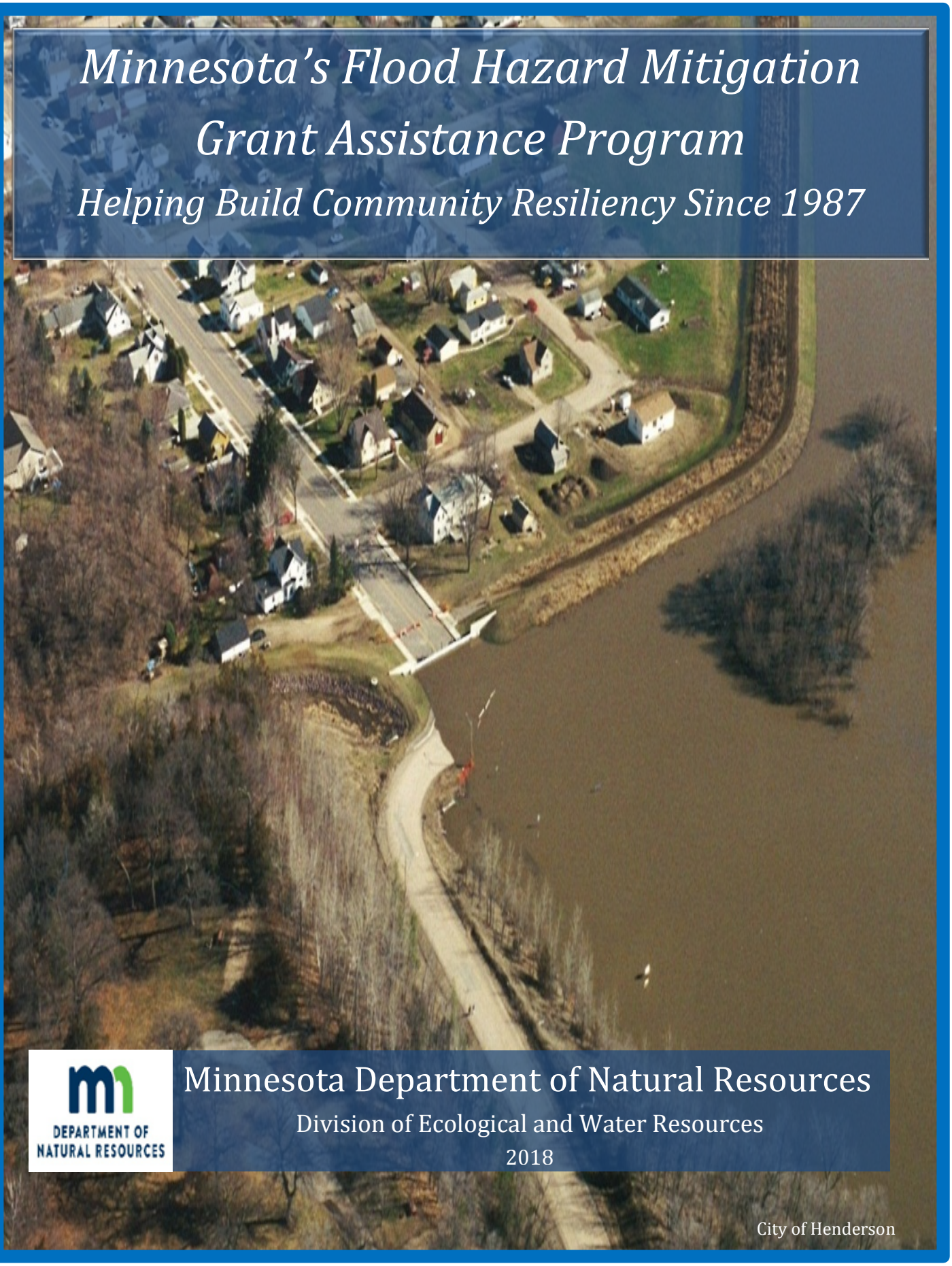
Minnesota's Flood Hazard Mitigation Grant Assistance Program

Helping Build Community Resiliency Since 1987



DEPARTMENT OF NATURAL RESOURCES

Minnesota Department of Natural Resources

Division of Ecological and Water Resources

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City of Henderson

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I. Introduction

Flooding is the most frequent and costly of natural disasters in the U.S., averaging $8 billion in flood damage and 89 flood-related fatalities per year since 1984. Flood damage has increased in the U.S., despite federal, state and local government effort to mitigate flood hazards and regulate development in flood-risk areas. In Minnesota, flooding has resulted in significant negative socio-economic impacts, as well as the loss of life. Since 1957, there have 45 flood-related presidential disaster declarations in Minnesota, 15 of which have occurred since 2004. Historically, many communities along the Red River of the North, Minnesota River, and Mississippi River, endured near-annual flood losses. Flooding represents the largest portion of disaster related costs in Minnesota.

Zumbro Falls 2010, photo courtesy of the MNDNR

Recognizing the negative impacts associated with severe flooding in the state, the Minnesota legislature established the *Flood Hazard Mitigation Grant Assistance Program* in 1987. The law charged the Department of Natural Resources with administering a cost-share grant program to provide technical and financial assistance to local units of government to reduce long-term flood risk. Since its inception, the Flood Hazard Mitigation Grant Assistance Program has awarded over $510 million in state funds to implement over 365 flood risk reduction projects throughout the state.

Federal, state and local investment in flood hazard mitigation has resulted in a significant reduction in the number of communities at high risk of flooding and flood-related damage. The communities historically most at-risk and experiencing repetitive loss have, with the assistance of the state cost–share program, implemented a host of projects ranging from improved flood mapping and warning systems to capital improvements including diversions, floodwalls, levees, pumping stations, and removal or relocation of at risk structures and facilities. Over the last few decades, these efforts, in conjunction with the administration of sound floodplain land use regulations and improved

communication of flood risk to the public, have resulted in significant statewide flood protection. However, there is still work to be done. Climate change is presenting new challenges, land conversion and development put pressure on floodplains and their ability to store water, and long-term maintenance costs for projects will continue. The program will need to adapt to meet these challenges and needs. An assessment of the practical level of flood protection needs to occur. Updated hydrology data indicate that the frequency of high intensity rainfall events is increasing. Extreme late summer/fall rainfall events are occurring in greater frequency.

This report highlights some of the significant past flood events that have occurred in Minnesota, examples of cooperative measures taken to reduce flood risk through mitigation in several historically high-risk communities in Minnesota, and the mitigation work that still remains in Minnesota.

II. Flooding in Minnesota

Minnesota's diverse landscape has historically lent itself to natural flooding. From the relatively flat bed of glacial Lake Agassiz in northwest Minnesota's Red River Valley to the deeply-carved river valleys of the unglaciated area of the southeast, many areas of the State have landscapes that are predisposed to flooding. Over the years, land use in Minnesota has changed, with more development occurring in these flood-prone areas. Minnesota's climate is also changing, with higher intensity and more frequent storm events occurring. This has led to an increased frequency of large-scale flooding events and increased damages to infrastructure over the past decades. Some of the most significant flooding events in Minnesota history have occurred in the past 50 years. A number of the more notable Minnesota floods are described briefly below.

A. Historic Minnesota Flood Events (1965-Present)

1965

The floods of record for the Mississippi River at St. Paul, the St. Croix River at Stillwater, and the Minnesota River in Savage all occurred in spring of 1965. The preceding winter was cold and excessively snowy, with rapidly warming temperatures and widespread rain, resulting in record flooding along these rivers.

These flood events closed major transportation facilities, destroyed millions of dollars in public and private property, and resulted in construction of emergency levees. The flood event resulted in a presidential disaster declaration that included 65 Minnesota counties.

Kellogg Boulevard. St. Paul, 1965.
Courtesy of Minnesota Historical Society

1987

The single largest rainfall event in Minneapolis/St. Paul recorded history occurred in July 1987. Intense thunderstorms produced nearly 14 inches of rain recorded over the course of three days. This resulted in significant flooding of urban areas, particularly in the southern and western parts of the Twin Cities Metropolitan area. Flash flooding occurred across the Twin Cities metro area, with several major roads flooded and local ponds and streams overtopping their banks. Thousands of Twin City area homes were damaged by the flooding, along with public infrastructure. Property damage was estimated to be in excess of $30 million. Two flood related fatalities were reported. Shortly after this record-setting event, a presidential disaster declaration was made for seven twin cities metro area counties.

Twin Cities Metro Area Superstorm in 1987 Courtesy of Kare11

1997

The Red River and Minnesota River basins have a long history of flooding. One of the highest floods of record for the Red River near Moorhead occurred in 1897. 100 years later, in 1997, a flood of historic proportion impacted both of these major river basins. Similar to past spring floods, the 1997 Red River and Minnesota River floods were preceded by an excess snowfall late in to the winter season. The Moorhead area received nearly 34 inches of snow in March and early April. Warm temperatures in late March resulted in rapid snow melt and runoff into the Red River and Minnesota River basins.

Above: Oslo MN; Below: Red River Flooding, 1997
Photos by MNDNR

Compounding matters, widespread rainfall of 1 to 3 inches in early April resulted in record level river crests at several locations on both the Red and Minnesota Rivers. The Red River at East Grand Forks and the Minnesota River at both Montevideo and at Granite Falls experienced record crests that have not been exceeded since. Structural damage caused by 1997 flooding in Minnesota was roughly $300 million, and 58 counties were included in a declared federal disaster. Nearly 25,000 Minnesota households were affected by the floods, and the total economic impacts were estimated at nearly $2 billion.

2007

A devastating flash flood occurred over extreme southeastern Minnesota in late August 2007, when record breaking rainfall was recorded. 15.10 inches of rain was recorded in Hokah, MN, in a 24 hour period. This 24-hour rainfall amount far exceeded the previous 24-hour rainfall record for Minnesota of 10.84 inches. The largest multi-day rainfall total reported for this event was an astounding 20.85 inches observed near the town of Houston in Houston County.

Flood Damage in Minnesota City, 2007
Photo by MNDNR

The tremendous rainfall totals make this one of the most significant rainfall events in all of Minnesota's climate history. Major flood damage occurred in many southeastern Minnesota communities. Hundreds of homes and businesses were impacted. Stream flooding, urban flooding, mudslides, and road closures were numerous throughout southern Minnesota. This flash flood resulted in seven fatalities and $180 million in damage in Minnesota. A federal disaster declaration was made including eight Minnesota counties.

2010

Fall 2010 saw major flooding in a broad area covering nearly the entire southern quarter of the state. Two day rainfall totals of eight inches or more were common. Intense rainfall began in late September. The highest two-day rainfall total reported was 11.06 inches near Winnebago in Faribault County. The combination of very large rainfall totals over such a large area makes this one of the most significant floods in Minnesota's history. An area encompassing over 5,000 square miles in Minnesota alone received six or more inches of rain during this event. Many southern Minnesota river and stream flow levels approached or exceeded record highs. Although not unprecedented, September flash floods are not common. In the communities of Hammond, Owatonna, Pine Island, Pipestone, Zumbro Falls, and many others, scores of homes and businesses were destroyed by floodwater, and transportation corridors closed due to flood damaged roads and bridges. This widespread flood event resulted in a presidential disaster declaration covering 29 southern Minnesota counties.

Zumbro Falls in 2010 Flood
Photos by MNDNR

2012

The June 2012 flooding caused greatest damage in St. Louis, Lake, Pine, Carlton and Aitkin Counties. The highest precipitation total for the multi-day event was 10.10 inches reported northeast of Duluth. Further north, the City of Two Harbors experienced 9.93 inches of rain. These storm events resulted in the most damaging flood in Duluth's history. Problems began when excessive and intense rain fell on saturated ground and overwhelmed steep stream channels and bridge and culvert crossings.

Substantial flooding was reported in many areas in and around Duluth, including significant damage to the Lake Superior Zoo and to Jay Cooke State Park. The St. Louis River at Scanlon experienced a record high level, forcing evacuation of several homes. A number of local and state roads closed for extended periods due to damage, and several prized trout streams severely damaged by the flood. Saturation of steep slopes in the Duluth area resulted in numerous slope failures and sloughing, in many instances threatening roads and structures. Repair and mitigation of flood impacts in northeast Minnesota continue in to 2015. Also in 2012, a separate flood event south of the Twin Cities caused extensive damage in Dakota, Rice, and Goodhue Counties. The significant flood events of 2012 in the northeast and south of the Twin Cities resulted in a federal disaster declaration for 15 counties.

2012 Duluth Flood. Photo by MPR News

2015

Flooding, along with severe storms, straight-line winds, landslides and mudslides during June and July 2014 resulted in a federal disaster declaration for 37 Minnesota Counties and three tribal governments. The areas impacted the most from these event were in the extreme northern and southern third of the state. Heavy persistent precipitation over a four-week period led to prolonged periods of high stream flow and basin levels.

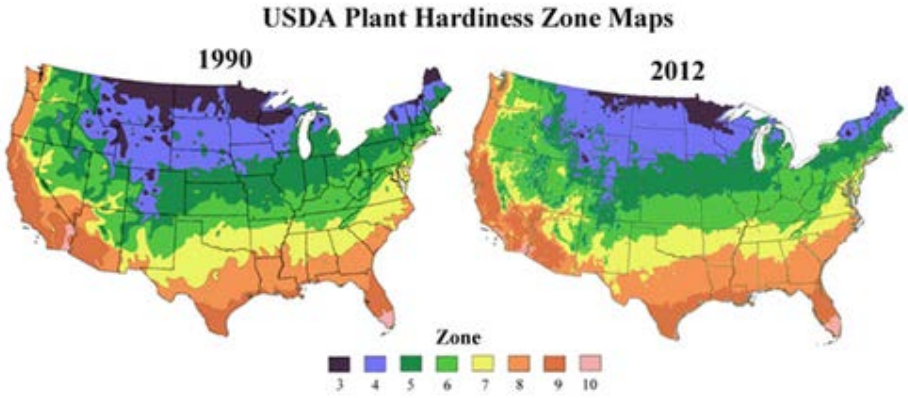
Blakeley, 2014. Photo by MNDNR

In turn, these high water conditions led to stream and lake bank slope stability issues like never before experienced. Significant damage to public and private property occurred. Over $30 million in damage to public infrastructure alone were documented. Approximately 20 homes either substantially flood damaged or threatened by unstable slopes were acquired by local units of government to mitigate future damage.

B. Climate Change/Flood Frequency and Intensity/Atlas 14

Research has long suggested that with warmer temperatures, there is more evaporation, which leads to more water vapor in the atmosphere. This increase in temperature and water vapor can lead to an increase in storm severity and intensity. A recent report from Minnesota Public Radio found that Minnesota is warmer than it used to be and that is affecting the amount of rainfall the State receives. The report found that not only does it rain more in the State, but the distribution, severity and intensity of storms is also changing. There is an increase in the amount of really big storms (storms with >6" of rain over 1,000 square miles) and during these large storm events, 37% more rain falls than was true 50 years ago (Jaime Chismar: MPR News). Because of an increase in large storm events and increased land use in flood prone areas, insurance claims for damages are on the rise.

Besides increased rainfall and changing storm patterns, the effects from increased temperature in Minnesota are visible in other examples. Other visible changes include: the snow season ending sooner, growing season lasting longer, hardiness zones are moving north and animal species die or change their ranges.



Courtesy of MPR News

All these elements also affect the hydrology in the state and can have an effect on how water moves through our environment, which can lead to changing flooding patterns and impacts to natural and altered systems.

The National Weather Service Hydrometeorological Design Studies Center has released NOAA Atlas 14, Volume 8. The Atlas provides precipitation frequency estimates for many of the Midwestern states, including Minnesota. Analyses of the historical frequency of heavy rainfall events are of importance to engineers and others involved in designing and operating infrastructure such as culverts and stormwater runoff ponds. The new estimates are based on improvements in three primary areas: denser data networks with a greater period of record, the application of regional frequency analysis using L-moments for selecting and parameterizing probability distributions, and new techniques for spatial interpolation and mapping. The new, more accurate estimates have shown some significant increases in most areas in the State compared with the former reference Technical Paper 40 (TP 40). In

Minneapolis, there was a 25% increase in the 24 hour/100 year storm event, going up from 6" to 7.5". Dakota County 24 hour/100 year storm precipitation estimates have gone up from 6.0 to 7.4 inches, and increase of 23%.

This means that the infrastructure designed for a 100-year flood event will be undersized in many situations. Also, building codes that require one foot of freeboard above the 100-year event, may also be underestimated. MNDOT has incorporated Atlas 14 in its building plans and many cities and counties are beginning to change how they install culverts and bridges to allow for passage of larger volumes of water.

C. Flooding Impacts to the State and Communities

Flooding is a natural hydrologic function of lake and riverine systems. Periodic inundation of flood water is both beneficial and vital to the health of riparian overbank and wetland areas, some of the most biologically diverse habitats on earth. Flooding, in some cases, can also result in the deposition of nutrient-rich sediment in floodplain areas that increase agricultural yield. Flooding can also aid in the recharge of groundwater. It is when flooding is severe, or occurs in areas that have experienced human encroachment, the effects can be catastrophic.

Early settlement in Minnesota tended to concentrate near sources of surface water that provided domestic water supply, power generation, and a mode to transport commodities. Some of the oldest communities in the state are largely developed on major rivers and lakes. The majority of existing floodplain development occurred prior to the recognition and understanding of flood risk, mapping of high-risk flood areas and the land use controls that now regulate development in flood prone areas. The negative impacts of flooding on individuals and communities can be devastating. On an individual level, flooding can result in structural damage to homes and accessory structures, personal property damage or loss, reduced property value, and elevated stress. In some cases, the risk of loss of life is real. Even minor flooding of homes can result in ruined furniture, irreparable damage to utilities and appliances, walls and floors. Mold growth is a common after effect of structural flooding. Homes constructed in mapped floodplain areas have a higher risk of being flooded than of experiencing a fire over the 30-year life of a mortgage, yet many people do not carry flood insurance. Federal regulations require homes with federally backed mortgages to carry mandatory flood insurance. While flood insurance may provide some monetary relief after a flood, it does not address the added stress and disruption to daily life that flooding brings.

Communities are negatively impacted by floods in many of the same ways an individual is. Public facilities (offices, schools, water treatment plants, wells, police and fire stations) may be subject to flooding. Floodwater can concentrate and deposit garbage, debris and toxic pollutants that can result in human health hazards. The disruption of public services can be more than a mere inconvenience.

Impaired drinking water supply, inability to treat sanitary waste, loss of gas or electrical service disrupt business, and can result in loss of local jobs. Insurance rates may increase. Flooding can result in costly cleanup and repair at taxpayer expense. Recovery from a catastrophic flood can take significant financial resources and years to repair.

Without careful consideration to the implications of development in flood risk areas, communities place themselves at risk of higher incidence of flooding.

Development in or near floodplain areas should only be done with a thorough understanding of the risk, and implementation of measures to minimize or reduce that risk. For existing development in high-risk areas, mitigating the risk is key to ending the cycle of flood damage-recovery-repair-damage. Mitigation results in safer, healthier, and more economically viable communities, and has proven to be cost effective.

III. Floodplain Management in Minnesota

A. Minnesota's Floodplain Management Rules

Minnesota's floodplain management dates back to the late 1960's, and is rooted in federal regulations created to manage development in flood-prone areas. The National Flood Insurance Program (NFIP) was created by the US Congress in 1968. The purpose of the NFIP is threefold; identification of flood risk through publication of Flood Insurance Rate Maps, development of minimum building and floodplain management standards to be implemented by local units of government, and offering federally-subsidized flood insurance. The long term goal of the NFIP is to reduce flood risk, in turn, reducing the need for post-flood federal disaster assistance.

Recognizing the state's susceptibility to and consequences of recurring flooding, in 1969 the Minnesota Legislature enacted the first State Floodplain Management Act. The law charged the DNR with developing a floodplain management program to coordinate local, state, and federal floodplain management activities in the state. Through the creation and promulgation of minimum state development standards, the DNR encourages and assists local governments to adopt, administer, and enforce sound floodplain management ordinances compliant with minimum federal and state floodplain management standards. The adoption of these minimum standards are intended to avoid flood risk in new development areas, and modification of existing flood-prone areas to reduce or eliminate future damage potential when removal of the at-risk asset is not practical. Currently, over 500 local units of government in Minnesota administer floodplain management controls meeting minimum state and federal standards.

B. Minnesota's Flood Hazard Mitigation Grant Assistance Program

In 1987, the Minnesota Legislature established the Flood Hazard Mitigation Grant Assistance Program. Its purpose is to provide technical and financial assistance to local units of government to reduce the severity and recurrence of flood damage. Funding for the program is provided through an appropriation of the legislature, the majority of which has been through inclusion in a state bonding bill. The grant program complements local floodplain zoning and other state and federal grant programs intended to reduce long-term risk and societal cost of flooding.

Through the efforts of the Flood Hazard Mitigation Grant Assistance Program, Minnesota's resilience to flooding has increased considerably in the past 20 years. It is estimated that through program cost-share funding, over 3,500 flood-damaged or flood-prone homes have been acquired and removed from high flood risk areas. Another 215 farmsteads are afforded protection to homes, gain bins, commodities and equipment to the 100-year flood level by perimeter ring dikes funded in part with State grant assistance.

Farmstead Ring Dike
Photo courtesy of Middle-Snake-Tamarac Rivers Watershed District

2009 Red River Flood
Photo courtesy of MNDNR

A majority of the most at-risk and historically high repetitive loss communities have planned and implemented community flood mitigation projects that provide flood risk reduction to tens of thousands of citizens and businesses to at least the 100-year (1% chance) flood elevation. These projects include construction of earthen levees, diversions, floodwalls, pumping stations, and flood impoundments. Providing a basic level of flood protection has reduced the negative impacts of flooding in many areas of the state, increased economic viability, and avoided costly post-disaster federal and state financial disaster recovery assistance. In addition, flood mitigation projects frequently result in increased public open space and habitat improvement. Figure 1 depicts locations of projects funded in whole or in part with assistance from the DNR's Flood Hazard Mitigation Grant Assistance Program.

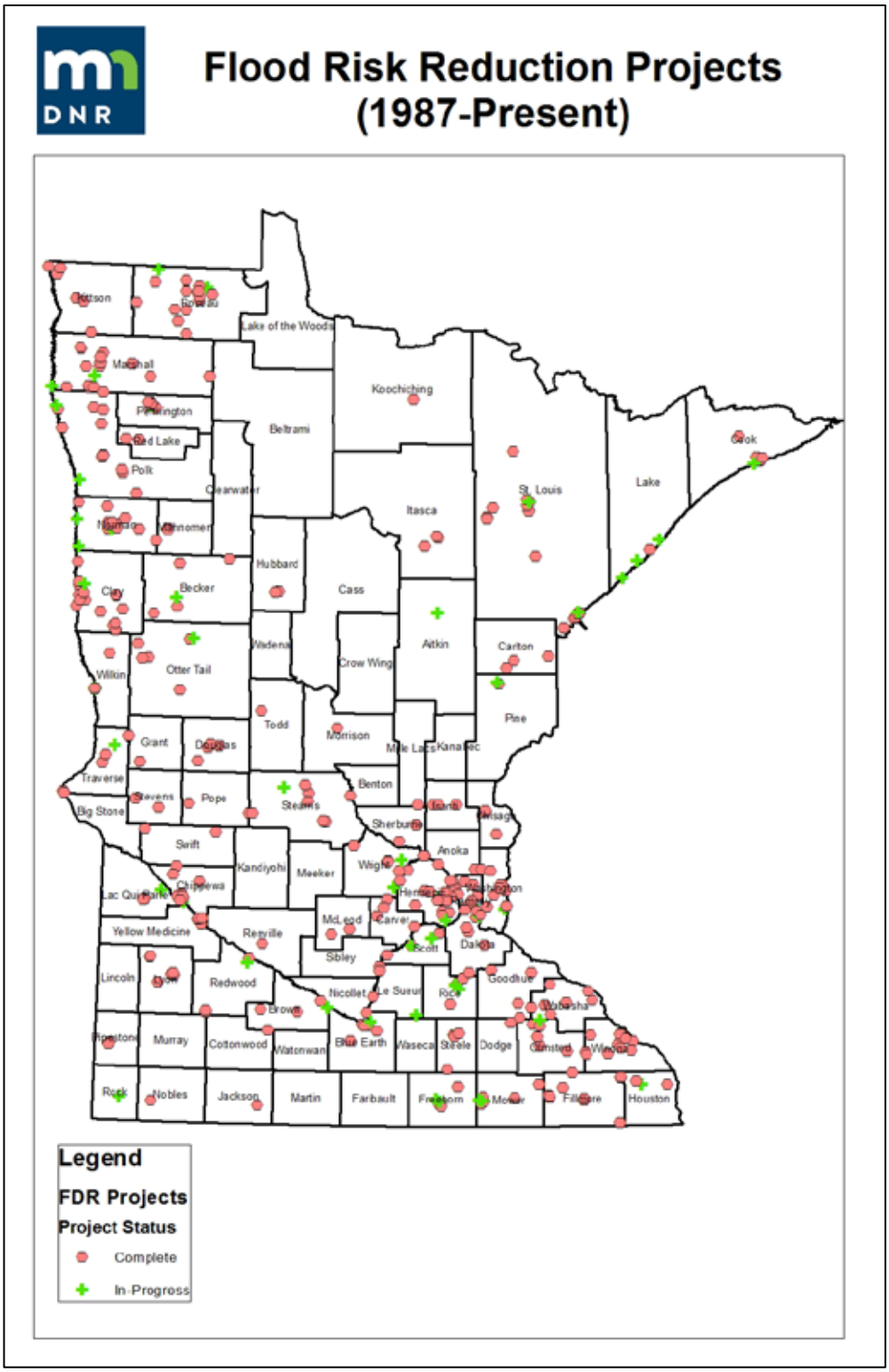


Figure 1: Project Locations Funded with DNR Flood Hazard Mitigation Grant Assistance

C. Flood Mitigation Program Funding

Since its establishment in 1987, Minnesota's Flood Hazard Mitigation Grant Assistance Program has awarded over $521 million in state cost-share funding to eligible local units of government. The majority of program funding comes from bond appropriations of the Minnesota legislature. A minor share of program funding comes from the State's general fund. Following major flood events or presidentially-declared disasters, the State will often pass disaster relief legislation authorizing appropriations of bond and general fund monies for post –flood recovery and mitigation in affected counties. Frequently, these state disaster relief funds are used to provide the local match required of FEMA mitigation grants. Without assistance from the state, many communities would not have the financial resources to mitigate, recover and rebuild after a flood. Figure 2 illustrates the State's funding of the Flood Hazard Mitigation Grant Assistance Program since 1988. It is interesting to note that since the historic flooding in the Red and Minnesota River basins in 1997, the state has significantly increased its financial commitment to flood mitigation.

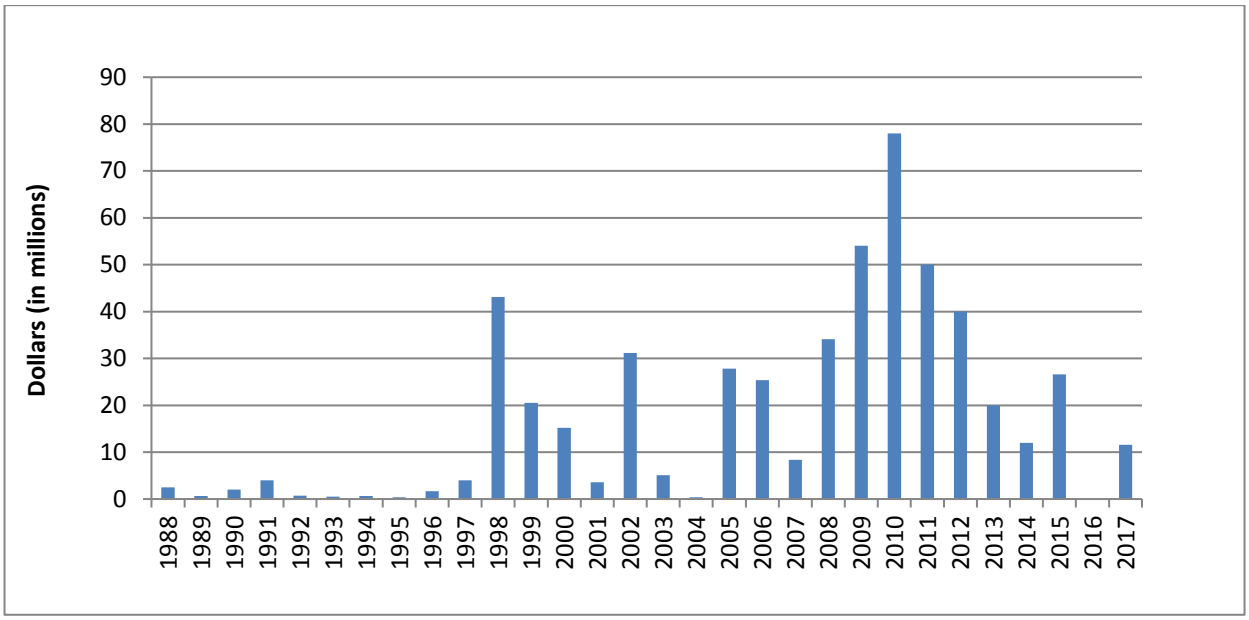


Figure 2: State of Minnesota Funding of the Flood Hazard Mitigation Grant Assistance Program

IV.) Flood Mitigation

Identification of high-risk (defined as the 100-year, or 1% chance) floodplain areas through mapping was initiated after the establishment of the federal National Flood Insurance Program (NFIP). The NFIP was created as a result of the passage of the National Flood Insurance Act of 1968. Congress enacted the NFIP primarily because flood insurance was virtually unavailable from the private insurance markets following frequent widespread flooding along the Mississippi River in the early 1960s. The NFIP is a Federal program, administered by the Federal Emergency Management Agency (FEMA) to provide flood insurance, improve management of floodplain areas and to develop maps of flood hazard zones. This important mapping effort is a key component to mitigating future flood losses.

A. What is Flood Mitigation?

Removal of Flood Damaged Structure in Pine County
Photo Courtesy of Pine County

Flood mitigation is the act of implementing measures that reduce the extent and occurrence of loss of life, future damages, and need for public response and recovery funding caused by flooding. Mitigation effectively lessens the potential for future flood damages by breaking the repetitive damage-repair-damage cycle. Mitigation can be in form of both structural and non-structural actions. Structural mitigation measures include construction of levees, floodwalls, diversions, impoundments, etc. Non-structural mitigation measures include acquisition and removal of at-risk structures, flood proofing, enforcement of building codes, sound land use planning, flood warning systems, floodplain mapping, education, and individual flood insurance. Typically, the most effective flood mitigation strategies are comprehensive and include both structural and non-structural components.

B. Flood Mitigation Benefits

The benefits of effective flood mitigation are many. Most importantly, it reduces the future potential for loss of human life. Annually in the U.S., an average of 94 lives are lost due to flooding. Flood mitigation reduces the social and economic impacts to communities by elimination of disruption to critical infrastructure like power, sewer and water, reduces stress on emergency services like police, fire, and ambulance, and allows for continuance of normal commerce. Workers are not displaced, or otherwise temporarily without employment due to flooded industry or transportation. Schools continue to operate, and volunteers are not put at risk implementing emergency flood fighting measures like construction of temporary levees, sand bagging, elevating utilities, and emergency evacuation.

Flood mitigation also results in environmental benefits, including re-establishment of floodplain habitats, reduction in soil loss in agricultural areas, and a lower risk of flood – induced contaminants entering surface water from inundation of toxic materials.

Further, mitigation reduces the future expenditure of public resources both to prepare for and recover from a flood event. A 2017 update of the 2005 study by the Multi-hazard Mitigation Council concluded that each dollar spent on flood mitigation yields future societal benefits an average of seven dollars. This makes mitigation extremely cost effective.

C. Federal, State and Local Partners in Flood Mitigation

At every opportunity, the DNR coordinates with local, state, and federal partners to leverage additional flood mitigation funds. Absent the financial collaboration these partners offer, many flood mitigation projects would be unaffordable to the communities with flood mitigation needs. The typical cost share for the State Flood Hazard Mitigation Grant Assistance Program is 50%. FEMA –funded mitigation projects receive 75% federal funding of eligible mitigation project costs. The State Flood Hazard Mitigation Grant Assistance Program will often split the remaining 25% non-federal share with the local project sponsor. This represents a state investment of 12.5% in a local flood mitigation project. Many times, following a presidential disaster declaration, the State will cover the entire 25% non-federal share. The FEMA grant program is administered at the State level by staff of the Minnesota Department of Public Safety, Division of Homeland Security and Emergency Management (HSEM). DNR and HSEM staff work closely together to ensure potential mitigation projects are utilizing the best funding opportunities available.

FEMA/State Floodplain Acquisition
Photo Courtesy of City of Duluth

Another federal partner is the US Army Corps of Engineers (COE). Since 1936, the COE, with local partners, have had a major role in engineering and constructing flood control works, mainly in form of diversions, levees, impoundments, and floodwalls. The COE will fund 50% of the costs for flood studies, and 65% of the costs to engineer and build flood mitigation projects. The State Flood Hazard Mitigation Grant Assistance Program often coordinates with the COE and local project sponsor, and equally splits the non-federal costs of flood studies and construction projects. Some notable federal flood risk reduction projects in Minnesota include community flood protection in the Cities of Rochester, East Grand Forks, Chaska, Winona, Henderson, Mankato, Montevideo, Breckenridge, and Roseau. In addition, the COE owns and operates several large reservoir and impoundment projects around the state that help mitigate downstream flooding, while providing important recreational, fishery, and wildlife benefits.

Occasionally, the State will cooperate with the US Department of Agriculture, Natural Resource Conservation Service (NRCS) on flood impoundment or emergency watershed protection projects through its PL 566 or Emergency Watershed Protection Program, both of which provide financial assistance to state and local governments to reduce flooding, control erosion, and create fish and wildlife habitat.

V.) Flood Mitigation Successes

A. City of Ada

Located in the Red River Valley of northwestern Minnesota, the City of Ada has experienced significant flooding seven times between 1997 and 2009. Due to its proximity to Judicial Ditch 51 and the Marsh and Wild Rice Rivers, Ada is subject to overland flooding. In 2009, a partnership between the city and the DNR began a comprehensive flood risk reduction project completed in 2017. Realignment of JD-51, construction of levees, road raises, and internal drainage improvements are features of this $10 million flood risk reduction effort that provides greater than 100-year flood protection to hundreds of Ada citizens and businesses.

Image Courtesy of MNDNR

B. City of Austin

The City of Austin in southeast Minnesota, has long struggled with repeated riverine flash flooding from sources that converge at the city. The Cedar River, along with Dobbins and Turtle Creeks have frequently overtopped their banks and caused extensive damage to homes, businesses, and public infrastructure. Eight of the highest fifteen crests on the Cedar River have occurred since 2000. Since 2002, Austin has been implementing a community –wide flood risk reduction plan that includes acquisition and removal of at-risk structures, construction of levees and floodwalls, road raises, and installation of pumping stations.

To date, nearly 275 homes and businesses have been acquired by the city and removed from the floodplain. Unlike most communities in the state, Austin utilizes a local option sales tax to generate a portion of its local share of flood mitigation projects. Its largest and most comprehensive flood risk reduction project to date, the $15 million *North Main Flood Control* project is scheduled for completion in 2018. The DNR's Flood Hazard Mitigation Grant Assistance Program provided 50% cost share

assistance to this important local project. With the State's financial assistance, the City of Austin continues to implement additional phases of its flood risk reduction plan in the Cedar River and Dobbins and Turtle Creek watersheds as funding allows. These efforts include the acquisition and removal of structures from voluntary sellers remaining in the floodplain.

Image courtesy of City of Austin

C. Clay County

Clay County is located in northwestern Minnesota. The Red River of the North defines its western boundary. In addition to the Red River, other flooding sources in the county include the Buffalo River, Whiskey Creek, and two tributaries to the Wild Rice River. The record flood event of 2009 impacted over 330 rural properties in one form or another. In response to citizen interest, Clay County pursued funding assistance through both the FEMA Hazard Mitigation Grant Program and the state's Flood Hazard Mitigation Grant Assistance Program. Local funds of $1.25 million leveraged $1.28 million in federal and $7.7 million in state funding to acquire and remove 44 rural residences from the floodplain. The acquired properties remain in permanent public ownership and are now void of structures or other obstacles, available for unimpeded conveyance and storage of flood flows.

Image Courtesy of Clay County

D. City of Crookston

In 2015, the City of Crookston completed the last of nearly $46 million in flood risk reduction projects. A long history of residential and business flooding along the Red Lake River prompted the city to take permanent action to reduce the costs of repetitive flood damage and the cost and risks of temporary flood fighting. Original emergency levees hastily constructed in the early 1950's lacked proper engineering, design, and construction. Further, over time they succumbed to fatigue and lack of maintenance. To spare their city, city staff and citizen volunteers frequently sandbagged under treacherous conditions during flood.

Following the historic flood of 1997, the city embarked on a comprehensive flood mitigation plan to provide reliable and permanent flood protection. Their phased plan included participation in a federal (Corps of Engineers) high flow bypass channel, acquisition and removal of at-risk structures, river bank slope stabilization, construction of 3.8 miles of earthen levee, and over a half mile of concrete floodwall. The completed projects provide greater than 100 –year flood protection to nearly 900 homes and businesses in the community.

Image Courtesy of City of Crookston

E. City of Duluth

Located on the shores of Lake Superior in northeast Minnesota, the City of Duluth is not accustomed to frequent, widespread, or damaging flooding, but following two days of torrential rain in June of 2012, Duluth experienced the most costly flood in its history. The St. Louis River and dozens of tributaries to Lake Superior saw record flows. Flash flooding severely damaged the Lake Superior Zoo, killing a number of its animals. Interstate Highway I-35 was closed for a short time, and 250 Duluth residents were evacuated from their homes. Nearly 40 streams, including two dozen trout streams, were severely impacted, and the city's storm sewer conveyance systems were overwhelmed.

Damage to public infrastructure in the region was nearly $110 million, with an additional estimated $30 million in private property loss. Damage reports estimate that 1,700 homes and businesses were

affected. FEMA and the State of Minnesota acted quickly to provide disaster relief to the city. The DNR Flood Hazard Mitigation Grant Assistance Program provided the city $2.9 million to acquire and remove 30 homes damaged of threatened by flood. An additional $1.1 million was awarded the city for removal of debris and sediment from and restoration of streams in the city.

The City's efforts to date to remove structures from high risk areas and to improve its public infrastructure have resulted in a more resilient community, and restoration of a number of its valued stream resources.

Acquisition before and after photos. Courtesy of City of Duluth

F. City of Granite Falls

The City of Granite Falls is located on the Minnesota River in western Minnesota. Past floods have impacted the city from poor internal drainage, the main channel of the Minnesota River, and from a secondary, historic river channel (oxbow). A significant flood event 1997 resulted in record flood levels. This flood resulted in significant damage to public facilities and destroyed a number of homes.

High-risk emergency levees, supplemented with sandbagging, helped save the city from catastrophic loss. The city spent over $1 million fighting and cleaning up after the flood. Following another significant flood in 2001 (third highest on record) and an additional $800,000 expended, to deal with it, the city developed a long-term strategy to increase resiliency and reduce long-term costs of flooding in the community. Its flood mitigation plan itemized a lengthy list of mitigation measures, phased over time, and identified potential sources of funding assistance. Since 2000, the city and state have partnered with FEMA and others to nearly complete the city's flood mitigation plan. The Flood Hazard Mitigation Grant Assistance Program has contributed nearly $13 million toward efforts to construct levees, improve internal drainage, relocate city hall, and acquire and remove over 50 homes and businesses from the floodplain.

Image Courtesy
City of Granite Falls

Flood Damage Reduction
Minnesota River at
Granite Falls, Minnesota

G. Middle Snake Tamarac Rivers Watershed District Agassiz Valley Multi-Purpose Impoundment

The Agassiz Valley Multi-purpose Impoundment project in Polk and Marshall Counties is a four-square mile flood risk reduction project that incorporated significant natural resource enhancement features in to its design and operation. This project provides peak flow reduction to the downstream community of Warren on the Snake River, as well as substantial habitat and water quality benefits. The former agricultural property now includes wetland, prairie and woodland habitats that provide recreational, educational, and water quality benefits in addition to the flood risk reduction features. Because of the inclusion of these natural resource enhancements in to the project design, the Flood Hazard Mitigation Grant Assistance Program provided 75% of the $10.8 million project cost.

Photo Courtesy of MSTRWD

H. City of Moorhead

The City of Moorhead has long been plagued by flooding from the Red River of the North. The frequency and severity of floods since 1997 had increased considerably. Major flooding in consecutive years of 2009 (flood of record), 2010, and 2011 compelled the city to develop a comprehensive long-term flood risk reduction plan.

With nearly $73 million in state Flood Hazard Mitigation Grant assistance, the city has since completed a comprehensive and phased $105 million flood risk reduction initiative that included voluntary acquisition of 250 properties, 12 miles of levee and floodwall, and 25 sanitary and stormwater pump stations. These mitigation efforts result in flood protection to a level three feet above the flood of record and significant reduction in costs associated with emergency flood preparation and response.

Photo by MNDNR

I. City of Roseau

Located roughly 10 miles south of the Canadian border, the City of Roseau is bisected by the Roseau River. The city experienced frequent flooding, despite a series of emergency levees and other flood protection measures. Record flooding in 2002 resulted in damage to 90% of commercial buildings, 90% of public buildings, and 80% of the town's 1,200 homes, totaling over $50 million in total losses. Following this devastating flood of record, the city asked the US Army Corps of Engineers (COE) to conduct a feasibility study for a flood control project in Roseau. The COE determines there was a cost-beneficial project, and subsequently entered in to a federal-local partnership with the city to design and construct a flood risk reduction project. In 2015, construction of a 4.5-mile Roseau River diversion channel was completed, removing nearly all of the city from the 100-year floodplain.

Photo Courtesy
City of Roseau

VI.) Future Hazard Mitigation Program Needs

Since the State's Flood Hazard Mitigation Grant Assistance Program was established in 1987, over $521 million in state funding has leveraged other state, local and federal funds to complete over one billion dollars in flood mitigation efforts across the state. According to published studies which indicate mitigation provides a seven to one return on investment, these efforts will result in long term mitigation benefits of nearly seven billion dollars. While this public investment in long term flood mitigation has significantly increased resiliency to flooding in the majority of historically at-risk communities in Minnesota, more work remains. Climate change, flood events exceeding design capacity of existing flood control works, aging infrastructure, changes to state and federal standards, rising costs of flood insurance, and land use development all will determine the future flood mitigation needs in Minnesota. At current estimates, about $25 million in additional state funding would complete basic 100-year flood protection to the remaining at- risk communities in the state.

VII.) Resources/Related Links

Minnesota Flood Hazard Mitigation Grant Assistance Program
http://www.dnr.state.mn.us/waters/watermgmt_section/flood_damage/index.html

Minnesota Department of Public Safety- Division of Homeland Security and Emergency Management
https://dps.mn.gov/divisions/hsem/hazard-mitigation/Pages/default.aspx

Federal Emergency Management Agency (FEMA)
https://www.floodsmart.gov/floodsmart/

US Army Corps of Engineers (COE)
http://www.iwr.usace.army.mil/Missions/FloodRiskManagement/FloodRiskManagementProgram.aspx

Multi-Hazard Mitigation Council Report on the Benefits of Hazard Mitigation
http://www.floods.org/PDF/MMC_Volume1_FindingsConclusionsRecommendations.pdf

Association of State Floodplain Managers (ASFPM)
http://www.floods.org/

National Weather Service North Central River Forecast Center
http://www.weather.gov/ncrfc/#

References:

Climate Change in Minnesota. Jamie Chismar for Minnesota Public Radio. *http://www.mprnews.org/story/2015/02/02/climate-change-primer.* Website Accessed 2-11-15.