Agenda item: 6

Memorandum

To: PPO Subcommittee
From: Paul Woodward, Water Resources Engineer
Date: May 8, 2006
Re: P-MRNRD All-Hazards Mitigation Plan Draft Report

In May 2005, the District secured a grant with the Nebraska Emergency Management Agency (NEMA), and retained the services of the U.S. Army Corps of Engineers (USACE) and the Nebraska Department of Natural Resources (NDNR) to develop an All-Hazards Mitigation Plan for the entire District. This type of plan is required for local communities and counties to receive future disaster mitigation assistance, and increases the potential of federal funding assistance for mitigation projects identified in the plan, such as the District's Floodway Purchase Program.

The USACE Floodplain Management Branch conducted the flood hazard mitigation portion of the study by analyzing existing flood hazards and in some cases producing an inventory of structures in hazardous areas. The Corps completed the plan by the May 31, 2006 deadline for a total cost $206,667. Reimbursement from the grant in the amount of $155,000 will cover 75% of the total cost, but the NRD is responsible for the remaining 25%, or $51,667.

The NDNR prepared the remaining sections of the plan relating to other natural hazards as well as assisting the District and USACE in holding public meetings throughout the NRD to gather input. NDNR's services did not require additional funding.

At this time, District staff is requesting approval of the enclosed draft All-Hazards Mitigation Plan in order to submit the draft plan along with the grant reimbursement request to NEMA prior to the grant expiring on May 31, 2006. Following NEMA's review of the draft plan, any necessary revisions will be completed along with each local community or counties portion of the plan. This final plan would then be forwarded to these local communities or counties for their adoption.

Management recommends that the Subcommittee recommend to the Board that the May 2006 Draft All-Hazards Mitigation Plan for the Papio-Missouri River Natural Resources District prepared by the U.S. Army Corps of Engineers and Nebraska Department of Natural Resources be adopted, subject to changes deemed necessary by the Acting General Manager.

Papio-Missouri River Natural Resources District

All-Hazards Mitigation Plan

Completed by
Nebraska Department of Natural Resources
U.S. Army Corps of Engineers

May 2006

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Chapter 1 – Introduction

I. Purpose of this Plan

The purpose of this plan is to fulfill local multi-jurisdictional Hazard Mitigation Plan requirements. The plan will identify hazards, establish community goals and objectives, and select mitigation activities that are appropriate for the Papio-Missouri River Natural Resources District (Papio NRD).

The Disaster Mitigation Act of 2000 (DMA2000), Section 322 (a-d) requires that local governments, as a condition of receiving federal disaster mitigation funds, have a mitigation plan that describes the process of identifying hazards, risks and vulnerabilities, identify a prioritize mitigation actions, encourage the development of local mitigation, and provide technical support for those efforts.

In addition, this plan has fulfilled the requirements of the National Flood Insurance Reform Act of 1994 (NFIRA). With this Act, Congress authorized the establishment of a Federal grant program to provide financial assistance to States and communities for flood mitigation planning and activities. The Federal Emergency Management Agency (FEMA) has designated this the Flood Mitigation Assistance (FMA) program.

Under the FMA program, FEMA provides assistance to States and communities for activities that will reduce the risk of flood damages to structures insurance under the National Flood Insurance Program (NFIP). FMA is a state-administered cost-share program through which states and communities can receive grants for flood mitigation planning, technical assistance, and mitigation projects.

Only projects for mitigation activities specified in an approved Flood Mitigation Plan are eligible for FMA project grants. These activities include elevation, acquisition, and relocation of flood-prone insurable structures.

The purpose of this plan is to produce a program of activities that will best tackle the Papio NRD's hazard and flood problems and meet other, community-specific needs. Consistent with FEMA planning process guidelines, the purpose of this plan is to accomplish the following objectives:

- Ensure that all possible activities are reviewed and implemented so that disaster related hazards are addressed by the most appropriate and efficient solution;
- Link hazard management policies to specific activities;
- Educate residents about potential hazards that threaten the community, including but not limited to floods, extreme weather events, tornadoes and high wind events, earthquakes, and human-made events;
- Build public and political support for projects that prevent new problems from known hazards and reduce future losses;
- Fulfill planning requirements for future hazard mitigation project grants, and;

- Facilitate implementation of hazard mitigation management activities through an action plan.

II. Methodology

The methodology used for the development and updating of the Papio NRD Hazard Mitigation Plan, consisted of the following tasks:

1. Public Involvement
2. Coordination with other agencies or organizations
3. Hazard area inventory
4. Problem identification
5. Review and analysis of possible mitigation activities
6. Local adoption following a public hearing
7. Periodic review and update

This hazard mitigation plan contains a list of potential projects and a brief rationale or explanation of how each project or group of projects contributes to the overall mitigation strategy outlined in the plan.

This plan summarizes the activities outlined above to assess the effects of the hazards to which Papio NRD residents deemed they were most vulnerable, and recommends mitigation solutions.

The Mitigation Plan will be evaluated and updated every five years. In addition, the plan will be updated as appropriate when a disaster occurs that significantly affects the NRD, whether or not it receives a Presidential Declaration. The update will be completed as soon as possible, but no later than 12 months following the date of the disaster event.

Routine maintenance of the plan will include adding projects as new funding sources become available, or removing projects as they are completed.

<u>People involved in the planning process</u>:
There was no official planning committee for this mitigation plan. Main personnel involved were:

Steve McMaster – Nebraska Department of Natural Resources
Randy Behm – U.S. Army Corps of Engineers
Jeffrey Brady – U.S. Army Corps of Engineers
Paul Woodward – Papio-Missouri River Natural Resources District
Papio-Missouri River Natural Resources District Board

<u>Elected officials and/or personnel involved in this multi-jurisdictional planning process</u>:

Arlington, Village of
Gene Harris, Village Board
Gordon Stork, Sewage Plant Operator
Blair, City of
Phil Green, Assistant City Administrator

Daryl Miller, citizen
Kent Wilcox, citizen
Douglas County
Jim Rogers, Douglas County Emergency Management Agency Assistant Director
Lisa Rink, Grant Writer
Elkhorn, City of
Jesse Robinson, Building Inspector and Floodplain Administrator
Fort Calhoun, City of
Ron Woracek, City Engineer
Larry Brodkey, City Attorney
Herman, Village of
Ray Polley, Village Trustee
Homer, Village of
Darrin Brand, Village Trustee
Corbet Dorsey, Village Board
Kennard, Village of
Duane Wilcox, citizen
LaVista, City of
Joe Soucie, Public Works Director
Omaha, City of
State Senator Gwen Howard
Barb Nichols, citizen, former NRD Board member
Papillion, City of
Mark Stursma, Planning Director
Sharon Whalen, President of Papillion Tree Board
Papio-Missouri River Natural Resources District
Paul Woodward, NRD Engineer
Rick Kolowski, NRD Board
Dorothy Lamphier, NRD Board
Ralston, City of
Ron Woracek, City Engineer
Mike Kennelly, Emergency Management Coordinator
Sarpy County
Larry Lavelle, Emergency Manager
Joe Mastandrea, Sarpy County Emergency Management Agency
Lisa Rink, Grant Writer
South Sioux City
Lance Hedquist, City Administrator
Springfield, City of
Sandra Powell, City Administrator
Tekamah, City of
Mayor Bill Anderson
Mary Beavers, Tekamah City Clerk
Gail Twining, City Council
Mark Jackson, Editor of Burt County Plaindealer Newspaper
Thurston County

Don Newton, County Road Superintendent
Valley, City of
Mayor Mary Caffey
Washington County
Daryl Miller, Washington County Board
Duane Wilcox, Washington County Board
Kent Wilcox, Washington County Board
Jeff Quist, Washington County Supervisor
Washington, Village of
Louis Kologenski, Volunteer Fire Department
Duane Wilcox, citizen
Waterloo, Village of
Troy Peterson, Emergency Manager
Chad Witt, Fire Chief
Stan Benke, Lyman Richey

Other plans/documents used in the development of this mitigation plan:

- The flood portion of this plan was largely completed by the US Army Corps of Engineers, which has a different flood document library.
- *Flood Insurance Study* was used to supplement the information from the Corps of Engineers with additional information about specific flood history. FIS information was obtained for: Arlington, Blair, Douglas County, Elkhorn, Fort Calhoun, Homer, LaVista, Omaha, Papillion, Ralston, Sarpy County, South Sioux City, Springfield, Tekamah, Valley, Washington County, and Waterloo.
- Community Comprehensive Plans were used to identify future growth areas and objectives.
- Proprietary NDNR spreadsheet of significant historic flood events in Nebraska.

Public Participation

To begin the planning process, a series of four initial public meetings was held. They took place in the following locations and dates:

August 3, 2005: Douglas County meeting at Elkhorn High School Lecture Hall
August 4, 2005: Sarpy County meeting at Papio-Missouri River NRD Headquarters
August 24, 2005: Washington and Burt County meeting at Tekamah City Auditorium
August 31, 2005: Dakota and Thurston County meeting at Papio-Missouri River NRD, Dakota County Office

During these public meetings, citizens of the Papio NRD identified four main goals of this mitigation planning effort:

1) Reduce or prevent future damage from natural hazard events,
2) Increase public safety,
3) Increase public education about natural hazard events in their community, and
4) Increase or enhance public green space.

Sign-in sheets and other public participation documentation is provided in this report as **Appendix C**.

III. Organization of Plan

Chapter 1 – presents the purpose and goals of the plan, methodology used, organization of the plan, and a background study of the Papio NRD.

Chapter 2 – by section, known hazards in the Papio NRD are identified. For each hazard, a background, list of historical events, hazard assessment, vulnerability assessment, and possible mitigation actions is also given.

Chapter 3 – outlines the public participation process undertaken during the planning process, for prioritizing projects, and for updating the plan.

Chapter 4 – addresses implementation procedures and a process for updating the plan.

IV. Papio-Missouri River Natural Resources District – Background

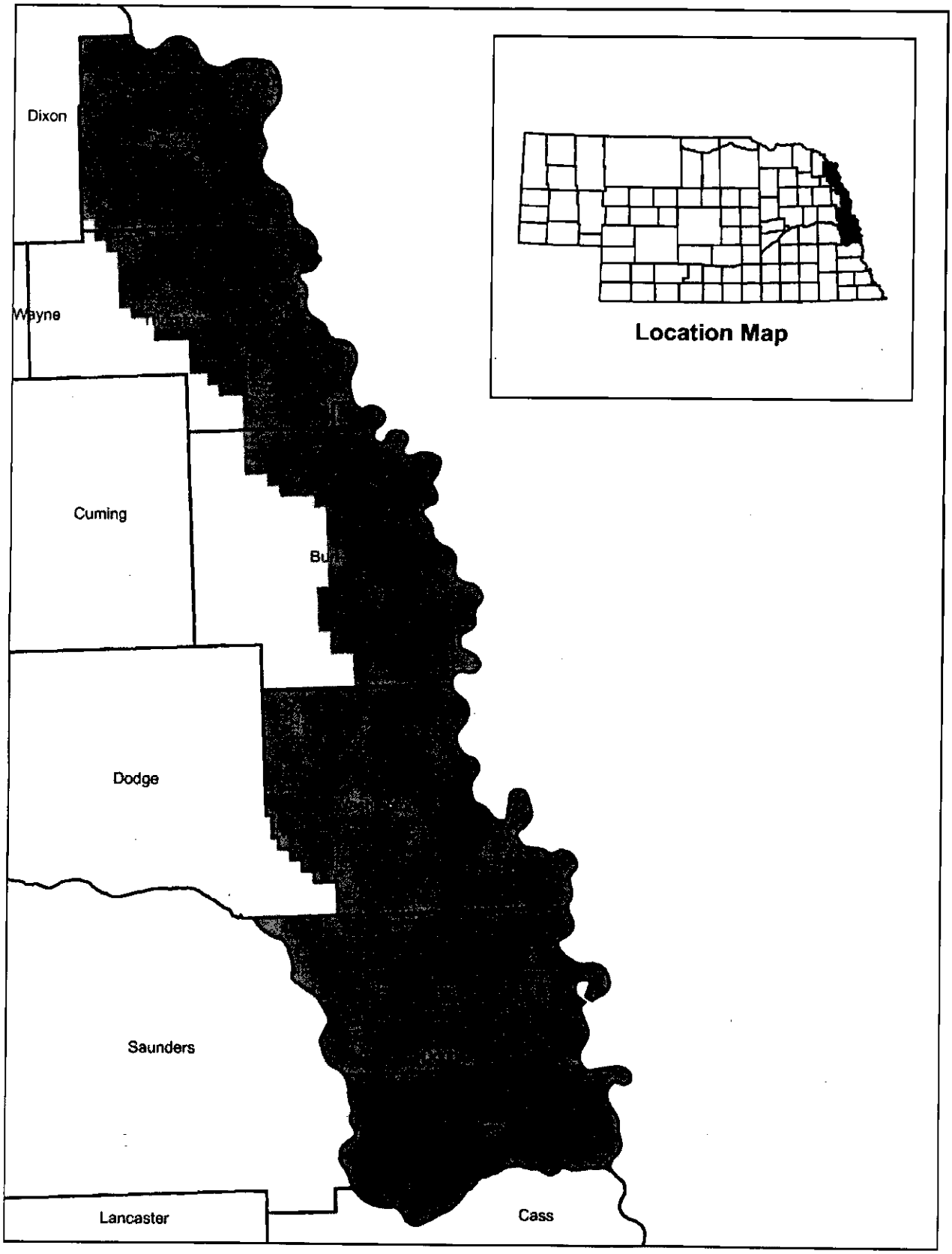
Nebraska's Natural Resources Districts were created by the Nebraska Legislature and began serving the people of the state in 1972. The legislature combined 154 special purpose resources management entities, including county soil and water conservation districts, drainage districts and watershed boards into 24 NRDs. In 1989, this number was reduced to 23 NRDs through a merger of the Papio-Missouri River NRD and the Middle Missouri Tributaries NRD. Natural resources districts are unique to Nebraska – no other state has a system for managing its natural resources identical to our NRDs. The extent of the Papio NRD boundary is shown on the next page as **Figure 1**.

NRDs are local government units with broad responsibilities to protect and enhance our state's natural resources. Major Nebraska river basins form the boundaries, enabling the NRDs to respond best to local needs.

Elected boards govern each district. Much of the funding for resources management programs and projects come from property taxes amounting to approximately one percent of property taxes collected in the area served by the district.

Partnerships built between NRDs and other resources management agencies - both state and federal - have strengthened the overall conservation effort. Nebraska's Department of Natural Resources, Game and Parks Commission, and Department of Environmental Quality work closely with natural resources districts. Federal government partners often include the Federal Emergency Management Agency, USDA's Natural Resources Conservation Service, and Farm Services Agency. Others, such as the U.S. Army Corps of Engineers, Environmental Protection Agency, Fish and Wildlife Service, and National Park Service also join NRDs to effectively address local needs.

Figure 1
Papio-Missouri River NRD Boundary



	Dam Failure	Drought	Earth-quake	Flood	Summer Storm	Land slide	Winter Storm	Tornado /Wind	Wildfire
Probability	Low	High	Low	High	High	Low	High	High	Low
Extent	Limited	Limited	Unknown	Limited	Severe	Limited	Severe	Severe	Limited
Previous Occurrence	No	Yes	No	Yes	Yes	Yes	Yes	Yes	No

Probability – Based on history, what is the likelihood that this type or event will happen again?
- None, Low, Medium, or High

Extent – If this event were to happen, how extensive could the damage be?
- Zero, Limited, Severe, Full, or Unknown

Previous Occurrence – Is there an historic record for this type of hazard in the Papio NRD?

The above figure shows the cumulative input from each of the four initial public meetings and is not necessarily representative of individual communities. Community-specific information is provided in the sections in this plan for each participating community in **Appendix D**.

In the initial public meeting for the development of this hazard mitigation plan, Papio NRD residents ranked their community most vulnerable to the hazard types in this order: severe summer storms, severe winter storms, tornadoes, flood, drought, dam failure, wildfire, earthquake, and landslide. Due to the geographical proximity, the following hazard types were not considered due to there being no likelihood of occurring in Nebraska: volcanic eruptions, avalanches, hurricanes, tidal surges, and tsunamis.

In the following sections, only the hazard types which have a significant likelihood of occurring or have a reason to potentially occur are listed. These types are: severe weather (summer and winter), tornado, flood, drought, and dam failure. Although there is a small risk for earthquakes, wildfires, and landslides, Papio NRD citizens did not rank it high enough to warrant detailed discussion in this plan. This may change in future updates.

NRD Vulnerability Assessment

With a financial vulnerability perspective, the Nebraska Department of Property Assessment and Taxation keeps records for counties but not by NRD boundary. Therefore, the county information will be inaccurate for the counties which are not completely within the Papio NRD (Burt and Thurston – **See Figure 1**). However, since western Burt County and western Thurston County are both sparsely-inhabited, the numbers will not be significantly incorrect. The entire taxable value of assets in the Papio NRD for 2005 was $40,290,231,815. Broken out by county, the total assessment valuation is:

	2005 Total
County	Taxable Value
BURT	$326,952,869
DAKOTA	$959,446,579
DOUGLAS	$29,210,992,160
SARPY	$8,148,816,108
THURSTON	$129,548,809
WASHINGTON	$1,514,475,290
	$40,290,231,815

Broken out by property class, the significant components of the total evaluation are:

Residential real property:	$26,263,554,892 (65% of total)
Commercial real property:	$ 8,243,849,062 (21%)
Commercial/Industrial personal property:	$ 1,936,364,151 (5%)
Industrial real property:	$ 1,757,346,368 (4%)

Realistically, the entire building stock within the complete NRD boundary will not all be impacted by one disaster event. However, each structure in the NRD is at the same vulnerability to disaster types like severe weather and tornadoes.

For smaller communities, the NDNR completed fieldwork which determined the number of structures by main structure type (residential, commercial, public, non-profit, and out buildings). For the larger communities of the Omaha metropolitan area, Blair, and South Sioux City, the intent was to use HAZUS software to assist with the vulnerability assessment since it would not be possible to drive every street in those communities. However, due to technical difficulties, the HAZUS analysis was not able to be completed within the grant period. As a result, the structural inventory is identified as a task which will be provided in the plan's update in five years.

2.10 SEVERE WEATHER

2.11 Background

Severe weather can be separated into severe winter storms and severe summer storms. Weather hazards for severe summer storms include the qualities of a storm which make it severe: winds exceeding 58 mph and hail in excess of ¼-inch diameter. For the purposes of this plan, severe summer weather will also include intense rainfall and frequent lightning. Weather hazards for severe winter storms are not defined, but usually include many of the following: extreme cold, heavy snowfall, ice, and strong winds which push the wind chill well below zero degrees. An additional summer weather hazard that is not storm-related is intense summer heat.

In the non-winter months, thunderstorms and supercell thunderstorms produce lightning, and severe storms can produce hail. Lightning is one of the most consistent causes of death for natural hazards in Nebraska because it can kill people who are outside when a

thunderstorm is overhead or nearby. Although hail has the potential to kill people, the primary risk is to property like windows, roofs, siding, trees, and cars. In Nebraska, hail can also cause total losses in agricultural fields across extensive areas. Strong winds down tree limbs and power lines, in addition to having the potential for causing significant property damage and community interruption. Structure owners can obtain insurance to cover themselves financially, but there may be ways to prevent tree damage from occurring through property urban tree management.

Periods of extreme heat are common in all parts of Nebraska during the warmest months. The problem is made worse when the high temperature is accompanied by high humidity. The main risk for intense heat is to persons who may become isolated in an unventilated area. Recorded deaths in Nebraska that are associated with extreme heat are largely a result of outdoor exercise or work during this kind of weather condition. The very young and very old are at additional risk because they tend to have weaker respiratory systems.

For severe winter storms, heavy snow can bring a community to a standstill by inhibiting transportation (like whiteout conditions), knocking down utility lines, and by causing structural collapse in buildings not designed to withstand the weight of the snow. Repair and snow removal costs can be significant. Ice buildup can collapse utility lines and communication towers, as well as make transportation difficult and hazardous. Ice can also become a problem on roadways if the air temperature is high enough so that precipitation falls as freezing rain rather than snow.

Extreme cold can lead to hypothermia and frostbite in people who are exposed to the weather without adequate clothing protection. Cold causes fuel to congeal in storage tanks and supply lines, stopping electric generators. Cold temperatures can also overpower a building's heating system and cause water and sewer pipes to freeze and rupture. Extreme cold also increases to likelihood for ice jams on flat rivers or streams. When combined with high winds from winter storm, extreme cold becomes extreme wind chill, which is extremely hazardous to health and safety.

2.12 Severe Weather History

Through its National Climate Data Center (NCDC), the National Oceanic and Atmospheric Administration (NOAA) compiles a list of recorded storm events. These records go back to 1950; however, reports were given by county only, and community-specific information was not provided until 1993.

Hail

Since 2000, there has been an increase in the number of hail events impacting the Omaha metropolitan area, Blair, and other communities in the NRD. Following are only the most damaging hail events, as given by the National Climate Data Center.

July 24, 1995: $300,000 in property damage caused by 1¾-inch hail, downtown Omaha.
May 17, 1996: $200,000 in property damage reported from 2¾-inch hail in Elkhorn.
July 16, 1996: $500,000 in property damage was caused by 1¾-inch hail in South Sioux

City. Coupled with strong winds, this hail event destroyed more than half of Dakota County's corn and bean acreage, resulting in an estimated $22 million in damage.

July 27, 1996: $300,000 in damage to aircraft and vehicles at Offutt Air Force Base, $5000 in property damage was reported near Dakota City on the same day.

July 2, 1999: 1-inch hail caused $1.8 million in damage to 5000 acres of corn and soybeans. South Sioux City witnessed $200,000 in property damage to vehicles and buildings.

April 10, 2001: Property damage estimated at $300 million caused by a 5- to 15-minute hail storm in Omaha which consisted of hail in the ½-inch to 1 ½-inch range. There was one reported injury caused by this hail event. State Farm estimated 100,000 home insurance claims as hail drifted like snow across sidewalks and roads.

April 30, 2001: The second major hail event in three weeks caused an additional $200 million in property damage in Elkhorn and western Omaha.

May 13, 2001: Hail up to three inches in diameter caused significant damage to commercial and private aircraft at Eppley Airfield in Omaha. Combined with residential property damages, the damage estimate topped $1 million.

July 25, 2002: $100,000 in property damage caused by 1¾-inch hail near Jackson.

May 4, 2003: 2½- to 4½-inch hail reported from Gretna to Bellevue, no damage reports.

June 9, 2003: $50,000 in vehicle and window damage caused by 1¾-inch hail in Jackson.

May 22, 2004: Hail up to baseball size fell in Blair, causing extensive damage to car dealership inventories and residences. Damage totals for Dodge County and Washington County was $10 million, with at least half of this amount coming from Washington County and Blair.

June 4, 2005: Up to 4-inch hail caused scattered damage in the Papillion area.

June 27, 2005: 4¼-inch hail was reported in Pender – no damage estimates available.

In the last ten years, nearly every year has had at least one major hail event. It would be safe to assume that damaging hail storms occur somewhere in the Papio NRD at least one time per year.

Severe Summer Storms:

It is safe to say that at least one severe winter or summer storm will occur every year, and a detailed history of these events would be too extensive to chronicle. According to the NCDC statistics since 2000, the following counties experienced this many severe thunderstorms (in parenthesis) in each year:

Sarpy:	2000 (2), 2001 (3), 2002 (4), 2003 (3), 2004 (3), 2005 (4)
Douglas:	2000 (4), 2001 (4), 2002 (3), 2003 (3), 2004 (8), 2005 (2)
Washington:	2000 (2), 2001 (2), 2002 (2), 2003 (3), 2004 (3), 2005 (2)
Burt:	2000 (1), 2001 (4), 2002 (0), 2003 (3), 2004 (1), 2005 (1)
Thurston	2000 (1), 2001 (1), 2002 (1), 2003 (3), 2004 (1), 2005 (1)
Dakota	2000 (4), 2001 (3), 2002 (2), 2003 (4), 2004 (2), 2005 (2)

Noteworthy severe summer storms and weather events are:

April 25, 1996: a boy was killed in Omaha when wind gusts up to 70 mph toppled a tree, which fell on him as he played outdoors.

June 12, 1996: A dry microburst was recorded with wind speeds up to 92 miles per hour,

which snapped off ten power utility poles, tore the roof off a convenience store, and overturned several central-pivot irrigation systems within a mile radius of the National Weather Service office. Damage for this event was placed at $80,000.

July 16, 1996: Thunderstorm winds caused widespread damage estimated at $3 million in property damage and $3 million in crop damage from Homer to South Sioux City. There was widespread tree damage, downed power poles and lines, farm buildings were destroyed, and homes were damaged. Winds were measured at 70 knots, which equals slightly more than 80 mph.

April 5, 2000: Sustained winds of 40-50 mph and gusts over 60 mph caused $20,000 in structural damage in South Sioux City and fanned grass fires near Hubbard.

September 2, 2000: 60 mph winds caused $3000 to outbuildings near Herman.

April 20, 2001: Thunderstorm gusts estimated at 70-80 mph did major roof damage to several homes and businesses in Papillion. Damage was estimated at $250,000.

June 13, 2001: $50,000 in property damage was caused by strong winds in South Sioux City.

July 25, 2002: Thunderstorm winds severely damaged grain elevators on a farm and caused tree damage in and around Homer. Damage was estimated at $20,000. This same storm brought 70 mph winds to Jackson, which destroyed or damaged several buildings, resulting in $500,000 in damage, extensive tree damage, and power outage.

October 1, 2002: An intense thunderstorm brought hail and 100 mph winds from five miles southwest of Fort Calhoun into the Fort Calhoun area. Extensive tree damage was reported, and two injuries were caused when the strong winds destroyed a house northwest of Fort Calhoun. Another injury was reported when a person was caught outside in the wind-driven hail. An estimated 85% of homes in Fort Calhoun sustained damage to some degree. The storm caused an estimated $3 million worth of damage.

July 5, 2003: A large bowing line of thunderstorms dropped temperatures more than 20 degrees in addition to causing brief intense rain and wind gusts up to 87 mph. $2 million in damage was reported in Omaha, especially due to the larger trees in the central and eastern sections of town. Extensive tree damage across the city brought down power lines and cut power to 60,000 OPPD customers. OPPD also estimated cleanup expenses at $200,000.

August 18, 2003: A strong thunderstorm caused a tree to fall on a home in Homer, resulting in $10,000 in property damage.

July 12, 2004: 70 mph winds downed large trees and power lines in Blair. Many homes and cars sustained damage, and power was knocked out to parts of the city for up to 24 hours. Several people narrowly escaped severe injury or death, and damage was estimated at $100,000.

March 10, 2005: Sustained winds of 30-40 mph with gusts over 60 mph overturned semi trailers and injured one person in Decatur .

May 10, 2005: Thunderstorm wind gusts of 62 mph brought down trees on homes and other private property in western and northern Omaha. Damage was estimated at $500,000. 13,000 OPPD customers were without power from the storms. This same line of storms caused minor damage to buildings in Dakota County.

July 25, 2005: Thunderstorm winds caused damage to trees and structures estimated at $500,000 in the Jackson area.

It is safe to assume that a severe summer storm will occur in the Papio NRD boundary at least once per year.

Lightning:
Since 2000, there were no reported lightning strike damages for Dakota County, Thurston County, Burt County, Washington County.

There are twelve reported lightning events for Douglas County, with one death and three injuries. The death occurred on July 17, 2001, to a man who was outdoors on a bicycle trail. Two men were injured when lightning struck them near Lake Zorinsky in Omaha on May 29, 2004. The third injury occurred on July 2, 2004, when lightning struck the ground near a woman who was standing outside. Many of the other lightning events struck buildings and caused fires – damage figures range from $5000 to $165,000.

Three lightning events were recorded for Sarpy County, causing only property damage and no fatalities or injuries. The worst lightning strike hit a home in Bellevue on August 17, 2002, causing $125,000 in damage.

Severe Winter Storm
One of the most spectacular and harrowing events in the history of the Great Plains was the Blizzard of January 12, 1888. Other storms had produced colder temperatures and greater amounts of snow. It was the combination of gale winds, blinding snow, and rapidly falling temperatures that made the 1888 blizzard so dangerous. No accurate count of the total deaths from the storm is possible, but estimates for Nebraska have ranged from 40 to 100.

The Blizzard of 1975 occurred in January and dropped 19 inches of snow. Winds up to 65 mph, and rapidly falling temperatures left the Omaha virtually paralyzed for days. Ten people died in Omaha, and only heroic effects by thousands of unknown people kept the toll from being higher.

The major snow and ice storm on October 25 and 26, 1997, ranks as a snow event likely to be seen once in only 200 years. A heavy wet snowfall of 6 to 14 inches fell on trees, many of which were still fully- or partially-leafed, and caused extensive damage and/or total destruction. At least 205,000 residents in the affected area were without power just after the storm, many of the outages lasted for several days. Omaha Public Power District estimated that it was the worst outage in 50 years. Nearly 85% of the trees in the Omaha area and 25% of the trees in the Lincoln area sustained damage or were totally destroyed. Many emergency shelters in and around the Omaha and Lincoln areas were opened for use by those who suffered a hardship from the storm. Property damage was estimated at $56.5 million with crop damage an additional $1.6 million.

Like severe summer storms, it is a virtual certainty that the Papio NRD area will experience a severe winter storm every year. Since 2000, the following counties experienced this many severe thunderstorms (in parenthesis) in each year:

Sarpy:	2000 (3), 2001 (3), 2002 (3), 2003 (3), 2004 (4), 2005 (1)
Douglas:	2000 (3), 2001 (4), 2002 (2), 2003 (4), 2004 (4), 2005 (1)
Washington:	2000 (3), 2001 (4), 2002 (3), 2003 (4), 2004 (4), 2005 (1)
Burt:	2000 (2), 2001 (2), 2002 (3), 2003 (3), 2004 (4), 2005 (1)
Thurston:	2000 (1), 2001 (2), 2002 (3), 2003 (2), 2004 (3), 2005 (1)
Dakota:	2000 (1), 2001 (2), 2002 (2), 2003 (4), 2004 (6), 2005 (1)

Temperature extremes:
Although extreme heat and extreme cold are not common, they are also not rare. What makes these events truly dangerous is when extreme heat is combined with high humidity and when extreme cold combines with high winds to produce dangerous windchills.

On July 10-14, 1995, three people died in eastern Nebraska due to high temperatures and humidity. Also during this time, $150,000 in property damage due to cattle deaths and $160,000 in crop damage was reported. From July 19-30, 1999, daytime temperatures were over 90 to low 100s and overnight lows stayed in the 80s in eastern Nebraska. Combined with high humidity, this heat wave killed two people in the Omaha metropolitan area: a young jogger outside and an elderly man in a trailer with a broken air conditioner. An estimated 5000 head of cattle perished, pushing the total damage from this event to reach $3.3 million. A woman died in her uncooled apartment in South Sioux City during the period of July 28-29, 1999, when heat indices exceeded 120 degrees. On July 28 to August 9, 2001, high temperatures and very high humidity combined to kill one person while he was outside working. On July 22-24, 2005, $3 million in cattle deaths was reported in eastern Nebraska due to a temperature of 105 degrees and stifling humidity. The heat also lead to the death of an infant left briefly in a vehicle.

Extreme cold temperatures can get down to –20 or –30 degrees. When combined with high winds, recorded extreme wind chills are most commonly –30 to –50 degrees. Sub-zero temperatures were recorded for 63 consecutive hours on February 1 to 4, 1996. One injury was reported due to frostbite. Combined with low temperatures, 55 mph winds on January 10, 1997, produced a windchill lower than –70 degrees. On January 22, 2003, a homeless man in Omaha died from severe frostbite suffered during the -30 degree windchill. Windchills of -25 degrees were recorded on January 6, 2004. During this event, an elderly woman in Omaha went out to check on her vehicle during the early morning hours, and passed away after falling and incapacitating herself.

Previous NRD Severe Weather Mitigation Actions
Severe weather preparedness, response, and mitigation are primarily responsibilities of county and region emergency management agencies in the area. For this reason, the Papio NRD has not assisted with or completed severe weather mitigation projects. However, through its Conservation Assistance Program, the NRD has helped with tree planting which has reduced tree-related damages in the urban forest of the Omaha metropolitan area.

2.13 Probability of Severe Weather Events

It is certain that the Papio NRD area will continue to be impacted by severe summer storms and severe winter storms, along with the various dangerous and damaging components which accompany both.

2.14 Vulnerability Assessment of the Severe Weather Hazard

Every structure in every community participating in this planning effort is at equal risk to hail damage or being impacted by other severe weather events. According to the Nebraska Department of Property Assessment and Taxation, this represents approximately $40,290,231,815. See the community-specific section for a more structural inventory and financial damage potential for each city.

2.15 Potential Severe Weather Mitigation Measures

Like tornadoes, there is little one can do to mitigate severe weather events – just be prepared.

GOALS: 1) Reduce or prevent future damage from natural hazard events,
2) Increase public safety

Objective 3.1 Ensure continued operation of critical facilities, utilities, and the local transportation system.

- Action 3.1.1: Work with owners of critical facilities to ensure they are adequately protected against extreme winter conditions and have an uninterruptible power supply.
- Action 3.1.2: Work with schools and other critical facilities to ensure that they receive severe weather warnings – perhaps have them purchase weather radios.
- Action 3.1.3: Develop a snow route plan for the community that takes major streets and critical facilities into account. Post "Emergency Snow Route" signs along this route and educate the public to keep their vehicles off of these routes during heavy snow events, or risk being towed. Publish this route in the local telephone books or other locations which could be referenced by the majority of Papio NRD residents.
- Action 3.1.4: Require all new development, where appropriate, to bury all electric lines.
- Action 3.1.5: Work with local property owners in developed areas to bury power lines in areas which experience power outages due to downed lines.

Objective 3.2: Reduce tree-related damage to property and utilities

- Action 3.2.1: Develop an urban tree management plan. As a free service, the Nebraska Forest Service offers advice on proper "urban forest" planning, tree selection, planting, and tree care. This service should be utilized in areas of the city which experience more tree-related problems. The Nebraska Forest Service performs a free "Tree inventory" and offers technical advice for communities. Communities can then use this information to develop or change their local tree programs.
- Action 3.2.2: Bury overhead power lines and service lines in areas where tree

problems exist.

- Action 3.2.3: Require new development to bury main and service electric lines
- Action 3.2.4: Communities can provide information about proper tree selection (especially in power line rights-of-way) and maintenance to residents.
- Action 3.2.5: Communities should consider becoming a "Tree City USA". This program is offered through the National Arbor Day Foundation, and through it communities receive direction, technical assistance, public attention, and national recognition for their urban and community forestry programs through the Nebraska Forest Service and USDA Forest Service.

Goal 3: Increase Public Education

Objective 3.2: Increase severe weather awareness

- Action 3.2.1: For awareness, severe weather safety tips could be made public by newspaper or other media outlets. Such a campaign should include practical tips like staying indoors when lightning is around and recommended behavior during extreme temperatures. This could be combined with awareness campaigns from other disasters.
- Action 3.2.2: The city could develop a Severe Weather Preparedness Week outreach program to educate children and/or the public about the nature of different disaster types, where to watch for storm warnings, what to do, where to go during a severe weather warning, and others.

2.20 FLOOD

2.21 Background

Flooding has been a major problem for many of the communities in the Papio NRD. Omaha was settled and developed largely because of its proximity to the water resources provided by the Missouri River. Other communities were founded on rivers and creeks for similar reasons. The Papio NRD has the distinction of having the three major Nebraska rivers within its boundary: the Platte River, Missouri River, and Elkhorn River. Before large Missouri River main stem dams were completed by the Corps of Engineers in the 1940s to 1960s, Nebraska communities situated on the Missouri River had an extensive history of Missouri River flooding. These communities were South Sioux City, Dakota City, Decatur, Blair, and Omaha. The entire reach of the Missouri River from the northwest corner of Dakota County to the southeast corner of Sarpy County is under the NRD's administration, which means that it must deal the stormwater problem of steep tributaries draining to Missouri River bottomlands.

The second major Nebraska river which impacts the Papio NRD is the Platte River, which flows along Sarpy County's southern border. Problems with the Platte River in the Papio NRD boundary have not been significant when compared to other communities on the Platte like North Bend, Columbus, and Grand Island. However, Valley, Waterloo, and unincorporated areas of Sarpy County have historically been impacted by Platte River flooding.

The third major Nebraska river to impact the Papio NRD is the Elkhorn River, which acts as the NRD's western border for Washington County. Like the Platte River, the Elkhorn's flood problems are not as significant in the Papio NRD area as they are in other upstream locations – in this case for communities like Norfolk, West Point, Hooper, and Nickerson. However, the communities on the Elkhorn which are in the Papio NRD boundary which have experienced flooding are Arlington, Valley, Waterloo, and King Lake.

In addition to the three major Nebraska rivers, the NRD must also work with the Big Papillion Creek, which drains the majority of the Omaha metropolitan area through its main stem and tributaries.

In addition to the normal riverine flooding, the Papio NRD is also forced to deal with ice jams on the Platte River. Although other NRDs are on the other side of the Platte, most of the damages from ice jams occur on the Papio NRD side of the River. One of the worst ice jams occurred in 1978 when ice conditions helped the Platte River to overtop the Union Dike. As a result, the entire city of Valley was flooded.

Repetitive Loss Properties in the Papio NRD

A repetitive loss property is defined as any structure which has had two or more flood insurance claims filed for it in any ten-year period since 1978. The Federal Emergency Management Agency (FEMA) has started targeting mitigation efforts for these repetitive loss properties because of the significant drain they represent to the flood insurance pool of the National Flood Insurance Program. Mitigation of these properties in Nebraska has been slow because of the regulation which requires the jurisdictions the properties are in to have an adopted and approved all-hazards mitigation plan as a condition of eligibility for federal mitigation assistance. Once this NRD all-hazards mitigation plan is approved, Nebraska will finally be in a situation to mitigate some of these repetitive loss properties.

According to the 2005 Repetitive Loss list provided by FEMA in January 2006, the following communities have this many repetitive loss properties:

Arlington: 2
Bellevue: 11
Douglas County: 17
Fort Calhoun: 4
Omaha: 11
Sarpy County: 122
Springfield: 3
Valley: 2
Washington County: 8
PAPIO NRD TOTAL: 180

Of the 317 properties on the list, the 180 properties in the Papio NRD represents 57% of the State's repetitive loss properties. It should be stated that the repetitive loss list is notoriously inaccurate, especially when it comes to having the correct jurisdictional

name. For example, the two repetitive loss properties listed for Valley should be listed under Douglas County since both are located in the Sokol Camp area. However, no matter where they are located, they ought to be and will be considered as good acquisition candidates.

2.22 Flood History

Historic Flood Events

Since floods impact communities and not areas, more detailed and older flood records have been placed in the community-specific section in **Appendix D**. The National Climatic Data Center (NCDC) has flood events recorded for counties since 1994. Prior to 1994, some of the significant flood events which impacted communities in the Papio NRD area were (* denotes floods of record):

- Missouri River: 1881, 1943, 1947, 1950, 1952*, 1978, 1984
  South Sioux City, Dakota City, Blair, Omaha, Bellevue
- Elkhorn River: 1881, 1917, 1920, 1940, 1944*, 1960, 1962, 1970, 1978, 1990
  Waterloo, Valley, Arlington, King Lake
- Platte River (at Louisville): 1881, 1882, 1912, 1936, 1944, 1947, 1952, 1960* (highest stage from ice jam), 1962, 1967, 1970, 1978, 1984, 1993* (highest flow volume)
- Big Papillion Creek: 1950, 1952, 1959, 1964*, 1965
  Omaha, Irvington, Fort Crook, Papillion, Millard, Ralston, Bennington, Bellevue
- Little Papillion Creek: 1960, 1964, 1965*
  Omaha
- West Branch Papillion Creek: 1948, 1959, 1964*, 1965
  Elkhorn, Papillion
- Omaha Creek: 1922, 1940*, 1954, 1957, 1967, 1993
  Homer
- Tekamah Creek: 1904, 1915, 1944*, 1963, 1974
  Tekamah

The following is a list of each flood event after 1994 given in NCDC's database by county in tabular format first, followed by a narrative description of each even.

Sarpy County

There is an extensive history of flooding in Sarpy County due to its proximity to the Missouri River on the east, Platte River on the west and south, and Big Papillion Creek through its middle. Much of this area is urbanized, which typically compounds flood problems.

Location or County	Date	Time	Type	Mag	Dth	Inj	Property
1 Platte River	02/18/1994	0000	Flood	N/A	0	0	0
2 Platte River	02/18/1997	06:00 PM	Flood	N/A	0	0	620K
3 Missouri River	04/02/1997	12:00 PM	Flood	N/A	0	0	0

4 Near Offutt AFB	06/24/1997	02:00 AM	Flood	N/A	0	0	1.1M
5 Countywide	09/02/1997	01:35 AM	Flash Flood	N/A	0	0	0
6 Platte River	03/16/1998	02:52 PM	Flood	N/A	0	0	23K
7 La Platte	06/13/1998	11:25 PM	Flash Flood	N/A	0	0	0
8 Bellevue	08/07/1999	02:00 AM	Flash Flood	N/A	0	0	0
9 Platte River	03/14/2001	05:00 PM	Flood	N/A	0	0	0
10 Gretna	08/22/2002	11:50 PM	Flash Flood	N/A	0	0	0
				TOTALS:	0	0	1.743M

February 18-20, 1994
Ice action caused minor overflows along the Platte River. An ice jam forced the river to locally reach around two feet over bank-full for a short time in Sarpy County. Some residents of the Beacon View housing area were evacuated and the flooding caused an undetermined amount of water damage to homes.

February 18-28, 1997
Mild temperatures melted snow cover in a short time period allowing for a sudden runoff into streams and rivers which were still intact with thicker-than-normal ice. The runoff into the streams and rivers was sufficient to break up the ice, and ice jams formed at many locations, causing flooding. Serious flooding occurred on the lower Loup and lower Platte rivers. The strongest and most urban flooding occurred in the stretch of the Platte river along Saunders County and Sarpy County between the mouth of the Elkhorn river to the Highway 6 bridge near Linoma Beach/Beacon View. This was the result of a 2½ mile long ice jam along the Platte river. Thomas Lakes was severely impacted with ice jam flooding, and homes in Beacon View were also flooded. Several structures at Camp Ashland were flooded, forcing the evacuation of 150 people. Two to three days of dynamiting the Platte river ice jam near Beacon View beginning on the 20th did much to break up the strongest ice jam that acted as the main blockage in the area.

April 2 – May 3, 1997
Flooding on the Missouri River was the result of snowmelt runoff from the James, Vermillion, Big and Little Sioux, and Floyd rivers in South Dakota and northwest Iowa. In addition, record high releases from Gavins Point Dam added to the flooding. Lowland flooding of agricultural bottomlands, boat marinas, and some local parks was common along the river east of Blair and points further south.

June 24, 1997
Heavy rains caused debris to clog a drainage ditch near a railroad track. The ditch filled with water and washed part of the track away. This lead to a derailment of 28 train box cars that were filled with grain.

September 2, 1997
A cluster of thunderstorms dumped rains of three to five inches in the Papillion Creek basin in and near Omaha, causing numerous pockets of urban flooding. Streets were closed streets in several locations in the Omaha metropolitan area.

March 16 – March 18, 1998
Ice jamming was evident near the confluence of the Platte and Elkhorn rivers near Vencil's Island. Most of the flooding occurred on the west side of the Platte river. Demolition experts used dynamite to open up channels near Vencil's Island and Woodcliff. The dynamiting was successful and water levels receded.

June 13, 1998
Water flowed two to three feet deep over the Highway 75 Platte River bridge near La Platte.

August 7, 1999
Heavy rain from this event caused Douglas, Washington, and Burt County to be declared federal disaster areas. Although not as heavy as locations to the north, rainfall of two to seven inches in a 24-hour period was reported over Sarpy county. Flash flooding was confined to mainly farm fields, but several roads, including 36th Street and Highway 370, were flooded.

March 14-16, 2001
A one-mile ice jam and other smaller ice jams caused considerable flooding along the Platte River, especially southwest of Valley near Sokol Camp and Vencil's Island. The higher river level and ice jams were the result of several warm days that caused snow melt and ice breakup. The ice was unusually thick, around 12 to 18 inches, due to a colder than normal winter season that saw prolonged subfreezing temperatures. Sokol Camp was evacuated due to water that came over a local dike that protected the mainly summer-type cabins, and an evacuation by boat was needed for a residence at Vencil's Island.

August 22-23, 2002
Heavy rain producing thunderstorms tracked across parts of southeast and east central Nebraska. In Sarpy county, flood waters sent water and mud two to three feet deep across Highway 6 southwest of Gretna.

Douglas County
Like Sarpy County, there are many flood sources, most with urbanization pressure which compounds flood problems.

Location or County	Date	Time	Type	Mag	Dth	Inj	Property
1 Douglas County	06/22/1994	0630	Flash Flood	N/A	0	0	0
2 Douglas County	02/18/1997	06:00 PM	Flood	N/A	0	0	620K
3 Douglas County	04/02/1997	12:00 PM	Flood	N/A	0	0	0

4 Missouri River	05/01/1997	12:00 AM	Flood	N/A	0	0	0
5 Platte River	03/16/1998	02:52 PM	Flood	N/A	0	0	23K
6 Omaha	08/07/1999	01:15 AM	Flash Flood	N/A	1	0	11.0M
7 Platte River	02/06/2000	12:30 PM	Flood	N/A	0	0	0
8 Platte River	03/14/2001	05:00 PM	Flood	N/A	0	0	0
9 Omaha	05/24/2004	04:07 PM	Flash Flood	N/A	0	0	0
10 Omaha	07/22/2004	03:50 AM	Flash Flood	N/A	2	0	0
				TOTALS:	3	0	11.643M

June 22, 1994
Two to five inches of rain fell in a short amount of time, which forced Cole Creek out of its banks in Omaha. The flood water affected a car dealership, residential yards, baseball fields, and a golf course. Approximately 150 vehicles had water damage at the car dealership, and widespread street flooding was reported.

February 18, 1997
Mild temperatures melted snow cover in a short time period, allowing for a sudden runoff into streams and rivers, which were still intact with thicker than normal ice. The runoff into the streams and rivers was sufficient to break up the ice. Ice jams formed at many locations, causing serious flooding on the lower Loup River and Platte River. A 2½ mile ice jam on the Platte River caused the worst flooding along a stretch between the mouth of the Elkhorn River downstream to the Highway 6 bridge near Linoma Beach/Beacon View. Thomas Lakes was severely impacted with ice jam flooding, and Beacon View homes were also flooded. Nearly 3000 acres of farmland in western Sarpy county were flooded when the local levee was overtopped upstream of Beacon View. Two to three days of dynamiting of the Platte River ice jam near Beacon View beginning on the 20th did much to break up the strongest ice jam.

April 2 – May 20, 1997
Flooding on the Missouri River was the result of snowmelt runoff from the James, Vermillion, Big and Little Sioux, and Floyd rivers in South Dakota and northwest Iowa. In addition, record high releases from Gavins Point Dam added to the flooding. Lowland flooding of agricultural bottomlands, boat marinas, and some local parks was common along the river east of Blair and points further south.

September 2, 1997
Strong storms dumped three to five inches of rain in the Papillion Creek Basin in and near Omaha. This caused numerous pockets of urban flooding and closed streets in several locations in Douglas County and within the Omaha city limits.

March 16, 1998
Ice jamming was evident near the confluence of the Platte and Elkhorn rivers near Vencil's Island. Most of the flooding occurred on the west side of the Platte River.

Demolition experts used dynamite to open up channels near Vencil's Island and Woodcliff. The dynamiting was successful and water levels receded.

August 7, 1999
Record rains caused extensive flooding over the Omaha metropolitan area and surrounding counties. Rainfall at Eppley Airfield in Omaha totaled 10.46 inches in a 24-hour period, which was the most rainfall recorded in a 24 hour period in Omaha since 1900. The heaviest rain was mainly confined to the eastern part of Omaha, with amounts in the 8 to over 10 inch range. Rainfall generally tapered down in western Douglas County. The Aksarben area in the central Omaha reported around seven inches, Boystown saw a little over five inches, while the National Weather Service office in Valley only received around 2½ inches. The rain caused extensive flooding along Cole Creek in the east-central part of Omaha, where one man drowned after his basement wall washed out. Flooding on the Big Papillion Creek caused substantial damage to two golf courses and a nursery. The Metro Area Transit Headquarters was hit by an eight-foot wall of water which flooded equipment and numerous buses, and caused around $4.5 million of damage. More than 1000 homes, 8 apartment complexes, and over 30 businesses sustained significant damage from flooding, with total damage estimated at between $6.5 million and 11 million. Flooded basements, collapsed walls, and damaged vehicles appeared to bear the brunt of the damage in the Omaha Metro area. Douglas, Burt, and Washington counties of east central Nebraska were declared Federal disaster areas.

February 6-9, 2000
An extensive ice jam from just upstream of Leshara downstream to near the Highway 92 bridge caused lowland flooding along the Platte River. Union Dike prevented more significant flooding from occurring. However, an access road for residences on County Road T, just east of Leshara, flooded. Overall, a 10-mile stretch of the river was flooded due to this ice jam.

March 14-16, 2001
A 1-mile ice jam and other smaller ice jams caused considerable flooding along the Platte River, especially southwest of Valley near Sokol Camp and Vencil's Island. The higher river level and ice jams were the result of several warm days that caused snow melt and ice breakup. The ice was unusually thick, around 12 to 18 inches, due to a colder than normal winter season that saw prolonged subfreezing temperatures. Sokol Camp was evacuated due to water that came over a local dike that protected the mainly summer-type cabins, and an evacuation by boat was needed for a residence at Vencil's Island.

May 24, 2004
Flash flooding was reported across sections of central and eastern Omaha. The flooding was caused by heavy rain of 2 to 3 inches which fell across much of the central, eastern and southern sections of the city over a several hour period during the late afternoon hours. 2.28 inches was reported at Eppley Airfield. The ground over much of the area was already nearly saturated from a two to three inch rain that fell two days earlier. Four-

foot deep flood waters stranded cars in the Saddle Creek and Farnam areas, and a health center reported that floodwater flooded a wing of the unit.

July 22, 2004
Heavy rainfall in the Omaha metropolitan area caused areas of flash flooding, especially near the Saddle Creek and Center Street areas, near the intersections of 96th & Q, 17th & Ames Avenue, and 108th & Q. It was near that last location where a 29-year-old male apparently drowned after his car became stalled in flood waters and he was swept away in a nearby drainage ditch as he was walking for help. Other flooding occurred when a pool of water six feet deep near the Saddle Creek location carried off a few vehicles and flooded at least one apartment complex. Several businesses were flooded, and sewers backed up into properties. Eppley Airfield reported 2.66 inches of rain from the storm in two to three hours, while some locations in midtown Omaha received almost 3.5 inches of rain. After the flash flooding subsided, flooding was reported along the Big Papillion Creek. The creek at Fort Crook was above flood stage for around 2½ hours. Another person drowned during this event when his kayak flipped over in high water on one of the branches of the Papillion Creek system.

Washington County
Many of the flood reports for Washington County occurred on the Elkhorn River, which is the County's western boundary. However, the Papio NRD boundary does not stretch to the Elkhorn River and were therefore not included in this report.

Location or County	Date	Time	Type	Mag	Dth	Inj	Property
1 Kennard	06/23/1996	01:00 AM	Flash Flood	N/A	0	0	0
2 Missouri River	04/02/1997	12:00 PM	Flood	N/A	0	0	0
3 Countywide	09/02/1997	01:35 AM	Flash Flood	N/A	0	0	0
4 Herman	06/08/1998	11:06 PM	Flash Flood	N/A	0	0	0
8 Countywide	07/05/1998	03:30 AM	Flash Flood	N/A	0	0	240K
9 Arlington	08/06/1999	10:00 PM	Flash Flood	N/A	0	0	4.0M
10 Blair	06/14/2001	02:10 AM	Flash Flood	N/A	0	0	0
				TOTALS:	0	0	4.240M

June 23, 1996
Rains of two to three inches fell over much of Washington County, pushing the Bell and Big Papio Creeks out of banks.

April 2 – May 3, 1997
Flooding on the Missouri River was the result of snowmelt runoff from the James, Vermillion, Big and Little Sioux, and Floyd rivers in South Dakota and northwest Iowa. In addition, record high releases from Gavins Point Dam added to the flooding. Lowland flooding of agricultural bottomlands, boat marinas, and some local parks was common along the river east of Blair and points further south.

September 2, 1997
A cluster of thunderstorms dumped rains of three to five inches in the Papillion Creek basin in and near Omaha, causing numerous pockets of urban flooding. Streets were closed streets in several locations.

June 8-9, 1998
Heavy rains caused some flooding near homes southwest of Herman. Up to a foot of water flowed over Highway 75 at New York Creek.

July 5, 1998
Heavy rain from thunderstorms produced flash flooding. New York Creek near Herman and Bell Creek just east of Arlington overflowed their banks. Some homes east of Arlington had to be evacuated, and eight of these homes were flooded. A portion of Highway 30 at Arlington had to be closed for a period of time. Nearly 3000 acres of soybeans were destroyed near Arlington.

June 14, 2001
Heavy rains caused flash flooding that briefly closed Highway 75 north of Blair. Flooding was also observed along Bell Creek near Arlington.

Burt County

Location or County	Date	Time	Type	Mag	Dth	Inj	Property
1 Burt County	02/18/1997	06:00 PM	Flood	N/A	0	0	620K
2 Tekamah	08/07/1999	02:30 AM	Flash Flood	N/A	0	0	500K
3 Oakland	04/30/2003	03:00 AM	Flash Flood	N/A	0	0	0
				TOTALS:	0	0	1.120M

The first flood occurred in extreme western Burt County closer to Nickerson – this area is outside of the Papio-Missouri River Natural Resources District boundary. The second flood recorded for Tekamah was a federally-declared disaster (FEMA-1286). Maximum recorded rainfall was ten inches in less than twelve hours (verify with Tekamah info). Although only officially listed as impacting Tekamah, the entire eastern portion of Burt County witnessed similar flood problems, especially in valleys and low-lying areas adjacent to creeks. For the third flood, rainfall of 4½ to 6½ inches was reported three to four miles west of Oakland, with 5.37 inches measured in town. The rain flooded several tributaries of Logan Creek and flooded across several county roads, but otherwise caused very little damage.

Thurston County

Location or County	Date	Time	Type	Mag	Dth	Inj	Property
1 Countywide	03/07/1993	0000	Flood	N/A	2	0	0
2 Walthill	06/25/2000	11:00 AM	Flash Flood	N/A	0	0	400K
3 Countywide	05/21/2004	11:15 PM	Flash Flood	N/A	0	0	0

4 Countywide	06/11/2004	01:15 AM	Flash Flood	N/A	0	0	0
				TOTALS:	2	0	400K

March 7, 1993
As a part of the unprecedented Great Midwest Flood of 1993, Thurston County witnessed flooding, just like most Nebraska counties and all counties in Iowa. However, since this damage report is prior to 1994, NCDC did not have specific details or damage amounts. The two deaths reported for this event are for the entire region and may not be specific to Thurston County.

June 25, 2000
Four to eight inches of rain which fell in five to six hours, causing flooding of several roads, mainly in eastern Thurston County. At least one road was partially washed out near Walthill, and more than 65 bridges and road culverts were damaged by the storm. The Natural Resources Conservation Service and the Thurston County Road Department estimated that the flooding caused around $400,000 worth of damage.

May 21, 2001
Heavy rainfall from thunderstorms during produced flash flooding across several county roads in Thurston County. Pender picked up around 3½ inches of rain from the storms.

June 11, 2004
Heavy rain caused flash flooding of several roads and Highway 77 across the County. Although rain amounts over the county were only one to two inches, it was the second consecutive night that rainfall of that magnitude fell. The rain washed out back roads between Pender and Thurston, and Highway 77 south of Winnebago was briefly closed by flood waters.

Dakota County

Location or County	Date	Time	Type	Mag	Dth	Inj	Property
1 Countywide	03/07/1993	0000	Flood	N/A	0	0	500K
2 Jackson	07/16/1996	09:20 PM	Flash Flood	N/A	0	0	1.0M
3 Dakota City	07/02/1999	08:40 AM	Flash Flood	N/A	0	0	0
4 West Portion	05/17/2000	09:30 PM	Flash Flood	N/A	0	0	0
5 Hubbard	06/25/2000	12:00 PM	Flood	N/A	0	0	0
6 Willis	06/07/2002	06:50 PM	Flash Flood	N/A	0	0	0
7 South Sioux City	06/09/2003	08:10 PM	Flash Flood	N/A	0	0	0
8 South Sioux City	06/16/2004	10:00 AM	Flash Flood	N/A	0	0	0
9 South Sioux City	04/20/2005	05:00 AM	Flash Flood	N/A	0	0	0
10 Hubbard	10/04/2005	05:50 PM	Flash Flood	N/A	0	0	0
				TOTALS:	2	0	1.500M

March 7-11, 1993
Although only a damage claim of $500,000 is available, NCDC did not provide specific information. As a part of the unprecedented Great Midwest Flood of 1993, Dakota County witnessed flooding, just like most Nebraska counties and all counties in Iowa. However, since this damage report is prior to 1994, NCDC did not have specific details or damage amounts. The two deaths reported for this event are for the entire region and may not be specific to Dakota County.

July 16, 1996
Heavy rain of six to ten inches caused flash flooding of lowlands and creeks in northern and eastern Dakota County. Roads were closed by the flooding with damage occurring to some roads. Several motorists were stranded and had to be rescued during the early morning hours. Basement flooding was widespread, with resulting damage. Flooding of cropland may have damaged crops, but any damage caused by flooding could not be separated from extensive hail damage which occurred with the storm.

July 2, 1999
Rainfall of three inches in a half-hour flooded streets and basements in Dakota City. The amount of damage was not known.

May 17, 2000
Heavy rain caused flooding of streets and lowlands across western Dakota County.

June 25, 2000
Very heavy rain caused flooding of lowlands and roads, including part of Highway 35 which was closed for a while.

June 7, 2002
Heavy rain caused flooding of rural roads and lowlands along Elk Creek in the Willis unincorporated area, which is approximately 3½ miles west of Jackson on Highway 20.

June 9, 2003
Very heavy rain caused widespread flooding of streets and other low areas in South Sioux City. Several vehicles were stranded, but no damage estimate is available.

June 16, 2004
Heavy rain caused widespread street flooding in South Sioux City, stalling numerous vehicles. No damage estimate is available.

April 20, 2005
Runoff from heavy rain caused street flooding, including water covering a large part of Dakota Avenue in South Sioux City.

October 4, 2005
Heavy thunderstorm rain caused street flooding, but caused no damage.

Previous NRD Flood Mitigation Actions

One of the primary reasons that natural resources districts were created in the 1970s was to help with flood control. As a result, all NRDs around the state have initiated their own programs. The Papio NRD has gone the next step to help fund non-structural mitigation such as acquisition and demolition projects. The following is an exhaustive list of the different programs that the NRD administers, along with specific projects that have been completed within each – if known.

Flood Control

Urban Drainageway Program

This program provides technical and financial assistance to municipalities to control erosion, and/or flooding, along major urban drainageways. From 1984 to 2006, this program has been used to complete the projects in the table below.

Completion Date	Project Description	Cost Share Amount
1984	**Omaha** - Meadowlane Park Drainageway improvements	$ 80,000
1986	**Blair** - Cauble Creek grade stabilization structures	$ 70,000
1986	**Omaha** - Latvian Village Drainageway	$ 60,000
1987	**Ralston** - grade control structure in Wildwoode Park.	$ 43,715
1988	**Omaha** - Frederick Street Drainageway improvements	$ 800,000
1989	**Bellevue** - Betz Road Ditch improvements	$ 422,000
1989	**Omaha** - Cottner Street Drainageway, Phase 1	$ 70,000
1992	**Fort Calhoun** - Clay Street Drainageway	$ 60,650
1992	**Omaha** - Improvements to Hell Creek through Roxbury Park	$ 202,750
1994	**South Sioux City**-Westside Drainageway Project, phases 1-3	$ 410,000
1995	**Omaha** - Cottner Street Drainageway	$ 420,000
1996	**Omaha** - Meadowlane Park Drainageway	$ 284,940
1997	**Omaha** - East Omaha Stormwater Detention Cell	$ 114,900
1997	**Ralston** - Ralston Creek stabilization Project at 78th Street	$ 133,000
1997	**Gretna** - Angus Street drainageway	$ 37,800
1998	**Douglas County** - Hefflinger Park Drainageway	$ 200,635
1998	**South Sioux City** - Eastside Drainageway Project	$ 813,000
1999	**Omaha** - F Street Drainageway	$ 126,000
1999	**Bellevue** - Brown River Drainageway	$ 77,100
2000	**Ralston** - Ralston Creek Stabilization Project	$ 500,000
2000	**LaVista** - Thompson Creek Stabilization Project	$ 284,700
2000	**Fort Calhoun** - Eastside Drainageway Project	$ 265,296
2000	**Elkhorn** - Ta-Ha-Zouka Park Drainageway	$ 117,000
2001	**Omaha** - Rockbrook Creek Stabilization Project	$ 266,000
2002	**LaVista** - Thompson Creek Project (west 84th Street)	$ 72,000

2003	**Tekamah** - Tekamah Creek Stabilization	$	32,250
2004	**Elkhorn** - Greenbrier Park Drainageway	$	86,430
2004	**La Vista** - La Vista Falls Golf Course Channel	$	102,570
2004	**Omaha** - Regency Storm Sewer Stabilization	$	258,690
2005	**Elkhorn** - West Branch Phase 3	$	75,632
2006	**Papillion** - Halleck Park Drainageway	$	180,000
2006	**La Vista** - Thompson Creek Phase 5	$	174,000
2006	**Omaha Tribe** - Macy Stormwater Management	$	144,427
	Total All Projects:	**$**	**6,152,736**

District-Priority Watershed Flood Control

The Papillion Creek and Tributaries project originally sponsored by the U.S. Army Corps of Engineers has been supported by the NRD in several ways. Prior Soil and Water Conservation Districts and Watershed Boards which later merged to form the Papio NRD sponsored the original Watershed Work Plan for the Papillion Creek Watershed prepared in August 1966 with assistance from the USDA and State of Nebraska. This plan later lead to the development of a flood control plan by U.S. Army Corps of Engineers involving 21 proposed reservoirs. To date, seven of these reservoirs have been completed as detailed below.

The Watershed P.L. 566 Projects authorize the District to construct and maintain dam structures in watershed work plans and other written agreements with the USDA Natural Resources Conservation Service (NRSC). For example, the work plan for the Papillion Creek Watershed, prepared and administered by the NRCS, calls for 52 grade stabilization and sediment control structures to be built. To enable the NRD to carry out its obligations as the local sponsor, the NRD acquires land rights, easements, and right-of-way; provides for relocations; and the operates and maintains completed structures.

Under these programs, the dams and reservoirs that have been completed are:

- Corps-sponsored lakes like: Lake Zorinsky (DS 18), Cunningham Lake (DS 11), Standing Bear Lake (DS 16), Wehrspann Lake (DS 20), and Candlewood Lake (DS 17)
- Papio Creek and Tributaries Reservoirs like: Bennington Lake (DS 6) and Walnut Creek (DS 21)
- Turtle Creek watershed: 2 completed
- Southern Sarpy watershed: 0 completed
- New York Creek watershed: 0 completed
- Buffalo Creek watershed: 10 completed
- Papio Channel, Little Papio Channel Maintenance
- Tekamah/Mud Creek: 15 completed including Summit Lake
- Elm/Lonetree Creek near Decatur: 0 completed
- Silver Creek watershed in Burt County: 12 completed
- Pigeon/Jones Creek watershed in Dakota County: 6 completed

Flood Control Improvement Corridor Program

This program identifies reaches of streams which are targeted for improvement and offers a variety of techniques to allow the NRD to eventually improve them.

- Big Papillion Creek from Blondo Street to Fort Street
- West Branch of Papillion Creek from 96th Street to West Center Road
- South Branch of Papillion Creek from mouth to Highway 50

Previously improved reaches completed by the District or others include:

- Big Papillion Creek from "L" Street to W. Center Rd.
- Big Papillion Creek from W. Center Road to Blondo Street
- West Branch of Papillion Creek from Confluence to Papillion
- West Branch of Papillion Creek from "F" Street to W. Center Road

Future improvement corridors may include:

- West Branch of Papillion Creek from Papillion to Giles Road
- Big Papillion Creek from Blondo Street to Fort Street

Small Flood Control Structure Program

This program provides technical and financial assistance to landowners in the installation of small flood control structures within the Papillion Creek Watershed. An example of a flood control structure completed under this authorization is the Sachs-Palmer Dam. Criteria for Assistance are:

- The watershed for each structure shall be at least 500 acres.
- All projects shall be designed as high hazard flood control structures to contain the 100-year flood below the emergency spillway.
- Projects under this program shall have a total project cost of less than $500,000, such costs to include but are not limited to preliminary design, geotechnical investigations, final design and construction engineering, soils and materials testing and project construction.
- At least 75% of the applicant's property in the watershed shall have adequate land treatment.

Project Operation and Maintenance Assistance Program

The NRD will consider assuming the operation and maintenance for existing flood control levee projects, previously maintained by others, on a case-by-case basis. Examples of these projects are maintaining the Union Dike/Unnamed Dike at Valley; levees along West Branch Papillion Creek, Little Papillion Creek, and Big Papillion Creek; Corps of Engineers levees R-613 and R-616; Pigeon/Elk Creek levees in Dakota County; and tie-back levees from the Big Papillion Creek to higher ground at Mud Creek, Giles Creek, Whitted Creek, Big Elk Creek, and Thompson Creek.

Emergency Dike Protection, Fortification, Repair Assistance Program

This program provides technical and financial assistance on eligible projects where a flood control dike or levee is, at the discretion of the NRD, in imminent danger of failure.

Flood Mitigation and Management

Floodway Purchase Program

This program promotes the health, safety, and well-being of the public and reduces flood damages through the purchase of floodway lands and improvements.

The purposes are:

- To reduce future flood insurance and disaster assistance costs by removing repetitively and/or substantially damaged structures from flood risk areas.
- To provide an opportunity for owners of repetitively and/or substantially damaged structures to have those structures permanently removed from flood risk areas, and to reduce risk to life from flooding.
- To complement Federal, state and local efforts to restore floodplain values, protect the environment and provide recreational and open space uses.

The objective of this program is to provide a voluntary program whereby property in the floodway would be purchased, and whereby buildings in the floodway would be razed or relocated outside of the floodway, on a willing seller/willing buyer basis, without exercise of eminent domain. The NRD receives periodic requests to be bought out from owners of property in a floodplain/floodway, but the State and NRD have no consistent funding mechanism with which to complete these acquisitions.

Previous floodway acquisitions have taken place in the Elbow Bend/Iske Park area of unincorporated Sarpy County in the Missouri River floodplain, Cole Creek floodplain of Omaha, Weircrest area of Omaha, Cauble Creek in Blair, Beacon View area of the Platte River floodway east of Ashland, and the 61st Street & Harrison Street area in LaVista.

Flood Mitigation Planning and Mapping Assistance Program

This program provides technical and financial assistance to governmental entities located within the NRD to help identify flood prone areas and to plan projects to reduce flood risk and damage. The Papio NRD is a Cooperating Technical Partner (CTP) with FEMA, and administers floodplain mapping and remapping projects through this program.

Criteria for Assistance are:

- Assistance in flood mitigation planning and mapping requires sponsorship by a city, town, village, county, municipality or other unit of local government with the authority and capability to carry out the Flood Mitigation Plan and/or adopt any new or revised National Flood Insurance Program (NFIP) Flood Hazard Studies and Maps.
- The Sponsor must participate in the NFIP and be in "good-standing" status.
- All Flood mitigation planning and floodplain mapping must conform with all federal, state and local laws, standards or guidelines.

The NRD has assisted with the non-federal cost-share of federally-funded mitigation plans in Tekamah, Valley, Blair, and the Cole Creek watershed in Omaha.

The NRD currently administers the floodplain remapping for 50 miles of the West Papillion Creek and its Tributaries in Douglas County and Sarpy County (CTP funds – fiscal year 2004).

Ice Jam Removal Program

The General Manager may determine that flood waters impounded by an ice jam in the Platte River or Elkhorn River within the NRD boundary pose an imminent threat of flood damage, injury, or loss of life or property in an area intended to be protected by a NRD flood control project. In such cases, the General Manager may employ any qualified persons to remove the ice jam in order to release the impounded flood waters. The use of explosives or other techniques is authorized. During cold weather, the NRD monitors up to 12 sites where ice jams have been problematic in the past. The findings of this monitoring is uploaded to the ice jam monitoring website hosted by the Nebraska Department of Natural Resources and overseen by the Nebraska Emergency Management Agency.

Flood Plain Management Program

Technical assistance for flood plain management is given to all communities, counties and individuals in the NRD. Staff makes recommendations regarding development and improvements in flood plain areas. These recommendations are based on federal flood insurance maps, state regulations, and/or currently accepted flood plain management standards which cohere to wise uses of flood plain areas. Staff also deals with the general public on a day-to-day basis to determine the flood plain status of the individual's land or soon-to-be-acquired land.

Urban Stormwater Management Program

To promote the health, safety, and well-being of the public, it is the present and long range intent of the NRD to:

- Serve as a regional coordination and management agency for major urban drainage and flood control systems which are those systems that involve open channels where the drainage area is more than approximately 200 acres.
- Develop Urban Drainage Master Plans which define policies and outline plans for the development, financing, implementation and continued maintenance of urban drainage and flood control systems in each basin. This will be done with the assistance of and in consultation with other local governmental agencies.
- Expect and continue to review and comment on other local governmental subdivisions (cities, counties and Sanitary Improvement Districts) plans to continue to develop, finance, implement, operate and maintain urban drainage and flood control systems that involve enclosed conduits (storm sewers), road crossing and other similar appurtenant systems.
- Assume responsibility for major urban drainage and flood control systems in the District in accordance with the Urban Drainage Master Plan. For areas where no Urban Drainage Master Plan is currently available, the District will consider the planning, development, improvement, financing, implementation and continued maintenance of existing and proposed improvements to major urban drainage and flood control systems on an individual basis.

- Expect, concurrent with or prior to assumption of responsibility for an urban drainage and flood control system, that the local subdivision with regulatory responsibility and authority enact for existing and proposed urban development Sediment and Erosion Control ordinances and Stormwater Management ordinances that provide for District review and concurrence of basin development proposals to ensure that they comply with Urban Drainage Master Plans if the District is expected to assume responsibility for any portion of the development plan.

Flood Warning

Alert Floodwarning System

The Alert Floodwarning System has been installed in the Papio basin. This system consists of 17 combination rain and stream gauges and five individual rain gauges. Information collected by this system is transmitted to the National Weather Service office in Valley where it is stored on a computer and used by the National Weather Service. Through an interlocal agreement, the NRD maintains this system with the City of Omaha, Douglas County, Washington County, and Sarpy County. All parties help to share the cost of this maintenance. The National Weather Service, through this same agreement, has agreed to monitor the system and provide watches and warnings as well as forecasts based on the information provided by this system. The information stored on the computer is available to the Douglas County, Sarpy County, the City of Omaha, the Corps of Engineers, and the NRD through the internet and through telephone modems.

NRD staff communicates with emergency management agencies, law enforcement agencies, and the National Weather Service to help them provide the general public with advance warning prior to floods. First priority is given to NRD project areas. Field information on the status of flooding along project areas is provided to these agencies by the NRD staff. The agencies are expected to provide the NRD staff with information concerning upstream conditions and forecasted flood levels in project areas.

Stream Staff Gauge Program

Stream staff gauges have been placed by the NRD at various locations along the Platte River, Elkhorn River, and along the Papio Creeks, Springfield Creek, and Bell Creek, to aid in determining stream flows and flood stages. The NRD maintains these gauges. During high water events, staff, spotters for the National Weather Service, and others make visual observations of these gauges to document stream stages and assist in flood forecasting.

Rain Gauge Program

The NRD maintains a rain gauge network by supplying individual cooperators with rain gauges and data books to develop long-term rainfall data and assist in flash flood warning. During period of intense rainfall, the National Weather Service and the news media can contact cooperators and receive rainfall information. This network also allows the NRD to evaluate emergency operations needs while providing hydrologic data for future use.

Education and Outreach

Information and Education Program

Informing the public is done to provide them with accurate information on projects and programs and to develop an awareness and concern for natural resource conservation and management. Major support activities include: program brochures, newsletters, education programs, teacher scholarships, a speakers bureau, news releases, internet websites, and a volunteer program.

2.23 Probability of Future Flood Events

It is certain that the Papio NRD area will continue to be impacted by flood events of all three major types: riverine floods, flash floods, and ice jams.

2.24 Vulnerability Assessment of the Flood Hazard

The US Army Corps of Engineers completed the vulnerability assessment portion of this report. Community-specific flood vulnerability information is given for each community in **Appendix D**. For the entire NRD, the Corps was able to find 1,388 structures in the floodplain and was able to determine assessed valuations for 616 of them, which totals $105,641,665.

2.25 Potential Flood Mitigation Measures

Objective 1: Determine valuation information for the remaining structures in the vulnerability assessment in order to have a more complete concept of the NRD's true total flood risk.

GOALS: 1) Reduce or prevent future damage from natural hazard events,
2) Increase public safety

Objective 2: Undertake flood control projects under the NRD's authority

- Action 2.1: Continue to utilize existing programs for the NRD's various flood control programs. Specific proposed projects for flood control reservoirs are Site 13 dam, Site 1, Site 3C, Pigeon/Jones Site 15. These sites will need to go through a rigorous process to determine project feasibility before they are constructed.

Objective 3: Mitigate losses for floodprone buildings

- Action 3.1: Operate as non-federal cost-share partner for FEMA-funded or other sponsored nonstructural mitigation projects such as buyout/removal and elevation. All communities and jurisdictions will be considered if there is need; however, higher priority will be given to structures in an identified floodway and for structures which are listed on FEMA's National Flood Insurance Program repetitive loss list. Specifically targeted areas are: Elbow Bend/Iske Park in unincorporated Sarpy County in the Missouri River floodway, King Lake in unincorporated Douglas County in the Elkhorn River floodway, Beaconview in unincorporated Douglas County in the Platte River floodway, Cole Creek watershed in Omaha, Weircrest area of Omaha, 61st & Harrison area of LaVista, and properties in the Bell Creek floodplain in Arlington.

- Action 3.2: Continue to operate the NRD's ice jam monitoring and removal program

Objective 4: Provide floodplain management technical assistance within the NRD
- Action 4.1: Continue to provide assistance under the NRD's authority

Objective 5: Provide flood warnings and stream and rain data for the use of the NRD, National Weather Service, county emergency management agencies, and others
- Action 5.1: Continue to operate the NRD's Alert Floodwarning System and other stream or rain monitoring systems

GOALS: 3) Increase Public Education

Objective 6: Increase awareness of citizens in the Papio NRD about natural hazards and what can be done to reduce vulnerability to severe events
- Action 6.1: Continue to use existing NRD education and outreach programs to educate and inform the public about natural hazard mitigation options and what the NRD is doing in this area.

2.30 TORNADO

2.31 Background

Tornadoes and high winds have been a way of life in Nebraska since the time of pioneers in the 1800s. With its location at the frequent convergence area for Canadian, Gulf of Mexico, and Pacific air masses, Nebraska is located in a part of the United States where tornadoes are a common occurrence. Nebraska is ranked fifth in the nation for the number of tornadoes, but 23rd in number of tornado fatalities and 24th in tornado injuries. Nebraska averages 39 tornadoes per year, with the most recorded tornadoes being 102 in 1999. All 93 counties in Nebraska have had tornadoes since 1950. The peak month for tornadoes is June, and 78% of all Nebraska tornadoes have occurred in May through July. In terms of timing, 71% of all Nebraska tornadoes have occurred between 3:00 and 9:00 pm, and 53% of all Nebraska tornadoes between 4:00 and 8:00 pm.

The intensity of tornadoes is measured by the Fujita Scale, which is shown by the letter "F" followed by a number from zero to five. The higher then number, the more intense the tornado, as witnessed by the extent of damage left by the tornado. Since the Fujita Scale is determined by actual damage, the wind speeds for each are not as important.

F0 – Very Weak (less than 73 mph)
F1 – Weak (73 to 112 mph)
F2 – Strong (113 to 157 mph)
F3 – Severe (158 to 206 mph)
F4 – Devastating (207 to 260 mph)
F5 – Incredible (261 to 318 mph)

Although F1 storms are classified as "weak," F1 winds can reach over 112 miles per hour and cause considerable damage, injury, or death.

2.32 Tornado History

A town called St. John's City was established in 1856 and was one of the earliest settlements along the Missouri River. In addition to being prone to flooding from the unruly Missouri, a tornado destroyed nearly all of the buildings in town. The people who stayed to resettle in the area decided to move the town south, which became known as the town of Jackson.

Reports indicate that most of the entire Village of Herman was leveled by a tornado on June 13, 1899. The downtown was completely demolished, and 13 people were killed.

A tornado that destroyed the Tekamah's opera house on June 1, 1904. Built in 1884, this building was used for general entertainment of the citizens, including political debates, plays, commencement exercises, revival meetings, dances, and roller skating parties. The tornado destroyed the building and it was not rebuilt.

The Easter Tornado of 1913 caused major damage in Millard, Omaha, and other small communities in today's metropolitan area. In this tornado, 191 people were killed, 2000 homes destroyed, and $10 million in property damage was recorded (1913 dollars). Damage and injuries were also reported in Ralston and Valley from this storm, but surely it impacted other communities as well.

The second historic tornado to hit Tekamah took place in 1930. A photograph from the Nebraska State Historical Society shows widespread destruction with damage consistent with an F3 or F4 tornado. However, damage and casualty information for both tornadoes was not given, and no additional references to this tornado were found.

An F4 tornado impacted Omaha on May 6, 1975. Good fortune, a storm spotting network, and an advanced and adequate warning kept the death toll from exceeding three persons. A ten-mile swath was ground through the heart of the City. 2000 homes, 120 businesses, and many public facilities were destroyed. The final damage estimate was $200 million and an estimated 2,600 persons were injured.

On August 17, 2001, an F2 tornado destroyed at least ten houses and damaged several more in Jackson. The town's school, church, and telephone company building were heavily damaged. Three injuries were reported from this event, and property damage was estimated at $3 million.

By county, tornado statistics are:

	Number of Tornadoes	Tornado Fatalities
County	(1950 to 2004)	(1916 to 2004)
Sarpy	30	2
Douglas	12	3
Washington	12	0
Burt	12	4

Thurston	13	3
Dakota	8	2

Tornado-specific information for each county is as follows:

Sarpy County

DATE	TIME	Deaths	Injured	F-Scale
MAY 13, 1957	1845	0	0	F1
MAY 16, 1957	1200	0	0	F1
JUN 06, 1971	2130	0	0	F0
MAY 06, 1975	1533	0	15	F4
MAY 07, 1988	2139	2	1	F2
AUG 13, 1952	1900	0	20	F4
JLY 03, 1953	1530	0	0	F1
JLY 18, 1956	1900	0	0	F1
JLY 30, 1956	1530	0	0	F1
JUN 15, 1957	2100	0	0	F1
JUN 21, 1957	1852	0	0	F1
AUG 05, 1958	1730	0	0	F0
MAY 02, 1959	1315	0	0	F1
MAY 04, 1959	1630	0	1	F1
MAY 20, 1959	2100	0	0	F2
MAY 06, 1964	0550	0	0	F2
MAY 23, 1964	1900	0	0	F1
MAY 22, 1966	1948	0	1	F2
MAY 23, 1971	1515	0	0	F1
JLY 03, 1973	2130	0	0	F1
MAY 06, 1975	1500	0	0	F0
MAY 04, 1977	1615	0	0	F1
MAY 26, 1977	1420	0	0	F1
MAY 29, 1980	1945	0	0	F1
MAY 07, 1988	2125	0	0	F2
MAY 18, 1989	1720	0	0	F0
JUN 07, 1989	1705	0	0	F0
JUN 07, 1989	1727	0	0	F0
JUN 12, 1993	0215	0	0	F0
APR 11, 2001	1115	0	0	F0

Douglas County

DATE	TIME	Deaths	Injured	F-Scale
MAY 12, 1956	2200	0	0	F1
MAY 13, 1957	1900	0	0	F1
MAR 30, 1967	1845	0	0	F1
JUN 24, 1968	1840	0	0	F0
AUG 18, 1968	1745	0	0	F3
JUN 06, 1971	2130	0	0	F0
JUN 07, 1972	1616	0	0	F0
MAR 27, 1975	1645	0	4	F2
MAY 06, 1975	1535	3	118	F4
JUN 26, 1976	1645	0	23	F1
MAY 07, 1988	2152	0	0	F2
APR 29, 1991	1215	0	0	F0

Washington County

DATE	TIME	Deaths	Injured	F-Scale

JUN 07, 1953	1845	0	1	F2
JUN 04, 1955	2125	0	0	F0
MAY 10, 1956	2000	0	0	F1
MAY 30, 1958	0300	0	0	F1
JUN 24, 1968	0215	0	0	F1
AUG 20, 1977	1950	0	0	F1
APR 08, 1978	0340	0	0	F1
AUG 02, 1990	1535	0	0	F0
AUG 02, 1990	1555	0	0	F1
JUN 20, 1996	2430	0	0	F1
APR 08, 1999	1248	0	0	F0
APR 22, 2001	2457	0	1	F1

Burt County

DATE	TIME	Deaths	Injured	F-Scale
JLY 15, 1950	1730	0	33	F4
JUN 15, 1960	2000	0	0	F2
MAY 06, 1964	0530	0	0	F1
MAY 22, 1966	1900	0	0	F1
JUN 13, 1967	2000	0	0	F0
JLY 07, 1977	0310	0	0	F1
JUN 17, 1984	1800	0	0	F1
JUN 17, 1984	1814	0	0	F1
MAY 27, 1991	2345	0	2	F3
MAY 28, 1991	0030	0	0	F2
JUN 16, 1992	2200	0	0	F2
JUN 18, 2001	2436	0	0	F0

Thurston County

DATE	TIME	Deaths	Injured	F-Scale
JUN 17, 1954	2015	0	0	F3
AUG 25, 1954	0330	0	0	F0
JUN 14, 1967	0130	0	0	F2
JLY 01, 1973	2115	0	0	F1
MAY 25, 1975	1900	0	0	F0
MAY 25, 1975	1900	0	0	F0
JLY 07, 1977	0230	0	0	F1
JLY 30, 1977	0130	0	0	F1
MAY 28, 1978	2050	0	0	F1
MAR 13, 1990	2201	0	0	F1
AUG 26, 1993	2127	0	0	F1
JUN 23, 1998	2415	0	0	F0
JUL 25, 2002	0325	0	0	F0

Dakota County

DATE	TIME	Deaths	Injured	F-Scale
MAY 26, 1955	1700	0	0	F1
MAY 08, 1965	1830	0	0	F1
JUN 15, 1970	2225	0	0	F2
JLY 28, 1986	1815	0	1	F3
JUN 24, 1987	1741	0	0	F0
MAY 27, 1995	1638	0	0	F0
JUL 16, 1996	2200	0	0	F0
AUG 17, 2001	1645	0	0	F2

Previous NRD Tornado Mitigation Actions
Tornado preparedness, response, and mitigation are primarily responsibilities of county and region emergency management agencies in the area. For this reason, the Papio NRD has not assisted with or completed tornado mitigation projects.

2.33 Probability of Tornado Events

Although they do not necessarily occur every year, history shows that tornadoes in the Papio NRD are common and that they should be expected.

2.34 Vulnerability Assessment of the Tornado Hazard

Every structure in the Papio NRD is at risk to tornadoes. According to the Nebraska Department of Property Assessment and Taxation, this represents a value of $40,290,231,815. **Appendix D** includes the structural inventories and vulnerability information for the communities participating in this plan.

2.35 Potential Tornado Mitigation Measures

Unlike floods, tornadoes and high winds do not occur in a defined area – the entire community is vulnerable. Therefore, instead of mitigation, the primary focus should be on warning and response. But there are projects that the city and homeowners can undertake to reduce the damage from these events.

Goal 1: Increase Public Safety from Tornadoes

The locations of tornado sirens in the communities participating in this plan are given in **Appendix D**. On these maps, a series of buffer zones (1/2 mile, 1 mile, 1.5 miles) is provided to show different distances from these sirens. A half-mile area (green on the maps) is a very conservative estimate for adequate hearing distance. However, tornado sirens are meant for outdoor warning only and are not designed to up people while they are sleeping, alert motorists who have their windows rolled up and the radio playing, or alert people who are in their houses with appliances on or with radios or televisions playing. In addition, the weather that is necessary for these sirens to function may have loud wind and thunder noise which may affect how the siren s are heard. The decibel level of the existing sirens should be identified and a maximum range of the sirens should be determined to see if there is adequate coverage of the entire city. By city statute, new sirens should be added as new development takes place which is outside or on the edge of the existing tornado siren coverage.

The same is true for tornado shelters. There is usually a concentration of potential public buildings which could be used as shelters in the downtown area of a community. However, for homes without basements, mobile homes, and businesses, there is usually no recognized shelter. Major employers may have designated tornado safe rooms for their workers, but all businesses and high-density residential concentrations would benefit from designating and publicizing a shelter or other existing structure which meets

tornado safe room specifications. A private consultant may be required to complete this sort of assessment.

Objective 3.1: Increase safety of students during daytime hours
- Action 3.1.1: Pursue a federal grant to retrofit public school buildings with a tornado shelter.

Objective 3.2: Increase safety of the general public in the business district and in parts of communities with few shelter options
- Action 3.2.1: Identify and designate tornado shelters, publicize the locations of all public tornado shelters to increase public awareness – perhaps with a sign on the building.
- Action 3.2.2: Construct tornado shelters for mobile home concentrations or in other locations with vulnerable construction.
- Action 3.2.3: In areas especially prone to damaging high winds, "hurricane straps" can be used to attach the roof rafters to the ceiling supports of the highest floor. This would need to be done as a building retrofit and would not be expensive. New construction can use this building technique very cheaply.
- Action 3.2.4: Offer information to home owners about tornado safe rooms to be constructed as a part of their homes.

Objective 3.3: Ensure adequate outdoor warning siren coverage
- Action 3.3.1: Perform assessment of the tornado siren coverage for communities, add sirens if found to be deficient.
- Action 3.3.2: Codify regulations that require additional tornado sirens as development occurs outside of current coverage areas.

Objective 3.4: Oversee adequate indoor warning coverage
- Action 3.4.1: Purchase NOAA weather radios for critical facilities like public schools
- Action 3.4.2: Purchase or encourage non-public critical facilities (i.e., nursing homes) to purchase weather radios.
- Action 3.4.3: Educate a community's businesses about purchasing additional warning systems, especially in manufacturing facilities where it may not be possible to hear the outdoor sirens.

Goal 3: Increase Public Education

In communities that have not seen a tornado or high wind events recently, there is the danger that residents will not know what to do when they happen.

Objective 3.5: Help residents know what to do in case of a tornado warning
- Action 3.5.1: Residents should be made aware that tornadoes are possible in their community. They should know where to go in the event of a tornado (i.e., to a shelter or internal room/basement in their houses).
- Action 3.5.2: Educate homeowners about how to maintain trees on their property since they are responsible for them.
- Action 3.5.3: Have available information to educate homeowners about types of

desired trees for planting on private property. Information should include: insect susceptibility, potential disease problems, blossom or seed characteristics, cold weather hardiness, and other items.

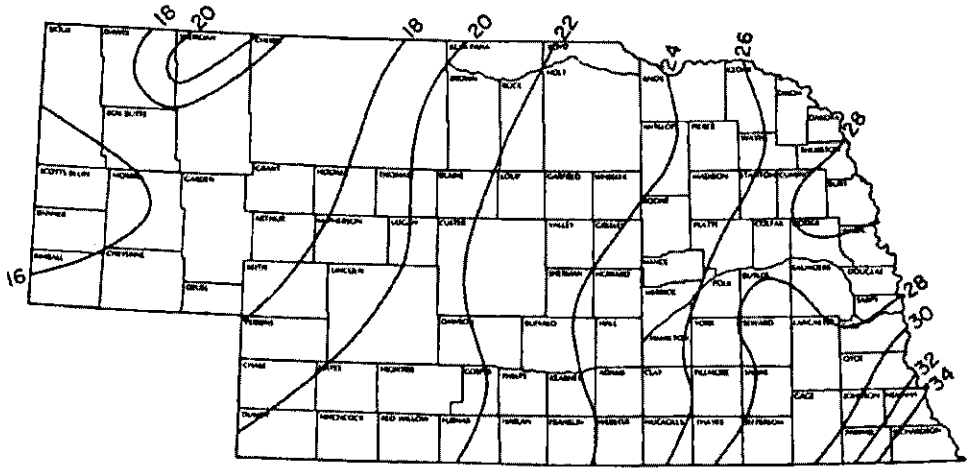
2.40 DROUGHT

2.41 Background

Figure 2 is the isohyet map of the State of Nebraska which shows the average rainfall across the State. Eastern Nebraska receives more abundant rainfall than the west, and in the Papio NRD area that equals an average rainfall is 28-32 inches per year. In average years this represents enough rainfall to prevent drought; however, it is during successive years of below-average rainfall that droughts do impact this area.

Confounding the discussion of drought is the fact that there are different definitions of drought: meteorological drought, agricultural drought, and hydrological drought. Meteorological drought is defined usually on the basis of the degree of dryness (in comparison to some "normal" or average amount) and the duration of the dry period. A meteorological drought must be considered as region-specific since the atmospheric conditions that result in deficiencies of precipitation are highly variable from region to region. For example, some definitions of meteorological drought identify periods of drought on the basis of the number of days with precipitation less than some specified threshold.

Figure 2 – Nebraska Isohyet Map
(Average Annual Rainfall in Inches)



Hydrological drought is associated with the effects of periods of precipitation (including snowfall) shortfalls on surface or subsurface water supply (i.e., streamflow, reservoir and lake levels, ground water). The frequency and severity of hydrological drought is often defined on a watershed or river basin scale. Although all droughts originate with a deficiency of precipitation, hydrologists are more concerned with how this deficiency

plays out through the hydrologic system. Hydrological droughts are usually out of phase with or lag the occurrence of meteorological and agricultural droughts. It takes longer for precipitation deficiencies to show up in components of the hydrological system such as soil moisture, streamflow, and ground water and reservoir levels. As a result, these impacts are out of phase with impacts in other economic sectors.

Agricultural drought links various characteristics of meteorological (or hydrological) drought to agricultural impacts, focusing on precipitation shortages, differences between actual and potential evapotranspiration, soil water deficits, reduced ground water or reservoir levels, and so forth. Plant water demand depends on prevailing weather conditions, biological characteristics of the specific plant, its stage of growth, and the physical and biological properties of the soil. Deficient topsoil moisture at planting may hinder germination, leading to low plant populations per hectare and a reduction of final yield. However, if topsoil moisture is sufficient for early growth requirements, deficiencies in subsoil moisture at this early stage may not affect final yield if subsoil moisture is replenished as the growing season progresses or if rainfall meets plant water needs.

The three different definitions all represent significant things in Nebraska. A meteorological drought is the easiest to determine based on rainfall data and is an easier drought to monitor from rain gauges and reports. An agricultural drought represents difficulty for Nebraska's agricultural-based economy and is also relatively easy to monitor based on crop viabilities for different regions. A hydrological drought means that stream and river levels are low, which also has an impact for surface water and ground water irrigators. In addition, in-stream discharges that fall below a pre-required level also place the State in a regulatory difficulty with US Fish and Wildlife and with neighboring states over cross-border flowage rights. Hydrologic drought is somewhat more difficult to monitor since it requires some field verification of stream levels.

Nebraska is fortunate to have the National Drought Mitigation Center on the campus of the University of Nebraska in Lincoln. The NDMC provides drought monitoring and technical assistance to all areas of the world.
NDMC's website is found at: http://www.drought.unl.edu/.
Specific drought impacts by county are recorded at: http://droughtreporter.unl.edu/.

The impacts of drought can be categorized as economic, environmental, or social. Many economic impacts occur in agriculture and related sectors, including forestry and fisheries, because of the reliance of these sectors on surface and subsurface water supplies. In addition to obvious losses in yields in both crop and livestock production, drought is associated with increases in insect infestations, plant disease, and wind erosion. Droughts also bring increased problems with insects and diseases to forests and reduce growth. The incidence of forest and range fires increases substantially during extended droughts, which in turn places both human and wildlife populations at higher levels of risk. Income loss is another indicator used in assessing the impacts of drought because so many sectors are affected.

Although environmental losses are difficult to quantify, growing public awareness and concern for environmental quality has forced public officials to focus greater attention and resources on these effects. Environmental losses are the result of damages to plant and animal species, wildlife habitat, and air and water quality; forest and range fires; degradation of landscape quality; loss of biodiversity; and soil erosion. Some of the effects are short-term and conditions quickly return to normal following the end of the drought. Other environmental effects linger for some time or may even become permanent. Wildlife habitat, for example, may be degraded through the loss of wetlands, lakes, and vegetation. However, many species will eventually recover from this temporary aberration. The degradation of landscape quality, including increased soil erosion, may lead to a more permanent loss of biological productivity of the landscape.

Social impacts mainly involve public safety, health, conflicts between water users, reduced quality of life, and inequities in the distribution of impacts and disaster relief. Many of the impacts specified as economic and environmental have social components as well.

2.42 Drought History

In addition to differing definitions, there is also some debate about whether or not an area has experienced or is currently experiencing a drought. Certainly the City of Omaha has experienced periods of time when lawn watering had to be voluntarily curtailed in order to maintain an adequate water reserve. However, although these periods may have witnessed below-average rainfall, the impacts were not felt much further than an inconvenience to homeowners. There have been no instances of drought which have caused drastic impacts in the Papio NRD area to the extent that land use regulations or emergency actions have had to be used.

Previous NRD Drought Mitigation Actions

Other than monitoring, there is precious little that can be done to mitigate a drought. As a result, extensive drought monitoring networks have been established. The purpose of monitoring is to see that a drought is indeed happening so that planners are then able to take appropriate actions to stem the impacts before they reach crisis level.

The Papio NRD participates in programs which help with drought monitoring. The NRD maintains a rain gauge network by supplying individual cooperators with rain gauges and data books to develop long-term rainfall data. This network also allows the NRD to evaluate emergency operations needs while providing hydrologic data for future use. The Papio NRD is also involved in the Nebraska Rainfall Assessment and Information Network. In NeRAIN, the Nebraska Natural Resources Districts, Nebraska Department of Natural Resources, and other water-focused organizations, analyze and document data gathered by volunteers. The data will provide important daily decision-making information for agriculture, industry, home water use, utility providers, insurance companies, resource managers, and educators.

2.43 Probably of Drought Events

It is probable that a drought will impact the Papio NRD area in the future.

2.44 Vulnerability Assessment of the Drought Hazard

Due to the nature of a drought and the uncertainty about when it begins and ends, a vulnerability assessment is equally difficult to ascertain. One of the biggest drought impacts that could happen would be to a community's water system intake being rendered useless by declining water levels in a hydrological drought. The entire population in the Papio NRD area is theoretically at-risk for a drought. However, there is a disparity of risk between rural and urban areas. Most urban areas have water system in place which allows for adequate distribution of water, even in times when drought conditions prevail. Rural areas are more dependent on single-site water wells. In addition, since water is the economic lifeblood of agriculture in these areas, there is a much greater economic vulnerability to these areas. Since relevant drought impacts are more community-specific than area-based, drought issues are chronicled in the community reports found in **Appendix D**.

2.45 Potential Drought Mitigation Measures

The main drought mitigation measures can be grouped into five main categories: legislation/public policy, water supply augmentation, demand reduction/water conservation programs, emergency response programs, and drought contingency plans.

For legislation/public policy, some action items could include:

- Prepare position papers for legislature on public policy issues
- Examine statutes governing water rights for possible modification during water shortages
- Pass legislation to protect in-stream flows
- Pass legislation providing guaranteed low-interest loans to farmers
- Impose limits on urban development

Water supply augmentation:

- Issue emergency permits for water use
- Provide pumps and pipes for distribution
- Propose and implemented program to rehabilitate reservoirs to operate at design capacity
- Undertake water supply vulnerability assessments
- Inventory self-supplied industrial water users for possible use of their supplies for emergency public water supplies
- Inventory and reviewed reservoir operation plans

Demand reduction/water conservation programs:

- Established stronger economic incentives for private investment in water conservation
- Encouraged voluntary water conservation
- Improved water use and conveyance efficiencies
- Implemented water metering and leak detection programs

Emergency response programs:

- Establish alert procedures for water quality problems
- Stockpile pumps, pipes, water filters, and other equipment
- Establish water hauling programs for livestock
- List livestock watering locations
- Establish hay hotline
- Fund water system improvements, new systems, and new wells
- Fund drought recovery programs
- Lower well intakes on reservoirs for rural water supplies
- Extend boat ramps and docks in recreational areas
- Issue emergency irrigation permits for using state waters for irrigation
- Create low-interest loan and aid programs for agricultural sector
- Create drought property tax credit program for farmers
- Establish a tuition assistance program for farmers to enroll in farm management classes

Drought contingency plans:

- Establish statewide contingency plan
- Recommend that water suppliers develop drought plans
- Evaluate worst-case drought scenarios for possible further actions
- Establish natural hazard mitigation council

Funding sources and potential cost: There is a general lack of funding for drought mitigation projects. Most projects that are completed are based on crisis need, so federal grants with application periods are not frequently used. Cost would vary greatly depending on scope and type of project.

2.50 DAM FAILURE

2.51 Background

Many of Nebraska's communities were founded due to their proximity to water resources. Often, these streams or rivers later needed a dam for flood control or a reservoir for a constant water release. The Nebraska Department of Natural Resources performs annual inspections on all high-hazard dams in the State. A high-hazard dam is one where a large discharge and/or breach of the dam could potentially lead to downstream loss of life. High-hazard dams are designed to the Probable Maximum Precipitation event, which is typically three or four times the rainfall expected from a 500-year event.

2.52 Dam Failure History

In the development of this mitigation plan, no record could be found of a dam failure in the last 40 years.

Previous NRD Dam Failure Mitigation Actions
Through its maintenance programs, the Papio NRD performs routine inspections to significant dams in the NRD. If dams are owned by the NRD, then any repairs needed are performed.

2.53 Probability of Dam Failures
There is a low probability of dam failures in the Papio NRD. This is due to the routine inspections and regular maintenance and because the dams are designed to the Probable Maximum Precipitation level.

2.54 Vulnerability Assessment of the Dam Failure Hazard
Vulnerability assessments have been completed for each high-hazard dam. These reports are kept on-file at the Nebraska Department of Natural Resources. For homeland security purposes, these reports are kept confidential and are not meant for public dissemination.

2.55 Potential Dam Failure Mitigation Measures
With the routine inspections and maintenance requirement, it is believed that all mitigation measures are being performed that can be performed.

2.60 FUTURE DEVELOPMENT AND HAZARD VULNERABILITY

Future development is not a primary concern of the Papio NRD since development decisions are made at the local level. When possible, future development plans are shown for each participating community in **Appendix D**.

Chapter 3 – Public Participation on Plan

The Nebraska Department of Natural Resources is the lead agency in the planning issues. All of the meetings were open to the public and noticed.

Present at the initial public meetings on August 3, 4, 24, and 31, 2005, were representatives from the US Army Corps of Engineers, Nebraska Department of Natural Resources, Papio-Missouri River Natural Resources District, County Emergency Management personnel, community elected officials, and many citizens. See the sign-in sheets and newspaper article in **Appendix C** for documentation.

In place of a second public meeting, this plan used the public input system available at the local level through the public hearing process. Local governments were notified by letter from NDNR of the projects identified by their community representatives in the initial public meeting. In this letter, they were asked if the projects listed were still an adequate representation of their hazard mitigation goals. In addition, local governments were also requested to prioritize their projects. The adoption by each participating community took place after the respective city councils or village boards had worked through the public hearing process.

Steve McMaster, Water Resources Planner for the Nebraska Department of Natural Resources, wrote this plan. The draft plan was sent to the Papio NRD Board for review at its May 10, 2006, meeting for prioritization of mitigation alternatives and to provide comments. The NRD Board was then requested to adopt the plan at their meeting on May 24, 2006. Documentation showing the adoption at the NRD level is given as the first page of this report. Work on the communities participating in the plan was still in progress at the time that the NRD Board adopted the plan. Once all communities have replied with comments and have adopted their individual portions of the plan, a completed **Appendix D** will be submitted to FEMA. Documentation of local plan adoption is given as the first page of the reports for the participating communities.

Subsequent evaluations and updating of the plan will involve public display advertisements in the local newspaper or other public notices. The plan will be reviewed and revised as necessary every five years or after a Federally-declared disaster.

Plans and Other Information Used in the Development of this Plan

City of Arlington Flood Insurance Study, FEMA. July 1980.
Information: Flood history, boundary, and statistics

City of Blair Flood Insurance Study, FEMA. July 17, 1995.
Information: Flood history, boundary, and statistics

City of Dakota City Flood Insurance Study, FEMA. March 16, 1981.
Information: Flood history, boundary, and statistics

City of Elkhorn Flood Insurance Study, FEMA. February 1979.
Information: Flood history, boundary, and statistics

City of Omaha Flood Insurance Study, FEMA. September 17, 1997.
Information: Flood history, boundary, and statistics

City of Ralston Flood Insurance Study, FEMA. November 1979.
Information: Flood history, boundary, and statistics

City of South Sioux City Flood Insurance Study, FEMA. February 1979.
Information: Flood history, boundary, and statistics

City of Tekamah Flood Insurance Study, FEMA. August 1981.
Information: Flood history, boundary, and statistics

City of Tekamah Flood Mitigation Plan, Nebraska Department of Natural Resources.
Information: Flood history, mitigation options, structural inventory

City of Valley Comprehensive Plan.
Information: Future development areas

City of Valley Flood Insurance Study, September 1979.
Information: Flood history, boundary, and statistics

Flood Plain Study, Platte River, Missouri River to Louisville, Nebraska, Nebraska Natural Resources Commission. November 1975.
Information: Flood history and statistics

Flood Proofing: How to Evaluate Your Options, U.S. Army Corps of Engineers, National Flood Proofing Committee. July 1993.
Information: Flood mitigation options and evaluation strategies

Flood Proofing Performance; Successes and Failures, U.S. Army Corps of Engineers, National Flood Proofing Committee. December 1998.
Information: Floodproofing mitigation options

National Arbor Day Foundation – Tree City USA website located at:
http://www.arborday.org/programs/treeCityUSA.cfm
Information: Tree City USA information

National Climate Data Center searchable severe weather database located at:
http://www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwevent~storms
Information: All-hazard statistics

National Flood Insurance Program, Community Rating System Coordinator's Manual, July 1994.
Information: CRS point-earning activities

Nebraska flood data, Nebraska Department of Natural Resources spreadsheet.
Information: Historic flood events in Nebraska

Our Town Nebraska ----- "Nebraska...Our Towns" Taylor Publishing, Dallas, TX. 1990.

Sarpy County Flood Insurance Study, FEMA. January 19, 1995.
Information: Flood history, boundary, and statistics – LaVista, Papillion, Sarpy County, Springfield

Village of Homer Flood Insurance Study, FEMA. June 18, 1996.
Information: Flood history, boundary, and statistics

Village of Waterloo Flood Insurance Study, FEMA. February 19, 1987.
Information: Flood history, boundary, and statistics

Washington County Flood Insurance Study, FEMA. May 16, 1995.
Information: Flood history, boundary, and statistics

Chapter 4 – Implementation

The Papio NRD will implement this plan by the methods outlined in this chapter. In addition to a positive benefit-cost ratio, projects will be prioritized and selected for implementation based on community goals, planning objectives, funding availability, environmental concerns, and public support. Projects sponsored for implementation by the Papio NRD or by a participating community will follow a public process.

Determining which projects should be submitted for funding will be based on a FEMA-approved cost-benefit method. This means that proposed projects would need to be reviewed for cost effectiveness with the assistance of state emergency management or floodplain management personnel. In addition to a positive cost-benefit ratio, projects will be prioritized and selected for implementation based on community goals, planning objectives, funding availability, environmental concerns, and public support.

At its discretion, the Papio NRD may choose to not implement any of the proposed mitigation projects at this time with the realization that future events may change this stance as well as the prioritization of projects.

The Papio NRD Board reviewed the following projects for a recommendation on which projects should receive the highest priority. The Papio NRD is responsible for making the final decision on which projects are submitted to the appropriate funding agency/program for funding. Unless otherwise decided for specific projects, the Papio NRD will be the agency responsible for project administration.

In the plan, several potential mitigation projects are identified. This plan is not designed to have an all-inclusive list of projects, so the plan should be revised and updated as new projects are identified and prioritized by the Papio NRD and participating communities. During the planning process, community representatives and the Papio NRD Board heard the range of potential mitigation options available to them, and identified and prioritized the projects listed below. There are two groups into which the various options were prioritized: a higher-priority and lower-priority. The highest priority projects for each community are listed, along with the priority ranking from the Papio NRD Board. Higher priority projects are listed in order of highest priority to lowest, as ranked by the public. Lower priority projects are not ranked in any order, but did receive votes by the public.

Recommendations

HIGHER PRIORITY PROJECTS

Include Additional Communities in Next NRD Plan Update
Prior to the commencement of this mitigation planning initiative, every community in the Papio NRD area was invited to attend one of the public meetings and to participate in the planning process. Communities that should be targeted for inclusion in the plan at the

next update are: Bellevue, Gretna, Bennington, Irvington, Boys Town, Decatur, Burt County, Winnebago Tribe/Winnebago, Macy, Walthill, Dakota City, and Hubbard.

Acquisition and Demolition of Floodprone Structures

The Papio NRD has an existing floodway purchase program. However, even though the NRD has acquired floodplain and floodway properties in the past, the program suffers from a lack of sustained funding. It is not unusual for the NRD to receive intermittent requests about buyouts; however, it is unable to complete the acquisitions of these properties because: 1) there is no funding available, 2) the property is located in an area which has no mitigation plan, or 3) it is not possible to develop a larger acquisition project that would be approved by the Nebraska Emergency Management Agency or Federal Emergency Management Agency. One of the benefits of a NRD-wide all-hazards mitigation plan is that all properties in the NRD boundary will be eligible for FEMA funding from its annually-funded mitigation programs.

Specific areas targeted for acquisition projects are:

- King Lake (unincorporated Douglas County) in the Elkhorn River floodway
- Elbow Bend & Iske Park (unincorporated Sarpy County) in the Missouri River floodway/floodplain
- Thompson Creek floodplain in LaVista
- All areas in the Papio NRD boundary will be considered for buyouts, as requested

Drainage Improvements

A fully-developed scenario as seen in much of the Omaha metropolitan area means that drainage and stormwater management will be an important means of reducing flood damages and flood-related nuisances. Furthermore, the flooding dynamics will continue to change as additional construction occurs around the fringes of existing development.

Potential funding sources:

1. Community Development Block Grant (CDBG) funds are available through the Nebraska Department of Economic Development for planning. Drainage studies and improvements are eligible for funding as long as the City meets low-to-moderate income requirements. Applications are always open, but there are two funding cycles each year.
2. The Papio-Missouri River Natural Resources District has funded drainage improvements in the District, some of which were identified as a part of a mitigation plan. As a stipulation for funding, the NRD will require written documentation of who or which interest will be in charge of maintaining the improvements.
3. The Flood Mitigation Assistance (FMA) program and Pre-Disaster Mitigation program through the Federal Emergency Management Agency (FEMA) receives annual allocations for projects. Fundable projects are identified in the community's approved mitigation plan, and these funds will supply up to 75% of the total project cost.

Floodplain Management

Although not commonly viewed as mitigation, effective floodplain management is the most powerful tool in preventing unwise development in floodprone areas. Most communities in the Papio NRD boundary already participate in the National Flood Insurance Program. These communities will continue to participate and will be able to turn to the Papio NRD or Nebraska Department of Natural Resources for technical assistance with specific problems and issues. The main responsibility for the administration of the local floodplain management ordinance has to do with the various aspects of reviewing and issuing floodplain development permits. If there is no or very little floodplain area in a community's jurisdiction or if there is no or very little growth, a community's administration responsibilities in the NFIP will be extremely easy.

Also in the floodplain management category, downstream zoning of dams is idea whose time has come. There are three hazard classes of dams in Nebraska: high, significant, and low-hazard. The hazard class is determined based on the downstream land use and, as a result, have different construction standards. High hazard dams have population concentrations in the area that would be inundated if the dam were to fail. As a result, high hazard dams are constructed with ultimate safety in mind through the use of emergency spillways and extra scrutiny for dam construction plans and routine maintenance requirements. Each high hazard dam must also have an Emergency Action Plan for what to do in the event of a catastrophic failure or if the emergency spillways are used following an intense rain event. As a result of the Safety of Dams and Reservoirs Act passed by the Nebraska Unicameral in 2005, zoning of areas downstream of low and significant hazards dams is now possible. The intent is to allow development to be regulated and restricted in these areas since population moving in below a low hazard dam will cause it to be reclassified as a high hazard dam. When this happens, the dam owner would be responsible to undertake costly construction actions to raise the height of the dam, improve the dam to high-hazard specifications, and to ensure regular maintenance and inspections.

Potential funding sources:

There is no expense to communities to participate in the NFIP program other than personnel time to administer the program at the local level. Communities are also encouraged to pass zoning regulations for areas downstream of low-hazard and significant-hazard dams. The Papio NRD will also continue to provide technical assistance for floodplain management, as requested.

Flood Control

Flood control and flood damage reduction is one of the primary responsibilities of the Papio NRD. Since the NRD was created in 1972, it has constructed numerous flood retention reservoirs and has channelized long stretches of creeks in the Omaha metropolitan area. As the population of Omaha continues to increase and the area of development expands, the need for flood control dams and channelization also increases.

Flood control reservoirs deemed necessary by the Papio NRD are:

- Site 3C – Douglas County/Washington County, Big Papillion Creek

- Site 1 – Washington County, Big Papillion Creek

Channelization has been identified by the Papio NRD for:
- West Branch Papillion Creek from Papillion to Giles Road
- Big Papillion Creek from Blondo Street to Fort Street

Flood Warning
The Papio-Missouri River Natural Resources District has a real-time flood warning system for the Omaha metropolitan area – it should be explored if this warning system could be expanded to include areas outside of the metro.

Some potential flooding situations on the Platte River through the Valley area would have enough lead time for the National Weather Service to issue flood warnings. Dissemination of these flood warnings through the regular news media would provide adequate warning. In certain flood situations with less warning time, such as ice jam conditions, Papio NRD or local officials may need to directly notify affected residents.

Potential funding sources:
The U.S. Department of Commerce has grant funds for developing automated local flood warning systems, which could consist of gages installed by the USGS or from a vendor.

Outdoor Tornado Siren Assessment
Assess the outdoor tornado siren coverage for all communities within the Papio NRD boundary, using decibel and frequency of the existing sirens. Develop and implement a plan to add sirens if found to be deficient.

Potential funding sources:
Pre-Disaster Mitigation (PDM) grant funds through the Federal Emergency Management Agency could be used for this sort of project. PDM funds are competitive nationwide and are offered annually with the qualification that Congress must first authorize the funds. County and regional emergency management agencies could assist with this activity and might be able to provide free technical assistance.

Purchase NOAA Weather Radio for Critical Facilities
Weather radios are inexpensive enough that communities could purchase them for public critical facilities, such as schools and hospitals. Communities can encourage local businesses to purchase radios, especially elderly care facilities and noisy manufacturing plants which either need to be sure to receive warnings or may not be able to hear outdoor warning sirens.

Potential funding sources:
A brief online search of sites which offer NOAA Weather Radios for sale show several options with the average price being about $50-70. Depending on how many radios communities would need for critical public facilities, they might be able to purchase them. Several years ago, Region 5/6 Emergency Management out of Fremont acquired weather radios at a discounted cost and was distributing them to interested communities.

County or regional emergency management agencies could perhaps perform a similar service.

Tornado Shelter Assessment
Identify and designate tornado shelters. Any shelters that are identified should be entered into a GIS coverage for spatial analysis of shelter distribution and needs. Publicize the locations of all public tornado shelters to increase public awareness – perhaps with a sign on the building. County and regional emergency management agencies could assist with this activity.

Potential funding sources:
Pre-Disaster Mitigation grant funds through the Federal Emergency Management Agency could be used for this sort of project. Assessments should be made with the guidance of FEMA publication 361 ("Design and Construction Guidance for Community Shelters").

Urban Tree Management Plan
For the Omaha metropolitan area, it would be beneficial to develop a comprehensive urban forest management plan, especially in areas of the city which experience tree-related problems. Smaller communities should request a tree inventory from the Nebraska Forest Service which would give recommended actions to local tree boards. Outside of an inventory or urban forest plan, homeowners should also know how to maintain trees on their property since they are responsible for them.

Potential funding sources:
Instead of assessing the need for financial assistance, interested communities should send a letter to the Nebraska Forest Service, requesting a community tree inventory. Tree inventories are a free service from the NFS and are beneficial in determining tree-related activities which should be taken immediately or in the near future. Even in communities which have had a tree inventory completed in the last ten year, an updated inventory would be beneficial for local tree boards or other tree-related groups to assess required actions to reduce vulnerability.

Severe Weather Awareness Education
For awareness, severe weather safety tips could be made public by newspaper or other media outlets. Such a campaign should include practical tips like staying indoors when lightning is around and could be combined with awareness campaigns from other disasters, and could take place during Severe Weather Awareness week every March.

Potential funding sources:
This is another activity which would not need to require financial resources other than staff time. Severe weather awareness campaigns can be done through various media, in cooperation with the National Weather Service, Douglas County Emergency Management Agency, Papio-Missouri River Natural Resources District, Nebraska Emergency Management Agency, Nebraska Department of Natural Resources, Federal Emergency Management Agency, U.S. Army Corps of Engineers, and other agencies at all levels.

Severe Weather Alerts
Expand public awareness about National Oceanic and Atmospheric Administration (NOAA) Weather Radio for continuous weather broadcasts and warning tone alert capability. Newer models of the weather radios are capable of supplying warnings for selected counties. The education about these radios could be done at little expense through a local newspaper article or other media outlet. County and regional emergency management agencies could offer assistance.

Identify Snow Emergency Routes
In order to most efficiently clear the streets for emergency transportation and normal vehicular traffic, snow routes should be made official and posted with signage so that local residents know to move their vehicles with the impending threat of a large snowfall. After communities determine an official snow route, maps of the snow route should be created for dissemination in publications which will be received by a majority of the community's citizens. Many communities publish snow route maps in telephone books or local newspapers. Communities should have a plan to disseminate the issuance of a snow emergency, preferably as far in advance of the culmination of the snow event as possible to allow residents to move their vehicles. Communities should have a plan to tow vehicles which are not moved upon the time a snow emergency declaration. Local officials can pass an ordinance which creates a fine for not moving vehicles which would serve as a revenue source and deterrent. The goal is to allow plow drivers to remove snow as quickly and efficiently as possible as a public safety and transportation concern. Many communities have an unofficial snow clearing route which plow operators and residents know by heart. However, making it official and codified into local bylaws would improve efficiencies and inform all residents.

LOWER PRIORITY PROJECTS

Since these projects are of a lower priority, potential funding sources are not as important to identify at this stage.

Comprehensive Levee System for Valley
A comprehensive levee system, Union Dike and No Name Dike, currently provides flood protection for almost all of the area within Valley's jurisdiction. The levee system could be improved to provide a higher level of flood protection. Providing protection against the 100-year (combined open-water and ice affected condition) would relieve residents of the requirement to purchase flood insurance and certain requirements for new development.

Potential funding sources:
Due to the large scope of the work required to raise Union Dike, the only feasible agency which could undertake such a project is the U.S. Army Corps of Engineers. This issue has been extensively explored in the last several years, and the likelihood for funding this project is relatively small. However, conditions may change in the future or a special

congressional appropriation could be made specifically for this project. If this project would be funded and built, it would have a dramatic positive impact for Valley. Therefore, no matter the likelihood of funding, this project should remain in the list of potential projects.

Education and Improved Hail Warning System
Some of the most damaging natural hazards events in the Omaha metropolitan area over the last five years have been severe hail storms. There is not a lot that can be done to prevent hail damage to existing homes, but there are things that can be done to reduce future damage to new homes and to vehicles. For new homes, building options would be metal roofs instead of wood shake or traditional asphalt shingles. Another building improvement would be metal siding instead of vinyl or wood, which can be destroyed by hail strikes. Improved warning times would allow owners to move their vehicles to a protected location.

Flood Awareness Education
A flood awareness program would require the commitment of staff time from each interested community. As an example, a successful flood education public information seminar was held in Valley in 2005. Other agencies, such as the Papio-Missouri River NRD, the Nebraska Department of Natural Resources, Federal Emergency Management Agency, and the US Army Corps of Engineers could provide assistance and educational materials. An on-going flood awareness education program might attract interested members of the public to assist as volunteers.

Potential funding sources:
Most education and outreach programs would not require funding. The only commitment would be staff time and time and money spent advertising meetings.

Flood Insurance Education for Homeowners
Information on how to obtain flood insurance should be provided to private property owners – it would be at their discretion to actually purchase the insurance coverage. Since the passage of the National Flood Insurance Reform Act of 1994, lenders have been required to determine if the property to be insured is in a floodplain. If it is, lenders will require flood insurance as a condition of protecting their loan. This is only for loans which are federally-backed such as mortgages or home improvements. For this potential project, "education" could mean something as easy as having FEMA flood insurance brochures available at city hall and the library up to public meetings to inform the public.

Plan Evaluation

Future plan monitoring, evaluating, and updating will follow this process:
1. Unless otherwise designated by the Papio NRD Board, the Papio NRD project staff will oversee the plan evaluation and revision process.
2. To assist with the monitoring of the plan, as a recommended project is completed, a detailed timeline of how that project was completed will be written and attached to

the plan in a format selected by the Papio NRD staff. Items to be included will be: timelines, agencies involved, area(s) benefited, total funding (if complete), etc.

3. At the discretion of the Papio NRD staff, a local task force may be used to review the original draft of the mitigation plan and to recommend changes.
4. The persons overseeing the evaluation process will review the goals and objectives of the previous plan and evaluate them to see that they are still pertinent and current. Among other questions, they may want to ask themselves:
    - Do the goals and objective address current and expected conditions?
    - If any of the recommended projects have been completed, did they have the desired impact on the goal for which they were identified? If not, what was the reason it was not successful (lack of funds/resources, lack of political/popular support, underestimation of the amount of time needed, etc.)?
    - Have the nature, magnitude, and/or type of risks changed?
    - Have there been implementation problems?
    - Are current resources appropriate to implement the plan?
    - Were the outcomes as expected?
    - Are there other agencies which should be included in the revision process?
5. Any projects that have been completed since the previous plan will be noted in a "Previous Mitigation Projects" section and removed from further consideration for new projects.
6. If no further action has been made on the recommended projects of the previous version of the plan, the Papio NRD staff will document this fact.
7. Before incorporating the changes to the plan that are identified as necessary as a part of the monitoring and evaluating portions, the public will be invited to comment through the same process used in the development of the original plan: public notification through newspaper article/public notice, public meetings, and by letter of invitation to relevant stakeholders.
8. At its discretion, the Papio NRD may opt to use the plan evaluation, update, and revision worksheets given in this plan in **Appendix B.**

Incorporation into Existing Planning Mechanisms

There is a lack of regional planning documents into which this NRD-wide plan could be incorporated. At the discretion of the participating communities, this plan could be incorporated into the comprehensive plans of these communities. This would ensure that the mitigation component of the comprehensive plan would be consistently revisited and reviewed. However, care must taken so that this mitigation plan is reviewed and updated every five years.

Building code administration is handled at the local level and is not overseen by the Papio NRD. Upon the local adoption of the mitigation plan, each participating community will make sure that it adopts, and is enforcing, the minimum standards established in the building code used in the State of Nebraska. This is to ensure that life/safety criteria are met for new construction.

Any capital improvement planning that occurs in the future will also contribute to the goals in this hazard mitigation plan. This is another item administered at the local level and is not overseen by the Papio NRD. However, the Papio NRD may be able to work with capital improvement planners to secure high-hazard areas for low risk uses.

Appendix A
Study Area Building Inventory

The complete building inventory for the study area was completed using Microsoft Access. The property description information shown in this database was obtained from the Nebraska Department of Property Assessment and Taxation in Lincoln, Nebraska. The property information shown is limited by the data obtained through the assessor's office and may require updating. The elevation data were gathered through field surveys conducted by the U.S. Army Corps of Engineers using current assessor property records. Any questions concerning elevation information for a structure should be directed to the U.S. Army Corps of Engineers.

The complete database has 27 data fields, all of which contain information describing a specific property parcel. For the purpose of this study, only six fields are displayed in this appendix. It was determined that these fields offered the reader the most pertinent information for this application. The fields chosen for this report are listed below with descriptions and reason for inclusion.

DATA BASE FIELDS

Street Address – The current location of a structure. These addresses were obtained from the Nebraska Assessors office. Included to help the reader locate a specific property.

Structure Type – The type of the principle building on the property as per the Nebraska State Assessor. Included to help describe the main structure. The following explains the abbreviations: 1.5SF – One and a half story frame; M – Masonry; I – Industrial.

Year Built – The date the primary structure on the property was built. Included so the reader can determine if a property was built before or after the floodplain map was implemented by Valley for new development.

Adjacent Ground Elevation (feet) – The elevation of the adjacent ground of each structure, in feet to the National Vertical Datum of 1929. Obtained through field surveys by the Corps of Engineers. Included in report to determine if a property is above or below the base flood elevation.

Base Flood Elevation (feet) – The elevation of the base (100-year) flood event, in feet to the National Geodetic Vertical Datum of 1929. Included to show if the base flood is above or below the adjacent ground elevation for individual houses.

Elevation Difference – The relative height of the adjacent ground of the structure above or below the Base Flood Elevation. Included so the reader can determine the level of flood risk to their house. The more negative the number the greater the potential for flood damage during a 100-year flood event. Positive values indicate the structure is located above the base flood elevation. The equation used for this would be:
(Adjacent Ground Elevation) – (Base Flood Elevation)

APPENDIX B – SAMPLE PLAN UPDATE WORKSHEETS

Worksheet # 1: Progress Report

Progress Report Period: _____ (Date) to _____ (Date)

Project Title: _____ Project ID#: _____

Responsible Agency: _____

Address: _____

City/County: _____

Contact Person: _____ Title: _____

Phone #(s): _____ e-mail address: _____

List Supporting Agencies and Contacts: _____

_____

Total Project Cost: $_____ Anticipated Cost Overrun/Under run: _____

Date of Project Approval: _____ Start date of the project: _____

Anticipated completion date: _____

Description of the Project (include a description of each phase, if applicable, and the time frame for completing each phase).

_____
_____
_____
_____
_____

Milestones	Complete	Projected Date of Completion

Plan Goal(s)/Objective(s) Addressed:

Goal: _____

Objective: _____

Indicator of Success (e.g., losses avoided as a result of the acquisition program):
In most cases, you will list losses avoided as the indicator. In cases where it is difficult to quantify the benefits in dollar amounts, you will use other indicators, such as the number of people who now know about mitigation or who are taking mitigation actions to reduce their vulnerability to hazards.

_____
_____
_____

Status *(Please checks pertinent information and provide explanations for items with an asterisk. For completed or canceled projects, see Worksheet #2 — to complete a project evaluation):*

Project Status	Project Cost Status
(1) ☐ Project on schedule	(1) ☐ Cost unchanged
(2) ☐ Project completed	(2) ☐ Cost overrun* *explain: _____ _____
(3) ☐ Project delayed* *explain: _____ _____	(3) ☐ Cost under-run* *explain: _____ _____
(4) ☐ Project canceled	

Summary of progress on project for this report:

A. What was accomplished during this reporting period?

B. What obstacles, problems, or delays did you encounter, if any?

C. How was each problem resolved?

Next Steps: What is/are the next step(s) to be accomplished over the next reporting period?

Other comments:

Worksheet #2: Evaluating Your Planning Team

When gearing up for the plan evaluation, the planning team should reassess its composition and ask the following questions:

	YES	NO
Have there been local staffing changes that would warrant inviting different members to the planning team? **Comments/Proposed Action:**		
Are there organizations that have been invaluable to the planning process or to project implementation that should be represented on the planning team? **Comments/Proposed Action:**		
Are there any representatives of essential organizations who have not fully participated in the planning and implementation of actions? If so, can someone else from this organization commit to the planning team? **Comments/Proposed Action:**		
Are there procedures (e.g., signing of MOAs, commenting on submitted progress reports, distributing meeting minutes, etc.) that can be done more efficiently? **Comments/Proposed Action:**		
Are there ways to gain more diverse and widespread cooperation? **Comments/Proposed Action:**		
Are there different or additional resources (financial, technical, and human) that are now available for mitigation planning? **Comments/Proposed Action:**		

If the planning team determines the answer to any of these questions is "yes," some changes may be necessary.

Worksheet #3: Evaluate Your Project Results

Project Name and Number:

Project Budget:

Project Description:

Associated Goal and Objective (s):

Indicator of Success (e.g., losses avoided):

Insert location map

include before and after photos if appropriate

Was the action implemented?

IF YES ↓

What were the results of the implemented action?

IF NO ↓

Why not?

Was there political support for the action?	**YES**	**NO**
Were enough funds available?	**YES**	**NO**
Were workloads equitably or realistically distributed?	**YES**	**NO**
Was new information discovered about the risks or community that made implementation difficult or no longer sensible?	**YES**	**NO**
Was the estimated time of implementation reasonable?	**YES**	**NO**
Were sufficient resources (for example staff and technical assistance) available?	**YES**	**NO**

Were the outcomes as expected? **YES** **NO** **Additional comments or other outcomes:**
If No, please explain:

Did the results achieve the goal and objective (s)? **YES** **NO**
Explain how:

↓

Was the action cost-effective? **YES** **NO**
Explain how or how not:

What were the losses avoided after having completed the project?

If it was a structural project, how did it change the hazard profile?

Date _____

Prepared by: _____

Worksheet #4: Revisit Your Risk Assessment

Risk Assessment Steps	Questions	YES	NO	COMMENTS
Identify hazards	Are there new hazards that can affect your community?			
Profile hazard events	Are new historical records available?			
	Are additional maps or new hazard studies available?			
	Have chances of future events (along with their magnitude, extent, etc.) changed?			
	Have recent and future development in the community been checked for their effect on hazard areas?			
Inventory assets	Have inventories of existing structures in hazard areas been updated?			
	Are future developments foreseen and accounted for in the inventories?			
	Are there any new special high-risk populations?			
Estimate losses	Have loss estimates been updated to account for recent changes?			

If you answered "Yes" to any of the above questions, review your data and update your risk assessment information accordingly.

Worksheet #5: Revise the Plan

Prepare to update the plan.

When preparing to update the plan: **Check the box when addressed ✓**

1. Gather information, including project evaluation worksheets, progress reports, studies, related plans, etc. ☐
Comments:

2. Reconvene the planning team, making changes to the team composition as necessary (see results from *Worksheet #2*). ☐
Comments:

Consider the results of the evaluation and new strategies for the future.

When examining the community consider: **Check the box when addressed ✓**

1. The results of the planning and outreach efforts. ☐
Comments:

2. The results of the mitigation efforts. ☐
Comments:

3. Shifts in development trends. ☐
Comments:

4. Areas affected by recent disasters. ☐
Comments:

5. The recent magnitude, location, and type of the most recent hazard or disaster. ☐
Comments:

6. New studies or technologies. ☐
Comments:

7. Changes in local, state, or federal laws, policies, plans, priorities, or funding. ☐

8. Changes in the socioeconomic fabric of the community. ☐

Comments:

9. Other changing conditions. ☐

Comments:

Incorporate your findings into the plan.

When examining the plan: **Check the box when addressed ✓**

1. Revisit the risk assessment. ☐

Comments:

2. Update your goals and strategies. ☐

Comments:

3. Recalculate benefit-cost analyses of projects to prioritize action items. ☐

Comments:

Use the following criteria to evaluate the plan:

Criteria	YES	NO	Solution
Are the goals still applicable?			
Have any changes in the state or community made the goals obsolete or irrelevant?			
Do existing actions need to be reprioritized for implementation?			
Do the plan's priorities correspond with state priorities?			
Can actions be implemented with available resources?			

Comments:

APPENDIX C

Compendium of Public Meeting Documentation

Papio-Missouri River NRD
All-Hazards Mitigation Public Meeting

SIGN-IN SHEET

August 4, 2005 – 7 PM – Board Room
Natural Resources Center, 8901 S. 154th Street, Omaha, NE
(Please Print)

NAME & AFFILIATION	MAILING ADDRESS STERET - CITY/ZIP	TELEPHONE & EMAIL ADDRESS
LISA RINK SARPY CO. EMA	1210 Golden Gate Papillion, NE	593-5955 LRINK@SARPY.com
Sharon Whalen Papillion Tree Board	1125 Sally St papillion NE	537-0493 TWhalen2@cox.net
Sandra K. Powell City of Springfield	PO Box 189, 170 N. 3rd St Springfield, NE 68059	253-2204 cityofspringfield@charter.net
MIKE KENNELLY CITY of RALSTON	4918 So. 78th AVE RALSTON, NE 68127	592-0806 ofdcapt0298@aol.net
Joe Soucie City of La Vista	9900 Cornhusker La Vista NE 68128	331-8927 jsoucie@ci.la-vista.ne.us
Joseph Mastandrea Sarpy County EMA	1210 Golden Gate Dr Papillion NE 68046	593-5785 ema@sarpy.com
Marlin Petermann P-MRNRD	8901 S. 154th St Omaha NE 68138	402-444-6222 mpetermann@pmrnrd.org
Larry Lavelle Sarpy Co EM	1210 Golden Gate Dr Papillion NE 68046	593-2203 llavelle@sarpy.com
TED ARGINTEAN DOUGLAS CNTY-LEPC	PO Box 553 VALLEY, NE 68064-0553	402-677-8333 w/ VM
MARK STURSMA CITY OF PAPILLION	122 E. THIRD ST. PAPILLION, NE 68046	402.597.2060 mstursma@papillion.org

Douglas County meeting - Elkhorn High School, August 3rd 2005 7:00PM

Name	Community or Affiliation
Senator Gwen Howard	
RANDY BEHM	USACE
Mary Caffey valleymayor@dtnspeed.net	City of Valley
Jim Rogers	DCEMA
TROY PETERSON tpeterson@wsdx.com	VILLAGE OF WATERLOO
Chad Witt - chiefchad801@hotmail.com	Waterloo Fire Dept.
Louis L Kologenski llkolo@yahoo.com	Village of Washington Bon. Vol. Fire
Ron Woracek	Schemmer / Ralston / Fort Calhoun
Larry Brezikey	[illegible]
Phil Green	City of Blair
Jesse Robinson	City of Elkhorn
Stan Benke stan.benke@lymanrichey.com	Waterloo
Rick Kolowski	NRD
Paul Woodward	PMRNRD
Dorothy Lanphier	PMRNRD
Steve McMaster	NDNR

8/24/05 WASHINGTON/BURT COUNTY ALL-HAZARDS MITIGATION PLAN PUBLIC MEETING

NAME	Community Representing
MARY C. BEAVERS	TEKAMAH
Paul Woodward	PNRNRD
Gene Harris	Arlington
Rodon Stub	Arlington
Daryl Sheller	Blair - Wash Co Board
Duane Wilcox	Kennard - Wash Co Board
Kent Wilson	Blair - Wash. Co. Board
[signature]	Tekamah
[signature]	Tekamah
RAY POLLEY	HERMAN
JEFF QUIST	WASHINGTON CO BOARD
Barb Nichols	Omaha
[signature] Christopher Solberg	The Schemmer Associates

8/31/05
Dakota City
7 PM

THURSTON/DAKOTA COUNTY ALL-HAZARDS MITIGATION PLAN
PUBLIC MEETING

NAME	COMMUNITY OR INTEREST
Lance Hedquist	City of So. Sioux City
Paul Woodward	P-MRNRD
Randy Behm	Corps of Engineers
Don Newton	Thurston County
Corbet Dorsey	Homer
Darrin Brand	Homer

APPENDIX D

Community-Specific Mitigation Planning Information

This section contains mitigation planning information specific to each participating community. Communities are listed in alphabetical order. More detailed information for each community, including: disaster history for each hazard type, structural inventory, and desired mitigation alternatives – listed in order of highest priority to lowest. Local adoption documentation is provided on the page following the community's information.

Arlington

Disaster History

Flood

There are two potential flood sources which could impact Arlington: the Elkhorn River on the city's western boundary, and Bell Creek on the east. Comparing the two, Bell Creek offers much more flood risk. On the current effective Flood Insurance Rate Map, the Elkhorn floodplain covers the fairgrounds on the north side of Highway 30 on the west side of the city. Information for the Elkhorn River at Arlington indicates that flood events occurred on June 2, 1940; June 10-12, 1944; early April, 1960; June 21, 1960. However, it is unclear from these reports whether any damage was recorded in the city from these flood events – they could be merely stream gauge reports for the River. Of the four flood events listed above, the *City of Arlington Flood Insurance Study* hints that the 1944 flood was the worst.

Almost the entire reach of Bell Creek through Washington County was straightened between 1920 and 1940. This was done for various reasons related to agriculture and flood control. Farmers and land owners back then did not understand the implications of straightening a stream. As a result of the straightening, Bell Creek has developed severe problems with erosion and bank/channel cutting that continue to this day. There are also very few records of flooding for Bell Creek at Arlington. The only reliable information comes from the FEMA repetitive loss record, which lists one property that was flooded in 1996 and 1998. In addition, a residence was substantially damaged by a Presidentially-declared flood disaster (FEMA-DR-1286-NE) in August of 1999. Flood damage in all of Washington County from this event was estimated at $4 million. On June 14, 2000, Bell Creek flooded and reached the front yards of the most vulnerable properties. Therefore, it is safe to assume that Bell Creek threatens development much more frequently than the Elkhorn River.

Severe Weather

Hail of 2¾-inch diameter was recorded on June 20, 1996, with no further information available. Since 1994, the National Climatic Data Center lists six additional reports with hail at least ¾-inch diameter (severe thunderstorm).

Since 2000, the highest reported wind gust was reported to be 69 mph (60 knots) on May 9, 2001.

Severe winter weather reports are given by regional data, which shows that 23 reports of winter storms or excessive wind chill for the region since 2000.

Tornado

An F1 tornado touched down north of Arlington and damaged St. Paul's Lutheran Church and eight nearby farmsteads on June 20, 1996. Property damage was listed at $300,000.

Past Flood Mitigation Efforts

The City of Arlington participates and is in good standing in the National Flood Insurance Program. The first flood map for the City of Arlington became effective on December 17, 1973, and has been participating in the National Flood Insurance Program since June 11, 1975. The current effective flood insurance rate maps are dated November 23, 1982. Through FEMA's Flood Map Modernization program, the floodplain maps for Washington County are slated to be reviewed starting in 2008, with new countywide floodplain maps targeted to become effective in 2010.

A flood mitigation plan was competed for Arlington by the Nebraska Department of Natural Resources in November 2001. Also in 2001, one floodprone property in Arlington was acquired as a direct result of the federal disaster of 1999. This property was on FEMA's repetitive loss list and used to be located at 445 North 2nd Street in the Bell Creek floodplain.

In addition to the 445 North 2nd Street property, there are two more repetitive loss properties noted for Arlington in the 2005 list from FEMA.

Vulnerability Assessment

The structural inventory for Arlington is given following this report. Data shows the following:
# of structures blah blah blah
assessment values

As a portion of the approved flood mitigation plan, staff from the Nebraska Department of Natural Resources performed a field survey to determine the elevations for the ten structures in Arlington that are situated in the Bell Creek floodplain. This information was collected (elevation data are given in feet and is referenced to the National Vertical Datum of 1929):

Address	Structure Type	Ground Elevation	First floor Elevation	Lowest Entry
435 N 1st Street	House	1160.01	1162.51	
415 N 1st Street	Mobile Home	1159.78	1163.42	
120 Elm Street	House	1162.66	1164.06	
430 N 2nd Street	House	1163.21	1165.62	1162.95(E)
440 N 2nd Street	Mobile Home	1162.30	1164.41	
435 N 2nd Street	House	1164.51	1166.47	
450 N 2nd Street	House	1160.68	1162.59	1160.46(C)
455 N 2nd Street	Mobile Home	1160.65	1163.65	
460 N 2nd Street	House	1160.20	1162.34	
3rd & Ellsworth	Mobile Home	1160.31	1164.24	

(Note: "lowest entry" is the elevation that floodwater can first enter the structure. (E) denotes an entrance other than the main entrance to the structure and (C) is for a crawl space.)

According to panel 2 of the *Village of Arlington Flood Insurance Rate Map*, the 1% chance annual flood (100-year flood) level in this area of Arlington is approximately between 1168.1 and 1168.6 feet. This means that a flood of this magnitude will inundate these structures up to a depth of six feet on the first floor.

Mitigation Alternatives

GOALS: 1) Reduce or prevent future damage from natural hazard events,
2) Increase public safety

To address these goals, mitigation alternatives were suggested in the public meeting and prioritized by the Arlington City Council.

1) Maintain good standing in the National Flood Insurance Program
Objective 1: Continue to regulate development in floodplain areas
Funding sources and potential cost: No funding needed, no cost.

2) Reduce flood damage to structures in the Bell Creek floodplain, with Arlington's two repetitive loss properties as priority
Objective 2: Mitigate these properties through voluntary acquisition or elevation
- Action 2.1: There are ten flood-prone structures in Arlington (see structural inventory with floodplain overlay on the following pages). FEMA's repetitive loss list shows that there are currently two properties in Arlington. These properties should be given highest priority since they are the largest drain on the National Flood Insurance Program's insurance pool.

Funding sources and potential cost: FEMA's mitigation programs with the Papio NRD providing non-federal matching funds Usually about $6000 more than fair market value ($5000 for demolition and $1500 for legal fees such as title insurance, closing, deed preparation, etc.).

3) Perform a tornado shelter assessment
Objective 3: Determine which buildings offer adequate tornado protection
- Action 3.1: Study existing public buildings to see if they offer adequate tornado shelter. If buildings are found, they should be identified with proper signage so that citizens know where they can go during a tornado warning.

Funding sources: Pre-Disaster Mitigation funds through the FEMA – cost unknown

4) Perform a watershed study on Bell Creek
Objective 4: Determine specific ways to reduce flood flows in Bell Creek before it reaches Arlington
- Action 4.1: Determine appropriate placement of upstream dams and for wise use of channel and bank stabilization structures. The Washington County Highway Superintendent noted that they had spent $1.5 million on replacing bridges over Bell Creek since 1993 due to channel widening undermining the bridge foundations.

Funding sources and potential cost: Papio NRD, Natural Resources Conservation Service – approximate cost $50,000

5) Construction options to reduce flows or prevent further erosion

Objective 5.1: Construct small upland dams

- Action 5.1: One of the most common ways to reduce flood flows is to build several small dams which are situated on tributaries or on the main stem of the stream higher up in the watershed. Cumulatively, these small upstream dams may be able to hold back as much water as a larger dam downstream with the additional benefit of reducing erosion on the tributaries.

Funding sources and potential cost: Variable depending on size and engineering needed – would be determined by watershed study.

Objective 5.2: Construct grade stabilization structures

By removing the curves and meanders when Bell Creek was straightened in the 1920-1940s, the creek became shorter and steeper (the same elevation to drop, but in less stream length). This means that the creek has been seeking equilibrium by downcutting its channel and laterally eroding its banks ever since. This process began as soon as the straightening was completed and will continue until the creek reaches equilibrium. With the large expenditure for bridge replacements since 1993, it is clear this process is far from over.

- Action 5.2: One of the most common forms of grade stabilization structures is called a "drop structure." A drop structure is essentially a wall built across the bottom of the channel of a creek that is low enough that it will not function as a dam, is grounded deep enough that channel erosion will be halted as it moves upstream, and is strong enough that flood flows will not wash it away. A watershed study would determine the best places to put these drop structures.

Funding sources and potential cost: Grade and bank stabilization projects on Skull Creek in Butler County cost about $50,000 per site.

Objective 5.3: Bank Stabilization Structures

The deeper the channel cuts, the more unstable the banks become. A stream under equilibrium will have a stable channel and banks with a consistent slope. On the other hand, when the channel of the stream is unstable and actively eroding the banks, the stream banks are often nearly vertical.

- Action 5.3: One option would be to stabilize the banks to help prevent further erosion. Another option would be to excavate the bank so that the banks would not be so steep; however, in this watershed this option would mean removing land from agricultural production. Bank stabilization could be done in combination with grade stabilization to effectively halt both kinds of stream erosion at the same time. A watershed study would determine the best places to stabilize the banks.

Funding sources and potential cost: Varies by site and design

Funding sources:

1) Natural Resources Conservation Service (NRCS) is the agency most suited for this type of watershed study.

2) The Papio-Missouri River Natural Resources District could assist with funding for erosion structures.

6) Allow flood flows to move unimpeded to the Elkhorn River

Objective 6: The railroad bridge and Highway 30 bridges in close proximity to each other were viewed as impeding the flow of Bell Creek, especially when debris was trapped at either location.

- Action 6.1: To determine if this is true, a hydraulic analysis of both bridges together will be needed.

Funding sources and potential cost: Source unknown, cost unknown

Blair

Disaster History

Flood

With its proximity to the Missouri River, reports of flooding at Blair date back to the late 1800s. More detailed flood records, however, start with the Missouri River flood of April 1-13, 1943. At the height of this event, the River was fifteen miles wide from Decatur to Onawa, Iowa. A flood of such a magnitude would have surely inundated low-lying properties between Blair and the Missouri River. The flood of record for the Missouri River at the Omaha stream gage took place on April 18, 1952, when the river crested at 23.15 feet (flood stage is 18 feet). The Missouri River main-stem dams were completed at operational starting in 1954, which greatly reduced the flood peaks. As a result, Blair has not seen significant flooding from the Missouri River since the mid-50s.

Aside from the Missouri River, there are three other watercourses which could cause flooding in or around Blair: Cameron Ditch, Unnamed Creek, and Cauble Creek. Cameron Ditch is a combination of drainage ditch and levee which was constructed to drain the flat topography east of the Missouri River bluff line. Since it runs north-to-south through Burt County and Washington County, it drains a relatively large area. Cameron Ditch and Unnamed Creek join approximately one-half of a mile upstream of where the it flows into the Missouri River.

Unnamed Creek flows mostly west-to-east along the southern side of Blair. Its path has been changed to flow around and old landfill before it joins with Cameron Ditch. Unnamed Creek does not have an especially large drainage area; however, the topography in the basin is steep, which tends to create more of a flash flood scenario.

Cauble Creek flows in a mostly south-to-north path on the western side of Blair. Cauble Creek flows north of Highway 73 a little more than one mile before it joins Cameron Ditch. On June 14, 2001, heavy rains caused flash flooding that briefly closed Highway 75. The primary hazard related to Cauble Creek is erosion instead of flooding. One property on Cauble Creek was acquired with FEMA funds in 2001 because the erosion hazard was in danger of undermining the structure. Like Unnamed Creek, the drainage basin for Cauble Creek is not large, but the topography in the basin creates flash floods. This type of flooding may still not directly impact structures, but does exacerbate the erosion problem.

The last time Washington County was declared a federal disaster area due to flooding was in 1999. Residences in Blair sustained primarily basement and garage flooding as a result of this event, which dropped over 10 inches of rain overnight in north Omaha, up to north of Tekamah. Areas that sustained the damage were in the older parts of the City which have the older sewers – areas around the intersection of Highway 75 and 30, and from Washington Street to the south.

There are no repetitive loss properties in Blair.

Through FEMA's Flood Map Modernization program, the floodplain maps for Washington County are slated to be reviewed starting in 2008, with new countywide floodplain maps targeted to become effective in 2010.

Severe Weather

Blair has some of the largest car dealerships in the country, so hail storms can have the biggest financial impact of all the severe weather related hazards. On May 22, 2004, hail up to baseball size fell in Blair and west through south of town. The hail caused extensive damage to cars and at least two large car dealerships were hit with over 4500 cars damaged. Houses and trees in town were also damaged and Dana College sustained $1 million in damage in broken windows, skylights, and vents. Two hundred windows were broken on campus. The total figure of $10 million in damage was from eastern Dodge County into Washington County, with over half of it likely in Washington County around and in the Blair area.

Since detailed community-specific reports were made available by the National Climatic Data Center in 1993, the highest reported wind speed was 81 mph (70 knots) on May 15, 1998. On April 6, 2001, Dana College sustained major roof damage estimated at $75,000. On this day, winds were sustained at 40-50 mph, gusting to over 60 mph. On July 12, 2004, thunderstorm wind gusts over 70 mph downed numerous trees and power lines in town, especially on the north side of town. Damage was estimated at $100,000 as branches fell on homes and vehicles. Power was out for 24 hours, the Cargill plant lost power for three hours, and the water plant had no electricity for 48 hours. On May 10, 2005, a thunderstorm wind gust of 70 mph was measured at Eagle Field, about six miles south of Blair.

Lightning killed one and injured another as they were jogging outside on June 22, 1994. Lightning also caused $35,000 in unspecified damages on May 31, 1996.

Severe winter weather reports are given by regional data, which shows that 24 reports of winter storms or extreme windchill for the region since 2000. The snow/ice storm of 1997 affected Blair's urban forest, but not to the extent of Omaha and Lincoln. Multiple snow storms in February 2004 led to concerns about access to emergency services and the drain on the City's resources. However, all emergency services remained operational.

Tornado

No tornadoes have been found to have directly-impacted Blair. However, on May 24, 1998, there was a report of a funnel cloud five miles west of Blair.

Dam Failure

There are no regulated dams or reservoirs upstream of the Blair city limits.

Drought

There has been a sustained drought impacting the entire Missouri River basin, including the City of Blair. The City has already noticed an increased cost for pumping water and maintenance. Half of one intake structure at the City's water plant has been exposed due to dropping water levels, which exposes the intake structure to freezing in addition to the drought danger. If the drought continues and water levels continue to decline, a lower intake structure will need to be installed at the City's water plant. This would allow the existing users of the City's water system to continue to use and drink good water.

Past Hazard Mitigation Efforts

The City of Blair participates and is in good standing in the National Flood Insurance Program. Initial identification for Blair's Flood Hazard Boundary Map was finalized on June 21, 1974, and was revised on April 23, 1976. This map was converted to a Flood Insurance Rate Map on July 16, 1981, and revised on July 17, 1995, which is the current effective floodplain map. Through FEMA's Flood Map Modernization program, the floodplain maps for Washington County are slated to be reviewed starting in 2008, with new countywide floodplain maps targeted to become effective in 2010.

As mentioned above, a residence on Cauble Creek was acquired and demolished in 2001 because it was in danger of having its foundation undermined by erosion.

Blair has snow routes identified, which allows more efficient use of City resources for snow clearing and keeps access open for emergency vehicles and commercial traffic.

City personnel reports that the tornado siren system has been upgraded and improved.

Blair has a city ordinance which requires new mobile home parks to have a tornado shelter.

Vulnerability Assessment

The intent was to use the HAZUS software to assist with the vulnerability assessment for Blair since it would take a considerable amount of time to conduct fieldwork and drive every street in community of this size. However, due to technical difficulties, the HAZUS analysis was not able to be completed within the grant period. As a result, NDNR contacted the Washington County Assessor, who was able to provide an estimate of 2,396 residences and 323 commercial properties. Additional property classes were not available. If needed, the structural inventory will be provided in the plan's update in five years and is identified as a mitigation action below.

For 2005, the Nebraska Department of Property Assessment and Taxation has a total valuation of $384,213,450 for Blair. This figure is broken out into the following property classes:

Residential real property:	$278,424,265	(72.5% of valuation)
Commercial real property:	$ 80,290,955	(20.9%)
Comm/Ind private property:	$ 12,128,984	(3.2%)
Public Service Co personal:	$ 5,940,041	(1.5%)

Industrial real property:	$	4,496,510	(1.2%)
Railroad real property:	$	1,826,371	(0.5%)
Public Service Co real:	$	736,124	
Railroad personal:	$	352,903	
Agricultural equip personal:	$	17,297	

Mitigation Alternatives

1) Complete the structural inventory for the next Papio NRD plan update.
Objective 1: Have a more reliable structural inventory and to meet the federal requirements for the vulnerability assessment
- Action 1.1: Complete the structural inventory for Blair

Funding sources and potential cost: If completed by the NDNR, then there will be no cost.

GOALS: 1) Reduce or prevent future damage from natural hazard events, 2) Increase public safety

To address these goals, mitigation alternatives were suggested in the public meeting and prioritized by the Blair City Council.

2) Maintain good standing in the National Flood Insurance Program
Objective 2: Continue to regulate development in floodplain areas
Funding sources and potential cost: No funding needed, no cost.

3) Reduce impacts of stormwater problems
Objective 3: Complete a drainage study
- Action 3.1: A drainage study is needed in Blair for three reasons: 1) to better delineate floodplains and floodways, 2) to help the City map future stormwater needs, identify where their infrastructure is weak, and identify ways to address these weaknesses, and 3) to identify good flood mitigation projects.

Funding sources and potential cost: Papio-Missouri River NRD, Community Development Block Grant, City – cost varies on scope, but expect $25,000 minimum

4) Reduce flood damages through non-structural mitigation methods
Objective 4: Increase public safety by reducing flood damages
- Action 4.1: Floodproof existing homes which sustain basement or other flood damage
- Action 4.2: Buyout and removal of the most flood-prone structures, with cleared area to be retained as public open space
- Action 4.3: Flood warning system to alert citizens with assets in flood-prone areas

Funding sources and potential cost: cost varies by technique and structure to be mitigated – funding available from FEMA's mitigation programs with the Papio NRD as potential provider of a portion of the non-federal cost share

5) Increase channel capacity of area creeks

Objective 5: Keep flowage rates at its current level. If discharge increases from current levels, the floodplain will expand into residential neighborhoods.

- Action 5.1: Develop a stormwater management ordinance

Funding sources and potential cost: No funding required in the development of an ordinance. Technical assistance is available through the Nebraska Department of Natural Resources and Nebraska Floodplain and Stormwater Managers Association.

- Action 5.2: Clear and grub creeks

Funding sources and potential cost: Papio NRD, City, FEMA – average cost for channel clearing has a range of costs from $6000 to $10,000 per 1000 linear feet

- Action 5.3: Initiating an annual maintenance schedule in conjunction with the Papio NRD and with the local irrigation and drainage district to prevent the capacity of creeks from diminishing over time.

Funding sources and potential cost: No cost to develop a maintenance schedule

- Action 5.4: Increase capacity of the constrictions on creeks at bridge or culvert crossings by reconstructing them with larger spans and by excavating a larger cross-section under the bridges.

Funding sources and potential cost: Unknown cost. Roads with the bridges and culverts may be city-, county-, or state-owned.

6) Ensure consistent water intake at Blair's water plant despite drought threat

Objective 6: Install a lower intake structure at the City's water plant.

- Action 6.1: Apply for assistance from Nebraska Drinking Water State Revolving Loan Fund Program, City of Blair, or Papio-Missouri River Natural Resources District

Potential cost: A lower intake structure was installed in Kansas City for $250,000

7) Identify and designate additional tornado shelters, publicize the locations of all public tornado shelters to increase public awareness – perhaps with a sign on the building.

Objective 7: Provide emergency shelter(s) to which local residents would evacuate in the event of a tornado warning

- Action 7.1: Perform an assessment of existing structures to determine their capability to be used as tornado shelters
- Action 7.2: Create public shelters by retrofitting or new construction. FEMA has retrofitted schools and constructed all-new shelters in several places in the Midwest. However, most tornadoes occur in late-afternoon to early evening when a school might be closed for the day. Furthermore, it has been reported that public tornado shelters that are left open to the public are not used properly, with vandalism and use by vagrants as problems. At-risk structure types include mobile homes and slab-on-grade construction which has no basement.
- Action 7.3: Consider constructing tornado shelters for vulnerable construction like manufactured home concentrations.

Funding sources and potential cost: FEMA's Pre-Disaster Mitigation program – cost uncertain

8) Determine Blair's susceptibility to tree problems

Objective 8: Complete a tree inventory with assistance from the Nebraska Forest Service

- Action 8.1: Write to the Nebraska Forest Service and request a tree inventory. An inventory is especially helpful in mitigation planning for communities which experience regular tree-related damages. An inventory can identify problem trees and recommend changes to the way a community administer a local tree management program (i.e., through a Tree Board or Park Board).

Funding sources and potential cost: Free

9) Ensure on-site emergency power generating capacity for major employers and critical facilities

Objective 9: Work with major employers and critical facility owners to assess their capability to function in the event of a prolonged power outage. The wind storm of July 2004 knocked out power to the water plant for 48 hours, which could have created public health and safety problems. Also, Cargill (Blair's number-one employer) was without power for three hours.

- Action 9.1: Although the City of Blair has a good working relationship with the local public power provider, critical facilities and major employers should examine the need and cost of purchasing emergency power generators.

Funding sources and potential cost: City of Blair, local businesses, Department of Homeland Security grant – cost varies

10) Remove snow from large events to allow normal and emergency traffic to move

Objective 10: Return local traffic flow as soon as possible following a large snow event

- Action 10.1: In combination with the City's snow clearing plan, purchase "Emergency Snow Route" signage and enforce street parking regulations so that the streets can be cleared as quickly and efficiently as possible

Funding sources and potential cost: Minimal cost to the City for signage

Burt County

Disaster History
County-specific disaster histories are given for each hazard type in Chapter 2.

Past Hazard Mitigation Efforts
Burt County currently does not participate in the National Flood Insurance Program. Through FEMA's Flood Map Modernization program, the floodplain maps for Burt County are slated to be reviewed starting in 2009, with new countywide floodplain maps targeted to become effective in 2010.

Mitigation Alternatives

Vulnerability Assessment

Mitigation Alternatives

Dakota County

Disaster History
County-specific disaster histories are given for each hazard type in Chapter 2.

There are no repetitive loss properties in Dakota County.

Past Hazard Mitigation Efforts
Dakota County participates and is in good standing in the National Flood Insurance Program. The initial identification for Dakota County's floodplain maps was completed on June 28, 1977, and the Flood Insurance Rate Map became effective on April 15, 1982.

Mitigation Alternatives

Vulnerability Assessment

Mitigation Alternatives

GOALS: 1) Reduce or prevent future damage from natural hazard events,
2) Increase public safety

To address these goals, mitigation alternatives were suggested in the public meeting and prioritized by the Dakota County Board.

1) Maintain good standing in the National Flood Insurance Program
Objective 1: Continue to regulate development in floodplain areas
Funding sources and potential cost: No funding needed, no cost.

2) Remap Dakota County's floodplains
Objective 2: Ensure local floodplain ordinance is regulating an accurate floodplain
- Action 2.1: Through FEMA's Flood Map Modernization program, the floodplain maps for Dakota County are slated to be reviewed starting in 2008, with new countywide floodplain maps targeted to become effective in 2010.

Funding sources and potential cost: No cost – mapping to be completed by the Nebraska Department of Natural Resources

3) Upgrade problem Dakota County bridges
Objective 3: Increase the ability of vulnerable county bridges to withstand flooding
- Action 3.1: Mitigate county road bridges which restrict flood flows and cause flood damage to the road, bridge, and surrounding land and development. **Figure 1** shows the locations of bridges that the Dakota County Highway Superintendent would like to mitigate if funding were available. The numbers adjacent to the dots are the chronological order of priority given by the Highway Superintendent. In these cases, the mitigation action would be to reconstruct the bridge to increase the

span, which would prevent flood flows from eroding bridge approaches and would allow flood flows to pass unimpeded under the bridge.

By number (See Figure 1), the bridge improvements are:

#1: Elma Road at Omaha Creek, 2½ miles east of Homer

#2: 200th Street at Pigeon Creek, 5 miles east of Hubbard and 4 miles northwest of Homer

#3: Q Avenue at Elk Creek, 2½ miles northwest of Hubbard

Funding sources and potential cost: Public Assistance funds from FEMA following a federally-declared disaster for Dakota County – cost varies by project and scope

Douglas County

Disaster History
County-specific disaster histories are given for each hazard type in Chapter 2.

There are 17 repetitive loss properties identified for Douglas County in FEMA's 2005 Repetitive Loss List.

Past Hazard Mitigation Actions
Douglas County participates and is in good standing in the National Flood Insurance Program. The initial identification for Douglas County's floodplain maps was completed on July 26, 1974, and the Flood Hazard Boundary Map became effective on August 2, 1977. The floodplain maps were upgraded to a Flood Insurance Rate Map which became effective on January 16, 1981. Through FEMA's Flood Map Modernization program, new countywide floodplain maps for Douglas County were made effective on December 2, 2005.

Vulnerability Assessment

Mitigation Alternatives

GOALS: 1) Reduce or prevent future damage from natural hazard events,
2) Increase public safety

To address these goals, mitigation alternatives were suggested in the public meeting and prioritized by the Douglas County Board.

1) Maintain good standing in the National Flood Insurance Program
Objective 1: Continue to regulate development in floodplain areas
Funding sources and potential cost: No funding needed, no cost.

2) Upgrade problem Douglas County bridges
Objective 2: Increase the ability of vulnerable county bridges to withstand flooding
- Action 2.1: Mitigate county road bridges which restrict flood flows and cause flood damage to the road, bridge, and surrounding land and development. **Figure 1** shows the locations of the bridge that the Douglas County Engineer would like to mitigate if funding were available. It is for the Q Street bridge which crosses the Elkhorn River. The propose mitigation solution would be to increase the span length and to construct bank protection to keep the River from washing out the approaches to the bridge. In addition, 245th Street south of Q Street in this same area needs to be protected from the Elkhorn River – it runs parallel to the River and is in danger of being washed out from high-flow events.

Funding sources and potential cost: Public Assistance funds from FEMA following a federally-declared disaster for Douglas County – cost varies by project and scope

3) Mitigate Douglas County's repetitive loss properties

Objective 3: Increase public safety and prevent a further drain on the National Flood Insurance Program

- Action 3.1: Mitigate future flood losses through acquisition or elevation projects.

Funding sources and potential cost: FEMA's mitigation programs like the Hazard Mitigation Grant Program, Flood Mitigation Assistance program, Pre-Disaster Mitigation program, and Severe Repetitive Loss Mitigation Program can be used. Cost would vary by individual parcel being mitigated.

Elkhorn

Disaster History

Flood

The *City of Elkhorn Flood Insurance Study* reports that the only significant riverine flood on the West Papillion Creek occurred in June of 1964. In this flood event, water was reported to have been two feet over the railroad tracks and three feet deep at the intersections of Blondo Street and Main Street.

Elkhorn is growing quickly, which often presents stormwater management problems which need to be addressed.

Elkhorn has no repetitive loss properties.

Severe weather

Based on statistics from the National Climatic Data Center, hail and high winds seem to be the most frequent severe weather phenomena to impact Elkhorn. Since 2000, there have been ten recorded events whereby large hail of at least ¾-inch diameter has been observed. The more significant events are:
On May 17, 1996, 2 ¾-inch hail caused $200,000 in damage to property, vehicles, and plants. On June 20, 1996, 1 ¾-inch hail caused an estimated $2000 damage to car windows. On April 30, 2001, 2 ¼-inch hail fell, but there were not reports of damage given.

Since 2000, there have been six reports of high winds which have exceeded 60 mph in Elkhorn. On May 15, 1998, thunderstorm winds of 78 mph (68 knots) caused significant tree damage and widespread power outages. October 1, 2002, 75 mph (65 knots) thunderstorm winds downed trees in and around Elkhorn. On April 18, 2004, 78 mph winds caused damage to construction sites and caused minor roof damage to residences.

On April 22, 2001, lightning struck a garage and caused extensive damage. Smoke and water damage totaled $165,000.

Severe winter weather reports are given by regional data, which shows that 23 reports of winter storms or extreme windchill for the region since 2000. The snow/ice storm of 1997 affected Elkhorn's urban forest, but not to the extent of Omaha and Lincoln.

Tornado

There are no reports for tornadoes to have directly-impacted Elkhorn.

Dam Failure

There are no regulated dams or reservoirs which could impact the Elkhorn corporate limits.

Drought

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Past Hazard Mitigation Efforts
The City of Elkhorn participates and is in good standing in the National Flood Insurance Program. The initial identification for Elkhorn's Flood Hazard Boundary Map was finalized on March 22, 1974, and was updated on April 16, 1976. This map was converted to a Flood Insurance Rate Map on August 15, 1979. Through FEMA's Flood Map Modernization program, new countywide floodplain maps for Douglas County were made effective on December 2, 2005, and is the current effective floodplain map.

Vulnerability Assessment

Mitigation Alternatives

GOALS: 1) Reduce or prevent future damage from natural hazard events,
2) Increase public safety

To address these goals, mitigation alternatives were suggested in the public meeting and prioritized by the Elkhorn City Council.

1) Maintain good standing in the National Flood Insurance Program
Objective 1: Continue to regulate development in floodplain areas
Funding sources and potential cost: No funding needed, no cost

Fort Calhoun

Fort Calhoun has an adopted flood mitigation that was approved by the Federal Emergency Management Agency on August 13, 2002. The flood portion of this all-hazards plan is taken directly from the flood mitigation plan.

Disaster History

Flood

The *City of Fort Calhoun Flood Insurance Study* has an extensive history of Missouri River flooding at Fort Calhoun. While the Missouri River floodplain may take up a portion of the City's extra-territorial zoning boundary, the community is situated on higher ground in between the bluffs and the flatland. The primary risk of flooding comes from an unnamed tributary of the Missouri River which drains the bluffs above town, then flows west to east through town along its southern edge. There is another drainage which joins this unnamed tributary from the north at about 9th & Madison Streets. The risk for flooding for these two tributaries is from extreme rainfall events which overwhelm the City's drainage system.

Such an event occurred on August 6, 1999, when approximately 9.29 inches of rain fell in a twenty-four hour period. This event was declared a federal disaster area and was given the disaster number FEMA-1286-DR-NE. During this flood event, one residence was substantially damaged and was later acquired and demolished.

Fort Calhoun has four repetitive loss properties according to the 2005 Repetitive Loss List provided by FEMA. However, as researched and verified as a portion of the Fort Calhoun flood mitigation plan, all four properties should be reclassified to be in Washington County. All four properties are located in the "Anderson's Cabins" manufactured home area in the Missouri River bottomland floodplain outside of Fort Calhoun's zoning jurisdiction, approximately 1.5 miles northeast of the City.

Severe Weather

On October 1, 2002, thunderstorm downburst winds produced a 5- to 6-mile wide path of damage from around 5 miles southwest of Fort Calhoun into the Fort Calhoun area. Winds with this damage path were estimated by the National Weather Service to be perhaps around 100 mph. The winds caused extensive tree damage and also destroyed a house just northwest of Fort Calhoun, causing two minor injuries. Windows were blown out by the wind, and the wind-driven hail also caused substantial window, roof, and siding damage. An estimated 85 percent of all homes in town damaged to some degree. One woman required emergency room treatment after being caught out in the open and pelted with quarter-sized hail. The storm caused an estimated $3 million worth of damage.

The storm detailed above has the highest estimated wind speed recorded for Fort Calhoun. Since 1993, the National Climatic Data Center has recorded an additional four reports of winds exceeding the 60 mph severe thunderstorm threshold: April 14, 1994

(65-70 mph recorded at the nuclear power plant), April 14, 1998 (no speed given, but caused $15,000 damage to area pole barns), May 15, 1998 (80 mph recorded – no damage figure given, but caused tree damage, tore metal roofs from sheds, and moved grain bins), and May 8, 2004 (60 mph winds damaged trees and a power pole in town, and a few residential windows were broken).

Since 1993, the eight recorded hail events in excess of ¾-inch diameter were: April 14, 1998 (1 inch); May 24, 1998 (1¼ inch); June 26, 1998 (1 inch); June 13, 2000 (1¾ inch); May 9, 2001 (¾ inch); August 22, 2002 (1 inch); September 25, 2002 (¾ inch); and October 1, 2002 (2 inch).

Severe winter weather reports are given by regional data, which shows that 24 reports of winter storms or extreme windchill for the region since 2000. The snow/ice storm of 1997 affected Fort Calhoun's urban forest, but not to the extent of Omaha and Lincoln.

Tornado
There are no known instances of tornadoes directly impacting Fort Calhoun.

Dam Failure
There are no upstream regulated dams which would have an impact on the unnamed tributaries flowing through Fort Calhoun.

Drought

Past Hazard Mitigation Efforts
The City of Fort Calhoun participates and is in good standing in the National Flood Insurance Program. The initial identification for Fort Calhoun's Flood Hazard Boundary Map was finalized on July 25, 1975. This map was converted to a Flood Insurance Rate Map on December 1, 1983, and revised on May 16, 1995. This is the date of the current effective floodplain map. Through FEMA's Flood Map Modernization program, the floodplain maps for Washington County are slated to be reviewed starting in 2008, with new countywide floodplain maps targeted to become effective in 2010.

The address for the property that was substantially damaged in the 1999 flood was 203 South 9th Street. Flood Mitigation Assistance project funds from the Federal Emergency Management Agency (FEMA) were used to acquire and demolish this residence. The deed restriction which accompanies all voluntary FEMA buyout projects means that this area will be kept as undeveloped open space in perpetuity.

Vulnerability Assessment

Mitigation Alternatives

GOALS: 1) Reduce or prevent future damage from natural hazard events,
2) Increase public safety

To address these goals, mitigation alternatives were suggested in the public meeting and prioritized by the Fort Calhoun City Council.

1) Maintain good standing in the National Flood Insurance Program
   Objective 1: Continue to regulate development in floodplain areas
   Funding sources and potential cost: No funding needed, no cost

Herman

Disaster History

Flood

Historic flood events on New York Creek in Herman's zoning jurisdiction go back to June 11, 1944 and July 15, 1950, but no specific damage narratives are available. On June 8, 1998, some homes southwest of Herman were flooded because of an intense summer storm. Water flowed eight to twelve inches deep over Highway 75. No damage report was available.

Herman has no repetitive loss properties.

Severe Weather

On September 2, 2000, thunderstorm winds estimated at 60 mph caused an estimated $3000 in damage to outbuildings near Herman. On June 18, 2001, thunderstorm wind gusts over 60 mph caused extensive tree damage, but no financial estimates were available. Thunderstorm wind gusts downed power lines near Herman on April 16, 2002. Hail with a diameter of 1¾ inches fell in Herman on April 17, 2002, but no damage estimates were available. All together, since 1993 there have been three reports of large hail (at least ¾-inch) and three reports of damaging winds over 60 mph. Severe winter weather reports are given by regional data, which shows that 24 reports of winter storms or extreme windchill for the region since 2000.

Tornado

Reports indicate that most of the entire Village of Herman was leveled by a tornado on June 13, 1899. The downtown was completely demolished, and 13 people were killed.

Dam Failure

There are no regulated dams or reservoirs which could impact the Village of Herman corporate limits.

Drought

Past Hazard Mitigation Efforts

Vulnerability Assessment

Mitigation Alternatives

GOALS: 1) Reduce or prevent future damage from natural hazard events,
2) Increase public safety

To address these goals, mitigation alternatives were suggested in the public meeting and prioritized by the Herman Village Board.

1) Maintain good standing in the National Flood Insurance Program

Objective 1: Continue to regulate development in floodplain areas. Washington County is currently slated to be mapped for floodplains starting in 2008, with the maps becoming effective in 2010.

Funding sources and potential cost: No funding needed, no cost.

Homer

Disaster History

Flood

The flood threat for Homer comes from Omaha Creek, which has caused serious flooding in the past. In a report written in 1949, the Corps of Engineers identified 24 floods: 5 major, 8 moderate, and 11 minor. The worst of these floods occurred on June 3, 1940, but no records of heights of damage could be found. At 51,000 cubic feet per second, the volume of this flood was greater than a 500-year flood. The next most severe flood took place on May 31, 1922, and Omaha Creek flooded to a depth of 8 feet. A report from local newspapers state that the entire Village was evacuated during the record flooding on the Missouri River in April of 1952.

There are no repetitive loss properties in Homer.

Severe Weather

On July 14, 1995, 60 mph thunderstorm winds blew down some small trees, causing an estimated $5000 in damage. On June 29, 1998, 60 mph winds caused tree damage with 3-inch diameter limbs being torn from trees. 70 mph thunderstorm winds caused $20,000 in Homer when trees and grain elevators on a farm were damaged. On August 18, 2003, thunderstorm winds estimated at 70 mph caused tree damage, including one tree which fell on a house, causing $10,000 in damage. Thunderstorm winds estimated at 70 mph caused tree damage on May 21, 2004.

Although severe thunderstorms drop hail in Homer every year, there have been only three large hail (classified as ¾-inch diameter or greater) reports since 1993:
June 20, 1996; April 30, 2001; May 21, 2004 – all three reports were for 1¾-inch hail.

Severe winter weather reports are given by regional data, which shows that 16 reports of winter storms or extreme windchill for the region since 2000.

Tornado

There are no records to indicate that a tornado has ever directly struck Homer.

Dam Failure

There are no regulated dams or reservoirs which could impact the Village of Homer corporate limits.

Drought

Past Hazard Mitigation Efforts

The Village of Homer participates and is in good standing in the National Flood Insurance Program. The initial identification for Homer's floodplain map took place on September 6, 1974. The flood hazard boundary map was revised on June 4, 1976, and

this map was converted to a Flood Insurance Rate Map on April 3, 1984. This map was revised on June 18, 1996, and is the date of the current effective floodplain map.

Vulnerability Assessment

Mitigation Alternatives

GOALS: 1) Reduce or prevent future damage from natural hazard events,
2) Increase public safety

To address these goals, mitigation alternatives were suggested in the public meeting and prioritized by the Homer Village Board.

1) Maintain good standing in the National Flood Insurance Program
Objective 1: Continue to regulate development in floodplain areas
Funding sources and potential cost: No funding needed, no cost.

The floodplain and floodway of Omaha Creek cover much of Homer, especially the downtown area. These flood designations are making it very difficult for the community to grow spatially and economically. According to the *Village of Homer Flood Insurance Study*, Omaha Creek drains an approximate area of 200 square miles in Thurston County and Dakota County. The problem is that at Homer, drainage for this entire watershed needs to squeeze through a narrow gap of the Missouri River bluff line on its way to the Missouri River. There is a broad range of potential alternatives to change this situation, including doing nothing. However, the remainder of the alternatives addressed below are for potential projects that could be completed to reduce the floodplain, protect the town, or just keep the flood situation from getting worse over time.

2) Remap floodplain in Homer
Objective 2: Ensure local floodplain ordinance is regulating an accurate floodplain
- Action 2.1: Through FEMA's Flood Map Modernization program, the floodplain maps for Dakota County are slated to be reviewed starting in 2008, with new countywide floodplain maps targeted to become effective in 2010.

Funding sources and potential cost: No funding needed, no cost.
- Action 2.2: The City could undertake a flood study of its entire floodplain or specific problem areas with its own funds or with funding assistance from a community assistance funding source like the Community Development Block Grant program offered from the Nebraska Department of Economic Development.

3) Complete a comprehensive flood mitigation study
Objective 3: Assess the options and potential costs for different flood reduction techniques – this option will allow for a more detailed analysis
- Action 3.1: Contact the Corps of Engineers Omaha District and request a Section 22 Planning study for flood damage reduction on Omaha Creek

Funding sources and potential cost: Corps of Engineers, 50% cost-shared

4) Increase the capacity of Omaha Creek

Objective 4: Allow Omaha Creek to carry more water and to shrink the floodplain

- Action 4.1: Channelize Omaha Creek to give it a consistent bank slope. This option will be very expensive because the channelization would need to be completed from Fiddlers Creek or Wigle Creek at least to the intersection of Highway 77, and potentially to the Missouri River, which is approximately 7.3 stream miles downstream of Highway 77. This option may also put Homer's water treatment plant at risk.

Funding sources and potential cost: Corps of Engineers, Natural Resources Development Fund, Community Development Block Grant, Papio NRD. Cost: varies greatly by scope and design, but likely well over $1 million.

- Action 4.2: Clear debris, clean and grub Omaha Creek

Funding sources and potential cost: Papio NRD, city, county – estimates of cost range from $6000 to $10,000 per 1000 linear feet

5) Retain more floodwater in watershed upland areas

Objective 5: Reduce flood flows on Omaha Creek

- Action 5.1: Construct upstream dams on tributaries to Omaha Creek

Funding sources and potential cost: Papio NRD, Natural Resources Conservation Service, Natural Resources Development Fund, county highway departments – cost varies depending on number of dams and design.

6) Physically protect Homer from Omaha Creek flooding

Objective 6: Reduce or eliminate flooding and floodplain area in Homer

- Action 6.1: Due to the narrow distance between Omaha Creek and Village of Homer development, a floodwall is the only feasible structural flood control measure. If this option were to be built, it would likely push more floodwater on to Homer's water treatment plant. In addition, there may be other induced damages on the east side of the Creek which may need to be covered by an easement as a portion of the project cost. There appears to be adequate high ground on both the north and south sides of Homer to which a floodwall could be connected.

Funding sources and potential cost: Corps of Engineers, Papio NRD, Natural Resources Development Fund – cost varies depending on scope and design, but it could cost as much as $1000 per linear foot for an engineered floodwall

Jackson

Disaster History

Flood

Newspaper reports indicate that half of Jackson was inundated by Elk Creek due to heavy rains on June 19, 1951. A late-season ice jam on Elk Creek lead to 15 to 25 families needing to be evacuated on March 25, 1962. On July 16, 1996, heavy rain of 6 to 10 inches caused flash flooding of lowlands and creeks in northern and eastern Dakota County. Widespread basement flooding was reported, and property damage from flooding and hail was estimated at $1 million in the area from north of Jackson to Homer.

There are no repetitive loss properties in Jackson.

Severe Weather

Thunderstorm winds measured at over 80 mph and the accompanying hail caused extensive damage on July 16, 1996. All of Dakota County was impacted as $3 million in property damage and $3 million in agricultural damage due to crop loss or destroyed farm buildings. Thunderstorm winds measured at 60 mph caused $10,000 in tree damage in Jackson on June 3, 2000. On July 7, 2001, 60 mph winds caused minor tree damage. On July 25, 2002, as a result of 80 mph winds, shingles were blown off the roofs of buildings, siding was damaged from wind blown debris, and a few homes suffered damage when large branches fell. Major tree damage in Jackson included a few large trees blown over. Power lines and poles were blown down or damaged by falling trees, resulting in power outages. Hail damage to home siding and vehicles from this event was estimated at $100,000. On June 9, 2003, 1 ¾-inch hail caused $50,000 in damage to vehicles and windows in Jackson. On June 23, 2003, thunderstorm winds estimated at 70 mph caused widespread tree damage, including several trees blown down. There was also damage to power lines, and at least two buildings received minor damage from wind blown debris.

Tornado

An F0 tornado destroyed farm buildings one mile south of Jackson on July 16, 1996. On August 17, 2001, an F2 tornado completely destroyed at least ten houses and heavily damaged several others. The tornado heavily damaged the town school, especially to the roof. The only church in town and a telephone company building were also heavily damaged. Power lines, poles, and trees were blown down, and electricity and water service were knocked out. Three empty box cars on the southeast side of Jackson were toppled. Three injuries were reported, including a woman with a broken leg and cuts rescued from the rubble of a house, and two children with minor injuries. The total damage figure from this tornado was set at $3 million.

Dam Failure

There are no regulated dams or reservoirs which could impact the City of LaVista corporate limits.

Drought

Past Hazard Mitigation Efforts

The Village of Jackson participates and is in good standing in the National Flood Insurance Program. The initial identification for Jackson's Flood Hazard Boundary Map was finalized on December 20, 1974. This map was converted to a Flood Insurance Rate Map on September 4, 1987, and is the date of the current effective floodplain map. Through FEMA's Flood Map Modernization program, the floodplain maps for Dakota County are slated to be reviewed starting in 2008, with new countywide floodplain maps targeted to become effective in 2010.

Vulnerability Assessment

Mitigation Alternatives

GOALS: 1) Reduce or prevent future damage from natural hazard events,
2) Increase public safety

To address these goals, mitigation alternatives were suggested in the public meeting and prioritized by the Jackson Village Board.

1) Maintain good standing in the National Flood Insurance Program
   Objective 1: Continue to regulate development in floodplain areas
   Funding sources and potential cost: No funding needed, no cost

LaVista

Disaster History

Flood

An historical report notes that, "Early financial problems, a drought, and lowland flooding threatened the future existence of the town after it was founded." The history of flooding which has directly impacted LaVista is somewhat unclear since most of the flood reports are given for the entire Omaha area. There are four potential flood sources in the LaVista corporate limits: Hell Creek on the west, West Papillion Creek on the extreme western edge, Big Papillion Creek on the extreme eastern edge, and Thompson Creek which flows through LaVista.

Reports for almost all of these flood sources point to the severe rainfall events of June 16, 1964, and September 7, 1965, as being the significant flood events. On the West Papillion Creek, the flood of 1964 registered at just under the 100-year flood event and caused extensive damage in Papillion. The flood of 1964 was closer to the 500-year flood for Hell Creek. Eight inches of rain in three hours in this small watershed led to making Hell Creek 50 feet wide with five-foot waves. This same rain event caused an equivalent of a 10-year flood on Big Papillion Creek. No specific damages for LaVista for the 1964 or 1965 floods was available. As is the case in most rapidly-urbanizing areas, there are stormwater management problems scattered throughout LaVista.

There are no repetitive loss properties in LaVista.

Severe Weather

Severe summer thunderstorms are common in LaVista; however, specific storm reports are commonly combined with those of Omaha. The National Climate Data Center does note several severe weather events for LaVista. On April 10, 2001, a 5- to 15-minute hail storm hit the Omaha metropolitan area, including LaVista, causing extensive auto and roof damage. The hail covered the ground to several inches in some locations with most stones in the ½ to 1½-inch range, although some were larger. As the hail fell, visibilities fell to near zero, and the hail drifted like snow so that shovels were used to clear some sidewalks. According to State Farm Insurance agents, the storm was the costliest hailstorm in the Omaha area at least since the late 1980's – possibly ever. State Farm estimated that there would be 100,000 claims in the Omaha Metro area. On October 22, 2001, a supercell thunderstorm tracked across Sarpy County, producing golf ball-sized hail. The storm lasted for 10-to-12 minutes, covered the ground with hail, and damaged cars and broke sky lights. On August 21, 2002, thunderstorm winds of 55 knots downed trees and power lines, knocking out power to 2,500 people. On August 10, 2003, golf ball sized hail fell, but no damage was reported. On May 10, 2005, winds measured at (55 knots) knocked down several eight-to-twelve inch tree limbs, which blocked streets. On June 27, 2005, high winds estimated at 60 mph knocked down power lines. No damage was reported for any of these events.

On the severe winter weather side, the Blizzard of 1975 dumped 19 inches of snow along with 65 mph winds, effectively immobilizing the entire Omaha metropolitan area. Ten

people died from this severe winter storm. On October 25-26, 1997, a major early season snowstorm struck the area. A heavy wet snowfall of 6 to 14 inches fell on trees, many of which were still fully or partially leafed, and caused extensive damage and/or total destruction. At least 205,000 residents in the affected area were without power just after the storm, many of the outages lasted for several days. Omaha Public Power District estimated that it was the worst outage in 50 years. Nearly 85% of the trees in the Omaha area sustained damage or were totally destroyed. Many emergency shelters in and around the Omaha area were opened for use by those who suffered a hardship from the storm.

Tornado
The May 5, 1976, tornado struck the extreme western portion of LaVista, but this was close to where it made touchdown. Most of the devastating F4 tornado damage caused by this storm occurred in Omaha's jurisdiction to the north. See the Omaha tornado history for a more detailed account.

Dam Failure
There are no regulated dams or reservoirs which could impact the City of LaVista corporate limits.

Drought

Past Hazard Mitigation Efforts
The City of LaVista participates and is in good standing in the National Flood Insurance Program. Initial identification for LaVista's Flood Insurance Rate Map was finalized on June 21, 1974 and revised on January 16, 1980. On January 19, 1995, the Sarpy County countywide Flood Insurance Rate Map incorporated the LaVista floodplain map. Through FEMA's Flood Map Modernization program, new countywide floodplain maps for Sarpy County were made effective on December 2, 2005.

Vulnerability Assessment

Mitigation Alternatives

GOALS: 1) Reduce or prevent future damage from natural hazard events,
2) Increase public safety

To address these goals, mitigation alternatives were suggested in the public meeting and prioritized by the LaVista City Council.

1) Maintain good standing in the National Flood Insurance Program
   Objective 1: Continue to regulate development in floodplain areas
   Funding sources and potential cost: No funding needed, no cost.

2) Acquire and demolish flood-prone properties

Objective 2: Reduce/eliminate future flood damages and move homeowners from harm's way; improve the cleared land for public recreational use.

- Action 2.1: Develop an application and apply for federal funding to complete floodplain acquisitions.

Funding sources and potential cost: Federal Emergency Management Agency's Hazard Mitigation Grant Program or Pre-Disaster Mitigation Program for 75% of total costs with Papio-Missouri River Natural Resources District providing half of the non-federal cost as match. LaVista or another non-federal source would be required to provide 12.5% of the total cost. Cost estimates would vary depending on the number of structures in the acquisition project, but a good estimate for the total cost for a parcel would be $15,000 over the assessed valuation.

3) Improve LaVista's stormwater management and drainage

Objective 3: Increase the capacity of Thompson Creek

- Action 3.1: Channelize Thompson Creek to give it a consistent bank slope. This option will be expensive because channelization projects need to be completed for long distances upstream and downstream of the desired protection area.

Funding sources and potential cost: Corps of Engineers, Natural Resources Development Fund, Community Development Block Grant, Papio NRD. Cost: varies greatly by scope and design.

- Action 3.2: Clear debris, clean and grub Thompson Creek

Funding sources and potential cost: Papio NRD, city, county – estimates of cost range from $6000 to $10,000 per 1000 linear feet.

- Action 3.3: Perform a drainage study for LaVista to see if there are inflow improvements (i.e., culverts, manhole covers, sewers) which could be improved.

Funding sources and potential cost: Cost would vary by the detail in the scope of work for a drainage study but could be potentially funded by the Community Development Block Grant of the Nebraska Department of Economic Development, Papio-Missouri NRD, or City with the assistance of the City's engineer.

4) Bury overhead power lines

Objective 4: Reduce the duration or eliminate power outages from severe weather. Overhead power lines are vulnerable to collapse from icing in the cold weather months and from high winds or tree limbs falling on power lines in warm weather months.

- Action 4.1: Initiate a power line burying project.

Funding sources and potential cost: FEMA's Hazard Mitigation Grant Program or Pre-Disaster Mitigation Program could provide up to 75% of the project cost. The remaining cost might be shared with the Omaha Public Power District, City, or property owners.

- Action 4.2: Write to the Nebraska Forest Service and request a tree inventory. An inventory is especially helpful in mitigation planning for communities which experience regular tree-related damages. An inventory can identify problem trees and recommend changes to the way a community administer a local tree management program (i.e., through a Tree Board or Park Board). Problematic areas of tree limbs with power lines could be addressed as a priority.

Funding sources and potential cost: Free

- Action 4.3: The City Council could create a regulation requiring underground utilities for all new development.

Funding sources and potential cost: No funding needed, no cost.

Kennard

Disaster History

Flood

There are two potential flood sources which could impact Kennard: the Big Papillion Creek on the city's eastern boundary, and Northwest Branch/Southwest Branch on the south. On June 23, 1996, a three-inch rain fell over much of Washington County, pushing the Bell Creek and Big Papio Creek out of their banks. It is not known if any damage was caused by this flash flood event. Countywide flooding in Washington County was reported on:

September 2, 1997: 3-8" rains in Dodge County and 4-5" rains in Douglas County lead to flooding from feeder streams and main stem rivers. Big Papio Creek was one of the water courses which reported flooding from this event.

July 5, 1998: Heavy rains fell across the entire County, but flooding was the worst on Bell Creek and York Creek near Herman. Total damage was estimated at $340,000.

August 6, 1999: Up to ten inches of rain in 24 hours caused flooding from northern Omaha to north of Tekamah. All of Washington County was flooded, but Arlington and Blair were hit especially hard. The flooding caused around $4 million in damage, mainly due to flooded basements, vehicles, and washed out roads and bridges.

There are no repetitive loss properties in Kennard.

Severe Weather

Severe weather reports for Kennard are overshadowed by the larger communities of Blair and Arlington. Read the reports for these communities to determine the true extent and possibilities of severe weather in Kennard

The National Climate Data Center has only one severe summer weather report: on July 12, 2004, thunderstorm wind gusts estimated at 60 mph broke large tree branches in town. No damage estimate is available for this event. NCDC reports four significant hail events since 1999, all with no damage reported: June 9, 1999 (0.88" diameter); April 18, 2005 (0.75"); May 8, 2005 (0.75"); and August 21, 2005 (0.75").

On April 6, 1998, lightning struck a windmill near a home and followed the wiring into a nearby house, sparking a fire. Damage was estimated at $15,000.

Tornado

There are no known instances of a tornado directly impacting Kennard. However, this does not mean that the Village is not vulnerable to tornadoes.

Dam Failure

There are no regulated dams or reservoirs which could impact the Village of Kennard corporate limits.

Drought

Past Hazard Mitigation Efforts
The Village of Kennard participates and is in good standing in the National Flood Insurance Program.

Vulnerability Assessment
Through FEMA's Flood Map Modernization program, the floodplain maps for Washington County are slated to be reviewed starting in 2008, with new countywide floodplain maps targeted to become effective in 2010.

Mitigation Alternatives

GOALS: 1) Reduce or prevent future damage from natural hazard events,
2) Increase public safety

To address these goals, mitigation alternatives were suggested in the public meeting and prioritized by the Kennard Village Board.

1) Maintain good standing in the National Flood Insurance Program
Objective 1: Continue to regulate development in floodplain areas
Funding sources and potential cost: No funding needed, no cost

Omaha

Disaster History

Flood

With a multi-county metropolitan area, there are many flood sources which impact Omaha. Here is a brief description, by source, for the flood sources.

Missouri River

The first flood record that could be found was dated April 6, 1881, which was a major flood because a large ice jam was breached in Cedar County. This flood swept away entire towns and the Missouri was five miles wide at Omaha. People were forced to evacuate to the roofs of their homes on 9th Street. Along the Missouri, there was a total of three people killed, thousands of livestock perished, and damaged was placed in the "many millions". Another major flood occurred in 1943. At Omaha, the river crested at 22.45 feet and had a discharge of 200,000 cubic feet/second (89,760,000 gallons/minute). Three thousand men helped fight the flood, but after a week, the Missouri found a weak spot in the temporary dike and the battle was lost. One hundred homes were flooded when the floodwater also breached a new dike at Locust Street. The industrial section on Grace Street was flooded, and businesses were closed several days. One thousand people were evacuated from Carter Lake and East Omaha as the old Lake Florence bed filled and inundated the airport with seven feet of water in 18 hours. One person was killed in Omaha, and the damage estimate there was $1.4 million. A $6 million floodwall was constructed as a result of the 1943 flood, which served Omaha well during major floods in 1947 and 1950. The flood of record on the Missouri River took place on April 16, 1952 with a recorded discharge of 396,000 cfs (177,724,800 gallons per minute) with a record stage of 40.2 feet (flood stage at Omaha is 29 feet). Emergency freeboard was added to the top of the floodwall in order to keep Omaha from being flooded. The severe flooding on the Missouri River in the 1940s and 50s lead to the authorization for the construction of six large dams by the United States Army Corps of Engineers. These dams were completed in the early 1960s, and flooding on the Missouri has not been a significant problem since. The Corps also constructed a levee/floodwall system in Omaha which provides protection to the 500-year (0.2% chance per-year) flood. The only significant flooding at Omaha after the completion of the dams took place in 1993, the year with record flooding over the entire Midwest. However, Missouri River flooding was much more pronounced south of Omaha, below the juncture with the Platte River and other large rivers from Iowa.

Big Papillion Creek

The two largest floods of record on the Big Papillion Creek took place in 1964 (45,900 cfs) and 1965 (31,200 cfs). The flood of June 16th and 17th, 1964, killed seven people and caused $5 million in damage, not including losses to personal property. 95 trailer homes were destroyed, with several being swept more than a half-mile downstream by the torrent. Flood damages were recorded in the Big Papio Creek watershed from the consistent heavy downpours in the summer of 1993. Many homeowners had problems with bowing or collapsed foundation and retaining walls.

Little Papillion Creek
The flood of record for Little Papillion Creek took place on June 21, 1960. Intense localized thunderstorms in the watershed led to a discharge of 15,300 cfs at Irvington Street and 10,000 cfs at Cass Street. The severe thunderstorm of September 6, 1965 caused a discharge of 12,800 cfs at the mouth with the Big Papillion Creek.

West Papillion Creek
The largest flood on West Papillion Creek occurred in June 1964 having an approximate discharge of 40,800 cfs in the Elkhorn area and 31,500 cfs at the mouth with Big Papillion Creek. Mobile homes were swept away by this flood in the Millard area.

Hell Creek
Hell Creek flows from Boys Town to its confluence with West Papillion Creek. The flood of June 16-17, 1964, was caused by eight inches of rain falling in three hours. The 500-year flood discharge was exceeded, and reports noted that Hell Creek was fifty feet wide and had five-foot waves. Houses were moved from their foundations and garages were destroyed by these floodwaters. After some channel improvements earlier in 1965, the September 7, 1965, flood event on Hell Creek nearly equaled the severity of the 1964 event.

Cole Creek
Up to ten inches of rain fell overnight on August 6-7, 1999, forcing Cole Creek out of its banks. Cole Creek flows through the fully-urbanized watershed in northern Omaha of Debolt and Benson neighborhoods before joining the Little Papillion Creek near 77th & Dodge. One man was killed from the 1999 flood as a result of a basement wall caving in on top of him.

Thomas Creek
Thomas Creek flows primarily north-to-south past Irvington before joining Little Papillion Creek at Blairhigh Road. The Thomas Creek watershed has been rapidly developing in the last ten years, and downstream flood problems have been the result. During the August 1999 storm, one property owner was trapped by the rising water and nearly lost her life while trying to open the fences for her horses.

Boxelder Creek
Much of Rapidly-developing west Omaha is drained by Boxelder Creek. As a result, it should be expected that runoff rates will cause more water to flow in the creek more quickly. However, Zorinsky Lake is a flood control structure on Boxelder Creek which will minimize flooding.

There are 11 repetitive loss properties in Omaha. The loss dates for these properties are: March 1979, February 1982, May 1982, June 1984, September 1989, June 1991, July 1993, June 1994, September 1997, July 1998, and July 2004.
Of these properties:

- Five are single-family residences, five are apartment buildings, and one is a non-residential building.

- Seven experienced two losses, one experienced three losses, and three had four losses.
- Only three are located in a regulated floodplain.

Severe Weather

The Blizzard of 1975 dumped 19 inches of snow along with 65 mph winds, effectively immobilizing the entire City. Ten people died from this severe winter storm. Straight-line winds measured at 100 mph caused extensive damage to trees and public utilities in July of 1993. Hail measuring to 1 ¾-inch diameter caused $300,000 in property damage in the area of Interstate 480 downtown on July 24, 1995. On October 25-26, 1997, a major early season snowstorm struck the area. A heavy wet snowfall of 6 to 14 inches fell on trees, many of which were still fully or partially leafed, and caused extensive damage and/or total destruction. At least 205,000 residents in the affected area were without power just after the storm, many of the outages lasted for several days. Omaha Public Power District estimated that it was the worst outage in 50 years. Nearly 85% of the trees in the Omaha area sustained damage or were totally destroyed. Many emergency shelters in and around the Omaha area were opened for use by those who suffered a hardship from the storm. A brief but intense hail storm hit the Omaha, Council Bluffs and Bellevue area on April 10, 2000, causing extensive auto and roof damage. The hail covered the ground to several inches in some locations with most stones in the ½ to 1½-inch range, although some were larger. An elderly Omaha woman was injured with some cuts and bruises from the hail when she was caught outside. According to State Farm Insurance, the storm was the costliest hailstorm in the Omaha area at least since the late 1980's and possibly ever – damage estimates were placed at $300 million. On April 30, 2001, a supercell thunderstorm tracked across Elkhorn and then hit the western portions of Omaha with hail up to golf ball size. The hail decreased in size to around ¾-inch by the time the storm reached the eastern parts of the city. The majority of hail damage from the storm was in a 2 or 3 mile wide west to east strip centered on Blondo Street beginning west of 156th Street in far western Omaha, and ending around 40th Street in the east central part of the city. Damage included roof and skylights along with vehicles. Since the storm occurred in the late evening, and many vehicles were in garages, vehicle damage was not as severe as what was recorded with the hailstorm that hit Omaha earlier in the month. However, damage was still estimated at $200 million. On May 13, 2001, another hail storm caused $1 million in damage, concentrated on Eppley Airfield and vehicles parked at its facilities. On July 17, 2001, a man was killed by lightning while biking on a trail in central Omaha. On July 5, 2003, a wind gust was measured at 84 mph in downtown Omaha, and gusts were measured at 75 mph in other parts of town. The line of intense thunderstorms causing these strong winds caused major damage to Omaha's urban forest. Downed trees and tree limbs caused property damage as well is taking out power lines. Omaha Public Power District estimated cleanup to cost $200,000 with an additional $1.5 million in damage. At the peak 60,000 customers in Omaha were without power, some for almost a week. More damage was seen in central and eastern Omaha because these areas had a more mature tree canopy. Total damage from this storm was estimated at $2 million. On May 29, 2004, two men were injured by lightning near Zorinsky Lake. On July 2, 2004, a woman was slightly injured by a lightning strike. On January 4, 2005, two people died when they became

disoriented outside during a severe winter storm and were unable to provide enough detail to be located before they collapsed and froze to death. The storm which caused their deaths dropped over 14 inches of snow and had wind chills as low as 25 degrees below zero. On May 10, 2005, thunderstorm wind gusts over 60 mph blew a construction crane onto the City's performing arts center downtown, causing $300,000 in damage. There was widespread tree damage and resulting property damage. OPPD reported that 13,000 customers lost power due to this storm. On August 10, 2005, a lightning strike in midtown Omaha struck a holiday decorating business, starting it on fire. Total damage was estimated at $2 million.

Tornado

Omaha has been hit directly by tornadoes. The famous Easter Tornado of 1913 killed 191 and destroyed 2000 homes, causing $10 million in damage (1913 dollars). The other major tornado hit on May 6, 1975, which killed three and officially injured 118 (one source puts the injury count up to 2,600). The ten-mile path of this F4 tornado tracked west-to-east, paralleling Interstate 80 on the south side, then turned north at around 72nd Street. 572 residential units were declared destroyed or heavily damaged and nearly 1,887 more received moderate to minor damage. Commercially, 153 units were destroyed or damaged, and 23 industrial businesses were destroyed or damaged. Hundreds of automobiles were completely destroyed, leaving thousands homeless, out of work, and without transportation. At least 30 food-and-drink establishments were destroyed or ordered to temporarily close. In final assessments: A loss estimated between $150 million and a half billion dollars (1975 standards).
The May 6, 1975, tornado impacted the northwest corner of Ralston.

Dam Failure

There are several significant dams in and around the Omaha metropolitan area: Zorinsky Lake, Lake Cunningham, Standing Bear Lake, Wehrspann Lake, Candlewood Lake, Bennington Lake, and Walnut Creek Reservoir to name a few. The Papio-Missouri River Natural Resources District performs routine inspections and maintenance on these high-hazard dams with assistance from the Nebraska Department of Natural Resources. Although it is possible that a dam failure could occur, the likelihood is so small that further discussion is not warranted.

Drought

Past Hazard Mitigation Efforts

The City of Omaha participates and is in good standing in the National Flood Insurance Program. The initial identification for Omaha's Flood Insurance Rate Map was finalized on May 7, 1971. This map was revised on July 1, 1974; May 21, 1976; October 7, 1980; October 15, 1982; January 16, 1987; and February 6, 1991. Through FEMA's Flood Map Modernization program, new countywide floodplain maps for Douglas County were made effective on December 2, 2005.

A buyout for the Cole Creek watershed was completed with the use of Flood Mitigation Assistance funds and Hazard Mitigation Grant Program funds from FEMA. The City of Omaha and the Papio NRD split the non-federal 25% cost share for this project. Several properties still exist in the Cole Creek buyout area that were not able to be purchased, and Omaha and the NRD would like to acquire them.

Vulnerability Assessment

Mitigation Alternatives

GOALS: 1) Reduce or prevent future damage from natural hazard events,
2) Increase public safety

To address these goals, mitigation alternatives were suggested in the public meeting and prioritized by the Omaha City Council.

1) Maintain good standing in the National Flood Insurance Program
Objective 1: Continue to regulate development in floodplain areas
Funding sources and potential cost: No funding needed, no cost

2) Mitigate repetitive loss properties
Objective 2: Reduce future flood insurance payments and reduce flood losses by mitigating repetitive loss properties through acquisition, elevation, or other techniques. Acquisition should be first priority.
Funding sources and potential cost: FEMA's mitigation programs – cost will vary by structure and by mitigation technique used

Papillion

Disaster History

Flood

Big Papillion Creek
On August 3, 1959, six families were evacuated and many basements were flooded from an intense summer rainstorm. It was said that the water was the highest in 41 years, which would mean that a significant – but unreported – flood occurred in 1918. The two largest floods of record on the Big Papillion Creek took place in 1964 (45,900 cfs) and 1965 (31,200 cfs). The flood of June 16th and 17th, 1964, killed seven people and caused $5 million in damage, not including losses to personal property. 5.2 inches of rain fell in a short period, which destroyed 95 trailer homes, several being swept more than a half-mile downstream by the torrent. Flood damages were recorded in the Big Papio Creek watershed from the consistent heavy downpours in the summer of 1993. Many homeowners had problems with bowing or collapsed foundation and retaining walls.

West Papillion Creek
A flood occurred in 1948 which had a 59-year recurrence interval at 25,500 cfs; another flood occurred in 1959 which had a 35-year recurrence interval at 22,500 cfs. The June 16/17, 1964, flood led to a 100-year discharge (31,500 cfs) at the mouth and 40,800 cfs at Giles Road.

Hell Creek
The June 1964 flood caused water in Hell Creek to rise eight feet, with water six feet at 180th and Center Street.

There are no repetitive loss properties in Papillion.

Severe Weather
Severe summer weather is experienced in Papillion every year. Rather than chronicle every occurrence, here are the significant severe weather events. Wind gusts have been reported over 100 mph in Sarpy County, but since it occurred in September of 1989, it is not possible to tell where in the County winds of this magnitude were experienced or how much damage was caused. On May 29, 2000, 65 mph winds knocked down an 80-foot tree, which fell on a vehicle and caused $5000 in property damage. On April 20, 2001, thunderstorm wind gusts estimated at 70 to 80 mph did major roof damage estimated at $250,000 to several homes and businesses in Papillion. On July 6, 2003, thunderstorm wind gusts estimated at over 60 mph caused extensive damage to a large tree, which fell and blocked a road. On June 4, 2005, a swath of 1-inch or larger hailstones was seen generally east of 72nd Street and stretched from just southwest of the Capehart area southwest of Offutt AFB, into Papillion then toward the Florence area. Softball sized hail with a diameter of 4 inches was reported in Papillion. The hail caused scattered house and car damage, but caused surprisingly light damage for its size - no damage estimate was available. On June 29, 2005, thunderstorm wind gusts estimated at 60 to 70 mph

rolled across the Papillion and Bellevue area. The strong winds were accompanied by hail up to 2 inches in diameter and caused scattered tree and building damage across the area, including knocking down several large trees. The winds also overturned some truck trailers near 72nd Street and Highway 370. OPPD reported that 3000 customers lost their power from the storm.

On the severe winter weather side, the Blizzard of 1975 dumped 19 inches of snow along with 65 mph winds, effectively immobilizing the entire Omaha metropolitan area. Ten people died from this severe winter storm. On October 25-26, 1997, a major early season snowstorm struck the area. A heavy wet snowfall of 6 to 14 inches fell on trees, many of which were still fully or partially leafed, and caused extensive damage and/or total destruction. At least 205,000 residents in the affected area were without power just after the storm, many of the outages lasted for several days. Omaha Public Power District estimated that it was the worst outage in 50 years. Nearly 85% of the trees in the Omaha area sustained damage or were totally destroyed. Many emergency shelters in and around the Omaha area were opened for use by those who suffered a hardship from the storm.

Tornado

There are no recorded examples of tornadoes directly striking Papillion. However, there have been six documented tornadoes in Sarpy County and twelve in Douglas County since 1950, so there is a definite risk. The Easter Tornado of 1913 killed 115 people in Omaha and Ralston, but did not directly hit Papillion. The May 6, 1975, tornado also narrowly missed Papillion, but did strike LaVista, Ralston, and Omaha.

Dam Failure

There are no regulated dams or reservoirs which could impact the City of Papillion corporate limits.

Drought

Past Hazard Mitigation Efforts

The City of Papillion participates and is in good standing in the National Flood Insurance Program. The initial identification for Papillion's Flood Insurance Rate Map was finalized on August 18, 1972. This map was revised on July 1, 1974; April 11, 1975; October 10, 1975; and January 16, 1981. On January 19, 1995, the Sarpy County countywide Flood Insurance Rate Map incorporated the Papillion floodplain map. Through FEMA's Flood Map Modernization program, new countywide floodplain maps for Sarpy County were made effective on December 2, 2005.

Vulnerability Assessment

Mitigation Alternatives

GOALS: 1) Reduce or prevent future damage from natural hazard events,
2) Increase public safety

To address these goals, mitigation alternatives were suggested in the public meeting and prioritized by the Papillion City Council.

1) Maintain good standing in the National Flood Insurance Program
Objective 1: Continue to regulate development in floodplain areas
Funding sources and potential cost: No funding needed, no cost

2) Improve stormwater management and drainage
Objective 2: Reduce the quantity or manage the stormwater which results from intense warm weather rains. The steep west-sloping topography of Springfield means that intense rainfall events cause rapid runoff which flows to Springfield Creek on the City's west side. On the way from the uplands to Springfield Creek, runoff has the potential to cause problems to development.
- Action 2.1: Work with farmers and landowners to terrace the hills above town to hold back upland runoff.

Funding sources and potential cost: The Natural Resources Conservation Service has terracing cost share programs. The Papio-Missouri River Natural Resources District is also a potential funding source.
- Action 2.2: The City Council should consider passing a stormwater management ordinance. Such an ordinance would be designed to hold back stormwater on-site from large developments. The City of Lincoln has passed a stormwater management ordinance which could be used as a model or guide. The Papio-Missouri Natural Resources District can also provide technical assistance in the development of a stormwater management ordinance.

Funding sources and potential cost: No funding needed, no cost.

3) Bury overhead power lines
Objective 3: Reduce the duration or eliminate power outages from severe weather. Overhead power lines are vulnerable to collapse from icing in the cold weather months and from high winds or tree limbs falling on power lines in warm weather months.
- Action 3.1: Initiate a power line burying project.

Funding sources and potential cost: FEMA's Hazard Mitigation Grant Program or Pre-Disaster Mitigation Program could provide up to 75% of the project cost. The remaining cost might be shared with the Nebraska Public Power District, City, or property owners.
- Action 3.2: Write to the Nebraska Forest Service and request a tree inventory. An inventory is especially helpful in mitigation planning for communities which experience regular tree-related damages. An inventory can identify problem trees and recommend changes to the way a community administer a local tree management program (i.e., through a Tree Board or Park Board). Problematic areas of tree limbs with power lines could be addressed as a priority.

Funding sources and potential cost: Free

- Action 3.3: The City Council could create a regulation requiring underground utilities for all new development.

Funding sources and potential cost: No funding needed, no cost.

4) Tornado shelters and proper warning for vulnerable populations

Objective 4: Protect lives by creating a shelter(s) to which local residents would evacuate in the event of a tornado warning

Funding is available from the Federal Emergency Management Agency to construct public tornado shelters. FEMA has retrofitted schools and constructed all-new shelters in several places in the Midwest. However, most tornadoes occur in late-afternoon to early evening when a school might be closed for the day. Furthermore, it has been reported that public tornado shelters that are left open to the public are not used properly, with vandalism and use by vagrants as problems. At-risk structure types include mobile homes and slab-on-grade construction which has no basement.

- Action 4.1: Encourage all dwellers of at-risk structures to have an action plan of their own in the event of a tornado warning
- Action 4.2: Seek FEMA funding for tornado shelters to retrofit public buildings or to construct new buildings in the immediate vicinity of the at-risk construction types.

Funding sources and potential cost: FEMA – varies greatly by scope of project.

Ralston

Disaster History

Flood
Big Papillion Creek
During the major June 1964 flood, water was up to five feet deep in the city, which caused an unreported amount of "heavy" business damage.

The primary flood threat for Ralston is not from a river or stream, but from stormwater management issues related to intense rain events. Since Ralston's corporate limits are entirely surrounded by Omaha and LaVista, and continued development will increase runoff to streams outside of its jurisdiction.

There are no repetitive loss properties in Ralston.

Severe Weather
Severe thunderstorms and winter storms impact Ralston nearly every year. Here is a list of storms which have information of resulting damage or other significant information. Specific information for Ralston is likely absorbed by the reporting for Omaha, so the lack of significant events is lower than it should be.

According to the National Climatic Data Center, on July 27, 1996, thunderstorm winds over 70 mph took down trees, causing about $50,000 in property damage. On July 5, 2003, a large line of thunderstorms moved through the Omaha area, bringing very strong winds and causing areas of substantial tree damage. A wind gust of 59 mph was recorded at Eppley Airfield, while a wind gust of 84 mph was recorded on top of a building in downtown Omaha and a 75 mph gust was recorded on a building on the Creighton campus. OPPD estimated that cleanup expenses alone were around $200,000, with damage estimated at around 1.5 million dollars. At the peak, 60,000 customers were without power, some for the better part of a week.

On the severe winter weather side, the Blizzard of 1975 dumped 19 inches of snow along with 65 mph winds, effectively immobilizing the entire Omaha metropolitan area. Ten people died from this severe winter storm. On October 25-26, 1997, a major early season snowstorm struck the area. A heavy wet snowfall of 6 to 14 inches fell on trees, many of which were still fully or partially leafed, and caused extensive damage and/or total destruction. At least 205,000 residents in the affected area were without power just after the storm, many of the outages lasted for several days. Omaha Public Power District estimated that it was the worst outage in 50 years. Nearly 85% of the trees in the Omaha area sustained damage or were totally destroyed. Many emergency shelters in and around the Omaha area were opened for use by those who suffered a hardship from the storm.

Tornado
The famous Easter Sunday tornado of March 23, 1913, killed seven people in Ralston. The Omaha metropolitan area has been directly hit by tornadoes since the 1913 event,

most notably the 1975 tornado which took three lives and injured another 118. However, there were no casualties in Ralston from this tornado even though it hit or destroyed schools, businesses, and homes in the northwest corner of the City.

Dam Failure
There are no regulated dams or reservoirs which could impact the City of Ralston corporate limits.

Drought

Past Hazard Mitigation Efforts
The City of Ralston participates and is in good standing in the National Flood Insurance Program. The initial identification for Ralston's Flood Hazard Boundary Map was finalized on January 23, 1974, and revised on December 26, 1975. This map was converted to a Flood Insurance Rate Map on May 15, 1980, and this is the date of the current effective floodplain map. Through FEMA's Flood Map Modernization program, new countywide floodplain maps for Douglas County were made effective on December 2, 2005.

Vulnerability Assessment

Mitigation Alternatives

GOALS: 1) Reduce or prevent future damage from natural hazard events,
2) Increase public safety

To address these goals, mitigation alternatives were suggested in the public meeting and prioritized by the Ralston City Council.

1) Maintain good standing in the National Flood Insurance Program
Objective 1: Continue to regulate development in floodplain areas
Funding sources and potential cost: No funding needed, no cost

Sarpy County

Disaster History
County-specific disaster histories are given for each hazard type in Chapter 2.

There are 122 repetitive loss properties in Sarpy County.

Past Hazard Mitigation Efforts
Sarpy County participates and is in good standing in the National Flood Insurance Program. The initial identification for Sarpy County's Flood Insurance Rate Map was made effective on January 19, 1995. Through FEMA's Flood Map Modernization program, new countywide floodplain maps for Sarpy County were made effective on December 2, 2005.

Mitigation Alternatives

GOALS: 1) Reduce or prevent future damage from natural hazard events,
2) Increase public safety

To address these goals, mitigation alternatives were suggested in the public meeting and prioritized by the Sarpy County Board.

1) Maintain good standing in the National Flood Insurance Program
Objective 1: Continue to regulate development in floodplain areas
Funding sources and potential cost: No funding needed, no cost.

2) Upgrade problem Sarpy County bridges
Objective 2: Increase the ability of vulnerable county bridges to withstand flooding
- Action 2.1: Mitigate county road bridges which restrict flood flows and cause flood damage to the road, bridge, and surrounding land and development. **Figure 1** shows the locations of the two bridges that the Sarpy County Highway Superintendent would like to mitigate if funding were available. The numbers adjacent to the dots are the chronological order of priority given by the Highway Superintendent. In both cases, the mitigation action would be raise the bridge to the elevation of the adjacent levee and to lengthen the approaches and spans accordingly.

  By number (See Figure 1), the bridge improvements are:
  #1: 36th Street and West Branch Papillion Creek, 1 mile north of Bellevue
  #2: Rumsey Road and West Branch Papillion Creek, near Papillion

Funding sources and potential cost: Public Assistance funds from FEMA following a federally-declared disaster for Sarpy County – cost varies by project and scope

3) Remove very flood-prone structures in the Elbow Bend and Iske Park areas
Objective 3: Reduce future disaster assistance and flood insurance payments
- Action 3.1: The Papio NRD completed a buyout of the Elbow Bend/Iske Park area

of unincorporated Sarpy County in the Missouri River floodway. Many of these properties were old fishing cabins which were upgraded to provide more permanent living areas. Several properties still exist in these flood-prone areas that the NRD would like to acquire and remove.

Funding sources and potential cost: FEMA's mitigation programs – cost will vary by individual property

4) Mitigate repetitive loss properties

Objective 4: Reduce future flood insurance payments and reduce flood losses by mitigating repetitive loss properties through acquisition, elevation, or other techniques. Acquisition should be first priority.

Funding sources and potential cost: FEMA's mitigation programs – cost will vary by structure and by mitigation technique used

South Sioux City

Disaster History

Flood

South Sioux City is situated on a bend where the Missouri River turns from flowing east to flowing south. Before the main-stem dams on the Missouri River were constructed in the 1950s and 1960s, flooding from the Missouri River was a significant problem. The first recorded flood of record occurred in March of 1881 when an ice jam broke free in Cedar County, causing major flooding all the way to Rulo and beyond. South Sioux City was completed inundated. Three people and "Thousands" of livestock were killed from this flood, with "millions" in untold damage. In Omaha, the Missouri flowed five miles wide and people had to be rescued from the roofs of their homes. The stage at South Sioux City for this event was 22.5 feet. During the flooding of April 1943, a crest of 18.7 feet was recorded, also due to an ice jam. In April of 1950, a dike was breached in four places and 100 families had to be evacuated. The flood of record on the Missouri took place on April 7-19, 1952, when the City was again completely inundated. All 5,557 residents were urged to evacuate as one-third of town was under eight feet of water on April 13th. The crest passed on April 14th at 24.38 feet. Damage for South Sioux City was estimated at $2.5 million.

After the main-stem dams were completed, large Missouri River floods were removed as the primary flood hazard. In its place, the main flood problem is more stormwater-related lowland ponding and flooding. Since South Sioux City is very flat, intense warm season rainfalls fill up certain low-lying areas of the City, flooding roadways and potentially inundating basements of structures. The National Climatic Data reports more stormwater-related flood events in the summers of 1999, 2002, 2003, and 2004. Some of the identified road intersections where this is a problem are: East 16th & B Street, 31st & C, 31st & G, 9th & G, 9th & F, West 13th & 1st Avenue, and along various locations of Colonial Drive and Wedgewood Drive.

There are no repetitive loss properties in South Sioux City.

Severe Weather

Severe weather visits Dakota County every year without exception. According to the National Climatic Data Center (NCDC), the strongest winds to hit Dakota County were 80 mph (70 knots) on July 16, 1996. The largest hail was 2½ in diameter reported on May 25, 1964, and again on June 17, 1978. Specific damage information is not available for severe weather events before 1994. Severe winter weather is reported on the county level and is included in the county-level data for Severe Winter Storm in Section 2.21. The following is a list of significant severe weather events which have documented, as noted in the NCDC database.

On May 27, 1995, 70 mph wind gusts took the roof off of a horse stable, causing $3000 in damage.

On July 16, 1996, lightning caused $5000 in damage to an electrical substation, which caused a power outage over much of South Sioux City. 70 mph thunderstorm winds also caused widespread damage over most of Dakota County. The winds caused widespread tree damage, blew down power lines and poles, destroyed many farm buildings, and damaged many homes. 1¾-inch hail also caused damage to vehicles and buildings in South Sioux City estimated at $500,000. To give an idea of the extent of this hail event, large hail caused devastating crop damage in much of Dakota County with many crops totally destroyed. Total crop damage in the County was estimated at $22 million. An estimated half of the county's 64,300 acres of corn was wiped out with about half of the remaining corn acreage sustaining damage. About a third of the County's 52,200 acres of beans was wiped out, while most of the remaining bean acreage sustained varying damage. Smaller crops also suffered extensive damage.

On July 2, 1999, large hail (1¾ in diameter) dented cars and siding and broke windows. Damage was estimated at $200,000.

On October 29, 1996, 60 mph winds behind a cold front caused tree and power line damage and other scattered damages, including the roof of a horse barn blown off and a vacant mobile home blown onto another mobile home. Total damage was $100,000.

On April 5, 2000, high winds with sustained speeds of 40 to 50 mph and gusts above 60 mph persisted from early afternoon into early evening. The wind blew shingles off of roofs and exacerbated grass fires near Hubbard, South Sioux City, and a few other open places. Total damage was estimated at $20,000.

On June 13, 2001, 65 mph thunderstorm winds caused $50,000 in tree and power line damage, including numerous trees blown down.

On June 27, 2003, 70 mph thunderstorm winds caused tree damage, including numerous large trees blown down. Power lines were also knocked down, mostly by falling trees, and power outages resulted. No damage estimate or length of power outage information is available.

On May 28, 2004, 1¾-inch hail damaged vehicles and cracked windows. The amount of damage was not known.

On March 10, 2005, sustained winds of 40 to 45 mph with gusts around 60 mph persisted from late morning until late afternoon. The wind caused tree damage with a few branches and smaller tree debris broken off. There was minor damage totaling $20,000 to buildings, mostly to shingles and gutters.

Tornado

On May 27, 1995, a F0 tornado touched down briefly and caused no damage. The tornado was observed by the observer on duty at the Sioux City Iowa Airport.

Dam Failure

Drought

Past Hazard Mitigation Efforts
The City of South Sioux City participates and is in good standing in the National Flood Insurance Program. The initial identification for South Sioux City's Flood Hazard Boundary Map was made effective on December 7, 1973, and revisions were completed on January 23, 1976. This map was converted to a Flood Insurance Rate Map on August 15, 1979, and this is the date of the current effective floodplain map.

Vulnerability Assessment

Mitigation Alternatives

GOALS: 1) Reduce or prevent future damage from natural hazard events,
2) Increase public safety

To address these goals, mitigation alternatives were suggested in the public meeting and prioritized by the South Sioux City City Council.

1) Maintain good standing in the National Flood Insurance Program
Objective 1: Continue to regulate development in floodplain areas
Funding sources and potential cost: No funding needed, no cost.

2) Remap the floodplain for South Sioux City's corporate and zoning boundaries
Objective 2: Ensure local floodplain ordinance is regulating an accurate floodplain
- Action 2.1: Through FEMA's Flood Map Modernization program, the floodplain maps for Dakota County are slated to be reviewed starting in 2008, with new countywide floodplain maps targeted to become effective in 2010.

Funding sources and potential cost: No funding needed, no cost.
- Action 2.2: The City could undertake a flood study of its entire floodplain or specific problem areas with its own funds or with funding assistance from a community assistance funding source like the Community Development Block Grant program offered from the Nebraska Department of Economic Development.

3) Return local traffic flow as soon as possible following a large snow event
Objective 3: Return emergency and normal traffic flow as soon as possible after large snowfall events
- Action 3.1: Find an alternative location to dump snow from large snow events South Sioux City currently dumps snow where it can in public locations like schools and parks. This leads to community complaints, it looks ugly, and when the snow melts it leaves debris which must be cleared by the City. The City has grown in such a way that additional snow storage space is very limited. At the same time, the snow from large events needs to be moved from the City's roadways to allow normal and emergency traffic to move. The US Environmental Protection Agency

prohibits the dumping of snow in watercourses like the Missouri River because the snow would also contain road contaminants.

Funding sources and potential cost: The City should assess if there are any public open spaces which are not already identified for snow dumping. If there are no more public spaces which can be used, then the City should look into entering into contracts or easements on privately-owned lands which could be used for snow dumping. If this is not an option, then the City should look into funding a study which would seek a solution to this difficult problem. The only potential funding source from FEMA would be the Pre-Disaster Mitigation program; however, this program is competitive nationwide, and snow storage planning would likely not compete well with other applications.

- Action 3.2: In order to most efficiently clear the streets for emergency transportation and normal vehicular traffic, snow routes should be made official and posted with signage so that local residents know to move their vehicles with the impending threat of a large snowfall. After communities determine an official snow route, maps of the snow route should be created for dissemination in publications which will be received by a majority of the community's citizens. Many communities publish snow route maps in telephone books or local newspapers. Communities should have a plan to disseminate the issuance of a snow emergency, preferably as far in advance of the culmination of the snow event as possible to allow residents to move their vehicles. Communities should have a plan to tow vehicles which are not moved upon the time a snow emergency declaration. Local officials can pass an ordinance which creates a fine for not moving vehicles which would serve as a revenue source and deterrent. The goal is to allow plow drivers to remove snow as quickly and efficiently as possible as a public safety and transportation concern. Many communities have an unofficial snow clearing route which plow operators and residents know by heart. However, making it official and codified into local bylaws would improve efficiencies and inform all residents.

Funding sources and potential cost: There is no cost to develop an emergency snow route ordinance, and the City would be encourage to purchase the snow route signage out of its own budget.

4) Alleviate lowland flooding following intense rain events

Objective 4: Reduce traffic interruption and damage potential caused by this flooding

- Action 4.1: Complete a drainage study of the impacted area to assess the root of the problem (i.e., lack of stormwater conveyance, inadequate sewer capacity). Seek funding for specific improvements identified in the study upon its completion.

Funding sources and potential cost: Community Development Block Grant – estimated cost based on area studied, likely $10,000 to $30,000.

5) Use non-structural mitigation measures to reduce flood damages

Objective 5: Remove vulnerable populations from floodprone areas

- Action 5.1: Non-structural mitigation solutions include acquisition and demolition, elevation, and floodproofing. After the buildings are acquired, the land is cleared and then must be in public ownership as open space. Open space uses can be used

for recreation or a host of other options, but the land must remain free of any insurable structures.

Funding sources and potential cost: All of FEMA's mitigation programs can be used for non-structural mitigation: Flood Mitigation Assistance program, Hazard Mitigation Grant Program, and Pre-Disaster Mitigation program.

6) Upgrade communications equipment

Objective 6: Ensure emergency communications to function during any type of disaster

- Action 6.1: Apply for grant funds to upgrade communications equipment

Funding sources and potential cost: Homeland Security grant from the Nebraska Emergency Management Agency (NEMA); cost varies by desired equipment

7) Provide emergency tornado shelter to manufactured home concentrations

Objective 7: Protect lives by creating a shelter(s) to which local residents would evacuate in the event of a tornado warning

Funding is available from the Federal Emergency Management Agency to construct public tornado shelters. FEMA has retrofitted schools and constructed all-new shelters in several places in the Midwest. However, most tornadoes occur in late-afternoon to early evening when a school might be closed for the day. Furthermore, it has been reported that public tornado shelters that are left open to the public are not used properly, with vandalism and use by vagrants as problems. At-risk structure types include mobile homes and slab-on-grade construction which has no basement.

- Action 7.1: Encourage all dwellers of at-risk structures to have an action plan of their own in the event of a tornado warning
- Action 7.2: Seek FEMA funding for tornado shelters to retrofit public buildings in the immediate vicinity of these at-risk construction types

Funding sources and potential cost: FEMA – varies greatly by scope of project

GOAL: 3) Increase Public Education

8) Hurricane straps for manufactured homes

Objective 8: Increase awareness of this structural retrofit option

- Action 8.1: Mobile homes are vulnerable to being rolled by high winds. When this happens, any inhabitants inside are usually injured or killed. Since mobile homes are private property and are either rented or owned, the most effective mitigation technique is to educate the owners and renters of the availability of "hurricane straps" which are designed to secure a mobile home to its support, pad, or foundation.

Funding sources and potential cost: No known funding sources, very little cost.

9) Perform a tornado shelter assessment

Objective 9: Determine which existing structures provide adequate tornado protection

- Action 9.1: Public buildings should be studied to see if they offer adequate tornado shelter. If buildings are found, they should be identified with proper signage so that the public will know places where they can go for shelter.

Funding sources: Pre-Disaster Mitigation funds through the FEMA – cost unknown

Springfield

Disaster History

Flood

The town's most traumatic year was 1903. Shortly after midnight on March 19, a fire broke out, and a dozen buildings on the south side of the main street went up in flames. Wet blankets and canvas hung on the wooden storefronts on the north side of the street saved them. As one of its first major reconstruction projects, the Peter Kiewit Company came in and rebuilt the whole block – this time of brick and stone. However, later that summer, the creek flooded and destroyed a great deal of property.

There are three repetitive loss properties identified for Springfield in FEMA's 2005 Repetitive Loss List. However, from the addresses given for each of these three properties, it does not appear as though any of the three is in the actual City corporate limits. Instead, it appears as though the properties have a Springfield mailing address and should be reclassified to Sarpy County.

Severe Weather

Severe winter weather is reported on the county level and is included in the county-level data for Severe Winter Storm in Section 2.21. On June 20, 1997, thunderstorm wind gusts were estimated at 70 mph, but no damage was reported. On May 15, 1998, wind gusts up to 60 mph and hail of ¾- inch diameter were recorded, but no damage was reported. On June 23, 2000, hail of 1¾ inch diameter fell, but no damage was reported. On April 20, 2001, thunderstorm winds estimated at around 60 mph downed a few trees and power lines. Hail of ¾-inch diameter was recorded on October 1, 2002. On May 29, 2004, law enforcement estimated wind gusts from an approaching thunderstorm at 60 mph. One-inch diameter hail fell in and around Springfield on June 27, 2005, but no damage was reported.

Tornado

The May 6, 1976, tornado which caused three deaths, 118 injuries, and $250 million in damage in Omaha was spotted near Springfield as a funnel cloud.

On April 11, 2001, a brief touchdown of a tornado near Springfield severely damaged a horse barn, downed power lines, and pushed a car into a trailer, causing some damage to each. The tornado was registered as an F0, or very weak tornado; however, it was strong enough to cause an estimated $10,000 in property damage.

Dam Failure

There are no regulated dams or reservoirs which could impact the City of Springfield corporate limits.

Drought

Past Hazard Mitigation Efforts

The City of Springfield participates and is in good standing in the National Flood Insurance Program. The initial identification for Springfield's Flood Hazard Boundary Map was finalized on May 3, 1974. This map was revised on November 28, 1975, and converted to a Flood Insurance Rate Map on February 15, 1978. This map was then revised on October 13, 1981, which is the date of the current effective floodplain map. Through FEMA's Flood Map Modernization program, new countywide floodplain maps for Sarpy County were made effective on December 2, 2005.

Vulnerability Assessment

According to an assessment completed by the Nebraska Department of Natural Resources in March of 2006, there are 662 total structures in Springfield. **Figure 1** shows the structures broken out by type, and the count is:

585 residences
32 businesses
29 (at least) out buildings large enough to be seen on aerial photographs
10 publicly-owned structures, including the municipal building, school, library, and fairgrounds
6 church or non-profit buildings

According to the Nebraska Department of Property Assessment and Taxation, the total assessed taxable value for Springfield in 2005 was $56,223,760. Broken out by relevant real property types, this is:

Residential real property: $48,666,012
Commercial real property: $ 5,549,490
Industrial real property: $ 1,173,800

The difference between the total taxable and real property values is from irrelevant real property values and private taxable values.

The entire structure stock is vulnerable to the severe weather, tornado, and drought hazard. This means that, as of 2005, there is $56,223,760 in at-risk assets for these hazard types.

Figure 2 shows that there are 17 structures in the Springfield Creek floodplain in Springfield. There are two residences, one apartment building, eight out buildings, and six publicly-owned buildings (fairgrounds) that are in the floodplain. Using an average valuation for the different structure types, it is estimated that the total assets vulnerable to flooding in Springfield is:

	Total Valuation	Total Number	Average Per structure	Number	Total Value
Residential:	$48,666,012	585	$83,190	2	$166,380
Apartments:			$83,190	(6 apts)	$499,140
Out Buildings:			$20,000	8	$160,000
Public-owned:			$25,000	6	$150,000
TOTAL					**$975,520**

Figure 3 shows the potential ranges of the tornado warning sirens in Springfield, with the green shading being a half-mile from the siren and yellow one mile from the siren. As shown by the figure, the entire current development within the Springfield corporate limits is in the green shaded area. It must be recognized, however, that these are outdoor warning sirens which are designed to alert residents who are outside and in close proximity to the sirens. They are not designed to warn persons indoors at-distance, traveling in vehicles, or in noisy environments. In addition, a warning system works best if there are operational redundancies – meaning that it is always safer to have additional sirens in a network in case a siren malfunctions or is destroyed. An additional consideration is that periods during which warning sirens are needed are often noisy in themselves with high wind, intense rain, and hail which all act to reduce peoples' ability to hear the sirens. It is easier to hear a warning for people who are downwind of the siren. Since most severe weather in Nebraska comes from the south or west, residents living on the north and east sides of Springfield are more likely to hear warning sirens.

Mitigation Alternatives

GOALS: 1) Reduce or prevent future damage from natural hazard events,
2) Increase public safety

To address these goals, mitigation alternatives were suggested in the public meeting and prioritized by the Springfield City Council.

1) Maintain good standing in the National Flood Insurance Program
Objective 1: Continue to regulate development in floodplain areas
Funding sources and potential cost: No funding needed, no cost.

2) Bury overhead power lines
Objective 2: Reduce the duration or eliminate power outages from severe weather. Overhead power lines are vulnerable to collapse from icing in the cold weather months and from high winds or tree limbs falling on power lines in warm weather months.
- Action 2.1: Initiate a power line burying project.

Funding sources and potential cost: FEMA's Hazard Mitigation Grant Program or Pre-Disaster Mitigation Program could provide up to 75% of the project cost. The remaining cost might be shared with the Nebraska Public Power District, City, or property owners.
- Action 2.2: Write to the Nebraska Forest Service and request a tree inventory. An inventory is especially helpful in mitigation planning for communities which experience regular tree-related damages. An inventory can identify problem trees and recommend changes to the way a community administer a local tree management program (i.e., through a Tree Board or Park Board). Problematic areas of tree limbs with power lines could be addressed as a priority.

Funding sources and potential cost: Free
- Action 2.3: The City Council could create a regulation requiring underground utilities for all new development.

Funding sources and potential cost: No funding needed, no cost.

3) Assessment of tornado siren coverage

Objective 3: Ensure adequate warning siren coverage for all Springfield citizens. The effective warning distance from a siren is typically a function of decibel and pitch levels.

- Action 3.1: Determine the effective distance from the locations of each warning siren in Springfield, then assess whether existing sirens should be upgraded or if more sirens should be added.

Funding sources and potential cost: Little cost to complete the assessment, but purchasing a siren could cost up to $25,000 – upgrading should cost less.

- Action 3.2: Consider purchasing or recommending the purchase of a NOAA Weather Radio for each public facility, school, church, significant employer, or other location in Springfield which witnesses congregations of people or has a noisy environment.

Funding sources and potential cost: NOAA Weather Radios typically cost about $50.

4) Improve stormwater drainage

Objective 4: Reduce the quantity or manage the stormwater which results from intense warm weather rains. The steep west-sloping topography of Springfield means that intense rainfall events cause rapid runoff which flows to Springfield Creek on the City's west side. On the way from the uplands to Springfield Creek, runoff has the potential to cause problems to development.

- Action 4.1: Work with farmers and landowners to terrace the hills above town to hold back upland runoff.

Funding sources and potential cost: The Natural Resources Conservation Service has terracing cost share programs. The Papio-Missouri River Natural Resources District is also a potential funding source.

- Action 4.2: The City Council should consider passing a stormwater management ordinance. Such an ordinance would be designed to hold back stormwater on-site from large developments. The City of Lincoln has passed a stormwater management ordinance which could be used as a model or guide.

Funding sources and potential cost: No funding needed, no cost.

5) Increase the capacity of Springfield Creek

Objective 5: Allow Springfield Creek to carry more water

- Action 5.1: Channelize Springfield Creek to give it a consistent bank slope. This option will be very expensive because the channelization would need to be completed from above Springfield to where Springfield Creek drains into the Platte River, approximately 2½ stream miles south of town.

Funding sources and potential cost: Corps of Engineers, Natural Resources Development Fund, Community Development Block Grant, Papio NRD. Cost varies greatly by scope and design.

- Action 5.2: Clear debris, clean and grub Springfield Creek

Funding sources and potential cost: Papio NRD, city, county – estimates of cost range from $6000 to $10,000 per 1000 linear feet

6) Verify the location of the three repetitive loss properties

Objective 6: Update FEMA's Repetitive Loss List and increase the list's accuracy. Since it is believed none of the three properties is in the Springfield jurisdiction, these properties should be reclassified to Sarpy County.

- Action 6.1: Determine the location of the three repetitive loss properties for Springfield. County Assessor records or other information should be used. Once known, file the appropriate paperwork to FEMA to reclassify them to Sarpy County. If these properties are in Springfield's jurisdiction, then mitigating them should be considered.

Funding sources and potential cost: Local, NRD, or State technical assistance – no cost

Tekamah

The *City of Tekamah Flood Mitigation Plan* was approved for Flood Mitigation Assistance program funding on September 25, 2001.

Disaster History

Flood

Tekamah developed where it did due to the good water of Tekamah Creek. This creek is now the primary flood problem for the community. The low-lying areas on the east side of town are subject to shallow flooding from Tekamah Creek and Tekamah Creek North Branch. North of the city, Mud Creek was largely eliminated as a source of flooding by the construction of an earthen dam. According to the Federal Emergency Management Agency (FEMA), this dam provides a 200-year level of protection. The biggest flood threat to Tekamah is intense summer rainfalls in the Tekamah Creek watershed west of the city.

From 1960 to 2000, Burt County has been declared a Presidential Disaster Area six times due to flooding. Tekamah has a long history of flooding from Tekamah Creek. According to the *City of Tekamah Flood Insurance Study*, major floods have occurred in Tekamah in 1904, 1915, and 1944, with extensive damage to businesses, homes, streets, bridges, and utilities. During the 1944 flood, water was four to five feet deep at 13th & L Street. This flood event also took one life and was estimated to have a 135-year recurrence interval. The flood mitigation plan for Tekamah also notes flood events in 1963, 1974, 1975, 1984, 1986, and two floods in 1987. In 1974, a small amount of flooding in Tekamah was recorded due to a debris blockage of the drainage ditches and Creek on the east side of town. The most recent flood occurred on August 7th, 1999. This flood was caused by 8.25 inches of rain in a ten-hour period that fell in the watershed, mostly to the west of town. This was the highest recorded one-day precipitation for this area since 1948. Some homes near Tekamah Creek along 8th Street and 9th Street sustained some damage, and additional homes were damaged due to sewer backups caused by high floodwater.

There are no repetitive loss properties in Tekamah, as identified by FEMA's repetitive loss list.

Severe Weather

Hail: Hail of 1.25" diameter was recorded in Tekamah on May 28, 1998, but caused no damage. July 30, 1999, saw 0.75" diameter hail without damage. May 1, 2001, recorded hail of 1.75" diameter but there was no damage reported. Non-damaging hail events were also recorded on 9/20/01 (0.75"), 4/16/02 (0.88"), 4/17/02 (1.75"), and 7/20/03 (1.75"). Hail up to 1 inch in diameter broke windshields and caused other property damage in Tekamah on June 14, 2004 – no total damage amount was available.

Severe Storms: It is safe to say that at least one severe winter or summer storm will occur every year, and a history of these events would be too extensive to chronicle. The National Climatic Data Center (NCDC) statistics for 2004 lists four winter storms and

three severe summer storms. Records for 2003 indicate four severe winter storms and two severe summer storms.

High wind: High wind events typically occur at least once a year in Tekamah. Since Tekamah has an airport, good information about wind events is available. The following is a list of the number of high wind events for the last five years – the maximum wind speed in miles per hour is given in parenthesis:

2004 – 1 (58) July 12
2003 – 3 (75) June 23, July 5, August 18
2002 – 0
2001 – 4 (64) April 6, April 22, May 9, June 18
2000 – 1 (63) May 19

Lightning: the only recorded instance of damage caused by lightning since 1995 in Tekamah was on September 18, 1995, which caused $2000 in unspecified crop damage. There are records of other communities in Burt County having more extensive lightning damage when lightning struck and caused fires in homes.

Temperature extremes: Since 1995, there have been four extreme heat and fourteen extreme cold events. From July 10-14th, 1995, three people died in eastern Nebraska due to high temperatures and humidity. Also during this time, $150,000 in unspecified property damage and $160,000 in crop damage was reported. From July 19-30, 1999, daytime temperatures were over 90 to low 100s and overnight lows stayed in the 80s in eastern Nebraska. Combined with humidity, this heat wave killed two people – a young jogger outside and an elderly man in a trailer with a broken air conditioner. An estimated 5000 head of cattle perished, pushing the total damage from this event to reach $3.3 million.

For the cold extremes, on December 8, 1995, strong winds pushed the wind chill to –50 degrees. On January 17, 1996, a strong cold front brought very strong winds that gusted to 60 mph – this pushed the wind chill down to –60 degrees. A cold snap from February 1st to the 4th in 1996 caused several cases of frostbite as the air temperature dipped to –23 degrees. Similar instances of low wind chills and air temperatures occurred two more times in 1996, 1997 (6 times), 1999 (1), 2000 (1), 2003 (1), and 2004 (2).

Tornado

Before modern records of tornadoes was started in 1950, there were at least two significant tornadoes that directly impacted Tekamah. The first was a tornado that destroyed the city's opera house on June 1, 1904. Built in 1884, this building was used for general entertainment of the citizens, including political debates, plays, commencement exercises, revival meetings, dances, and roller skating parties. The tornado destroyed the building and it was not rebuilt. The second historic tornado took place in 1930. A photograph from the Nebraska State Historical Society shows widespread destruction with damage consistent with an F3 or F4 tornado. Damage and casualty information for both tornadoes was not given.

Statistics from the University of Nebraska at Lincoln show that four persons have been killed by tornadoes in Burt County since 1916 and that 12 tornadoes have been recorded in the county from 1950 to 2001. Although there have been no deaths in the County in this timeframe, there have been 35 injuries attributed to tornadoes.

Dam Failure

Tekamah-Mud Dam 5-A (Summit Lake) is located on Tekamah Creek approximately three miles west of Tekamah near Highway 32. At normal levels, the reservoir has a surface area of 192.75 acres impounds 2,616.1 acre-feet of water. This dam was completed in June, 1980 and is owned by the Papio-Missouri River Natural Resources District, which performs routine inspections of the dam. Since it is a "High Hazard" dam (a dam with population concentrations immediately downstream), the Dam Safety Division of the Nebraska Department of Natural Resources also completes a more thorough annual inspection for the presence of cracks, seepage, slope failure or slumps, trees, animal burrows, or other signs of problems.

There is no history of dam failures impacting Tekamah, but operators were within inches of opening the emergency spillway of Summit Lake during the August 1999 flood event.

Because it is inspected and watched many times throughout the year, the probability of a dam failure is very low. However, this only takes routine wear and tear into consideration and does not allow for extreme events like earthquake damage or terrorism. According to the Natural Resources Conservation Service, Summit Lake was designed and constructed with additional seismic (seismic zone 1) standards. Therefore, even with earthquakes taken into consideration, there is still a low possibility of a dam failure.

Drought

Past Hazard Mitigation Efforts

The first floodplain map for Tekamah was completed in 1974 with subsequent revisions in 1975, 1977, and 1979. The current Flood Insurance Rate Map became effective on August 11, 1981. Tekamah's most recent Floodplain ordinance was passed on May 9, 1989. The community has been regulating development off of this floodplain map. However, the map shows everything east of Highway 75 as Zone B and Tekamah Creek loses its identification as a flood source altogether. Also, Summit Lake, a recreation and flood control reservoir on Tekamah Creek three miles west of town, was completed in 1982. Since the current floodplain map did not represent a true picture of Tekamah's flood risk, a floodplain remapping project was funded by the Nebraska Department of Natural Resources and completed by JEO Consulting Group, Inc. A flood mitigation plan was completed at about the same time as the remapping effort. A Letter of Map Revision was submitted to FEMA in September of 2004. Because the new floodplain map is currently in the approval phase by FEMA's mapping contractors and may not be finalized for two years, a reduced floodplain map has been included in this report as **Figure 1**. Because this qualifies as best available data and because the old map was used in the flood mitigation plan, this new map will be used as the basis for the flood vulnerability assessment portion of this all-hazards mitigation plan.

The new floodplain map takes some areas out of the floodplain which are shown as in the floodplain on the 1981 (currently effective) map. However, the flows during a 100-year flood event at the highway bridge are so close to bank-full that continued upstream and upland development may cause future base flows to damage areas outside of the channel. In addition, where the flood models show that Tekamah Creek does get out of its banks during a base flood event, any obstruction to the sheet flow could push this water into Cameron Ditch or other watersheds. Therefore, it is recommended that the City look at developing some sort of stormwater management ordinance to prevent the discharge in Tekamah Creek from increasing to the point where areas outside of the floodplain are inundated and to prevent Tekamah Creek floodwater from flowing into another watershed.

Two projects identified in the city's flood mitigation plan have already been completed. First was a project to increase the channel capacity and to stabilize the banks at the sharp "S-curve" of Tekamah Creek near 9th Street. There were residences that were in danger of being undermined by the creek erosion. This project helped to increase the channel conveyance and to reduce the erosion threat. The other project was to clean out brush and deposited sediment from Tekamah Creek from the S-curve to the highway bridge. Overgrown areas of the creek banks serves to back up water during flood events instead of allowing higher amounts of water flow through the city area. This project also enhanced the carrying capacity of the creek in combination with the S-curve project area. Both projects were funded with funds from the Federal Emergency Management Agency made available through the Nebraska Department of Natural Resources. Half of the non-federal match was provided by the Papio-Missouri Natural Resources District, with the other half coming from the City of Tekamah.

Vulnerability Assessment

Figure 2 shows gives an inventory for every structure in the city. In this inventory there are 1,041 structures (only the structures visible on the aerial photograph of Tekamah were counted). Of these structures:

823 are residences
98 are commercial
85 are out buildings (large garages or warehouses)
19 are publicly-owned
7 are churches
9 are critical facilities

According to the Nebraska Department of Property Assessment & Taxation, the total taxable value of all structures in Tekamah for 2005 was $58,405,478.

The most recent floodplain map shows no structures in the 100-year regulatory flood zone. However, for the federally-declared flood event of 1999, the National Climatic Data Center reports $500,000 in flood damage in Tekamah.

The Emergency Action Plan for Summit Lake is kept at the Nebraska Department of Natural Resources office. This EAP contains a dam breach analysis which contains

detailed information about the number of structures which would be impacted by a failure. An analysis of this probable dam breach area shows that 449 total structures would be inundated or potentially destroyed. This dam breach routing map is overlaid on the structural inventory map and included as **Figure 3**. Of these structures, they are composed of 395 residences, 22 businesses, 11 public buildings, 18 out buildings, and 3 churches. In addition, a rudimentary analysis of the population that could be impacted by a dam breach was performed by the NDNR using their dam breach routing map and population data from the U.S. Census Bureau. That analysis shows that there is the potential that 446 persons could be impacted, or about 24% of Tekamah's population (year 2000 data). However, assuming the nationwide average household count of 2.1 persons per residence, 395 residences would equate to 830 people at risk, or about 44% of the City's population.

Mitigation Alternatives

To address these goals, mitigation alternatives were suggested in the public meeting and prioritized by the Tekamah City Council.

GOALS: 1) Reduce or prevent future damage from natural hazard events,
2) Increase public safety

1) Maintain good standing in the National Flood Insurance Program
Objective 1: Continue to regulate development in floodplain areas
Through FEMA's Flood Map Modernization program, the floodplain maps for Burt County are slated to be reviewed starting in 2009, with new countywide floodplain maps targeted to become effective in 2010. This means that Tekamah should expect a new floodplain map no later than 2010.
Funding sources and potential cost: No funding needed, no cost.

2) Increase channel capacity of Tekamah Creek
Objective 2: Keep flowage rates at its current level. If discharge increases from current levels, the floodplain will expand into residential neighborhoods and potentially into adjacent watersheds.
- Action 2.1: Develop a stormwater management ordinance

Funding sources and potential cost: No funding required in the development of an ordinance. Technical assistance is available through the Nebraska Department of Natural Resources and Nebraska Floodplain and Stormwater Managers Association.
- Action 2.2: Clear and grub Tekamah Creek from the Highway 75 bridge west along Highway 32.

Funding sources and potential cost: Papio NRD, City, FEMA – average cost for channel clearing has a range of costs from $6000 to $10,000 per 1000 linear feet
- Action 2.3: Initiating an annual maintenance schedule in conjunction with the Papio NRD and with the local irrigation and drainage district to prevent the capacity of Tekamah Creek from diminishing over time.

Funding sources and potential cost: No cost to develop a maintenance schedule

- Action 2.4: Increase capacity of the constrictions on Tekamah Creek at Highway 75 and at 12th Street by reconstructing the bridges with larger spans and by excavating a larger cross-section under the bridges.

Funding sources and potential cost: Unknown cost. For the Highway 75 bridge, the City would need to request a review from the Nebraska Department of Roads. Since the 12th Street bridge is city-owned, City funds would need to be used to pay for a least a portion of the cost.

3) Identify and designate additional tornado shelters, publicize the locations of all public tornado shelters to increase public awareness – perhaps with a sign on the building.
Objective 3: Provide emergency shelter(s) to which local residents would evacuate in the event of a tornado warning
- Action 3.1: Perform an assessment of existing structures to determine their capability to be used as tornado shelters
- Action 3.2: Create public shelters by retrofitting or new construction. FEMA has retrofitted schools and constructed all-new shelters in several places in the Midwest. However, most tornadoes occur in late-afternoon to early evening when a school might be closed for the day. Furthermore, it has been reported that public tornado shelters that are left open to the public are not used properly, with vandalism and use by vagrants as problems. At-risk structure types include mobile homes and slab-on-grade construction which has no basement.
- Action 3.3: Consider constructing tornado shelters for vulnerable construction like manufactured home concentrations – such as 10th & F Streets and Summit Heights & P Street.

Funding sources and potential cost: FEMA's Pre-Disaster Mitigation program – cost uncertain

4) Develop an urban tree management plan
Objective 4: Reduce damages caused by falling trees and tree branches
- Action 4.1: Request a tree inventory from the Nebraska Forest Service offers advice on proper "urban forest" planning, tree selection, planting, and tree care. This service should be especially utilized in any areas of the city which experience more tree-related problems.
- Action 4.2: Bury overhead power lines and service lines in areas where tree problems exist.

Funding sources and potential cost: Tree inventory is free from the Nebraska Forest Service; funding for burying power lines may be available through FEMA's mitigation programs.

GOAL: 3) Increase Public Education

5) Objective 5: Increase public awareness of tornado, high wind, and flood mitigation techniques and actions
- Action 5.1: Encourage all dwellers of at-risk structures to have an action plan of their own in the event of a tornado warning
- Action 5.2: In areas especially prone to damaging high winds, "hurricane straps" can be used to attach the roof rafters to the ceiling supports of the highest floor.

Similarly, "tie-downs" can be used to anchor manufactured homes to their pads or concrete foundations. These options would need to be done as a building retrofit and would not be expensive. New construction can use these building techniques very cheaply.

- Action 5.3: Supply technical assistance to homeowners east of Highway 75 about shallow flood damage reduction measures

Funding sources and potential cost: Very low cost to undertake public awareness campaigns – any cost would be to print educational materials and staff time.

Thurston County

Disaster History

Past Hazard Mitigation Efforts

Through FEMA's Flood Map Modernization program, the floodplain maps for Thurston County were started in 2005, with new countywide floodplain maps targeted to become effective in 2007.

There are no repetitive loss properties in Thurston County.

Vulnerability Assessment

Mitigation Alternatives

1) Participate in the National Flood Insurance Program

Objective 1: Give people who live in unincorporated Thurston County the option to purchase flood insurance. The US Army Corps of Engineers and Nebraska Department of Natural Resources are currently working on completing preliminary floodplain maps for Thurston County with anticipated completion targeted for 2006 or 2007. Once preliminary maps are completed, there are official federal protocols which require public review and comment periods. After this period is completed, the preliminary maps are sent to the mapping contractor of the Federal Emergency Management Agency to revise them and to issue final maps. Thurston County will have one year from the effective date of these final maps to pass a floodplain management resolution or it will face being considered a "sanctioned" community. Sanctioning means floodplain maps have been completed, but the jurisdiction has not passed the ordinance and is not regulating floodplain development. A sanctioned status also may jeopardize various forms of grant funds.

- Action 1.1: Pass a floodplain management ordinance after the final floodplain maps are issued by FEMA

Funding sources and potential cost: There is no cost to pass the resolution; however, a local administrator will be required to put in staff time. Since the small amount of development in Thurston County is not likely to take place in a floodplain, the administration of the National Flood Insurance Program will not be burdensome.

2) Upgrade problem Thurston County bridges

Objective 2: Increase the ability of vulnerable county bridges to withstand flooding

- Action 2.1: Mitigate county road bridges which restrict flood flows and cause flood damage to the road, bridge, and surrounding land and development. **Figure 1** shows the locations of the three bridges that the Thurston County Roads Department would like to mitigate if funding were available. The numbers adjacent to the dots are the chronological order of priority given by the Highway Superintendent. In all three cases, the mitigation action would be to replace the existing bridge with a longer bridge and to provide protection from streambank erosion to the bridge supports and approaches.

By number (See Figure 1), the bridge improvements are:

#1: Parker Bridge on Q Avenue near 36 Road on South Blackbird Creek, 4 miles south of Macy

#2: Moore Bridge on 25 Road near F Avenue on North Omaha Creek, 5 miles northwest of Walthill

#3: Schmedding Bridge on an unnamed tributary of North Omaha Creek, 6.3 miles northwest of Walthill and 6.1 miles northeast of Thurston

Funding sources and potential cost: Public Assistance funds from FEMA following a federally-declared disaster for Sarpy County – cost varies by project and scope

Valley

Washington

Disaster History

Flood

There is no Flood Insurance Study for the Village of Washington and no historic flood reports were found. However, in the "Our Town: Nebraska" report for Washington, it does say that, "In 1926 it was decided to widen and deepen the creek. It has been deepened more since then, so it hasn't flooded nearly so often."

There are no repetitive loss properties in the Village of Washington.

Severe Weather

On April 14, 1998, thunderstorms produced high winds which damaged or destroyed several sheds and barns and scattered trees were downed. Total property damage was estimated at $150,000. The National Climate Data Center (NCDC) also records high wind events for larger areas for Washington County or multi-county areas. On June 6, 1980, the highest recorded wind gust for Washington County of 98 mph (85 knots) was recorded. In addition to this event, wind gusts of at least 75 mph (65 knots) have been recorded nine times since 1964: April 15, 1976; June 12, 1980; July 19, 1982; August 5, 1989; March 13, 1990; June 20, 1996; May 15, 1998; October 1, 2002; and July 12, 2004. Since these records are for areas rather than for specific communities, there are no reliable damage figures available for the Village of Washington.

Like some of the wind reports, most of the severe winter weather reports are given for National Weather Service "zones" since large snow and ice events typically occur over significant areas. According to the NCDC, there were three severe winter weather events in 2000, four in 2001, three in 2002 , four in 2003, four in 2004, and one in 2005. These events could be significant snow or ice events or extreme windchills. At any rate, this information shows that at least one severe winter weather event should be expected each year in Washington.

Tornado

There is no record that a tornado has ever directly impacted the Village of Washington.

Dam Failure

There are no regulated dams or reservoirs which could impact the Village of Washington corporate limits.

Drought

Past Hazard Mitigation Efforts

The Village of Washington participates and is in good standing in the National Flood Insurance Program. The initial identification for the Village of Washington floodplain map was completed on September 14, 1990. This is also the current effective map. Through FEMA's Flood Map Modernization program, the floodplain maps for

Washington County are slated to be reviewed starting in 2008, with new countywide floodplain maps targeted to become effective in 2010.

Vulnerability Assessment

Mitigation Alternatives

GOALS: 1) Reduce or prevent future damage from natural hazard events,
2) Increase public safety

To address these goals, mitigation alternatives were suggested in the public meeting and prioritized by the Washington Village Board.

1) Maintain good standing in the National Flood Insurance Program
Objective 1: Continue to regulate development in floodplain areas
Funding sources and potential cost: No funding needed, no cost

Washington County

Disaster History
County-specific disaster histories are given for each hazard type in Chapter 2.

There are eight repetitive loss properties in Washington County.
Of these eight properties:

- Four have a Fort Calhoun address, two have an Omaha address, and two have a Washington address (these may be in error since the repetitive loss list address information is notoriously inaccurate)
- One property has recorded four losses, two have recorded three losses, and five have recorded two losses
- The loss dates are: June 1984, July 1993, June 1996, and April 1997
- Seven are single family residences and one is a condominium
- All eight are in a regulated floodplain area

Past Hazard Mitigation Efforts
Washington County participates and is in good standing in the National Flood Insurance Program. The initial identification for the Washington County floodplain maps was completed on June 3, 1977. The current maps became effective on February 4, 1981.

Vulnerability Assessment

Mitigation Alternatives

GOALS: 1) Reduce or prevent future damage from natural hazard events,
2) Increase public safety

To address these goals, mitigation alternatives were suggested in the public meeting and prioritized by the Washington County Board.

1) Maintain good standing in the National Flood Insurance Program
Objective 1: Continue to regulate development in floodplain areas
Funding sources and potential cost: No funding needed, no cost.

2) Remap the floodplains for Washington County
Objective 2: Ensure local floodplain ordinance is regulating an accurate floodplain
- Action 2.1: Through FEMA's Flood Map Modernization program, the floodplain maps for Washington County are slated to be reviewed starting in 2008, with new countywide floodplain maps targeted to become effective in 2010.

Funding sources and potential cost: No funding needed, no cost.
- Action 2.2: The City could undertake a flood study of its entire floodplain or specific problem areas with its own funds or with funding assistance from a community assistance funding source like the Community Development Block Grant program offered from the Nebraska Department of Economic Development.

3) Upgrade problem Washington County bridges

Objective 3: Increase the ability of vulnerable county bridges to withstand flooding

- Action 3.1: Mitigate county road bridges which restrict flood flows and cause flood damage to the road, bridge, and surrounding land and development. **Figure 1** shows the locations of bridges that the Washington County Road Department would like to mitigate if funding were available. The numbers adjacent to the dots are the chronological order of priority given by the County Road Department. In most cases, the mitigation action would be to reconstruct the bridge to increase the span, which would prevent flood flows from eroding bridge approaches and would allow flood flows to pass unimpeded under the bridge.

  By number (See Figure 1), the bridge improvements are:
  #1: County Road 28 on Bell Creek, 2½ miles north of Arlington
  #2: County Road 28 on Ray Creek, 2½ miles north and 0.3 miles west of Arlington
  #3: County Road 24 on Little Bell Creek, 0.4 miles east and 4½ miles north of Arlington
  #4: County Road 24 on unnamed stream, 3½ miles west of Blair
  #5: County Road 27 on unnamed stream, 0.3 miles east of Kennard
  #6: County Road 32 on unnamed stream, 0.3 miles south and 0.4 miles west of Kennard
  #7: County Road 20 on Little Bell Creek, 1 mile north and 4.9 miles east of Fontanelle
  #8: County Road 24 on unnamed stream, 3 miles east and 4½ miles north of Arlington
  #9: County Road P11 on unnamed stream, ½ mile south and ½ mile east of Arlington
  #10: County Road 21 on unnamed stream, 2.3 miles west and 1 mile south of Kennard
  #11: County Road 5 on Brown Creek, 1 mile east and 1½ miles north of Fontanelle
  #12: County Road 26 on Brown Creek, 3½ miles north and 0.6 miles west of Arlington
  #13: County Road 30 on unnamed stream, 2.6 miles west of Kennard

Funding sources and potential cost: Public Assistance funds from FEMA following a federally-declared disaster for Washington County – cost varies by project and scope

4) Perform a watershed study on Bell Creek

Objective 4: Determine specific ways to reduce flood flows in Bell Creek before it reaches Arlington

- Action 4.1: Determine appropriate placement of upstream dams and for wise use of channel and bank stabilization structures. The Washington County Highway Superintendent noted that they had spent $1.5 million on replacing bridges over Bell Creek since 1993 due to channel widening undermining the bridge foundations.

Funding sources and potential cost: Papio NRD, Natural Resources Conservation Service – approximate cost $50,000

5) Complete a countywide flood warning system
Objective 5: Increase public safety by issuing flood and flash flood warnings in a timely manner
- Action 5.1: Determine which portions of Washington County need more precise flood warnings and work to install a flood warning system

Funding sources and potential cost: United State Geological Survey, Papio NRD – cost varies by warning system type (automatic-dialer, real-time, hand-measured floats, etc.) and extent of warning network

6) Replace box culverts on Fish Creek (also known as Cameron Ditch) with bridges
Objective 6: Reduce lowland flooding and floodwater back-up by removing the flow restrictions currently caused by the box culverts
- Action 6.1: From the Burt/Washington County line on the north, replace box culverts all the way to the Missouri River. The box culvert at Blair is the highest priority.

Funding sources and potential cost: Washington County Highway Department, Papio NRD, Public Assistance funds from FEMA following a federally-declared disaster for Washington County – cost varies by site and design

7) Mitigate repetitive loss properties
Objective 7: Reduce future flood insurance payments and reduce flood losses by mitigating repetitive loss properties through acquisition, elevation, or other techniques. Acquisition should be first priority.

Funding sources and potential cost: FEMA's mitigation programs – cost will vary by structure and by mitigation technique used

Waterloo

Disaster History

Flood

Because of its location between the Platte River and Elkhorn River, two very unpredictable rivers, Waterloo has been ravaged by many floods dating back to the 1880s. The flood of record on the Elkhorn at Waterloo took place in June of 1944, but better records were kept for the severe flooding in the early 1960s. In March/April of 1960, Waterloo was totally evacuated when was was five to six feet deep in town as the Platte River went on a rampage. In March/April of 1962, Elkhorn River flooding lead to 60% of the population being evacuated as there was three feet of water downtown. As a result of these floods, a bond issue in 1965 resulted in a ring levee built around the town for protection. This levee was constructed by the US Army Corps of Engineers and was completed in 1967. Minor improvements to the levee were completed in 1968, and reconstruction of Highway 64 in 1985 improved the levee so that it currently provides 100-year protection. Therefore, the entire Village inside the levee is not in the floodplain; however, there is regulated floodplain on all sides of the levee-protected area.

There are no repetitive loss properties in Waterloo.

Severe Weather

Severe weather occurs every year in Waterloo, whether it be severe warm-season weather like high winds, hail, heat, and intense rainfall, or severe cold-season weather like large snow events, ice, and dangerous windchills. The National Climatic Data Center does not have any severe weather events recorded for Waterloo, but this is because of its close proximity to other communities like Omaha and Valley. The severe weather history for these communities is very likely to be similar to what was experienced in Waterloo.

Tornado

Six people were injured and $2,500 in property damage was caused in Waterloo by the Easter Tornado of 1913. This twister was the worst of several strong tornadoes which occurred on this day. The tornado which struck Waterloo is thought to have also hit Yutan (18 killed, 22 injured, $300,000 in damage) in Saunders County and Valley (6 injured, $1,250 in damage) in Douglas County before turning. It then hit Waterloo before killing 115, injuring 400, and causing $9 million in property damage in Omaha. Since 1913, there have been no recorded tornadoes to have directly impacted Waterloo.

Dam Failure

There are no regulated dams or reservoirs which could impact the Village of Waterloo corporate limits.

Drought

Past Hazard Mitigation Efforts

The Village of Waterloo participates and is in good standing in the National Flood Insurance Program. The initial identification for the Village of Waterloo floodplain map was completed on September 6, 1974. The Flood Hazard Boundary Map was revised on December 19, 1975, and this map was converted to a Flood Insurance Rate Map on January 14, 1977. Revisions to this map were completed on February 19, 1987, which is the date of the current effective floodplain map. Through FEMA's Flood Map Modernization program, new countywide floodplain maps for Douglas County were made effective on December 2, 2005.

Vulnerability Assessment

Mitigation Alternatives

GOALS: 1) Reduce or prevent future damage from natural hazard events,
2) Increase public safety

To address these goals, mitigation alternatives were suggested in the public meeting and prioritized by the Waterloo City Council.

1) Maintain good standing in the National Flood Insurance Program
Objective 1: Continue to regulate development in floodplain areas
Funding sources and potential cost: No funding needed, no cost

2) Maintain the flood protection levee surrounding the Village
Objective 2: Protect the Village and prevent the mandatory purchase of flood insurance
- Action 2.1: Work with the Papio NRD to ensure that the levee is inspected regularly and that any problems are repaired immediately

3) Improve drainage inside the levee
Objective 3: Prevent intense warm-weather rainfall events from flooding portions of land inside the levee
- Action 3.1: A drainage study is needed in Waterloo: 1) to help the Village map future stormwater needs, identify where their infrastructure is weak, and identify ways to address these weaknesses, and 2) to identify good flood mitigation projects.
- Action 3.2: Maintain a service log of response calls which details the specific location and problem. Such a log would be helpful in assessing future infrastructure upgrades.

Funding sources and potential cost: Papio-Missouri River NRD, Community Development Block Grant, Village – cost varies on scope, but expect $15,000 minimum

4) Construct a tornado shelter in the fire station as a component of the current remodeling project
Objective 4: Provide public tornado shelter
- Action 4.1: Apply for federal assistance from one of the Federal Emergency

Management Agency's mitigation programs. The Village would need to secure the non-federal match funding (25%) of the project.

Funding sources and potential cost: Pre-Disaster Mitigation program or Hazard Mitigation Grant Program from FEMA, Community Development Block Grant from Nebraska Department of Economic Development. Cost varies by design and scope.