

Cass County Multi-Jurisdictional, Multi-Hazard Mitigation Plan

2014



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EXECUTIVE SUMMARY

Cass County officials recognize the threat of natural hazards within Cass County, North Dakota, and these officials are committed to mitigating the effects of such hazards. To this end, numerous stakeholders in Cass County and several of the county's communities have prepared this 2014 Cass County MultiJurisdictional, Multi-Hazard Mitigation Plan.

Cass County has limited the scope of this multi-jurisdictional plan to natural hazards. Hazards profiled include dam failure, drought, flood, severe summer storm, severe winter weather, urban fire, wildland fire and geologic hazards.

The focal outcome of the process used to develop the 2014 Cass County Multi-Jurisdictional, Multi-Hazard Mitigation Plan is an outline of goals, objectives and action items as they relate to mitigation. The seven overarching goals identified through this planning process include:

- Goal 1: Encourage County and local planning related to hazard understanding and mitigation
- Goal 2: Enhance the public's awareness of hazards
- Goal 3: Reduce the impact future development has on potential losses and vulnerabilities
- Goal 4: Reduce impacts of flooding and geotechnical hazards to people and property in Cass County
- Goal 5: Mitigate the effects severe summer and winter weather has on people and property
- Goal 6: Mitigate the effects strong winds have on people and property
- Goal 7: Reduce impacts of drought and wildland fires on Cass County communities

SECTION I: INTRODUCTION

Cass County officials recognize the threat that natural hazards pose to people and property within Cass County, North Dakota. Cass County has experienced seventeen Presidential Disaster Declarations since 1989 reinforcing the importance of planning and coordinating among multiple agencies. Together, stakeholders of Cass County agencies and the county's communities have developed this 2014 Cass County Multi-Jurisdictional, Multi-Hazard Mitigation Plan, hereafter referred to as "this Plan".

Purpose

This Plan represents a coordinated effort and ongoing commitment to mitigate the potential impacts of hazards that continue to be experienced in Cass County. In the wake of recent events there is a renewed commitment to maintaining this Multi-Hazard Mitigation Plan that was first adopted on May 21, 2001. This plan is an update to the Cass County Multi-Jurisdictional, Multi-Hazard Mitigation Plan approved in January of 2009.

The resources and information within the mitigation plan establish a foundation for coordination and collaboration among agencies and the public in Cass County, identify and prioritize future mitigation projects, and assist in meeting qualifications for federal assistance programs. This Plan works in conjunction with other county plans, including the local and county comprehensive plans and emergency operations plans. This Plan offers mitigation strategies for coordination among all the county's plans.

Scope

The scope of this Plan is countywide. It is the goal of this Plan to analyze all local jurisdictions within the county as well as unincorporated area's vulnerabilities and capacity in responding to natural disasters. Jurisdictions analyzed include Alice, Amenia, Argusville, Arthur, Ayr, Briarwood, Buffalo, Casselton, Daveport, Enderlin, Fargo, Frontier, Gardner, Grandin, Harwood, Horace, Hunter, Kindred, Leonard, Mapleton, North River, Oxbow, Page, Prairie Rose, Reile's Acres, Tower City and West Fargo. This Plan also identifies mitigation actions to improve the outlook for individual jurisdictions and the entire county regarding the impact of natural hazards.

Laws and Authorities

This Plan has been developed in accordance with the Disaster Mitigation Act of 2000, Public Law 106-390. The Disaster Mitigation Act of 2000 provides the legal basis for mitigation planning requirements as a condition of mitigation grant assistance. The Disaster Mitigation Act of 2000 also established a new requirement for local mitigation plans, hereby providing guidance to the planning process in the development of this Plan.

Nothing in this Plan supersedes or contradicts the Disaster Mitigation Act of 2000 or any other Federal, State or Local laws.

Administration and Maintenance

The planning process implemented during development of this Plan, details of the steering team and plan stakeholders, and involvement of the public and each participating group is outlined in Section Two. The strategy for adoption and plan maintenance and a sample resolution are also included in Section Two. Executed resolutions for all jurisdictions can be found in **Appendix B**.

Plan Structure and Contents

This Plan is organized into six sections beginning with this introduction which outlines the plan's purpose, scope, laws and authorities, and details of plan administration and maintenance.

Section Three of this Plan gives the reader a brief overview of Cass County including its people, natural features, land use and transportation infrastructure. All of these factors influence the risk assessment provided in Section Four.

The most significant information gathered and deduced during the planning process is presented in sections four through six.

Section Four includes a discussion of natural hazards most likely to affect Cass County including dam failure, drought, flood, severe summer storm, severe winter weather, urban fire, wildland fire and geologic hazards. Each hazard is further broken down into subcategories of description, location, extent, previous occurrences, probability of future events and the designation of a risk class. Location describes the geographic areas within the planning area that are affected by each hazard. For several identified hazards in the County, all locations have an equal chance of being effected. Therefore, location information is most relevant when considering dam failure, flood and geologic hazards. Extent is the strength or magnitude of the hazard. Although extent defines the characteristics of the hazard regardless of its effect on people and the built environment, potential impacts that refer to these effects are also included in this section. Previous

occurrences describe historic incidences with the natural hazards. These occurrences have been compiled from national, state and local data sources therefore detail may vary. Probability of future events is a compilation of statistical data based on past events and trends and experiences of local officials knowledgeable of the subject matter. The risk classes defined in the previous version of the plan were also reevaluated and included in this section. The risk class rating system used ranges from A to D with A being the greatest risk. The steering committee thoroughly discussed the ratings identified for the 2009 plan and adjusted the flood risk. Below please find a brief description of each risk class.

- A High risk condition, highest priority for mitigation and contingency planning
- B Moderate to high risk condition, sufficiently high to give consideration for further mitigation
- C Low to moderate risk condition, sufficiently high to give some consideration for further mitigation
- D Low risk condition, not given a great deal of planning consideration

HAZUS was utilized for the flood risk assessment and a similar model was used to assess a possible tornado scenario. Outputs derived from extensive local data being entered into the model can be found in **Appendix D**. HAZUS was also run using default FEMA data; however, due to the level of detail added in from local data the default outputs are not included in this plan. The full default report can be provided upon request. An interactive map including the damage estimates for 100-year flood event can be accessed at <http://cityoffargond.maps.arcgis.com/home/webmap/viewer.html?webmap=863c4078f19b47ec9b86df6f8e371b65>.

Section five includes a detail of the long range goals and objectives of the County in regards to mitigation. These goals and objectives closely align with the state of North Dakota objectives and contain several ongoing efforts. **Appendix C** contains detail regarding specific mitigation projects since the previous plan as well as narrative explaining the progress, continuation or removal of previously identified goals, objectives and action items.

Section Six contains all of the action items identified by the County as well as individual action items for each jurisdiction. Priority was requested from each jurisdiction providing action items which was reviewed by the steering committee to ensure consistency. Hazards are described in fairly broad terms in Section Four; therefor, Section Six also narrows the focus to each jurisdictions unique vulnerabilities and capacity for carrying out projects before describing mitigation actions.

SECTION II: PLANNING PROCESS

Representatives from the City of Fargo, County offices, Fargo Cass Public Health and Cass water resource districts comprise the steering committee tasked with development of this Plan. In an effort to maintain continuity, some members of the committee have been involved in the mitigation planning process since the development of the 2009 plan. In recognizing the value of a fresh perspective, new members have also been included. **Table 2.1** contains a brief description of all steering committee members and **Table 2.2** is an attendance record of all steering committee meetings. In response to the subject matter being covered, additional persons were invited to some meetings as reflected in the attendance table. Many County representatives work extensively with rural Cass County and thus had insights into needs in the unincorporated county and smaller jurisdictions. The significant flood risk faced by Cass County made a representative from the water resources districts invaluable when discussing large scale water related projects. These entities have been integrally involved in previous studies and are responsible for water management, drainage and flood control issues. Buy in from these districts significantly increases the likelihood of concepts from this plan being incorporated into future studies, projects and regulation.

Table 2.1 Steering Committee

Name	Position	Agency Represented
*Kay Anderson	GIS Coordinator	Cass County
*Jason Benson	Cass County Engineer	Cass County
*Nathan Boerboom	Division Engineer	City of Fargo
*Hali Durand	County Planner	Cass County
*Kurt Lysne	PE, Moore Engineering	Cass Water Resource Districts
*Daryl Masten	GIS Manager	City of Fargo
*Doug Murphy	Emergency Preparedness Coordinator	Fargo Cass Public Health
*Mike Reitan	Assistant Police Chief/Emergency Manager	City of West Fargo
*Dave Rogness	Emergency Manager	Cass County
*Leon Schlafmann	Emergency Manager	City of Fargo
*Brady Scribner	SNS/CRI Coordinator	Fargo Cass Public Health
*Tim Solberg	County Planner/West Fargo Planner	Cass County/City of West Fargo
*April Walker	City Engineer	City of Fargo
Josh Hassell	Moore Engineering (sitting in for Lysne)	Cass Water Resource Districts
Dave Kirkpatrick	GIS Specialist , Houston Engineering	Consultant
Sean, O'Brien	GIS Technician , Houston Engineering	Consultant
Wayne Lorshbough	GIS Specialist	City of Fargo
Dan Mahli	Senior Planner	City of Fargo
Brielle Edwards	Administrative Assistant	Cass Fargo EM
Amber Schaan	Lake Agassiz Regional Council	Consultant

**Core Committee Members*

Table 2.2 Steering Committee Meeting Attendance

Name	12/4/12	1/9/13	2/6/13	3/6/13	6/5/13	8/7/13	9/4/13	10/16/13	11/20/13
Kay Anderson	X	X	X	X	X	X	X	X	X
Jason Benson	X		X	X	X				X
Nathan Boerboom	X	X		X	X	X		X	X
Kurt Lysne			X	X	X	X	X	X	
Daryl Masten	X	X							X
Doug Murphy	X	X	X	X	X	X	X	X	X
Mike Reitan				X	X		X	X	
Dave Rogness	X	X	X	X	X	X	X		X
Leon Schlafmann	X	X		X	X	X	X	X	
Brady Scribner	X	X	X	X		X	X	X	X
Tim Solberg	X	X	X	X	X			X	
April Walker		X	X	X		X	X		
Hali Durand							X	X	
Josh Hassell		X							
Dave Kirkpatrick						X			X
Sean, O'Brien									X
Wayne Lorshbough						X	X	X	
Dan Mahli								X	X
Brielle Edwards	X	X	X		X	X	X	X	X
Amber Schaan	X	X	X	X	X	X	X	X	X

The mitigation planning process began with a commitment from Cass County jurisdictions to participate in an upcoming planning process prior to the Cass County planning grant application. Copies of those commitment letters are included in **Appendix A**. Introductory meetings were held in Fargo and Casselton. Notification for these meetings was published in the Fargo Forum. Email invitations were also sent to all local jurisdictions mayors, auditors and other interested parties. A copy of the notice follows as **Figure 3.1**.

Figure 2.1 Notice of Public Meeting

Notice of Public Meeting

Cass Fargo Emergency Management is beginning an update of its Multi-Hazard Mitigation Plan to remain in compliance with the Federal Emergency Management Agency (FEMA). To kick off the planning process two public meetings will be held to describe the plan and update process as well as gathering public input on past performance of mitigation activities and a strategy for moving forward.

The location and meeting times are as follows:

Tuesday, January 8th at 4:30pm at the Cass County Public Safety Building,
4630 15th Avenue North, Fargo, ND.

Thursday, January 10th at 7:30pm in the Casselton Auditorium (City Hall)
702 1st Street North, Casselton, ND.

Please call 701-235-1197, should special accommodations be required.

The planning process was mentioned at several other local meetings where stakeholders were present; they were encouraged to visit the website often, complete a survey, and welcomed to become more involved in the process if they had an interest in the plan. Flyers with general information about the mitigation plan and planning process were handed out to attendees of these meetings; an example is attached as **Figure 2.2**. The Committee felt it would be beneficial to engage stakeholders at meetings where they were already present. Members of the steering committee or consultants working on the plan attended many of these meetings including the Cass County Township Officers Association Meeting on November 29, 2012, the Cass County Local Emergency Planning Committee (LEPC) Meeting on January 28, 2012, the Cass County Rural Fire District meeting on January 9, 2013, several city council meetings including West Fargo, Fargo, Mapleton and Hunter and rural water resource district meetings. Informing township officers at their meeting at the onset of the planning process was very important as they are not jurisdictions in this plan; however, in North Dakota they have significant planning and zoning authority. Dave Rogness is also a member of the local Breakfast Club group, a local stakeholders group that meets quarterly. He provided the planning process status throughout 2013 at meetings on March 12th, June 6th, September 9th and December 3rd also allowing for further input by anyone in attendance. A list of Breakfast Club members is included in **Appendix A**. A general list of identified stakeholder groups can be found in **Table 2.3**. A concerted effort was made to contact regulatory agencies during the planning process. Care will also be taken to maintain availability of the plan for other agency use and collect any feedback they may have during this five year planning cycle.

Meetings were not held in each participating jurisdiction; however, the importance of including all participating jurisdictions in the planning process was not overlooked. After the initial commitments to participate and introductory meetings, the steering committee made a commitment to keeping all jurisdictions informed and allowing them avenues to provide feedback at their convenience. An introductory letter was sent to each jurisdiction once again reminding them of the planning process as well as introducing Schaan who could be contacting them for additional information. Contact information was included. A website and survey were developed and linked to the Cass County Emergency Management page where meeting agendas and minutes were posted throughout the planning process as well as contact information for both Rogness and Schaan. **Figure 2.3** shows a screen shot of the website. Meeting agendas and minutes

continue to be posted to this site as will the final approved document. Please see <https://www.casscountynd.gov/county/depts/EM/HazardMitigation/Pages/default.aspx>. **Figure 2.4** is a copy of the survey questions. A summary of all survey responses can be found in **Appendix A**. Survey respondents were targeted via email including all city mayors and auditors as well as those providing engineering services to participating jurisdictions. Care was taken to follow up with individual jurisdictions to gather the most accurate and appropriate information. Schaan conducted several phone and in person interviews as well as exchanged emails with a number of knowledgeable local sources. A list of contacts and types of correspondence is also included in **Appendix A**.

Figure 2.2 Plan Information for the Public



CASS COUNTY MULTI-HAZARD MITIGATION PLAN UPDATE

Cass County is in the process of completing a Multi-Hazard Mitigation Plan Update as the current plan will expire in January of 2014. A County Steering Committee has been identified to lead the planning process and Lake Agassiz Regional Council has been contracted with to facilitate the update. Existing groups and local entities will be contacted throughout the process to provide insight for a future mitigation strategy.

WHAT IS HAZARD MITIGATION?

“Hazard Mitigation” means to permanently reduce or alleviate the losses of life, injuries and property resulting from natural and man-made hazards through long-term strategies. These long-term strategies include planning, policy changes, programs, projects and other activities. Mitigation is the responsibility of individuals, private businesses and industries, state local and federal governments.

WHAT IS REQUIRED OF MY COMMUNITY?

Counties, cities and towns are not mandated by law to have approved mitigation plans; the program is voluntary. Congress indicates; however, that communities which do not have FEMA-approved mitigation plans will not qualify for certain kinds of federal disaster assistance.

Cass County plans to offer a variety of ways to become involved including meetings, personal interviews, surveys, and public comment opportunities via the Cass County EM web page. Some involvement in the planning process as well as formal adoption of the plan will ensure your community is covered under the county plan for future funding opportunities.

HOW CAN I BECOME MORE INVOLVED?

Please take a few moments to fill out a survey at <http://www.surveymonkey.com/s/RLYLBRX>.

If you would like to become more involved in the planning process or have questions regarding the plan please contact Dave Rogness, Cass County Emergency Manager, at 701.476.4065 or at rognessd@casscountynd.gov or Amber Schaan at 701.235.1197 or at amber@lakeagassiz.com.

Table 2.3 Plan Stakeholders

Plan Stakeholders		
County Commission	City Councils	City Mayors
City Commission/Council Members	City/County Auditors	City Administrator
County Coordinator	City Assessors	City Public Works
Fire Districts	City/County Law Enforcement	City Forestry
City Finance	City/County Engineers	County Tax Director
County Treasurer	Sanford Health	Essentia Health
Salvation Army	American Red Cross	FirstLink
VA Medical Center	Rescue and Ambulance Services	Fargo Cass Public Health
Cass County Social Services	County Emergency Management	GIS Coordinators
Cass County Township Officer's Association	Cass County Rural Water Association	Cass Water Resource Districts
North Dakota Air National Guard	Red River Regional Dispatch Center	North Dakota State University
Cass County Electric	Moore Engineering	Houston Engineering
KLJ	Interstate Engineering	Advanced Engineering and Environmental Services
Xcel Energy	Otter Tail Power Company	Minnkota Power
Cass County Electric	School Districts	*Cass County LEPC
State Water Commission	ND Department of Emergency Services	*Breakfast Club

**individual members listed in Appendix A*

Figure 2.3 Cass County Website – Hazard Mitigation Plan

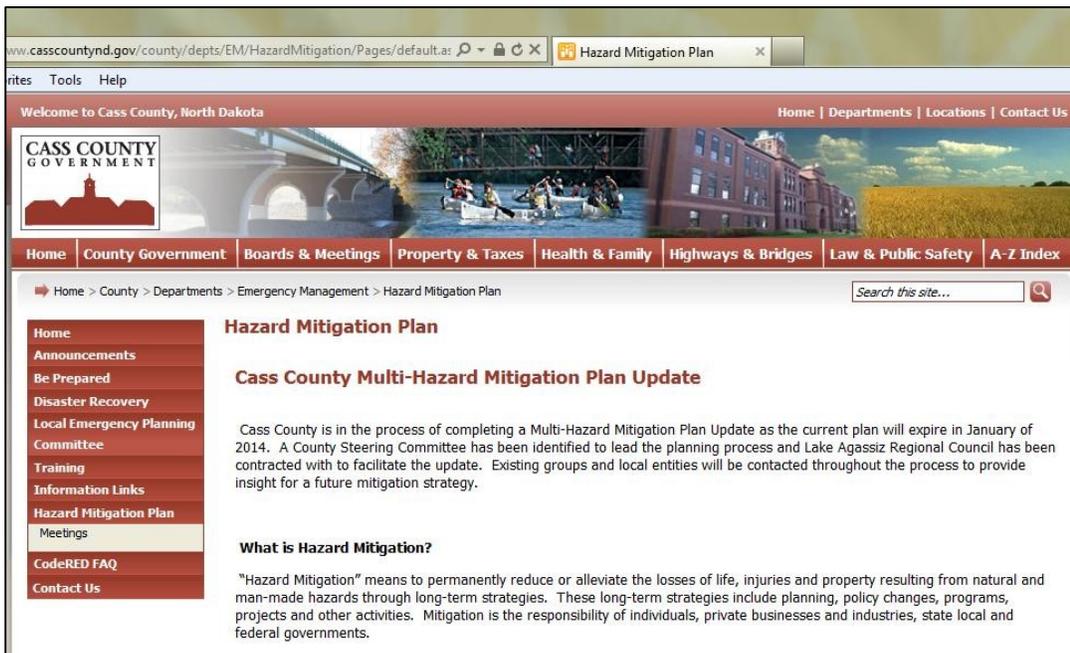


Figure 2.4 Survey Questions

1. Please mark all hazards you consider to be a risk to your community:
(Response: Multiple Choice/Multiple Answers)

<input type="checkbox"/> Riverine Flooding	<input type="checkbox"/> Urban Fire
<input type="checkbox"/> Overland Flooding	<input type="checkbox"/> Rural Fire
<input type="checkbox"/> Winter Storms	<input type="checkbox"/> Drought
<input type="checkbox"/> Summer Storms	<input type="checkbox"/> Dam Failure

2. Please identify the critical facilities in your community (such as hospitals, schools, storm shelters, water treatment facilities, etc.) Please include Facility Name, Address, and Estimated Value.
(Response: Multiple Text Boxes)

3. Has there been a natural hazard event in your community since January 2009?
(Response: Comment/Essay Box)

4. Please list any mitigation projects been completed in your community since January 2009:
(Response: Comment/Essay Box)

5. Please list any local plans or other documents you are aware of that relate to natural hazards:
(Response: Comment/Essay Box)

6. Please list any zoning or other ordinances in place addressing natural hazards:
(Response: Comment/Essay Box)

7. In your opinion please rate the following areas in order of greatest importance (1) to least important (4) for future activities:
(Response: Matrix of Choices)

	1	2	3	4
Emergency Management Public Awareness and Education	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Installing and Updating Warning Systems	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Flood Protection	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Update or Enhance Growth Planning and Zoning Ordinances	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

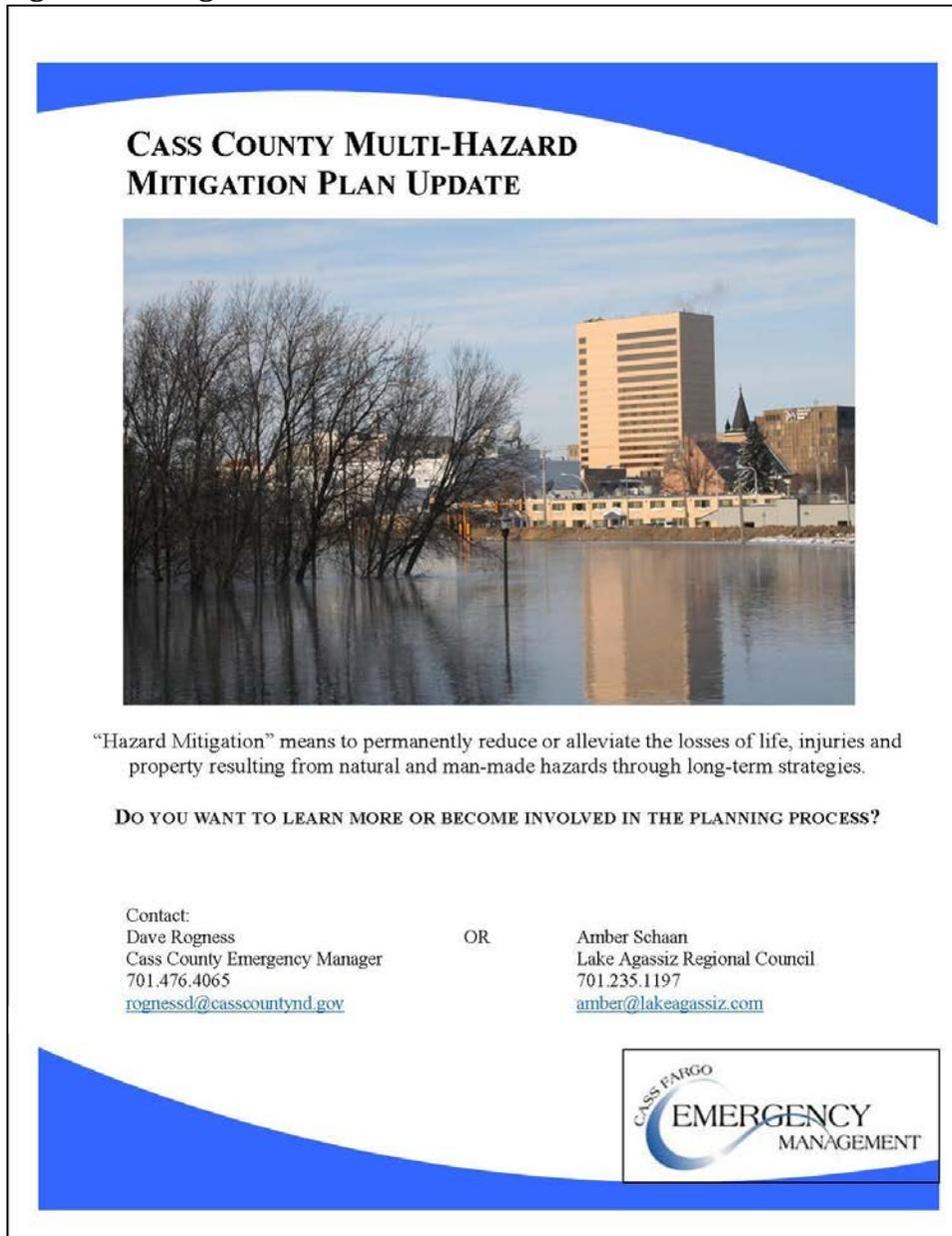
8. Please list any mitigation projects the community plans to undertake within the next 5 years (through 2018) Include approximate cost if available. Please include the following information about yourself and your community to enhance the survey results.
(Response: Comment/Essay Box)

9. Please include the following information about yourself and your community to enhance the survey results.
(Response: Multiple Text Boxes)

Name	<input type="text"/>
Organization	<input type="text"/>
Community	<input type="text"/>
Other Comments	<input type="text"/>

In an attempt to get more local perspective and individual buy-in posters were placed at large local events such as the Home Show at the Fargodome and in the entrance of the Cass County Courthouse, the City of Fargo Public Safety Building, and Fargo and West Fargo City Halls. These facilities each have a unique clientele and host a number of local meetings allowing a wide variety of the public to be exposed to the plan and given contact information should they have questions or wish to become more involved. The poster follows as **Figure 2.5**.

Figure 2.5 Mitigation Plan Poster



Public meetings are a regular occurrence for Cass County leading up to, during, and after disasters. These meetings have traditionally focused on preparedness and response; however, they offer an opportunity to gather public information on mitigation projects. Adding mitigation as a focus of committee members during these meetings will allow public perception and input to be gathered and incorporated throughout the plan maintenance process. Committee members can report on public perceptions and interactions involving stakeholder groups at a yearly meeting.

The current steering committee will meet annually to monitor goals, objectives and action items and evaluate the effectiveness and progress in the past year. The committee will also discuss events of the previous year and examine their effect on the plan.

Upon State of North Dakota and FEMA Region VIII approval, the plan will be formally adopted by all jurisdictions in Cass County, including the Cass County Commission and the City Councils of Alice, Amenia, Argusville, Arthur, Ayr, Briarwood, Buffalo, Casselton, Davenport, Enderlin, Fargo, Frontier, Gardner, Grandin, Harwood, Horace, Hunter, Kindred, Leonard, Mapleton, North River, Oxbow, Page, Prairie Rose, Reiles Acres, Tower City and West Fargo. A sample adoption resolution follows as **Figure 3.6**.

Figure 2.6 Adoption Resolution

<p>RESOLUTION NO. _____</p> <p>RESOLUTION TO ADOPT THE MULTI-HAZARD MITIGATION PLAN</p> <p>A RESOLUTION OF THE CASS COUNTY COMMISSION AND PARTICIPATING CITY COMMISSIONS TO ADOPT THE 2014 CASS COUNTY MULTI-JURISDICTIONAL, MULTI-HAZARD MITIGATION PLAN</p> <p>WHEREAS, the Cass County Commission and participating city commissions recognize the threat that natural hazards pose to people and property within Cass County, North Dakota; and</p> <p>WHEREAS, the Cass County Commission and participating city commissions have prepared a multi-hazard mitigation plan, hereby known as 2014 Cass County Multi-Jurisdictional, Multi-Hazard Mitigation Plan in accordance with the Disaster Mitigation Act of 2000; and</p> <p>WHEREAS, the as 2014 Cass County Multi-Jurisdictional, Multi-Hazard Mitigation Plan identifies mitigation goals and actions to reduce or eliminate long-term risk to people and property in Cass County from the impacts of future hazards and disasters; and</p> <p>WHEREAS, adoption by the Cass County Commission and participating city commissions demonstrates their commitment to hazard mitigation and achieving the goals outlined in the 2014 Cass County Multi-Jurisdictional, Multi-Hazard Mitigation Plan.</p> <p>NOW THEREFORE, BE IT RESOLVED BY CASS COUNTY, NORTH DAKOTA, THAT:</p> <p>In accordance with the participating commissions, the Cass County Commission and participating city commissions adopt the as 2014 Cass County Multi-Jurisdictional, Multi-Hazard Mitigation Plan.</p> <p>ADOPTED by a vote of ___ in favor and ___ against, and ___ abstaining, this ___ day of _____, ____.</p> <table style="width: 100%; border: none;"> <tr> <td style="width: 50%; vertical-align: top; padding-top: 20px;"> <p>APPROVED:</p> <p>By: _____ (print name)</p> </td> <td style="width: 50%; vertical-align: top; padding-top: 20px;"> <p>ATTEST:</p> <p>By: _____ (print name)</p> </td> </tr> </table>		<p>APPROVED:</p> <p>By: _____ (print name)</p>	<p>ATTEST:</p> <p>By: _____ (print name)</p>
<p>APPROVED:</p> <p>By: _____ (print name)</p>	<p>ATTEST:</p> <p>By: _____ (print name)</p>		

Upon review and approval of this Plan, Cass County and all participating communities will pass a resolution to adopt the plan. Executed resolutions for all jurisdictions can be found in **Appendix B**.

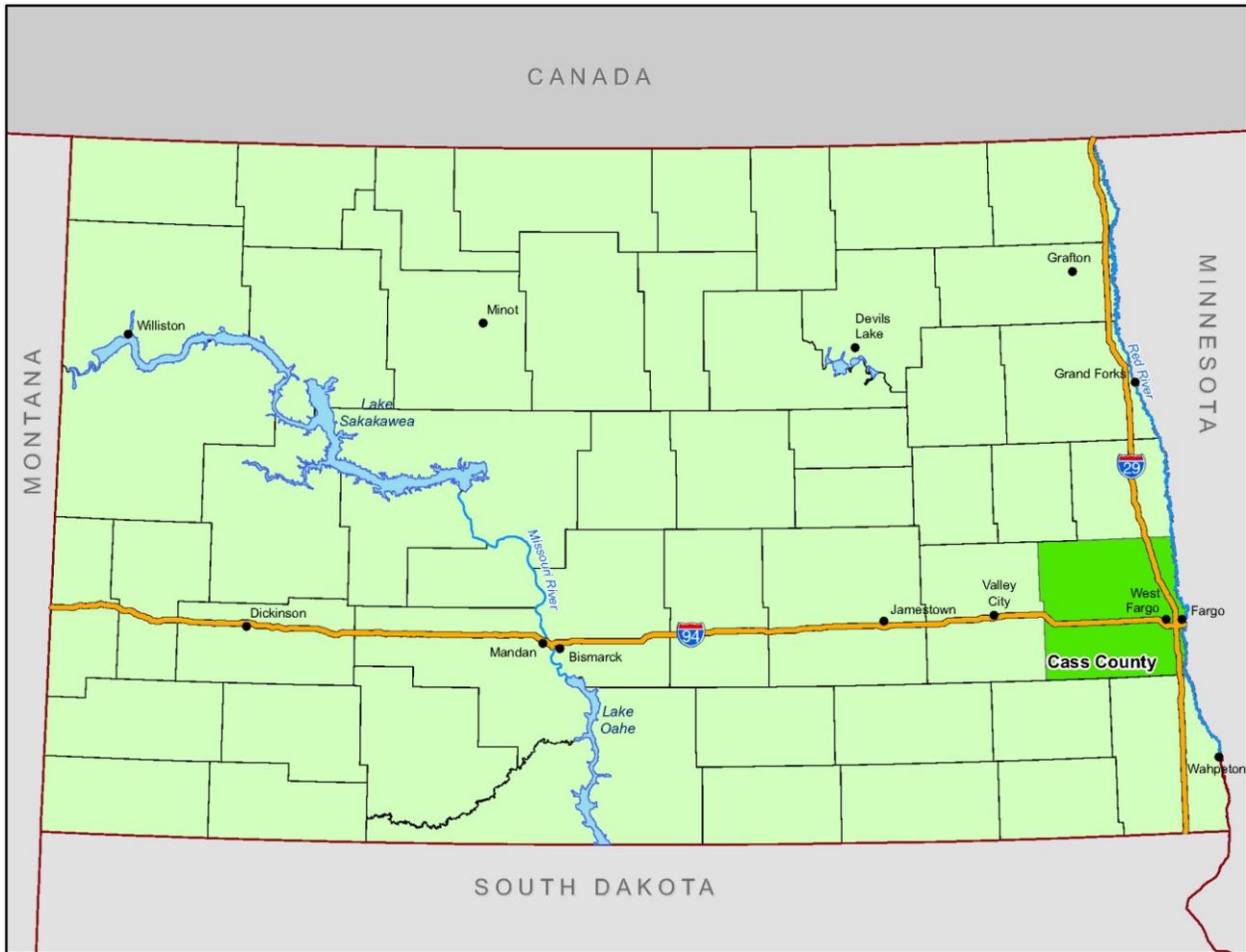
A key component to the development of a quality mitigation plan as well as integration of this Plan into other plans in the county is buy-in and developing key relationships. Cass Fargo Emergency Management and the County and City staffs strive to develop and maintain these relationships to work together to accomplish common goals. This steering committee was comprised of key individuals who will be involved other planning processes and can bring mitigation goals and objectives with them to future planning sessions. The process to develop this plan has brought a heightened awareness of concerns and changes in mitigation projects to local officials that will carry forward. It is a focus of this committee to have this Plan readily accessible to any interested parties for use in the future. This Plan will be utilized for the HIRA which will also be utilized in future Emergency Operation Plans and pre-flood plans. City and County Comprehensive plans have been completed recently and were referenced for objectives and action items in this plan. As

planning is an ongoing effort this plan will be similarly utilized for future zoning ordinances any updates to the County Comprehensive Plan and the City of Fargo Plan. It will also be provided to all local jurisdictions for any planning efforts that may take place. The county floodplain administrator has been integrally involved in this plan and will be utilizing the information for future decision making.

SECTION III: COUNTY PROFILE

Cass County is located in southeastern North Dakota in the Red River Valley and is the most populous county in the State. The 2010 Census reported Cass County’s population at 149,788. The county seat is Fargo where over 70 percent of the population resides. The Red River of the North establishes Cass County’s eastern border, separating North Dakota from Minnesota. The county has a total area of over 1.13 million acres; based on land use, this area is primarily agricultural.

Figure 3.1 Cass County Location



Population

The continuous increase in the population of Cass County is unique when compared to the state and surrounding predominately rural counties. The diversified economy that has developed in the Fargo area as well as Fargo ranking as the largest North Dakota city have contributed to the consistent growth. **Table 3.1** and **Figures 3.2 and 3.3** show the population of Cass County as compared to the fluctuating state population.

Table 3.1 Cass County and State of North Dakota Populations 1900 - 2010

Year	North Dakota	Cass County
1900	319,146	28,625
1910	577,056	33,935
1920	646,872	41,477
1930	680,845	48,735
1940	641,935	52,849
1950	619,636	58,877
1960	632,446	66,947
1970	617,761	73,653
1980	652,717	88,247
1990	638,800	102,874
2000	642,200	123,138
2010	672,591	149,778

Figure 3.2 North Dakota Population 1900 - 2010

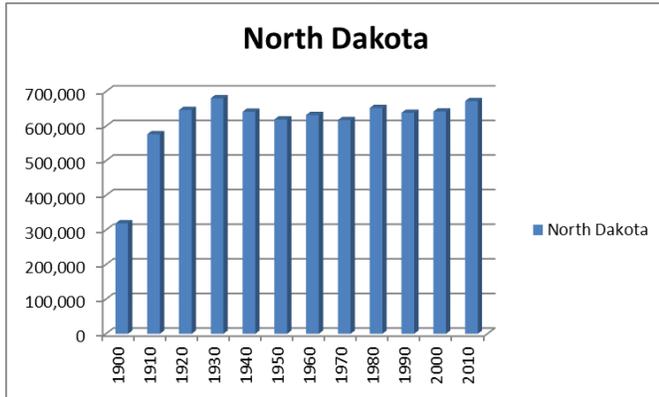
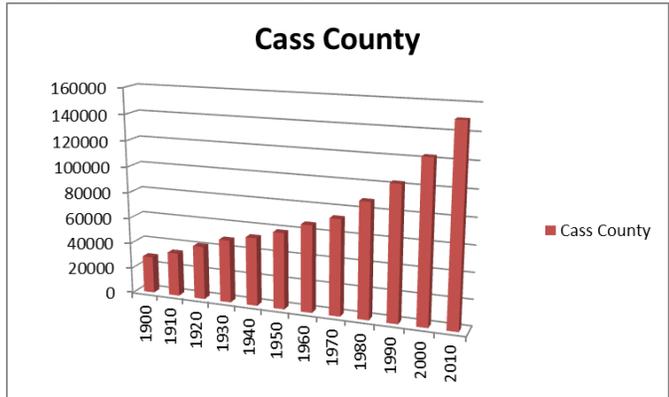


Figure 3.3 Cass County Population 1900 - 2010



Source: U.S. Decennial Census

Cass County’s population increased by 26,640 people, or 21.63 percent, between the years of 2000 and 2010. The population residing within city limits of Cass County communities increased by 28,535 people, or 25.11 percent, while the population living in rural Cass County decreased by 1,895 people, nearly 20 percent. Population changes in Cass County communities from 2000 to 2010 are shown in **Table 3.2**. Current Cass County population density as shown in **Figure 3.4** is telling of a continuing migratory trend in the county. Fargo and communities within a 30 mile commuting distance of the Fargo-Moorhead Metropolitan Statistical Area (FM MSA) are growing while the populations of communities farther from the FM MSA continue to decline.

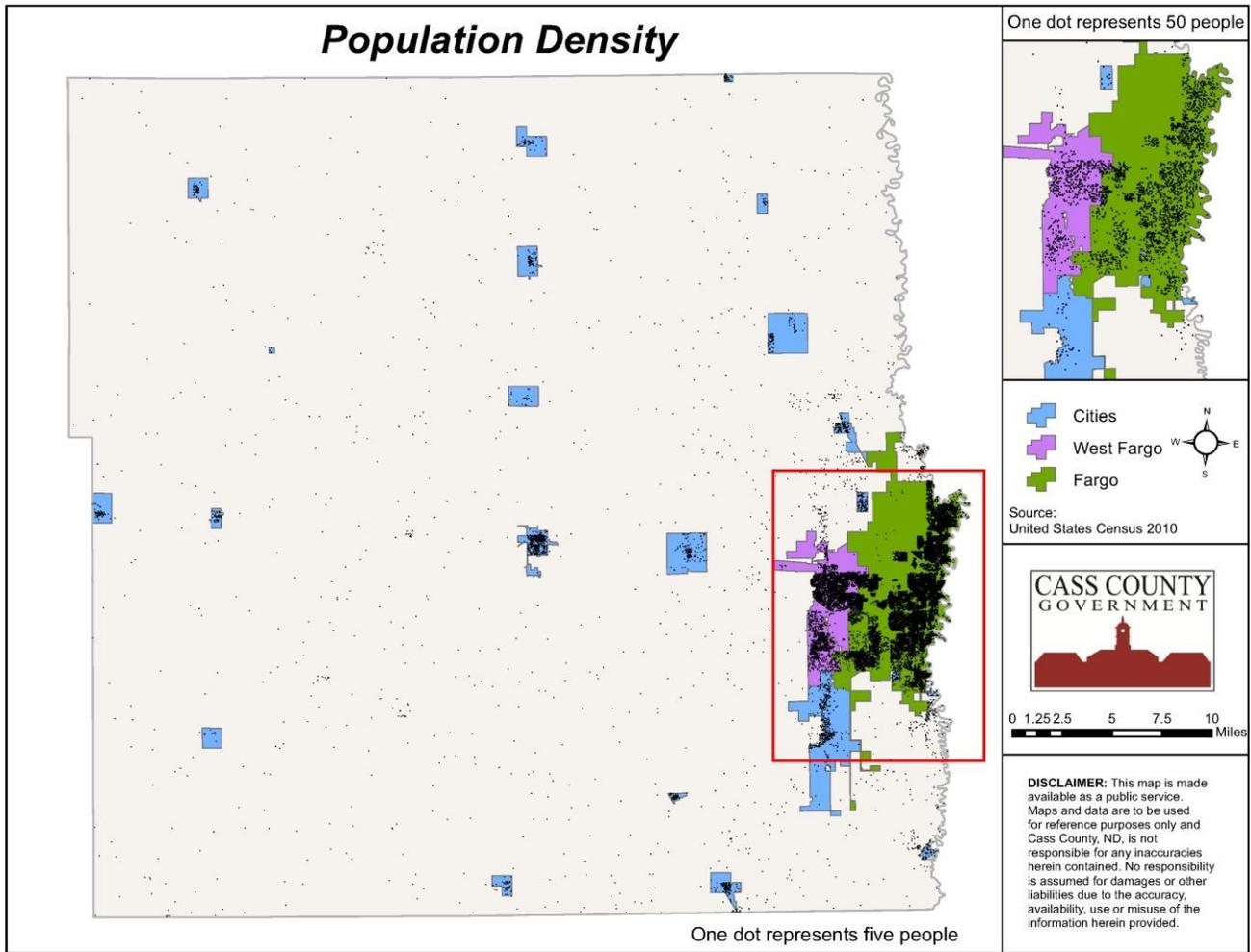
Table 3.2 City Populations in Cass County 2000 - 2010

Community	2000	2010	%Change	Community	2000	2010	%Change
Argusville	147	475	223.13%	Tower City	252	253	0.40%
Horace	915	2,430	165.57%	Davenport	261	252	-3.45%
Reile's Acres	254	513	101.97%	Grandin	181	173	-4.42%
West Fargo	14,940	25,830	72.89%	Briarwood	78	73	-6.41%
Mapleton	606	762	25.74%	Gardner	80	74	-7.50%

Casselton	1,855	2,329	25.55%	Buffalo	209	188	-10.05%
Oxbow	248	305	22.98%	Leonard	255	223	-12.55%
Harwood	607	718	18.29%	North River	65	56	-13.85%
Fargo	90,599	105,549	16.50%	Arthur	402	337	-16.17%
Kindred	614	692	12.70%	Hunter	326	261	-19.94%
Prairie Rose	68	73	7.35%	Frontier	273	214	-21.61%
Amenia	89	94	5.62%	Ayr	23	17	-26.09%
Page	225	232	3.11%	Alice	56	40	-28.57%

Source: U.S. Census

Figure 3.4 Cass County Population Density as of 2010



Source: Cass County

The Fargo-Moorhead Metropolitan Council of Governments (FM Metro COG) developed population projections for the metropolitan area to aid its transportation planning efforts. With the assistance of McKibben Demographic Research, the Demographic Forecast for the FM MSA established demographic projections through 2035. The Cass County Population projection for the year 2020 is 174,340 people. This “High Growth” scenario was adopted by the FM Metro COG policy board; the board assumed that local jurisdictions would be proactive in countering negative population trends. The projected population of Cass

County in 2035 is 201,190 people; this reflects an average annual growth rate of about 1.2 percent over the next 25 years and a 34.3 percent increase from 2010. While this projection appears to be aggressive for both urban and rural Cass County, it is reasonably attainable considering continued growth in Fargo's diversified economy.

Hydrology

Rivers

Five rivers comprise the major components of Cass County's surface drainage system: Red River of the North, Sheyenne River, Maple River, Rush River and Wild Rice River. Other significant tributaries include Swan Creek and Buffalo Creek. Rivers play a vital role in irrigation, recreation, and municipal water supplies in the County. The flat nature of the Red River Valley, the minimal gradient of the rivers, and the northerly flow of the Red River of the North make the area prone to extensive and prolonged flooding during the spring melt.

Lakes, Reservoirs and Wetlands

Cass County has 32 lakes found mostly in the west and southwest averaging 42 acres in size and 10 artificially created lakes averaging 36 acres in size. These lakes and reservoirs provide flood protection, irrigation, and recreation. The remaining sources of surface water found in the county are wetlands; which are valuable for surface and subsurface water storage, nutrient cycling, retention of sedimentation, and plant and animal habitats. The fertile soils found in wetland areas make them productive areas for farming and resulted in drainage and removal of many acres of wetlands; many of these wetlands are now protected by federal and state laws. According to the National Wetlands Inventory, Cass County has 21,036 acres of wetlands (excluding lakes and rivers); of this area 7,693 acres are permanently or semi-permanently flooded.

Aquifers

The county has several larger aquifers being utilized for agricultural, residential and commercial use to varying degrees which possess limited additional development possibility. These aquifers include the West Fargo Aquifer System (WFAS), the Page Aquifer, and the Sheyenne Delta Aquifer.

The West Fargo Aquifer System is made of multiple loosely related aquifer units located in the Fargo metro area from Argusville through West Fargo down to the Wild Rice (Ripley 2004), roughly the same areas experiencing high growth during recent years. These nine aquifer units share similar characteristics and are loosely connected; meaning changes in one unit could likely be somewhat transmitted to the other units. The individual channels of the WFAS were created during different times of glacial melting traveling through the valley that predated the Red River Valley as we know it. As a result, this aquifer system is covered by glacial lake clays of the bottom of Lake Agassiz; these clays inhibiting seepage of surface water into the aquifer to recharge water levels (Ripley 2004).

Recharge of an aquifer is limited to the snowmelt and rainfall seeping through the ground down to the aquifer. In the case of the WFAS, the 60 to 90 feet of lake clays above the aquifer limits any recharge. This is a benefit in reducing contamination, but results in an aquifer with a finite amount of water (Ripley 2004). The profile of the water in the WFAS indicates the majority of the water has characteristics of cold water precipitation, rather than mixture of cold and warm water precipitation. The fact that the area only receives a small portion of precipitation in the form of snow indicates the water in the WFAS dates back to the cold water trapped during the glacial melts, meaning little apparent modern day recharge has occurred (Ripley 2000).

The declining levels in the WFAS's finite amount of water suggest little potential for new users to utilize the aquifer. The WFAS has experienced some of the largest water declines in the area; as a result, proper planning of new development will need to find other sources of water and in the future current users of the system will likely need to find alternative water sources.

The Page Aquifer is another significant aquifer which is located in the northwest portion of the county and extends into Traill and Steele counties (Ripley 2004). This aquifer was primarily used as municipal water supply for the town of Page and since 1976 approximately 15,000 acres of land have been supplied water for irrigation from the Page Aquifer. This aquifer has received significant recharge since 1993 following the droughts of the 1980s and is considered imbalanced with recharge and managed as a sustainable resource, which may allow for some additional water to new users (Ripley 2004).

The Sheyenne Delta Aquifer is a large and substantial aquifer located in southern Cass, northern Richland, northeastern Sargent, and eastern Ransom counties. While this is a large aquifer, the majority of it is located outside the county, limiting its usefulness for Cass County (Ripley 2004).

Cass County also has smaller and less significant aquifers having lower potential and water output, with some more greatly affected by climatic extremes. Included in this group are the Tower, Bantel, and Dakota aquifers (Arndt and Moran 1974, Ripley 2000, Ripley 2004).

The Tower Aquifer located in western Cass County supplies the water needs of Tower City. This shallow aquifer is very vulnerable to climatic extremes and experienced declining water levels during the 1980s and early 1990s drought conditions. Since 1993, the aquifer has begun a period of recharge, but its small size limits its usefulness to supplying only the current water requirements of Tower City (Ripley 2004).

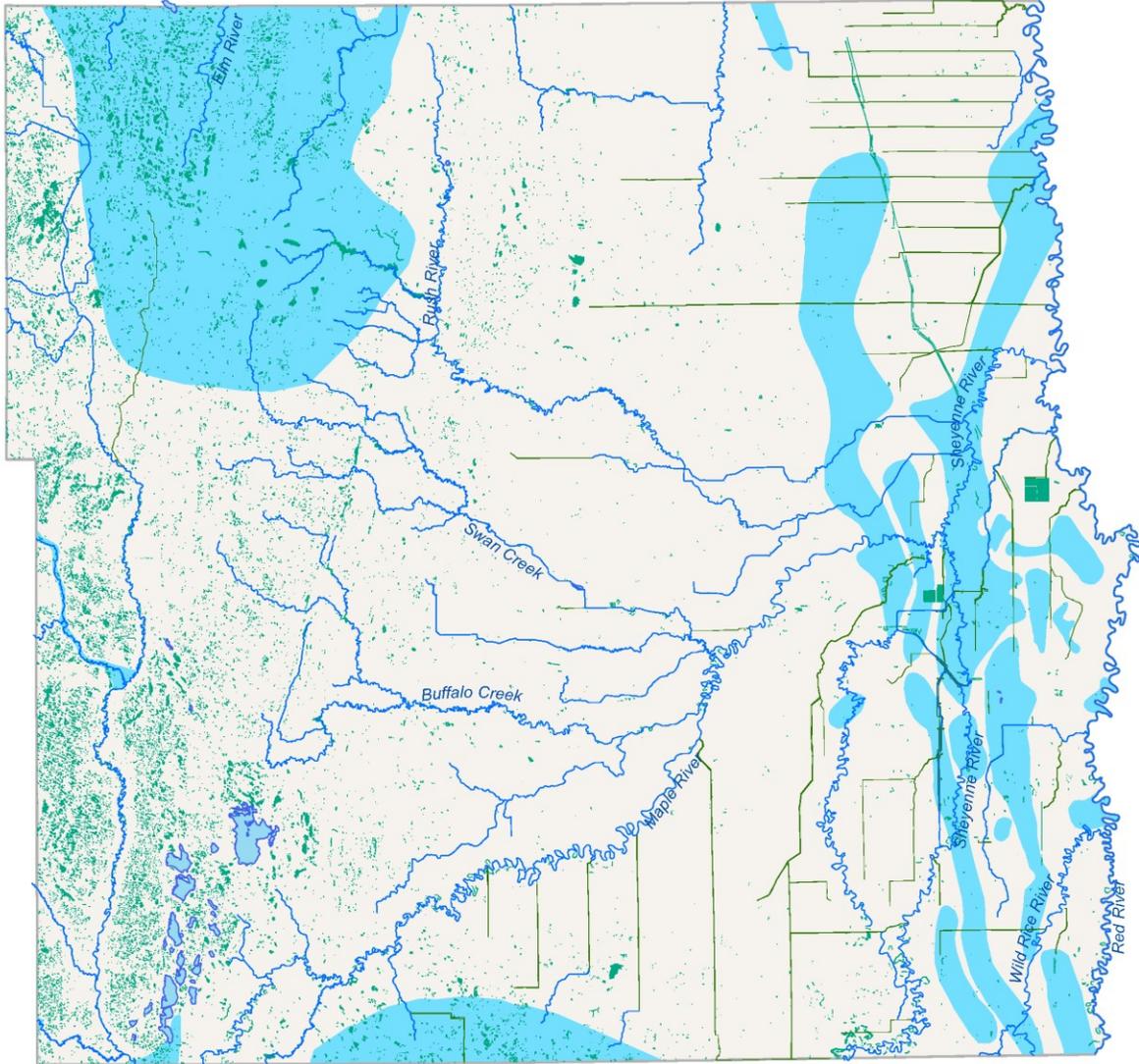
The Bantel Aquifers use has been limited to domestic and stock wells in southwest corner of Cass County. This aquifer is capable of recharge and should have increased levels as a result of the current wet cycle (Arndt and Moran 1974, Ripley 2004).

The Dakota Aquifer is the deepest aquifer in Cass County, with some wells in western portions of the county descending 800 feet, covering areas from the eastern to western borders of Cass County. The water in this aquifer contains high amounts of saline and mineralization, deterring its use, except for limited applications for watering stock (Arndt and Moran 1974).

The data points to the fact that the use of groundwater in Cass County is limited to the current users and currently used aquifers, with only the Page Aquifer appearing to have limited potential for new users in certain geographical areas. Either the aquifers are being used at or near capacity or not being utilized because they are too small, too deep, or poor water quality; all of which will not change. The WFAS is unique in that the area it is located is expected to witness continued growth and the lack of recharge results in a finite amount of water. This will demand proper planning to protect the current resource as well as determining sources for future development. It should be noted that the last 15 years of increased growth experienced by Fargo and West Fargo has also been during a wet cycle. The increased amount of precipitation has reduced the demands on the ground and surface water needed by the area and it should be expected these demands will only increase with the greater populations and during times of drought conditions. A map of the hydrologic features in Cass County follows as **Figure 3.5**.

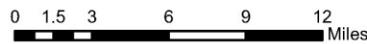
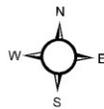
Figure 3.5 Cass County Hydrology

Hydrology



-  River/Stream
-  County Drain
-  Lake or Pond
-  Wetland
-  Aquifer

Sources:
 North Dakota State Water Commission
 U.S. Fish and Wildlife Service



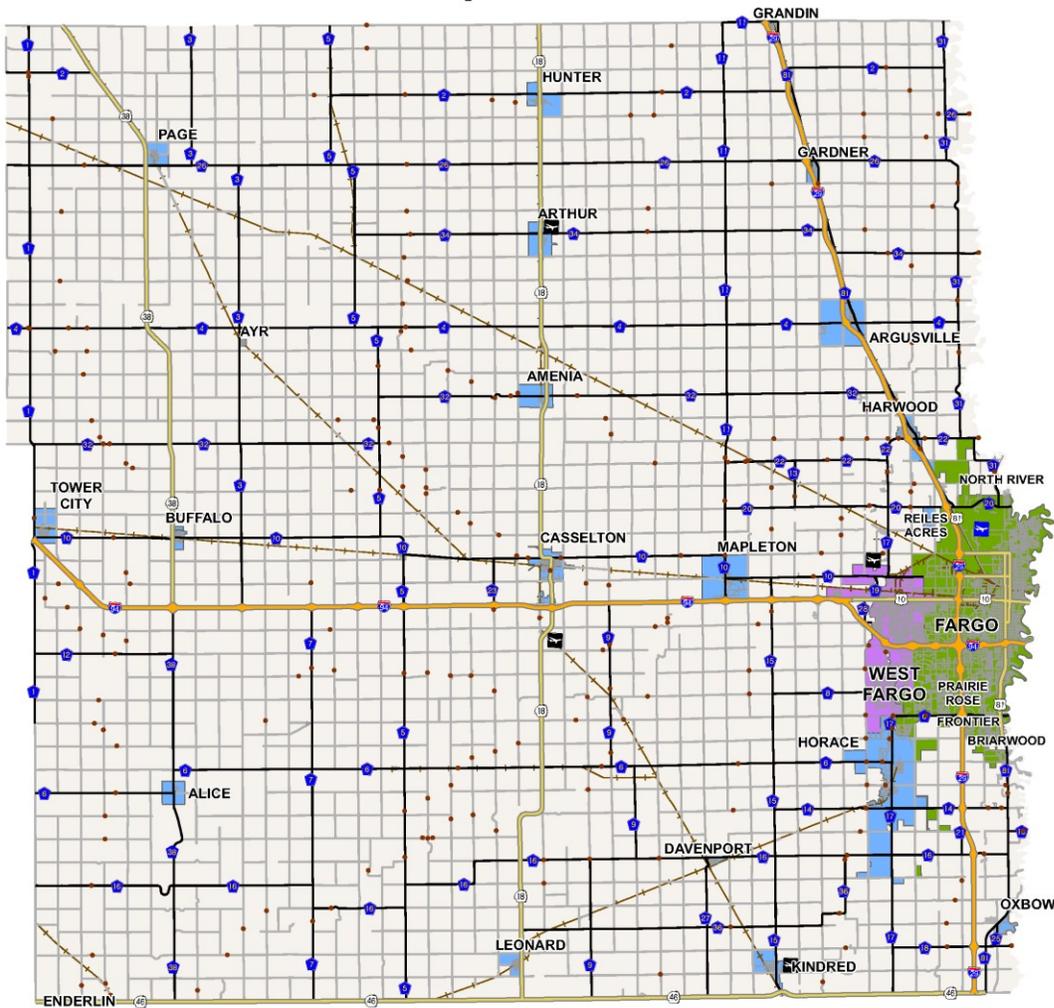
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Transportation

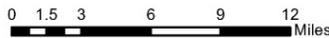
It is important to understand transportation and its connection to all phases of disasters. Although a more direct link can be drawn between transportation and preparedness and response there is potential for mitigation actions to have a significant impact on this crucial infrastructure. Details on area highways and roads, railways, air service and mass transit are included in this section. **Figure 3.6** is an overview of Cass County transportation.

Figure 3.6 Transportation in Cass County

Transportation



- Bridges
- Commercial Aviation
- Interstates
- General Aviation
- US Routes
- Cities
- County Highways
- West Fargo
- Other Roads
- Fargo
- Railroads



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Highways and Roads

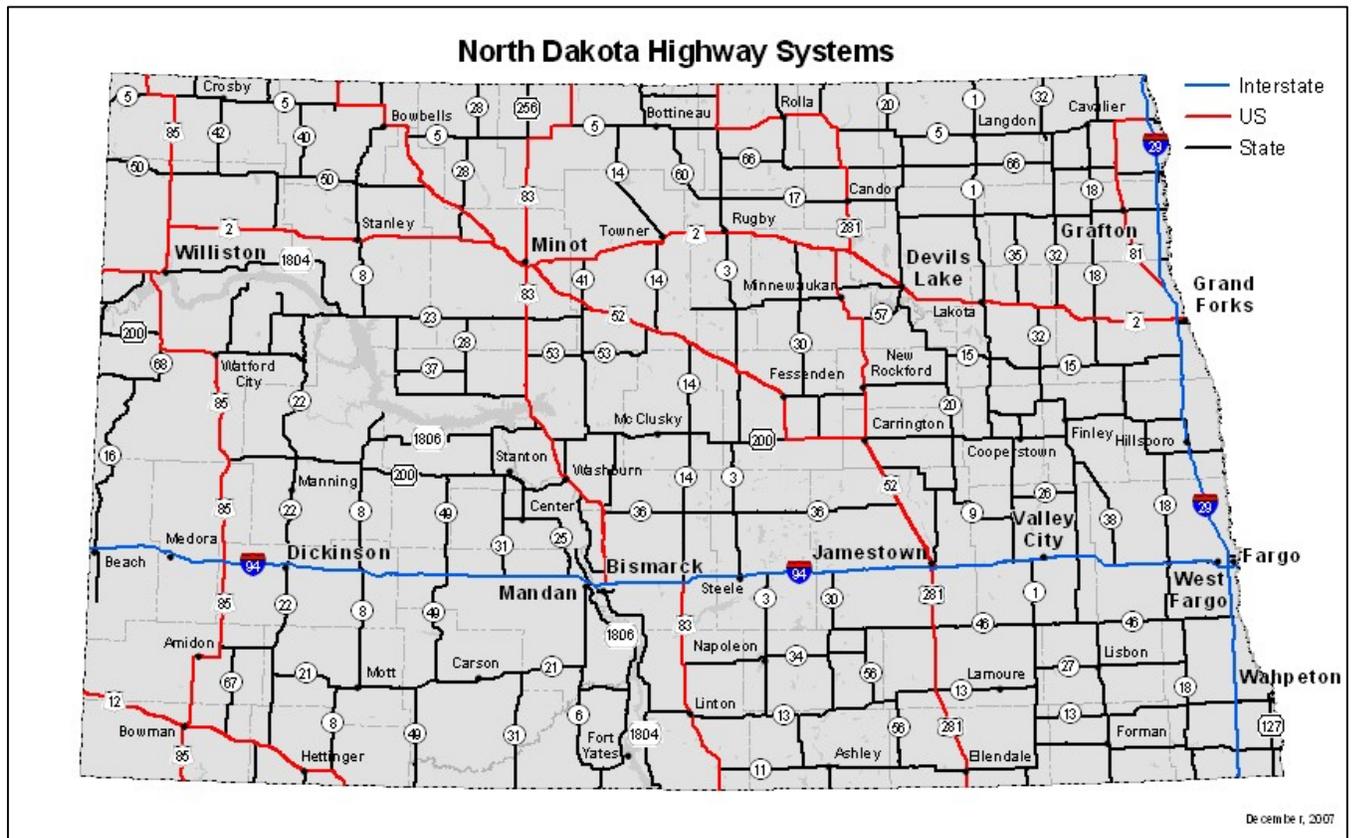
Cass County is served by two Interstate Highways; north-southbound Interstate-29 and eastwestbound Interstate-94 intersect at Fargo. The state highway classification system identifies state highways as Principal Arterials and Major Arterials. Interstate Highways, Principal Arterials and Major Arterials in Cass County are outlined in **Table 3.3** and shown on the North Dakota Highway System Map, **Figure 3.7**.

Table 3.3 Principal Arterials and Major Arterial Highways in Cass County

Highway Classification	Interstate	Counties Served	Principal Cities Served	Directional Orientation
Interstate	I-94	Cass	Fargo, Mapleton, Casselton	East-West – Minneapolis, St. Paul, MN; Billings, MT
Interstate	I-29	Richland, Cass, Traill	Hankinson, Fargo, Hillsboro	North-South – Kansas City, MO; Winnipeg, Manitoba
Major Arterial	ND 18	Traill, Cass Richland	Mayville, Hunter, Arthur, Casselton, Leonard, Wyndmere, Lidgerwood	North-South
Major Arterial	ND46	Cass, Ransom	Kindred, Enderlin	East-West

Source: ND Department of Transportation

Figure 3.7 North Dakota Highway System



Source: ND Department of Transportation

Cass County is also served by a system of county, township and municipal roads. These roads make up over 90 percent of the total miles of roads in the county. Local government budgets are increasingly pressured by escalating road maintenance and improvement costs. Floods in 2009, 2010 and 2011 caused considerable damage to county and township roads, and although Federal Emergency Management Agency’s (FEMA) Public Assistance funding has borne a majority of the repair costs, local budgets remain strained.

Rail

The county is served by both freight and passenger rail service. Amtrak provides daily passenger rail service to the Fargo-Moorhead area. The Burlington Northern Santa Fe (BNSF) and the Canadian Pacific (CP) Rail System provide mainline freight service to major cities in the region including Fargo, Casselton, and Mapleton. The Red River Valley and Western (RRVWRR) short line railroad provides localized service to rural communities along 577 miles of track formerly owned by BNSF. The RRVWRR recently celebrated its 25th anniversary of providing service to grain elevators and agricultural processing plants including the Tharaldson ethanol plant at Casselton. The vast majority of RRVWRR's customers are agriculturally related and many were threatened with the loss of rail service when the region's main line railroads were abandoning branch lines in rural areas.

Air Service

Hector International Airport in Fargo is the region's largest and only airport served by major air carriers. Allegiant, American, Delta, Frontier and United Airlines provide daily passenger service to and from Hector International Airport. These carriers offer non-stop flights to Atlanta, Los Angeles, Phoenix, Las Vegas, Denver, Dallas-Ft. Worth, Minneapolis, Chicago, Salt Lake City and Orlando. Allegiant Airlines recently announced the addition of a non-stop route from Hector International Airport to Tampa beginning in November of 2013. Six fixed base operators are located at Hector International Airport and provide charter air service, flight school, and aircraft maintenance and repair. The county is also served by five general aviation airports, detailed in **Table 3.4**

Table 3.4 General Aviation Airports, Cass County, ND

Airport	Ownership	Runway	Surface/Condition	Services
Arthur (1A2)	Arthur Airport Authority	Runway 17 – 3100x85 ft.	Turf/Fair	Tiedowns
Casselton (5N8)	Casselton Regional Airport Authority	Runway 13/31– 3900 x 75 ft.	Concrete/Good	Hangars, Tiedowns, Fuel, Major Airframe
Kindred (K74)	Kindred-Davenport Regional Airport Authority	Runway 11/29 – 3300 x 60 ft.	Concrete/Good	Tiedowns, Fuel, Major Airframe, Major Powerplant
Page (64G)	Leased to Page Regional Airport Authority	Runway 17/35 – 2600 x 30 ft.	Asphalt/Fair	Tiedowns, Fuel, Major Airframe, Major Powerplant
West Fargo (D54)	West Fargo Airport Authority	Runway 18/36 – 3300 x 50 ft.	Asphalt/Good	Tiedowns, Hangars, Major Airframe, Major Powerplant, Bottled Oxygen

Mass Transit

Valley Senior Services offers transportation in the Fargo, Moorhead, West Fargo and Dilworth area for individuals age 60 and older. Rides are provided to greater Cass County on a regular basis and can accommodate medical, dental, and eye appointments, shopping, visiting and other personal needs. (Valley Senior Services)

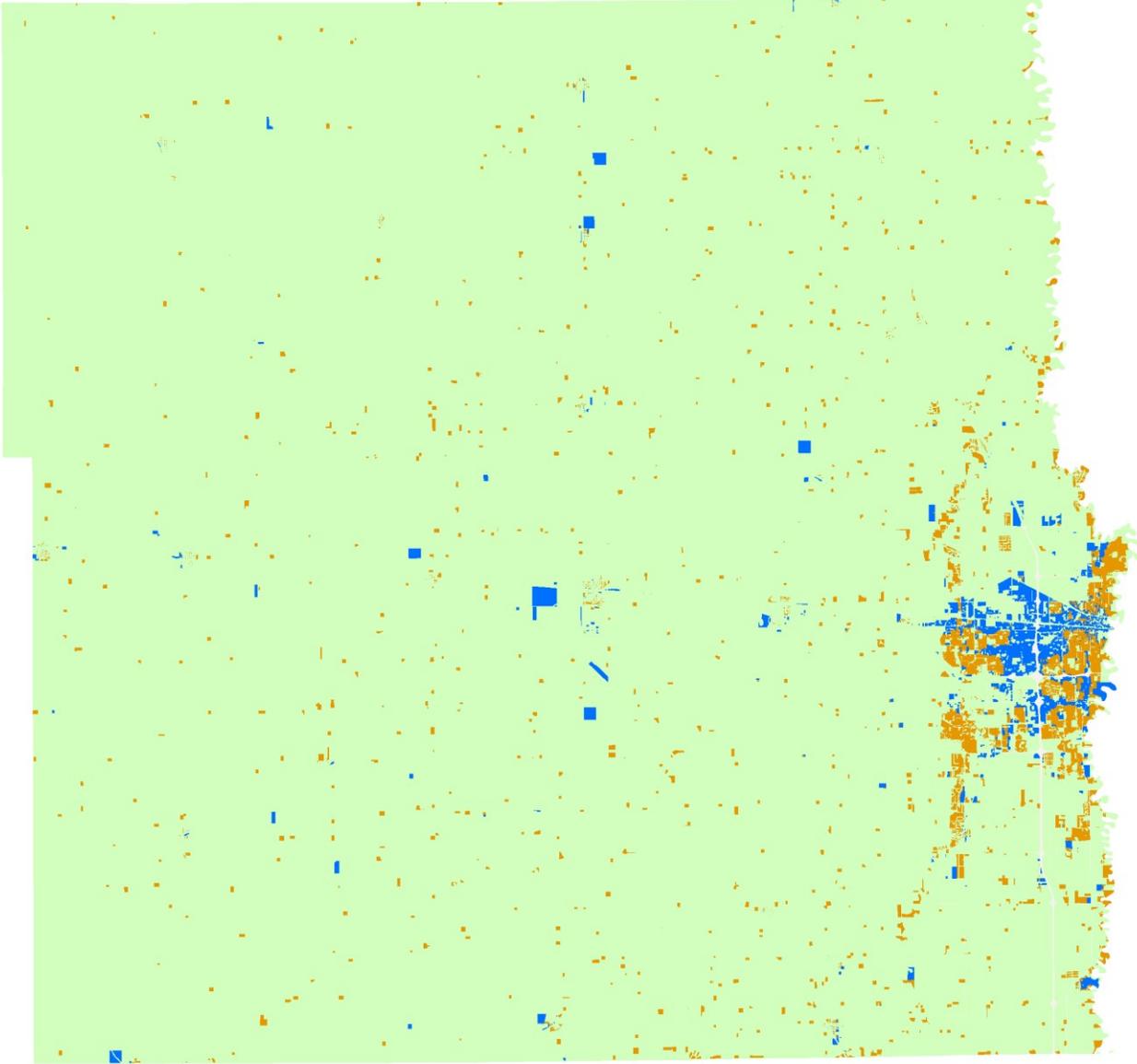
Through a quick look at ridership trends on the mass transit system in the Fargo-Moorhead Metropolitan Area, it is clearly evident that public transit is becoming an increasingly more important element of the surface transportation system. In 2010, the Metropolitan Area mass transit systems provided a total of 2,133,908 rides which includes all fixed route, paratransit services, rural commuter services senior ride and ADA demand response services. From a fixed route perspective, over the five year timeframe between 2006 and 2010 MATBUS ridership has increased by 747,100 rides or 53 percent. Similarly for other transit services, paratransit ridership over the same five year timeframe has increased by 8,861 rides or 18 percent. Beyond ridership figures the system has served an important role during flood fights in recent years. The cities of Fargo and Moorhead have relied heavily on volunteers and their ability to fill and place sandbags to create the necessary temporary levees to protect core infrastructure. MATBUS personnel and their fleet are a critical factor in mobilization and implementation of the flood fight effort.

Land Use

Cass County contains over 1,131,000 acres of total land area covering a nearly square area roughly 44 miles east to west and 42 miles north to south. The county has over 52,000 parcels of land totaling 1,124,00 acres. Three general land use categories are used to classify land use in the county in ascending order commercial, residential and agricultural. See **Figure 3.8** for a visual representation of the land use in Cass County.

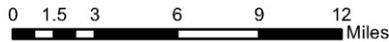
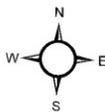
Figure 3.8 Cass County Land Use

Land Use



Land Use

-  Agriculture
-  Commercial
-  Residential



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SECTION IV: HAZARD IDENTIFICATION AND RISK ASSESSMENT

Cass County has chosen to focus on natural hazards for this plan. Hazards to be reviewed include dam failure, drought, flood, severe summer storm, severe winter storm urban fire, wildland fire, and geologic hazards. Since dams are manmade structures and are closely tied to the flood hazard, dam failure has been included as a hazard in the plan. Each hazard will be broken down into description, location, extent, previous occurrences and probability of future events.

This hazard identification and risk assessment section focuses on hazards from a county-wide perspective. Unique features, risks and vulnerabilities that exist in individual jurisdictions can be found along with each community's mitigation actions in Section VI.

Dam Failure

Description

A dam is any artificial barrier, including appurtenant works, which impounds or diverts water. Dam failure is defined as a sudden, rapid, and uncontrolled release of impounded water that can create a potentially significant downstream hazard. The purpose of dams includes storage of water for irrigation, hydroelectric power generation, flood control, water supply, fire protection, recreation, and wildlife habitat. Should a dam fail, the consequences are determined by the potential loss of life and downstream property damage it may cause; in some cases, these consequences could be devastating. The vast array of dam failure causes includes terrorism and earthquakes. The most common reasons for dam failure are hydrologic inadequacy and seepage related problems.

Hydrologic Failures – Hydrologic failures are typically associated with flood events. A hydrologic failure may occur due to dam overtopping or excessive spillway erosion. A dam can be overtopped during a flood event due to insufficient reservoir storage and insufficient spillway capacity. Earthen dams are particularly susceptible to failure when overtopped since earthen material may erode relatively easily. Some dams have an earthen auxiliary spillway designed to carry excess flows during a flood event. Since these are earthen spillways, some erosion can be expected, but under certain conditions excessive erosion can occur. (North Dakota State Water Commission)

Seepage Failures - All dams have some seepage occurring through the structure and foundation. Seepage, if uncontrolled, can erode material from the embankment of an earthen dam and lead to complete failure of the dam. Piping is a specific seepage problem which occurs when erosion starts at the point where seepage is exiting the downstream slope or foundation, then works backwards toward the upstream slope. Internal erosion, another type of seepage failure, occurs when water flowing through the dam causes erosion along a crack in the embankment or foundation, or along some other discontinuity or preferential flow path in the embankment, such as along a spillway conduit. Tree roots and animal burrows can also provide paths for seepage. Seepage failures can occur during the course of normal operations, but can also occur during flood conditions when reservoir levels are abnormally high. (North Dakota State Water Commission)

Location

The Dam Inventory managed by the North Dakota State Water Commission includes 27 dams within the County; these dams are located primarily in the Maple River and Red River basins. A full listing of Cass County dams follows as **Table 4.1**. **Figure 4.1** is a map detailing the dam locations.

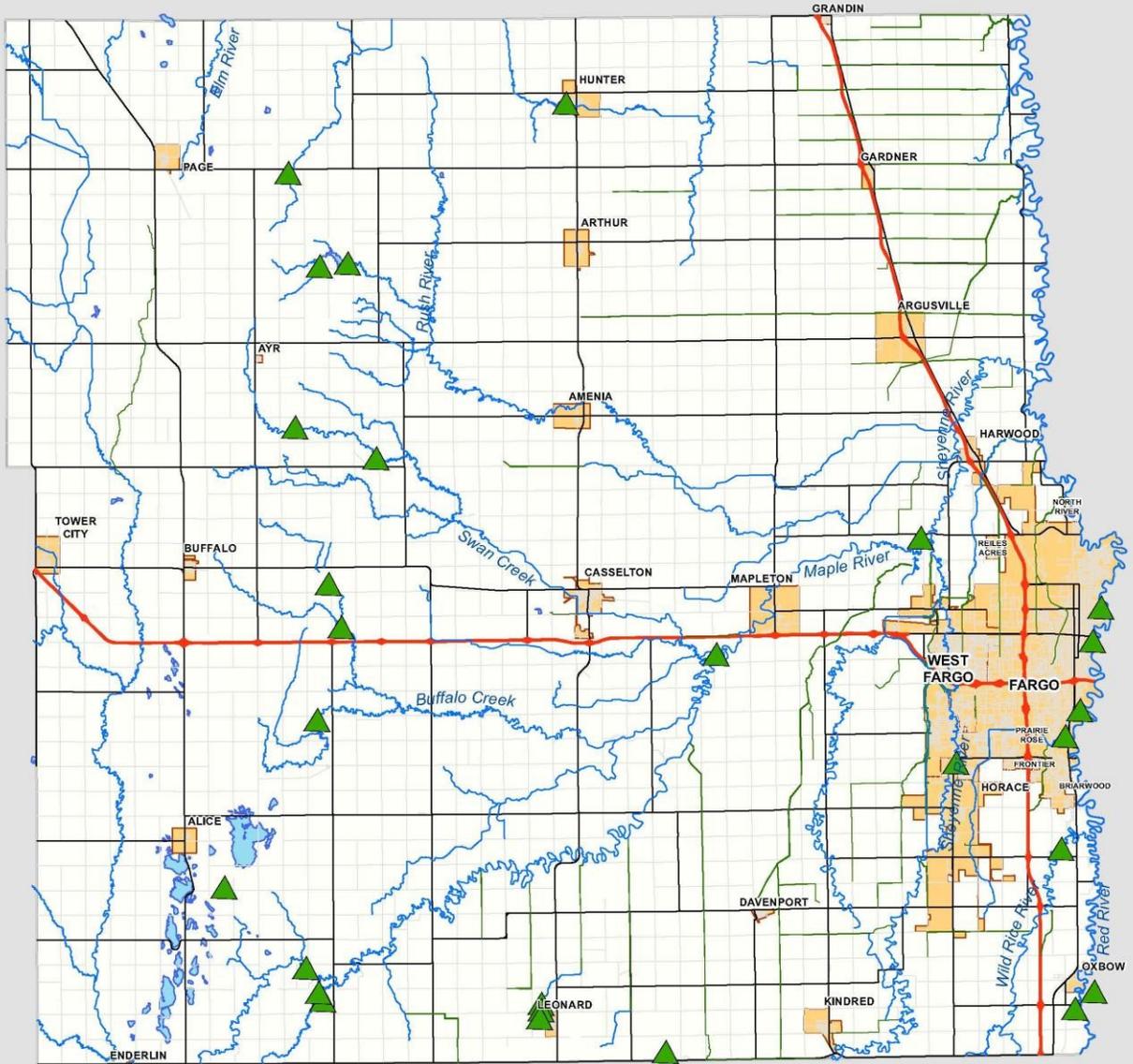
Table 4.1 Cass County Dams

Location	Type	Structure Name	Purpose	Owner	Potential Impacts
13704819BB	Dam	Hickson Dam	Water Supply	City of Fargo	Unavailable
13704925AA	Dam	Leher Dam; George	Fish & Wildlife	George Leher	Agricultural land
13705132CA	Dam	Lunder Dam; Wayne	Flood Control	Wayne Lunder	Agricultural land
13705221CA	Dam	Lemke Dam; Albert 1	Irrigation	Albert Lemke	Agricultural land
13705221CD	Dam	Lemke Dam; Albert 2	Irrigation	Albert Lemke	Agricultural land
137052288AC	Dam	Leonard Golf Club Inc.	Irrigation	Leonard Golf Club Inc.	Unavailable
13705414AA	Dam	Maple River Dam	Flood Control	Cass County Joint WRD	Unavailable
13705424ACC9	Dam	Unavailable	Unavailable	Unavailable	Unavailable
13705424BA	Dam	Maple River Dam (T-180)	Flood Control	Maple River WRD	Unavailable
13804905BB	Dam	Sheyenne River Div. Dam	Water Supply	SE Cass County WRD	Unavailable
13804924CA	Dam	Wild Rice Dam - Cass	Recreation	SE Cass County WRD	Unavailable
13805429DC	Dam	Kemmer Dam; Harrey	Fish & Wildlife	Harvey Kemmer	Agricultural land
13904807AD	Dam	Fargo 4 th St South Dam	Water Supply	City of Fargo	Unavailable
13904830BA	Dam	Fargo Dam #2	Water Supply	City of Fargo	Low head dam minimal impact
13904936AB	Dam	Rose Coulee Dam	Other	City of Fargo	Low head dam minimal impact
13905110DB	Dam	Brownlee Dam	Recreation	Maple River WRD	Unavailable
13905306BD	Dam	Swan Buffalo Det D# 5	Flood Control	Maple River WRD	35 homes
13905425BA	Dam	Swan Buffalo Det D# 8	Flood Control	Maple River WRD	32 homes
14004832CD	Dam	Fargo 12 th Ave N Dam	Water Supply	City of Fargo	Low head dam minimal impact
14005024AA	Dam	ND No Name 227	Livestock	Maple River WRD	Agricultural land
14005425DA	Dam	Magnolia Dam & State GMA	Fish & Wildlife	ND Game & Fish Dept.	Agricultural land
14105333DA	Dam	Swan Buffalo Det D #12	Flood Control	Maple River WRD	8 homes, 1 business
14105425AC	Dam	Eckart Dam	Livestock	Donald Eckart	Agricultural land
14205319DC	Dam	Brewer Lake 2	Fish & Wildlife	ND Game & Fish Dept.	Agricultural land
14205320D	Dam	Erie Dam	Recreation	Rush River WRD	29 homes
14205401BA	Dam	Elm River Det D #3	Flood Control	North Cass WRD	14 homes
14305223AC	Dam	Hunter Dam	Water Supply	City of Hunter	Agricultural land

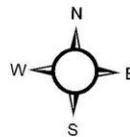
Source: ND State Water Commission

Figure 4.1 Dams in Cass County

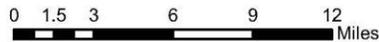
Cass County Dams



- River/Stream
- County Drain
- Lake or Pond
- Other Road
- County Road
- Interstate
- State Highway
- Cities
- Dam



Source:
North Dakota State Water Commission
Cass County Government



DISCLAIMER: This map is made available as a public service. Maps and data are to be used for reference purposes only and Cass County, ND, is not responsible for any inaccuracies herein contained. No responsibility is assumed for damages or other liabilities due to the accuracy, availability, use, or misuse of the information herein provided.

Extent

Most dams are classified based on the potential hazard to life and property should the dam suddenly fail. The hazard rating is not an indicator of the condition of the dam or its probability of failure. The following hazard categories have been established for North Dakota according to the North Dakota Dam Design Handbook (North Dakota State Engineer, June 1985, page 3):

- **Low Hazard:** These dams are located where there is little possibility of future development such as rural or agricultural areas. Failure of low hazard dams may result in damage to agricultural land, township and county roads, and non-residential farm buildings. No loss of life is expected if failure occurs.
- **Medium (Significant) Hazard:** These dams are located in predominately rural or agricultural areas where failure may damage isolated homes, main highways, railroads, or cause interruption of minor public utilities. The potential for the loss of a few lives exists if the dam fails.
- **High Hazard:** These are dams located upstream of developed and urban areas where failure may cause serious damage to homes, industrial and commercial buildings, and major public utilities. There is a potential for the loss of more than a few lives if the dam fails.

According to the North Dakota State Water Commission three dams in Cass County are considered High Hazard, seven are considered Medium Hazard and seventeen are considered Low Hazard. Note the hazard classifications of some of these dams are currently under review by the agency.

Previous occurrences

There have been no incidents of dam failure within Cass County since 1989.

Probability of future events

Although history would suggest a low probability of future events the current wet cycle and flooding history make dam failure a significant risk to areas of Cass County.

Dam Emergency Action Plans have been developed for all High Hazard and Medium Hazard Dams in the County. Specific details regarding potential events should those dams fail can be found in these plans on file with the County Emergency Management office. Included in these plans is a list of residents that could be impacted should a breach occur. Each of these lists is preformatted in the county Code Red system to receive an alert should a situation warrant such communication.

Risk Class

C: Low to moderate risk condition, sufficiently high to give consideration for further mitigation. Risk rating is unchanged since last plan.

Drought

Description

Drought is a condition of climatic dryness severe enough to reduce soil moisture below the minimum necessary level for sustaining plant, animal, and human life systems. Drought characteristics usually include precipitation levels well below normal and temperatures higher than normal. Under these conditions, topsoil crumbles and is lost due to wind erosion. Streams, ponds, and wells often dry up and water levels in lakes and rivers drastically fall, creating severe strain on vegetation, wildlife, and

livestock. Although the agricultural economy may be more negatively impacted, urban economies are also constrained when the amount of domestic and industrial water is in short supply.

Location

Drought can affect the entire planning area including all participating jurisdictions in any given year. Agriculture is most likely to be impacted first; therefore, rural areas of the county are likely to experience the effects of drought more often as a greater change in precipitation over a longer period of time will be necessary to cause the changes to water supply or industry that effect the urban population.

Mapping of the current drought status is published by the U.S. Drought Monitor each Thursday at <http://drought.unl.edu/>. Ground water information, including hydrographs, recent water levels and chemistry conditions, can be found at <http://mapservice.swc.state.nd.us/>. Daily streamflow conditions are maintained by the U.S. Geological Survey and can be found at <http://waterdata.usgs.gov/nd/nwis/rt>.

Extent

Drought is a creeping phenomenon, pervasive in nature. The effects of drought are slowly accumulated and tend to persist over long periods of time. Drought effects on agriculture depend on time of year, timing of precipitation, amount of stored soil moisture, type of crop, stage of growth, and meteorological variables such as temperature, humidity, and wind. Precipitation deficits as little as four to six inches can cause severe agricultural drought conditions.

A number of secondary hazards are generally associated with drought. Rural grassland fires increase due to dry vegetation. Reduction in vegetation will expose the soil to wind erosion. Reduced flow characteristics adversely affect chemical quality of lakes and rivers. Sediment transport regimes in streams and rivers are altered. Deterioration of water quality results in injury and death to plants and animals. Stagnant pools along rivers provide favorable habitat for insects, particularly mosquitoes. When normal rain patterns develop, the dry, unstable topsoil becomes vulnerable to gullies and flooding.

Determining whether conditions warrant drought status versus an extended dry spell is difficult and experts often disagree. However, a typical drought in Cass County would begin with limited winter snowfall, deficient spring precipitation accompanied by warmer than normal temperatures and windy conditions. At this point, normal spring greening does not occur causing a shortage of natural livestock feed. Spring planting plans most likely change. Fire danger to grasslands begins to increase. Growth and production of cash crops and feed grains become questionable. Continued drought negatively affects farm income, ultimately affecting agriculture-related businesses. Besides crop loss, recreational opportunities are reduced and hydroelectric power production is affected by drought. Water supplies for industries such as food processing may become limited and threaten the continuity of operations. Eventually, public drinking water supplies could be affected, resulting in a direct threat to lives. Drought causes serious economic problems for the entire State of North Dakota.

Several drought indices are used to measure a drought’s severity and any combination of these indices and others may be used to trigger a wide variety of response activities by governments, individuals, and organizations. **Table 4.2** lists the more common indices and their use.

Table 4.2 Common Drought Indices

Index	Use
Percent of Normal	The percent of normal is a simple calculation well suited to the needs of television weathercasters and general audiences.

Standardized Precipitation Index (SPI)	The SPI is an index based on the probability of precipitation for any time scale.
Palmer Drought Severity Index (PDSI)	The Palmer is a soil moisture algorithm calibrated for relatively homogeneous regions.
Crop Moisture Index (CMI)	A Palmer derivative, the CMI reflects moisture supply in the short term across major crop-producing regions and is not intended to assess longterm droughts.
Surface Water Supply Index (SWSI)	The SWSI was originally designed to complement the Palmer in the State of Colorado, where mountain snowpack is a key element of water supply. The SWSI is calculated by river basin, based on snowpack, streamflow, precipitation, and reservoir storage. Other states have modified the SWSI for their areas.
Reclamation Drought Index (RDI)	Like the SWSI, the RDI is calculated at the river basin level, incorporating temperature as well as precipitation, snowpack, streamflow, and reservoir levels as input.
Deciles	Groups monthly precipitation occurrences into deciles so that, by definition, "much lower than normal" weather cannot occur more often than 20 percent of the time.

Previous occurrences

SHELDUS shows no drought occurrences since 1989. Local knowledge suggests drought conditions were experienced from 1988-92. The severity of the 1988-1992 drought in North Dakota has been described by documenting the drought as a climatic and hydrologic event, documenting the effect of the drought on people and resources, and comparing the drought to previous droughts. Indices such as the Palmer Drought Severity Index, drought recurrence intervals and water levels were used to compare the 1988-1992 drought to previous droughts prior to the previous plan. It was determined that the 1988-1992 drought was the second most severe drought in North Dakota since 1930. It has been suggested that drought conditions also existed the summer of 2012; however, the relatively short duration and limited time since the event does not allow for significant analysis at this time. The hot dry conditions calling attention to the possibility of drought in the middle of what seems to be a persistent wet cycle in the area reinforces the need for comprehensive planning for all types of hazards.

Probability of future events

The probability of drought is fairly high in any given year. The Valley's growing population combined with the likelihood of a severe drought occurring in the Red River Valley in the next 50 years warranted the creation of the Lake Agassiz Water Authority by the state legislature in 2003. LAWA's purpose is to provide a reliable supply of drinking water to eastern North Dakota with a focus on the economic welfare of the people and reliability of high-quality water supply. LAWA is comprised of cities and water districts in the Red River Valley including the eastern 13 counties in North Dakota and three border cities in Minnesota (<http://lakeagassiz.org>).

Agriculture is one of the largest industries in Cass County accounting for significant revenues. According to the 2007 Census of Agriculture the Crop exposure value in Cass County was over \$252 million. Although approximately 89 percent of North Dakota crops are insured according to the 2011 North Dakota Crop Insurance Profile Report issued by the USDA Risk Management Agency, ripple effects of even a small number of drought years would be felt throughout the local economy.

Risk Class

A: High risk condition, highest priority for mitigation and contingency planning. All areas in Cass County are at the same risk of this hazard. Risk rating is unchanged since last plan.

Flood

Description

Flooding has been a part of the County's conflict with nature throughout history. Flooding is an overflow of water on land not normally covered by water. Floods are a natural phenomenon; however, human activities often intensify flood hazards because of the alteration of natural conditions. Floods often occur along rivers and streams, along closed basin lakes, in poor drainage areas, or in oversaturated soils. Flooding of land adjoining the normal course of a stream or river or a closed basin lake is a natural occurrence. If these floodplain areas were left in a natural state, the floods would not cause major damage. The economic attractiveness of vacant land has resulted in the development of some floodplain areas despite the risk. The urban, industrial, and agricultural encroachment on natural floodplain areas has increased the potential for dangerous flooding, and causes the flood waters to adversely affect these areas. The flood potential is increased further due to introduction of impervious surfaces and tilled ground to areas whose natural state consisted of more pervious and absorptive materials. Rainfall that would normally soak into the ground or take several days to reach a stream or river via a natural drainage basin now quickly runs off streets, parking lots, rooftops, and tilled and ditched agricultural fields, through channels and pipes.

Surface water is that water found on the land surface and includes overland flow and flow in distinct channels. The three major sources of surface water include: 1) streams and rivers flowing into the state, 2) precipitation, and 3) groundwater discharge along streambeds. Surface water leaves the state in out-flowing streams and rivers, by evaporation, and by percolating downward into the subsurface groundwater flow system.

Many floods in Cass County occur because the ground is frozen and/or saturated with moisture and cannot absorb any further moisture. This moisture can come from several different sources and circumstances. One source is a heavy snowpack, which is affected by a rapid warming trend as well as spring rain falling directly on the snowpack.

Several types of flooding can and do occur in Cass County: riverine flooding, levee failure, ice jam flooding and flash flooding. Ice jam flooding occurs in winter and early spring months during thawing periods. Riverine flooding of major rivers and any associated levee failure generally occur during the spring flash flooding possible in the spring and into summer months. The magnitude of the flooding varies from year to year depending on such factors as characteristics of the snow cover, soil moisture conditions, frost depth, winter temperatures, temperatures during spring melting, spring precipitation, and the extent of ice jams. A wet fall, early freeze up with saturated ground at the time of freezing, heavy winter precipitation, and warm rains during and after spring thaw add to the seriousness of the spring flooding situation. Smaller streams are more susceptible to flooding in the summer with peak flows resulting from thunderstorms.

Riverine Flooding – Riverine flooding originates from a body of water, typically a river, creek, or stream, as water levels rise onto normally dry land. The riverine hazard areas may be mapped as part of the National Flood Insurance Program (NFIP). Under this program, an area is broken into zones to depict the level of flood hazard. Most commonly, the areas within the 100-year floodplain are considered the

greatest risk. The 100-year floodplain is that area of the floodplain that has a 1 percent chance of flooding in any given year. Over a 100-year period, a flood of this magnitude or greater has a

63.5 percent chance of occurring. According to the Federal Emergency Management Agency, structures in the 100-year floodplain are nearly three times more likely to be damaged by flood than a major fire. Locations outside the 100-year floodplain may also experience flood conditions during greater magnitude floods, localized events, flash flooding, or along unmapped creeks, streams, and ditches.

Most riverine floods are slow developing events with a natural, predictable source of water or moisture, such as snowmelt, slow rain, or a controlled dam release. This type of flood can often be forecast based on the amount of moisture or water available. The timing and location of flood conditions can often be calculated to a reasonable degree. If implemented in a timely manner, protective measures can sometimes mitigate the potential damage and loss.

For the purpose of this plan the 100-year floodplain referenced was produced for the US Army Corps of Engineers for the potential FM Diversion. It is meant to represent a 100-year-flood event with existing conditions. As several design phases have occurred for that project any mention of Phase 7 is reference only to the diversion project phase. The steering committee is of the opinion that this model is a more realistic picture of potential damages in light of the recent wet cycle.

Levee Failure - Levees are earth embankments constructed along rivers and coastlines to protect adjacent lands from flooding. Floodwalls are concrete structures, often components of levee systems, designed for urban areas where there is insufficient room for earthen levees. Levees are usually engineered to withstand a flood with a computed risk of occurrence. When a larger flood occurs and/or levees and floodwalls and their appurtenant structures are stressed beyond their capabilities to withstand floods, levee failure can result in loss of life and injuries as well as damages to property, the environment, and the economy. In North Dakota, there are hundreds of levees ranging in size from small agricultural levees that were constructed primarily to protect farmland from high frequency flooding to large urban levees that were constructed to protect people and property from larger, less frequent flooding events, such as the 100-year and 500-year flood events. For purposes of this plan, the levee failure hazard will refer to both overtopping and breach of a levee as defined in FEMA's publication "So You Live Behind a Levee" (<http://content.asce.org/ASCELeveeGuide.html>)

Levees are usually engineered to withstand a flood with a computed risk of occurrence. Many flood control dikes and levees have been constructed over the years in attempts to contain floodwaters within the channel and protect development. Some of these structures have not been built to current standards. A majority of these structures have been built under emergency conditions, with changing cross sections or elevations; some lack the necessary free board, many are not strong enough, have not been maintained properly, or other problems may exist. The presence of levees that are not built in accordance with current standards and/or are not intended to protect against larger floods such as the 100-year or 500-year flood can, in some cases, generate a false sense of security.

Ice Jams - Flooding can also result from ice jamming or blockage along streams. Ice breaking up into pieces, called floes, moves along with the flowing rivers or streams. The ice floes can jam at curves, narrow places in the channel, structures, river/stream confluences, or where there is a sharp decrease in river bed gradient, creating an effective dam that produces water backup and overflow. Ice jams can cause considerable increases in upstream water levels, while at the same time downstream water levels may drop. According to the US Army Corps of Engineers, the types of ice jams include freeze up jams, breakup jams, or combinations of both. When an ice jam releases, the effects downstream can be similar to that of a flash flood levee failure, or dam failure. Ice jams are more prevalent on the Red River of the North due to its northward flow into often colder areas where melting is delayed.

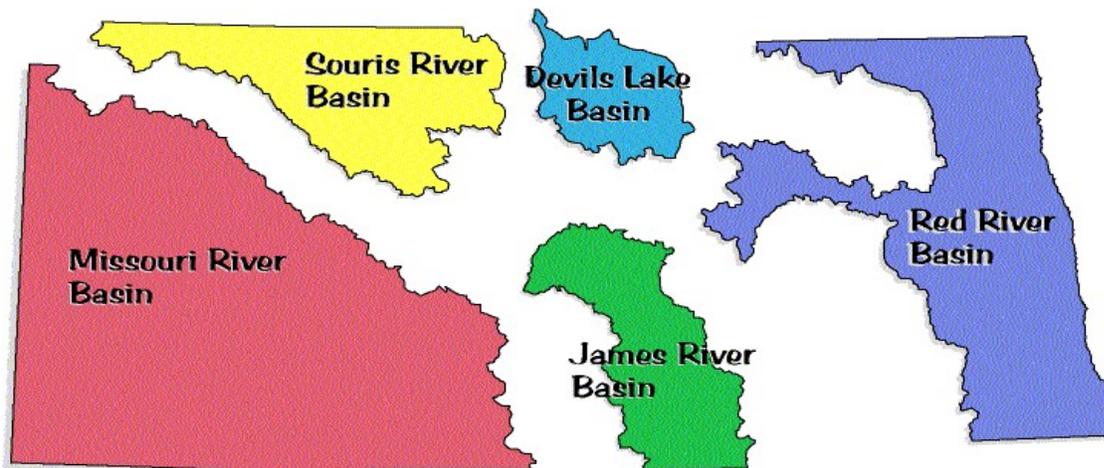
Flash Flood - Another source of flooding, called flash flooding, occurs when heavy rain falls in such a short time that the soil cannot absorb it and/or drainage systems (natural or mad made) cannot carry the volume of water away as quickly as it accumulates. Flash flooding also occurs when heavy rain falls over a prolonged period of time and the ground becomes saturated and cannot absorb the additional moisture fast enough.

A flash flood is usually caused by severe thunderstorms, heavy rains on snowpack, slow moving storms, dam, dike, or levee failures, or ice jam releases. Flash floods can occur anywhere when a large volume of water inundates an area over a short time period. Because of the localized nature of flash floods and variables in rainfall amounts and duration, clearly defined areas prone to flash flooding are difficult to identify. These types of floods often occur rapidly with significant impacts. Rapidly moving water, only a few inches deep, can lift people off their feet, and only a depth of a foot or two, is needed to sweep cars away. Substantial damage is not common from flash floods in Cass County; however, traffic delays from water running over roadways and underpasses becoming impassible are a real concern.

Location

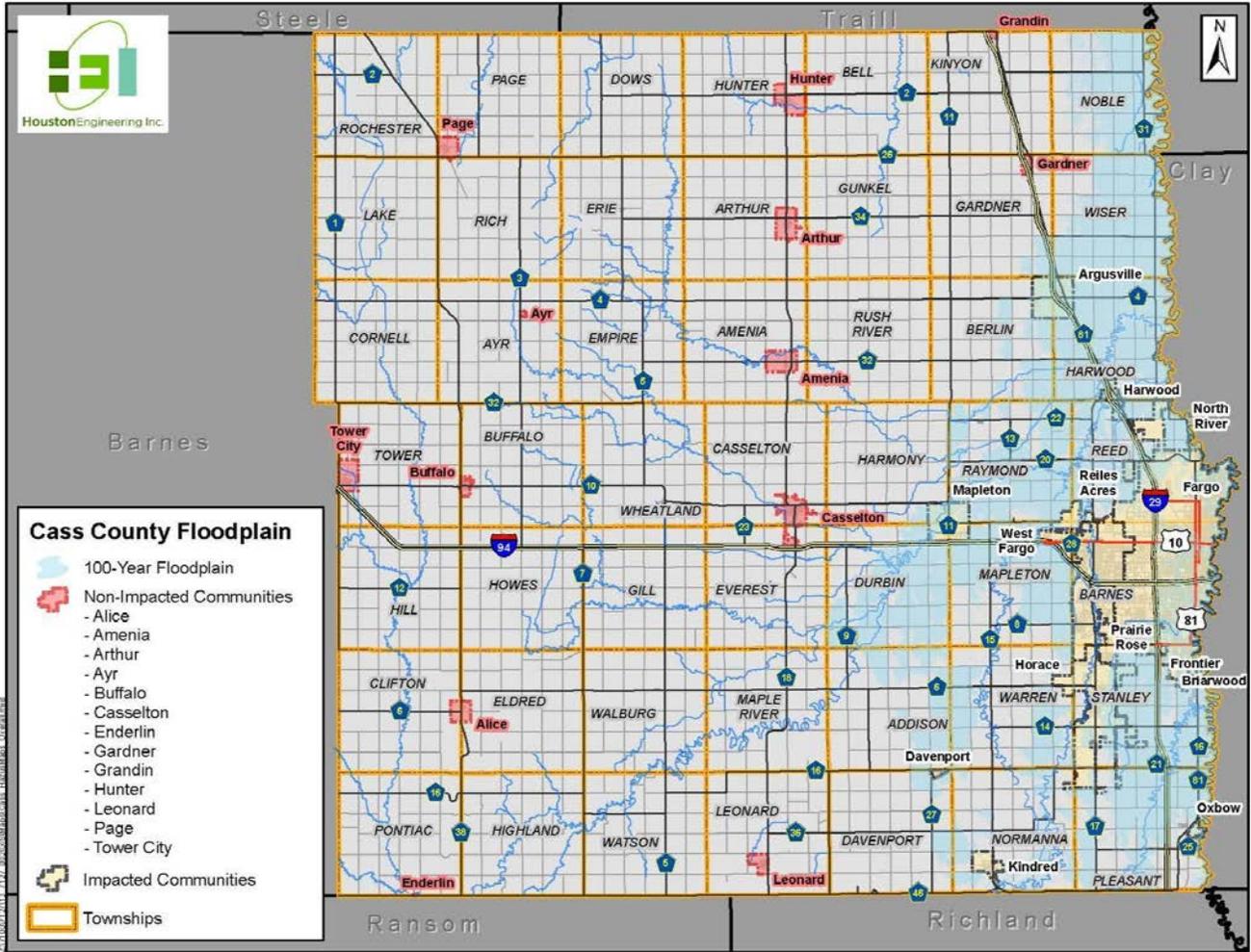
Cass County is located in the Red River Basin. A map of the various river basins in North Dakota can be found in **Figure 4.2**. The Red River is the principal river of the basin. It serves as the border between North Dakota and Minnesota and winds nearly 400 river miles from its origin at the confluence of the Otter Tail and Bois de Sioux Rivers at Wahpeton, North Dakota and Breckenridge, Minnesota, north to the Canadian border. The Red River continues to flow about 155 river miles to Lake Winnipeg in Manitoba. The valley through which the river flows is the flat lakebed of pre-historic Lake Agassiz. The very flat gradient causes widespread overland flooding when the channel capacity is exceeded.

Figure 4.2 North Dakota Basins



Riverine flooding is the main concern in Cass County. Flash flooding can occur anywhere in the County and poor drainage areas that can cause pooling and overland flooding are spread throughout. The most likely damage from riverine flooding can be seen in **Figure 4.3** which depicts the 100 year flood plain according to the Army Corps of Engineers modeling. City limits of the communities highlighted in red do not intersect the floodplain. More detailed views of jurisdictions whose city limits do intersect the floodplain can be found in Section 6.

Figure 4.3 Cass County 100 Year Floodplain



Source: Houston Engineering data developed for US Army Corps of Engineers existing conditions study

Extent

Flooding has impacted Cass County with increasing frequency and severity in recent years. Ten of the top twenty crests have occurred since 1989 with crests in 2009, 2010 and 2011 ranking first, seventh and fourth respectively of all time. Additional detail about historical crests can be found in **Table 4.3**.

Table 4.3 Historical Crests for Red River of the North at Fargo

Rank	Crest	Date	Rank	Crest	Date
1	40.84	3/28/2009	11	34.41	4/2/1978
2	39.72	4/18/1997	12	33.26	7/4/1975
3	39.10	4/7/1897	13	33.22	5/1/2013

4	38.81	4/9/2011	14	30.88	6/9/2007
5	37.34	4/15/1969	15	30.50	4/15/1965
6	37.13	4/5/2006	16	30.16	3/22/1966
7	36.99	3/21/2010	17	29.8	3/31/1907
8	36.69	4/14/2001	18	28.79	4/16/1952
9	35.39	4/9/1989	19	28.75	4/15/1996
10	34.93	4/19/1979	20	28.40	4/7/1943

Previous occurrences

Cass County has experienced several flood events since 1989 including seven of the top ten crests of the Red River of the North at Fargo. The County has also been included in fourteen Presidential Disaster Declarations that have included flooding in the description. The Disaster Declarations follow in **Table 4.4**.

Table 4.4 Presidential Disaster Declarations Related to Flooding since 1989, Cass County, ND

Disaster Number	Date	Description
4118	5/29/2013	Flooding
1981	5/10/2011	Flooding
1907	4/30/2010	Flooding
1829	3/24/2009	Severe Storms and Flooding
1713	7/17/2007	Severe Storms and Flooding
1645	6/5/2006	Severe Storms, Flooding and Ground Saturation
1376	5/28/2001	Floods
1334	6/27/2000	Severe Storms and Flooding
1279	6/8/1999	Severe Storms, Tornadoes, Snow and Ice, Flooding, Ground Saturation, Landslides and Mudslides

1220	6/15/1998	Flooding and Ground Saturation
1174	4/7/1997	Severe Storms and Flooding
1118	6/5/1996	Flooding
1001	7/26/1993	Flooding, Severe Storms
825	5/8/1989	Flooding

Source: www.fema.gov/diasters

The following information details significant flood events including, but not limited to the situations spurring the Presidential Disaster Declarations noted above.

April 10, 1996 – Moderate to severe flooding occurred on the Red River of the North and many of its tributaries in North Dakota. Above normal precipitation was observed over the basin for the six months prior to the flood. In addition, heavy snow cover, with drifts up to 12 feet, lingered into early April. This combined with rapid snowmelt to produce a memorable spring flood, despite below average precipitation from mid-March through April. On April 19th at 7:00 pm, a 19 year-old man from Warroad, MN, drowned while attempting to cross the Robin Bridge over the Red River at Drayton, ND. The man unfortunately did not heed a road-closed sign. Residents along the Sheyenne River were hit particularly hard. At Kindred, ND, Governor Schafer declared a flood disaster and activated the National Guard to assist in response and recovery.

May 17, 1996 – A flash flood in Fargo resulted in extensive basement flooding and roads closed. Property damage from this event is estimated at \$100,000.

April 2, 1997 – Overland flooding due to melting snow forced the towns of Casselton, Amenia, and Mapleton to dike and sandbag. Water filled entire fields along Interstate-94 between Casselton and West Fargo, even flowing over Interstate-94 in several points. The Maple River set a new record in Mapleton on April 4th. Property damage from this event is estimated at \$10 million.

April 8, 1997 – Record levels on the Sheyenne River forced the closing of Interstate-29 near Harwood. New records were set on the Sheyenne at Kindred on the 8th, West Fargo on the 9th, and Harwood on the 10th. The 600 people of Harwood, inside a newly constructed ring dike, could only leave by boat. Property damage in Cass County from this event is estimated at \$100 million.

April 16, 1997 – The cresting Red River caused numerous problems in the Hickson and Fargo areas. Numerous homes along the river were flooded as the river rose to a new record for the century on the 18th, at 39.55 feet. Overland flooding caused problems along the south and southwest sides of Fargo, as water from the Wild Rice River broke out of its banks and headed overland toward Fargo. The water flowed over Interstate-29 near the Horace exit. A clay dike was built along the south side of the city to prevent this water from flooding thousands of homes. A section was also cut out of US Highway 81 to relieve the water level along the south side of Fargo. Property damage in Cass County from this event is estimated at \$150 million.

April 17, 1997 – The Red River broke through a dike along South Terrace Drive in Fargo, flooding 30 homes and the Oak Grove High School. Two hundred and seventy students and their teachers and parents had sandbagged at the high school for three weeks to try to save the school.

June 18, 1998 – Three to five inches of rain fell in less than three hours across portions of Fargo resulting in a flash flood. The Fargo airport reported 3.03 inches of rain. The western edge of the city was hit the hardest. The interchange between Interstate-29 and Interstate-94 was closed due to high water. Several garages in the basement levels of apartment buildings flooded. Major underpasses around the city also had to be closed. Property damage from this event is estimated at \$250,000.

June 19, 2000 – After three to five inches of rain fell on the Casselton area, flash flooding occurred. Roughly 40 percent of the homes sustained some sort of water damage, which equated to about 200 homes. Property damage from this event is estimated at \$500,000.

June 19, 2000 – A series of thunderstorms brought heavy rain to the Fargo area. A total of 6.82 inches was reported at the ASOS site at the Fargo airport. The official observer in north Moorhead reported 7.31 inches. This is believed to be a new 24-hour rainfall record for the Fargo-Moorhead area. The heavy rain halted traffic, inundated storm sewers, and knocked out electricity and phones. Approximately 20,000 customers lost power when a power station was submerged. A state of emergency was declared in the city at 3:00 am. At one point, fifty percent of the city streets were flooded. The major traffic arteries, Interstate-29 and Interstate-94, were flooded and closed for several days. The Fargo dome sustained major damage when flooding along 19th Avenue North overflowed into the parking lot and into the lower level of the building. Eight to 12 feet of water, roughly 51.8 million gallons filled the bottom level. This was up to the first row of seats. There was an unconfirmed report of a man injured from a flying manhole cover that blew out from the force of the sewer line backup. Damage was particularly high at North Dakota State University, where nearly all 88 buildings took on water. Four feet of water in the campus library damaged the periodical section. The telephone and Internet services for the campus were also disrupted. 54 percent of the residences in the city of Fargo had water damage. Property damage from this event is estimated at \$100 million.

June 19, 2000 – After the six to eight inches of rain fell across eastern Cass County; the runoff affected area rivers. The Sheyenne River broke outside its banks north of Fargo, flooding the rest stop along Interstate-29. The Red River in Fargo stood at 15.64 feet late in the day on the 19th. By early on the 21st, the river rose to 22.85 feet. Several low-lying roads along the river had to be closed. One-half of the cropland in Cass County was damaged. Crop damage from this event is estimated at \$20 million.

April 8, 2001 – The Maple River at Mapleton, ND crested at 14.77 feet. This crest was the third highest recorded with the National Weather Service.

April 10, 2001 – The Sheyenne River at Harwood, ND crested at 891.30 feet. This crest was the second highest recorded with the National Weather Service

April 10, 2001 – The Wild Rice River at Abercrombie, ND crested at 22.13 feet. This crest was the third highest recorded with the National Weather Service

April 11, 2001 – The Sheyenne Diversion just on the northwest corner of West Fargo, ND crested at 22.13 feet. This was the second highest crest recorded with the National Weather Service. The nondiverted stretch of the Sheyenne River at West Fargo crested at 17.79 feet on April 4, 2001.

April 30, 2001 – Flood fight costs and damages from the flooding and overflows of the rivers in Cass County was \$2.8 million. Eleven cities reported damages and flood fight costs due to flooding rivers. A lot of additional damage was averted due to extensive mitigation efforts undertaken by all of Cass County after the 1997 flooding of Cass County Rivers and just prior to the cresting of the rivers in 2001.

Volunteer efforts lead by First Link in Fargo allowed for many homeowners to protect their property early enough to avert a high level of home damage. Both the City of Fargo and Cass County provided homeowners and other large residential areas with free sand and sandbags to assist in the flood fight.

April 1, 2006 - The Red River at Fargo/Moorhead rose above flood stage around 1:00 am on March 30th and remained above flood stage until around 7:00 pm on April 19th. The river peaked at roughly 37.18 feet around 2:00 am on April 5th. Unofficially, 37.18 feet would be the fifth highest modern-day river stage recorded. The third highest modern-day river stage of 891.35 feet MSL (unofficial) was recorded on the Sheyenne River at Harwood on April 3rd and the seventh highest was recorded at the West Fargo Diversion on April 3rd. Overland flooding also occurred in addition to the river flooding, with over 40 roads around the county closed due to flooding. The body of a homeless man was also found in the Red River north of Main Avenue on April 7th. Cass County received a Presidential Disaster Declaration for damages caused by spring flooding. In summary, the total public and private flood losses experienced within the Red River of the North basin through late March and April 2006 were in excess of \$20 million.

March 28, 2009 - The Red River of the North crested at a record 40.82 feet. Cass County received a Presidential Disaster Declaration for damages caused by spring flooding including both Individual Assistance and Public Assistance. Volunteers filled and placed sandbags along most drains in Fargo to protect homes and other critical infrastructure. Miles of clay levees were built along the river and on streets near the river to protect the FM MSA. Expenditures by the City of Fargo and Cass County total more than \$15 million dollars. This does not include small cities or any private damage costs. Total losses across the state from the floods of 2009 are estimated at \$623 million.

March 21, 2010 - The flood depth on the Red River at Fargo reached 36.99 feet. In the Fargo-Moorhead area alone, about 1.5 million sandbags were put in place to protect property. Several bridges over the Red River were closed, but no major damage was reported. Emergency expenditures by the City of Fargo and Cass County total more than \$7.5 million dollars. This does not include small cities or any private damage costs.

April 9, 2011 - The Red River at Fargo crested at 38.81 feet, the fourth highest crest on record. The Red River Valley began flooding on March 22nd, with Fargo reaching flood stage on March 29th. Due to a rather wet summer, Fargo experienced 150 days above flood stage this spring and finally dropped below flood stage on the 27th of August. Expenditures by the City of Fargo and Cass County total more than \$13.7 million dollars. This does not include small cities or any private damage costs.

May 1, 2013 - The Red River at Fargo crested at 33.22. Flood predictions were much worse than the flood experienced therefore damage was minimal. The City of Fargo and Cass County still spent more than \$3 million dollars primarily in preparation.

Probability of future events

Considering the extensive history of flooding in Cass County the probability of an event in any given year is fairly high. Experiencing flooding that warranted Presidential Disaster Declarations fourteen times in the past 25 years shows that a major flood has occurred more frequently than once in every two years. Generally, the more frequent events have a low impact, and the high impact events occur less frequently; however in recent history the County has experienced several high impact events. Knowledge has been gained with every event and substantial mitigation projects have significantly reduced potential damages going forward.

Risk Class

A: High risk condition, highest priority for mitigation and contingency planning. Recent flooding caused the county to upgrade this hazard to an A countywide from a B or C in the prior plan depending on area. All townships have experienced some degree of flood damage in the past five years, including a number with nearly yearly damage.

NFIP Compliance

Cass County sees great value in the NFIP program and does what it can to inform residents and encourage participation. According to the County's Comprehensive plan Goal One: Objective D "The County will ensure new development will protect the short and long term health, safety, and general welfare of the county's citizens from flooding."

The policies are as follows:

Policy 1. Prevent development from occurring in flood prone areas.

Policy 2. Prevent development with the potential need for flood buyouts, flood mitigation, and temporary flood protection.

Policy 3. Prevent development having limited access during times of high water.

Policy 4. Deter development which adversely impacts the flooding potential in the county.

Policy 5. Require new developments near potential flood areas to submit a flood protection plan outlining the risk of flooding and necessary solutions to protect the lives and investments of the county's citizens.

The County has implemented procedures to address specific NFIP requirements and regulations. A floodplain ordinance has been adopted and is adjusted as new information becomes available. Residents are provided information on flood hazards, floodplain map data, flood insurance and proper construction measures. An interactive floodplain map can be found on the County website at <https://www.casscountynd.gov/county/depts/GIS/interactive/Pages/default.aspx>. When issuing building permits it is ensured that new development does not cause increased flooding elsewhere and new buildings will be protected to the current BFE.

Flood Insurance for Cass County as well as repetitive loss buildings are detailed in **Table 4.5**.

Table 4.5 Flood Insurance Detail

**Federal Emergency Management Agency
Disaster Report - NORTH DAKOTA
Flood Insurance - Detail**

CID	Community	CRS Class Rating	Policies	Insurance In Force	Total Paid Losses	Total Paid Amount	Repetitive Loss Buildings	Repetitive Loss Payment	Target Rep. Loss Buildings
** CASS COUNTY **									
380363	ALICE, CITY OF		0	0	0	0	0	0	0
380019	AMENIA, CITY OF		1	175,000	4	16,088	0	0	0
380686	AMENIA, TOWNSHIP OF		0	0	1	726	0	0	0
380639#	ARGUSVILLE, CITY OF		4	1,050,500	5	13,162	1	8,623	0
380156#	ARTHUR, CITY OF		1	18,000	0	0	0	0	0
380350	AYR, CITY OF		0	0	0	0	0	0	0
380256#	BARNES, TOWNSHIP OF		308	86,572,000	70	240,367	0	0	0
380620#	BERLIN, TOWNSHIP OF		5	1,004,400	2	46,833	0	0	0
380651#	BRIARWOOD, CITY OF		13	4,380,100	36	2,226,087	1	489,590	0
380160	BUFFALO, CITY OF		0	0	0	0	0	0	0
385362	CASS COUNTY *		8	2,205,000	8	205,280	1	155,404	0
380020#	CASSELTON, CITY OF		25	6,039,000	6	28,980	0	0	0
380690	DAVENPORT, TOWNSHIP OF		1	280,000	1	12,355	0	0	0
380325#	DURBIN, TOWNSHIP OF		6	611,800	12	49,737	0	0	0
380366	EMPIRE, TOWNSHIP OF		0	0	0	0	0	0	0
385363#	ENDERLIN, CITY OF		4	568,000	12	39,538	0	0	0
380352	EVEREST, TOWNSHIP OF		0	0	0	0	0	0	0
385364#	FARGO, CITY OF	7	3,769	1,049,447,100	1,256	7,912,489	4	74,528	0
380347	FRONTIER, CITY OF		1	45,000	0	0	0	0	0
385412	GARDNER, CITY OF		0	0	0	0	0	0	0
380286	GARDNER, TOWNSHIP OF		1	210,000	9	23,786	0	0	0
380335	GRADIN, CITY OF		0	0	0	0	0	0	0
380338#	HARWOOD, CITY OF		65	11,741,800	39	86,685	1	14,218	0
380259#	HARWOOD, TOWNSHIP OF		66	11,344,000	188	491,363	4	74,917	0
380022#	HORACE, CITY OF		7	1,268,700	28	108,029	0	0	0
380181#	HUNTER, CITY OF		0	0	1	3,011	0	0	0
380182	KINDRED, CITY OF		4	980,000	8	38,201	1	30,360	0
380185	LEONARD, CITY OF		0	0	0	0	0	0	0
380023#	MAPLETON, CITY OF		6	1,078,600	9	38,804	0	0	0
380262#	MAPLETON, TOWNSHIP OF		34	6,216,900	17	30,688	0	0	0
380268#	NOBLE, TOWNSHIP OF		10	1,236,700	35	195,121	3	45,300	1
380264#	NORMANNA, TOWNSHIP OF		44	6,658,100	42	234,772	3	108,847	0
380623#	NORTH RIVER, CITY OF		4	1,330,000	8	32,559	0	0	0
380681	OSBOW, CITY OF		2	565,000	15	243,128	0	0	0

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10/07/2013

**Federal Emergency Management Agency
Disaster Report - NORTH DAKOTA
Flood Insurance - Detail**

CID	Community	CRS Class Rating	Policies	Insurance In Force	Total Paid Losses	Total Paid Amount	Repetitive Loss Buildings	Repetitive Loss Payment	Target Rep. Loss Buildings
380193	PAGE, CITY OF		0	0	0	0	0	0	0
380263#	PLEASANT, TOWNSHIP OF		114	31,514,500	164	1,837,343	4	256,471	0
380655	PRAIRIE ROSE, CITY OF		11	3,465,000	2	1,750	0	0	0
380261#	RAYMOND, TOWNSHIP OF		36	6,692,800	34	152,833	2	17,340	0
380257#	REED, TOWNSHIP OF		71	13,374,600	312	970,745	9	112,597	0
380324#	REILES ACRES, CITY OF		34	7,724,200	17	15,712	0	0	0
380258#	STANLEY, TOWNSHIP OF		270	72,607,000	568	8,766,883	23	2,111,885	0
380210	TOWER CITY, CITY OF		0	0	0	0	0	0	0
380652#	WALBURG, TOWNSHIP OF		1	91,000	4	37,900	0	0	0
380265#	WARREN, TOWNSHIP OF		28	3,825,600	15	28,373	0	0	0
380024#	WEST FARGO, CITY OF		185	47,746,200	342	542,950	6	94,727	1
380267#	WISER, TOWNSHIP OF		16	2,059,000	36	298,374	1	55,538	1
County Total :			5,155	1,384,125,600	3,306	24,970,652	64	3,650,343	3
Grand Total :			5,155	1,384,125,600	3,306	24,970,652	64	3,650,343	3

Geologic Hazards

Description

Geologic hazards in Cass County usually do not cause severe damage, but the potential exists for the occasional landslide or earthquake.

Landslide - A landslide is the movement of rock, soil, artificial fill, or a combination thereof on a slope in a downward or outward direction. The primary causes of landslides are slope saturation by water from intense rainfall, snowmelt, or changes in ground-water levels on primarily steep slopes, earthen dams, and the banks of lakes, reservoirs, canals, and rivers (US Geological Survey).

Riverbank slumping can be considered a form of landslide and is often found along the rivers in Cass County. The riverbank soils are inherently weak, and natural forces are always moving river channels. Urbanization has artificially accelerated riverbank slumping and instability through activities such as placing homes and structures too close to the riverbank in a way that adds pressure to the bank and increases soil hydration through increased storm water runoff, using irrigation systems that saturate the soil and decrease its strength, adding weight to the riverbank with structures, retaining walls, and riprap, and planting shallow-rooted vegetation. Minimizing these types of activities and placing structures away from riverbanks can mitigate some, but not all, riverbank slumping.

Earthquake - An earthquake is the sudden movement of the Earth, caused by the abrupt release of strain that has accumulated over a long time. For hundreds of millions of years, the forces of plate tectonics have shaped the Earth's surface. Huge plates slowly move over, under, and past each other. Sometimes the movement is gradual. At other times, the plates are locked together, unable to release the accumulating energy. When the accumulated energy grows strong enough, the plates break free, thus, producing an earthquake (US Geological Survey).

Location

Cass County is not located on a major fault line or other high probability geologic hazard area thus the main geologic threat is along the waterways throughout the County. Bank slumping is a concern sparking set back requirements and riparian projects where possible.

Extent

Riverbank slumping is typically a creeping phenomenon caused by a number of natural forces. Over the years, human interaction has accelerated the problem. Impacts to the built environment are what cause this natural occurrence to be considered a hazard. Impacts to community infrastructure are the main concern to the County and local jurisdictions followed closely by effects experienced by individual residents.

A geotechnical evaluation can be performed by engineering firms to study soil stability, the impacts of a landslide on the integrity of any structures nearby and the likelihood of future movement in landslide locations. This is the best way to determine potential impacts.

Previous occurrences

A condo complex and approximately 12 residences have been identified in West Fargo with slumping issues along the Sheyenne River. Other areas in the County have been identified where riparian projects may be a solution or buildings may need to be acquired and removed or relocated to areas further from the unstable river banks. These areas are primarily along the Red River, Sheyenne River and Wild Rice River in the unincorporated County.

Probability of future events

In an effort to diminish future slumping problems, education programs have been developed to inform the public. Grand Forks County and Cass County Soil Conservation Districts, along with several other organizations, recently completed a guidebook, *Living with a River*. It is hoped this publication will give

people a better understanding of rivers and how they function, so wise management decisions with our river ecosystems can be made by landowners and government entities. (North Dakota Forest Service)

Risk Class

B: Moderate to high risk condition, risk addressed by mitigation and contingency planning. Geologic hazards were not identified in the previous plan. Unstable soils and slumping along rivers has been a concern in recent years in many areas throughout the County.

Severe Summer Storm

Description

Thunderstorms are the most common summer storm that can become severe resulting in loss of life, injuries, and damage to property and crops. Severe summer weather also includes tornadoes, hail, downbursts, straight-line winds, lightning and extreme heat.

Tornado - A tornado is a violently rotating column of air extending from a thunderstorm to the ground. A tornado is initially a cloud within the thunderstorm, composed of condensed water vapor. A tornado forms when a change in wind direction and increase in wind speed with increasing height creates a horizontal spinning effect in the lower atmosphere. This area of rotation may be two to six miles wide, extending through much of the storm. Most tornadoes form within this area of strong rotation when the rising air within the thunderstorm updraft tilts the rotating air from horizontal to vertical. Tornadoes may appear nearly transparent until the circulating wind in the funnel reaches the ground and picks up debris that eventually darkens the whole funnel.

Tornadoes can vary greatly in shape, size, and wind speed. Most tornadoes, 88 percent, have wind speeds of less than 110 miles per hour (mph) and a lifetime of less than ten minutes. These weak tornadoes result in less than five percent of tornado deaths. Tornadoes commonly move from southwest to northeast, but tornadoes have been known to move in any direction. The average forward speed is 30 mph, but may vary from nearly stationary to 70 mph. Approximately 11 percent of all tornadoes have wind speeds between 110 mph and 205 mph and result in nearly 30 percent of all tornado deaths. These strong tornadoes may last 20 minutes or longer. Less than one percent of all tornadoes have resulted in 70 percent of all tornado deaths. These violent tornadoes can be over a mile wide with documented rotating winds of more than 250 mph, and they can have lifetimes exceeding one hour and stay on the ground for over 50 miles.

Hail - Hail is precipitation in the form of a lump of ice that forms during some thunderstorms. Hail occurs when strong rising currents of air within a storm, called updrafts, carry water droplets to a height where freezing occurs. The ice particles grow in size, finally becoming too heavy to be supported by the updraft and fall to the ground. Hailstones are usually round but can be conical or irregular in shape. They can range from pea size to the size of grapefruit, and large hailstones can fall at speeds faster than 100 mph. Hail tends to fall in swaths that range from a few acres to an area ten miles wide and one hundred miles long. Most hail events, however, affect only relatively small areas. (National Severe Storms Laboratory, 2007)

Downbursts - Downbursts form along the leading edge of a thunderstorm. Downbursts are intense concentrations of sinking air, which can fan out upon striking the earth's surface, producing damaging horizontal winds also referred to as straight line winds. These strong winds can produce damage similar to a tornado.

Straight Line Winds - Straight-line winds are responsible for most thunderstorm wind damage. These winds occur most often at the leading edge of a storm. They do not tend to last long but can approach

100 mph. Straight-line winds can have much the same effect on structures as tornadoes; the primary difference between the two phenomena is the lack of rotation in straight-line winds. Strong sustained winds and gusts accompanying severe thunderstorms can last for several hours, causing significant damage to crops, buildings, power lines, and trees.

Lightning – Lightning is produced by the interaction of charged particles that produce an intense electrical field within the cloud of a thunderstorm. The earth is normally negatively charged with respect to the atmosphere, but as a thunderstorm passes over the ground, the negative charge in the base of the cloud induces a positive charge on the ground below for several miles around the storm. The ground charge follows the storm like an electrical shadow, growing stronger as the negative cloud charge increases. Air is a poor conductor of electricity which insulates the cloud and ground charges preventing a flow of current until huge electrical charges are built up. Lightning occurs when the difference between the positive and negative charges becomes great enough to overcome the resistance of the insulating air and to force a conductive path for current to flow.

Lightning can cause fatalities, injuries, and property damage directly and indirectly. It can strike humans, animals, aircraft, buildings, equipment, and the surface of the earth causing death and destruction. Lightning can trigger other hazards including fires, power surges, interruption of communications, downed power lines, and exposure to noxious gas due to vaporization of materials. Computer equipment is especially vulnerable to damage from power surges.

Extreme Heat – According to information provided by FEMA, extreme heat is defined as temperatures that hover ten degrees or more above the average high temperature for the region and last for several weeks. Heat kills by taxing the human body beyond its abilities.

Heat illnesses generally have to do with a reduction or collapse of the body's ability to shed heat by circulatory changes and sweating or a chemical (salt) imbalance caused by too much sweating. When heat gain exceeds the level of heat the body can remove, or when the body cannot compensate for fluids and salt lost through perspiration, the temperature of the body's inner core begins to rise and heat-related illness may develop. People who are elderly, young, chronically ill, on certain medications or drugs, or afflicted with weight or alcohol problems are particularly susceptible to heat reactions, especially during heat waves in areas where moderate climate usually prevails.

Figure 4.4 shows the Heat Index (HI) as a function of heat and relative humidity. The HI describes how hot the heat and humidity combination makes it feel. As relative humidity increases, the air seems warmer than it actually is because the body is less able to cool itself via evaporation of perspiration. As the HI rises, so do health risks.

- When the HI is 90°F, heat exhaustion is possible with prolonged exposure and/or physical activity.
- When it is 90° to 105°F, heat exhaustion is probable with the possibility of sunstroke or heat cramps with prolonged exposure and/or physical activity.
- When it is 105° to 129°F, sunstroke, heat cramps or heat exhaustion is likely, and heatstroke is possible with prolonged exposure and/or physical activity.
- When it is 130°F and higher, heatstroke and sunstroke are extremely likely with continued exposure. Physical activity and prolonged exposure to the heat increase the risks.

Figure 4.4 Heat Index

Temperature (°F)

		80	82	84	86	88	90	92	94	96	98	100	102	104	106	118	110	
Relative Humidity (%)	40	80	81	83	85	88	91	94	97	101	105	109	114	119	124	130	136	
	45	80	82	84	87	89	93	96	100	104	109	114	119	124	130	137		
	50	81	83	85	88	91	95	99	103	108	113	118	124	131	137			
	55	81	84	86	89	93	97	101	106	112	117	124	130	137				
	60	82	84	88	91	95	100	105	110	116	123	129	137					
	65	82	85	89	93	98	103	108	114	121	126	130						
	70	83	86	90	95	100	105	112	119	126	134							
	75	84	88	92	97	103	109	116	124	132								
	80	84	89	94	100	106	113	121	129									
	85	85	90	96	102	110	117	126	135									
	90	86	91	98	105	113	122	131										
	95	86	93	100	108	117	127											
	100	87	95	103	112	121	132											

Likelihood of Heat Disorders with Prolonged Exposure or Strenuous Activity

- Caution
 Extreme Caution
 Danger
 Extreme Danger

Source: National Weather Service

Most summer storms occur during the hot summer months and may be associated with other summer hazards. Lightning in thunderstorms may spark wildfires. When coupled with strong winds, these fires can quickly spread. Slow-moving thunderstorms often trigger flash floods due to the extended duration of heavy rainfall. The heavy rain, hail, strong winds, and tornadoes in summer storms may become problematic for ground and air travelers. Such conditions can cause accidents and could possibly lead to a hazardous material release such as storage tanks being overturned and punctured or hazardous lagoon walls being compromised or simply overtopped. Should winds be strong enough, they can take down power and communication infrastructure and lead to long-term outages. Severe thunderstorms associated with the passage of a strong cold front may usher in cooler temperatures and relieve extreme heat and drought conditions.

Location

Severe summer storms can affect the entire planning area including all participating jurisdictions.

Extent

Reported tornado and severe thunderstorm events over the past several decades provide an acceptable framework for determining the magnitude of summer storms that can be expected and should be planned for. Cass County is located right on the transition of FEMA’s wind zone map with the northern part of the county being in Zone II (160 mph) while the southern half of the county including Fargo lies in Zone III (200mph). (www.fema.gov) The potential for tornados of this magnitude make shelters extremely important when considering the total destruction of a single family residence is expected in winds of approximately 170mph, small barns and outbuildings 93mph and small retain facilities at 167mph. (Storm Prediction Center)

Previous occurrences

According to the Hazards and Vulnerability Research Institute at the University of South Carolina there have been 95 occurrences of summer storm phenomena in Cass County since 1989. An F5 tornado impacted Cass County in 1957 causing 13 fatalities and 103 injuries. Incidents of this magnitude call for continued vigilance. **Table 4.6** follows with a list of notable summer storm occurrences in the past 25 years.

Table 4.6 Notable Severe Summer Storm Occurrences since 1989

Date	Description	Damage Estimate
Thunderstorms (including straight-line winds)		
6/22/1992	Severe thunderstorm producing hail and an F1 tornado	\$6 million
7/31/1993	Severe thunderstorm with heavy rains causing flash flooding	\$940,000
7/1/1997	Severe thunderstorm with straight-line winds causing power lines to be blown down	\$20,000
8/5/1997	Thunderstorm with strong winds peaking at 41 knots according to Fargo ASOS. A building under construction was blown down	\$20,000
7/4/1999	Severe thunderstorm affecting a large area of Cass County produced strong winds that knocked down trees, power, lines, and buildings under construction. Significant roof damage occurred to both residential, agricultural and commercial structures	\$85 million
8/8/2001	Thunderstorm producing strong winds was reported in Fargo, Alice and Grandin. The storm caused down trees, power lines, grain bins and small outbuildings	\$85,000
6/24/2003	Thunderstorms with downburst winds over 100mph caused damage to power lines, poles, towers and other electrical structures. Trees down and residential damage were reported in Tower City, Buffalo, Ayr, Arthur and Gardner. The Cass County Commission declared a state of emergency, a preliminary damage assessment was done by FEMA a Presidential Disaster Declaration was not issued.	\$1.7 million

7/15/2007	Severe thunderstorm that followed a 5-7 mile swath from the northwest passing through Page, Tower City, Buffalo, and Embden areas. Hail and strong winds caused damages indicative of an F1 – F2 tornado in spots. Power lines were down leaving residents without power for hours. Trees, crops, livestock and farm buildings all contributed to significant losses. A Presidential Disaster Declaration was declared.	\$3 million
Hail		
9/7/1997	Hailstorm hit several car dealerships along I-29 in Fargo. 0.75 inch hail reported	\$500,000

Hail Cont'd		
7/14/1998	1.75 inch hail reported in Horace	
7/17/2001	0.75 – 4.5 inch hail was reported in the areas of Lynchburg, Chaffee, Kindred, Alice and Leonard	
7/10/2004	0.75 – 1.75 inch hail was reported in Kindred, Chaffee, Horace, Amenia, Casselton and Fargo	
7/12/2004	1 – 1.75 inch hail was reported in the Argusville, Harwood area	
8/29/2004	1.5 – 1.75 inch hail was reported 6 miles SW of Fargo	
5/20/2005	0.75 – 2.5 inch hail was reported near Casselton, Kindred, Tower City, Embden and Chaffee	
Lightning		
7/1/1997	Lightning struck three workers in a sugar beet field near Davenport resulting in one fatality and two injuries.	
6/1/2005	A house near Rose Creek Golf Course, Fargo was hit by lightning causing a fire.	
Tornado		
6/5/1996	A F0 (40-72mph) tornado touched down one mile northeast of Gardner. The path was one mile long by 20 yards wide.	

6/26/1997	Rapid convection produced several brief tornado touchdowns north of Fargo. A F0 (40-72mph) tornado touched down one mile west of Argusville. The width of the path was 25 yards	
8/22/1999	A F0 (40-72mph) tornado briefly touched down five miles northwest of Casselton. The path was one mile long by 25 yards wide	
8/28/2002	A F0 (40-72mph) tornado briefly touched down two miles north of Lynchburg. Several large tree tops were broken off. The path was less than one mile long and 25 yards wide	
5/19/2004	A F1 (73-112mph) tornado briefly touched down three miles southwest of Durbin. Several trees were uprooted. The path was one mile long by 50 yards wide.	
7/10/2004	A F0 (40-72mph) tornado briefly touched down two miles southeast of Horace. Numerous trees and power poles were snapped off at ground level. The path was seven miles long by 25 yards wide.	
7/10/2004	A F0 (40-72mph) tornado briefly touched down two miles southwest of Wild Rice heading toward the Red River. The path was one mile long by 25	
	yards wide.	
7/18/2004	A F0 (40-72mph) tornado briefly touched down eight miles southwest of Page. The path was less than a mile long by 25 yards wide	
7/18/2004	A F2 (113-157mph) tornado touched down two miles southeast of Tower City. The tornado knocked down high voltage power lines and three metal towers north of the City. Several farm buildings were also damaged. The path was four miles long by 100 yards wide	\$500,000
7/18/2004	A F0 (40-72mph) tornado briefly touched down seven miles southwest of Buffalo. The tornado touched down in an open field with a path one mile wide by 25 yards wide.	
5/20/2005	A F1 (73-112mph) tornado touched down seven miles southwest of Casselton through a construction zone on Interstate 94 dislodging temporary lane markers, twisting highway signs and flipping over lighted arrows. Interstate travel was disrupted for over an hour. The path was nearly three miles long and 75 yards wide.	\$10,000
5/20/2005	A F0 (40-72mph) tornado briefly touched down three miles southwest of Kindred. A dust plume was generated as the tornado touched down in an open field. The tornado tracked into Richland County with a path one mile long and 50 yards wide.	

6/29/2005	A F0 (40-72mph) tornado touched down four miles southeast Kindred. The path was one mile long by 50 yards wide	None reported
9/5/2005	A F2 (113-157mph) tornado touched down two miles north of Hickson. A farmstead was hit with a 30 foot concrete silo being lifted and blown onto a machine shed. Concrete debris demolished half of the shed, trees were snapped off and the house also sustained some exterior damage. The tornado tracked intermittently along a 4 mile path with a width of 200 yards with peak wind speeds estimated at 120mph.	
9/5/2005	A F1 (73-112mph) tornado touched down one mile northeast of Wild Rice. The path was two miles long by 100 yards wide that continued from Wild Rice toward the Red River and into Clay County. Signs, fences, and many trees were destroyed with debris being thrown downwind for hundreds of feet.	
5/7/2006	A F0 (40-72mph) tornado was reported five miles north east of Gardner by a motorist. The path was less than a mile long by 25 yards wide.	
6/5/2006	A F0 (40-72mph) tornado was reported by a deputy two miles southwest of Leonard. The path was less than a mile long by 25 yards wide.	

Probability of future events

Combining all types of severe summer storms, the past 25 years would suggest that approximately 3.8 storms will occur in any given year. Another concerning statistic is that 91 tornadoes have occurred in Cass County between 1950 and 2012 which averages out to more than one tornado per year.

Risk Class

B: Moderate to high risk condition, risk addressed by mitigation and contingency planning. All areas in Cass County are at the same risk of this hazard. Risk rating is unchanged since last plan.

Severe Winter Weather

Description

Severe winter weather includes blizzards, heavy snow, ice storms, and extreme cold. Important factors when evaluating the severity of winter storms include temperature, wind, wind chill, rain, sleet, snow, and blowing snow. The winter season can begin as early as September and last into May. Average annual snowfall in Cass County is 35.17 inches, slightly below the state average of 37 inches, and the average number of days with one inch or more snow depth is 54.36 days per year. (usa.com)

Blizzard - Blizzards, as defined by the National Weather Service, are a combination of sustained winds or frequent gusts of 35 mph or greater and visibilities of less than a quarter mile from falling or blowing snow for 3 hours or more. A blizzard, by definition, does not indicate heavy amounts of snow, although they can happen together. The falling or blowing snow usually creates large drifts from the strong winds. The reduced visibilities make travel, even on foot, particularly treacherous. The strong winds may also support dangerous wind chills. A blizzard is the most dramatic and perilous of all winter storms.

Blizzard conditions can also exist without a major storm system. Strong surface winds can blow already fallen snow, which is known as a "ground blizzard." Visibility can be reduced to near zero even though the sun is shining and the tops of power poles and trees are seen easily. These conditions are extremely variable in duration and are usually accompanied by very cold temperatures and wind chill conditions, making them as potentially deadly as a conventional blizzard.

Heavy Snow - Six inches of snow or more in 12 hours or eight inches or more in 24 hours constitutes conditions that may significantly hamper travel or create hazardous conditions. The National Weather Service issues warnings for such events. Smaller amounts can also make travel hazardous, but in most cases, only results in minor inconveniences.

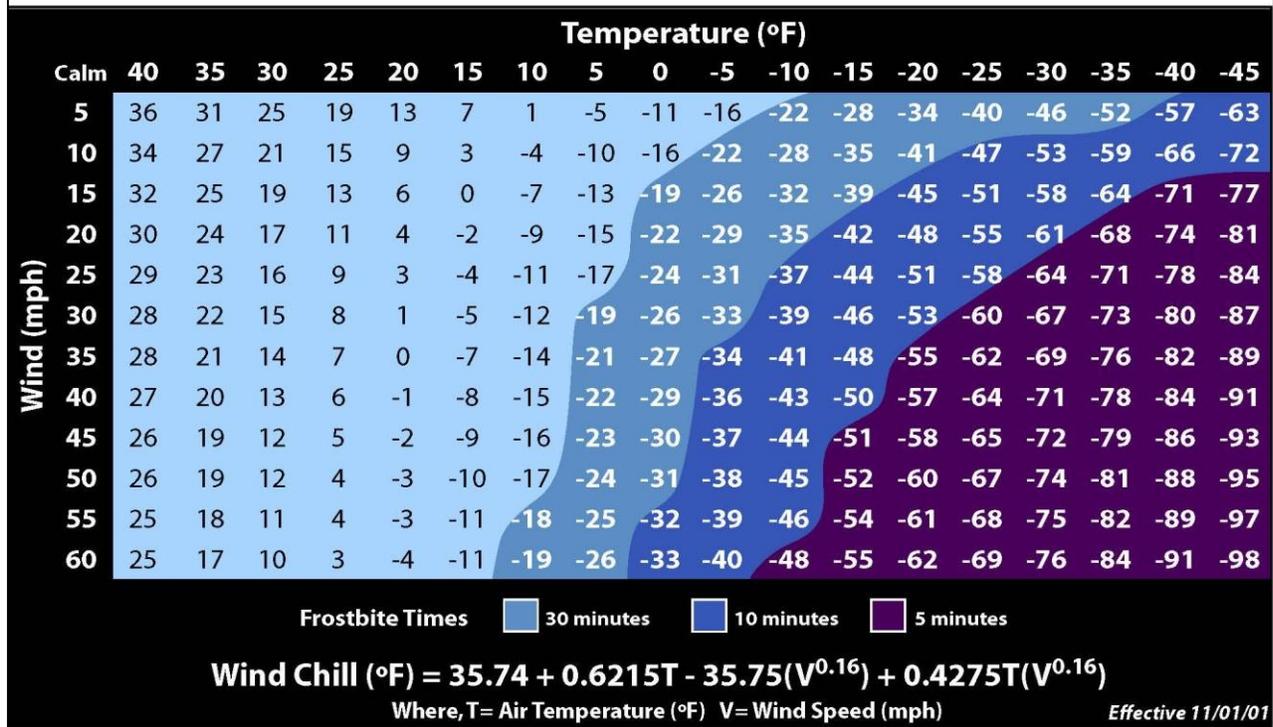
Ice Storms - Ice storms develop when a layer of above freezing moist air aloft coincides with a below freezing pool of air at or near the earth's surface. As rain or sleet falls it freezes at or near the surface creating a layer of ice. Extended periods of freezing rain can lead to accumulations of ice on roadways and walkways making any form of travel difficult. Ice will also build up on trees, power lines and communication towers causing dysfunction or in some cases break degradation of the structures.

Extreme Cold - Extended periods of cold temperatures frequently occur throughout the winter months in Cass County. When cold temperatures and wind combine, dangerous wind chills can develop. Wind chill is how cold it feels when outside. Wind chill is based on the rate of heat loss on exposed skin from wind and cold. As the wind increases, it draws heat from the body, driving down skin temperature, and eventually, internal body temperature. Therefore, the wind makes it feel much colder than the actual temperature and can be quite dangerous if a person is exposed to the elements for any extended period of time. **Figure 4.5** is the National Weather Service Wind Chill Chart.

Figure 4.5 National Weather Service Wind Chill Chart



Wind Chill Chart



Source: National Weather Service

Location

Severe winter weather events can affect the entire planning area including all participating jurisdictions. Open rural areas are often at greater risk for blowing and drifting snow causing reduced visibility more quickly than in built up areas.

Extent

The impact of a severe blizzard with low visibility, heavy snow, and cold temperatures can bring not only the County but the entire region to a standstill. Utility and communication systems are often interrupted. Road systems are rendered impassable which causes school, workplace, and commercial shutdowns. This in turn magnifies the emergency and medical management needs of the community. Rural residents are especially hard hit if they are not adequately stocked with food and fuel. The livestock industry can be severely impacted. The inability to get feed and water to livestock can become critical quickly. Dehydration is a major cause of livestock casualties.

Strong winds and ice or snow accumulations can take down utility lines. A long-term utility outage becomes more significant during extended cold periods as sheltering and cold weather exposure becomes more challenging. Accessing those in rural areas following heavy snow events to deliver supplies or provide emergency services can be difficult; the need for such services would be compounded by any long-term utility outage. In Cass County, severe winter seasons often translate to severe flooding potential in the spring.

The lack of adherence to warnings and safety precautions are a significant factor when considering the effects of severe winter weather making education extremely important to combat loss of property, injury or even death.

Hypothermia has often been called “the killer of the unprepared”. It is also the number one killer of outdoor sports enthusiasts. Hypothermia is a condition where the body temperature or core temperature is lowered. The blood is cooled, reducing the oxygen carried to the brain and dulling the senses. The victim becomes fatigued, delirious, and loses dexterity of arms and legs. If the body’s core temperature continues to drop to about 85 degrees Fahrenheit, the victim eventually slips into unconsciousness. If treatment is not started immediately, the end result is arrest of the circulatory and respiratory systems and death.

Previous occurrences

Each year during the winter months (typically November through March) the communities of Cass County can expect to be exposed to a variety of winter weather. Cass County has been included in sixteen winter weather declared disasters and emergencies since 1989. These events are listed in **Table 4.7**.

Table 4.7 Winter Weather Declared Disasters and Emergencies

Declaration	Location	Date	Other Information	Casualties	Damages
DR 1157	All counties in North Dakota	January 2-31, 1997	Public Assistance. For blizzards and severe winter storms.	8 deaths 91 injuries	\$14,801,246* \$317,000,000 estimated total
DR 1279	34 counties and 3 tribes in Central and Eastern North Dakota	March 1 – July 19, 1999	Public Assistance and Individual Assistance. For snow and ice. Also included impacts from severe storms, tornadoes, flooding, ground saturation, landslides, and mudslides	None	\$124,391,622*~
State EO	North Dakota	2003	State Declared Winter Emergency	Unknown	Unknown
State EO 2005-09	North Dakota	10/6/2005	State declared snow emergency	Unknown	Unknown
State EO 2005-11	North Dakota	10/31/2005	State declared snow disaster	Unknown	Unknown
State EO 2005-12	North Dakota	11/29/2005	State declared snow emergency	Unknown	Unknown
DR 1621	Cass, Ransom, Richland, and Sargent Counties	November 27-30, 2005	Public Assistance. For severe winter storms.	None	\$2,728,807* \$3,000,000 estimated total
State EO 2005-13	North Dakota	12/20/2005	State declared snow disaster	Unknown	Unknown
State EO 2009-02	North Dakota	1/22/2009	State declared winter storm emergency	Unknown	Unknown
State EO 2009-03	North Dakota	1/28/2009	State declare winter storm emergency	Unknown	Unknown

State EO 2009-04	North Dakota	2/20/2009	State declared winter storm emergency	Unknown	Unknown
State EO 2010-01	North Dakota	1/22/2010	State declared severe winter storm emergency	Unknown	Unknown
State EO	North Dakota	1/27/2010	State declared winter storm	Unknown	Unknown
Declaration	Location	Date	Other Information	Casualties	Damages
2010-03			disaster		
State EO 2010-16	North Dakota	12/30/2010	State declared winter storm emergency	Unknown	Unknown
State EO 2011-04	North Dakota	3/11/2011	State declared winter storm emergency	Unknown	Unknown
State EO 2011-11	North Dakota	5/13/2011	State declared winter storm disaster	Unknown	Unknown

Source: North Dakota Multi Hazard Mitigation Plan

* Federal Share (includes Individual and Family Grant, Disaster Housing, Manufactured Housing, Crisis Counseling Immediate and Regular Programs, Disaster Unemployment Assistance, Hazard Mitigation Grant Program, Public Assistance, FEMA Mission Assignments, and SBA Home, Business, and Economic Injury Loans.;~ primarily includes flood impacts.

Probability of future events

Based on blizzard studies, a typical North Dakota county may experience an average of two blizzards annually (National Weather Service). As previously discussed, blizzards are not the only concerning winter weather conditions. There is nearly 100 percent chance of severe winter weather occurring each year in Cass County.

Risk Class

B: Moderate to high risk condition, risk addressed by mitigation and contingency planning. All areas in Cass County are at the same risk of this hazard. Risk rating is unchanged since last plan.

Urban Fire

Description

Fire is the result of three components: a heat source, a fuel source, and an oxygen source according to the U.S. Fire Administration. When combined, these three sustaining factors will allow a fire to ignite and spread. Within a structure, a small flame can get completely out of control and turn into a major fire within seconds. Thick black smoke can fill a structure within minutes. The heat from a fire can be 100 degrees Fahrenheit at floor level and rise to 600 degrees at eye level. In five minutes, a room can get so hot that everything in it ignites at once; this is called flashover.

The urban fire department is one of the oldest continuing institutions in the United States. Professional firefighters are well trained in the latest skills for preserving life and applying their abilities to limit property damages. They attempt to arrive at the fire as soon as possible, get all human life to safety, and suppress the fire as quickly as possible. The amount of lives and property saved from fire by fire departments tremendously exceeds losses which are reported in statistics.

Location

Urban fires can occur anywhere, but are generally most significant in downtown areas. To maintain continuity with the State of ND Multi-Hazard Mitigation Plan communities with 1,000 or more people will be focused on as they generally have a downtown area or other public venue that might be at increased risk of larger scale urban fires. These communities include Fargo, West Fargo, Horace, and Casselton as of the 2010 census.

Extent

Property and the population are at risk from urban fires and structure collapses. Property losses are usually covered by insurance, but can be devastating to the building occupants, particularly for primary residences. These types of events often do not result in community-wide disasters, unless the structure is critically important to the economy. Fires and collapses that result in a significant loss of life or encompass the large part of a downtown or urban area would present the most significant challenges to local and county governments.

Depending on the time and location, a major structure fire could result in the loss of life either to firefighters or building occupants. The potential for this type of loss is difficult to determine due to advances in firefighter safety and the installation of sprinkler and alarm systems in many commercial and apartment structures. Those structures lacking smoke detectors are especially dangerous to the population. Should lives be lost, significant resources could be needed to manage the recovery.

Economic values could be lost if a business district were destroyed in an urban fire or structure collapse. For example, facilities of large employers or central community structures such as grain elevators could lead to significant community losses. Most historic buildings lack sprinkler systems and would lose much of their historical value in a fire or collapse.

Due to the housing density of Cass County being 38.49 per square mile in 2010 The State of ND MultiHazard Mitigation plan has given the County a vulnerability rating of high. A lack of County-wide building codes also has an effect on this determination.

Damage can vary greatly based on response time of responders. Cass County is served by twenty fire departments detailed below in **Table 4.8**.

Table 4.8 Cass County Fire Departments by City

City	Fire Department	City	Fire Department
Argusville	Argusville Fire Protection District	Harwood	Harwood Area Fire & Rescue
Arthur	Arthur Volunteer Fire Department	Hunter	Hunter Fire Protection District
Buffalo	Buffalo Fire Department	Kindred	Kindred Community & Rural Fire Protection
Casselton	Casselton Fire Department	Leonard	Leonard Fire Protection District

	Casselton Rural Fire Department	Mapleton	Mapleton Fire Department
Davenport	Davenport Rural Fire Protection	Page	Page Fire Department
Erie	Erie Rural Fire Department	Tower City	Tower City Rural Fire Protection District
Fargo	Fargo Fire Department	West Fargo	West Fargo Fire Department
	119 th CES – CEF Fire Department		West Fargo Fire Department – Southside
Grandin	Grandin Fire Department		West Fargo Rural Fire Department

Source: *FireDepartment.net*

Previous occurrences

All cities in Cass County have experienced urban fire within their fire districts. Primary sources continue to be residential and vehicle fires. Even though Fargo experiences numerous fires every year, in the past 25 years there have been only two that have extended beyond the property where the fire started. The potential for catastrophic loss is highest in those areas built before adoption of modern building and fire codes. In Fargo, the properties most at risk are those in close proximity to one another, those with inadequate fire separations or common basements, and large multi-family apartment buildings constructed without adequate fire protection before the adoption of the 2000 International Fire Code.

One of the most significant fire events in recent history in the County occurred in Fargo on October 11, 2010. Nearly 150 residents were displaced after a massive fire destroyed an apartment building at Galleria apartments on 42nd Street. Two firefighters had to be rescued when a third floor roof collapsed during a fight that lasted more than four hours. No casualties or serious injuries were reported.

Probability of future events

The probability of multiple urban fires in any given year is very high. There is also a high probability that at least one fire in any given year will require resources beyond the capability of the on-duty shift or first wave of volunteer fire fighters in the rural communities. Generally, the more frequent events have a low impact such as a single vehicle or partial residence fire, while high impact events affecting a large number of people or property like an apartment building or office complex occur much less frequently.

Risk Class

D: Low risk condition, to be considered in planning. Risk rating is unchanged since last plan.

Wildland Fire

Description

A wildland fire is an uncontrolled fire in a vegetated area. Wildland fires are a natural part of the ecosystem. They have a purpose in nature and following years of fire suppression, many areas have built up fuels that can lead to larger, more intense fires.

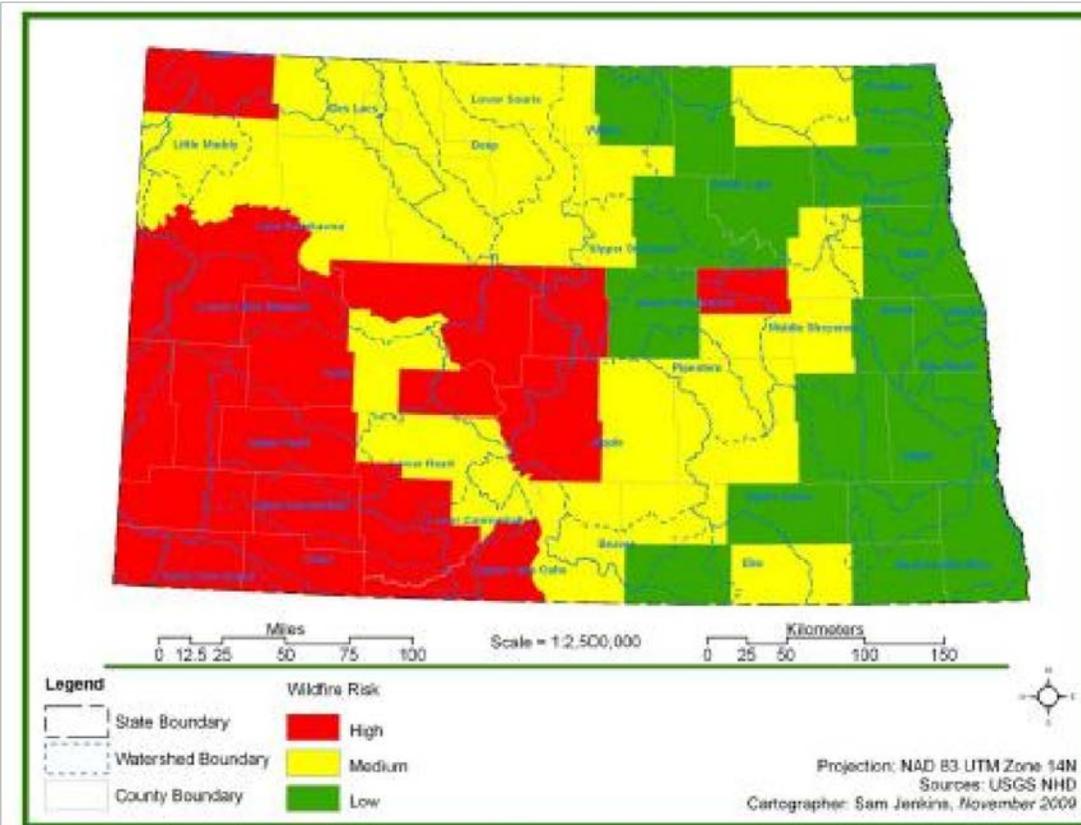
Any flame source can trigger a wildland fire. Once ignited, ambient conditions dictate whether the fire will spread or not. Moist, cool, and calm conditions or a lack of fuels will suppress the fire, whereas, dry, warm, and windy conditions and dry fuels will contribute to fire spread. The terrain, accessibility, and capabilities of the fire agencies are also factors in the fire’s growth potential. Problems with wildfire occur when combined with the human environment. People and structures near wildfires can be threatened unless adequately protected through evacuation, mitigation, or suppression.

Location

Wildland fires could occur in most areas of the County especially over the more than one million agricultural acres. See the **Figure 3.8 Cass County Land Use** for a graphic representation. Land cover demonstrates the type of fuels available for wildfires. In the case of agriculture, the flammability depends on the crop and its condition at that point in the growing season. Grasslands and shrub lands are not usually managed significantly and may contain a build-up of flashy fuels year round.

Based on wildfire occurrences, fire department response capabilities, and weather the North Dakota Forest Service put together the map shown in **Figure 4.6** in 2010 with a determination of low wildfire risk for Cass County.

Figure 4.6: Wildfire Risk by County



Extent

Agricultural losses are the typically the most significant measure of a wildland fire. Insurance often will cover these losses but depending on the acres burned, time of year and possibility of a fire spreading to outbuildings and equipment it could be devastating to owners.

Crop cover, time of year and the terrain, including fire breaks such as streams or roads, can greatly impact the characteristics exhibited by a wildland fire.

Previous occurrences

Cass County experiences wildland fires nearly every year although there have been no wildland fires 1,000 acres or more in Cass County since 1989. According to the North Dakota Forest Service from 2009-2012 thirty wildland fires were reported in Cass County burning 269. This is an average of less than nine acres per incident.

Probability of future events

The probability of a wildland fire occurring in Cass County in any given year is quite high. However, a fire of significant magnitude or one that would require additional resources beyond that of the first responding fire department is much less likely. Education is a key component of reducing all types of fires as most are caused by human error. Paying attention to key burn warnings can prevent unnecessary losses.

Risk Class

D: Low risk condition, to be considered in planning. Risk rating adjusted from a C in the previous plan. Although small wildland fires are likely every year the ground cover in Cass County and the rapid response time of emergency responders has only allowed for negligible damage.

SECTION V – CASS COUNTY GOALS AND OBJECTIVES

Goal 1: Encourage County and local planning related to hazard understanding and mitigation

- Integrate mitigation data in community planning
- Utilize hazard mitigation plan data when seeking grant opportunities and writing applications
- Integrate mitigation data into township zoning and small city land use regulation
- Integrate mitigation data in business continuity, school district, transportation and park district planning

Goal 2: Enhance the public's awareness of hazards

- Continue to support and enhance current tools such as education campaigns through local media and Code Red system
- Provide community training
- Include rural communities in trainings and exercises
- Continue to provide access to the public and update the interactive flood stage maps
- Increase social media usage
- Continue public meetings during events and add post disaster meetings to gather feedback

Goal 3: Reduce the impact future development has on potential losses and vulnerabilities

- Require new roads be built no more than 6" below Base Flood Elevation (BFE) and that the top of the curb be at or above BFE
- Require new structures be built at or above BFE
- Encourage stricter building code dictating new structures be built 2 ½ feet above BFE throughout the County
- Invest in studies that help to better define and identify risks
- Continue to improve floodplain maps and reflect findings in building ordinances
- Enforce protective ordinances
- Educate small cities and townships on building codes and the benefits of implementing such codes
- Encourage tornado preparedness in new construction including evacuation plans and safe room identification
- Enforce current setback requirements as they relate to drains and rivers, and encourage adoption of stricter setbacks where necessary

Goal 4: Reduce impacts of flooding and geotechnical hazards to people and property in Cass County

- Continue identifying forms of permanent flood protection for areas continually affected by flooding
- Continue creating and enforcing ordinances, and planning and zoning requirements
- Continue acquiring properties in flood prone areas
- Identify basin-wide areas available for water storing and retention
- Support levee accreditations and dam emergency plans
- Coordinate planning and strategies existing and being developed by other entities and agencies
- Distribute Cass County mitigation plans and activities to other interested parties

Goal 5: Mitigate the effects severe summer and winter weather has on people and property

- Continue public education and awareness for severe weather
- Continue enhancing and promoting warning systems
- Encourage burying power lines or trimming trees to avoid downed power lines where possible
- Increase public awareness of safety actions during severe weather
- Examine potential shelter challenges in cases of prolonged electrical interruptions

Goal 6: Mitigate the effects strong winds have on people and property

- Promote the construction of safe rooms
- Encourage wind engineering measures and construction techniques that protect against structural failure
- Conduct outreach activities to increase awareness of tornado risk
- Promote the use of weather warning systems

Goal 7: Reduce impacts of drought and wildland fires on Cass County communities

- Develop a drought emergency plan
- Continue to monitor drought conditions and water supplies
- Support the Lake Agassiz Water Authority in their efforts to provide a high-quality water supply to the Red River Valley in times of drought
- Support local fire districts and include these entities in trainings and exercises
- Educate residents on water saving techniques
- Educate farmers on soil and water conservation practices
- Encourage farmers to utilize crop insurance

SECTION VI: MITIGATION ACTIONS

Prioritization

A wide range of evaluation criteria was discussed by the planning committee while evaluating and prioritizing mitigation actions including a technical evaluation of the effectiveness of the solution, political, social and local support, legal constraints, environmental concerns and objectives identified in other plans and the flood of record. Matrixes such as the STAPLEE method and new FEMA mitigation action evaluation worksheet were reviewed and the steering committee decided that several of these criteria were subjective and going through such worksheets was helpful to put reviewers in the right frame of mind; however, the full number review was not chosen to be utilized. Instead, reviewers relied on the expertise of the individual communities to prioritize their own actions with all of the above mentioned criteria in mind. Actions were prioritized into categories of high, med-high, medium, med-low, and low. The general rationale for classifying an action as high priority included the prevention of life lost and significant property damage which relays quite well into a positive benefit cost. Medium priority included slightly less significant property damage, the prevention of infrastructure damage and access issues. Low priority projects were identified as those that protected less valuable land and assets and likely didn't have the benefit cost ration or public and political will behind them to readily be put into action.

Cass County

Mitigation Action/Description	Upper Maple River Dam Floodwater detention of 4,700 acre-feet
Hazards Addressed	Flooding
Responsible Agency	Maple-Steele Joint Water Resource District
Cost	\$8 million
Benefits	Prevent damages to roadways, crops and property in the upper Maple River area
Potential Funding Sources	ND State Water Commission, Cass County, Red River Joint WRD, Cass County Joint WRD
Timeline	1-2 years
Priority	High

Mitigation Action/Description	Pontiac Township Improvement District No. 73 Excess surface water mitigation
Hazards Addressed	Flooding
Responsible Agency	Maple River WRD
Cost	\$3 million
Benefits	Excess water in isolation depressional basins in flooding roads, septic systems and cropland
Potential Funding Sources	ND State Water Commission, Cass County
Timeline	1 year
Priority	High

Mitigation Action/Description	Build Permanent Levy Structure	Ongoing Effort
Hazards Addressed	Flooding	
Responsible Agency	Cass County Government	

Cost	\$10.5 million
Benefits	Will reduce damage to personal property, buildings and structures
Potential Funding Sources	Federal, State and Local
Timeline	Short term (1-5 years)
Priority	Medium

Mitigation Action/Description	Grade Raise 57 th Street, Update Culverts and/or Bridge	Ongoing Effort
Hazards Addressed	Flooding	
Responsible Agency	Cass County Government	
Cost	\$2.1 million	
Benefits	Will reduce damage to personal property, life, safe transportation	
Potential Funding Sources	Federal, State and Local	
Timeline	Short term (1-5 years)	
Priority	Medium	

Mitigation Action/Description	Increase Greenway Buffer Zone	Ongoing Effort
Hazards Addressed	Flooding, foundation failures, riverbank slumping, erosion	
Responsible Agency	Cass County Government	
Cost	\$4 million	
Benefits	Will reduce damage to personal property has future impacts on development in flood prone areas	
Potential Funding Sources	Federal, State and Local	
Timeline	Short term (1-5 years)	
Priority	Medium	

Mitigation Action/Description	Increase Protective Measures for Residences	Ongoing Effort
Hazards Addressed	Flooding, sewer backup	
Responsible Agency	Cass County Government	
Cost	\$75,000	
Benefits	Will reduce waterflow into personal property including sewer problems	
Potential Funding Sources	Federal, State and Local	
Timeline	Short term (1-5 years)	
Priority	Medium	

Mitigation Action/Description	Property Acquisitions
Hazards Addressed	Flooding
Responsible Agency	Cass County Government
Cost	\$3 million
Benefits	Damage to personal property buildings, and other structures will be reduced will also increase area for future protection and greenway
Potential Funding Sources	Federal, State, Local
Timeline	Short Term (1-5 years)

Priority	High
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Mitigation Action/Description	Create Permanent Access in and out of Flood Prone Areas
Hazards Addressed	Flooding
Responsible Agency	Cass County Government
Cost	\$2 million
Benefits	Will reduce road closures and loss of access as well as reduce safety risks associated with lack of access or delayed response of emergency personnel
Potential Funding Sources	Federal, State, Local
Timeline	Short term (1-5 years)
Priority	High

Mitigation Action/Description	Permanent Protection Against a 100 year Red River Flood
Hazards Addressed	Flooding, Dam Failure
Responsible Agency	Cass County Government
Cost	\$900 million
Benefits	Will substantially reduce the risk of loss of life and property, health and safety concerns, extraordinary public expenditures for emergency flood protection and relief
Potential Funding Sources	Federal, State, Local
Timeline	Long term (beyond 5 years)
Priority	High

Mitigation Action/Description	Road Washout Mitigation
Hazards Addressed	Flooding, specifically safe transportation during flooding
Responsible Agency	Cass County Government
Cost	\$2 million
Benefits	Will reduce damage to roadways due to flood water
Potential Funding Sources	Federal, State, Local
Timeline	Short term (1-5 years)
Priority	High

Mitigation Action/Description	Retention Projects that Support the Red River Basin Commission Goals for Flood Protection
Hazards Addressed	Flooding
Responsible Agency	Cass County Government
Cost	\$150 million
Benefits	Will substantially reduce damage to property including agricultural lands and irrigation systems
Potential Funding Sources	Federal, State, Local

Timeline	Long term (beyond 5 years)
Priority	Medium

Mitigation Action/Description	Elevate Bridge Structures
Hazards Addressed	Flooding
Responsible Agency	Cass County Government
Cost	\$3 million
Benefits	Will avoid costly reconstruction and traffic delays associated with damage to the bridge structures experienced during recent events. It will also avoid traffic disruptions for residents and would reduce emergency service delays during an event
Potential Funding Sources	Federal, State, Local
Timeline	Long term (beyond 5 years)
Priority	Medium

Mitigation Action/Description	Bridge Structure Protection
Hazards Addressed	Flooding
Responsible Agency	Cass County Government
Cost	\$600,000
Benefits	Protection will reduce unsafe bridge conditions and transportation disruptions as well as the public safety concern associated with unstable bridge structures and the costly reconstruction experienced
Potential Funding Sources	Federal, State, Local
Timeline	Long term (beyond 5 years)
Priority	Medium

Mitigation Action/Description	Construct Long Term Alternate Water Source for Cass County Communities
Hazards Addressed	Drought
Responsible Agency	Cass County Government
Cost	TBD
Benefits	Will reduce effects of drought as most area water is supplied by the Red River which in times of drought could be impossible. Water is one of the most basic needs so benefits are nearly immeasurable.
Potential Funding Sources	Federal, State, Local
Timeline	Long term (beyond 5 years)

Priority	Medium
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Mitigation Action/Description	Property Acquisitions in Landslide Prone Areas
Hazards Addressed	Geologic Hazard (landslide)
Responsible Agency	Cass County Government
Cost	\$2 million
Benefits	Will remove residences from eminent danger due to instability in the riverbank, will reduce environmental disturbance and prevent any future property damage or personal injury that could occur
Potential Funding Sources	Federal, State, Local
Timeline	Short Term (1-5 years)
Priority	High

Mitigation Action/Description	Realign Roadways to Prevent Slumping
Hazards Addressed	Geologic Hazard (landslide)
Responsible Agency	Cass County Government
Cost	\$4 million
Benefits	Will reduce environmental disturbance, property damage and allow safer transportation on stable soils as well as potentially adding to the green way
Potential Funding Sources	Federal, State, Local
Timeline	Short term (1-5 years)
Priority	Medium

Alice



The City of Alice experiences hazards similarly to the majority of Cass County. No part of the City is within the current 100 year flood plain, the 100 year floodplain designated in the FIS awaiting approval or the newest United States Army Corps of Engineers (USACE) study. High wind (straight-line wind) was the only event identified by the company that has been experienced since 2009.

- **Jurisdictional Capacity**

This small community of forty people according to the 2010 Census does not have personnel nor financial resources to execute significant mitigation projects on their own. They rely on the County, State and other agencies for assistance. The Fire Hall in town is critical to the community.

- **Mitigation Projects**

Mitigation Action/Description	Installation of warning sirens
Hazards Addressed	Severe weather
Responsible Agency	City of Alice/Cass County
Cost	\$25,000
Benefits	Advanced warning will allow for increased preparedness with potential to reduce property damage and lessen the potential of loss of life
Potential Funding Sources	HMGP, Local
Timeline	1-2 years depending on funding availability
Priority	High

Amenia

- **Unique Vulnerabilities**

The City of Amenia experiences hazards similarly to the majority of Cass County. No part of the City is within the current 100 year flood plain, the 100 year floodplain designated in the FIS awaiting approval or the newest USACE study. In spite of the lack of flood plain overland flooding originating at the Rush River is a concern. Improper drainage leaves the City more vulnerable to flash flooding and associated damages. A single sewer lift station and pump house are the only critical infrastructure.

- **Jurisdictional Capacity**

The City of Amenia is connected to Cass Rural Water and has its own City sewer system. The City has maintained a contract for outside engineering services; however, does not have resources to accomplish significant projects independently.

- **Mitigation Projects**

Mitigation Action/Description	Installation of warning sirens
Hazards Addressed	Severe weather
Responsible Agency	City of Amenia/Cass County

Unique Vulnerabilities

Cost	\$25,000
Benefits	Advanced warning will allow for increased preparedness with potential to reduce property damage and lessen the potential of loss of life
Potential Funding Sources	HMGP, Local
Timeline	1-2 years depending on funding availability
Priority	High

Mitigation Action/Description	Diking Northwest Area of Town
Hazards Addressed	Overland flooding
Responsible Agency	City of Amenia
Cost	\$450,000
Benefits	Would reduce the threat of overland flooding in town reducing damages, traffic interruptions and lost productivity experienced when reacting to such hazards today
Potential Funding Sources	ND State Water Commission, Cass County Flood Sales Tax Fund
Timeline	5 years
Priority	Medium

Mitigation Action/Description	Installation of storm sewer and a storm sewer lift station
Hazards Addressed	Overland Flooding
Responsible Agency	City of Amenia
Cost	\$500,000
Benefits	Would reduce overland flooding due to high precipitation including individual residential damage due to seepage
Potential Funding Sources	ND State Water Commission, ND Health Department State Revolving Fund
Timeline	5 years
Priority	Medium

Argusville



The City of Argusville has a significant flooding risk as illustrated in **Figure 6.1**. It is important to note that this floodplain is not the proposed FIRM and was utilized simply for planning purposes as it places greater emphasis on the wet cycle expected to continue. Flood forecasts in this model are higher. Flooding has been an issue in the springs of 2009, 2010 and 2011 since the previous mitigation plan. Important infrastructure to the community includes the Fire Department/Community Center, two sanitary sewer lift stations, one storm sewer lift station and a pump house where the Cass Rural Water lines enter town. One levee in town was recertified in 2012.

- **Jurisdictional Capacity**

The City has an active park district as well as planning and zoning committee in addition to the City Council. Although they do not have a public works department they do have a contract for outside engineering services. Argusville has interested and active people; however, does not have the technical or financial resources to accomplish significant projects independently.

- **Mitigation Projects**

Mitigation Action/Description	Installation of warning sirens
Hazards Addressed	Severe weather
Responsible Agency	City of Argusville/Cass County
Cost	\$25,000
Benefits	Advanced warning will allow for increased preparedness with potential to reduce property damage and lessen the potential of loss of life
Potential Funding Sources	HMGP, Local
Timeline	1-2 years depending on funding availability
Priority	High

Mitigation Action/Description	Raise and certify the levee around Richwood Estates/Leonards Way
Hazards Addressed	Flooding
Responsible Agency	City of Argusville with assistance of Moore Engineering
Cost	\$500,000
Benefits	Reduce flood risk to new housing development of approximately 85 homes
Potential Funding Sources	ND State Water Commission, Cass County Flood Sales Tax Fund
Timeline	5 years
Priority	High – Difficult with uncertainty regarding flood plain maps

Figure 6.1 : Argusville Floodplain Map

Unique Vulnerabilities



Arthur



Critical infrastructure in Arthur includes a pumping station that connects the City system to Cass Rural Water, a water tower and one sanitary sewer lift station. Although Arthur is not in a designated SFHA they do experience overland flooding from the west and flooding due to the drainage ditch that runs through town.

- **Jurisdictional Capacity**

Arthur is a community of 337 people as of the 2010 Census so local funds and capacity are somewhat limited. The City is connected to Cass Rural Water and has its own sewer and storm sewer system. Contract engineering services are in place to help identify and carry out improvement projects.

- **Mitigation Actions**

Mitigation Action/Description	Installation of warning sirens
Hazards Addressed	Severe weather
Responsible Agency	City of Arthur/Cass County
Cost	\$25,000
Benefits	Advanced warning will allow for increased preparedness with potential to reduce property damage and lessen the potential of loss of life
Potential Funding Sources	HMGP, Local
Timeline	1-2 years depending on funding availability
Priority	High

Mitigation Action/Description	Create a new legal drain (to move water north of City limits)
Hazards Addressed	Flooding
Responsible Agency	City of Arthur
Cost	\$1,000,000
Benefits	Reduces flood risk to the entire community, protects public and private property
Potential Funding Sources	ND State Water Commission, Cass County Flood Sales Tax,
Timeline	5-10 Years
Priority	Medium

Mitigation Action/Description	Install a Backup Generator at Lift Station
Hazards Addressed	Flooding
Responsible Agency	City of Arthur
Cost	\$2000
Benefits	Reduces the risk of the lift station going down during any number of incidents
Potential Funding Sources	ND State Water Commission, Cass County Flood Sales Tax, HMGP, Local
Timeline	1-2 years

Unique Vulnerabilities

Priority	Medium
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Ayr

- **Unique Vulnerabilities**

The City of Ayr is not in a SFHA however the current drainage system has deteriorated to a point where attention is required. The City is hooked up to Cass Rural Water but no sewer system is in place. Residents have their own individual septic systems. There is no central community facility from which to disseminate information in Ayr.

- **Jurisdictional Capacity**

Ayr is the smallest incorporated community in Cass County with a population of 17 according to the 2010 Census. Due to their size, capacity is limited and the community must rely on state and local governments for assistance.

- **Mitigation Actions**

Mitigation Action/Description	Installation of warning sirens
Hazards Addressed	Severe weather
Responsible Agency	City of Ayr/Cass County
Cost	\$25,000
Benefits	Advanced warning will allow for increased preparedness with potential to reduce property damage and lessen the potential of loss of life
Potential Funding Sources	HMGP, Local
Timeline	1-5 years depending on funding availability
Priority	High

Mitigation Action/Description	Dredging ditches and replacing 4 culverts in town
Hazards Addressed	Flooding (drainage issues)
Responsible Agency	City of Ayr
Cost	TBD
Benefits	Will reduce standing water and impacts to private property and city infrastructure. Streets have been improved with gravel recently and the it would also reduce the risk of have to redo it in a short time
Potential Funding Sources	HMGP, County, Local
Timeline	1-5 years depending on funding availability
Priority	High

Briarwood



The City of Briarwood has a significant flooding risk as illustrated in **Figure 6.2**. It is important to note that the floodplain depicted was recently developed for the Army Corps of Engineers. It is not the proposed FIRM and was utilized simply for planning purposes as it places greater emphasis on the wet cycle expected to continue. Flood forecasts in this model are higher. Flooding has been an issue in the springs of 2009, 2010 and 2011 since the previous mitigation plan. Since the 2009 flood event eight properties have been acquired and removed through an HMGP grant reducing future risks.

- **Jurisdictional Capacity**

The City has an active Mayor and City Council; however, does not have the technical or financial resources to accomplish significant projects independently.

- **Mitigation Projects**

Mitigation Action/Description	Installation of warning sirens
Hazards Addressed	Severe weather
Responsible Agency	City of Briarwood/Cass County
Cost	\$25,000
Benefits	Advanced warning will allow for increased preparedness with potential to reduce property damage and lessen the potential of loss of life
Potential Funding Sources	HMGP, Local
Timeline	1-5 years depending on funding availability
Priority	High

Figure 6.2 Briarwood Floodplain Map

Unique Vulnerabilities



Buffalo



The City of Buffalo is not in a SFHA and has recently completed a drainage improvement project that has had a positive impact on any previous drainage and overland flooding issues. Straight line winds have caused damage and power outages in the past which is a concern to the local government.

An elementary school, community center, pump house and water tower have been identified by the community as critical facilities. The City has adopted the State Building Code, does not allow open burning in City limits and has ordinances relating to substandard, unsafe and dilapidated structures.

- **Jurisdictional Capacity**

Although a small community, Buffalo has active residents that join together to accomplish projects. The maintenance and restoration of the historic stone church in town as well as the old school being turned into a museum are good examples of the community coming together to accomplish a common goal. Buffalo has a contract with outside engineering services to help identify and carry out improvement projects.

- **Mitigation Projects**

Mitigation Action/Description	Installation of a backup generator at the lift station
Hazards Addressed	Various Severe weather
Responsible Agency	City of Buffalo
Cost	\$2,000
Benefits	Reduces the risk of the lift station going down during any number of incidents
Potential Funding Sources	HMGP, Local
Timeline	1-2 years depending on funding availability
Priority	High

Mitigation Action/Description	Building a Storm Shelter
Hazards Addressed	Severe weather
Responsible Agency	City of Buffalo
Cost	\$2,000
Benefits	Provides a safe place for residents in times of a tornado or other severe weather. During power outages the community center has served as a make shift shelter but is not particularly suited to the purpose leaving occupants vulnerable
Potential Funding Sources	HMGP, State, Local
Timeline	5-10 years
Priority	Medium

Unique Vulnerabilities

Casselton



Overland flooding and drainage issues are a concern in Casselton although the City is not in a SFHA. The only natural hazards the community identified as having experiences with in the five years since the previous plan are winter storms.

The City is connected to Cass Rural Water and has their own sewer, storm sewer and City run sanitation services. Critical infrastructure and facilities to the City include Central Cass School valued at \$20 million, a water treatment plant valued at \$2.3 million, nine sanitary sewer lift stations valued at \$6 million, four storm sewer lift stations valued at \$600,000, two water towers totaling over \$2.5 million, an Ottertail substation and CenturyLink tower.

- **Jurisdictional Capacity**

The City of Casselton with its population of 2,329 people as of the 2010 Census makes it one of the larger cities in the county with greater funds and local capacity to apply for federal and state funds and administer their own projects. A full time City auditor and public works staff compliment the contract engineering services in place in the community. A Capital Improvement Plan also exists in the City guiding infrastructure improvement and growth decisions.

- **Mitigation Project**

Mitigation Action/Description	Raising levee on North Side of town
Hazards Addressed	Flooding
Responsible Agency	City of Casselton with assistance from City Engineer
Cost	\$1.6 million
Benefits	Will reduce overland flooding in the city also reducing potential property damages that may be more likely depending on new information being developed in regards to the floodplain
Potential Funding Sources	Federal, State, Local
Timeline	5 years
Priority	High – dependent on new map information

Davenport



The City of Davenport is a small community of 252 people as of the 2010 Census located southwest of the FM MSA. Although the majority of the built up area in the community is outside the SFHA the community is nearly completely surrounded during a 100-year event. See **Figure 6.3** for the 100 year floodplain according to the new Corps of Engineers study in the City of Davenport. It is important to note that this floodplain is not the proposed FIRM and was utilized simply for planning purposes as it places greater emphasis on the wet cycle expected to continue. Flood forecasts in this model are higher.

- **Jurisdictional Capacity**

The City of Davenport has limited financial and technical resources so it does rely on state and county resources for large scale projects.

- **Mitigation Actions**

Mitigation Action/Description	Installation of warning sirens
Hazards Addressed	Severe weather
Responsible Agency	City of Davenport/Cass County
Cost	\$25,000
Benefits	Advanced warning will allow for increased preparedness with potential to reduce property damage and lessen the potential of loss of life
Potential Funding Sources	HMGP, Local
Timeline	1-5 years depending on funding availability
Priority	High

Mitigation Action/Description	Drainage Improvement Project
Hazards Addressed	Flooding
Responsible Agency	City of Davenport
Cost	TBD
Benefits	An upgraded storm sewer system would reduce overland flooding issues in town and associated damages to private property and public infrastructure.
Potential Funding Sources	State Water Commission, Cass Flood Sales Tax, ND Health Dept. HMGP, USDA Rural Development, CDBG
Timeline	5-15 years
Priority	Low

Figure 6.3 Davenport Floodplain Map

Enderlin



The built up area, of the City of Enderlin, lies primarily south of Highway 46 in Ransom County with a very small portion extending into Cass County.

Critical infrastructure (all located in Ransom County) includes a school, city hall, fire station, six wells, five sanitary lift stations two water towers, Archer Daniels Midland (ADM) facility and CP switch yard. Since 2009 the City has moved the well controls out of the floodplain and recertified their levee.

- **Jurisdictional Capacity**

The City of Enderlin has a full time auditor, public works staff and contracted engineering services to assist with the identification and execution of public projects. The City like others of its size does rely on state and county resources and assistance for large scale improvements.

- **Mitigation Project**

Mitigation Action/Description	Installation of new storm water pumps
Hazards Addressed	Flooding
Responsible Agency	City of Enderlin
Cost	\$50,000
Benefits	Will reduce overland flooding and drainage issues in the city, also reducing potential property damages
Potential Funding Sources	Federal, State, Local
Timeline	1-5 years
Priority	High

Fargo

- **Unique Vulnerabilities**

The City of Fargo is the county seat and largest city in the county and state. The city is accessed by both Interstate 94 and 29 and multiple county roads. Several Burlington Northern/Santa Fe lines merge in the northern portion of the city crossing into Minnesota. Hector International Airport is located in the northern portion of the city and this area is also home to North Dakota State University. The City is roughly 42 square miles and has a perimeter approximately 48 miles long.

The City has experienced growth over the entire century with a 16.5% increase from 2000 to 2010 bringing the total population to 105,549 according to the Census. The City is home to two of the County's largest medical facilities, Sanford Health and Essentia Health. Fargo is also the main hub for most of the emergency services and location of most County offices and resources in addition to those specific to the City of Fargo. The larger population compounds the resources necessary to recover from many disasters but also lends itself to an increased capacity. Areas with large numbers of vulnerable populations are also a greater concern for the City of Fargo. An inventory of such facilities has been developed by the Department of Health and is on file with Fargo Cass Public Health.

Unique Vulnerabilities

Fargo has a significant flood risk outlined in **Figure 6.4**. The figure depicts the 100 year floodplain according to the new Corps of Engineers study in the City of Fargo. It is important to note that this floodplain is not the proposed FIRM and was utilized simply for planning purposes as it places greater emphasis on the wet cycle expected to continue. Flood forecasts in this model are higher. Greater detail regarding critical infrastructure and how it relates to the flood risk can be found in the HAZUS information in **Appendix D** and the associated digital maps accompanying this Plan.

- **Jurisdictional Capacity**

The City of Fargo has significantly more resources than many of the smaller communities in the County. A large staff including specialties in engineering, GIS, public works, planning, zoning, accounting and legal and a comparatively substantial budget puts Fargo in a good position to accomplish top ranking projects. Large scale projects still require assistance from federal and state resources.

- **Mitigation Actions**

Prioritization

Emphasis for the City of Fargo was placed on projects that have been identified in other plans and meet multiple objectives. Go2030 Fargo Comprehensive Plan was approved at the May 29, 2012 City Commission meeting. As the plan lays out a strategy for City infrastructure through 2030, it was a valuable tool when identifying projects for the City of Fargo to include in this plan.

Mitigation Action/Description	Install failsafe traffic signals, street lighting and message boards along designated emergency routes
Hazards Addressed	All hazards
Responsible Agency	City of Fargo
Cost	\$5 million
Benefits	Failsafe evacuation and emergency routes during all hazard emergencies and disasters.
Potential Funding Sources	Infrastructure sales tax
Timeline	10-50 years
Priority	Low

Mitigation Action/Description	Remove structures from slough and cutbank areas along Red River
Hazards Addressed	Flood, Severe thunderstorm
Responsible Agency	City of Fargo
Cost	\$15-20 million
Benefits	Remove threat to life and property by removing at risk structures
Potential Funding Sources	Infrastructure sales tax
Timeline	5-15 years
Priority	Low

Mitigation Action/Description	Execute Fargo Comprehensive Flood Mitigation Plan
Hazards Addressed	Flood
Responsible Agency	City of Fargo
Cost	\$250 million
Benefits	Saves nearly a billion dollars in structural losses. Removes threat to life and property by reducing reliance on emergency flood protection measures.
Potential Funding Sources	Infrastructure sales tax
Timeline	1-10 years
Priority	High

Mitigation Action/Description	Bury electrical power and communication lines
Hazards Addressed	Wind, Thunderstorms, Winter storms
Responsible Agency	Private
Cost	\$50 million
Benefits	Ensure electrical and communication delivery throughout the city during emergencies and disasters.
Potential Funding Sources	Private
Timeline	10-25 years
Priority	Low

Mitigation Action/Description	Elevate, Flood proof or fill basements of residential structures in the Special Flood Hazard Area
Hazards Addressed	Flood
Responsible Agency	Private
Cost	\$150 million
Benefits	Reduce flooding risk to life and property
Potential Funding Sources	Infrastructure sales tax
Timeline	15-30 years
Priority	Low

Mitigation Action/Description	Floodplain storage areas in select locations citywide (250 acre footprint or larger)
Hazards Addressed	Flood

Responsible Agency	City of Fargo
Cost	\$20 million x 3 ponds = \$60 million
Benefits	Increase floodplain storage area
Potential Funding Sources	Infrastructure sales tax
Timeline	1-10 years
Priority	High

Mitigation Action/Description	Storm water retention ponds in select locations citywide
Hazards Addressed	Thunderstorms, Flash Flooding
Responsible Agency	City of Fargo
Cost	\$5 million
Benefits	Provides relief to City storm sewer system during heavy rainfall events, which potentially minimizes flooding damages to commercial and residential properties. Reduces street flooding, which helps maintain traffic for emergency personnel.
Potential Funding Sources	Infrastructure sales tax
Timeline	1-10 years
Priority	High

Mitigation Action/Description	Relief Storm Sewer in select locations citywide
Hazards Addressed	Thunderstorms, Flash Flooding
Responsible Agency	City of Fargo
Cost	\$10 million
Benefits	Provides relief to City storm sewer system during heavy rainfall events, which potentially minimizes flooding damages to commercial and residential properties. Reduces street flooding, which helps maintain traffic for emergency personnel.
Potential Funding Sources	Infrastructure sales tax
Timeline	1-10 years
Priority	High

Mitigation Action/Description	Install permanent generator at STS LS #8 (Drain 10: 32 nd Street south of Main Avenue)
Hazards Addressed	Flooding, Thunderstorms
Responsible Agency	City of Fargo
Cost	\$150,000

Benefits	Maintain pumping to minimize flooding damages to residential and commercial properties along with maintaining traffic for civilian, city and emergency personnel. This lift station pumps water that collects in the storm sewer system from both residential and commercial properties. The potential for property damage along with street flooding is present if this lift station was to become inoperable. Lift station has free flow gates but if water downstream of the lift station is at a higher elevation the pumps are needed.
Potential Funding Sources	Infrastructure sales tax.
Timeline	5-15 years
Priority	Medium

Mitigation Action/Description	Install permanent generator at STS LS #9 (Drain 40: 45th Street at Main Avenue)
Hazards Addressed	Flooding, Thunderstorms
Responsible Agency	City of Fargo
Cost	\$150,000
Benefits	Maintain pumping to minimize flooding damages to residential and commercial properties along with maintaining traffic for civilian, city and emergency personnel. This lift station pumps water that collects in the storm sewer system from both residential and commercial properties. The potential for property damage along with street flooding is present if this lift station was to become inoperable. Lift station has free flow gates but if water downstream of the lift station is at a higher elevation the pumps are needed.
Potential Funding Sources	Infrastructure sales tax
Timeline	5-15 Years
Priority	Medium

Mitigation Action/Description	Install permanent generator at STS LS #16 (Drain 10 south of 2nd Avenue South)
Hazards Addressed	Flooding, Thunderstorms
Responsible Agency	City of Fargo
Cost	\$150,000

Benefits	Maintain pumping to minimize flooding damages to residential and commercial properties along with maintaining traffic for civilian, city and emergency personnel. This lift station pumps water that collects in the storm sewer system from both residential and commercial properties. The potential for property damage along with street flooding is present if this lift station was to become inoperable. Lift station has free flow gates but if water downstream of the lift station is at a higher elevation the pumps are needed.
Potential Funding Sources	Infrastructure sales tax
Timeline	5-15 Years
Priority	Medium

Mitigation Action/Description	Install permanent generator at STS LS #21 (Drain 3: West of 18th Street and north of 12th Avenue North)
Hazards Addressed	Flooding, Thunderstorms
Responsible Agency	City of Fargo
Cost	\$150,000
Benefits	Maintain pumping to minimize flooding damages to residential and commercial properties along with maintaining traffic for civilian, city and emergency personnel. This lift station pumps water that collects in the storm sewer system from both residential and commercial properties. The potential for property damage along with street flooding is present if this lift station was to become inoperable. Lift station has free flow gates but if water downstream of the lift station is at a higher elevation the pumps are needed.
Potential Funding Sources	Infrastructure sales tax
Timeline	5-15 Years
Priority	Medium

Mitigation Action/Description	Install permanent generator at STS LS #33 (East of Dakota Drive on 19th Avenue North)
Hazards Addressed	Flooding, Thunderstorms
Responsible Agency	City of Fargo
Cost	\$150,000
Benefits	Maintain pumping to minimize flooding damages to residential and commercial properties along with maintaining traffic for civilian, city and emergency personnel. This lift station pumps water that collects in the storm sewer system from both residential and commercial properties. The potential for property damage along with street flooding is present if this lift station was to become inoperable.
Potential Funding Sources	Infrastructure sales tax
Timeline	5-15 Years
Priority	Medium

Mitigation Action/Description	Install permanent generator at STS LS #50 (45th Street South of 3rd Avenue North)
Hazards Addressed	Flooding, Thunderstorms
Responsible Agency	City of Fargo
Cost	\$150,000
Benefits	Maintain pumping to maintain traffic for civilian, city and emergency personnel. This lift station pumps water from the underpass on 45th Street north of Main Avenue. If this lift station lost power the underpass would be impassable to citizens, city maintenance workers and emergency vehicles during rain events.
Potential Funding Sources	Infrastructure sales tax
Timeline	5-15 Years
Priority	Medium

Mitigation Action/Description	Raise gatewell and install permanent generator at STS LS #1 (2nd Street South at Main Avenue)
Hazards Addressed	Flooding, Thunderstorms
Responsible Agency	City of Fargo
Cost	Raise gatewell: \$100,000 Permanent generator: \$150,000
Benefits	Maintaining traffic for civilian, city and emergency personnel and also from river flooding. This lift station pumps water from the underpass on 2 nd Street north of Main Avenue. If this lift station lost power the underpass would be impassable to citizens, city maintenance workers and emergency vehicles during rain events. The top of the gatewell elevation is below the flood of record and needs to be ringed with sandbags during high flood events to keep river water from expelling out of the lift station.
Potential Funding Sources	Infrastructure sales tax, flood sales tax
Timeline	1-10 years
Priority	High

Mitigation Action/Description	Install permanent generator at STS LS #3 (25th Street at Main Avenue)
Hazards Addressed	Flooding, Thunderstorms
Responsible Agency	City of Fargo
Cost	\$150,000
Benefits	Maintaining traffic for civilian, city and emergency personnel. This lift station pumps water from the underpass on 25 th Street north of Main Avenue. If this lift station lost power the underpass would be impassable to citizens, city maintenance workers and emergency vehicles during rain events.

Potential Funding Sources	Infrastructure sales tax.
Timeline	1-10 years
Priority	High

Mitigation Action/Description	Install permanent generator at STS LS #6 (45th Street at 19th Avenue North)
Hazards Addressed	Flooding, Thunderstorms
Responsible Agency	City of Fargo
Cost	\$150,000
Benefits	Maintain pumping to minimize flooding damages to residential and commercial properties along with maintaining traffic for civilian, city and emergency personnel. This lift station pumps water in Cass County Drain 40 that collects water from both residential and commercial properties. The potential for property damage along with street flooding is present if this lift station was to become inoperable. Lift station has free flow gates but if water downstream of the lift station is at a higher elevation the pumps are needed.
Potential Funding Sources	Infrastructure sales tax.
Timeline	5-15 years
Priority	Medium.

Mitigation Action/Description	Install permanent generator at STS LS #11 Trollwood (east lift)
Hazards Addressed	Flooding, Thunderstorms
Responsible Agency	City of Fargo
Cost	\$150,000
Benefits	Maintain pumping to minimize flooding damages to residential and commercial properties along with maintaining traffic for civilian, city and emergency personnel. This lift station pumps water that collects in the storm sewer system from both residential and commercial properties. The potential for property damage along with street flooding is present if this lift station was to become inoperable.
Potential Funding Sources	Infrastructure sales tax.
Timeline	1-10 years
Priority	High

Mitigation Action/Description	Relocate lift station at STS LS #13 (East of 5th Street at Lindenwood Drive/17th Avenue South junction)
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Hazards Addressed	Flooding
Responsible Agency	City of Fargo
Cost	\$2 million
Benefits	Maintain pumping to minimize flooding damages to residential and commercial properties along with maintaining traffic for civilian, city and emergency personnel. This lift station pumps water that collects in the storm sewer system from both residential and commercial properties. The potential for property damage along with street flooding is present if this lift station was to become inoperable. Location of the lift station makes it susceptible to river flooding.
Potential Funding Sources	Infrastructure sales tax, flood sales tax
Timeline	1-10 years
Priority	High

Mitigation Action/Description	Install permanent generator at STS LS #14 (West of 25th Street at 26th Avenue South)
Hazards Addressed	Flooding, Thunderstorms
Responsible Agency	City of Fargo
Cost	\$150,000
Benefits	Maintain pumping to minimize flooding damages to residential and commercial properties along with maintaining traffic for civilian, city and emergency personnel. This lift station pumps water that collects in the storm sewer system from both residential and commercial properties. The potential for property damage along with street flooding is present if this lift station was to become inoperable. This lift station is critical to pump storm water out of Bluemont Lakes in the event of heavy rainfall/large runoff.
Potential Funding Sources	Infrastructure sales tax
Timeline	1-10 years
Priority	High (Radial Feed)

Mitigation Action/Description	Relocate lift station and install permanent generator at STS LS #15 (East of 9th Street at 26th Avenue South - Country Club)
Hazards Addressed	Flood
Responsible Agency	City of Fargo
Cost	Relocate lift station: \$2 million Install permanent generator: \$150,000
Benefits	Maintain pumping to minimize flooding damages to residential and commercial properties along with maintaining traffic for civilian, city and emergency personnel. This lift station pumps water that collects in the storm sewer system from both residential and commercial properties. The potential for property damage along with street flooding is present if this lift station was to become inoperable. Location of the lift station makes it susceptible to river flooding.
Potential Funding Sources	Infrastructure sales tax, flood sales tax.
Timeline	5-15 years

Priority	Medium/High (Radial Feed)
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Mitigation Action/Description	Install permanent generator at STS LS #16 (Cass County Drain 10 south of 2nd Avenue South)
Hazards Addressed	Flooding, Thunderstorms
Responsible Agency	City of Fargo
Cost	\$150,000
Benefits	Maintain pumping to minimize flooding damages to residential and commercial properties along with maintaining traffic for civilian, city and emergency personnel. This lift station pumps water that collects in the storm sewer system from both residential and commercial properties. The potential for property damage along with street flooding is present if this lift station was to become inoperable.
Potential Funding Sources	Infrastructure sales tax
Timeline	5-15 years
Priority	Medium (Radial feed)

Mitigation Action/Description	Install permanent generator at STS LS #17 (University Drive at Main Avenue)
Hazards Addressed	Flooding, Thunderstorms
Responsible Agency	City of Fargo
Cost	\$150,000
Benefits	Maintain pumping to minimize flooding damages to residential and commercial properties along with maintaining traffic for civilian, city and emergency personnel. This lift station pumps water from the underpass on University Drive north of Main Avenue. If this lift station lost power the underpass would be impassable to citizens, city maintenance workers and emergency vehicles during rain events.
Potential Funding Sources	Infrastructure sales tax.
Timeline	1-10 years
Priority	High

Mitigation Action/Description	Install permanent generator at STS LS #18 (USACE lift at 4th Street levee - north lift)
Hazards Addressed	Flooding, Thunderstorms
Responsible Agency	City of Fargo
Cost	\$250,000
Benefits	Maintain pumping to minimize flooding damages to residential and commercial properties along with maintaining traffic for civilian, city and emergency personnel. This lift station pumps water that collects in the storm sewer system from both residential and commercial properties. The potential for property damage along with street flooding is present if this lift station was to become inoperable.

Potential Funding Sources	Infrastructure sales tax.
Timeline	1-10 years
Priority	High

Mitigation Action/Description	Install permanent generator at STS LS #19 (USACE lift at 4th Street levee - south lift)
Hazards Addressed	Flooding, Thunderstorm
Responsible Agency	City of Fargo
Cost	\$250,000
Benefits	Maintain pumping to minimize flooding damages to residential and commercial properties along with maintaining traffic for civilian, city and emergency personnel. This lift station pumps water that collects in the storm sewer system from both residential and commercial properties. The potential for property damage along with street flooding is present if this lift station was to become inoperable.
Potential Funding Sources	Infrastructure sales tax.
Timeline	1-10 years
Priority	High

Mitigation Action/Description	Install permanent generator at STS LS #20 (Island Park)
Hazards Addressed	Flooding, Thunderstorm
Responsible Agency	City of Fargo
Cost	\$150,000
Benefits	Maintain pumping to minimize flooding damages to residential and commercial properties along with maintaining traffic for civilian, city and emergency personnel. This lift station pumps water that collects in the storm sewer system from both residential and commercial properties. The potential for property damage along with street flooding is present if this lift station was to become inoperable.
Potential Funding Sources	Infrastructure sales tax.
Timeline	1-10 years
Priority	High

Mitigation Action/Description	Upgrade to duplex pumping station for redundancy and install permanent generator at STS LS #24 (Wastewater treatment plant)
Hazards Addressed	Flooding

Responsible Agency	City of Fargo
Cost	\$2 million
Benefits	Maintain pumping to minimize flooding damages to residential and commercial properties along with maintaining traffic for civilian, city and emergency personnel. This lift station pumps water that collects in the storm sewer system from both residential and commercial properties. This lift station also pumps runoff from around the wastewater treatment plant. The potential for property damage, wastewater plant flooding along with street flooding is present if this lift station was to become inoperable.
Potential Funding Sources	Infrastructure sales tax, flood sales tax
Timeline	1-10 years
Priority	High

Mitigation Action/Description	Install permanent generator at STS LS #26 (Ridgewood Addition)
Hazards Addressed	Flooding, Thunderstorms
Responsible Agency	City of Fargo
Cost	\$150,000
Benefits	Maintain pumping to minimize flooding damages to residential and commercial properties along with maintaining traffic for civilian, city and emergency personnel. This lift station pumps water that collects in the storm sewer system from both residential and commercial properties. The potential for property damage along with street flooding is present if this lift station was to become inoperable.
Potential Funding Sources	Infrastructure sales tax
Timeline	10-20 years
Priority	Low

Mitigation Action/Description	Relocate lift station at STS LS #30 (Milwaukee bike trail south of 40th Avenue)
Hazards Addressed	Flooding, Thunderstorms
Responsible Agency	City of Fargo
Cost	\$200,000
Benefits	Maintain pumping to minimize flooding damages to residential and commercial properties along with maintaining traffic for civilian, city and emergency personnel. This lift station pumps water that collects in the storm sewer system from both residential and commercial properties. The potential

	for property damage along with street flooding is present if this lift station was to become inoperable.
Potential Funding Sources	Infrastructure sales tax, flood sales tax.
Timeline	1-10 years
Priority	High

Mitigation Action/Description	Install permanent generator at STS LS #34 (West of Elm Street on Forest Avenue)
Hazards Addressed	Flooding, Thunderstorms
Responsible Agency	City of Fargo
Cost	\$150,000
Benefits	Maintain pumping to minimize flooding damages to residential and commercial properties along with maintaining traffic for civilian, city and emergency personnel. This lift station pumps water that collects in the storm sewer system from both residential and commercial properties. The potential for property damage along with street flooding is present if this lift station was to become inoperable.
Potential Funding Sources	Infrastructure sales tax.
Timeline	1-10 years
Priority	High

Mitigation Action/Description	Install permanent generator at STS LS #35 (Cass County Drain 10 south of 6th Avenue South)
Hazards Addressed	Flooding
Responsible Agency	City of Fargo
Cost	\$150,000
Benefits	Maintain pumping to minimize flooding damages to residential and commercial properties along with maintaining traffic for civilian, city and emergency personnel. This lift station pumps water that collects in the storm sewer system from both residential and commercial properties. The potential for property damage along with street flooding is present if this lift station was to become inoperable.
Potential Funding Sources	Infrastructure sales tax

Timeline	1-10 years
Priority	High (Radial feed)

Mitigation Action/Description	Relocate lift station and install permanent generator at STS LS #39 (VA Hospital)
Hazards Addressed	Flooding
Responsible Agency	City of Fargo
Cost	Relocate lift station: \$2 million Install permanent generator: \$150,000
Benefits	Maintain pumping to minimize flooding damages to residential and commercial properties along with maintaining traffic for civilian, city and emergency personnel. This lift station pumps water that collects in the storm sewer system from both residential and commercial properties. The potential for property damage along with street flooding is present if this lift station was to become inoperable. Location of the lift station makes it susceptible to river flooding.
Potential Funding Sources	Infrastructure sales tax, flood sales tax
Timeline	5-15 years
Priority	Low-Medium

Mitigation Action/Description	Relocate lift station and install permanent generator at STS LS #40 (East of Eagle Street on 32nd Avenue North)
Hazards Addressed	Flooding
Responsible Agency	City of Fargo
Cost	Relocate lift station: \$2 million Install permanent generator: \$150,000
Benefits	Maintain pumping to minimize flooding damages to residential and commercial properties along with maintaining traffic for civilian, city and emergency personnel. This lift station pumps water that collects in the storm sewer system from both residential and commercial properties. The potential for property damage along with street flooding is present if this lift station was to become inoperable. Location of the lift station makes it susceptible to river flooding.
Potential Funding Sources	Infrastructure sales tax, flood sales tax.
Timeline	10-20 years
Priority	Low – Medium

Mitigation Action/Description	Raise gatewell at STS LS #41 (10th Street North – 3700 Block)
Hazards Addressed	Flooding
Responsible Agency	City of Fargo
Cost	\$10,000

Benefits	Minimize river flooding damages to residential and commercial properties along with maintaining traffic for civilian, city and emergency personnel. The top of the gatewell is close to the flood of record. If water was to expel out of the gatewell it would lead to flooding residential and commercial property along with street flooding.
Potential Funding Sources	Infrastructure sales tax, flood sales tax.
Timeline	10-20 Years
Priority	Low

Mitigation Action/Description	Relocate lift station and install permanent generator at STS LS #42 (5th Street South at 21st Avenue South)
Hazards Addressed	Flooding
Responsible Agency	City of Fargo
Cost	Relocate lift station: \$2 million Install permanent generator: \$150,000
Benefits	Maintain pumping to minimize flooding damages to residential and commercial properties along with maintaining traffic for civilian, city and emergency personnel. This lift station pumps water that collects in the storm sewer system from both residential and commercial properties. The potential for property damage along with street flooding is present if this lift station was to become inoperable. Location of the lift station makes it susceptible to river flooding.
Potential Funding Sources	Infrastructure sales tax, flood sales tax.
Timeline	1-10 years
Priority	High

Mitigation Action/Description	Relocate lift station and install permanent generator at STS LS #43 (West side of University Drive at Rose Coulee)
Hazards Addressed	Flooding
Responsible Agency	City of Fargo
Cost	Relocate lift station: \$2 million Install permanent generator: \$150,000
Benefits	Maintain pumping to minimize flooding damages to residential and commercial properties along with maintaining traffic for civilian, city and emergency personnel. This lift station pumps water that collects in the storm sewer system from both residential and commercial properties. The potential for property damage along with street flooding is present if this lift station was to become inoperable. Location of the lift station makes it susceptible to river flooding.
Potential Funding Sources	Infrastructure sales tax, flood sales tax.
Timeline	5-15 years
Priority	Medium

Mitigation Action/Description	Elevate lift station cover slab, pump and control panel at STS LS #47 (38th Street south of Cass County Drain 27)
Hazards Addressed	Flooding
Responsible Agency	City of Fargo
Cost	\$150,000
Benefits	Contain river water in the lift station structure and maintain pumping to minimize flooding damages to residential and commercial properties along with maintaining traffic for civilian, city and emergency personnel. The top of the lift station is lower than emergency levees installed in 2009. If water was to expel out of the gateway side of the lift station it would lead to flooding residential and commercial property along with street flooding.
Potential Funding Sources	Infrastructure sales tax
Timeline	5-15 years
Priority	Medium

Mitigation Action/Description	Raise gateway at STS LS #48 (38th Street north of Cass County Drain 27)
Hazards Addressed	Flooding
Responsible Agency	City of Fargo
Cost	\$50,000
Benefits	Contain river water in gateway and maintain pumping to minimize flooding damages to commercial properties along with maintaining traffic for civilian, city and emergency personnel. The top of the gateway elevation is below the flood of record elevation. If water was to expel out of the gateway it would lead to flooding commercial property along with street flooding.
Potential Funding Sources	Infrastructure sales tax, flood sales tax.
Timeline	5-15 years
Priority	Medium

Mitigation Action/Description	Raise gateway and install permanent generator at STS LS #49 45th (Street north of Cass County Drain 27)
Hazards Addressed	Flooding
Responsible Agency	City of Fargo
Cost	\$50,000 – Raise gateway \$150,000 – Install permanent generator
Benefits	Contain river water in gateway and maintain pumping to minimize flooding damages to commercial properties along with maintaining traffic for civilian, city and emergency personnel. The top of the gateway elevation is below the flood of record elevation. If water was to expel out of the gateway it would lead to flooding residential and commercial property along with street flooding.
Potential Funding Sources	Infrastructure sales tax, flood sales tax

Timeline	5-15 years
Priority	Medium

Mitigation Action/Description	Raise lift station at STS LS #52 (East of Broadway at Kandi Lane)
Hazards Addressed	Flooding
Responsible Agency	City of Fargo
Cost	\$100,000
Benefits	Contain river water in gatewell side of the lift station while maintaining pumping to minimize flooding damages to residential and commercial properties along with maintaining traffic for civilian, city and emergency personnel. This lift station pumps water that collects in the storm sewer system from both residential and commercial properties. The potential for property damage along with street flooding is present if this lift station was to become inoperable. The top cover of the lift station is above the 2009 highwater elevation however, the risk of flood water expelling out of the gatewell on a larger flood event is possible.
Potential Funding Sources	Infrastructure sales tax, flood sales tax.
Timeline	10-20 years
Priority	Low

Mitigation Action/Description	Install permanent generator at STS LS #53 (Drain 10 at 40th Avenue North - CC20)
Hazards Addressed	Flooding
Responsible Agency	City of Fargo
Cost	\$200,000
Benefits	Maintain pumping to minimize flooding damages to residential and commercial properties along with maintaining traffic for civilian, city and emergency personnel. This lift station pumps water in Cass County Drain 10 that collects water from both residential and commercial properties. The potential for property damage along with street flooding is present if this lift station was to become inoperable.
Potential Funding Sources	Infrastructure sales tax, flood sales tax.
Timeline	10-20 years
Priority	Low

Mitigation Action/Description	Raise gatewell and install permanent generator at STS LS #54 (Street north of 40th Avenue South)	36th
Hazards Addressed	Thunderstorms	

Responsible Agency	City of Fargo
Cost	Raise gatewell: \$50,000 Install permanent generator: \$150,000
Benefits	Contain river water in gatewell and maintain pumping to minimize flooding damages to residential and commercial properties along with maintaining traffic for civilian, city and emergency personnel. This lift station pumps water from the underpass on 40 th Avenue South at I29. If this lift station lost power the underpass would be impassable to citizens, city maintenance workers and emergency vehicles during rain events.
Potential Funding Sources	Infrastructure sales tax.
Timeline	1-10 years
Priority	High

Mitigation Action/Description	Raise gatewell and install permanent generator at STS LS #55 (Street north of Cass County Drain 27) 42nd
Hazards Addressed	Flooding, Thunderstorms
Responsible Agency	City of Fargo
Cost	\$50,000
Benefits	Contain river water in the gatewell and maintain pumping to minimize flooding damages to residential and commercial properties along with maintaining traffic for civilian, city and emergency personnel. The top of the gatewell elevation is below the flood of record elevation. If water was to expel out of the gatewell it would lead to flooding residential and commercial property along with street flooding.
Potential Funding Sources	Infrastructure sales tax, flood sales tax.
Timeline	5-15 years
Priority	Medium

Mitigation Action/Description	Raise lift station and install permanent generator at STS LS #56 (42nd Street south of Cass County Drain 27)
Hazards Addressed	Flooding, Thunderstorms
Responsible Agency	City of Fargo
Cost	\$150,000 – Raise lift station \$150,000 – Install permanent generator
Benefits	Contain river water in gatewell side of lift station and maintain pumping to minimize flooding damages to residential and commercial properties along with maintaining traffic for civilian, city and emergency personnel. The top of the lift station is lower than emergency levees installed in 2009. If water was to expel out of the gatewell side of the lift station it would lead to flooding residential and commercial property along with street flooding.

Potential Funding Sources	Infrastructure sales tax, flood sales tax.
Timeline	5-15 years
Priority	Medium

Mitigation Action/Description	Raise lift station and install permanent generator at STS LS #57 (Trollwood - west lift)
Hazards Addressed	Flooding
Responsible Agency	City of Fargo
Cost	Raise lift station: \$150,000 Install permanent generator: \$150,000
Benefits	Contain river water in gatewell side of lift station and maintain pumping to minimize flooding damages to residential and commercial properties along with maintaining traffic for civilian, city and emergency personnel. The top of the lift station is lower than emergency levees installed in 2009. If water was to expel out of the gatewell side of the lift station it would lead to flooding residential and commercial property along with street flooding.
Potential Funding Sources	Infrastructure sales tax, flood sales tax.
Timeline	1-10 years
Priority	High

Mitigation Action/Description	Raise lift station at STS LS #58 (University Drive at 64th Avenue South)
Hazards Addressed	Flooding
Responsible Agency	City of Fargo
Cost	\$150,000
Benefits	Contain river water in gatewell side of lift station and maintain pumping to minimize flooding damages to residential and commercial properties along with maintaining traffic for civilian, city and emergency personnel. The top of the lift station is lower than emergency levees installed in 2009. If water was to expel out of the gatewell side of the lift station it would lead to flooding residential and commercial property along with street flooding.
Potential Funding Sources	Infrastructure sales tax, flood sales tax.
Timeline	1-10 years
Priority	High

Mitigation Action/Description	Install permanent generator at STS LS #59 (36th Street at 9th Avenue South)
Hazards Addressed	Thunderstorms
Responsible Agency	City of Fargo
Cost	\$150,000

Benefits	Maintain pumping to minimize flooding damages to residential and commercial properties along with maintaining traffic for civilian, city and emergency personnel. This lift station pumps water primarily from commercial areas and from the 9 th Avenue South underpass at Interstate 29. If this lift station lost power the underpass would be impassable to citizens, city maintenance workers and emergency vehicles during rain events.
Potential Funding Sources	Infrastructure sales tax, flood sales tax.
Timeline	5-15 years
Priority	Medium/High (Radial Feed)

Mitigation Action/Description	Raise lift station and install permanent generator at STS LS #61 (East side of 5th Street at 18th Avenue South)
Hazards Addressed	Flooding, Thunderstorms
Responsible Agency	City of Fargo
Cost	Raise lift station: \$150,000 Install permanent generator: \$150,000
Benefits	Contain river water in gateway side of lift station and maintain pumping to minimize flooding damages to residential and commercial properties along with maintaining traffic for civilian, city and emergency personnel. The top of the lift station is lower than emergency levees installed in 2009. If water was to expel out of the gateway side of the lift station it would lead to flooding residential and commercial property along with street flooding.
Potential Funding Sources	Infrastructure sales tax.
Timeline	5-15 years
Priority	Medium/High (Radial Feed)

Mitigation Action/Description	Convert portable lift station to permanent lift station with permanent generator at STS LS #64 (Kennedy Street at River Drive South)
Hazards Addressed	Flooding, Thunderstorm
Responsible Agency	City of Fargo
Cost	\$2 million
Benefits	Maintain pumping to minimize flooding damages to residential and commercial properties along with maintaining traffic for civilian, city and emergency personnel. This lift station pumps water that collects in the storm sewer system from both residential and commercial properties. The potential for property damage along with street flooding is present if this lift station was to become inoperable.
Potential Funding Sources	Infrastructure sales tax, flood sales tax.
Timeline	1-10 years

Priority	High
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Mitigation Action/Description	Relocate storm sewer lift station and install permanent generator at STS LS #65 (River Drive at 35th Avenue South)
Hazards Addressed	Flooding, Thunderstorms
Responsible Agency	City of Fargo
Cost	\$2 million
Benefits	Maintain pumping to minimize flooding damages to residential and commercial properties along with maintaining traffic for civilian, city and emergency personnel. This lift station pumps water that collects in the storm sewer system from both residential and commercial properties. The potential for property damage along with street flooding is present if this lift station was to become inoperable.
Potential Funding Sources	Infrastructure sales tax, flood sales tax.
Timeline	1-10 years
Priority	High

Mitigation Action/Description	Raise lift station and install permanent generator at STS LS #67 (Osgood lift station - east side Cass County Drain 27)
Hazards Addressed	Flooding, Thunderstorm
Responsible Agency	City of Fargo
Cost	Raise lift station: \$150,000 Install permanent generator: \$150,000
Benefits	Contain river water in gateway side of lift station and maintain pumping to minimize flooding damages to residential and commercial properties along with maintaining traffic for civilian, city and emergency personnel. The top of the lift station is lower than emergency levees installed in 2009. If water was to expel out of the gateway side of the lift station it would lead to flooding residential and commercial property along with street flooding.
Potential Funding Sources	Infrastructure sales tax, flood sales tax.
Timeline	5-15 years
Priority	Medium

Mitigation Action/Description	Raise lift station and install permanent generator at STS LS #68 (Osgood lift station - west side Cass County Drain 27)
Hazards Addressed	Flooding, Thunderstorms
Responsible Agency	City of Fargo
Cost	Raise lift station: \$150,000 Install permanent generator: \$150,000

Benefits	Contain river water in gateway side of lift station and maintain pumping to minimize flooding damages to residential and commercial properties along with maintaining traffic for civilian, city and emergency personnel. The top of the lift station is lower than emergency levees installed in 2009. If water was to expel out of the gateway side of the lift station it would lead to flooding residential and commercial property along with street flooding.
Potential Funding Sources	Infrastructure sales tax, flood sales tax.
Timeline	5-15 years
Priority	Medium

Mitigation Action/Description	Raise lift station and install permanent generator at STS LS #70 (45th Street south of Cass County Drain 27)
Hazards Addressed	Flooding, Thunderstorms
Responsible Agency	City of Fargo
Cost	Raise lift station: \$150,000 Install permanent generator: \$150,000
Benefits	Contain river water in gateway side of lift station and maintain pumping to minimize flooding damages to residential and commercial properties along with maintaining traffic for civilian, city and emergency personnel. The top of the lift station is lower than emergency levees installed in 2009. If water was to expel out of the gateway side of the lift station it would lead to flooding residential and commercial property along with street flooding.
Potential Funding Sources	Infrastructure sales tax, flood sales tax.
Timeline	5-15 years
Priority	Medium

Mitigation Action/Description	Raise lift station and install permanent generator STS LS #71 (Cass County Drain 53 at 52nd Avenue South)
Hazards Addressed	Flooding, Thunderstorm
Responsible Agency	City of Fargo
Cost	Raise lift station: \$150,000 Install permanent generator: \$150,000
Benefits	Contain river water in gateway side of lift station and maintain pumping to minimize flooding damages to residential and commercial properties along with maintaining traffic for civilian, city and emergency personnel. The top of the lift station is lower than emergency levees installed in 2009. If water was to expel out of the gateway side of the lift station it would lead to flooding residential and commercial property along with street flooding.
Potential Funding Sources	Infrastructure sales tax, flood sales tax.
Timeline	5-15 years
Priority	Medium
Mitigation Action/Description	Install permanent generator at STS LS #75 (2nd Street North at 15th Avenue)
Hazards Addressed	Flooding, Thunderstorm

Responsible Agency	City of Fargo
Cost	\$150,000
Benefits	Maintain pumping to minimize flooding damages to residential and commercial properties along with maintaining traffic for civilian, city and emergency personnel. This lift station pumps water that collects in the storm sewer system from both residential and commercial properties. The potential for property damage along with street flooding is present if this lift station was to become inoperable.
Potential Funding Sources	Infrastructure sales tax, flood sales tax.
Timeline	5-15 years
Priority	Medium

Mitigation Action/Description	Headworks Improvements
Hazards Addressed	Thunderstorms, Flooding
Responsible Agency	City of Fargo
Cost	\$10 million
Benefits	Modify existing influent vault to the Wastewater Treatment Plant to more efficiently manage flows, which potentially minimizes flooding, overflows and sewer backup damages to commercial and residential properties.
Potential Funding Sources	Infrastructure sales tax
Timeline	1-5 years
Priority	High

Mitigation Action/Description	Install West Side Overflow Interconnect
Hazards Addressed	Thunderstorms, heavy rainfall intensity
Responsible Agency	City of Fargo
Cost	\$500,000
Benefits	Install an overflow from the West Side Interceptor into the 45th Street Interceptor during wet weather events that will allow the sewage to be pumped to the lagoons relieving capacity concerns at the Wastewater Treatment Plant.
Potential Funding Sources	Infrastructure sales tax
Timeline	1-5 years
Priority	High

Mitigation Action/Description	Flow Shedding Project
Hazards Addressed	Thunderstorms, heavy rainfall intensity
Responsible Agency	City of Fargo
Cost	\$15.5 million
Benefits	Provides relief to City sanitary sewer system during heavy rainfall events, which potentially minimizes flooding and sewer backup damages to commercial and residential properties.
Potential Funding Sources	Infrastructure Sales Tax

Timeline	1-10 years
Priority	High
Mitigation Action/Description	Emergency Generator Lift Station #26
Hazards Addressed	Thunderstorms, heavy rainfall intensity
Responsible Agency	City of Fargo
Cost	\$1 million
Benefits	Power supply to Lift Station #26 in event of grid power loss allowing the City to continue to pump sewage to the Wastewater Treatment Plant, which potentially minimizes flooding, overflows and sewer backup damages to commercial and residential properties.
Potential Funding Sources	Infrastructure sales tax
Timeline	1-10 years
Priority	High

Mitigation Action/Description	Emergency Generator Lift Station #46
Hazards Addressed	Thunderstorms, heavy rainfall intensity
Responsible Agency	City of Fargo
Cost	\$1 million
Benefits	Power supply to Lift Station #46 in event of grid power loss allowing the City to continue to pump sewage to the Wastewater Treatment Plant, which potentially minimizes flooding, overflows and sewer backup damages to commercial and residential properties.
Potential Funding Sources	Infrastructure sales tax
Timeline	1-10 years
Priority	High

Mitigation Action/Description	Emergency Generator Lift Station #2
Hazards Addressed	Thunderstorms,
Responsible Agency	City of Fargo
Cost	\$1 million
Benefits	Power supply to Lift Station #2 in event of grid power loss allowing the City to continue to pump sewage to the Wastewater Treatment Plant, which potentially minimizes flooding, overflows and sewer backup damages to commercial and residential properties.
Potential Funding Sources	Infrastructure sales tax
Timeline	1-10 years
Priority	Low

Mitigation Action/Description	Effluent Force Main Improvements
Hazards Addressed	Thunderstorms, Flooding
Responsible Agency	City of Fargo
Cost	\$4 million

Benefits	Modify existing force main to more efficiently manage flows, which potentially minimizes flooding, overflows and sewer backup damages to commercial and residential properties.
Potential Funding Sources	Infrastructure sales tax
Timeline	1-10 years
Priority	Low
Mitigation Action/Description	Storm Lift Station Upgrade - Wastewater Treatment Plant
Hazards Addressed	Thunderstorms, heavy rainfall intensity, flooding
Responsible Agency	City of Fargo
Cost	\$500,000
Benefits	Install a new pump and retrofit the existing pump station to allow the Storm Lift Station to operate correctly during high flow and high water events at the Wastewater Treatment Plant preventing surcharging of the storm sewer system.
Potential Funding Sources	Infrastructure sales tax
Timeline	1-10 years
Priority	Low

Mitigation Action/Description	Emergency Standby Generator at Water Treatment Plant
Hazards Addressed	All hazards
Responsible Agency	City of Fargo
Cost	\$1.5 million
Benefits	Power supply to the Water Treatment in event of grid power loss allowing the City to continue to provide potable water for fire protection and to end users
Potential Funding Sources	Infrastructure sales tax
Timeline	1-3 years
Priority	High

Mitigation Action/Description	Emergency Standby Generator at Sheyenne River Pump Station
Hazards Addressed	All hazards
Responsible Agency	City of Fargo
Cost	\$1 million
Benefits	Power supply to the Sheyenne River Pumping Station in event of grid power loss allowing the City to continue to provide raw water to the treatment plant to be treated for fire protection and to serve users
Potential Funding Sources	Infrastructure sales tax
Timeline	1-3 years
Priority	High

Mitigation Action/Description	Relocation of the Sheyenne River Pump Station
Hazards Addressed	Flooding
Responsible Agency	City of Fargo

Cost	\$15 million
Benefits	New location to remove loss of service due to flood event
Potential Funding Sources	Infrastructure sales tax
Timeline	1-3 years
Priority	High

Mitigation Action/Description	Emergency Standby Generator at Red River Pump Station
Hazards Addressed	All hazards
Responsible Agency	City of Fargo
Cost	\$1 million
Benefits	Power supply to Red River Pumping Station in event of grid power loss allowing the City to continue to provide raw water to the treatment plant to be treated for fire protection and to serve users
Potential Funding Sources	Infrastructure sales tax
Timeline	1-5 years
Priority	Low

Mitigation Action/Description	Relocation of the Red River Pump Station
Hazards Addressed	Flood
Responsible Agency	City of Fargo
Cost	\$10 million
Benefits	The City is reconstructing portions of the levee system, the new alignment will not protect the Red River Pumping Station. This project would protect the Red River raw water source.
Potential Funding Sources	Infrastructure sales tax
Timeline	5-10 years
Priority	Low

Mitigation Action/Description	Emergency Standby Generator at High Service Pump Station
Hazards Addressed	All hazards
Responsible Agency	City of Fargo
Cost	\$1 million
Benefits	Power supply to High Service Station in event of grid power loss allowing the City to continue to provide potable water for fire protection and to serve users and maintain pressure within the distribution system to prevent contamination
Potential Funding Sources	Infrastructure sales tax
Timeline	5-10 years
Priority	High

Mitigation Action/Description	Electric Actuated Valve for Water Source
Hazards Addressed	All hazards
Responsible Agency	City of Fargo
Cost	\$350,000
Benefits	The City of Fargo utilizes two surface water sources. The two sources come together in the yard of the Water Treatment Plant and currently a manual valve needs to be adjusted to switch water sources, this actuated valve would provide a near instantaneous transfer allowing the City to maintain their treatment process in the event of the loss of a raw water station
Potential Funding Sources	Infrastructure sales tax
Timeline	5-10 years
Priority	Low
Mitigation Action/Description	Dry Chemical Storage
Hazards Addressed	All hazards
Responsible Agency	City of Fargo
Cost	\$500,000
Benefits	The City of Fargo currently has 7 days capacity for dry chemical storage. This requires additional chemical deliveries weekly to provide for water treatment, this project would allow for 30 days' worth of storage.
Potential Funding Sources	Infrastructure sales tax
Timeline	1-3 years
Priority	Low

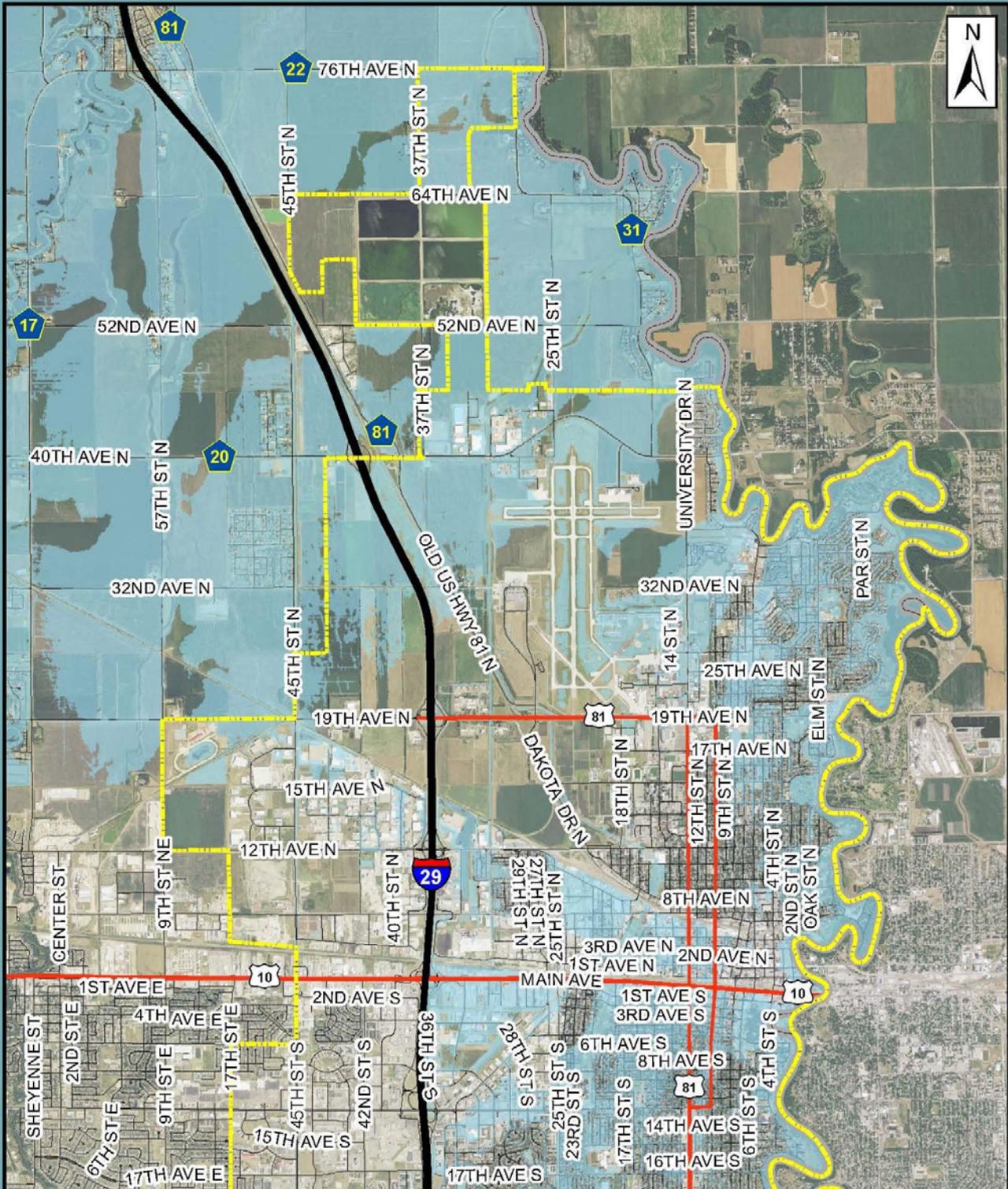
Mitigation Action/Description	Permanent Floodwalls at High Service Pump Station
Hazards Addressed	Flood
Responsible Agency	City of Fargo
Cost	\$500,000
Benefits	Floodwalls around the High Service Pump Station to protect against a flood allowing the High Service Station to stay in service allowing the City to continue to provide potable water for fire protection. serve users and maintain pressure within the distribution system to prevent contamination
Potential Funding Sources	Infrastructure sales tax
Timeline	5-10 years
Priority	High

Mitigation Action/Description	Relocation of Red River Intake Screens
Hazards Addressed	Drought
Responsible Agency	City of Fargo
Cost	\$1.5 million
Benefits	Relocating the intake screens from the side channel to the deeper center channel of the River would allow prolonged use of the Red River during drought periods.
Potential Funding Sources	Infrastructure sales tax

Timeline	5-10 years
Priority	Low

Mitigation Action/Description	Emergency Water Supply Line Improvements
Hazards Addressed	Drought
Responsible Agency	City of Fargo
Cost	\$12 million
Benefits	Provide water source Sheyenne River to the Water Treatment Plant for treatment in the event of the Red River being too low.
Potential Funding Sources	Infrastructure sales tax
Timeline	5-10 years
Priority	High

Figure 6.4 Fargo Floodplain Maps



-  Phase 7 100yr Floodplain
-  City Limits

Cass County Hazus Fargo



Frontier

- **Unique Vulnerabilities**

The City of Frontier is almost completely inundated during a 100-year flood event. See **Figure 6.5** for the 100 year floodplain according to the new Corps of Engineers study in the City of Frontier. It is important to note that this floodplain is not the proposed FIRM and was utilized simply for planning purposes as it places greater emphasis on the wet cycle expected to continue. Flood forecasts in this model are higher. The City is susceptible to other hazards similar to the rest of the County.

- **Jurisdictional Capacity**

The City of Frontier has limited financial and technical resources so it does rely on state and county resources for large scale projects.

- **Mitigation Actions**

Mitigation Action/Description	Installation of warning sirens
Hazards Addressed	Severe weather
Responsible Agency	City of Frontier/Cass County
Cost	\$25,000
Benefits	Advanced warning will allow for increased preparedness with potential to reduce property damage and lessen the potential of loss of life
Potential Funding Sources	HMGP, Local
Timeline	1-5 years depending on funding availability
Priority	High

Mitigation Action/Description	Create permanent flood protection around the City
Hazards Addressed	Flooding
Responsible Agency	City of Frontier/Cass County
Cost	TBD
Benefits	Would reduce damages to public and private property and allow a more resilient community to without the frequent emergency flood preparations that have recently plagued the area.
Potential Funding Sources	Federal, State, County
Timeline	5-10 years
Priority	High

Figure 6.5 Frontier Floodplain Map



-  Phase 7 100yr Floodplain
-  City Limits

Cass County Hazus Frontier



Gardner

- **Unique Vulnerabilities**

Gardner is not in a SFHA; however, have problems with overland flooding and poor drainage. Surface water flows from west of interstate-29 into town.

Critical infrastructure in Gardner includes a fire station, water pump station where the community connects to Cass Rural Water and a sanitary lift station.

- **Jurisdictional Capacity**

Gardner has limited financial and technical resources as a town of 74 people according to the 2010 Census. Assistance from the State and County is necessary for funding and carrying out large scale projects. The City does have contract engineering services to assist with identifying and carrying out improvement projects.

- **Mitigation Actions**

Mitigation Action/Description	Installation of generators at the Water Station and Sanitary Sewer Lift Station
Hazards Addressed	Severe Weather that may impact power
Responsible Agency	City of Gardner
Cost	\$5,000
Benefits	The water intake station and sanitary sewer lift station are critical to homes and business in town having basic services. Back-up generators would reduce the threat of discontinued service in the event of a power outage
Potential Funding Sources	HMGP, Local
Timeline	1-5 years
Priority	Medium

Mitigation Action/Description	Drainage Improvement Project
Hazards Addressed	Flooding
Responsible Agency	City of Gardner with assistance of City Engineer
Cost	\$2 million
Benefits	The installation of storm sewer and a storm sewer lift station would reduce overland flooding issues in town and associated damages to private property and public infrastructure.
Potential Funding Sources	State Water Commission, Cass Flood Sales Tax, ND Health Dept. HMGP, USDA Rural Development, CDBG
Timeline	5-15 years
Priority	Medium

Grandin

- **Unique Vulnerabilities**

Grandin is not in a SFHA; however, have problems with overland flooding and poor drainage. The city limits include portions of both Cass and Traill Counties.

Critical infrastructure in Gardner includes a fire station, water pump station where the community connects to Cass Rural Water and a sanitary lift station.

- **Jurisdictional Capacity**

Grandin has limited financial and technical resources as a town of 173 people according to the 2010 Census. Assistance from the State and County is necessary for funding and carrying out large scale projects. The City does have contract engineering services to assist with identifying and carrying out improvement projects.

- **Mitigation Actions**

Mitigation Action/Description	Replace ditch system with storm sewer
Hazards Addressed	Flooding (Interior drainage)
Responsible Agency	City of Grandin with assistance of City Engineer
Cost	\$2 million
Benefits	The installation of storm sewer and a storm sewer lift station would reduce overland flooding issues in town and associated damages to private property and public infrastructure.
Potential Funding Sources	State Water Commission, Cass Flood Sales Tax, ND Health Dept. HMGP, USDA Rural Development, CDBG
Timeline	5-15 years
Priority	Medium

Mitigation Action/Description	Installation of warning sirens
Hazards Addressed	Severe weather
Responsible Agency	City of Grandin/Cass County
Cost	\$25,000
Benefits	Advanced warning will allow for increased preparedness with potential to reduce property damage and lessen the potential of loss of life
Potential Funding Sources	HMGP, Local
Timeline	1-5 years depending on funding availability
Priority	High

Harwood



The City of Harwood has a population of 718 making it one of the larger communities in the county. The community has also experience growth of greater than 18% since 2000. Flooding is a significant issue to the City of Harwood as they have seen significant overland flooding damages in recent years from the Sheyenne River. See **Figure 6.6** for the 100 year floodplain according to the new Corps of Engineers study in the City of Harwood. It is important to note that this floodplain is not the proposed FIRM and was utilized simply for planning purposes as it places greater emphasis on the wet cycle expected to continue. Flood forecasts in this model are higher.

Critical infrastructure in the City of Harwood includes city hall, community center and an elementary school.

- **Jurisdictional Capacity**

The City of Harwood has an active City Council, mayor, auditor and public works superintendent in town and a contract with outside engineering services to assist the community in identifying and carrying out improvement projects. The City does rely on state and county resources for large scale projects. The City has adopted the State Building Code and the International Fire Prevention Code.

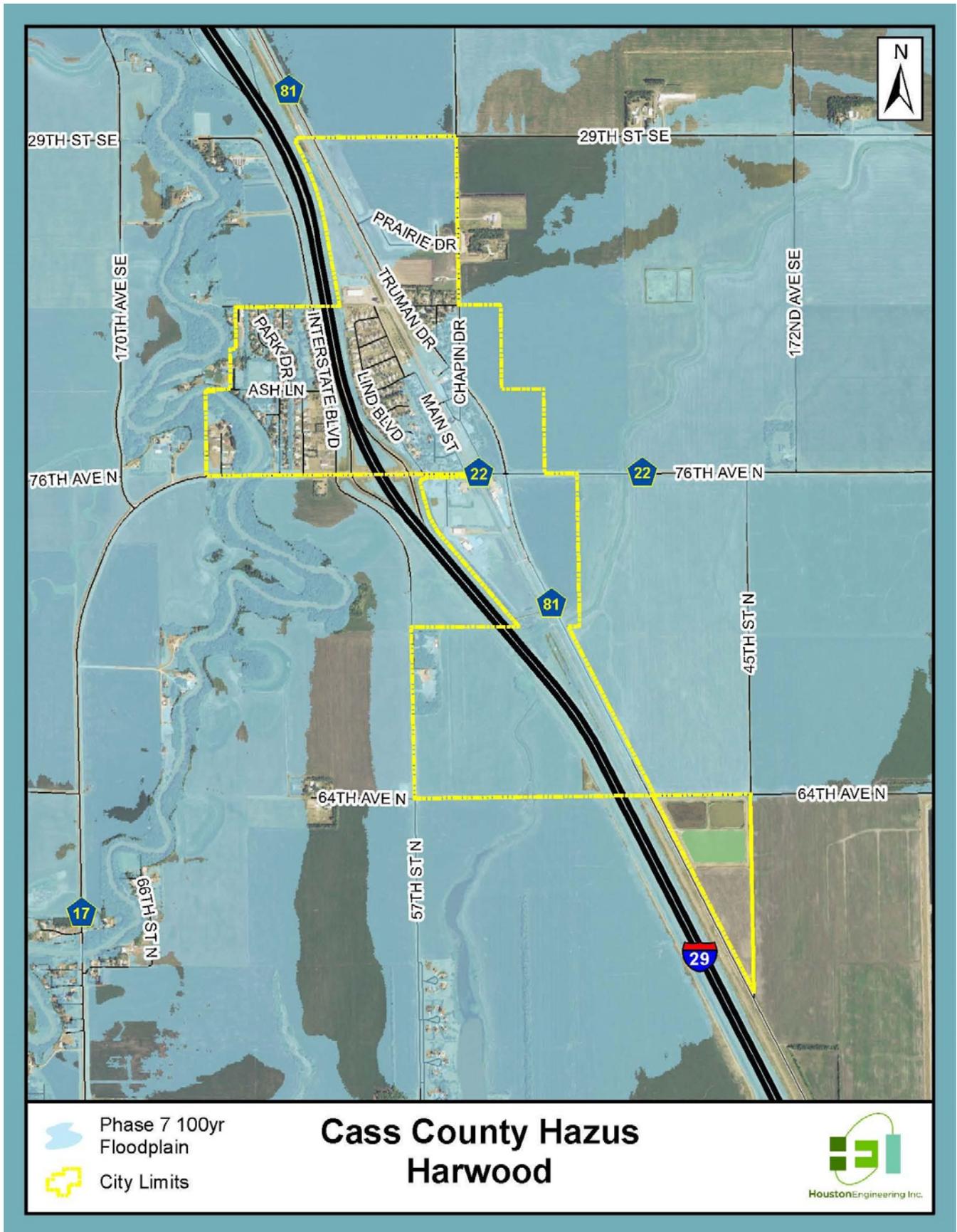
Other City ordinances and business can be found on the City's website at <http://www.cityofharwood.com>.

- **Mitigation Actions**

Mitigation Action/Description	Increase permanent flood protection throughout Harwood
Hazards Addressed	Flooding
Responsible Agency	City of Harwood
Cost	TBD
Benefits	Will reduce damages to public and private property and lessen strains on city infrastructure. Would allow for continued growth of the City.
Potential Funding Sources	Federal, ND State Water Commission, County, Local
Timeline	5 years
Priority	High

Figure 6.6 Harwood Floodplain Map

Unique Vulnerabilities



Horace



The City of Horace has a population of 2430 as of the 2010 Census making it the third largest community in the county behind Fargo and West Fargo. The community has also experienced the second highest growth rate in the County of 165% since 2000. Flooding is a challenge for the City of Horace. Recent flood incidences have required emergency protection. See **Figure 6.7** for the 100 year floodplain according to the new Corps of Engineers study in the City of Horace. It is important to note that this floodplain is not the proposed FIRM and was utilized simply for planning purposes as it places greater emphasis on the wet cycle expected to continue. Flood forecasts in this model are higher. Currently much of the built up area of the City is outside of the floodplain; however many areas for future growth are a concern.

Critical infrastructure in the City of Horace includes city hall, community center and an elementary school.

- **Jurisdictional Capacity**

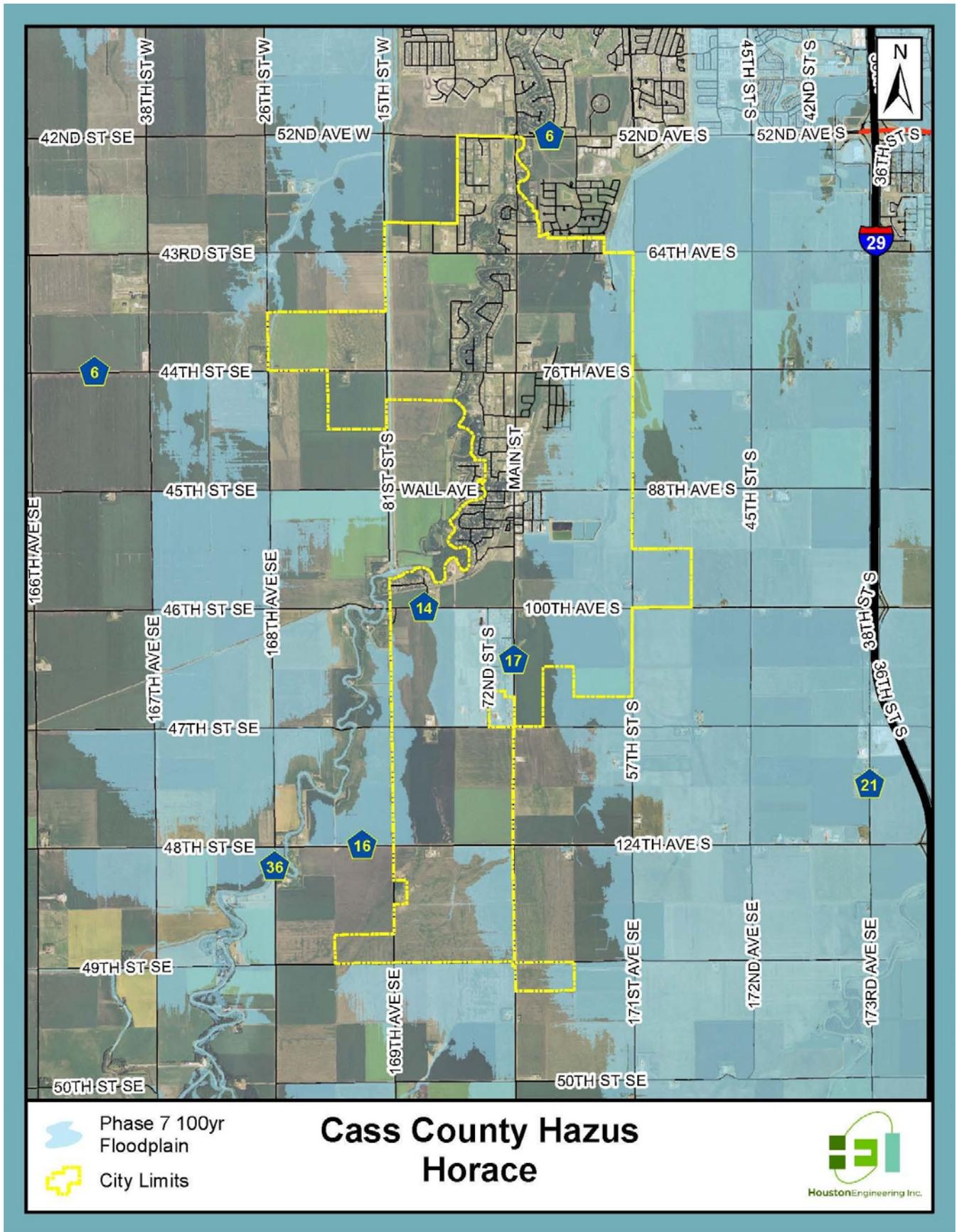
The City of Horace has an active City Council, mayor, auditor and public works department in town and a contract with outside engineering services to assist the community in identifying and carrying out improvement projects. The City does rely on state and county resources for large scale projects. The City has adopted a Building Code including a section on Flood Damage Prevention, and the International Fire Prevention Code. Other City ordinances and business can be found on the City's website at <http://www.cityofhorace.com>.

- **Mitigation Actions**

Mitigation Action/Description	Enhance Existing Storm Sewer and Lift Station Capacity
Hazards Addressed	Flooding
Responsible Agency	City of Horace
Cost	TBD
Benefits	Will reduce damages to public and private property and lessen strains on city infrastructure. Would allow for continued growth of the City.
Potential Funding Sources	Federal, ND State Water Commission, County, Local
Timeline	1-5 years
Priority	High

Figure 6.7 Horace Floodplain Map

Unique Vulnerabilities



Hunter



The City of Hunter is not located in a SFHA; however, interior drainage issues cause some concerns similar to flooding. A warning siren was recently installed in the community to enhance the outdoor public warning for summer storms. Critical infrastructure in Hunter includes a pump house where the City connects to Cass Rural Water worth \$500,000 and a sanitary sewer lift station worth nearly \$250,000.

- **Jurisdictional Capacity**

The City of Hunter has an active City Council, mayor, auditor and a maintenance provider in town and a contract with outside engineering services to assist the community in identifying and carrying out improvement projects. The City does rely on state and county resources for large scale projects.

- **Mitigation Actions**

Mitigation Action/Description	Installation of generators at the Water Pump House and Sanitary Sewer Lift Station
Hazards Addressed	Severe Weather that may impact power
Responsible Agency	City of Hunter
Cost	\$10,000
Benefits	The water intake station and sanitary sewer lift station are critical to homes and business in town having basic services. Generators would reduce the threat of discontinued service in the event of a power outage
Potential Funding Sources	HMGP, Local
Timeline	1-5 years
Priority	Medium

Mitigation Action/Description	Dredging ditches and replacing culverts in town
Hazards Addressed	Flooding (drainage issues)
Responsible Agency	City of Hunter
Cost	TBD
Benefits	Will reduce standing water and impacts to private property and city infrastructure.
Potential Funding Sources	HMGP, County, Local
Timeline	1-5 years depending on funding availability
Priority	High

Kindred

- **Unique Vulnerabilities**

The City of Kindred has a population of 692 making it one of the larger communities in the county. It is also a community that has experienced growth in recent years. Small areas of land within City limits are within the 100 year floodplain as it relates to the newest Corps of Engineers study. See **Figure 6.8** for Cass County Multi-Jurisdictional, Multi-Hazard Mitigation Plan

Unique Vulnerabilities

more detail. It is important to note that this floodplain is not the proposed FIRM and was utilized simply for planning purposes as it places greater emphasis on the wet cycle expected to continue. Flood forecasts in this model are higher.

Critical infrastructure in the City of Kindred includes two schools, city hall, a public works building, a water pump house valued at \$1 million, a water tower also valued at \$1 million, three sanitary lift stations valued at \$600,000 and two storm sewer lift stations valued at \$325,000.

- **Jurisdictional Capacity**

The City of Kindred has an active City Council, mayor, auditor and a maintenance provider in town and a contract with outside engineering services to assist the community in identifying and carrying out improvement projects. The City does rely on state and county resources for large scale projects.

- **Mitigation Actions**

Mitigation Action/Description	Build a new levee on the south end of town (South of Highway 46)
Hazards Addressed	Flooding
Responsible Agency	City of Kindred with assistance from the City Engineer
Cost	\$500,000
Benefits	Will reduce the risk of damages to infrastructure and public and private property
Potential Funding Sources	ND State Water Commission, Cass County, Local
Timeline	5 years
Priority	Medium

Mitigation Action/Description	Stabilize the slope north of Highway 46 along the bank of the Sheyenne River
Hazards Addressed	Flood
Responsible Agency	City of Kindred with assistance from the City Engineer
Cost	\$250,000
Benefits	Will reduce the risk of damages to infrastructure and public and private property
Potential Funding Sources	ND State Water Commission, Cass County, Local
Timeline	3 years
Priority	Medium

Figure 6.8 Kindred Floodplain Map



-  Phase 7 100yr Floodplain
-  City Limits

Cass County Hazus Kindred



Leonard

- **Unique Vulnerabilities**

The City of Leonard is not in a SFHA but like many other communities in Cass County the flat topography leaves them with interior drainage issues. The majority of the City is not hooked up to Cass Rural Water therefore most residences have individual wells. The City does operate and maintain a municipal sewer system with critical lift station valued at \$200,000.

- **Jurisdictional Capacity**

The City of Leonard has an active City Council and a contract with outside engineering services to assist the community in identifying and carrying out improvement projects. The City does rely on state and county resources for large scale projects.

- **Mitigation Actions**

Mitigation Action/Description	Drainage Improvements (install pump station to move water to legal drain approximately 1 mile south)
Hazards Addressed	Flooding (drainage)
Responsible Agency	City of Leonard
Cost	\$1 million
Benefits	Development of a permanent system to move standing water out of town would reduce damages to public and private property and lessen strains on city infrastructure. Utilizing an already established legal drain would also have less negative impacts than high water finding alternative courses.
Potential Funding Sources	HMGP, CDBG, County, Local
Timeline	5-10 years depending on funding availability
Priority	Medium-High

Mitigation Action/Description	Installation of warning sirens
Hazards Addressed	Severe weather
Responsible Agency	City of Leonard/Cass County
Cost	\$25,000
Benefits	Advanced warning will allow for increased preparedness with potential to reduce property damage and lessen the potential of loss of life
Potential Funding Sources	HMGP, Local
Timeline	1-2 years depending on funding availability
Priority	High

Mapleton

- **Unique Vulnerabilities**

The City of Mapleton has a population of 762 making it one of the larger communities in the county. The community has also experience growth of greater than 35% since 2000. A levee system protects most of the built up area of the City; however the floodplain is a concern for future growth and development.

Cass County Multi-Jurisdictional, Multi-Hazard Mitigation Plan

See **Figure 6.9** for the 100 year floodplain according to the new Corps of Engineers study in the City of Mapleton. It is important to note that this floodplain is not the proposed FIRM and was utilized simply for planning purposes as it places greater emphasis on the wet cycle expected to continue. Flood forecasts in this model are higher.

Critical infrastructure in the City of Mapleton includes two water towers valued at \$1.6 million, city hall and community center, a water pumping station where the City connects to Cass Rural Water valued at \$1.5 million, six sanitary lift stations and four storm sewer lift stations. Since the 2009 plan an additional water tower, a warning siren and storm sewer lift station have been installed. The City owns three portable generators that can be utilized at lift stations in emergency situations.

- **Jurisdictional Capacity**

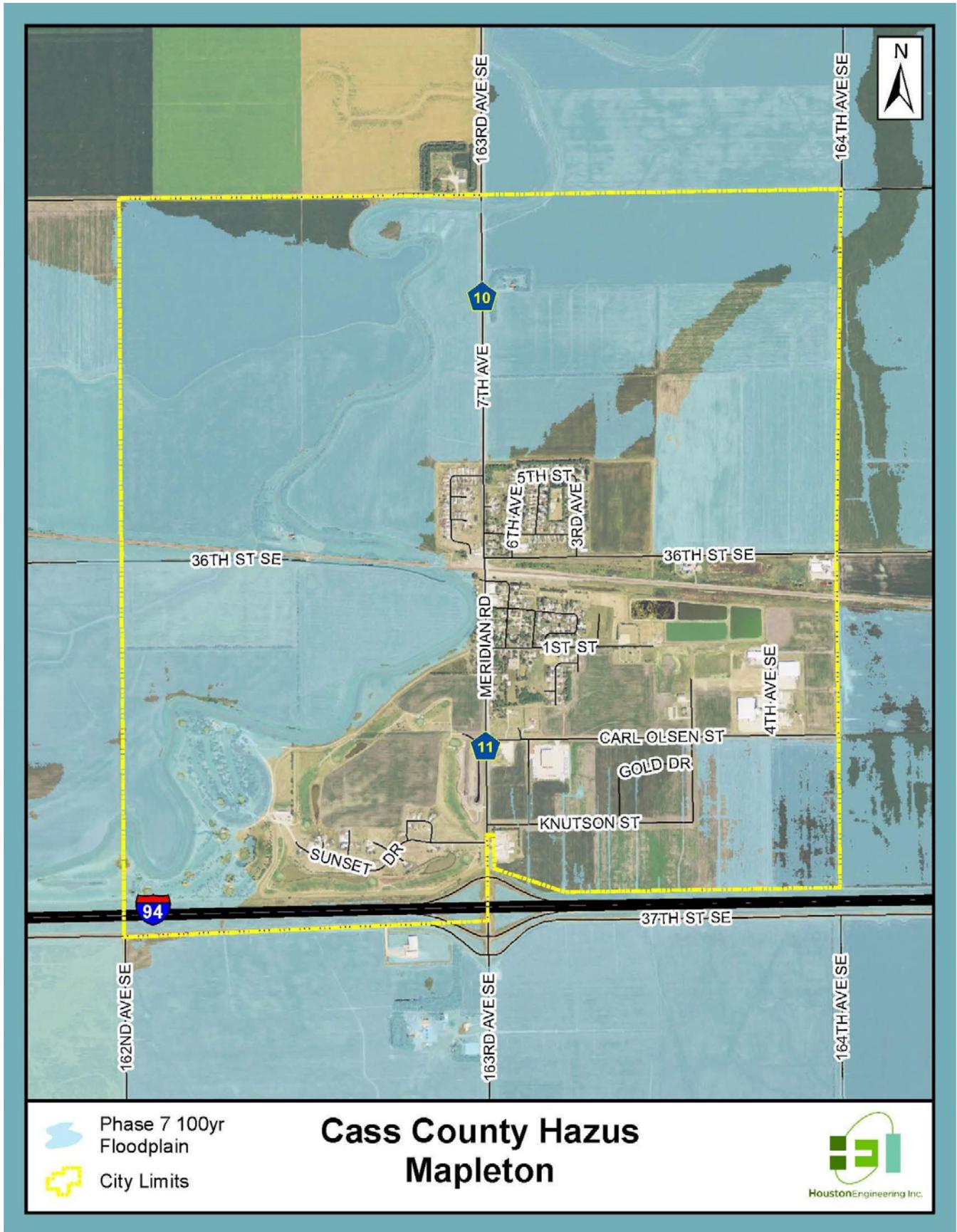
The City of Mapleton has an active City Council, mayor, auditor and public works director in town and a contract with outside engineering services to assist the community in identifying and carrying out improvement projects. The City does rely on state and county resources for large scale projects. The City has adopted the State Building Code, Methods of Reducing Flood Losses policy and a Flood Proofing Code.

- **Mitigation Actions**

Mitigation Action/Description	Repair and recertify existing levee
Hazards Addressed	Flooding
Responsible Agency	City of Mapleton
Cost	\$1 million
Benefits	Will reduce damages to public and private property and lessen strains on city infrastructure. The current levee benefits the entire built-up portion of the City.
Potential Funding Sources	ND State Water Commission, County, Local
Timeline	2 years
Priority	High

Mitigation Action/Description	Build levee to protect the southeast industrial area
Hazards Addressed	Flooding
Responsible Agency	City of Mapleton
Cost	\$500,000
Benefits	Will reduce damages to public and private property and lessen strains on city infrastructure. Would allow for future development in an industrial area outside of the floodplain
Potential Funding Sources	ND State Water Commission, County, Local
Timeline	5 years
Priority	Medium

Figure 6.9 Mapleton Floodplain Map



Unique Vulnerabilities

North River



The City of North River is almost completely inundated during a 100-year flood event. See **Figure 6.10** for the 100 year floodplain according to the new Corps of Engineers study in the City of North River. It is important to note that this floodplain is not the proposed FIRM and was utilized simply for planning purposes as it places greater emphasis on the wet cycle expected to continue. Flood forecasts in this model are higher. The City is susceptible to other hazards similar to the rest of the County.

- **Jurisdictional Capacity**

The City of North River has limited financial and technical resources so it does rely on state and county resources for large scale projects.

- **Mitigation Actions**

Mitigation Action/Description	Installation of warning sirens
Hazards Addressed	Severe weather
Responsible Agency	City of North River/Cass County
Cost	\$25,000
Benefits	Advanced warning will allow for increased preparedness with potential to reduce property damage and lessen the potential of loss of life
Potential Funding Sources	HMGP, Local
Timeline	1-5 years depending on funding availability
Priority	High

Figure 6.10 North River Floodplain Map



Unique Vulnerabilities

Oxbow



The City of Oxbow is positioned just south of Fargo which allows connection to Fargo services such as city sewer but Fargo decisions can also have significant impacts. This community of 305 as of the 2010 census is located on an oxbow of the Red River leaving it quite vulnerable as the Red River rises. Several acquisitions have taken place in Oxbow along Schnell Drive and Oxbow Drive leaving additional green way and significantly reducing risks to properties in the area. Permanent levee structures have also been placed in other areas of town to reduce vulnerabilities. See **Figure 6.11** for the 100 year floodplain according to the new Corps of Engineers study in the City of Oxbow. It is important to note that this floodplain is not the proposed FIRM and was utilized simply for planning purposes as it places greater emphasis on the wet cycle expected to continue. Flood forecasts in this model are higher.

Critical infrastructure in the City of Oxbow includes the city well, and storm sewer system that primarily diverts water back into the Red River channel.

- **Jurisdictional Capacity**

The City of Oxbow has an active City Council, and a contract with outside engineering services to assist the community in identifying and carrying out improvement projects. The City does rely on state, county, and the City of Fargo for additional resources for large scale projects.

- **Mitigation Actions**

Mitigation Action/Description	Relocate a lift station
Hazards Addressed	Flooding
Responsible Agency	City of Oxbow
Cost	\$300,000
Benefits	Will reduce the potential for the lift station to be inundated and discontinuing functioning during an event causing additional water to remain to damage public and private property
Potential Funding Sources	HMGP, ND State Water Commission, County, Local
Timeline	2 years
Priority	High

Mitigation Action/Description	Installation of backup generators
Hazards Addressed	Flooding & Severe Weather that may impact power
Responsible Agency	City of Oxbow
Cost	\$50,000
Benefits	Generators would reduce the threat of discontinued service in the event of a power outage or flood
Potential Funding Sources	HMGP, Local
Timeline	1-5 years
Priority	Medium

Figure 6.11 Oxbow Floodplain Map

Unique Vulnerabilities



Page



The City of Page is not in a SFHA and does not participate in NFIP; however, have problems with overland flooding and poor drainage. The community is connected to Cass Rural Water but maintains its own sanitary and storm sewer systems. In 2013 one-third of the communities clay pipes were relined.

Critical infrastructure in Page includes an elementary school, community center, a recently rehabilitated water tower valued at \$500,000 and one sanitary sewer lift station valued at \$250,000.

- **Jurisdictional Capacity**

Page has limited financial and technical resources as a town of 232 people according to the 2010 Census. Assistance from the State and County is necessary for funding and carrying out large scale projects. The City does have contract engineering services to assist with identifying and carrying out improvement projects.

- **Mitigation Actions**

Mitigation Action/Description	Installation of a backup generator at the lift station
Hazards Addressed	Severe weather
Responsible Agency	City of Page
Cost	\$2,000
Benefits	Reduces the risk of the lift station going down during any number of incidents
Potential Funding Sources	HMGP, Local
Timeline	1-2 years depending on funding availability
Priority	High

Mitigation Action/Description	Additional Storm Sewer installation and new lift station
Hazards Addressed	Flooding
Responsible Agency	City of Page
Cost	\$500,000
Benefits	Would reduce property damage to public and private land and reduce the strain on other infrastructure.
Potential Funding Sources	HMGP, ND State Water Commission, County, Local
Timeline	5 years depending on funding availability
Priority	Medium - High

Mitigation Action/Description	Installation of warning sirens
Hazards Addressed	Severe weather
Responsible Agency	City of Page

Unique Vulnerabilities

Cost	\$25,000
Benefits	Advanced warning will allow for increased preparedness with potential to reduce property damage and lessen the potential of loss of life
Potential Funding Sources	HMGP, Local
Timeline	1-5 years depending on funding availability
Priority	High

Unique Vulnerabilities

Prairie Rose



The City of Prairie Rose is almost completely inundated during a 100-year flood event. See **Figure 6.12** for the 100 year floodplain according to the new Corps of Engineers study in the City of Prairie Rose. It is important to note that this floodplain is not the proposed FIRM and was utilized simply for planning purposes as it places greater emphasis on the wet cycle expected to continue. Flood forecasts in this model are higher. The City is uniquely located within the city limits of Fargo creating opportunities while experiences impacts due to Fargo's decisions. The City is susceptible to other hazards similar to the rest of the County.

- **Jurisdictional Capacity**

The City of Prairie Rose has limited financial and technical resources so it does rely on state and county resources for large scale projects.

- **Mitigation Actions**

Mitigation Action/Description	Installation of warning sirens
Hazards Addressed	Severe weather
Responsible Agency	City of Prairie Rose/Cass County
Cost	\$25,000
Benefits	Advanced warning will allow for increased preparedness with potential to reduce property damage and lessen the potential of loss of life
Potential Funding Sources	HMGP, Local
Timeline	1-5 years depending on funding availability
Priority	High

Figure 6.12 Prairie Rose Floodplain Map



-  Phase 7 100yr Floodplain
-  City Limits

Cass County Hazus Prairie Rose



Unique Vulnerabilities

Reile's Acres



Nearly all of the land area with the City of Reile's Acres is within the 100-year floodplain. See **Figure 6.13** for the 100 year floodplain according to the new Corps of Engineers study in the City of Reile's Acres. It is important to note that this floodplain is not the proposed FIRM and was utilized simply for planning purposes as it places greater emphasis on the wet cycle expected to continue. Flood forecasts in this model are higher.

The City is located within the West Fargo School District, Cass Rural Water is the supplier for many homes with some individual wells still in service. The City provides sewer and garbage services.

- **Jurisdictional Capacity**

The City of Reile's Acres has an active City Council, and an up to date informative website to disseminate information. The city has grown to 513 people as of the 2010 census; nearly a 350% increase since established in 1977. Recognizing the floodplain the City has developed policies for new building and will print FIRM maps for residents for a fee. See <http://www.reilesacresnd.org>. The City does rely on state and county resources for large scale projects.

- **Mitigation Actions**

Mitigation Action/Description	Increase permanent flood protection from the Red River
Hazards Addressed	Flooding
Responsible Agency	City of Reile's Acres
Cost	TBD
Benefits	Will reduce damages to public and private property and lessen strains on city infrastructure. Would allow for continued growth of the City.
Potential Funding Sources	Federal, ND State Water Commission, County, Local
Timeline	5 years
Priority	High

Figure 6.13 Reile's Acres Floodplain Map



-  Phase 7 100yr Floodplain
-  City Limits

Cass County Hazus Reiles Acres



Unique Vulnerabilities

Tower City



The City of Tower City is not in a SFHA and since a drainage project completed nearly ten years ago does not have significant problems with drainage or overland flooding. The City is unique in that they have contracts and receive municipal water through both Cass Rural Water and Barnes Rural Water. There is a city sewer system but no true storm sewer. Drainage is taken care of through ditching.

- **Jurisdictional Capacity**

The City of Tower City has an active City Council, mayor, auditor and a maintenance provider in town and a contract with outside engineering services to assist the community in identifying and carrying out improvement projects. The City does rely on state and county resources for large scale projects.

- **Mitigation Actions**

Mitigation Action/Description	Installation of warning sirens
Hazards Addressed	Severe weather
Responsible Agency	City of Tower City
Cost	\$25,000
Benefits	Advanced warning will allow for increased preparedness with potential to reduce property damage and lessen the potential of loss of life
Potential Funding Sources	County, Local
Timeline	1-5 years depending on funding availability
Priority	High

West Fargo

- **Unique Vulnerabilities**

As the name implies, West Fargo is located just west of Fargo. With expansion occurring in both of these cities the boundary between them is nearly unrecognizable in many areas. The City has experienced rapid growth in recent years expanding by nearly 73% between 2000 and 2010 according to the census bureau. West Fargo has a few areas of concentrated vulnerable populations that can be found in the Department of Health's vulnerable population's inventory on file with Fargo Cass Public Health.

West Fargo has some flood risk as outlined in **Figure 6.4**. The figure depicts the 100 year floodplain according to the new Corps of Engineers study in the City of Fargo. It is important to note that this floodplain is not the proposed FIRM and was utilized simply for planning purposes as it places greater emphasis on the wet cycle expected to continue. Flood forecasts in this model are higher. Greater detail regarding critical infrastructure and how it relates to the flood risk can be found in the HAZUS information in **Appendix D** and the associated digital maps accompanying this Plan. Much of the flood risk in West Fargo was eliminated with the development of the Sheyenne Diversion in 1995.

- **Jurisdictional Capacity**

Second in population to Fargo, the City of West Fargo has the financial and technical resources to accomplish many high ranking priorities on its own. A local staff including specialties in city
Cass County Multi-Jurisdictional, Multi-Hazard Mitigation Plan

administration, planning, zoning, economic development, and outside contracts for legal and engineering are great assets to the City. Large scale projects still require assistance from federal and state and county resources.

- **Mitigation Actions**

Mitigation Action/Description	Replace storm sewer outfalls along Sheyenne River Strategy: Rehabilitation storm forcemain and stabilize river bank – approximately 12 locations
Hazards Addressed	River bank sloughing (geologic hazard)
Responsible Agency	City of West Fargo
Cost	\$600,000
Benefits	Will reduce future losses of land due to sloughing in the area and maintain integrity of infrastructure and private property in the area
Potential Funding Sources	Grant, Local
Timeline	1-2 years
Priority	High – Immediate

Mitigation Action/Description	Remove approximately 12 residential homes on the Sheyenne River. Strategy: acquire land, demo house, stabilize river bank, restore lots to green space
Hazards Addressed	River bank sloughing (geologic hazard)
Responsible Agency	City of West Fargo
Cost	\$1.5 - \$2.5 million
Benefits	Will reduce future damages to the removed structures as well as allow additional green way in for emergency protection in case of a future event. Bank stabilization would be an added benefit to land beyond the immediate project area.
Potential Funding Sources	Grant, Local
Timeline	1-2 years
Priority	High – Immediate

Mitigation Action/Description	Condos at 530 6th Ave Wand infrastructure rehabilitation and/or removal. Strategy: acquire land, demo condo buildings, repair and/or remove utilities, stabilize river bank, restore to green space
Hazards Addressed	River bank sloughing (geologic hazard)
Responsible Agency	City of West Fargo
Cost	\$1,250,000
Benefits	Will reduce future damages to the removed condos as well as allow additional green way in for emergency protection in case of a future event. Bank stabilization and utility rehabilitation or removal would be an added benefit to the entire system
Potential Funding Sources	Grant, Local
Timeline	1-2 years
Priority	High – Immediate

Mitigation Action/Description	Main Avenue Self Storage Strategy: River bank stabilization
Hazards Addressed	River bank sloughing (geologic hazard)
Responsible Agency	City of West Fargo
Cost	\$200,000
Benefits	Will reduce future losses of land due to sloughing in the area and maintain integrity of infrastructure and private property in the area
Potential Funding Sources	Grant, Local
Timeline	1-2 years
Priority	High – Immediate

Mitigation Action/Description	Center Street – land subsidence Strategy: stabilize river bank and possible street realignment
Hazards Addressed	River bank sloughing (geologic hazard)

Responsible Agency	City of West Fargo
Cost	\$750,000
Benefits	Will reduce future losses of land due to sloughing in the area and maintain integrity of infrastructure and property in the area
Potential Funding Sources	Grant, Local
Timeline	1-2 years
Priority	High – Immediate

Mitigation Action/Description	Riverwood/Chateau Cheyenne – land subsidence Strategy: evaluate river stabilization techniques and potentially remove residential homes in the area
Hazards Addressed	River bank sloughing (geologic hazard)
Responsible Agency	City of West Fargo
Cost	\$1,000,000
Benefits	Will reduce future damages to the removed structures as well as allow additional green way in for emergency protection in case of a future event. Bank stabilization would be an added benefit to land beyond the immediate project area.
Potential Funding Sources	Grant, Local
Timeline	1-2 years
Priority	High – Immediate

Mitigation Action/Description	Storm sewer force main rehabilitation Strategy: Replace flap-gate at Sheyenne River outfall and repair force main
Hazards Addressed	River bank sloughing (geologic hazard)
Responsible Agency	City of West Fargo
Cost	\$150,000
Benefits	Will reduce future losses of land due to sloughing in the area and maintain integrity of infrastructure and property in the area
Potential Funding Sources	Grant, Local
Timeline	1-2 years
Priority	High – Immediate

Mitigation Action/Description	PTO station replacement at south 2nd Ave and 21st Ave Strategy: Replace PTO pump stations
Hazards Addressed	Flooding
Responsible Agency	City of West Fargo
Cost	\$50,000
Benefits	Will reduce impacts of standing water near the station location.
Potential Funding Sources	Grant, Local
Timeline	1-2 years
Priority	High – Immediate

Mitigation Action/Description	Discharge structures with sluice gates on culverts on 52nd Ave, 40th Ave and 21st Ave Strategy: install new discharge structures with sluice gates
Hazards Addressed	Flooding
Responsible Agency	City of West Fargo
Cost	\$500,000
Benefits	Will reduce impacts and instances of standing water near the sluice gate locations.
Potential Funding Sources	Grant, Local
Timeline	1-2 years
Priority	High – Immediate

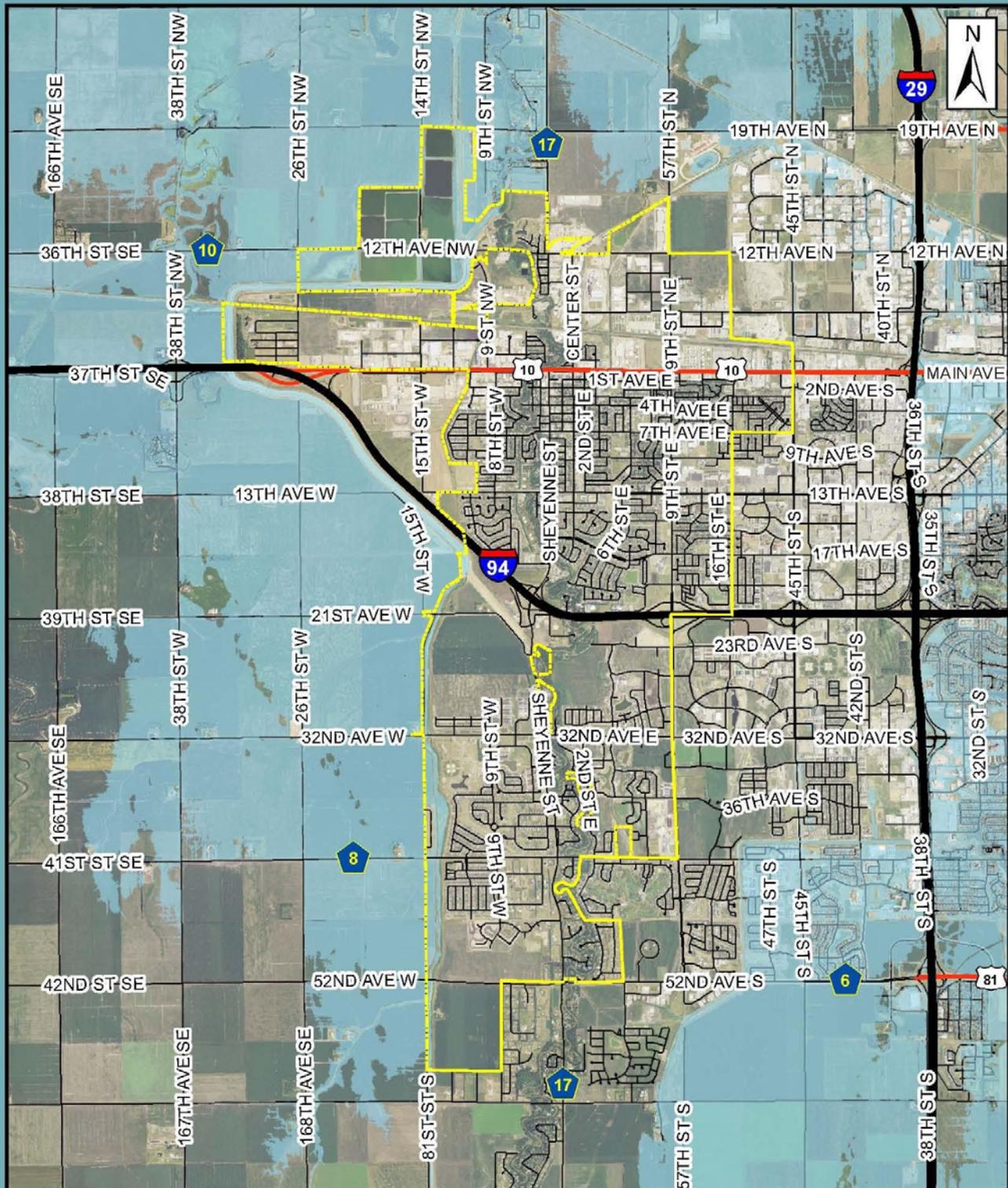
Mitigation Action/Description	Extend and connect culverts and fill ditch at Hayden Heights Strategy: CMP culverts and fill ditch including grading to blend with surrounding topography
Hazards Addressed	Flooding
Responsible Agency	City of West Fargo
Cost	\$500,000
Benefits	Will reduce impacts of standing water
Potential Funding Sources	Grant, Local
Timeline	1-2 years
Priority	High – Immediate

Mitigation Action/Description	Pavement and turnarounds at diversion crossings Strategy: Establish paved turnarounds at 52nd Ave, 40th Ave, 32nd Ave and 21st Ave
Hazards Addressed	Flooding
Responsible Agency	City of West Fargo
Cost	\$200,000
Benefits	Will reduce impacts to transportation at diversion crossings as well as creating a safer environment in instances of flooding
Potential Funding Sources	Grant, Local
Timeline	1-2 years
Priority	High – Immediate

Mitigation Action/Description	Restoration of all dike tops (outside and inside including tieback levees) Strategy: Repair dike tops including grading compaction and seeding
Hazards Addressed	Flooding
Responsible Agency	City of West Fargo
Cost	\$150,000

Benefits	Will improve the effectiveness of existing dikes and preserve functionality to reduce flood impacts to surrounding property during future events.
Potential Funding Sources	Grant, Local
Timeline	1-2 years
Priority	High – Immediate

Figure 6.14 West Fargo Floodplain Map



 Phase 7 100yr Floodplain	<h2>Cass County Hazus West Fargo</h2>	 HoustonEngineering Inc.
 City Limits		

ACRONYMS

BFE	Base Flood Elevation
BNSF	Burlington Northern Santa Fe
CDBG	Community Development Block Grant
CMI	Crop Moisture Index
CP	Canadian Pacific
EAPS	Emergency Action Plans
FEMA	Federal Emergency Management Agency
FIRM	Flood Insurance Rate Map
FM Metro COG	Fargo-Moorhead Metropolitan Council of Governments
FM MSA	Fargo-Moorhead Metropolitan Statistical Area
FMA	Flood Mitigation Assistance
HI	Heat Index
HMGP	Hazard Mitigation Grant Program
LAWA	Lake Agassiz Water Authority
LEPC	Local Emergency Planning Committee
mph	Miles per hour
NFIP	National Flood Insurance Program
PDSI	Palmer Drought Severity Index
RDI	Reclamation Drought Index
RRVWRR	Red River Valley and Western Short Line Rail Road
SPHA	Special Flood Hazard Area
SPI	Standardized Precipitation Index
STAPLEE	Social, Technical, Administrative, Political, Legal, Economical, Environmental (an evaluation method for mitigation actions)
SWSI	Surface Water Supply Index
USACE	United States Army Corps of Engineers
WFAS	West Fargo Aquifer System
WRD	Water Resource District

REFERENCES

- American Society of Civil Engineers, (2010). *So, you live behind a levee: What you should know to protect your home and loved ones from floods*. Retrieved from website:
<http://content.asce.org/files/pdf/SoYouLiveBehindLevee.pdf>
- Arndt and Moran (1974), Physical data for land-use planning – Cass County, North Dakota and Clay County, Minnesota. North Dakota Geological Survey Report of Investigations, No. 54.
 Cass County Multi-Jurisdictional, Multi-Hazard Mitigation Plan

Cass County Soil Conservation District, Grand Forks County, Lake Agassiz Regional Council and other organizations, (2012-2013). *Living with a river* [Special Publication]

City of Reiles Acres (2013). *Elevation & Flood Info*. Retrieved from website:
<http://www.reilesacresnd.org/7html>

Federal Emergency Management Agency. (n.d.). *Disaster declarations for North Dakota*. Retrieved from
http://www.fema.gov/disasters/grid/state-tribalgovernment/11?field_disaster_type_term_tid_1=All

FireDepartment.net. (2013). *Cass county, ND fire departments*. Retrieved from
<http://firedepartment.net/directory/north-dakota/cass-county>

FM Diversion (2013, February 18). *Flood Frequency and Retention*. White Paper. Retrieved from website:
<http://fmdam.org/wp-content/uploads/2013/08/2013-02-18-FM-Diversion-Detention-White-Paper.pdf>

Hector International Airports (2013) *Airlines, Airport Information and News*. Retrieved from website:
<http://www.fargoairport.com>

Lake Agassiz Water Authority. (2013). *Planning today for tomorrow's water*. Retrieved from
<http://lakeagassiz.org/>

National Severe Storms Laboratory. (2007). *Hail Climatology*. Retrieved from website:
http://www.nssl.noaa.gov/primer/hail/hail_climatology.html.

National Weather Service. (2009, December 17). *NWS windchill chart*. Retrieved from
<http://www.nws.noaa.gov/om/windchill/index.shtml>

North Dakota Forest Service (2010). *North Dakota Statewide Assessment of Forest Resources and Forest Resource Strategy*. Retrieved from <http://www.ndsu.edu/ndfs/>

North Dakota State Engineer, (1985, June) *Dam Design Handbook*. Retrieved from <http://www.swc.nd.gov>

North Dakota State University. (2013, July 2). *The "Fargo flood" homepage*. Retrieved from
<http://www.ndsu.edu/fargoflood/>

North Dakota State Water Commission. (2007). *North Dakota Five-Year Floodplain Management Work Plan Outline – FY 2007*.

North Dakota State Water Commission (n.d.). *ND state water commission mapservice*. Retrieved from
<http://mapservice.swc.state.nd.us/>

North Dakota State Water Commission (2013). *Map and Data Resources*. Retrieved from website:
<http://www.swc.nd.gov/4dlink8/4dcgi/structuresearchformweb/Map%20and%20Data%20Resources>.

North Dakota State Water Commission. (2013). E-mail Correspondence with Jeff Klein, North Dakota State Water Commission, dated October 7, 2013 and October 9, 2013.

National Drought Mitigation Center (2013) *U.S. Drought Monitor*. Retrieved from <http://drought.unl.edu>

National Weather Service (2013) *Advanced Hydrologic Prediction Service*. Retrieved from <http://water.weather.gov/ahps2/index.php?wfo=fgf>

Ripley, D.P. (2000). *The water resource characteristics of the West Fargo Aquifer System*. Bismarck, ND: North Dakota State Water Commission.

Ripley, D.P. (2004, January 13). *Interview by previous plan author*. Interview by phone conversation.

U.S. Geological Survey. (2013, December 14). *USGS current water data for North Dakota*. Retrieved from <http://waterdata.usgs.gov/nd/nwis/rt>

Valley Senior Services. (2010). *Welcome to valley senior services (formerly Fargo senior services)*. Retrieved from <http://valleyseniorservices.org/>

World Media Group, LLC. (2013). *Cass county weather*. Retrieved from <http://www.usa.com/cass-county-nd-weather.htm>

Planning Documents Reviewed and Referenced

Cass County Comprehensive Plan (2005). Retrieved from <https://www.casscountynd.gov/county/depts/planning/Pages/ComprehensivePlan.aspx>.

City of Casselton, (2014). *Casselton Capital Improvement Plan*. Draft on file with Moore Engineering. Reviewed October 2013

City of Fargo. (2012). *Go2030: Fargo comprehensive plan*. Retrieved from <http://go2030.net/2012/04/thefargo-comprehensive-plan-available/>

North Dakota State Water Commission and Office of the State Engineer.(2013) Strategic Plan 2013-2015. Retrieved from website: <http://www.swc.state.nd.us/4dlink9/4dcgi/GetCategoryRecord/Reports%20and%20Publications>.

Fargo-Moorhead Metropolitan Council of Governments. (2012). *Transit development plan*. Retrieved from <http://fmmetrocog.org/new/index.php?id=380>

State of North Dakota, Department of Emergency Services. (2014). *2014 Multi-hazard mitigation plan: Draft October 2013*

State of North Dakota, Department of Emergency Services, (2013, April 24) Legislative Flood Mitigation and Response Study. Print.

APPENDICES

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