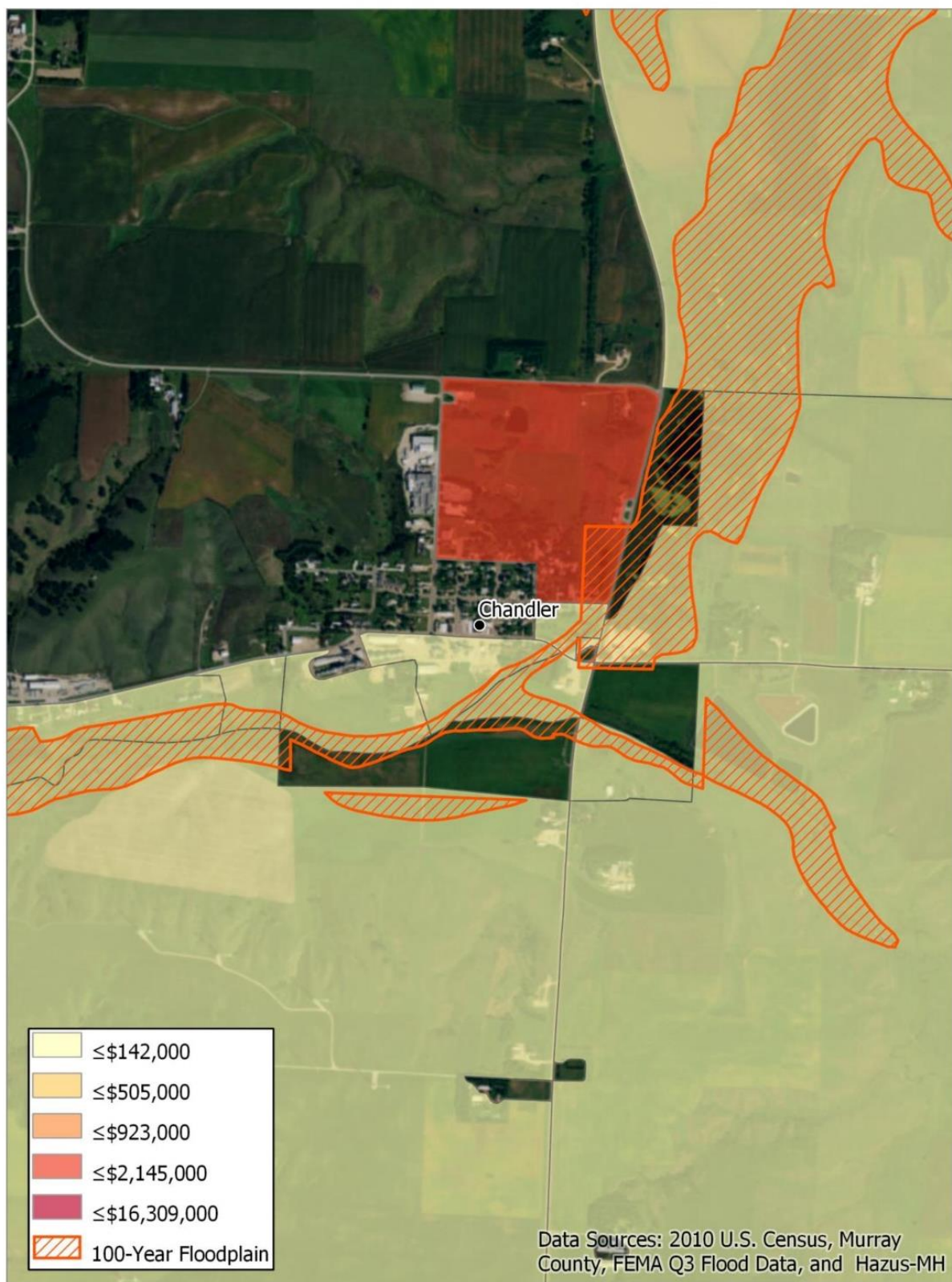


Figure 5. 100-Year Flood Loss Estimates in Chandler

Census blocks of concern should be reviewed in more detail to determine the actual location and proximity of facilities with respect to the flood hazard areas. The aggregate losses reported in this study may be overstated due to the fact that values are distributed evenly across a census block. The 3 census blocks with the greatest estimated loss values, which have parcels with buildings located within the floodplain, are shown in Table 2. These potentially high loss census blocks, used for the loss estimation, and the Hazus-MH output floodplain, are shown in Figure 6, Figure 7, and Figure 8. In some cases, the assets of value may not fall in the floodplain in the same proportion that the floodplain covers the entire census block. For this reason, some potential losses may be overstated.

Census Block Number	Total Estimated Loss	Location
271019001001179	\$16,309,000	3 miles northwest of Currie
271019002001130	\$2,145,000	Chandler
271019003002135	\$1,958,000	Slayton

Table 2. Census Blocks with the greatest estimated losses in the 100-Year Floodplain

An additional analysis was performed to identify the 10 parcels with the highest values (building + contents) that intersect the 100-year floodplain. Some of the parcels are located in one of the 3 census blocks with the greatest estimated loss; these parcels are labeled accordingly. The results of this analysis (and total building values) are shown in Table 3.

Parcel ID	Total Value of Building(s) & Building's Contents on Parcel	Class Description	Building Area (ft ²)
22-006-0090	\$1,440,000	Churches & other Non-profit Org.	95,569
17-007-0010	\$733,800	Government – General Services	15,192
18-030-0011	\$661,050	Single Family Dwelling	3,202
11-011-0040	\$646,600	Agriculture	2246
15-001-0210	\$642,300	Single Family Dwelling	3,091
15-012-0011	\$640,600	Agriculture	2,132
11-160-0240	\$587,850	Single Family Dwelling	2,797
11-160-0250	\$570,300	Single Family Dwelling	2,747
11-160-0210	\$558,300	Single Family Dwelling	2,677
11-150-0110	\$557,700	Single Family Dwelling	2,650
Total	\$7,038,500		

Table 3. Murray County Properties with Highest Building/Contents Value Intersecting 100-Year Floodplain

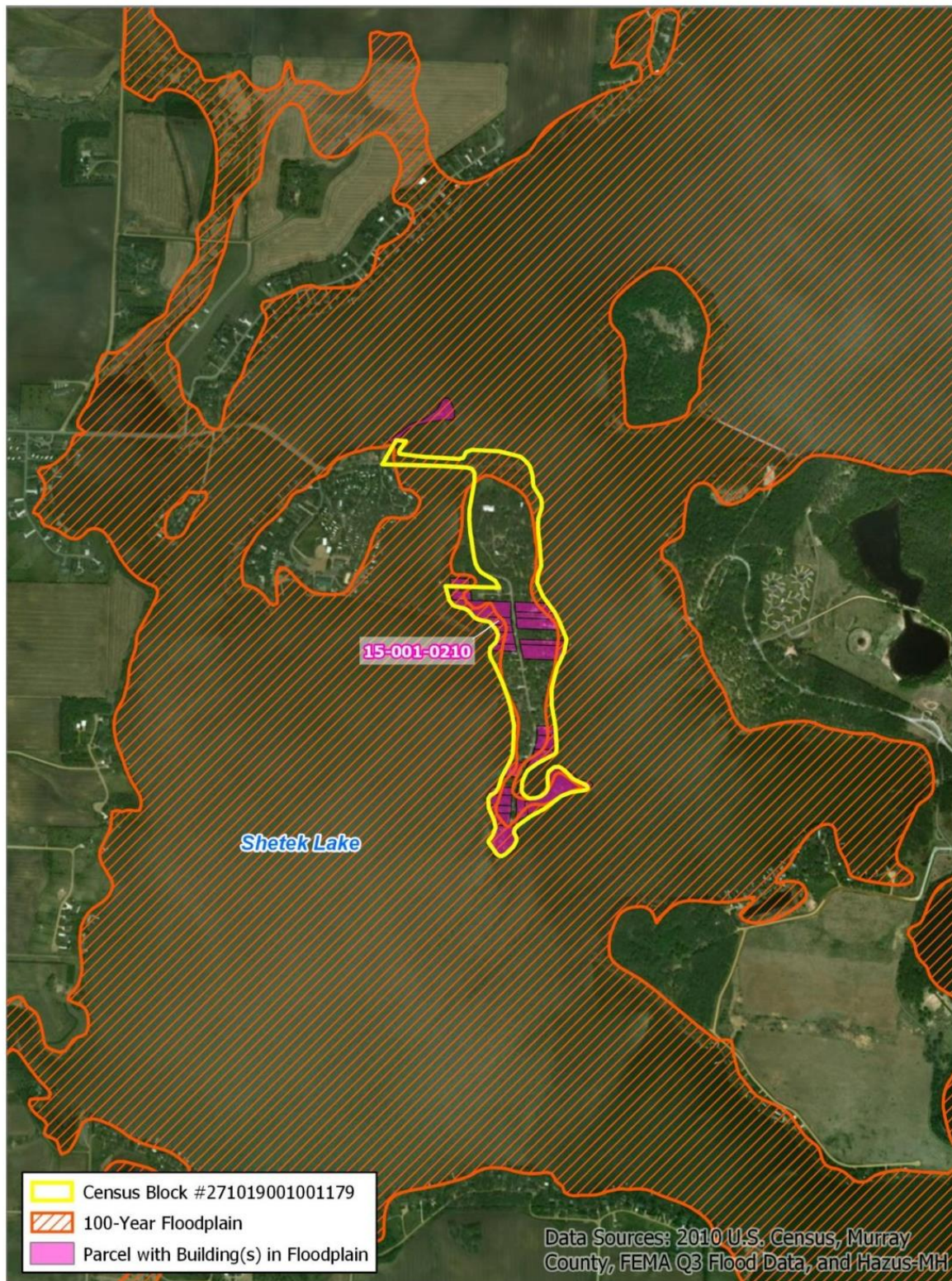


Figure 6. Census Block #271019001001179 and 100-Year Floodplain, 3 miles northwest of Currie

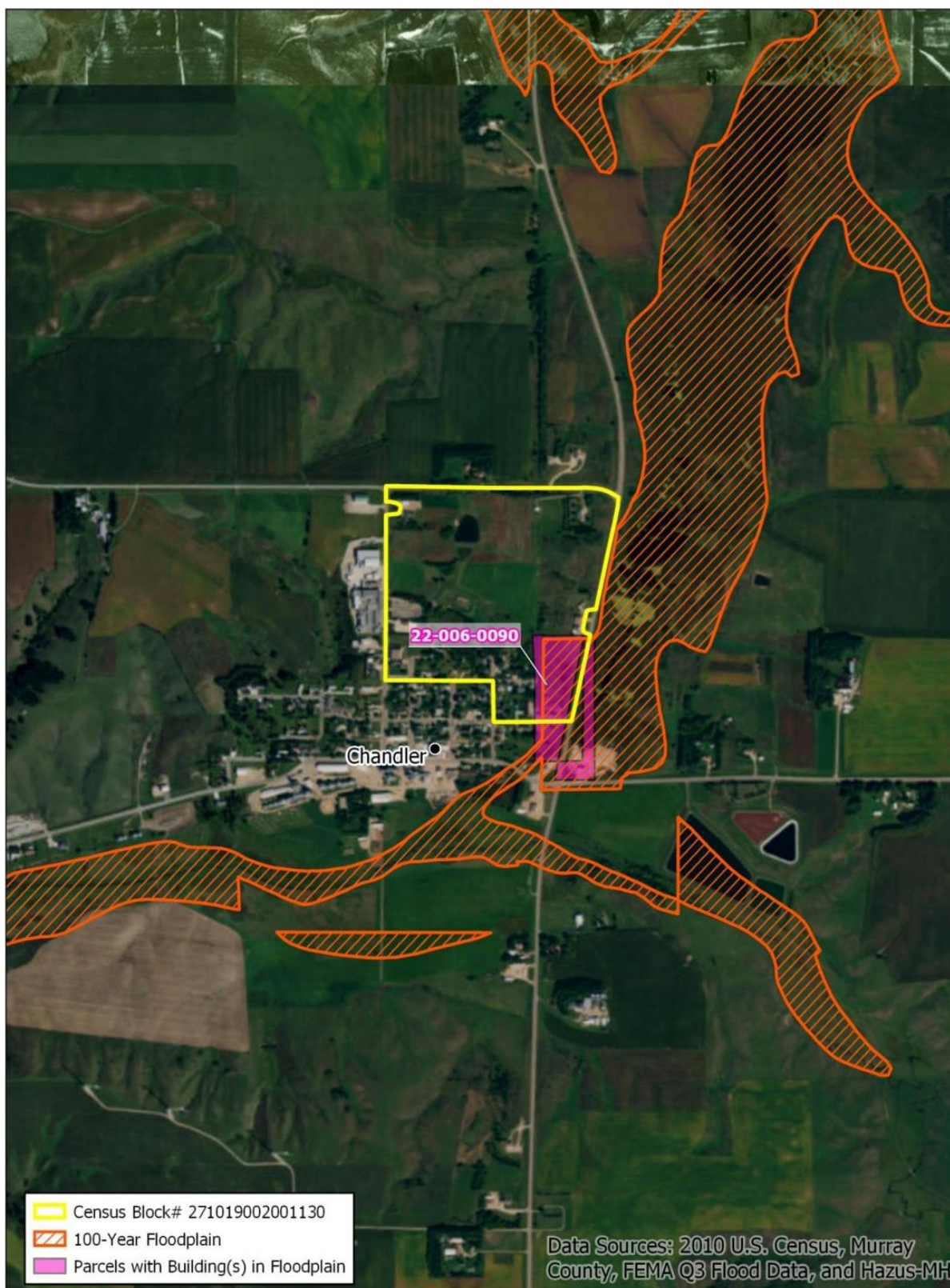


Figure 7. Census Block #271019002001130 and 100-Year Floodplain, Chandler

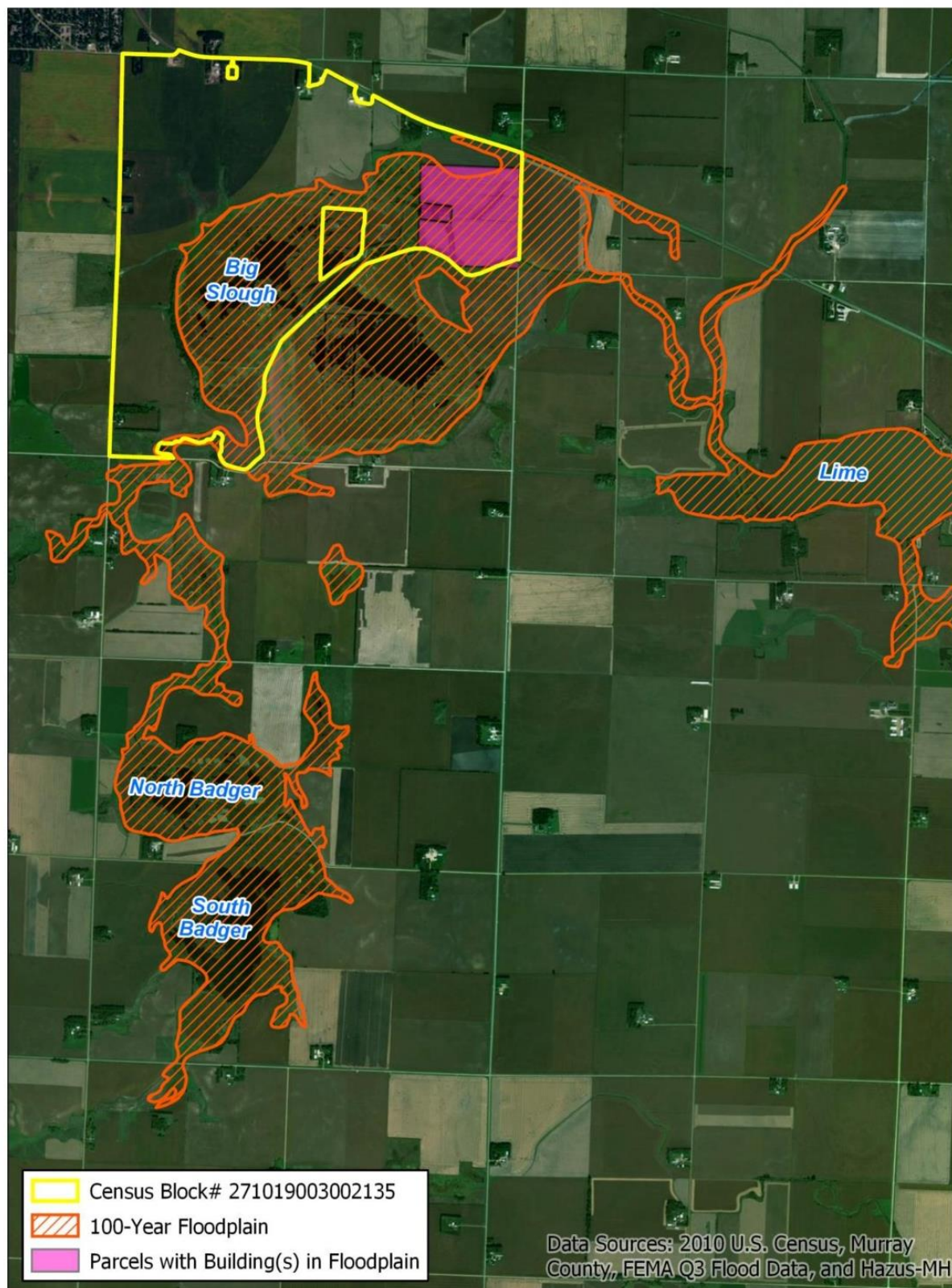


Figure 8. Census Block #271019003002135 and 100-Year Floodplain, Slayton

Hazus-MH Essential Facility Loss Analysis

Essential facilities encounter the same impacts as other buildings within the flood boundary: structural failure, extensive water damage to the facility, and loss of facility functionality (i.e. a damaged police station will no longer be able to serve the community). However, none of Murray County's essential facilities (care facilities, fire stations, police stations, and schools) included in the Hazus-MH analysis fall within the floodplain boundary.

Hazus-MH Shelter Requirement Analysis

Hazus-MH estimates the number of households that are expected to be displaced from their homes due to the flood and the associated potential evacuation. Hazus-MH also estimates those displaced people that may require accommodations in temporary public shelters. The countywide 100-year flood model estimates 40 households may be displaced due to the flood. Displacement includes households evacuated from within or very near to the inundated area. Of these, the model estimates 0 people (out of 8,725) may seek temporary shelter in public shelters.

Hazus-MH Debris Generation Analysis

Hazus estimates the amount of debris that may be generated by the flood. The countywide 100-year flood model breaks debris into 3 general categories: 1) Finishes (dry wall, insulation, etc.), 2) Structural (wood, brick, etc.) and 3) Foundations (concrete slab, concrete block, rebar, etc.). This distinction is made because of the different types of material handling equipment required to handle the debris.

The model estimates that a total of 960 tons of debris may be generated. Of the total amount, Finishes comprises 47% of the total, Structure comprises 30% of the total, and Foundation comprises 23%. If the debris tonnage is converted into an estimated number of truckloads, it will require 39 truckloads (@25 tons/truck) to remove the debris generated by the flood.

Appendix B - Murray County Hazard Events

The National Climatic Data Center Database was queried for all notable events through December, 2018. However, some categories of events do not have records prior to 1996.

Figure B-1: All blizzard events recorded by NCDC, 1950 through December 2018

Location or County	Date	Type	Deaths	Injuries	Property Damage
MURRAY (ZONE)	01/17/1996	Blizzard	0	0	10.00K
MURRAY (ZONE)	03/24/1996	Blizzard	0	0	10.00K
MURRAY (ZONE)	12/16/1996	Blizzard	0	0	0.00K
MURRAY (ZONE)	01/04/1997	Blizzard	0	0	0.00K
MURRAY (ZONE)	01/09/1997	Blizzard	0	0	10.00K
MURRAY (ZONE)	11/10/1998	Blizzard	0	0	25.00K
MURRAY (ZONE)	12/16/2000	Blizzard	0	0	0.00K
MURRAY (ZONE)	03/01/2007	Blizzard	0	0	0.00K
MURRAY (ZONE)	04/10/2008	Blizzard	0	0	0.00K
MURRAY (ZONE)	12/20/2008	Blizzard	0	0	0.00K
MURRAY (ZONE)	01/12/2009	Blizzard	0	0	0.00K
MURRAY (ZONE)	12/08/2009	Blizzard	0	0	0.00K
MURRAY (ZONE)	01/06/2010	Blizzard	0	0	0.00K
MURRAY (ZONE)	01/25/2010	Blizzard	0	0	0.00K
MURRAY (ZONE)	12/11/2010	Blizzard	0	0	0.00K
MURRAY (ZONE)	12/09/2012	Blizzard	0	0	0.00K
MURRAY (ZONE)	02/10/2013	Blizzard	0	0	0.00K
MURRAY (ZONE)	01/16/2014	Blizzard	0	0	0.00K
MURRAY (ZONE)	01/08/2015	Blizzard	0	0	0.00K
MURRAY (ZONE)	02/02/2016	Blizzard	0	0	0.00K
MURRAY (ZONE)	02/07/2016	Blizzard	0	0	0.00K
MURRAY (ZONE)	11/18/2016	Blizzard	0	0	0.00K
MURRAY (ZONE)	02/23/2017	Blizzard	0	0	0.00K
MURRAY (ZONE)	04/13/2018	Blizzard	0	0	0.00K

Figure B-2: All cold/wind chill events recorded by NCDC, 1950 through December 2018

Location or County	Date	Type	Deaths	Injuries	Property Damage
MURRAY (ZONE)	01/29/1996	Cold/wind Chill	0	0	0.00K
MURRAY (ZONE)	02/17/2006	Cold/wind Chill	0	0	0.00K
MURRAY (ZONE)	02/19/2008	Cold/wind Chill	0	0	0.00K

MURRAY (ZONE)	12/25/2017	Cold/wind Chill	0	0	0.00K
MURRAY (ZONE)	01/06/2018	Cold/wind Chill	0	0	0.00K
MURRAY (ZONE)	01/11/2018	Cold/wind Chill	0	0	0.00K
MURRAY (ZONE)	01/12/2018	Cold/wind Chill	0	0	0.00K
MURRAY (ZONE)	02/04/2018	Cold/wind Chill	0	0	0.00K

Figure B-3: All drought events recorded by NCDC, 1950 through December 2018

Location or County	Date	Type	Deaths	Injuries	Property Damage
MURRAY (ZONE)	11/01/1999	Drought	0	0	0.00K
MURRAY (ZONE)	12/01/1999	Drought	0	0	0.00K
MURRAY (ZONE)	02/01/2000	Drought	0	0	0.00K
MURRAY (ZONE)	03/01/2000	Drought	0	0	0.00K
MURRAY (ZONE)	04/01/2000	Drought	0	0	0.00K
MURRAY (ZONE)	07/01/2007	Drought	0	0	0.00K
MURRAY (ZONE)	07/01/2012	Drought	0	0	0.00K
MURRAY (ZONE)	08/01/2012	Drought	0	0	0.00K
MURRAY (ZONE)	09/01/2012	Drought	0	0	0.00K
MURRAY (ZONE)	10/01/2012	Drought	0	0	0.00K
MURRAY (ZONE)	11/01/2012	Drought	0	0	0.00K
MURRAY (ZONE)	12/01/2012	Drought	0	0	0.00K
MURRAY (ZONE)	01/01/2013	Drought	0	0	0.00K
MURRAY (ZONE)	02/01/2013	Drought	0	0	0.00K
MURRAY (ZONE)	03/01/2013	Drought	0	0	0.00K
MURRAY (ZONE)	04/01/2013	Drought	0	0	0.00K

Figure B-4: All excessive heat events recorded by NCDC, 1950 through December 2018

Location or County	Date	Type	Deaths	Injuries	Property Damage
MURRAY (ZONE)	07/15/2011	Excessive Heat	0	0	8.00K
MURRAY (ZONE)	06/27/2012	Excessive Heat	0	0	0.00K
MURRAY (ZONE)	07/02/2012	Excessive Heat	0	0	0.00K
MURRAY (ZONE)	07/16/2012	Excessive Heat	0	0	0.00K
MURRAY (ZONE)	06/10/2016	Excessive Heat	0	0	0.00K
MURRAY (ZONE)	07/20/2016	Excessive Heat	0	0	0.00K

Figure B-5: All extreme cold/wind chill events recorded by NCDC, 1950 through December 2018

Location or County	Date	Type	Deaths	Injuries	Property Damage
MURRAY (ZONE)	01/14/2009	Extreme Cold/wind Chill	0	0	0.00K
MURRAY (ZONE)	01/07/2010	Extreme Cold/wind Chill	0	0	0.00K
MURRAY (ZONE)	02/01/2011	Extreme Cold/wind Chill	0	0	0.00K
MURRAY (ZONE)	01/20/2013	Extreme Cold/wind Chill	0	0	0.00K
MURRAY (ZONE)	12/23/2013	Extreme Cold/wind Chill	0	0	0.00K
MURRAY (ZONE)	01/23/2014	Extreme Cold/wind Chill	0	0	0.00K
MURRAY (ZONE)	02/27/2014	Extreme Cold/wind Chill	0	0	0.00K
MURRAY (ZONE)	03/02/2014	Extreme Cold/wind Chill	0	0	0.00K
MURRAY (ZONE)	01/16/2016	Extreme Cold/wind Chill	0	0	0.00K
MURRAY (ZONE)	12/17/2016	Extreme Cold/wind Chill	0	0	0.00K
MURRAY (ZONE)	12/30/2017	Extreme Cold/wind Chill	0	0	0.00K
MURRAY (ZONE)	01/01/2018	Extreme Cold/wind Chill	0	0	0.00K
MURRAY (ZONE)	01/15/2018	Extreme Cold/wind Chill	0	0	0.00K

Figure B-6: All flash flood events recorded by NCDC, 1950 through December 2018

Location or County	Date	Type	Deaths	Injuries	Property Damage
COUNTYWIDE	05/29/2004	Flash Flood	0	0	0.00K
COUNTYWIDE	06/15/2004	Flash Flood	0	0	500.00K
LAKE WILSON	06/20/2005	Flash Flood	0	0	0.00K
LAKE WILSON	09/22/2010	Flash Flood	0	0	25.00K
CURRIE	06/24/2018	Flash Flood	0	0	0.00K
CURRIE	06/24/2018	Flash Flood	0	0	0.00K
CURRIE	07/03/2018	Flash Flood	0	0	0.00K
CURRIE	07/03/2018	Flash Flood	0	0	0.00K
CURRENT LAKE	07/03/2018	Flash Flood	0	0	0.00K
SLAYTON MUNI ARPT	07/03/2018	Flash Flood	0	0	0.00K
LAKE WILSON	07/03/2018	Flash Flood	0	0	0.00K
LAKE WILSON	07/03/2018	Flash Flood	0	0	0.00K
CHANDLER	07/03/2018	Flash Flood	0	0	0.00K
LAKE WILSON	07/03/2018	Flash Flood	0	0	0.00K

Figure B-7: All flood events recorded by NCDC, 1950 through December 2018

Location or County	Date	Type	Death	Injuries	Property Damage
MURRAY (ZONE)	03/25/1997	Flood	0	0	0.00K
MURRAY (ZONE)	04/01/1997	Flood	0	0	0.00K
CURRENT LAKE	03/16/2011	Flood	0	0	0.00K
CURRENT LAKE	04/01/2011	Flood	0	0	100.00K
CURRENT LAKE	06/15/2014	Flood	0	0	0.00K
CURRENT LAKE	06/16/2014	Flood	0	0	50.00K
CURRIE	06/21/2018	Flood	0	0	0.00K
CURRIE	07/01/2018	Flood	0	0	0.00K
CURRIE	07/03/2018	Flood	0	0	0.00K
CURRIE	09/23/2018	Flood	0	0	0.00K
CURRIE	10/12/2018	Flood	0	0	0.00K

Figure B-8: All hail events recorded by NCDC, 1950 through December 2018

Location	Date	Type	Magnitude	Deaths	Injuries	Property Damage
MURRAY CO.	06/08/1963	Hail	2.50 in.	0	0	0.00K
MURRAY CO.	07/04/1968	Hail	6.00 in.	0	0	0.00K
MURRAY CO.	08/08/1968	Hail	0.00 in.	0	0	0.00K
MURRAY CO.	08/18/1974	Hail	1.75 in.	0	0	0.00K
MURRAY CO.	07/06/1982	Hail	1.75 in.	0	0	0.00K
MURRAY CO.	04/26/1984	Hail	1.75 in.	0	0	0.00K
MURRAY CO.	07/03/1985	Hail	1.75 in.	0	0	0.00K
MURRAY CO.	07/28/1986	Hail	4.50 in.	0	0	0.00K
MURRAY CO.	05/20/1987	Hail	1.75 in.	0	0	0.00K
MURRAY CO.	05/28/1991	Hail	1.00 in.	0	0	0.00K
MURRAY CO.	05/28/1991	Hail	0.88 in.	0	0	0.00K
Lake Wilson	06/06/1994	Hail	1.00 in.	0	0	0.00K
Chandler	06/06/1994	Hail	2.75 in.	0	0	0.00K
Chandler	06/06/1994	Hail	1.75 in.	0	0	0.00K
Iona	06/06/1994	Hail	2.00 in.	0	0	0.00K
Dovray	07/18/1994	Hail	1.75 in.	0	0	0.00K
Dovray	07/18/1994	Hail	1.00 in.	0	0	0.00K
Chandler	07/18/1994	Hail	1.75 in.	0	0	0.00K
MURRAY CO.	08/07/1994	Hail	1.75 in.	0	0	0.00K

DOVRAY	07/01/1996	Hail	0.75 in.	0	0	0.00K
CHANDLER	03/29/1998	Hail	1.00 in.	0	0	0.00K
AVOCA	03/29/1998	Hail	3.00 in.	0	0	100.00K
DOVRAY	07/14/1998	Hail	0.75 in.	0	0	0.00K
FULDA	07/03/1999	Hail	0.75 in.	0	0	0.00K
CHANDLER	04/30/2001	Hail	1.00 in.	0	0	0.00K
IONA	04/30/2001	Hail	0.75 in.	0	0	0.00K
FULDA	04/30/2001	Hail	2.00 in.	0	0	0.00K
CHANDLER	06/13/2001	Hail	0.75 in.	0	0	0.00K
CURRENT LAKE	07/28/2002	Hail	0.75 in.	0	0	0.00K
SLAYTON	07/28/2002	Hail	1.75 in.	0	0	0.00K
AVOCA	06/23/2003	Hail	0.75 in.	0	0	0.00K
AVOCA	06/24/2003	Hail	0.75 in.	0	0	0.00K
SLAYTON	08/24/2003	Hail	0.75 in.	0	0	0.00K
DOVRAY	05/09/2004	Hail	0.88 in.	0	0	0.00K
AVOCA	05/09/2004	Hail	0.75 in.	0	0	0.00K
IONA	05/21/2004	Hail	0.75 in.	0	0	0.00K
IONA	05/21/2004	Hail	1.00 in.	0	0	0.00K
CURRENT LAKE	05/26/2004	Hail	0.75 in.	0	0	0.00K
FULDA	05/28/2004	Hail	0.75 in.	0	0	0.00K
SLAYTON	05/29/2004	Hail	0.88 in.	0	0	0.00K
CURRIE	06/11/2004	Hail	0.75 in.	0	0	0.00K
CURRENT LAKE	06/15/2004	Hail	1.75 in.	0	0	0.00K
CHANDLER	07/31/2004	Hail	0.75 in.	0	0	0.00K
FULDA	08/29/2004	Hail	1.00 in.	0	0	0.00K
DOVRAY	05/08/2005	Hail	1.00 in.	0	0	0.00K
CURRENT LAKE	06/13/2005	Hail	0.75 in.	0	0	0.00K
SLAYTON	06/20/2005	Hail	0.75 in.	0	0	0.00K
SLAYTON	06/20/2005	Hail	0.88 in.	0	0	0.00K
LAKE WILSON	06/20/2005	Hail	0.75 in.	0	0	0.00K
AVOCA	06/29/2005	Hail	1.00 in.	0	0	0.00K
SLAYTON	09/12/2005	Hail	0.75 in.	0	0	0.00K
IONA	09/12/2005	Hail	0.75 in.	0	0	0.00K
CURRIE	06/24/2006	Hail	1.75 in.	0	0	0.00K
CURRIE	06/24/2006	Hail	0.88 in.	0	0	0.00K
CURRIE	06/24/2006	Hail	1.00 in.	0	0	0.00K

CURRIE	06/24/2006	Hail	1.00 in.	0	0	0.00K
LAKE WILSON	06/16/2007	Hail	0.75 in.	0	0	0.00K
CURRIE	06/16/2007	Hail	0.75 in.	0	0	0.00K
LIME CREEK	06/05/2008	Hail	0.75 in.	0	0	0.00K
LAKE WILSON	08/13/2008	Hail	1.75 in.	0	0	0.00K
CURRENT LAKE	06/16/2009	Hail	1.00 in.	0	0	0.00K
SLAYTON MUNI ARPT	06/16/2009	Hail	1.75 in.	0	0	0.00K
CURRIE	07/07/2009	Hail	0.75 in.	0	0	0.00K
CURRENT LAKE	08/08/2009	Hail	1.00 in.	0	0	0.00K
CURRIE	09/02/2010	Hail	0.88 in.	0	0	0.00K
CURRENT LAKE	04/09/2011	Hail	1.25 in.	0	0	0.00K
DOVRAY	04/09/2011	Hail	1.00 in.	0	0	0.00K
AVOCA	07/25/2011	Hail	1.00 in.	0	0	0.00K
AVOCA	07/25/2011	Hail	1.00 in.	0	0	0.00K
AVOCA	07/25/2011	Hail	1.00 in.	0	0	0.00K
CURRENT LAKE	05/01/2012	Hail	1.25 in.	0	0	0.00K
CURRENT LAKE	05/01/2012	Hail	1.00 in.	0	0	0.00K
CURRIE	05/01/2012	Hail	1.00 in.	0	0	0.00K
LAKE WILSON	05/23/2012	Hail	0.88 in.	0	0	0.00K
CURRIE	05/23/2012	Hail	1.00 in.	0	0	0.00K
CURRIE	08/01/2012	Hail	1.25 in.	0	0	0.00K
CURRIE	08/04/2013	Hail	1.00 in.	0	0	0.00K
LAKE WILSON	05/08/2014	Hail	1.50 in.	0	0	0.00K
LAKE WILSON	05/08/2014	Hail	0.75 in.	0	0	0.00K
LAKE WILSON	05/08/2014	Hail	1.00 in.	0	0	0.00K
CHANDLER	07/07/2014	Hail	0.75 in.	0	0	0.00K
CHANDLER	07/07/2014	Hail	0.88 in.	0	0	0.00K
SLAYTON	06/11/2017	Hail	1.75 in.	0	0	0.00K
SLAYTON	06/11/2017	Hail	2.00 in.	0	0	0.00K
CURRENT LAKE	06/27/2017	Hail	1.00 in.	0	0	0.00K
LAKE WILSON	07/11/2017	Hail	0.88 in.	0	0	0.00K
LAKE WILSON	07/11/2017	Hail	0.88 in.	0	0	0.00K
IONA	07/11/2017	Hail	1.75 in.	0	0	0.00K
LAKE WILSON	08/18/2017	Hail	1.00 in.	0	0	0.00K
LIME CREEK	06/14/2018	Hail	1.25 in.	0	0	0.00K

Figure B-9: All heat events recorded by NCDC, 1950 through December 2018

Location or County	Date	Type	Deaths	Injuries	Property Damage
MURRAY (ZONE)	07/11/2018	Heat	0	0	0.00K

Figure B-10: All heavy rain events recorded by NCDC, 1950 through December 2018

Location or County	Date	Type	Deaths	Injuries	Property Damage
LAKE WILSON	06/16/1996	Heavy Rain	0	0	20.00K
CURRIE	07/16/2016	Heavy Rain	0	0	0.00K

Figure B-11: All heavy snow events recorded by NCDC, 1950 through December 2018

Location or County	Date	Type	Deaths	Injuries	Property Damage
MURRAY (ZONE)	12/14/1996	Heavy Snow	0	0	0.00K
MURRAY (ZONE)	02/03/1997	Heavy Snow	0	0	0.00K
MURRAY (ZONE)	10/01/1999	Heavy Snow	0	0	5.00K
MURRAY (ZONE)	04/07/2000	Heavy Snow	0	0	0.00K
MURRAY (ZONE)	11/26/2001	Heavy Snow	0	0	0.00K
MURRAY (ZONE)	04/20/2002	Heavy Snow	0	0	0.00K
MURRAY (ZONE)	04/10/2007	Heavy Snow	0	0	0.00K
MURRAY (ZONE)	12/01/2007	Heavy Snow	0	0	0.00K
MURRAY (ZONE)	02/20/2011	Heavy Snow	0	0	0.00K
MURRAY (ZONE)	11/05/2013	Heavy Snow	0	0	0.00K
MURRAY (ZONE)	03/04/2014	Heavy Snow	0	0	0.00K
MURRAY (ZONE)	04/03/2014	Heavy Snow	0	0	0.00K
MURRAY (ZONE)	03/12/2017	Heavy Snow	0	0	0.00K

Figure B-12: All high wind events recorded by NCDC, 1950 through December 2018

Location or County	Date	Type	Magnitude	Deaths	Injuries	Property Damage
MURRAY (ZONE)	02/10/1996	High Wind	52 kts.	0	0	10.00K
MURRAY (ZONE)	04/25/1996	High Wind	52 kts.	0	0	0.00K
MURRAY (ZONE)	10/29/1996	High Wind	50 kts.	0	0	20.00K
MURRAY (ZONE)	04/06/1997	High Wind	55 kts.	0	0	2.86K
MURRAY (ZONE)	05/05/1997	High Wind	52 kts.	0	0	0.00K
MURRAY (ZONE)	07/02/1997	High Wind	35 kts.	0	0	7.14K

MURRAY (ZONE)	03/17/1999	High Wind	52 kts.	0	0	0.00K
MURRAY (ZONE)	04/05/2000	High Wind	54 kts. E	0	0	12.50K
MURRAY (ZONE)	04/07/2001	High Wind	E	0	0	14.00K
MURRAY (ZONE)	02/11/2003	High Wind	58 kts. MG	0	0	0.00K
MURRAY (ZONE)	12/12/2004	High Wind	35 kts. ES	0	0	0.00K
MURRAY (ZONE)	01/21/2005	High Wind	35 kts. ES	0	0	100.00K
MURRAY (ZONE)	03/10/2005	High Wind	35 kts. ES	0	0	10.00K
MURRAY (ZONE)	11/12/2005	High Wind	38 kts. ES	0	0	0.00K
MURRAY (ZONE)	10/26/2008	High Wind	39 kts. ES	0	0	0.00K
MURRAY (ZONE)	10/26/2010	High Wind	53 kts. MG	0	0	0.00K
MURRAY (ZONE)	01/26/2014	High Wind	50 kts. MG	0	0	0.00K
MURRAY (ZONE)	06/22/2015	High Wind	58 kts. MG	0	0	0.00K
MURRAY (ZONE)	02/19/2016	High Wind	36 kts. ES	0	0	0.00K
MURRAY (ZONE)	12/25/2016	High Wind	57 kts. MG	0	0	0.00K

Figure B-13: All ice storm events recorded by NCDC, 1950 through December 2018

Location or County	Date	Type	Deaths	Injuries	Property Damage
MURRAY (ZONE)	11/14/1996	Ice Storm	0	0	2.500M
MURRAY (ZONE)	01/03/1997	Ice Storm	0	0	0.00K
MURRAY (ZONE)	03/13/1997	Ice Storm	0	0	0.00K
MURRAY (ZONE)	04/16/2000	Ice Storm	0	0	2.86K

Figure B-14: All lightning events recorded by NCDC, 1950 through December 2018

Location	Date	Type	Deaths	Injuries	Property Damage
FULDA	05/15/1998	Lightning	0	0	5.00K
SLAYTON	06/13/2001	Lightning	0	0	2.00K

Figure B-15: All thunderstorm wind events recorded by NCDC, 1950 through December 2018

Location	Date	Type	Magnitude	Deaths	Injuries	Property Damage
MURRAY CO.	08/18/1974	Thunderstorm Wind	52 kts.	0	0	0.00K
MURRAY CO.	07/06/1978	Thunderstorm Wind	0 kts.	0	0	0.00K
MURRAY CO.	06/16/1979	Thunderstorm Wind	0 kts.	0	0	0.00K
MURRAY CO.	08/18/1980	Thunderstorm Wind	0 kts.	0	0	0.00K
MURRAY CO.	07/06/1982	Thunderstorm Wind	0 kts.	0	0	0.00K

MURRAY CO.	04/26/1986	Thunderstorm Wind	0 kts.	0	0	0.00K
MURRAY CO.	07/11/1987	Thunderstorm Wind	0 kts.	0	0	0.00K
MURRAY CO.	07/08/1990	Thunderstorm Wind	52 kts.	0	0	0.00K
Lake Wilson	06/06/1994	Thunderstorm Wind	52 kts.	0	0	0.00K
Chandler	06/06/1994	Thunderstorm Wind	52 kts.	0	0	0.00K
SLAYTON	06/22/1997	Thunderstorm Wind	61 kts.	0	0	200.00K
FULDA	06/24/1998	Thunderstorm Wind	52 kts.	0	0	50.00K
SLAYTON	05/22/2000	Thunderstorm Wind	52 kts. E	0	0	0.00K
SLAYTON	07/05/2000	Thunderstorm Wind	52 kts. E	0	0	0.00K
DOVRAY	07/05/2000	Thunderstorm Wind	52 kts. E	0	0	0.00K
LAKE WILSON	08/07/2000	Thunderstorm Wind	57 kts. E	0	0	20.00K
CURRIE	08/07/2000	Thunderstorm Wind	57 kts. E	0	0	0.00K
SLAYTON	04/07/2001	Thunderstorm Wind	52 kts. E	0	0	0.00K
SLAYTON	06/10/2001	Thunderstorm Wind	52 kts. E	0	0	0.00K
LAKE WILSON	06/10/2001	Thunderstorm Wind	52 kts. E	0	0	0.00K
SLAYTON	06/12/2001	Thunderstorm Wind	61 kts. E	0	0	30.00K
FULDA	06/13/2001	Thunderstorm Wind	57 kts. E	0	0	10.00K
FULDA	06/13/2001	Thunderstorm Wind	74 kts. E	0	0	30.00K
SLAYTON	04/16/2002	Thunderstorm Wind	61 kts. E	0	0	50.00K
CURRENT LAKE	07/28/2002	Thunderstorm Wind	52 kts. E	0	0	0.00K
SLAYTON	08/03/2002	Thunderstorm Wind	52 kts. E	0	0	0.00K
DOVRAY	08/11/2002	Thunderstorm Wind	57 kts. E	0	0	0.00K
DOVRAY	07/03/2003	Thunderstorm Wind	50 kts. MG	0	0	0.00K
FULDA	07/03/2003	Thunderstorm Wind	52 kts. EG	0	0	10.00K
SLAYTON	08/24/2003	Thunderstorm Wind	57 kts. EG	0	0	0.00K
DOVRAY	05/09/2004	Thunderstorm Wind	57 kts. EG	0	0	0.00K
SLAYTON	05/16/2004	Thunderstorm Wind	52 kts. EG	0	0	0.00K
DOVRAY	05/16/2004	Thunderstorm Wind	61 kts. EG	0	0	0.00K
AVOCA	05/29/2004	Thunderstorm Wind	61 kts. EG	0	0	20.00K
CHANDLER	06/29/2005	Thunderstorm Wind	61 kts. EG	0	0	0.00K
IONA	08/03/2005	Thunderstorm Wind	52 kts. EG	0	0	0.00K
SLAYTON	08/03/2005	Thunderstorm Wind	52 kts. EG	0	0	0.00K
AVOCA	08/03/2005	Thunderstorm Wind	69 kts. EG	0	0	0.00K
FULDA	08/03/2005	Thunderstorm Wind	57 kts. EG	0	0	0.00K
SLAYTON MUNI ARPT	06/16/2009	Thunderstorm Wind	52 kts. EG	0	0	0.00K

CURRIE	07/07/2009	Thunderstorm Wind	56 kts. EG	0	0	0.00K
CURRIE	06/26/2010	Thunderstorm Wind	52 kts. EG	0	0	0.00K
CURRIE	07/17/2010	Thunderstorm Wind	52 kts. EG	0	0	0.00K
CURRIE	07/17/2010	Thunderstorm Wind	61 kts. EG	0	0	50.00K
CURRIE	07/23/2010	Thunderstorm Wind	52 kts. EG	0	0	0.00K
DOVRAY	07/23/2010	Thunderstorm Wind	72 kts. MG	0	0	0.00K
DOVRAY	08/12/2010	Thunderstorm Wind	52 kts. MG	0	0	0.00K
SLAYTON	09/04/2012	Thunderstorm Wind	51 kts. MG	0	0	0.00K
SLAYTON	09/04/2012	Thunderstorm Wind	55 kts. MG	0	0	0.00K
DOVRAY	06/16/2014	Thunderstorm Wind	70 kts. MG	0	0	0.00K
LAKE WILSON	06/09/2015	Thunderstorm Wind	52 kts. EG	0	0	0.00K
CURRIE	06/20/2015	Thunderstorm Wind	52 kts. EG	0	0	0.00K
CURRIE	09/24/2016	Thunderstorm Wind	61 kts. EG	0	0	0.00K
CURRIE	09/24/2016	Thunderstorm Wind	56 kts. EG	0	0	0.00K
LAKE WILSON	08/18/2017	Thunderstorm Wind	52 kts. EG	0	0	0.00K
SLAYTON	08/05/2018	Thunderstorm Wind	55 kts. MG	0	0	0.00K

Figure B-16: All tornado events recorded by NCDC, 1950 through December 2018

Location	Date	Type	Magnitude	Deaths	Injuries	Property Damage
MURRAY CO.	06/13/1968	Tornado	F5	0	0	2.500M
MURRAY CO.	07/26/1968	Tornado	F1	0	0	2.50K
MURRAY CO.	04/20/1985	Tornado	F3	0	2	2.500M
MURRAY CO.	04/21/1985	Tornado	F0	0	0	25.00K
MURRAY CO.	04/21/1985	Tornado	F1	0	0	250.00K
MURRAY CO.	04/21/1985	Tornado	F1	0	0	250.00K
MURRAY CO.	04/21/1985	Tornado	F1	0	0	0.00K
MURRAY CO.	06/16/1992	Tornado	F5	1	35	25.000M
MURRAY CO.	06/16/1992	Tornado	F4	0	3	25.000M
MURRAY CO.	06/16/1992	Tornado	F2	0	0	0.00K
MURRAY CO.	06/16/1992	Tornado	F3	0	0	0.00K
MURRAY CO.	06/16/1992	Tornado	F2	0	0	0.00K
MURRAY CO.	06/16/1992	Tornado	F2	0	0	0.00K
Chandler	05/07/1993	Tornado	F1	0	0	0.00K
Lake Wilson	05/07/1993	Tornado	F1	0	0	0.00K
Avoca	07/11/1994	Tornado		0	0	0.00K

.5 S Fulda to	08/07/1994	Tornado	F1	0	0	0.00K
AVOCA	03/29/1998	Tornado	F1	0	0	50.00K
FULDA	03/29/1998	Tornado	F1	0	0	50.00K
HADLEY	05/16/2004	Tornado	F0	0	0	20.00K
WIROCK	06/11/2008	Tornado	EF1	0	0	50.00K
LIME CREEK	06/11/2008	Tornado	EF1	0	1	100.00K
CURRENT LAKE	07/17/2010	Tornado	EF0	0	0	0.00K
CHANDLER	06/05/2014	Tornado	EF0	0	0	0.00K

Figure B-17: All winter storm events recorded by NCDC, 1950 through December 2018

Location or County	Date	Type	Deaths	Injuries	Property Damage
MURRAY (ZONE)	01/01/1999	Winter Storm	0	0	0.00K
MURRAY (ZONE)	03/08/1999	Winter Storm	0	0	0.00K
MURRAY (ZONE)	01/19/2000	Winter Storm	0	0	0.00K
MURRAY (ZONE)	11/11/2000	Winter Storm	0	0	0.00K
MURRAY (ZONE)	01/29/2001	Winter Storm	0	0	10.00K
MURRAY (ZONE)	02/24/2001	Winter Storm	0	0	0.00K
MURRAY (ZONE)	03/11/2001	Winter Storm	0	0	0.00K
MURRAY (ZONE)	02/09/2002	Winter Storm	0	0	0.00K
MURRAY (ZONE)	03/14/2002	Winter Storm	0	0	0.00K
MURRAY (ZONE)	11/23/2003	Winter Storm	0	0	0.00K
MURRAY (ZONE)	12/08/2003	Winter Storm	0	0	0.00K
MURRAY (ZONE)	12/15/2003	Winter Storm	0	0	10.00K
MURRAY (ZONE)	01/25/2004	Winter Storm	0	0	0.00K
MURRAY (ZONE)	01/21/2005	Winter Storm	0	0	0.00K
MURRAY (ZONE)	03/18/2005	Winter Storm	0	0	0.00K
MURRAY (ZONE)	03/12/2006	Winter Storm	0	0	0.00K
MURRAY (ZONE)	02/24/2007	Winter Storm	0	0	0.00K
MURRAY (ZONE)	12/23/2009	Winter Storm	0	0	0.00K
MURRAY (ZONE)	11/13/2010	Winter Storm	0	0	0.00K
MURRAY (ZONE)	01/31/2011	Winter Storm	0	0	0.00K
MURRAY (ZONE)	04/09/2013	Winter Storm	0	0	10.000M
MURRAY (ZONE)	04/18/2013	Winter Storm	0	0	0.00K
MURRAY (ZONE)	12/03/2013	Winter Storm	0	0	0.00K
MURRAY (ZONE)	12/15/2014	Winter Storm	0	0	0.00K

MURRAY (ZONE)	01/05/2015	Winter Storm	0	0	0.00K
MURRAY (ZONE)	11/30/2015	Winter Storm	0	0	0.00K
MURRAY (ZONE)	12/01/2015	Winter Storm	0	0	0.00K
MURRAY (ZONE)	12/25/2015	Winter Storm	0	0	0.00K
MURRAY (ZONE)	03/23/2016	Winter Storm	0	0	0.00K
MURRAY (ZONE)	12/16/2016	Winter Storm	0	0	0.00K
MURRAY (ZONE)	01/21/2018	Winter Storm	0	0	0.00K
MURRAY (ZONE)	03/23/2018	Winter Storm	0	0	0.00K
MURRAY (ZONE)	04/03/2018	Winter Storm	0	0	0.00K
MURRAY (ZONE)	04/08/2018	Winter Storm	0	0	0.00K

Figure B-17: All winter weather events recorded by NCDC, 1950 through December 2018

Location or County	Date	Type	Deaths	Injuries	Property Damage
MURRAY (ZONE)	02/14/2003	Winter Weather	0	0	0.00K
MURRAY (ZONE)	04/06/2003	Winter Weather	0	0	0.00K
MURRAY (ZONE)	11/03/2003	Winter Weather	0	0	0.00K
MURRAY (ZONE)	12/02/2003	Winter Weather	0	0	0.00K
MURRAY (ZONE)	02/01/2004	Winter Weather	0	0	0.00K
MURRAY (ZONE)	02/05/2004	Winter Weather	0	0	0.00K
MURRAY (ZONE)	02/11/2004	Winter Weather	0	0	0.00K
MURRAY (ZONE)	12/20/2004	Winter Weather	0	0	0.00K
MURRAY (ZONE)	11/28/2005	Winter Weather	0	0	0.00K
MURRAY (ZONE)	11/30/2005	Winter Weather	0	0	0.00K
MURRAY (ZONE)	12/13/2005	Winter Weather	0	0	0.00K
MURRAY (ZONE)	11/26/2006	Winter Weather	0	0	0.00K
MURRAY (ZONE)	12/20/2006	Winter Weather	0	0	0.00K
MURRAY (ZONE)	01/14/2007	Winter Weather	0	0	0.00K
MURRAY (ZONE)	01/21/2007	Winter Weather	0	0	0.00K
MURRAY (ZONE)	12/25/2007	Winter Weather	0	0	0.00K
MURRAY (ZONE)	03/31/2008	Winter Weather	0	0	0.00K
MURRAY (ZONE)	11/06/2008	Winter Weather	0	0	0.00K
MURRAY (ZONE)	12/08/2008	Winter Weather	0	0	0.00K
MURRAY (ZONE)	12/14/2008	Winter Weather	0	0	0.00K
MURRAY (ZONE)	01/08/2009	Winter Weather	0	0	0.00K
MURRAY (ZONE)	01/08/2009	Winter Weather	0	0	0.00K

MURRAY (ZONE)	02/16/2009	Winter Weather	0	0	0.00K
MURRAY (ZONE)	04/04/2009	Winter Weather	0	0	0.00K
MURRAY (ZONE)	10/12/2009	Winter Weather	0	0	0.00K
MURRAY (ZONE)	12/26/2009	Winter Weather	1	0	0.00K
MURRAY (ZONE)	02/07/2010	Winter Weather	0	0	0.00K
MURRAY (ZONE)	02/13/2010	Winter Weather	0	0	0.00K
MURRAY (ZONE)	11/29/2010	Winter Weather	0	0	0.00K
MURRAY (ZONE)	12/03/2010	Winter Weather	0	0	0.00K
MURRAY (ZONE)	12/20/2010	Winter Weather	0	0	0.00K
MURRAY (ZONE)	12/23/2010	Winter Weather	0	0	0.00K
MURRAY (ZONE)	01/09/2011	Winter Weather	0	0	0.00K
MURRAY (ZONE)	01/17/2011	Winter Weather	0	0	0.00K
MURRAY (ZONE)	01/31/2011	Winter Weather	0	0	0.00K
MURRAY (ZONE)	01/20/2012	Winter Weather	0	0	0.00K
MURRAY (ZONE)	12/27/2012	Winter Weather	0	0	0.00K
MURRAY (ZONE)	01/27/2013	Winter Weather	0	0	0.00K
MURRAY (ZONE)	03/18/2013	Winter Weather	0	0	0.00K
MURRAY (ZONE)	02/20/2014	Winter Weather	0	0	0.00K
MURRAY (ZONE)	11/15/2014	Winter Weather	0	0	0.00K
MURRAY (ZONE)	12/26/2014	Winter Weather	0	0	0.00K
MURRAY (ZONE)	01/31/2015	Winter Weather	0	0	0.00K
MURRAY (ZONE)	02/01/2015	Winter Weather	0	0	0.00K
MURRAY (ZONE)	02/08/2015	Winter Weather	0	0	0.00K
MURRAY (ZONE)	02/09/2015	Winter Weather	0	0	0.00K
MURRAY (ZONE)	02/25/2015	Winter Weather	0	0	0.00K
MURRAY (ZONE)	03/03/2015	Winter Weather	0	0	0.00K
MURRAY (ZONE)	12/28/2015	Winter Weather	0	0	0.00K
MURRAY (ZONE)	01/07/2016	Winter Weather	0	0	0.00K
MURRAY (ZONE)	02/03/2016	Winter Weather	0	0	0.00K
MURRAY (ZONE)	02/08/2016	Winter Weather	0	0	0.00K
MURRAY (ZONE)	02/29/2016	Winter Weather	0	0	0.00K
MURRAY (ZONE)	03/01/2016	Winter Weather	0	0	0.00K
MURRAY (ZONE)	12/10/2016	Winter Weather	0	0	0.00K
MURRAY (ZONE)	12/24/2016	Winter Weather	0	0	0.00K
MURRAY (ZONE)	01/01/2017	Winter Weather	0	0	0.00K
MURRAY (ZONE)	01/10/2017	Winter Weather	0	0	0.00K

MURRAY (ZONE)	01/16/2017	Winter Weather	0	0	0.00K
MURRAY (ZONE)	01/24/2017	Winter Weather	0	0	0.00K
MURRAY (ZONE)	12/21/2017	Winter Weather	0	0	0.00K
MURRAY (ZONE)	01/11/2018	Winter Weather	0	0	0.00K
MURRAY (ZONE)	02/08/2018	Winter Weather	0	0	0.00K
MURRAY (ZONE)	02/19/2018	Winter Weather	0	0	0.00K
MURRAY (ZONE)	02/22/2018	Winter Weather	0	0	0.00K
MURRAY (ZONE)	02/24/2018	Winter Weather	0	0	0.00K
MURRAY (ZONE)	03/05/2018	Winter Weather	0	0	0.00K
MURRAY (ZONE)	04/18/2018	Winter Weather	0	0	0.00K
MURRAY (ZONE)	10/14/2018	Winter Weather	0	0	0.00K
MURRAY (ZONE)	11/16/2018	Winter Weather	0	0	0.00K

Appendix C - Adopting Resolutions

Appendix D - Planning Team Meetings, Sign-In Sheets, and Notes

Murray County All-Hazard Mitigation Plan Update
Meeting #1 – Planning Process

Date: Monday, December 11, 2017
Time: 4:30 PM – 6:00 PM
Location: Murray County Courts Meeting Room, 2848 Broadway Ave, Slayton, MN 56172

Agenda

4:30 PM Introductions

4:35 PM Presentation – Max Kaufman, SW Regional Development Commission

Intro to Hazard Mitigation Planning & Benefits

- Planning Process/Timeline
 - Meeting #2
 - Meeting #3
 - Public Hearing
- Types of Mitigation Assistance

5:00 PM Sub-Committee Formation?

- Mitigation Strategies Subcommittee
- Plan Review Subcommittee

5:05 PM CPRI Worksheet “Homework” Handout & Explanation

Hazards identified in initial plan

- Hazards from 2010 plan will be reviewed and updated per their current status. Historical data since the initial plan will be discussed to determine if a hazard/mitigation strategy is still applicable or should be deleted.
- Hazards not addressed in the initial plan may also be added. All participating jurisdictions should be involved with hazard validation.

5:45 PM Questions, Comments, Observations – Schedule Meeting #2 and Adjourn

Meeting #1 Deliverables

- Better understanding of planning process
- Better understanding of research and data gathering responsibilities
- Updated list of hazards

- Schedule Meeting #2

Murray County All-Hazard Mitigation Plan Update

Meeting #1 – Planning Process

Date: Monday, December 11, 2017
Time: 4:30 PM – 6:00 PM
Location: Murray County Courts Meeting Room, 2848 Broadway Ave, Slayton, MN 56172

Attendees: Jon Bloemendaal, Jim DeYonge, Karen Frisk, Jean Christoffels, Rick Leebens, Jennifer Kirchner, Glenn Kluis, Adam Tromblay, Sherry Swanson, Brian Postma, Dave Thiner, Jim Brown, Jeb Malone, Marcy Barritt, Heath Landsman, Max Kaufman

Notes

Presentation (Intro to Hazard Mitigation Planning & Benefits)

- Rural electric co-ops are now eligible applicants for hazard mitigation assistance.
- Safe rooms are a need (specifically at Lake Sarah).
- Hazards to Include
 - None necessarily need to be taken out
 - Hazards that could be added:
 - Cyber-attack (hospital databases, etc.)
 - Utility failure (electricity, natural gas, communications)
 - Water Supply (insofar as availability of water at all)
 - Severe Wind
 - Transportation Infrastructure (looking at areas where there are a high number of crashes and if there is a way to mitigate that through engineering/design)
 - Invasive species
 - Civil disturbance: add an aspect for school safety against shooting threats

Update hazards identified in initial plan

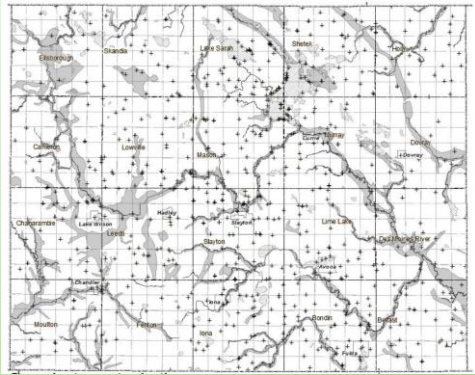
- Ag Disease
 - A1a.2: Murray County Environmental Office does this on an on-call basis
- Severe Storms
 - A1b.2: Heath does this through ads and Facebook posts. Schools are also active participants.
 - A1b.4: This is covered by CodeRED system. The downside to this is that it's only for Murray County residents since you have to provide an address when you sign up.
 - A1b.6: Murray County Medical Center (Slayton) has a generator.
 - A1b.7: Ongoing
 - A1b.8: Does the EMD need these maps? Many water utilities are not willing to give maps of their utilities. Nobles Co-op map is done and is constantly being updated.
 - A1b.9: Done.
 - A1b.10: Some townships do and some don't. Townships may have only been instructed to inform the sheriff of closed roads.

- Wildfire
 - A2b.3: The evacuation plans are in the Emergency Operations Plan.
 - A2b.4: Cutting of ditches and baling are required.
 - A2b.6: Dry hydrants are done. They have been installed at the following lakes: Hadley, Lime, Fulda, Fox, Wilson, Sarah, Shetek (2), Bloody, Buffalo.
- Drought
 - A3a.1: Wellhead Protection Plans are in the Water Management Plans and are in progress/ongoing. Done for Fulda, Chandler, Currie, Lake Wilson, and Hadley.
- Public Health
 - A1c.5: Generators are at MCMC (Slayton), what other critical facilities are in need?
- Water Supply
 - A1d.3: County Water Plan was just updated.
- Hazardous Materials
 - A2c.3: Fixed haz mat facilities have been mapped, but not transport corridors.
 - A2c.5: Haz mat training is ongoing.
 - A2c.6: Airport review: Reviewed. County ordinances are being updated.
- Civil Unrest/Terrorism
 - A3b.1: Increasing alarm systems and cameras: All county buildings have cameras.
- Flooding/Dam Failure
 - B1a.1: Discouraging future development within floodplains is ongoing.
 - B1a.2: Encouraging sound construction with regards to flood fringe areas is ongoing.
 - B1a.3: Improving floodplain maps is ongoing and working with the DNR to do that.
 - B1a.4: NFIP participation: Working with Cities of Hadley and Currie.
 - B1a.5: Done.
 - B1a.6: Purchasing flood insurance is required for mortgages for property owners in the flood hazard areas. Map amendment.
 - B1a.7: Developing a program to acquire/relocate/elevate at-risk structures: Need an inventory of structures that are in the actual floodplain.

CPRI Worksheet “Homework” Handout & Explanation

Slide 1

Murray County All-Hazard Mitigation Plan Update



*Planning Team Kickoff Meeting
December 5, 2017*

Murray County Emergency Management
+
Southwest Regional Development Commission

Slide 2

Agenda

- Welcome & Introductions
 - Heath Landsman, Murray County Emergency Management Director
- Presentation: Murray County All-Hazard Mitigation Plan
 - Maxwell Kaufman, Southwest Regional Development Commission
 - AHMP Overview
 - Hazard Ranking
 - Mitigation Actions
- Feedback
- Next Steps

What is Hazard Mitigation?

- HM is sustained action to reduce or eliminate long-term risk to people and their property from hazards.
- HM planning is the process local governments use to identify risks and vulnerabilities associated with natural disasters, and develop long-term strategies for protecting people and property from future hazard events.
- HM planning allows communities to strategically plan for and work together to implement activities that are cost-effective, technically feasible and environmentally sound BEFORE a disaster strikes.

Planning Process Timeline

- *Kickoff (HSEM, EMDs, SRDC)*
- *Meeting 1 (Overview, Choose & Rank Hazards, Update Strategies)*
- *Meeting 2 (Discuss Rankings and Existing & Potential Mitigation Projects)*
- *Meeting 3 as full team or Mitigation Strategies Subcommittee (Confirm updated mitigation strategies)*
- *Plan Review Subcommittee Meeting (review via email)*
- *Public Hearing*

AHMP Planning Team

Role of the Planning Team

1. Provide input on development of the plan
2. Rank hazards, prioritize mitigation strategies, and identify projects for implementation.
3. Assist with public outreach and participate in public meetings.
4. Review draft plans and provide feedback.
5. Facilitate final adoption of the AHMP by local governments.

About the Plan

- The All-Hazard Mitigation Plan (AHMP) is a requirement of the Federal Disaster Mitigation Act of 2000 (DMA 2000). The development of a local government plan is required in order to maintain eligibility for certain federal disaster assistance and hazard mitigation funding programs.
- Content:
 - Murray County physical and social profile
 - Asset Inventory
 - Hazard Assessment and Vulnerability Analysis
 - Mitigation Actions

Hazard Identification

- This plan is a multi-jurisdictional plan that covers Murray County, including all 9 incorporated cities. (To be considered a participating jurisdiction, you must do a CPRI and the mitigation development review.)
- Hazard Identification
 - Existing County Plans
 - Hazard Ranking
 - Record of Events (FEMA, NCDRC)
 - GIS and HAZUS (Flood only)

While only cities passed resolutions of participation in the plan, any townships can also participate and are encouraged to participate if they have specific hazard mitigation needs.

What hazards can be addressed?

- An All-Hazard Mitigation Plan looks primarily at natural disasters, which can include any of the following (not all required):

Drought	Earthquake	Erosion	Extreme Temperatures
Flood (+Dam/Levees)	Hail	Landslide	Lightning
Sea Level Rise	Severe Wind	Severe Winter Weather	Storm Surge
Subsidence	Tornado	Tsunami	Wildfire

Man-Made Hazards

- Non-natural hazards (man-made) are not required by the DMA 2000 to be addressed in the AHMP and are not eligible for FEMA mitigation funds, but may be eligible for mitigation funds from other departments.
- Can include, but not limited to:
 - Civil Disturbance/Terrorism
 - Dam, Impoundment, & Culvert Failure
 - Hazardous Materials
 - Public Health Emergencies
 - Transportation Infrastructure
 - Utility Failure
 - Water Supply Contamination

Hazard Events (2000-2017)

Natural

- Blizzards: 17
- Drought: 14 (4 separate years)
- Earthquake: 0
- Extreme Cold:
- Extreme Heat: 6
- Flash Floods: 10
- Floods & Flash Floods: 8
- Hail: 40

- Lightning: 1
- Thunderstorm Wind: 30
- Tornadoes: 5
- Wildfire: 0
- Winter Storms: 28

Man-Made

- Aviation: 0
- Hazardous Materials: 6

Lightning is much larger, but these are only the events recorded by NOAA.

Hail events are the largest in terms of number.

Flooding is what FEMA likes to focus on and what will be done by UMD with the HAZUS analysis.

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FEMA-Declared Disasters in Murray County						
Incident	Declaration Date and Disaster Number	Incident Period	Total PA Obligated by FEMA for Disaster in Minnesota	Total PA Obligated by FEMA for Disaster in Murray County	Individual Assistance in Minnesota	Individual Assistance in Murray County
Flooding	DR-255 4/18/1969	4/18/1969- 4/18/1969	Yes – Unknown Amount	Unknown	Yes – Unknown Amount	Unknown
Heavy Rains & Flooding	DR-268 8/5/1969	8/5/1969-8/5/1969	Yes – Unknown Amount	Unknown	Yes – Unknown Amount	Unknown
Severe Storms, Tornadoes & Flooding	DR-946 6/26/1992	6/16/1992- 6/20/1992	Yes – Unknown Amount	Unknown	Yes – Unknown Amount	Unknown
Severe Storms, Tornadoes & Flooding	DR-993 6/11/1993	5/6/1993- 8/25/1993	Yes – Unknown Amount	Unknown	Yes – Unknown Amount	Unknown
Severe Ice Storm	DR-1151 1/7/1997	11/14/1996- 11/30/1996	Yes – Unknown Amount	Unknown	\$0	\$0
Severe Winter Storms	DR-1158 1/16/1997	1/3/1997-2/3/1997	Yes – Unknown Amount	Unknown	\$0	\$0
Severe Flooding, High Winds, Severe Storms	DR-1175 4/8/1997	3/21/1997- 5/24/1997	Yes – Unknown Amount	Unknown	Yes – Unknown Amount	Unknown
Severe Storms and Flooding	DR-1941 10/13/2010	9/22/2010- 10/14/2010	\$25,963,422.37	\$190,966.29	\$0	\$0
Severe Storms, Straight-Line Winds, Flooding, Landslides, and Mudslides	DR-4182 7/21/2014	6/11/2014- 7/11/2014	\$41,013,709.98	\$299,641.67	\$0	\$0
Severe Winter Storm	DR-4113 5/3/2013	4/9/2013- 4/11/2013	\$11,090,674.37	\$164,526.76	\$0	\$0

10 FEMA-Declared Disasters

7 included flooding

5 included severe storms

2 winter storms

2 tornadoes

2 high winds

1 ice storm

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Mitigation Strategies

- **Prevention:** Government, administrative, or regulatory actions.
- **Property Protection:** Removal or modification of existing buildings or structures to protect them from a hazard.
- **Public Education and Awareness:** Actions to inform and educate citizens, elected officials, and property owners about the hazards and potential ways to mitigate them.
- **Natural Resource Protection:** Actions that minimize hazard losses and preserve or restore the functions of natural systems.
- **Emergency Services:** Actions that protect people and property during and immediately after a disaster or hazard event. Services include warning systems, emergency response services, and protection of critical facilities.
- **Structural Projects:** Actions that involve the construction of structures to reduce the impact of a hazard, for example: floodwalls, safe rooms.

6 categories of mitigation strategies (for our purposes). This is not any official categorization.

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Historical Hazard Mitigation Funding in Murray County

Year	Project Description	Sub-Grantee	Federal Share
1998	Installation of three NOAA Weather Radio Transmitters on existing towers in Murray County. This is a 5% state initiative project.	Murray County	\$149,120
2007	The Murray County All-Hazard Mitigation Plan was approved by FEMA on 11/5/2007. It is due to be updated and approved by 11/5/2012.- JMCCLOSK-01/07/2009 17:15 GMT The Southwest Regional Development Commission (SRDC) will be the subgrantee to update the plan for Murray County. The SRDC will work with the Murray County mitigation team and the emergency manager during all phases of the update process. Murray County will provide the local match with work in-kind. A HAZUS-MH river flood risk analysis will be performed by the SRDC. -JMCCLOSK-01/07/2009 17:21 GMT Increase in the amount of non-fed share matching funds along with project closeout in letter request by State dated 4/20/12-EHARDIMO-04/23/2012 19:13 GMT.	Southwest Regional Development Commission	\$16,831.00

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Implementation of Mitigation Actions

- Happens at every jurisdictional level.
- Happens in partnership with other local, State, and Federal agencies and non-profit organizations.
- Can be inexpensive (“low-hanging fruit”)
- Can be high-cost (some are HMA-eligible)
- Some may be implemented quickly, others may be ongoing, and some may occur over several years.



The impact of hazards on people and property can only be reduced when efforts are made to mitigate against them before they occur.

Not everything will be something that FEMA can cover. Their funds are limited. So sometimes things might have to be written in to a budget at a county or city level.

Mitigation Actions Eligible for HMA

1. Retrofit or construction of safe room facilities to protect public during extreme wind events.
2. Purchase of generators for backup power to support the operation of essential function in critical facilities in the event of severe storms.
3. Burying or strengthening of power lines to reduce the risk of power outages from downed lines during a severe storm.
4. Install new warning systems in identified vulnerable locations
5. Mitigation measures to reduce the threat of wildfire.
6. Infrastructure retrofit for flood prone areas.
7. Minor localized flood reduction projects to lessen the frequency of severity of flooding and decrease predicted flood damages.
8. Relocate flood-prone properties or acquire and demolish flood prone properties.
9. Dry-proof or wet-proof facilities that are flood prone.

- Retrofit or construction of safe room facilities to protect public during extreme wind events.
 - Locations may include schools, mobile home parks, campgrounds, or other areas where there are populations vulnerable to high winds and tornado events.
- Purchase of generators for backup power to support the operation of essential function in critical facilities in the event of severe storms.
 - Critical facilities may include police and fire stations, hospitals, and water and sewer treatment facilities, and other facilities that the county deems critical.
- Burying or strengthening of power lines to reduce the risk of power outages from downed lines during a severe storm.
 - Where it is feasible and cost-effective as part of new construction or retrofit.
- Install new warning systems in identified vulnerable locations
 - Used to alert people in high-risk, vulnerable areas such as campgrounds, parks and rural residents out of reach of other existing warning siren systems to approaching severe weather.
- Mitigation measures to reduce the threat of wildfire.
 - Activities such as creation of defensible space, application of ignition-resistant construction, hazardous fuels reduction, and installation of external wildfire sprinkler systems.
- Infrastructure retrofit for flood prone areas.
 - To make mitigation improvements for structures such as culverts, road, bridges, and government buildings.

- Minor localized flood reduction projects to lessen the frequency of severity of flooding and decrease predicted flood damages.
 - Such as installation or modification of culverts; stormwater management activities, such as creating retention and detention basins, protection of sanitary sewer lift stations in flood-prone areas, installation of flow-rate meters (stream gauges) on rivers and streams that are prone to flooding high-risk, vulnerable properties.
- Relocate flood-prone properties or acquire and demolish flood prone properties.
 - Located in the special flood hazard area and outside of the special flood hazard area.
- Dry-proof or wet-proof facilities that are flood prone.
 - Reduce potential infrastructure flood damages on utilities such as wastewater treatment, pipelines, and power facilities by dry-proofing or wet-proofing facilities that are flood prone.

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Discussion: Hazards to Include for Mitigation

NATURAL

- Drought
- Earthquake
- Erosion
- Extreme Temperatures
- Flood (+Dam/Levee Failure)
- Hail
- Landslide
- Lightning
- Sea Level Rise
- Severe Wind
- Severe Winter Weather
- Storm Surge
- Subsidence
- Tornado
- Tsunami
- Wildfire

MAN-MADE

- Agricultural Disease (animal/crop)
- Civil Disturbance/Terrorism
- Hazardous Materials
- Public Health Infectious Disease
- Transportation Infrastructure
- Utility Failure
- Structure Fire
- Water Supply Contamination
- Aviation
- Others?

Those in black had mitigation strategies in the 2010 plan.

Hazard Ranking – CPRI Worksheet

- Worksheet that allows each jurisdiction to rank the risk that each hazard poses to the jurisdiction.
 - Probability
 - Magnitude/Severity
 - Warning Time
 - Duration

6.4E Probability	6.5 Magnitude / Severity	6.6 Warning Time	6.7 Duration
1 - Very Low ☐ Event is probable within the calendar year. ☐ Event has up to 1 in 1 year chance of occurring (31% = 100%) ☐ Chance of event is greater than 33% likely per year ☐ Event is "highly likely" to occur	1 - Catastrophic ☐ Local jurisdiction is overwhelmed and unable to effectively respond to the hazard. Local resources are inadequate or non-existent. Complete loss of communications. Massive regional, state, EMAC and federal response is required. Federal disaster declaration. ☐ Local and regional medical services are unable to manage the volume of injuries and fatalities. Mass evacuation, sheltering and care of displaced residents, medical patients, high risk and vulnerable populations are required. ☐ Loss of public utilities, government and essential services for more than 1 month. Widespread destruction of critical infrastructure, public and private property. More than 50% of critical and non-critical facilities and infrastructure damaged or destroyed. Extended emergency response operations lasting more than 1 month may be required.	1 - Immediate ☐ No notice up to 5 Hours ☐ More Than 1 Week	
2 - Low ☐ Event is probable within the next three years. ☐ Event has up to 1 in 3 years chance of occurring (33% = 33%) ☐ Chance of event is greater than 20% but less than or equal to 33% per year. ☐ Event is "likely" to occur	2 - Critical ☐ Local jurisdiction is unable to effectively respond without District level mutual aid support and significant state assistance. Local resources have been expended and local agencies have reached the limits of their capabilities. Communications seriously impacted with significant impact on operations. State resource declaration. ☐ Local medical services are unable to manage number of injuries and fatalities. Patients require transportation to regional medical facilities outside of the affected areas. Local area evacuations, sheltering, and care of displaced residents, medical patients, high risk and vulnerable populations are required. ☐ Loss of public utilities, government and essential services for up to 1 month. Significant damage to critical infrastructure, public and private property over a large area. Up to 50% of critical and non-critical facilities and infrastructure damaged. Emergency response operations lasting up to 1 month may be required.	2 - Marginal ☐ 6 to 12 Hours ☐ Up to 1 Week	
3 - Possible ☐ Event is probable within the next five years. ☐ Event has up to 1 in 5 year chance of occurring (35% = 20%) ☐ Chance of event is greater than 10% but less than or equal to 20% per year. ☐ Event could "possibly" occur	3 - Moderate ☐ Local jurisdiction is able to effectively respond with significant inter-local mutual aid support and limited state assistance. Local and mutual aid resources are adequate to support response. Communications systems operating near capacity. Local medical services are able to manage volume of injuries and fatalities but are near the limits of their capabilities. Only critically injured patients are directed to facilities outside of the affected areas. Limited evacuations and sheltering required. ☐ Loss of public utilities, government and essential services for up to 1 week. Significant damage to critical infrastructure, public and private property over a localized area. Up to 25% of critical and non-critical facilities and infrastructure damaged. Emergency response operations lasting up to 1 week may be required.	3 - Limited ☐ 12-24 Hours ☐ Up to 1 Day	
4 - Unlikely ☐ Event is probable within the next 10 years. ☐ Event has up to 1 in 10 years chance of occurring (37% = 10%) ☐ Chance of event occurrence is less than or equal to 10% ☐ Event is "unlikely" to occur.	4 - Manageable ☐ Local jurisdiction is able to manage incident with standard mutual aid and little or no state assistance. Local resources are adequate to support response. Communications system operating normally. Local emergency resources. ☐ Local medical services are able to manage number of injuries and fatalities with on hand personnel and resources. ☐ Loss of public utilities, government and essential services for up to 24 hours. Damage contained to a single incident scene and immediate area. Up to 5% of critical and non-critical facilities and infrastructure damaged. ☐ Response operations lasting up to 72 hours may be required.	4 - Minimal ☐ 24+ Hours ☐ Up to 6 Hours	

Next Steps

- 2nd Planning Team meeting
- Subcommittee Formation (if needed)
 - Mitigation Strategies Subcommittee
 - Plan Review Subcommittee
- CPRI Worksheets & Completed Action Steps
 - Explanation
 - Will be sent as PDFs

- Retrofit or construction of safe room facilities to protect public during extreme wind events.
 - Locations may include schools, mobile home parks, campgrounds, or other areas where there are populations vulnerable to high winds and tornado events.

- Purchase of generators for backup power to support the operation of essential function in critical facilities in the event of severe storms.
 - Critical facilities may include police and fire stations, hospitals, and water and sewer treatment facilities, and other facilities that the county deems critical.
- Burying or strengthening of power lines to reduce the risk of power outages from downed lines during a severe storm.
 - Where it is feasible and cost-effective as part of new construction or retrofit.
- Install new warning systems in identified vulnerable locations
 - Used to alert people in high-risk, vulnerable areas such as campgrounds, parks and rural residents out of reach of other existing warning siren systems to approaching severe weather.
- Mitigation measures to reduce the threat of wildfire.
 - Activities such as creation of defensible space, application of ignition-resistant construction, hazardous fuels reduction, and installation of external wildfire sprinkler systems.
- Infrastructure retrofit for flood prone areas.
 - To make mitigation improvements for structures such as culverts, road, bridges, and government buildings.
- Minor localized flood reduction projects to lessen the frequency of severity of flooding and decrease predicted flood damages.
 - Such as installation or modification of culverts; stormwater management activities, such as creating retention and detention basins, protection of sanitary sewer lift stations in flood-prone areas, installation of flow-rate meters (stream gauges) on rivers and streams that are prone to flooding high-risk, vulnerable properties.
- Relocate flood-prone properties or acquire and demolish flood prone properties.
 - Located in the special flood hazard area and outside of the special flood hazard area.
- Dry-proof or wet-proof facilities that are flood prone.
 - Reduce potential infrastructure flood damages on utilities such as wastewater treatment, pipelines, and power facilities by dry-proofing or wet-proofing facilities that are flood prone.

Murray County AHMP Contacts:

Heath Landsman

Emergency Management Director – Murray County

2500 28th Street, Slayton, MN 56172

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Maxwell Kaufman

Development Planner – Southwest Regional Development Commission

2401 Broadway Ave, Slayton, MN 56172

maxk@swrdc.org | 507-836-1633

Public Meeting Sign In Sheet

Date: 12/11/17

Time Held: 4:30 to 6:00

City/ County Location: Murray County Purpose: AHMP Update Kickoff

PRINT NAME	SIGNATURE	COMMUNITY AFFILIATION
Jon Blumenthal	[Signature]	Murray Co.
Jim DeYonge	[Signature]	Leeds Twp. chair
Karen Frisk	[Signature]	Avoca city
Jean Christoffels	[Signature]	Murray Co. Zoning
Rick Leebens	[Signature]	Nobles Coop Electric
Jennifer Kishner	[Signature]	Murray County Ambulance
Blond Hilary	[Signature]	Coastal ISSUAR
Adam Trumbly	[Signature]	Nobles Cooperative Electric
Sherry Swanson	[Signature]	Nobles Cooperative Electric
Brian Postma	[Signature]	Nobles Cooperative Electric
Dave Thiner	[Signature]	Murray Co. Commissioner
Jim Brown	[Signature]	City of Fulda Council
Joe Malone	[Signature]	City of Currie Mayor
Marcy Barcitt	[Signature]	Murray Co. Assessor
Heath Landsman	[Signature]	Murray co. EM

Reported by: [Signature]
Signature

Agency: SW Regional Development Commission

The value of participation by volunteer members of the public is \$25.20/hour.

The Community Affiliation is if the attendee wish to state a public or private organization they are representing or if they are representing themselves.

Murray County All-Hazard Mitigation Plan Update
Planning Team Meeting #2

Monday, May 14, 2018
4:30 PM – 6:15 PM

Murray County Courts Meeting Room,
2848 Broadway Ave, Slayton, MN 56172

Agenda

- | | |
|---------|--|
| 4:30 PM | HAZUS Flood Assessment Presentation – <i>Max Kaufman, SRDC</i> |
| 4:45 PM | Review completed CPRI Rankings <ul style="list-style-type: none">• <i>(Compiled from CPRIs completed prior to meeting. Still missing: Chandler, Dovray, Hadley, Iona, Slayton)</i> Prioritize hazards to be in 2018 plan |
| 5:00 PM | Review Existing Plans/Programs and Gaps/Deficiencies for Each Hazard |
| 5:30 PM | Review Mitigation Strategies as discussed previously to carry over into new plan
Identify new strategies for updated plan |
| 6:00 PM | Sub-Committee Formation & scheduling of subcommittee meetings (if needed) <ul style="list-style-type: none">• Mitigation Strategies Subcommittee (STAPLE+E)• Plan Review Subcommittee |
| 6:10 PM | Questions, Comments, Observations |
| 6:15 PM | Adjourn |

Meeting Deliverables

- Updated list of hazards and prioritized hazards for county as well as plans/programs & gaps/deficiencies.
- Identified carry-over strategies and completed / deleted strategies
- Identify new strategies for insertion into updated plan
- Dedicated team members to review all strategies and the entire plan

Murray County All-Hazard Mitigation Plan Update
Planning Team Meeting #2

Monday, May 14, 2018
4:30 PM – 6:15 PM

Southwest Regional Development Commission,
2401 Broadway Ave, Slayton, MN 56172

Attendees: Karen Frisk, Dave Thiner, Jean Christoffels, Gerald Magnus, Heath Landsman, Lauren Mellenthin, Brian Postma, Glenn Kluis, Maxwell Kaufman

Agenda

- 4:30 PM HAZUS Flood Assessment Presentation – *Max Kaufman, SRDC*
- Flood Insurance
 - Are all homeowners eligible? Eligibility depends on the elevation of the structure and location. The higher the elevation of the structure, the better your flood insurance rate will be.
 - Fulda Lagoons
 - This could be an area that is a problem, but doesn't show on the floodplain maps or flood hazard analysis. The lagoons already pumping regularly and are at capacity when there is a heavy rain. If there were a 100-year flood, they wouldn't be able to handle it. This is public infrastructure so it would be eligible for funding. One idea would be more cells to the lagoons, but funding is limited.
- 4:45 PM Review completed CPRI Rankings
- Compiled from CPRI's completed prior to meeting.
 - The rankings in the presentation can still change because we are missing CPRI's from the cities of: Chandler, Dovray, Hadley, Iona, and Slayton.
 - If a city does not complete the CPRI and participate in the mitigation action updates, then they are not covered under this plan and they are not eligible for hazard mitigation assistance.
- 5:00 PM Review Existing Plans/Programs and Gaps/Deficiencies for Each Hazard and identify new strategies for updated plan
- Agricultural Disease
 - Plans & Programs: Major hog facilities are working on communication – UMN had a conference on this in Worthington. Subsidies for reporting problems.
 - Gaps & Deficiencies: Communications with county (top-down communication comes too late). Foot and mouth disease poses a risk.
 - Wildfire & Structure Fire
 - Gaps & Deficiencies: Prairies in southwest corner of county near Chandler (includes Lost Timber Bible Camp). The distance and accessibility to this area of the county and other very rural areas means response times are slower. Wind towers also pose a risk for fire. Main Streets and lakes area where buildings are very close together poses a structure fire risk. One strategy might be to encourage ATVs or trucks for fire departments to take to very rural areas – the downside is the low amount of water that can be brought.
 - Winter Storms
 - Plans & Programs: Set up operations at Nobles Coop in the case of a storm like the Rock/Nobles one this past winter.

- Gaps & Deficiencies: Loss of power. Backup generation is lacking in some areas. Two strategies would be (1) generators for essential facilities/shelters, and (2) underground power lines.
- Flooding
 - Gaps & Deficiencies: Fulda Lagoons (see above HAZUS discussion). Four cities with flood issues do not participate in the NFIP. No generator for lift station in Avoca. Strategy ideas: (1) Newer flood maps for the county (scheduled in 2-3 years), and (2) Get Avoca, Currie, Fulda, Hadley into the NFIP through the DNR.
- Summer Storms (Hail, Lightning, etc.)
 - Gaps & Deficiencies: Siren for Lake Shetek are not battery backup.
- Tornado/Severe Wind
 - Plans & Programs: Valhalla mobile home park has a safe room.
 - Gaps & Deficiencies: This would affect more overhead and substations for utilities. Strategies: (1) Safe rooms for county and private campgrounds, (2) Increase CodeRED registration education (add to campground info packets).
- Extreme Cold
 - Gaps & Deficiencies: Similar to utility failure. No listing of cell phone numbers in the event of needing to check on people.
- Extreme Heat
 - Same as Extreme Cold section.
- Drought
 - Plans & Programs: Crop insurance covers most concerns for this.
 - Gaps & Deficiencies: Do any cities run on rural water? This could be an issue.
- Civil Disturbance
 - Plans & Programs: Fulda & Slayton already have cameras in their school. Not sure about Chandler Christian and St. Paul's Lutheran.
 - Gaps & Deficiencies: No response plan for a large scale crisis.
- Cyber Attack
 - Plans & Programs: Murray County has firewalls for their own servers.
 - Gaps & Deficiencies: Strategy: Might be good to contact Jackson County Central to see what they did after their data breach.
- Public Health Emergency
 - Plans & Programs: SWHHS has an Emergency Response Plan, includes planning for mass immunizations. IPAWS (force message to all phones in a set geographic area) can be used in emergencies by the EMD.
 - Gaps & Deficiencies: Response communications hasn't always been effective (Pizza Ranch hepatitis incident).
- Invasive Species
 - -
- Dam Failure
 - Gaps & Deficiencies: Utility failure in the event of dam failure. Lake Sarah dam is old. Avoca dam is #6 on the state's list for repair – repair of the Avoca dam should be included in the strategies.
- Hazardous Materials
 - Plans & programs: SW MN is served by the Marshall Chemical Assessment Team (CAT), but they only tell you what kind of chemical has been spilled, they don't do cleanup.
 - Gaps & Deficiencies: No firemen are trained for this beyond awareness. There is no ability to do cleanup. Need for chemical storage disaster training.
- Utility Failure
 - Plans & Programs: All wires and poles are inspected regularly.

- Gaps & Deficiencies: No fuel sources in towns in the event of utility failure. Propane shortage is a concern. Strategy: Replace overhead wires, install underground wires – specifically bury the lines on Keely Island. Strategy: Portable substation.
- Transportation Infrastructure
 - Gaps & Deficiencies: Tile remains under Highway 30. Strategy ideas (1) Identify specific bridges/culverts/roads that are problem areas and (2) Map hazard areas.
- Water Supply & Contamination
 - Fulda pumping station is the only source of water and not sure if there's a backup generator – this station is also next to Asmus and there is a risk of contamination. Towns without wellhead protection plans are a gap. Chandler's well is in the flood plan, but likely low cost effectiveness in moving it.

Existing Strategies Discussion

- A1b-8: Delete this strategy. Utilities are hesitant to give maps of their underground utilities due to risk of misuse of that information. If EMD needs it, it is available.

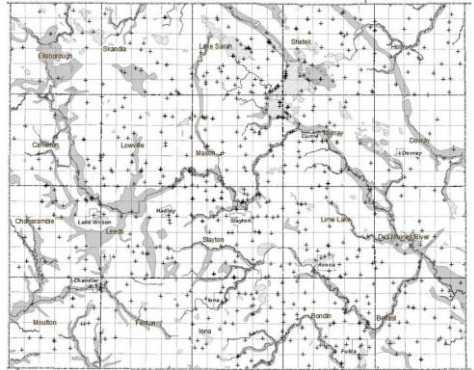
- | | |
|---------|--|
| 6:00 PM | Sub-Committee Formation & scheduling of subcommittee meetings (if needed) <ul style="list-style-type: none"> • The team prefers to do review via email. Team members will be informed where in the plan background information, mitigation strategies, and appendices are and will review accordingly, sending their feedback to Heath and Max. |
| 6:10 PM | Questions, Comments, Observations |
| 6:15 PM | Adjourn |

Meeting Deliverables

- Updated list of hazards and prioritized hazards for county as well as plans/programs & gaps/deficiencies.
- Identified carry-over strategies and completed / deleted strategies
- Identify new strategies for insertion into updated plan
- Dedicated team members to review all strategies and the entire plan

Slide 1

Murray County All-Hazard Mitigation Plan Update



Planning Team Meeting #2

May 14, 2018

Murray County Emergency Management
+
Southwest Regional Development Commission

Slide 2

Agenda

- HAZUS Flood Assessment
- CPRI Rankings
 - Still needed from: Chandler, Dovray, Hadley, Iona, Slayton
- Plans/Programs and Gaps/Deficiencies
- New Mitigation Strategies
- Subcommittees (If Needed)
 - Mitigation Strategies Subcommittee
 - Plan Review Subcommittee

Slide 3

HAZUS Flood Assessment

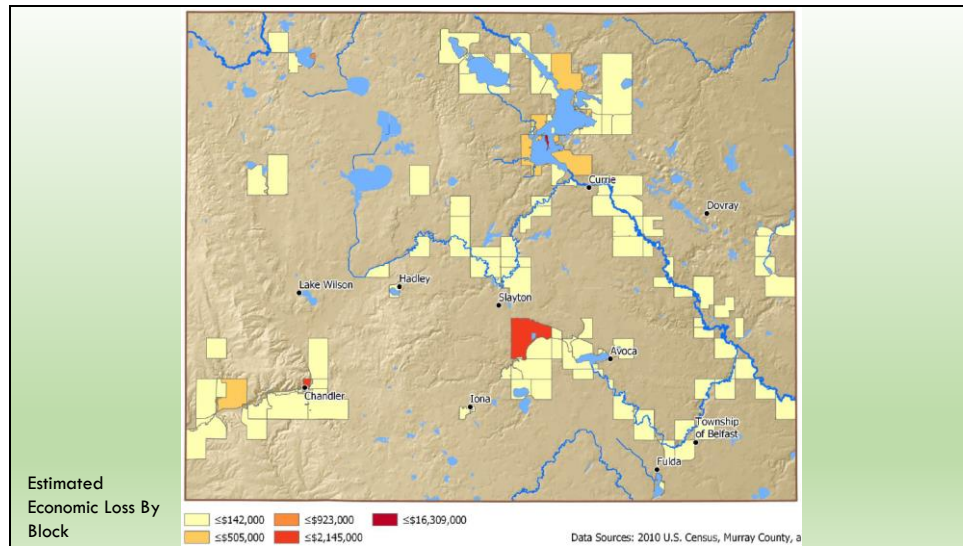
- 4,950 Parcels in Murray County, 18 parcels' buildings will be at least moderately damaged (>10% damage) in a 100-year flood. Zero are estimated to be completely destroyed.
- Total Economic Loss: \$26.91 million (17.47% of total replacement value of scenario buildings).
- Total Building-Related Losses: \$4.96 million
- 82% of estimated losses were related to business interruption.
- Residential occupancies made up 13.24% of total loss.

Slide 4

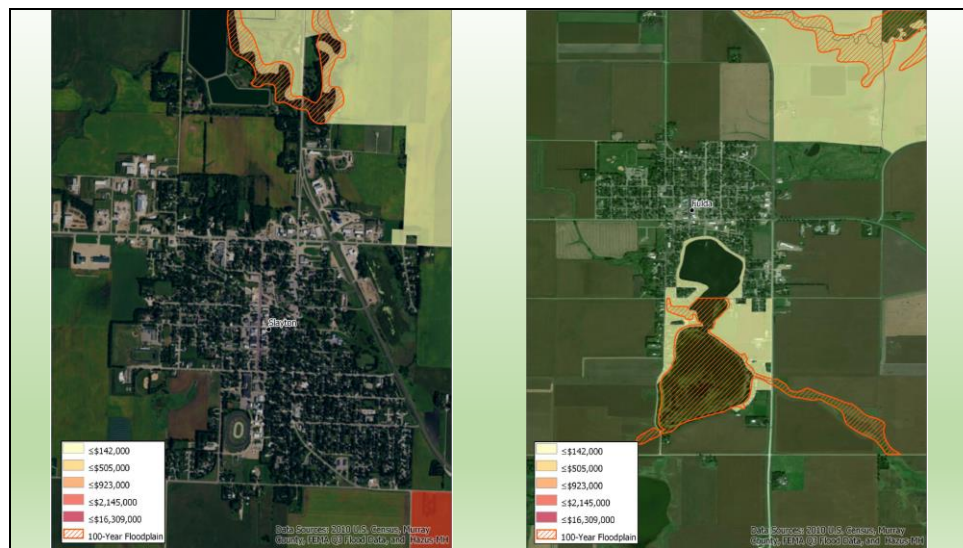
General Occupancy	Estimated Total Buildings	Total Damaged Buildings	Total Building Exposure	Total Economic Loss	Building Loss
Agriculture	741	0	\$109,073,000	\$1,465,000	\$324,000
Commercial	347	0	\$31,134,000	\$479,000	\$31,000
Education	6	0	\$12,046,000	\$150,000	\$14,000
Government	114	0	\$17,084,000	\$3,746,000	\$19,000
Industrial	25	0	\$9,261,000	\$17,000	\$4,000
Religious/Non-Profit	61	0	\$18,552,000	\$17,494,000	\$105,000
Residential	3,294	21	\$265,631,000	\$3,562,000	\$1,960,000
Total	4,590	21	\$462,781,000	\$26,913,000	\$2,457,000

Table 1. Murray County Total Economic Loss from 100-Year Flood

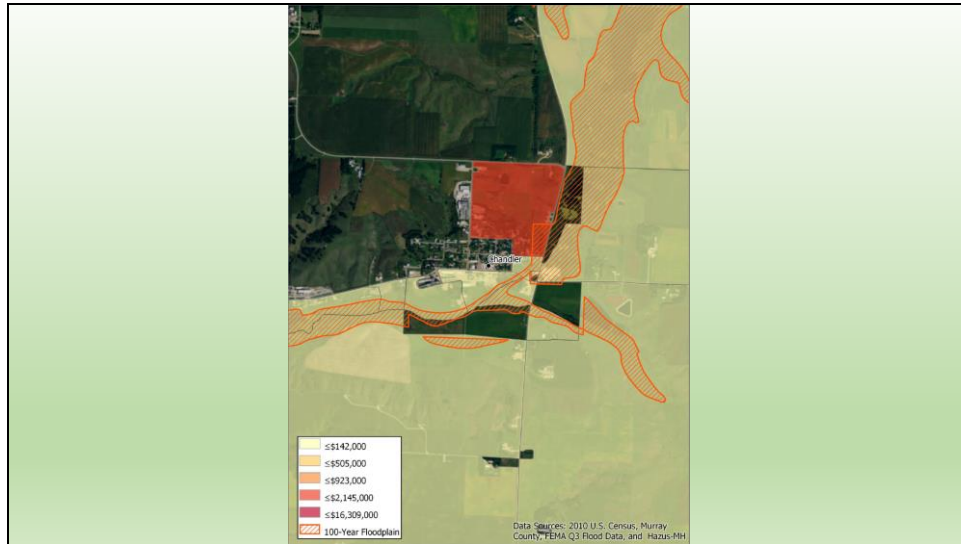
Slide 5



Slide 6



Slide 7



Slide 8

Census Blocks of Concern

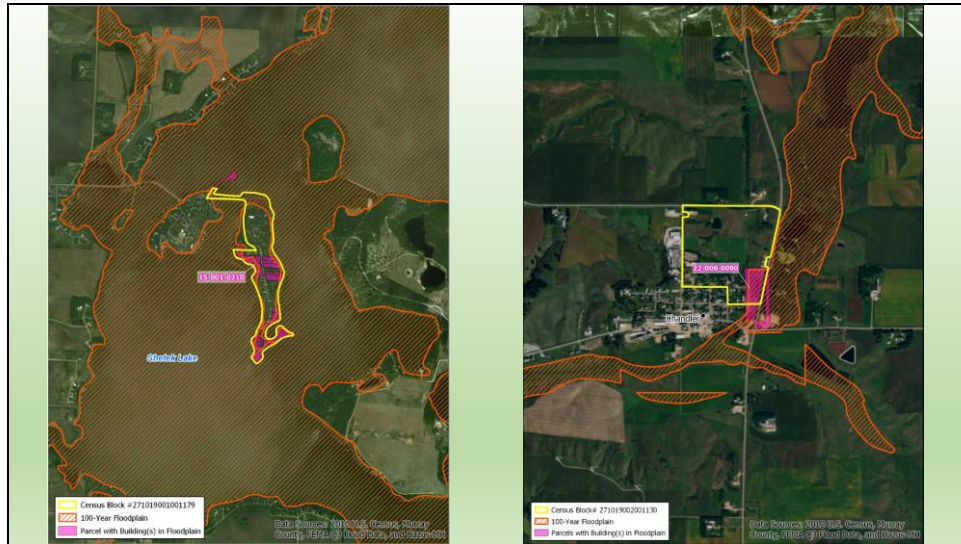
Census Block Number	Total Estimated Loss	Location
271019001001179	\$16,309,000	3 miles northwest of Currie
271019002001130	\$2,145,000	Chandler
271019003002135	\$1,958,000	Slayton

Table 2. Census Blocks with the greatest estimated losses in the 100-Year Floodplain

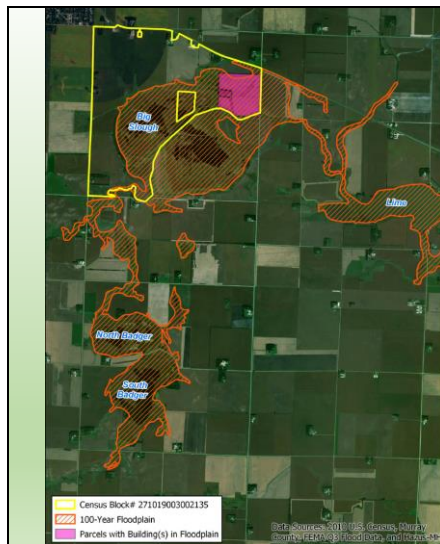
Parcel ID	Total Value of Building(s) & Building's Contents on Parcel	Class Description	Building Area (ft ²)
22-006-0090	\$1,440,000	Churches & other Non-profit Org.	95,569
17-007-0010	\$733,800	Government – General Services	15,192
18-030-0011	\$661,050	Single Family Dwelling	3,202
11-011-0040	\$646,600	Agriculture	2246
15-001-0210	\$642,300	Single Family Dwelling	3,091
15-012-0011	\$640,600	Agriculture	2,132
11-160-0240	\$587,850	Single Family Dwelling	2,797
11-160-0250	\$570,300	Single Family Dwelling	2,747
11-160-0210	\$558,300	Single Family Dwelling	2,677
11-150-0110	\$557,700	Single Family Dwelling	2,650
Total	\$7,038,500		

Table 3. Murray County Properties with Highest Building/Contents Value Intersecting 100-Year Floodplain

Slide 9



Slide 10



Essential Facilities

- No essential facilities (care, fire, police, schools) fall within the floodplain boundary.

Shelter Requirement

- 40 households are estimated to be displaced. 0 people estimated to seek temporary shelter in public shelters.

Debris Generation

- 960 tons of debris may be generated by a 100-year flood. It will require 39 truckloads to remove the debris.

Slide 11

Hazard Ranking – CPRI Worksheet

- Worksheet that allows each jurisdiction to rank the risk that each hazard poses to the jurisdiction.
 - Probability
 - Magnitude/Severity
 - Warning Time
 - Duration

0.41 Probability	0.5 Magnitude / Severity	0.16 Warning Time	0.1 Duration
1 - Highly Likely ☐ Event is probable within the calendar year. ☐ Event has up to 1 in 1 year chance of occurring (10% - 100%). ☐ Chance of event is greater than 35% likely per year. ☐ Event is "highly likely" to occur.	4 - Catastrophic ☐ Local jurisdiction is overwhelmed and unable to effectively respond to the hazard. Local resources are inadequate or non-existent. Complete loss of communications. Massive regional, state, EMAC and federal response is required. Federal disaster declaration. ☐ Local and regional medical services are unable to manage the volume of injuries and fatalities. Mass evacuation, sheltering, and care of displaced residents, medical patients, high risk and vulnerable populations are required. ☐ Loss of public utilities, government and essential services for more than 1 month. Widespread destruction of critical infrastructure, public and private property. More than 50% of critical and non-critical facilities and infrastructure damaged or destroyed. Extended emergency response operations lasting more than 1 month may be required.	☐ 6 to 12 Hours ☐ Up to 1 Day	☐ Up to 1 Week ☐ More Than 1 Week
2 - Likely ☐ Event is probable within the next three years. ☐ Event has up to 1 in 3 years chance of occurring (33% - 33%). ☐ Chance of event is greater than 20% but less than or equal to 35% per year. ☐ Event is "likely" to occur.	3 - Severe ☐ Local jurisdiction is unable to effectively respond without District-level mutual aid support and significant state assistance. Local resources have been expended and local agencies have reached the limits of their capabilities. Communications severely degraded with significant impact on operations. State disaster declaration. ☐ Local medical services are unable to manage number of injuries and fatalities. Patients require transportation to regional medical facilities outside of the affected areas. Local area evacuations, sheltering, and care of displaced residents, medical patients, high risk and vulnerable populations are required. ☐ Loss of public utilities, government and essential services for up to 1 month. Significant damage to critical infrastructure, public and private property over a large area. Up to 50% of critical and non-critical facilities and infrastructure damaged. Emergency response operations lasting up to 1 month may be required.	☐ 6 to 12 Hours ☐ Up to 1 Day	☐ Up to 1 Week ☐ More Than 1 Week
3 - Possible ☐ Event is probable within the next five years. ☐ Event has up to 1 in 5 year chance of occurring (20% - 20%). ☐ Chance of event is greater than 10% but less than or equal to 20% per year. ☐ Event could "possibly" occur.	2 - Moderate ☐ Local jurisdiction is able to effectively respond with significant inter-local mutual aid support and limited state assistance. Local and mutual aid resources are adequate to support response. Communications systems operating near capacity. Local medical services are able to manage volume of injuries and fatalities but are near the limits of their capabilities. Only critically injured patients are diverted to facilities outside of the affected areas. Limited evacuations and sheltering required. ☐ Loss of public utilities, government and essential services for up to 1 week. Significant damage to critical infrastructure, public and private property over a localized area. Up to 25% of critical and non-critical facilities and infrastructure damaged. Response operations lasting up to 1 week may be required.	☐ 12-24 Hours ☐ Up to 1 Day	☐ Up to 1 Week ☐ More Than 1 Week
4 - Unlikely ☐ Event is probable within the next 10 years. ☐ Event has an up to 1 in 10 year chance of occurring (10% - 10%). ☐ Chance of event occurrence is less than or equal to 10%. ☐ Event is "unlikely" to occur.	1 - Minimal ☐ Local jurisdiction is able to manage incident with standard mutual aid and little or no state assistance. Local resources are adequate to support response. Communications system operating normally. Local emergency response operations are able to manage number of injuries and fatalities with on-hand personnel and resources. ☐ Loss of public utilities, government and essential services for up to 24 hours. Damage confined to a single isolated area and immediate area. Up to 5% of critical and non-critical facilities and infrastructure damaged. Response operations lasting up to 72 hours may be required.	☐ 24+ Hours ☐ Up to 1 Day	☐ Up to 1 Week ☐ More Than 1 Week

Slide 12

CPRI Rankings

- Subject to change. Need: Chandler, Dovray, Hadley, Iona, Slayton.
- Highest Ranked
 1. Winter Storm
 2. Tornado
 3. Windstorm
 4. Hail
 5. Lightning
- Lowest Ranked
 - Landslide/Mudslide
 - Subsidence
 - Earthquake
 - Wildfire
 - Dam Failure

Type	Threat/Hazard/Technological Accident - do not alter alphabetical order - calculation in next categories are tied to the order of the hazards	Probability Magnitude/Severity Warning Time Duration			
		2.00	1.50	1.94	2.66
Natural Hazards	Flood (Riverine)	2.00	1.50	1.94	2.66
Natural Hazards	Flash Flood	1.88	1.74	2.53	2.00
Natural Hazards	Dam Failure	1.38	1.56	3.00	2.19
Natural Hazards	Tornado	2.47	2.94	3.35	1.94
Natural Hazards	Wildfire	1.29	1.65	3.00	1.81
Natural Hazards	Windstorm	2.94	2.06	2.38	1.75
Natural Hazards	Winter Storm	3.41	2.19	2.02	2.50
Natural Hazards	Lightning	3.00	1.49	2.59	1.19
Natural Hazards	Hail	3.06	1.69	3.00	1.06
Natural Hazards	Drought	2.47	1.94	1.35	3.50
Natural Hazards	Extreme Heat	2.35	1.71	1.41	2.81
Natural Hazards	Extreme Cold	2.71	1.71	1.41	2.88
Natural Hazards	Erosion	2.07	1.47	2.20	2.53
Natural Hazards	Subsidence	1.14	1.50	2.71	2.07
Natural Hazards	Landslide/Mudslide	1.13	1.44	2.63	1.73
Natural Hazards	Earthquake	1.06	1.98	3.08	1.53

Slide 13

Discussion: Hazards to Include for Mitigation

NATURAL

- Drought
- Extreme Temperatures
- Flood (+Dam/Levee Failure)
- Hail
- Lightning
- Severe Wind
- Severe Winter Weather
- Tornado
- Wildfire

MAN-MADE

- Agricultural Disease (animal/crop)
- Cyber Attack
- Civil Disturbance (specifically school shooting safety)
- Hazardous Materials
- Invasive Species
- Public Health Infectious Disease
- Transportation Infrastructure
- Utility Failure
- Structure Fire
- Water Supply Availability & Contamination

Slide 14

Existing Plans/Programs and Gaps/Deficiencies

- Take a look at the large Plans/Programs and Gaps/Deficiencies sheets placed around the room.
- Write any additions you have to these directly on the sheets.
- Feel free to look at *Mitigation Ideas* as well for ideas on where there might be gaps.
- Afterward we'll discuss new mitigation strategies.

Mitigation Strategies (Handout)

- Carryover Strategies
- Deleted/Completed Strategies
- New Strategies Discussion
 - Mitigation Ideas (https://www.fema.gov/media-library-data/20130726-1904-25045-0186/fema_mitigation_ideas_final508.pdf)

Mitigation Strategies

- **Prevention:** Government, administrative, or regulatory actions.
- **Property Protection:** Removal or modification of existing buildings or structures to protect them from a hazard.
- **Public Education and Awareness:** Actions to inform and educate citizens, elected officials, and property owners about the hazards and potential ways to mitigate them.
- **Natural Resource Protection:** Actions that minimize hazard losses and preserve or restore the functions of natural systems.
- **Emergency Services:** Actions that protect people and property during and immediately after a disaster or hazard event. Services include warning systems, emergency response services, and protection of critical facilities.
- **Structural Projects:** Actions that involve the construction of structures to reduce the impact of a hazard, for example: floodwalls, safe rooms.

Slide 17

Mitigation Actions Eligible for HMA

1. Retrofit or construction of safe room facilities to protect public during extreme wind events.
2. Purchase of generators for backup power to support the operation of essential function in critical facilities in the event of severe storms.
3. Burying or strengthening of power lines to reduce the risk of power outages from downed lines during a severe storm.
4. Install new warning systems in identified vulnerable locations
5. Mitigation measures to reduce the threat of wildfire.
6. Infrastructure retrofit for flood prone areas.
7. Minor localized flood reduction projects to lessen the frequency of severity of flooding and decrease predicted flood damages.
8. Relocate flood-prone properties or acquire and demolish flood prone properties.
9. Dry-proof or wet-proof facilities that are flood prone.

Slide 18

Next Steps

- Subcommittee Formation (if needed)
 - Mitigation Strategies Subcommittee
 - Plan Review Subcommittee
- Finalize Plan
- All participating jurisdictions must adopt the plan by resolution in order to be eligible for Hazard Mitigation Assistance.
 - Once Murray County has adopted the plan, it will be reviewed by HSEM and FEMA, any changes will be made, and the plan will be finalized.

Murray County AHMP Contacts:

Heath Landsman

Emergency Management Director – Murray County

2500 28th Street, Slayton, MN 56172

hlandsman@co.murray.mn.us | 507-836-1186

Maxwell Kaufman

Development Planner – Southwest Regional Development Commission

2401 Broadway Ave, Slayton, MN 56172

maxk@swrdc.org | 507-836-1633

Public Meeting Sign In Sheet

Date: 5/14/18

Time Held: 4:30 to _____

City/ County Location: Sluyton, MN

Purpose: Hazard Mitigation Mtg, #2

PRINT NAME	SIGNATURE	COMMUNITY AFFILIATION
Karen Frisk	<i>Karen Frisk</i>	Avoca city
PAUL THINER	<i>Paul Thiner</i>	Commissioner
Jean Christoffels	<i>Jean M. Christoffels</i>	Murray County Zoning
Gerald Magnus	<i>Gerald Magnus</i>	MC Commissioner
Heath Lindeman	<i>Heath Lindeman</i>	Murray County EM
Lauren Mullenbach	<i>Lauren Mullenbach</i>	SWHHS
Brian Pastma	<i>Brian Pastma</i>	Nobles Cooperative Electric
~~John King Glen Hill~~	~~John King~~	MC Commissioner

Reported by: *[Signature]*
Signature

Agency: SW Reg'l Development Commission

The value of participation by volunteer members of the public is \$26.40/hour.

The Community Affiliation is if the attendee wish to state a public or private organization they are representing or if they are representing themselves.

Flood Mitigation Meeting

9/6/18, Center for Regional Development (2401 Broadway Ave, Slayton, MN 56172)

Attendees: Jean Christoffels, Sarah Soderholm, Craig Christensen, Heath Landsman, Catherine Wegehaupt, Maxwell Kaufman

Notes

- WRAPS: Watershed Restoration & Protection Strategy: Des Moines River Watershed is working on this.
- Next year BWSR funds are available.
- PTM App identifies locations for holding structures.
- SWCD funds are largely conservation programming, restoring wetlands (with willing landowners).
- Area 2: Not Des Moines River Watershed
- Re-establish Bear Lake? All the water in Bear Lake comes from Beaver Creek. Need to figure out Beaver Creek & Lake Shetek.
 - If we can slow the rise of Beaver Creek then we can mitigate flooding.
 - Beaver Creek, ditch north of Beaver Creek (Mason 21), ditch in Lowville.
- Pattern tiling is overloading everything. No one regulates this.
 - No immediate, but ponded water takes longer.
- Inlet in the ditch to meter out the water with an overflow. Box culverts. MnDOT is probably not opposed.
- Unless there's a structural danger, you can't change the floodplain. Can't fill in like Lake Shetek owners want to.
- Is buying land an option?
 - Involve DNR and Pheasants Forever in this. If we can use DNR land as flood retention, it's a win/win. Don't get much for taxes on these anyway.
 - DNR likes wetland restoration in areas with lots of connected land.
- New Mitigation Strategy Ideas:
 - Identify areas where water retention can work.
 - Work with Heron Lake Watershed District to identify holding places through the PTM App.
 - Structures to meter water at roads susceptible to flooding.
 - Hold anything feeding into Lake Shetek & Beaver Creek that are unconnected to Lake Sarah. (Dry dams? Risers on existing culverts? Roadway retention basins? Landowner water retention ponds?)

Public Meeting Sign In Sheet

Date: 9/6/18

Time Held: 1:00 PM to 2:30

City/ County Location: Staleyton, Murray Co. Purpose: Flood Mitigation Meeting

PRINT NAME	SIGNATURE	COMMUNITY AFFILIATION
Jean Christoffels	Jean M. Christoffels	MC Environmental Services
Sarah Sebestolen	Sarah Sebestolen	MC Environmental Services
Craig Christensen	Craig Christensen	Murray SWCD
Kath Landsman	Kath Landsman	Murray County EMD
Catherine Weghaupt	Catherine Weghaupt	Heron Lake Watershed District

Reported by: Max R. P. Agency: SW Reg'l Development Commission
 Signature

The value of participation by volunteer members of the public is \$26.40/hour.

The Community Affiliation is if the attendee wish to state a public or private organization they are representing or if they are representing themselves.

Appendix E - Public Hearing Notices and Notes/Comments

Public Notice

The Murray County Planning Commission will conduct a public hearing on Monday, May 6, 2019, commencing at 7:00 pm, in the County Commissioner's Meeting Room, Murray County Government Center, Slayton, MN, to take public comment on the proposed Murray County All Hazard Mitigation Plan 2019 update.

A copy of the proposed plan update is available for review during normal business hours at the Murray County Auditor's Office, located in the Murray County Government Center, Slayton, MN, and on the Murray County Website - www.murraycountymn.com.

All interested parties are invited to attend. If you are unable to attend, any comments or questions may be submitted in writing by Monday, April 29, 2019, to the Murray County Environmental Services Office – PO Box 57, Slayton, MN 56172, or via email to Jean Christoffels: jchristoffels@co.murray.mn.us.

Murray County Hazard Mitigation Plan
Public Hearing/Review Meeting
May 6, 2019 | 7:00 PM-8:00 PM | Murray County Government Center

Notes

- Heath Landsman: Lake Wilson is in need of generator capacity. It is not currently large enough to run the lagoon system.
- Donald Vogel: Is there a standard height that new houses must be built at? Water was up to the siding on some Lake Shetek homes last summer.
 - Jean Christoffels detailed the height requirements, for which Murray County and Lake Shetek homes are in compliance.
- Comment: Just getting rid of water has downstream consequences.
 - Heath Landsman: Windom and Jackson have spent a lot on flood mitigation.
 - Dave Thiner: Pattern tiling is pushing water quickly into streams/lakes instead of retaining it. We should push for retention.
 - Vern Carlson: This depends on what is considered retention.
 - Comment: Until we can show that retention is more lucrative than tiling, Bear Lake will continue to be farmed.
 - Dave Thiner: Drain lakes in the winter to allow for spring flooding.
 - Heath Landsman: Lake Association has discussed something along these lines with dams that can be adjusted.
- Dave Thiner: The references to no invasive species in Murray County (page 171-172) should be corrected as Murray County has experienced this.
- Dave Thiner: The public health emergency section doesn't mention measles or current vaccination concerns.
 - Max Kaufman: Will update this.
- Dave Thiner: Are outdoor sirens useful anymore due to cell phone usage? They cannot be heard indoors and when they are heard people exit their homes to look at the weather.
 - Heath Landsman: Sirens are meant to warn those outdoors.
 - Vern Carlson: There are residents who don't have cell phones.
- Ron Holinka: Is the plan satisfactory for the concerns of Murray County?
 - Heath Landsman & Max Kaufman: Yes.
- Ron Holinka: Is there a motion to recommend forwarding the plan to HSEM and FEMA once public review has concluded?
 - Motioned, seconded, and carried

* Many comments were submitted in writing to the Murray County Planning and Zoning Office during the public review period (not during the public hearing). Those comments were incorporated into the plan and kept on file.

Hazard Mitigation
Public Meeting Sign In Sheet

Date: 5/6/19

Time Held: 7:00 PM to 8:00 PM

City/ County Location: Shelton, MN

Purpose: Murray County Has MFB Public Hearing

[illegible]

Reported by:

Signature

Agency:

SW Regional Development Commission

The value of participation by volunteer members of the public is \$27.58/hour.

The Community Affiliation is if the attendee wish to state a public or private organization they are representing or if they are representing themselves.

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Appendix F - Completed and Deleted Actions from the 2010 Plan

Figure F-1: Completed and Deleted Mitigation Actions

Hazard	Mitigation Action	Status	Timeframe	Jurisdictions	Responsibility	Murray County Comments	Estimated Cost
Severe Storms	Encourage all residents & public buildings have NOAA Public Alert radios with SAME technology, especially in rural areas away from community sirens.	Complete	2013-2016	Murray County, Avoca, Chandler, Currie, Dovray, Fulda	MCEM, Sch, CiA, CiCh, CiCu, CiD, CiF	CodeRED has been implemented.	Low
Severe Storms	Map location of underground facilities.	Deleted	Ongoing	Murray County	MCEM, MCEO, Utilities	These are available from utility companies upon the Emergency Management Director's request; however, because of the sensitive nature of this information maps are not provided for public reference or planning purposes.	Medium
Severe Storms	Support amateur radio/communications improvements.	Complete	Ongoing	Murray County	MCSO, MCEM, Hosp.		High
Severe Storms	Encourage township road authorities to cut back road ditches and bale where appropriate, which will limit potential for the spreading of wildfire	Complete	Ongoing	Murray County	MCHwy, Twp	This action is required.	Low
Severe Storms	Install & maintain dry hydrants in Lake Shetek Area.	Complete	2013-2016	Murray County	MCEM, MCEO, Fire	Dry hydrants have been installed at the lakes of: Hadley, Lime, Fulda, Fox, Wilson, Sarah, Shetek (2), Bloody, and Buffalo.	Medium

Hazard	Mitigation Action	Status	Timeframe	Jurisdictions	Responsibility	Murray County Comments	Estimated Cost
Flooding/ Dam Failure	Indicate on zoning forms if property is in flood hazard area	Complete	2012	Murray County, Avoca, Chandler, Lake Wilson	MCEO, CiA, CiCh, CiLW		Low
Flooding/ Dam Failure	Encourage all property owners in flood hazard areas to purchase flood insurance	Complete	Ongoing	Avoca, Chandler, Lake Wilson	CiA, CiCh, CiLW	Purchasing flood insurance is required for mortgages for property owners in flood hazard areas.	Low

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Appendix G - Mitigation Actions by Jurisdiction

Figures G-1, G-1M: CPRI\Mitigation Actions for the City of Avoca
Figures G-2, G2M: CPRI\Mitigation Actions for the City of Chandler
Figures G-3, G-3M: CPRI\Mitigation Actions for the City of Currie
Figures G-4, G-4M: CPRI\Mitigation Actions for the City of Dovray
Figures G-5, G-5M: CPRI\Mitigation Actions for the City of Fulda
Figures G-6, G-6M: Mitigation Actions for the City of Hadley
Figures G-7, G-7M: Mitigation Actions for the City of Iona
Figures G-8, G-8M: Mitigation Actions for the City of Lake Wilson
Figures G-9, G-9M: Mitigation Actions for the City of Slayton

Figure G-1: CPRI for the City of Avoca

Avoca Karen Frisk



Type	Threat/ Hazard/ Technological Accident	Probability	Magnitude/ Severity	Warning Time	Duration	Risk Index
Natural Hazards	Flood (Riverine)	3 ~~4~~	1	1	4	0
Natural Hazards	Flash Flood	3	1	4	2	0
Natural Hazards	Dam Failure	4	1	4	4	0
Natural Hazards	Tornado	4	3	3 ~~4~~	~~4~~ 1	0
Natural Hazards	Wildfire	1	3	4	2	0
Natural Hazards	Windstorm	4	4	4	2	0
Natural Hazards	Winter Storm	4	~~4~~	4	3	0
Natural Hazards	Lightning	4	4	4	1	0
Natural Hazards	Hail	4	4	4	1	0
Natural Hazards	Drought	3	4	4	4	0
Natural Hazards	Extreme Heat	4	4	1	4	0
Natural Hazards	Extreme Cold	4	4	1	4	0
Natural Hazards	Erosion	2	4	3	4	0
Natural Hazards	Subsidence	2	4	4	3	0
Natural Hazards	Landslide/Mudslide	2	4	4	3	0
Natural Hazards	Earthquake	1	4	4	1	0

PrD = Property Damage

CrD = Crop Damage

Figure G-1M: Mitigation Actions for the City of Avoca

Action Number	Hazard - Strategy	Mitigation Action	Priority	Status	Time-frame	Jurisdictions	Responsibility	Murray County Comments on Planning Mechanisms for Implementation	Est. Cost/ Source
3	Severe Summer Storms – Structural	Conduct a study to determine what places in the County and each city are deficient in safe rooms; Construct at least one new safe room or improve warning system in one community each year.	Moderate	Revised	2019-2029	Avoca, Chandler, Currie, Fulda, Iona, Lake Wilson, Slayton, Murray County	MCEM, MCSO, MCEO, CiA, CiCh, CiCu, CiF, CiI, CiLW, CiS	Hadley complete. Not applicable to Dovray.	High
12	Wildfire – Prevention	Conduct wildfire risk assessments periodically.	Low	Revised	2019-2024	Avoca, Chandler, Currie, Fulda, Hadley, Murray County	MCSO, CiA, CiCh, CiCu, CiF, CiH, Fire	Small hazard behind Hadley elevator.	Low
13	Wildfire – Prevention	Develop management plans that outline the scheduled maintenance of Conservation properties.	Low	Revised & Deferred	2019-2024	Avoca, Chandler, Currie, Fulda, Murray County	MCO, CiA, CiCh, CiCu, CiF, Fire	Hadley removed – none present.	Low
32	Structure Fires – Awareness	Work with community fire chiefs to educate and encourage residents on the need for having fire alarms and chimney inspections.	Moderate	Revised & In Progress	2019-2024	Murray County, Avoca, Chandler, Currie, Dovray, Fulda, Slayton	MCEM, CiA, CiCh, CiCu, CiD, CiF, CiS, Fire	Hadley removed as it is within Slayton FD. Ongoing with Dovray.	Low
38	Flooding / Dam Failure – Prevention	Discourage future development within floodplains	Moderate	Ongoing	2019-2029	Murray County, Avoca, Chandler, Currie, Iona, Lake Wilson	MCEO, MCHwy, SWCD, CiA, CiCh, CiCu, CiI, CiLW		Low
39	Flooding / Dam Failure – Protection	Encourage sound construction practices and agricultural Best Management Practices (BMPs) in flood fringe areas	Moderate	Ongoing	2019-2024	Murray County, Avoca, Currie, Fulda, Hadley, Iona, Lake Wilson	MCEO, CiA, CiCu, CiF, CiH, CiI, CiLW, HLWD, BWSR		Low

Action Number	Hazard - Strategy	Mitigation Action	Priority	Status	Time-frame	Jurisdictions	Responsibility	Murray County Comments on Planning Mechanisms for Implementation	Est. Cost/ Source
48	Flooding / Dam Failure – Prevention	Build identified water retention structures where feasible.	Moderate	New	2019-2029	Murray County, Cities	MCEO, MCEM, SWCD, Watershed Districts, CiA, CiCh, CiCu, CiD, CiF, CiH, CiI, CiLW, CiS		High
49	Flooding / Dam Failure – Prevention	Work with the DNR to repair the Avoca Dam.	Moderate	New	2019-2029	Murray County, Avoca	MCEO, MCEM, SWCD, Watershed Districts, DNR, CiA		High

Figure G-2: CPRI for the City of Chandler

City of Chandler

Type	Threat/ Hazard/ Technological Accident	Probability	Magnitude/ Severity	Warning Time	Duration	Risk Index
Natural Hazards	Flood (Riverine)	1	1	1	1	0
Natural Hazards	Flash Flood	1	1	1	1	0
Natural Hazards	Dam Failure	1	1	1	1	0
Natural Hazards	Tornado	2	3	1	1	0
Natural Hazards	Wildfire	2	2	2	2	0
Natural Hazards	Windstorm	2	2	2	2	0
Natural Hazards	Winter Storm	4	2	2	3	0
Natural Hazards	Lightning	4	2	4	2	0
Natural Hazards	Hail	3	2	1	1	0
Natural Hazards	Drought	1	2	1	1	0
Natural Hazards	Extreme Heat	2	2	2	2	0
Natural Hazards	Extreme Cold	3	2	2	2	0
Natural Hazards	Erosion	1	1	1	1	0
Natural Hazards	Subsidence	N/A				0
Natural Hazards	Landslide/Mudslide					0
Natural Hazards	Earthquake	1	1	1	1	0

PrD = Property Damage

CrD = Crop Damage

Figure G-2M: Mitigation Actions for the City of Chandler

Action Number	Hazard - Strategy	Mitigation Action	Priority	Status	Time-frame	Jurisdictions	Responsibility	Murray County Comments on Planning Mechanisms for Implementation	Est. Cost/ Source
3	Severe Summer Storms – Structural	Conduct a study to determine what places in the County and each city are deficient in safe rooms; Construct at least one new safe room or improve warning system in one community each year.	Moderate	Revised	2019-2029	Avoca, Chandler, Currie, Fulda, Iona, Lake Wilson, Slayton, Murray County	MCEM, MCSO, MCEO, CiA, CiCh, CiCu, CiF, CiI, CiLW, CiS	Hadley complete. Not applicable to Dovray.	High
4	Severe Summer Storms – Awareness	Educate local schools, nursing homes, hospitals, etc. on importance of doing a “Severe Weather Awareness Week” workshop for their staff, including identifying evacuation routes and safety shelters, etc.	Moderate	Ongoing	2019-2024	Chandler, Fulda, Slayton, Murray County	MCEM, CiCh, CiF, CiS, Sch	MCEM does this through ads and social media.	Low
12	Wildfire – Prevention	Conduct wildfire risk assessments periodically.	Low	Revised	2019-2024	Avoca, Chandler, Currie, Fulda, Hadley, Murray County	MCSO, CiA, CiCh, CiCu, CiF, CiH, Fire	Small hazard behind Hadley elevator.	Low
13	Wildfire – Prevention	Develop management plans that outline the scheduled maintenance of Conservation properties.	Low	Revised & Deferred	2019-2024	Avoca, Chandler, Currie, Fulda, Murray County	MCO, CiA, CiCh, CiCu, CiF, Fire	Hadley removed – none present.	Low

Action Number	Hazard - Strategy	Mitigation Action	Priority	Status	Time-frame	Jurisdictions	Responsibility	Murray County Comments on Planning Mechanisms for Implementation	Est. Cost/ Source
16	Drought – Prevention	Encourage development of ordinances that contain conservation provisions and use restrictions in times of severe drought	Low	Deferred	2019-2024	Chandler, Currie, Dovray, Fulda, Hadley, Lake Wilson, Slayton, Murray County	MCEO, MCEM, CiCh, CiCu, CiD, CiF, CiH, CiLW, CiS, BWSR	In progress for Slayton and Dovray.	Medium
23	Water Supply – Prevention	Update the Emergency Response Plan to identify alternate sources of drinking water, including the location of adequate amounts of bottled water.	Moderate	Deferred	2019-2024	Murray County, Chandler, Currie, Fulda, Hadley, Lake Wilson, Slayton	MCEM, CiCh, CiCu, CiF, CiH, CiLW, CiS, RWS		Low
25	Hazardous Materials – Awareness	Continue to educate county residents, farmers and businesses on the potential impact of hazardous material spills	Moderate	In Progress	2019-2024	Murray County, Chandler, Dovray, Fulda, Lake Wilson, Slayton	MCPZA, MCEM, CiCh, CiD, CiF, CiLW, CiS, MDH, MPCA		Low
32	Structure Fires – Awareness	Work with community fire chiefs to educate and encourage residents on the need for having fire alarms and chimney inspections.	Moderate	Revised & In Progress	2019-2024	Murray County, Avoca, Chandler, Currie, Dovray, Fulda, Slayton	MCEM, CiA, CiCh, CiCu, CiD, CiF, CiS, Fire	Hadley removed as it is within Slayton FD. Ongoing with Dovray.	Low
33	Civil Disturbance – Prevention	Increase security around critical facilities including the addition of fencing, alarm systems and surveillance cameras as appropriate	Moderate	In Progress	2019-2029	Chandler, Currie, Dovray, Hadley, Fulda, Slayton	LE, Sch, CiCh, CiCu, CiD, CiH, CiF, CiS	All county buildings currently have cameras. Hadley has system in municipal building & looking at cameras for parks.	High
38	Flooding / Dam Failure – Prevention	Discourage future development within floodplains	Moderate	Ongoing	2019-2029	Murray County, Avoca, Chandler, Currie, Iona, Lake Wilson	MCEO, MCHwy, SWCD, CiA, CiCh, CiCu, CiL, CiLW		Low

Action Number	Hazard - Strategy	Mitigation Action	Priority	Status	Time-frame	Jurisdictions	Responsibility	Murray County Comments on Planning Mechanisms for Implementation	Est. Cost/ Source
40	Flooding / Dam Failure – Prevention	Improve floodplain maps.	Moderate	In Progress	2019-2024	Murray County, Chandler, Currie, Fulda, Hadley, Iona, Slayton	MCEO, CiCh, CiCu, CiF, CiH, CiI, CiS, HLWD, DNR, FEMA	County is currently working with DNR to do so.	Medium
42	Flooding / Dam Failure – Prevention	Develop a program to voluntarily acquire, relocate or elevate at-risk structures in floodplains	Low	In Progress	2019-2029	Murray County, Chandler	MCEO, CiCh, MCEM, DNR, FEMA	Currently developing a program to acquire/ relocation/elevate at-risk structures. Inventory of structures in floodplain is needed.	High
48	Flooding / Dam Failure – Prevention	Build identified water retention structures where feasible.	Moderate	New	2019-2029	Murray County, Cities	MCEO, MCEM, SWCD, Watershed Districts, CiA, CiCh, CiCu, CiD, CiF, CiH, CiI, CiLW, CiS		High

Figure G-3: CPRI for the City of Currie

City of Currie

Jeb Malone



Type	Threat/ Hazard/ Technological Accident	Probability	Magnitude/ Severity	Warning Time	Duration	Risk Index
Natural Hazards	Flood (Riverine)	3	2	1	4	0
Natural Hazards	Flash Flood	1	2	1	1	0
Natural Hazards	Dam Failure	1	3	4	1	0
Natural Hazards	Tornado	1	4	3	1	0
Natural Hazards	Wildfire	1	2	4	3	0
Natural Hazards	Windstorm	3	2	1	2	0
Natural Hazards	Winter Storm	4	1	1	2	0
Natural Hazards	Lightning	3	1	2	1	0
Natural Hazards	Hail	4	1	0.1	1	0
Natural Hazards	Drought	2	2	1	4	0
Natural Hazards	Extreme Heat	2	2	1	4	0
Natural Hazards	Extreme Cold	3	2	1	4	0
Natural Hazards	Erosion	3	1	1	4	0
Natural Hazards	Subsidence	2	2	4	4	0
Natural Hazards	Landslide/Mudslide	2	2	2	1	0
Natural Hazards	Earthquake	1	4	4	1	0

PrD = Property Damage

CrD = Crop Damage

Figure G-3M: Mitigation Actions for the City of Currie

Action Number	Hazard - Strategy	Mitigation Action	Priority	Status	Time-frame	Jurisdictions	Responsibility	Murray County Comments on Planning Mechanisms for Implementation	Est. Cost/ Source
3	Severe Summer Storms – Structural	Conduct a study to determine what places in the County and each city are deficient in safe rooms; Construct at least one new safe room or improve warning system in one community each year.	Moderate	Revised	2019-2029	Avoca, Chandler, Currie, Fulda, Iona, Lake Wilson, Slayton, Murray County	MCEM, MCSO, MCEO, CiA, CiCh, CiCu, CiF, CiI, CiLW, CiS	Hadley complete. Not applicable to Dovray.	High
6	Severe Summer Storms – Awareness	Increase signage at public campgrounds warning campers of weather risks – i.e. those sites not covered by sirens.	Moderate	Revised	2019-2024	Currie, Fulda, Slayton, Murray County	MCEM, MCPF, SWHHS, CiCu, CiF, CiS	Hadley has no public campgrounds.	Medium
7	Severe Summer Storms – Protection	Ensure that critical facilities have access to back-up power generators.	High	Revised & In Progress	2019-2029	Currie, Fulda, Slayton, Murray County	MCEM, CiCu, CiF, CiS	Murray County Medical Center has a generator. Hadley complete – has access to Slayton's.	Medium
12	Wildfire – Prevention	Conduct wildfire risk assessments periodically.	Low	Revised	2019-2024	Avoca, Chandler, Currie, Fulda, Hadley, Murray County	MCSO, CiA, CiCh, CiCu, CiF, CiH, Fire	Small hazard behind Hadley elevator.	Low
13	Wildfire – Prevention	Develop management plans that outline the scheduled maintenance of Conservation properties.	Low	Revised & Deferred	2019-2024	Avoca, Chandler, Currie, Fulda, Murray County	MCO, CiA, CiCh, CiCu, CiF, Fire	Hadley removed – none present.	Low

Action Number	Hazard - Strategy	Mitigation Action	Priority	Status	Time-frame	Jurisdictions	Responsibility	Murray County Comments on Planning Mechanisms for Implementation	Est. Cost/ Source
16	Drought – Prevention	Encourage development of ordinances that contain conservation provisions and use restrictions in times of severe drought	Low	Deferred	2019-2024	Chandler, Currie, Dovray, Fulda, Hadley, Lake Wilson, Slayton, Murray County	MCEO, MCEM, CiCh, CiCu, CiD, CiF, CiH, CiLW, CiS, BWSR	In progress for Slayton and Dovray.	Medium
18	Public Health – Awareness	Improve coordination and communication with the local media	Moderate	In Progress	2019-2024	Murray County, Currie, Fulda, Slayton	MCEM, SWHHS, CiCu, CiF, CiS, MCSO	Ongoing for Slayton.	Low
23	Water Supply – Prevention	Update the Emergency Response Plan to identify alternate sources of drinking water, including the location of adequate amounts of bottled water.	Moderate	Deferred	2019-2024	Murray County, Chandler, Currie, Fulda, Hadley, Lake Wilson, Slayton	MCEM, CiCh, CiCu, CiF, CiH, CiLW, CiS, RWS		Low
24	Water Supply – Prevention	Review the county water plan for potential groundwater contaminants within the county.	Moderate	<i>Complete, Carried Over</i>	2019-2029	Murray County, Currie, Hadley, Fulda, Lake Wilson, Slayton	MCEO, CiCu, CiH, CiF, CiLW, CiS	This is complete for now, but <u>will need updating eventually</u> .	Medium
26	Hazardous Materials – Awareness	Increase awareness of the county household hazardous waste facility, its importance, and how to utilize its services	Moderate	In Progress	2019-2024	Murray County, Currie, Fulda, Hadley, Lake Wilson, Slayton	MCEO, MCEM, SWCD, CiCu, CiF, CiH, CiLW, CiS	Murray County does a radio spot. Hadley maintains access to recycling facility.	Low
27	Hazardous Materials – Prevention	Develop Geographic Information Systems capability to map locations of fixed facilities using hazardous materials and associated transportation corridors	Moderate	In Progress	2019-2029	Murray County, Currie, Fulda, Hadley, Lake Wilson, Slayton	MCEO, SWCD, CiCu, CiF, CiH, CiLW, CiS, MPCA	Fixed hazmat facilities have been mapped. Transportation corridors need mapping.	Medium

Action Number	Hazard - Strategy	Mitigation Action	Priority	Status	Time-frame	Jurisdictions	Responsibility	Murray County Comments on Planning Mechanisms for Implementation	Est. Cost/ Source
31	Structure Fires – Prevention	Ensure that snow removal ordinances are followed and encourage building construction to include fire/smoke alarms and sprinkler systems.	Moderate	In Progress	2019-2024	Murray County, Currie, Dovray, Fulda, Lake Wilson, Slayton	MCEM, MCEO, CiCu, CiD, CiF, CiLW, CiS, Fire	Dovray is adding this to their ordinances.	Low
32	Structure Fires – Awareness	Work with community fire chiefs to educate and encourage residents on the need for having fire alarms and chimney inspections.	Moderate	Revised & In Progress	2019-2024	Murray County, Avoca, Chandler, Currie, Dovray, Fulda, Slayton	MCEM, CiA, CiCh, CiCu, CiD, CiF, CiS, Fire	Hadley removed as it is within Slayton FD. Ongoing with Dovray.	Low
33	Civil Disturbance – Prevention	Increase security around critical facilities including the addition of fencing, alarm systems and surveillance cameras as appropriate	Moderate	In Progress	2019-2029	Chandler, Currie, Dovray, Hadley, Fulda, Slayton	LE, Sch, CiCh, CiCu, CiD, CiH, CiF, CiS	All county buildings currently have cameras. Hadley has system in municipal building & looking at cameras for parks.	High
34	Civil Disturbance – Emergency Services	Complete and maintain thorough community risk and threat assessments.	Low	In Progress & Ongoing	2019-2024	Murray County, Currie, Hadley, Fulda, Slayton	MCEM, CiCu, CiH, CiF, CiS		Low
38	Flooding / Dam Failure – Prevention	Discourage future development within floodplains	Moderate	Ongoing	2019-2029	Murray County, Avoca, Chandler, Currie, Iona, Lake Wilson	MCEO, MCHwy, SWCD, CiA, CiCh, CiCu, CiL, CiLW		Low
39	Flooding / Dam Failure – Protection	Encourage sound construction practices and agricultural Best Management Practices (BMPs) in flood fringe areas	Moderate	Ongoing	2019-2024	Murray County, Avoca, Currie, Fulda, Hadley, Iona, Lake Wilson	MCEO, CiA, CiCu, CiF, CiH, CiL, CiLW, HLWD, BWSR		Low

Action Number	Hazard - Strategy	Mitigation Action	Priority	Status	Time-frame	Jurisdictions	Responsibility	Murray County Comments on Planning Mechanisms for Implementation	Est. Cost/ Source
40	Flooding / Dam Failure – Prevention	Improve floodplain maps.	Moderate	In Progress	2019-2024	Murray County, Chandler, Currie, Fulda, Hadley, Iona, Slayton	MCEO, CiCh, CiCu, CiF, CiH, CiI, CiS, HLWD, DNR, FEMA	County is currently working with DNR to do so.	Medium
41	Flooding / Dam Failure – Prevention	Jurisdictions not currently participating in the National Flood Insurance Program (NFIP) will review their flood hazard areas and consider participation.	Moderate	In Progress	2019-2024	Currie, Fulda, Hadley, Slayton	DNR, CiCu, CiF, CiH, CiS	Currently working with Hadley and Currie. Fulda and Slayton have been annexed into County Maps.	Medium
48	Flooding / Dam Failure – Prevention	Build identified water retention structures where feasible.	Moderate	New	2019-2029	Murray County, Cities	MCEO, MCEM, SWCD, Watershed Districts, CiA, CiCh, CiCu, CiD, CiF, CiH, CiI, CiLW, CiS		High

Figure G-4: CPRI for the City of Dovray

City of Dovray

Type	Threat/ Hazard/ Technological Accident	Probability	Magnitude/ Severity	Warning Time	Duration	Risk Index
Natural Hazards	Flood (Riverine)	0	0	0	0	0
Natural Hazards	Flash Flood	2	2	3	3	0
Natural Hazards	Dam Failure	0	0	0	0	0
Natural Hazards	Tornado	1	3	4	1	0
Natural Hazards	Wildfire	1	2	4	2	0
Natural Hazards	Windstorm	2	2	2	1	0
Natural Hazards	Winter Storm	3	2	2	2	0
Natural Hazards	Lightning	2	2	4	1.4	0
Natural Hazards	Hail	2	1	4	1	0
Natural Hazards	Drought	1	0	0	4	0
Natural Hazards	Extreme Heat	2	1	1	3	0
Natural Hazards	Extreme Cold	2	1	1	3	0
Natural Hazards	Erosion	1	1	1	1	0
Natural Hazards	Subsidence	0	0	0	0	0
Natural Hazards	Landslide/Mudslide	0	0	0	0	0
Natural Hazards	Earthquake	0	0	0	0	0

PrD = Property Damage

CrD = Crop Damage

Figure G-4M: Mitigation Actions for the City of Dovray

Action Number	Hazard - Strategy	Mitigation Action	Priority	Status	Time-frame	Jurisdictions	Responsibility	Murray County Comments on Planning Mechanisms for Implementation	Est. Cost/ Source
16	Drought – Prevention	Encourage development of ordinances that contain conservation provisions and use restrictions in times of severe drought	Low	Deferred	2019-2024	Chandler, Currie, Dovray, Fulda, Hadley, Lake Wilson, Slayton, Murray County	MCEO, MCEM, CiCh, CiCu, CiD, CiF, CiH, CiLW, CiS, BWSR	In progress for Slayton and Dovray.	Medium
25	Hazardous Materials – Awareness	Continue to educate county residents, farmers and businesses on the potential impact of hazardous material spills	Moderate	In Progress	2019-2024	Murray County, Chandler, Dovray, Fulda, Lake Wilson, Slayton	MCPZA, MCEM, CiCh, CiD, CiF, CiLW, CiS, MDH, MPCA		Low
31	Structure Fires – Prevention	Ensure that snow removal ordinances are followed and encourage building construction to include fire/smoke alarms and sprinkler systems.	Moderate	In Progress	2019-2024	Murray County, Currie, Dovray, Fulda, Lake Wilson, Slayton	MCEM, MCEO, CiCu, CiD, CiF, CiLW, CiS, Fire	Dovray is adding this to their ordinances.	Low
32	Structure Fires – Awareness	Work with community fire chiefs to educate and encourage residents on the need for having fire alarms and chimney inspections.	Moderate	Revised & In Progress	2019-2024	Murray County, Avoca, Chandler, Currie, Dovray, Fulda, Slayton	MCEM, CiA, CiCh, CiCu, CiD, CiF, CiS, Fire	Hadley removed as it is within Slayton FD. Ongoing with Dovray.	Low
33	Civil Disturbance – Prevention	Increase security around critical facilities including the addition of fencing, alarm systems and surveillance cameras as appropriate	Moderate	In Progress	2019-2029	Chandler, Currie, Dovray, Hadley, Fulda, Slayton	LE, Sch, CiCh, CiCu, CiD, CiH, CiF, CiS	All county buildings currently have cameras. Hadley has system in municipal building & looking at cameras for parks.	High

Action Number	Hazard - Strategy	Mitigation Action	Priority	Status	Time-frame	Jurisdictions	Responsibility	Murray County Comments on Planning Mechanisms for Implementation	Est. Cost/ Source
48	Flooding / Dam Failure – Prevention	Build identified water retention structures where feasible.	Moderate	New	2019-2029	Murray County, Cities	MCEO, MCEM, SWCD, Watershed Districts, CiA, CiCh, CiCu, CiD, CiF, CiH, CiI, CiLW, CiS		High
51	Transportation Infrastructure – Prevention	Identify bridges, culverts, and roads that are problem areas and map the hazard areas. Include areas where tile lies under the roadway.	Moderate	New	2019-2024	Murray County, Dovray	MCEM, MCHwy, CiD	Dovray has culvert improvements that are needed.	Low

Figure G-5: CPRI for the City of Fulda

Type	Threat/ Hazard/ Technological Accident	Probability	Magnitude/ Severity	Warning Time	Duration	Risk Index
Natural Hazards	Flood (Riverine)	1	1	1	2	0
Natural Hazards	Flash Flood	2	2	2	2	0
Natural Hazards	Dam Failure	2	2	2	2	0
Natural Hazards	Tornado	2	3	3	4	0
Natural Hazards	Wildfire	1	1	3	1	0
Natural Hazards	Windstorm	3	2	3	2	0
Natural Hazards	Winter Storm	3	3	2	3	0
Natural Hazards	Lightning	2	2	2	3	0
Natural Hazards	Hail	3	2	3	2	0
Natural Hazards	Drought	2	2	1	4	0
Natural Hazards	Extreme Heat	2	2	1	3	0
Natural Hazards	Extreme Cold	2	2	1	3	0
Natural Hazards	Erosion	1	1	1	4	0
Natural Hazards	Subsidence	1	1	1	4	0
Natural Hazards	Landslide/Mudslide	1	1	1	3	0
Natural Hazards	Earthquake	1	1	1	4	0

PrD = Property Damage

CrD = Crop Damage

City of Fulda

Figure G-5M: Mitigation Actions for the City of Fulda

Action Number	Hazard - Strategy	Mitigation Action	Priority	Status	Time-frame	Jurisdictions	Responsibility	Murray County Comments on Planning Mechanisms for Implementation	Est. Cost/ Source
3	Severe Summer Storms – Structural	Conduct a study to determine what places in the County and each city are deficient in safe rooms; Construct at least one new safe room or improve warning system in one community each year.	Moderate	Revised	2019-2029	Avoca, Chandler, Currie, Fulda, Iona, Lake Wilson, Slayton, Murray County	MCEM, MCSO, MCEO, CiA, CiCh, CiCu, CiF, CiI, CiLW, CiS	Hadley complete. Not applicable to Dovray.	High
4	Severe Summer Storms – Awareness	Educate local schools, nursing homes, hospitals, etc. on importance of doing a “Severe Weather Awareness Week” workshop for their staff, including identifying evacuation routes and safety shelters, etc.	Moderate	Ongoing	2019-2024	Chandler, Fulda, Slayton, Murray County	MCEM, CiCh, CiF, CiS, Sch	MCEM does this through ads and social media.	Low
5	Severe Summer Storms – Awareness	Make nursing home staff aware of the need/importance of providing shelter locations and evacuation routes for nursing home residents in case of severe weather.	Moderate	In Progress	2019-2024	Fulda, Slayton, Murray County	MCEM, CiF, CiS		Low
6	Severe Summer Storms – Awareness	Increase signage at public campgrounds warning campers of weather risks – i.e. those sites not covered by sirens.	Moderate	Revised	2019-2024	Currie, Fulda, Slayton, Murray County	MCEM, MCPF, SWHHS, CiCu, CiF, CiS	Hadley has no public campgrounds.	Medium

Action Number	Hazard - Strategy	Mitigation Action	Priority	Status	Time-frame	Jurisdictions	Responsibility	Murray County Comments on Planning Mechanisms for Implementation	Est. Cost/ Source
7	Severe Summer Storms – Protection	Ensure that critical facilities have access to back-up power generators.	High	Revised & In Progress	2019-2029	Currie, Fulda, Slayton, Murray County	MCEM, CiCu, CiF, CiS	Murray County Medical Center has a generator. Hadley complete – has access to Slayton's.	Medium
12	Wildfire – Prevention	Conduct wildfire risk assessments periodically.	Low	Revised	2019-2024	Avoca, Chandler, Currie, Fulda, Hadley, Murray County	MCSO, CiA, CiCh, CiCu, CiF, CiH, Fire	Small hazard behind Hadley elevator.	Low
13	Wildfire – Prevention	Develop management plans that outline the scheduled maintenance of Conservation properties.	Low	Revised & Deferred	2019-2024	Avoca, Chandler, Currie, Fulda, Murray County	MCO, CiA, CiCh, CiCu, CiF, Fire	Hadley removed – none present.	Low
16	Drought – Prevention	Encourage development of ordinances that contain conservation provisions and use restrictions in times of severe drought	Low	Deferred	2019-2024	Chandler, Currie, Dovray, Fulda, Hadley, Lake Wilson, Slayton, Murray County	MCEO, MCEM, CiCh, CiCu, CiD, CiF, CiH, CiLW, CiS, BWSR	In progress for Slayton and Dovray.	Medium
18	Public Health – Awareness	Improve coordination and communication with the local media	Moderate	In Progress	2019-2024	Murray County, Currie, Fulda, Slayton	MCEM, SWHHS, CiCu, CiF, CiS, MCSO	Ongoing for Slayton.	Low
23	Water Supply – Prevention	Update the Emergency Response Plan to identify alternate sources of drinking water, including the location of adequate amounts of bottled water.	Moderate	Deferred	2019-2024	Murray County, Chandler, Currie, Fulda, Hadley, Lake Wilson, Slayton	MCEM, CiCh, CiCu, CiF, CiH, CiLW, CiS, RWS		Low

Action Number	Hazard - Strategy	Mitigation Action	Priority	Status	Time-frame	Jurisdictions	Responsibility	Murray County Comments on Planning Mechanisms for Implementation	Est. Cost/ Source
24	Water Supply – Prevention	Review the county water plan for potential groundwater contaminants within the county.	Moderate	<i>Complete, Carried Over</i>	2019-2029	Murray County, Currie, Hadley, Fulda, Lake Wilson, Slayton	MCEO, CiCu, CiH, CiF, CiLW, CiS	This is complete for now, but <u>will need updating eventually</u> .	Medium
25	Hazardous Materials – Awareness	Continue to educate county residents, farmers and businesses on the potential impact of hazardous material spills	Moderate	In Progress	2019-2024	Murray County, Chandler, Dovray, Fulda, Lake Wilson, Slayton	MCPZA, MCEM, CiCh, CiD, CiF, CiLW, CiS, MDH, MPCA		Low
26	Hazardous Materials – Awareness	Increase awareness of the county household hazardous waste facility, its importance, and how to utilize its services	Moderate	In Progress	2019-2024	Murray County, Currie, Fulda, Hadley, Lake Wilson, Slayton	MCEO, MCEM, SWCD, CiCu, CiF, CiH, CiLW, CiS	Murray County does a radio spot. Hadley maintains access to recycling facility.	Low
27	Hazardous Materials – Prevention	Develop Geographic Information Systems capability to map locations of fixed facilities using hazardous materials and associated transportation corridors	Moderate	In Progress	2019-2029	Murray County, Currie, Fulda, Hadley, Lake Wilson, Slayton	MCEO, SWCD, CiCu, CiF, CiH, CiLW, CiS, MPCA	Fixed hazmat facilities have been mapped. Transportation corridors need mapping.	Medium
31	Structure Fires – Prevention	Ensure that snow removal ordinances are followed and encourage building construction to include fire/smoke alarms and sprinkler systems.	Moderate	In Progress	2019-2024	Murray County, Currie, Dovray, Fulda, Lake Wilson, Slayton	MCEM, MCEO, CiCu, CiD, CiF, CiLW, CiS, Fire	Dovray is adding this to their ordinances.	Low

Action Number	Hazard - Strategy	Mitigation Action	Priority	Status	Time-frame	Jurisdictions	Responsibility	Murray County Comments on Planning Mechanisms for Implementation	Est. Cost/ Source
32	Structure Fires – Awareness	Work with community fire chiefs to educate and encourage residents on the need for having fire alarms and chimney inspections.	Moderate	Revised & In Progress	2019-2024	Murray County, Avoca, Chandler, Currie, Dovray, Fulda, Slayton	MCEM, CiA, CiCh, CiCu, CiD, CiF, CiS, Fire	Hadley removed as it is within Slayton FD. Ongoing with Dovray.	Low
33	Civil Disturbance – Prevention	Increase security around critical facilities including the addition of fencing, alarm systems and surveillance cameras as appropriate	Moderate	In Progress	2019-2029	Chandler, Currie, Dovray, Hadley, Fulda, Slayton	LE, Sch, CiCh, CiCu, CiD, CiH, CiF, CiS	All county buildings currently have cameras. Hadley has system in municipal building & looking at cameras for parks.	High
34	Civil Disturbance – Emergency Services	Complete and maintain thorough community risk and threat assessments.	Low	In Progress & Ongoing	2019-2024	Murray County, Currie, Hadley, Fulda, Slayton	MCEM, CiCu, CiH, CiF, CiS		Low
39	Flooding / Dam Failure – Protection	Encourage sound construction practices and agricultural Best Management Practices (BMPs) in flood fringe areas	Moderate	Ongoing	2019-2024	Murray County, Avoca, Currie, Fulda, Hadley, Iona, Lake Wilson	MCEO, CiA, CiCu, CiF, CiH, CiI, CiLW, HLWD, BWSR		Low
40	Flooding / Dam Failure – Prevention	Improve floodplain maps.	Moderate	In Progress	2019-2024	Murray County, Chandler, Currie, Fulda, Hadley, Iona, Slayton	MCEO, CiCh, CiCu, CiF, CiH, CiI, CiS, HLWD, DNR, FEMA	County is currently working with DNR to do so.	Medium
41	Flooding / Dam Failure – Prevention	Jurisdictions not currently participating in the National Flood Insurance Program (NFIP) will review their flood hazard areas and consider participation.	Moderate	In Progress	2019-2024	Currie, Fulda, Hadley, Slayton	DNR, CiCu, CiF, CiH, CiS	Currently working with Hadley and Currie. Fulda and Slayton have been annexed into County Maps.	Medium

Action Number	Hazard - Strategy	Mitigation Action	Priority	Status	Time-frame	Jurisdictions	Responsibility	Murray County Comments on Planning Mechanisms for Implementation	Est. Cost/ Source
48	Flooding / Dam Failure – Prevention	Build identified water retention structures where feasible.	Moderate	New	2019-2029	Murray County, Cities	MCEO, MCEM, SWCD, Watershed Districts, CiA, CiCh, CiCu, CiD, CiF, CiH, CiI, CiLW, CiS		High

Figure G-6: CPRI for the City of Hadley

Type	Threat/ Hazard/ Technological Accident	Probability	Magnitude/ Severity	Warning Time	Duration	Risk Index
Natural Hazards	Flood (Riverine)	1	1	4	3	0
Natural Hazards	Flash Flood	2	2	3	2	0
Natural Hazards	Dam Failure	2	2	1	3	0
Natural Hazards	Tornado	2	4	4	4	0
Natural Hazards	Wildfire	2	3	4	4	0
Natural Hazards	Windstorm	3	2	4	4	0
Natural Hazards	Winter Storm	3	2	2	3	0
Natural Hazards	Lightning	2	2	4	3	0
Natural Hazards	Hail	3	2	4	4	0
Natural Hazards	Drought	2	2	1	4	0
Natural Hazards	Extreme Heat	3	2	2	3	0
Natural Hazards	Extreme Cold	3	2	2	3	0
Natural Hazards	Erosion	3	2	1	3	0
Natural Hazards	Subsidence					0
Natural Hazards	Landslide/Mudslide	1	1	1	4	0
Natural Hazards	Earthquake	1	4	4	4	0

PrD = Property Damage

CrD = Crop Damage

City
of
Hadley

Figure G-6M: Mitigation Actions for the City of Hadley

Action Number	Hazard - Strategy	Mitigation Action	Priority	Status	Time-frame	Jurisdictions	Responsibility	Murray County Comments on Planning Mechanisms for Implementation	Est. Cost/ Source
12	Wildfire – Prevention	Conduct wildfire risk assessments periodically.	Low	Revised	2019-2024	Avoca, Chandler, Currie, Fulda, Hadley, Murray County	MCISO, CiA, CiCh, CiCu, CiF, CiH, Fire	Small hazard behind Hadley elevator.	Low
16	Drought – Prevention	Encourage development of ordinances that contain conservation provisions and use restrictions in times of severe drought	Low	Deferred	2019-2024	Chandler, Currie, Dovray, Fulda, Hadley, Lake Wilson, Slayton, Murray County	MCEO, MCEM, CiCh, CiCu, CiD, CiF, CiH, CiLW, CiS, BWSR	In progress for Slayton and Dovray.	Medium
21	Public Health – Prevention	Spray standing water areas for mosquito control	Moderate	Ongoing	2019-2029	Fulda, Hadley	CiF, CiH	Hadley sprays streets and parks. Dovray does this.	Medium
23	Water Supply – Prevention	Update the Emergency Response Plan to identify alternate sources of drinking water, including the location of adequate amounts of bottled water.	Moderate	Deferred	2019-2024	Murray County, Chandler, Currie, Fulda, Hadley, Lake Wilson, Slayton	MCEM, CiCh, CiCu, CiF, CiH, CiLW, CiS, RWS		Low
24	Water Supply – Prevention	Review the county water plan for potential groundwater contaminants within the county.	Moderate	<i>Complete, Carried Over</i>	2019-2029	Murray County, Currie, Hadley, Fulda, Lake Wilson, Slayton	MCEO, CiCu, CiH, CiF, CiLW, CiS	This is complete for now, but <u>will need updating eventually</u> .	Medium
26	Hazardous Materials – Awareness	Increase awareness of the county household hazardous waste facility, its importance, and how to utilize its services	Moderate	In Progress	2019-2024	Murray County, Currie, Fulda, Hadley, Lake Wilson, Slayton	MCEO, MCEM, SWCD, CiCu, CiF, CiH, CiLW, CiS	Murray County does a radio spot. Hadley maintains access to recycling facility.	Low

Action Number	Hazard - Strategy	Mitigation Action	Priority	Status	Time-frame	Jurisdictions	Responsibility	Murray County Comments on Planning Mechanisms for Implementation	Est. Cost/ Source
27	Hazardous Materials – Prevention	Develop Geographic Information Systems capability to map locations of fixed facilities using hazardous materials and associated transportation corridors	Moderate	In Progress	2019-2029	Murray County, Currie, Fulda, Hadley, Lake Wilson, Slayton	MCEO, SWCD, CiCu, CiF, CiH, CiLW, CiS, MPCA	Fixed hazmat facilities have been mapped. Transportation corridors need mapping.	Medium
33	Civil Disturbance – Prevention	Increase security around critical facilities including the addition of fencing, alarm systems and surveillance cameras as appropriate	Moderate	In Progress	2019-2029	Chandler, Currie, Dovray, Hadley, Fulda, Slayton	LE, Sch, CiCh, CiCu, CiD, CiH, CiF, CiS	All county buildings currently have cameras. Hadley has system in municipal building & looking at cameras for parks.	High
34	Civil Disturbance – Emergency Services	Complete and maintain thorough community risk and threat assessments.	Low	In Progress & Ongoing	2019-2024	Murray County, Currie, Hadley, Fulda, Slayton	MCEM, CiCu, CiH, CiF, CiS		Low
39	Flooding / Dam Failure – Protection	Encourage sound construction practices and agricultural Best Management Practices (BMPs) in flood fringe areas	Moderate	Ongoing	2019-2024	Murray County, Avoca, Currie, Fulda, Hadley, Iona, Lake Wilson	MCEO, CiA, CiCu, CiF, CiH, CiI, CiLW, HLWD, BWSR		Low
40	Flooding / Dam Failure – Prevention	Improve floodplain maps.	Moderate	In Progress	2019-2024	Murray County, Chandler, Currie, Fulda, Hadley, Iona, Slayton	MCEO, CiCh, CiCu, CiF, CiH, CiI, CiS, HLWD, DNR, FEMA	County is currently working with DNR to do so.	Medium
41	Flooding / Dam Failure – Prevention	Jurisdictions not currently participating in the National Flood Insurance Program (NFIP) will review their flood hazard areas and consider participation.	Moderate	In Progress	2019-2024	Currie, Fulda, Hadley, Slayton	DNR, CiCu, CiF, CiH, CiS	Currently working with Hadley and Currie. Fulda and Slayton have been annexed into County Maps.	Medium

Action Number	Hazard - Strategy	Mitigation Action	Priority	Status	Time-frame	Jurisdictions	Responsibility	Murray County Comments on Planning Mechanisms for Implementation	Est. Cost/ Source
48	Flooding / Dam Failure – Prevention	Build identified water retention structures where feasible.	Moderate	New	2019-2029	Murray County, Cities	MCEO, MCEM, SWCD, Watershed Districts, CiA, CiCh, CiCu, CiD, CiF, CiH, CiI, CiLW, CiS		High

Figure G-7: CPRI for the City of Iona

Photos – IonaCityCPRI.JPG

Type	Threat/ Hazard/ Technological Accident	Probability	Magnitude/ Severity	Warning Time	Duration	Risk Index
Natural Hazards	Flood (Riverine)	1	1	1	1	0
Natural Hazards	Flash Flood	1	1	1	1	0
Natural Hazards	Dam Failure	1	1	1	1	0
Natural Hazards	Tornado	2	3	4	1	0
Natural Hazards	Wildfire	1	1	1	1	0
Natural Hazards	Windstorm	2	1	1	1	0
Natural Hazards	Winter Storm	4	1	1	3	0
Natural Hazards	Lightning	4	1	1	1	0
Natural Hazards	Hail	4	1	1	1	0
Natural Hazards	Drought	2	1	1	4	0
Natural Hazards	Extreme Heat	3	1	2	3	0
Natural Hazards	Extreme Cold	4	1	2	3	0
Natural Hazards	Erosion	1	1	1	1	0
Natural Hazards	Subsidence	1	1	1	1	0
Natural Hazards	Landslide/Mudslide	1	1	1	1	0
Natural Hazards	Earthquake	1	1	1	1	0

PrD = Property Damage

CrD = Crop Damage

Figure G-7M: Mitigation Actions for the City of Iona

Action Number	Hazard - Strategy	Mitigation Action	Priority	Status	Time-frame	Jurisdictions	Responsibility	Murray County Comments on Planning Mechanisms for Implementation	Est. Cost/ Source
3	Severe Summer Storms – Structural	Conduct a study to determine what places in the County and each city are deficient in safe rooms; Construct at least one new safe room or improve warning system in one community each year.	Moderate	Revised	2019-2029	Avoca, Chandler, Currie, Fulda, Iona, Lake Wilson, Slayton, Murray County	MCEM, MCSO, MCEO, CiA, CiCh, CiCu, CiF, CiI, CiLW, CiS	Hadley complete. Not applicable to Dovray.	High
38	Flooding / Dam Failure – Prevention	Discourage future development within floodplains	Moderate	Ongoing	2019-2029	Murray County, Avoca, Chandler, Currie, Iona, Lake Wilson	MCEO, MCHwy, SWCD, CiA, CiCh, CiCu, CiI, CiLW		Low
39	Flooding / Dam Failure – Protection	Encourage sound construction practices and agricultural Best Management Practices (BMPs) in flood fringe areas	Moderate	Ongoing	2019-2024	Murray County, Avoca, Currie, Fulda, Hadley, Iona, Lake Wilson	MCEO, CiA, CiCu, CiF, CiH, CiI, CiLW, HLWD, BWSR		Low
40	Flooding / Dam Failure – Prevention	Improve floodplain maps.	Moderate	In Progress	2019-2024	Murray County, Chandler, Currie, Fulda, Hadley, Iona, Slayton	MCEO, CiCh, CiCu, CiF, CiH, CiI, CiS, HLWD, DNR, FEMA	County is currently working with DNR to do so.	Medium
48	Flooding / Dam Failure – Prevention	Build identified water retention structures where feasible.	Moderate	New	2019-2029	Murray County, Cities	MCEO, MCEM, SWCD, Watershed Districts, CiA, CiCh, CiCu, CiD, CiF, CiH, CiI, CiLW, CiS		High

Figure G-8: CPRI for the City of Lake Wilson



City of Lake Wilson

Type	Threat/ Hazard/ Technological Accident	Probability	Magnitude/ Severity	Warning Time	Duration	Risk Index
Natural Hazards	Flood (Riverine)	2	2	3	3	0
Natural Hazards	Flash Flood	2	2	3	3	0
Natural Hazards	Dam Failure	1	1	4	2	0
Natural Hazards	Tornado	2	2	4	1	0
Natural Hazards	Wildfire	2	2	3	3	0
Natural Hazards	Windstorm	1	2	2	2	0
Natural Hazards	Winter Storm	2	2	1	3	0
Natural Hazards	Lightning	2	1	4	1	0
Natural Hazards	Hail	2	1	4	1	0
Natural Hazards	Drought	2	1	1	4	0
Natural Hazards	Extreme Heat	1	1	1	3	0
Natural Hazards	Extreme Cold	2	1	1	3	0
Natural Hazards	Erosion	2	1	2	4	0
Natural Hazards	Subsidence	1	1	4	1	0
Natural Hazards	Landslide/Mudslide	1	1	2	1	0
Natural Hazards	Earthquake	1	1	4	1	0

PrD = Property Damage

CrD = Crop Damage

Figure G-8M: Mitigation Actions for the City of Lake Wilson

Action Number	Hazard - Strategy	Mitigation Action	Priority	Status	Time-frame	Jurisdictions	Responsibility	Murray County Comments on Planning Mechanisms for Implementation	Est. Cost/ Source
3	Severe Summer Storms – Structural	Conduct a study to determine what places in the County and each city are deficient in safe rooms; Construct at least one new safe room or improve warning system in one community each year.	Moderate	Revised	2019-2029	Avoca, Chandler, Currie, Fulda, Iona, Lake Wilson, Slayton, Murray County	MCEM, MCSO, MCEO, CiA, CiCh, CiCu, CiF, CiI, CiLW, CiS	Hadley complete. Not applicable to Dovray.	High
16	Drought – Prevention	Encourage development of ordinances that contain conservation provisions and use restrictions in times of severe drought	Low	Deferred	2019-2024	Chandler, Currie, Dovray, Fulda, Hadley, Lake Wilson, Slayton, Murray County	MCEO, MCEM, CiCh, CiCu, CiD, CiF, CiH, CiLW, CiS, BWSR	In progress for Slayton and Dovray.	Medium
23	Water Supply – Prevention	Update the Emergency Response Plan to identify alternate sources of drinking water, including the location of adequate amounts of bottled water.	Moderate	Deferred	2019-2024	Murray County, Chandler, Currie, Fulda, Hadley, Lake Wilson, Slayton	MCEM, CiCh, CiCu, CiF, CiH, CiLW, CiS, RWS		Low
24	Water Supply – Prevention	Review the county water plan for potential groundwater contaminants within the county.	Moderate	<i>Complete, Carried Over</i>	2019-2029	Murray County, Currie, Hadley, Fulda, Lake Wilson, Slayton	MCEO, CiCu, CiH, CiF, CiLW, CiS	This is complete for now, but <u>will need updating eventually</u> .	Medium

Action Number	Hazard - Strategy	Mitigation Action	Priority	Status	Time-frame	Jurisdictions	Responsibility	Murray County Comments on Planning Mechanisms for Implementation	Est. Cost/ Source
25	Hazardous Materials – Awareness	Continue to educate county residents, farmers and businesses on the potential impact of hazardous material spills	Moderate	In Progress	2019-2024	Murray County, Chandler, Dovray, Fulda, Lake Wilson, Slayton	MCPZA, MCEM, CiCh, CiD, CiF, CiLW, CiS, MDH, MPCA		Low
26	Hazardous Materials – Awareness	Increase awareness of the county household hazardous waste facility, its importance, and how to utilize its services	Moderate	In Progress	2019-2024	Murray County, Currie, Fulda, Hadley, Lake Wilson, Slayton	MCEO, MCEM, SWCD, CiCu, CiF, CiH, CiLW, CiS	Murray County does a radio spot. Hadley maintains access to recycling facility.	Low
27	Hazardous Materials – Prevention	Develop Geographic Information Systems capability to map locations of fixed facilities using hazardous materials and associated transportation corridors	Moderate	In Progress	2019-2029	Murray County, Currie, Fulda, Hadley, Lake Wilson, Slayton	MCEO, SWCD, CiCu, CiF, CiH, CiLW, CiS, MPCA	Fixed hazmat facilities have been mapped. Transportation corridors need mapping.	Medium
31	Structure Fires – Prevention	Ensure that snow removal ordinances are followed and encourage building construction to include fire/smoke alarms and sprinkler systems.	Moderate	In Progress	2019-2024	Murray County, Currie, Dovray, Fulda, Lake Wilson, Slayton	MCEM, MCEO, CiCu, CiD, CiF, CiLW, CiS, Fire	Dovray is adding this to their ordinances.	Low
38	Flooding / Dam Failure – Prevention	Discourage future development within floodplains	Moderate	Ongoing	2019-2029	Murray County, Avoca, Chandler, Currie, Iona, Lake Wilson	MCEO, MCHwy, SWCD, CiA, CiCh, CiCu, CiL, CiLW		Low
39	Flooding / Dam Failure – Protection	Encourage sound construction practices and agricultural Best Management Practices (BMPs) in flood fringe areas	Moderate	Ongoing	2019-2024	Murray County, Avoca, Currie, Fulda, Hadley, Iona, Lake Wilson	MCEO, CiA, CiCu, CiF, CiH, CiL, CiLW, HLWD, BWSR		Low

Action Number	Hazard - Strategy	Mitigation Action	Priority	Status	Time-frame	Jurisdictions	Responsibility	Murray County Comments on Planning Mechanisms for Implementation	Est. Cost/ Source
48	Flooding / Dam Failure – Prevention	Build identified water retention structures where feasible.	Moderate	New	2019-2029	Murray County, Cities	MCEO, MCEM, SWCD, Watershed Districts, CiA, CiCh, CiCu, CiD, CiF, CiH, CiI, CiLW, CiS		High

Figure G-9: CPRI for the City of Slayton

City of Slayton *1/23/2019* *for Malchow*

Type	Threat/ Hazard/ Technological Accident	Probability	Magnitude/ Severity	Warning Time	Duration	Risk Index
Natural Hazards	Flood (Riverine)	3	2	2	3	0
Natural Hazards	Flash Flood	2	2	2	3	0
Natural Hazards	Dam Failure	1	1	1	1	0
Natural Hazards	Tornado	2	2	4	4	0
Natural Hazards	Wildfire	1	1	1	1	0
Natural Hazards	Windstorm	2	2	2	2	0
Natural Hazards	Winter Storm	4	1	2	2	0
Natural Hazards	Lightning	4	1	2	2	0
Natural Hazards	Hail	4	1	2	2	0
Natural Hazards	Drought	1	1	1	3	0
Natural Hazards	Extreme Heat	2	1	2	2	0
Natural Hazards	Extreme Cold	4	1	2	2	0
Natural Hazards	Erosion	1	1	1	1	0
Natural Hazards	Subsidence	1	1	1	1	0
Natural Hazards	Landslide/Mudslide	1	1	1	1	0
Natural Hazards	Earthquake	1	1	1	1	0

PrD = Property Damage

CrD = Crop Damage

Figure G-9M: Mitigation Actions for the City of Slayton

Action Number	Hazard - Strategy	Mitigation Action	Priority	Status	Time-frame	Jurisdictions	Responsibility	Murray County Comments on Planning Mechanisms for Implementation	Est. Cost/ Source
3	Severe Summer Storms – Structural	Conduct a study to determine what places in the County and each city are deficient in safe rooms; Construct at least one new safe room or improve warning system in one community each year.	Moderate	Revised	2019-2029	Avoca, Chandler, Currie, Fulda, Iona, Lake Wilson, Slayton, Murray County	MCEM, MCSO, MCEO, CiA, CiCh, CiCu, CiF, CiI, CiLW, CiS	Hadley complete. Not applicable to Dovray.	High
4	Severe Summer Storms – Awareness	Educate local schools, nursing homes, hospitals, etc. on importance of doing a “Severe Weather Awareness Week” workshop for their staff, including identifying evacuation routes and safety shelters, etc.	Moderate	Ongoing	2019-2024	Chandler, Fulda, Slayton, Murray County	MCEM, CiCh, CiF, CiS, Sch	MCEM does this through ads and social media.	Low
5	Severe Summer Storms – Awareness	Make nursing home staff aware of the need/importance of providing shelter locations and evacuation routes for nursing home residents in case of severe weather.	Moderate	In Progress	2019-2024	Fulda, Slayton, Murray County	MCEM, CiF, CiS		Low
6	Severe Summer Storms – Awareness	Increase signage at public campgrounds warning campers of weather risks – i.e. those sites not covered by sirens.	Moderate	Revised	2019-2024	Currie, Fulda, Slayton, Murray County	MCEM, MCPF, SWHHS, CiCu, CiF, CiS	Hadley has no public campgrounds.	Medium

Action Number	Hazard - Strategy	Mitigation Action	Priority	Status	Time-frame	Jurisdictions	Responsibility	Murray County Comments on Planning Mechanisms for Implementation	Est. Cost/ Source
7	Severe Summer Storms – Protection	Ensure that critical facilities have access to back-up power generators.	High	Revised & In Progress	2019-2029	Currie, Fulda, Slayton, Murray County	MCEM, CiCu, CiF, CiS	Murray County Medical Center has a generator. Hadley complete – has access to Slayton's.	Medium
15	Drought – Prevention	Work with the Minnesota Department of Health to develop & implement Wellhead Protection Plans	Moderate	Revised & In Progress	2019-2024	Slayton, Murray County	MCEO, SWCD, CiS, MDH	Complete for Chandler, Currie, Fulda, Hadley, & Lake Wilson.	Medium
16	Drought – Prevention	Encourage development of ordinances that contain conservation provisions and use restrictions in times of severe drought	Low	Deferred	2019-2024	Chandler, Currie, Dovray, Fulda, Hadley, Lake Wilson, Slayton, Murray County	MCEO, MCEM, CiCh, CiCu, CiD, CiF, CiH, CiLW, CiS, BWSR	In progress for Slayton and Dovray.	Medium
18	Public Health – Awareness	Improve coordination and communication with the local media	Moderate	In Progress	2019-2024	Murray County, Currie, Fulda, Slayton	MCEM, SWHHS, CiCu, CiF, CiS, MCSO	Ongoing for Slayton.	Low
23	Water Supply – Prevention	Update the Emergency Response Plan to identify alternate sources of drinking water, including the location of adequate amounts of bottled water.	Moderate	Deferred	2019-2024	Murray County, Chandler, Currie, Fulda, Hadley, Lake Wilson, Slayton	MCEM, CiCh, CiCu, CiF, CiH, CiLW, CiS, RWS		Low
24	Water Supply – Prevention	Review the county water plan for potential groundwater contaminants within the county.	Moderate	Complete, Carried Over	2019-2029	Murray County, Currie, Hadley, Fulda, Lake Wilson, Slayton	MCEO, CiCu, CiH, CiF, CiLW, CiS	This is complete for now, but <u>will need updating eventually.</u>	Medium

Action Number	Hazard - Strategy	Mitigation Action	Priority	Status	Time-frame	Jurisdictions	Responsibility	Murray County Comments on Planning Mechanisms for Implementation	Est. Cost/ Source
25	Hazardous Materials – Awareness	Continue to educate county residents, farmers and businesses on the potential impact of hazardous material spills	Moderate	In Progress	2019-2024	Murray County, Chandler, Dovray, Fulda, Lake Wilson, Slayton	MCPZA, MCEM, CiCh, CiD, CiF, CiLW, CiS, MDH, MPCA		Low
26	Hazardous Materials – Awareness	Increase awareness of the county household hazardous waste facility, its importance, and how to utilize its services	Moderate	In Progress	2019-2024	Murray County, Currie, Fulda, Hadley, Lake Wilson, Slayton	MCEO, MCEM, SWCD, CiCu, CiF, CiH, CiLW, CiS	Murray County does a radio spot. Hadley maintains access to recycling facility.	Low
27	Hazardous Materials – Prevention	Develop Geographic Information Systems capability to map locations of fixed facilities using hazardous materials and associated transportation corridors	Moderate	In Progress	2019-2029	Murray County, Currie, Fulda, Hadley, Lake Wilson, Slayton	MCEO, SWCD, CiCu, CiF, CiH, CiLW, CiS, MPCA	Fixed hazmat facilities have been mapped. Transportation corridors need mapping.	Medium
30	Hazardous Materials – Prevention	County, townships and cities with airports review airport improvement plans and zoning.	Low	In Progress	2019-2024	Murray County, Slayton	MCEO, CiS, Twp, MnDOT	County ordinances being updated to review this.	Medium
31	Structure Fires – Prevention	Ensure that snow removal ordinances are followed and encourage building construction to include fire/smoke alarms and sprinkler systems.	Moderate	In Progress	2019-2024	Murray County, Currie, Dovray, Fulda, Lake Wilson, Slayton	MCEM, MCEO, CiCu, CiD, CiF, CiLW, CiS, Fire	Dovray is adding this to their ordinances.	Low

Action Number	Hazard - Strategy	Mitigation Action	Priority	Status	Time-frame	Jurisdictions	Responsibility	Murray County Comments on Planning Mechanisms for Implementation	Est. Cost/ Source
32	Structure Fires – Awareness	Work with community fire chiefs to educate and encourage residents on the need for having fire alarms and chimney inspections.	Moderate	Revised & In Progress	2019-2024	Murray County, Avoca, Chandler, Currie, Dovray, Fulda, Slayton	MCEM, CiA, CiCh, CiCu, CiD, CiF, CiS, Fire	Hadley removed as it is within Slayton FD. Ongoing with Dovray.	Low
33	Civil Disturbance – Prevention	Increase security around critical facilities including the addition of fencing, alarm systems and surveillance cameras as appropriate	Moderate	In Progress	2019-2029	Chandler, Currie, Dovray, Hadley, Fulda, Slayton	LE, Sch, CiCh, CiCu, CiD, CiH, CiF, CiS	All county buildings currently have cameras. Hadley has system in municipal building & looking at cameras for parks.	High
34	Civil Disturbance – Emergency Services	Complete and maintain thorough community risk and threat assessments.	Low	In Progress & Ongoing	2019-2024	Murray County, Currie, Hadley, Fulda, Slayton	MCEM, CiCu, CiH, CiF, CiS		Low
40	Flooding / Dam Failure – Prevention	Improve floodplain maps.	Moderate	In Progress	2019-2024	Murray County, Chandler, Currie, Fulda, Hadley, Iona, Slayton	MCEO, CiCh, CiCu, CiF, CiH, CiI, CiS, HLWD, DNR, FEMA	County is currently working with DNR to do so.	Medium
41	Flooding / Dam Failure – Prevention	Jurisdictions not currently participating in the National Flood Insurance Program (NFIP) will review their flood hazard areas and consider participation.	Moderate	In Progress	2019-2024	Currie, Fulda, Hadley, Slayton	DNR, CiCu, CiF, CiH, CiS	Currently working with Hadley and Currie. Fulda and Slayton have been annexed into County Maps.	Medium
48	Flooding / Dam Failure – Prevention	Build identified water retention structures where feasible.	Moderate	New	2019-2029	Murray County, Cities	MCEO, MCEM, SWCD, Watershed Districts, CiA, CiCh, CiCu, CiD, CiF, CiH, CiI, CiLW, CiS		High

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