



Hazard Mitigation in Iowa: Measuring Success

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OVERVIEW

Hazard Mitigation in Iowa: Measuring Success examines the effectiveness of actions to prevent future flood damage taken by several local governments in eastern Iowa after the Great Midwest Flood. Following the 1993 flood, the State of Iowa through the Iowa Emergency Management Division (IEMD), affected local communities, and federal agencies led by Federal Emergency Management Agency (FEMA) embarked on an initiative to break the cycle of reoccurring disaster damages by developing a program of hazard mitigation -- actions that prevent long-term damage to people and their property.

This report examines from both community and project perspectives the role and effectiveness of these preventive actions by comparing damage costs in 1993, hazard mitigation costs, and reduced damage costs from flooding of similar magnitude in 2001. The report analyzes the following categories of mitigation projects implemented by IEMD and FEMA:

- § Acquisition and demolition or relocation of structures from identified flood hazard areas (often referred to as “buyouts”);
- § Elevation of eligible structures in flood hazard areas;
- § Flood protection measures—including the construction of levees—for critical public facilities like water treatment and electric utilities.

From a community perspective, the study examines how mitigation measures that were implemented after the flood of 1993 have made a difference in reducing losses and in expediting recovery in the 2001 flood in four communities in eastern Iowa (Louisa County, the City of Davenport, the City of McGregor, and Des Moines County). At the project level, the study assesses the amount of losses avoided as a direct result of mitigation actions taken after the 1993 floods and the impact of funding from FEMA’s Hazard Mitigation Grant Program (HMGP) in reducing losses following the 2001 flood.

THE COMMUNITIES

Louisa County: A Strategy to Relocate Flood Prone Houses

Mitigation activity after the 1993 flooding focused on the Reggie Myers and Spitznoggle subdivisions where flood waters permeated earthen levees and caused seepage and flooding, resulting in high levels of bacteria and mold in homes and contamination of wells. During the flooding, 120 homes were flooded and their residents were evacuated, primarily because of the poor sanitary conditions. The 1993 flood event was only the most recent in a long history of flooding experienced by the subdivisions.

Working with the Muscatine Center for Strategic Action (MCSA), Louisa County used both acquisition and relocation techniques to alleviate the flooding problems in the two subdivisions.. Using HMGP funds, the County acquired 176 homes. Of the 176 homes, Louisa County sold 99 for \$1 each to the MCSA, which in turn sold them to low- to moderate-income residents who secured loans to relocate outside the floodplain and refurbish the homes. The other 77 homes were demolished.

By relocating over half of the homes, Louisa County helped to maintain the stock of affordable housing and retained homeowners who contribute over \$118,000 in property tax revenue annually. The demolition or relocation of the 176 helped the County avoid over \$1 million in damages to homes following the 2001 flood. Because residents no longer resided in flood hazard areas, only 11 people required evacuation and sheltering during the 2001 flood, saving over \$700,000 in sheltering costs.

City of Davenport: Promoting the Acquisition of Flood Prone Properties as Part of A Comprehensive Approach to Flood Hazard Reduction

The City of Davenport's history of flooding problems stemmed from development in floodplains along the Mississippi River, Duck Creek, and Black Hawk Creek. A flood study revealed that there were over 1500 structures located in the floodplain. In the flood of 1993, many these properties were damaged, and the City had total estimated damages of more than \$8 million to residences, businesses, and infrastructure.

Recognizing the adverse impacts of the 1993 and previous floods, the City implemented an aggressive strategy to reduce the number of floodprone properties and prevent drainage problems that lead to localized flooding. The multi-layered strategy consisted of:

- § The **Residential Acquisition Program** to acquire and demolish floodprone properties (45 have been acquired to date);
- § The **Flood Damage Prevention Ordinance** which regulates floodplain development and requires flood-resistant construction and improved land development practices;
- § The **Creek Inspection and Maintenance Program** to maintain creeks, preserving their flow capacity;
- § The **Stormwater Management Ordinance** to control surface water runoff in developing areas.

As a result of these programs, the City was able to avoid over \$40,000 in losses to structures following the 2001 Mississippi River flood, reduce by \$500,000 the amount of federal Public Assistance funds, reduce the number of victims needing shelter by more than 200, and eliminate the need for federal Disaster Housing Assistance funds.

The City of McGregor: Reducing the Vulnerability of a Critical Public Facility

In the 1993 flood, the McGregor Municipal Utility was threatened by floodwaters, requiring thousands of sandbags and hundreds of man-hours to protect the facility and keep it operational. The electric utility provides power to 261 residential and 89 commercial customers, including healthcare facilities, schools, and police and fire stations. The City, fearing the repercussions that the loss of power could have on the City, constructed a floodwall around the utility to provide protection up to a 500-year flood event (a flood that has a .02% chance of occurring in a given year).

With the floodwall protecting the utility, only \$1000 was expended solely for personnel overtime pay during the 2001 flood event, versus \$12,000 in the 1993 event for the labor and sandbagging efforts.

Des Moines County: A Partnership Approach to Flood Hazard Mitigation

From 1930 to 2001, Des Moines County averaged one flood every five years. The 1993 flood, the largest flood of record in Des Moines County, caused major damage in the City of Burlington, including \$1.4 million in losses to Memorial Auditorium and \$5.1 million in damages to public infrastructure. The flood also affected about 200 residential structures, causing substantial damage to 30 houses on the river side of the levee. The flood prompted intense response efforts, including emergency sandbagging along the Des Moines County levee system, including downtown Burlington; evacuation and sheltering of approximately 140 families; and disaster assistance to about 800 families.

The flood losses and response efforts from the 1993 event sparked a concerted and coordinated effort in Des Moines County to reduce future flood losses. County elected and government officials partnered with the Southeast Iowa Regional Planning Commission and the Two Rivers Levee and Drainage Association to implement several hazard mitigation endeavors, including:

- § Development of the Des Moines County Hazard Mitigation Plan;
- § Adoption of the Floodplain Management Ordinance;
- § Coordination of maintenance of the Iowa River-Flint Creek Levee District and three drainage districts; and
- § Acquisition and demolition of 46 residential structures and elevation of three houses.

The 2001 flood revealed that these measures paid off. In the 2001 flood, Des Moines County avoided \$193,000 in losses to residential structures, \$375,000 in federal Public Assistance expenditures, and nearly \$694,00 in Disaster Housing Assistance funding. Furthermore, the measures prevented the evacuation of 139 people.

THE PROJECTS

For seven communities, detailed analysis of flood mitigation projects shows that acquisition or elevation of flood prone structures and flood protection measures for the municipal water works in the City of Burlington has resulted in measurable benefits. After just one flood event, these flood mitigation projects prevented over \$1.6 million in losses.

Losses Avoided in the 2001 Flood		
Community	Mitigation Project	Total Avoided Losses
Scott County	Four Acquisitions and Two Elevations	\$34,511
City of Davenport	Five Acquisitions and One Elevation	\$41,392
Muscatine County	Two Acquisitions and Two Elevations and	\$34,537
City of Muscatine	Six Acquisitions	\$31,268
Louisa County	176 Acquisitions	\$1,256,815
Des Moines County	Forty-Six Acquisitions and Three Elevations	\$193,346
City of Burlington	Flood Control for the Municipal Water Works	\$48,001
Total for Projects Covered in this Report		\$1,639,870.00

CONCLUSION

Examination of Iowa communities implementing flood hazard mitigation programs and projects reveals that mitigation efforts can have measurable benefits after only one event of similar magnitude. Communities like Louisa County, the City of Davenport, the City of McGregor, and Des Moines County recognize that a comprehensive approach to hazard mitigation planning, floodplain management, and flood mitigation projects can realize long-term returns on investments of time and money. Even single projects, such as the flood control project for Burlington's water facility, can prove to be cost-effective. The reduction in federal assistance and the losses avoided to structures and infrastructure following the 2001 flood confirm that flood mitigation efforts throughout Iowa have been worthwhile.

HAZARD MITIGATION IN IOWA: MEASURING SUCCESS

In the 1980s and 1990s, communities across the United States experienced an unprecedented number and magnitude of natural disasters. Year after year, accounts of floods, tornadoes, hurricanes, and earthquakes and their effects made clear that not enough was being done to prevent damage from disasters.

Communities in the State of Iowa were victims of several flood, snow, and storm events throughout the 1990s. The repeated, enormous damages from these events illustrated for many the need for local, state, and federal governments to form a partnership for a coordinated approach to preventing or reducing future damage from natural disasters.

This document describes the approach taken by several local governments to prevent future flood damage after significant flood damage in their communities in 1993. These approaches are analyzed in light of a subsequent flood event in 2001 to determine the effectiveness of the preventive actions. *Hazard Mitigation in Iowa: Measuring Success* examines the role and effectiveness of preventive actions taken in eastern Iowa at two levels – community and project. From a community perspective, the study examines how mitigation measures that were implemented after the flood of 1993 have made a difference in reducing losses and in expediting recovery in the 2001 flood in four communities. At the project level, the study examines the role and contributions of the Federal Emergency Management Agency's (FEMA) Hazard Mitigation Grant Program (HMGP) in reducing losses in the 2001 flood. The project and community perspectives are closely related, since HMGP grants play a central role in community mitigation strategies in Iowa, particularly in rural communities with limited resources.

The report is organized into two sections. Section Two, *Measuring Mitigation Success: A Profile of Four Iowa Communities*, highlights the mitigation strategies of four diverse communities in eastern Iowa: the City of Davenport, Louisa County, Des Moines County, and the City of McGregor. Section Three, *Analysis of Hazard Mitigation Grant Projects* evaluates eight HMGP projects in these and other communities, according to two criteria: 1) the role of the projects in the overall local mitigation strategy; and 2) the effectiveness of the projects in reducing losses in the 2001 flood.

The Flood of 1993

In the spring and summer of 1993, the State of Iowa and other Midwestern States suffered one of the most devastating floods in U.S. history. Having received more than double its

Hazard Mitigation in Iowa: Measuring Success

Section One	Introduction
Section Two	Measuring Mitigation Success: A Profile of Four Iowa Communities
Section Three	Analysis of Hazard Mitigation Grant Projects

Hazard Mitigation

Any sustained action taken to eliminate or reduce the long-term risk to human life and property from the effects of natural, technological, or man-made hazards.

Hazard Mitigation Grant Program (HMGP).

Since 1988, a significant portion of the funding to support the implementation of mitigation programs in Iowa and across the nation has come through the Hazard Mitigation Grant Program, which was created in 1988 as Section 404 of the Robert T. Stafford Disaster Relief and Emergency Assistance Act ("Stafford Act"). It implements FEMA's strategy to help States and communities undertake long-term hazard mitigation measures following major disaster declarations. In the aftermath of the 1993 flood, President Clinton signed the Hazard Mitigation and Relocation Assistance Act, which amended Section 404 to increase federal funding of HMGP projects from 50 to 75 percent of total eligible costs.

The objectives of the Hazard Mitigation Grant Program are to:

- § avoid future losses of lives and property due to disasters;
- § implement State and local hazard mitigation strategies;
- § implement mitigation measures during the recovery period; and
- § provide funding for previously identified mitigation measures that benefit the disaster area.

normal precipitation in the months before the flood event, Iowa also experienced cooler than normal temperatures, leading to a decreased rate of evaporation and increased ground saturation. Moreover, rainfall and rapid snowmelt in the upper Mississippi River basin in central Minnesota and central and northern Wisconsin caused above normal water elevations along the Mississippi River. The Mississippi River drainage basin (including the Mississippi, Missouri, Kansas, Illinois, Des Moines, and Wisconsin Rivers) flooded Iowa and nine other States (North Dakota, South Dakota, Kansas, Nebraska, Kansas, Missouri, Wisconsin, Minnesota, and Illinois).

The flooding caused heavy damage to the State of Iowa, prompting President Clinton to issue a disaster declaration. The scope of damages to homes, businesses, and Iowa's infrastructure on the Mississippi and its tributaries was unprecedented. Every county in the State was affected, with the most significant flooding occurring in the ten counties located along the Mississippi River.

The damage from flooding and other hazards in Iowa is just one example of the cycle of damage experienced by many communities in the U.S. Since 1990, disaster recovery has cost Iowa over \$225 million, and nationally, disasters have cost citizens billions of dollars. During the last several years, the nation has experienced a series of the most costly disasters in its history both in terms of overall damages and in terms of federal expenditures for disaster relief and losses to the National Flood Insurance Program (NFIP). The direct and indirect costs to the private sector have also been staggering; disaster recovery expenses have affected jobs, profits, and local community tax revenues.



Figure 1-1: Relocating flood prone structure

Iowa Damage Reduction Strategy

The flood of 1993 marked a turning point in shaping our nation's approach to flood hazard mitigation policy. Following the 1993 flood, the State of Iowa, affected local communities, and federal agencies, led by FEMA, decided to try to end the cycle of damage by developing a program of hazard mitigation. The Iowa Emergency Management Division (IEMD), in partnership with federal agencies, gave priority to incorporating hazard mitigation into Iowa's flood recovery strategy. With funding from FEMA's HMGP, the IEMD implemented the following categories of mitigation projects:

- § Acquisition and demolition or relocation of structures from identified flood hazard areas (often referred to as "buyouts")
- § Elevation of eligible structures in flood hazard areas
- § Flood protection measures – including the construction of ring levees – for critical public facilities (for example, water treatment facilities, electric utilities)

Since 1990, the State of Iowa has given priority to acquiring, relocating, or elevating residential and commercial structures in flood hazard areas. The total investment during the period from 1993 to 2001 amounted to \$57.8 million, resulting in the removal of 1,344 flood prone structures from identified flood hazard areas. An additional \$9.4 million has been invested in mitigation projects to protect critical public facilities from flooding.



Figure 1-2: Elevation of structure above floodplain



Figure 1-3: Structural flood control measures

Flood of 2001: An Opportunity to Evaluate the Role and Effectiveness of Mitigation Projects in Eastern Iowa

In the spring of 2001, storms combined with rapid snowmelt and again created flood conditions along the Mississippi River. The water exceeded the historic floods experienced in 1993 in some areas and caused millions of dollars of damage to the State of Iowa. As a result of severe storms, tornadoes, and, most of all, flooding, President George W. Bush signed a federal disaster declaration on May 2, 2001. The disaster declaration authorized FEMA to provide technical and financial support with grants through the Individual Assistance, Public Assistance, and Hazard Mitigation Grant programs. In all, 13 Iowa counties received Presidential disaster declarations (DR-1367) as a result of the 2001 flood.

The flood of 2001 presented an opportunity to evaluate the progress that has been made since the 1993 flood in several Iowa communities that were impacted by both floods. Specifically, the 2001 flood allowed assessment of the losses that were avoided in the 2001 flood as a direct result of the mitigation actions that were taken after the 1993 flood.

To assess the role and effectiveness of post-1993 mitigation programs and actions in each of these communities, the following questions and issues were examined:

- § What was the nature and scope of damages from the 1993 flood in each community, and what mitigation actions were taken to reduce future losses?
- § What were the quantifiable losses avoided after the 2001 flood that can be attributed to mitigation actions taken after the 1993 flood?
- § To what extent did the flood protection measures for critical public facilities contribute to reduced losses and less down-time following the 2001 flood?
- § To what extent did the mitigation measures the 1993 flood make a difference in reducing the demands and resource requirements for response and recovery operations following the 2001 flood?

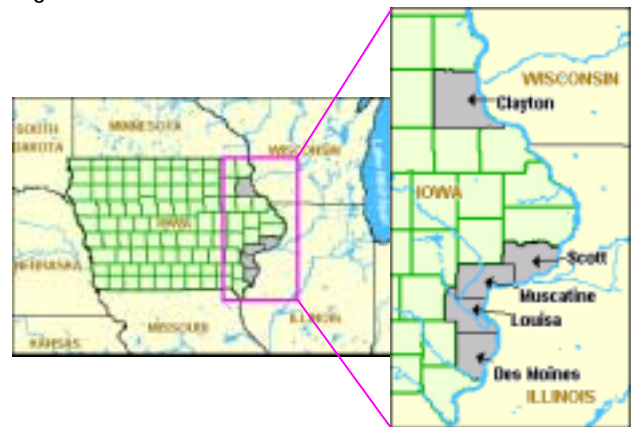


Figure 1-4: Iowa study area

In developing this report, the project team, consisting of senior and junior level hazard mitigation planners, conducted field visits in the seven communities to research the HMGP projects, to interview State and local officials who had responsibility for developing and implementing the local mitigation strategies, to gather site specific information and data on the 1993 and 2001 floods, and to interview officials who had roles in response and recovery in the two flood disasters. Appendix B lists the sources of information, organized by community.

To estimate losses avoided as a result of implementing the acquisitions, relocations and elevations in eastern Iowa, the project team collected information for each HMGP project that was carried out after the 1993 flood in communities located on the Mississippi River. These include:

- § City of Davenport (five residential acquisitions, one elevation)
- § Scott County (four residential acquisitions, two elevations)
- § City of Muscatine (six residential acquisitions and four adjacent lots)

- § Muscatine County (two residential acquisitions, two elevations)
- § City of Burlington (flood protection project for the water plant)
- § City of McGregor (flood protection project for the municipal utility)
- § Des Moines County (46 residential acquisitions, elevation of three structures)
- § Louisa County (176 residential acquisitions / relocations)

For each of the HMGP funded acquisitions and elevations, information was collected on the following:

- § **Mitigation Project Data**, including the type and location of the project
- § **Mitigation Project Costs**, including, acquisition, relocation, programmatic and project maintenance costs
- § **Building Data**, including total building area, lowest floor elevation, building type, and condition
- § **Building Cost Data**, including replacement value, contents replacement value, and displacement costs, expenses incurred by a displaced owner when the residence is being repaired or otherwise cannot be occupied
- § **Historical and Probabilistic Flood Data**, including maximum flood elevation at the sites for each flood event, building damage incurred, contents damage incurred, and displacement costs incurred

To estimate the losses avoided as a result of acquiring flood-prone structures, it was necessary to determine the costs that would have been incurred had the mitigation project not been implemented, including: 1) the costs to repair the dwelling, 2) the costs to replace damaged contents, and 3) displacement costs. Following each table of losses avoided is a description of the step-by-step process used in this study to calculate losses avoided through acquisitions and elevations.

The indicators used to evaluate the impact of mitigation measures adopted after the 1993 flood and to assess how these measures contributed to reduced losses and expenditures for response and recovery were:

- § expenditures of the Public Assistance Program (described below) to the impacted communities in 1993 and 2001, and
- § estimates of the number of households that were at least temporarily displaced by the floods, and related expenses like evacuation, sheltering, and feeding of these households.

The Public Assistance (PA) Program, administered by FEMA and the IEMD, provides supplemental federal disaster grant assistance for the repair, replacement, or restoration of disaster-damaged, publicly-owned facilities and some private non-profit facilities. There are seven categories of Public Assistance:

- § Debris Clearance (A),
- § Emergency Protective Services (B),
- § Roads, Bridges, Culverts (C),
- § Water Control Facilities and Levees (D),
- § Public Buildings (E),
- § Utility Distribution Systems (F), and

§ Public Parks (G).

Categories A and B are classified as emergency work, and the other categories are classified as permanent work. The results of the analysis are presented in two sections. Section Two of this document begins with an analysis of four Iowa communities that were flooded in 1993 and 2001, and the losses avoided as a result of implementing mitigation projects. Section Three, *Analysis of Hazard Mitigation Grant Projects* evaluates eight HMGP projects, and specifically: 1) the role of the projects in the overall local mitigation strategy; and 2) the effectiveness of the projects in reducing losses in the 2001 flood.

LOUISA COUNTY: A STRATEGY TO RELOCATE FLOOD PRONE HOUSES

The Flood of 1993



Like other places along the Mississippi River, Louisa County experiences periodic flooding. Since 1950, the average interval between significant floods in Louisa County – defined as flood levels of three feet or more above flood stage – is five years. The most damaging event was the 1993 flood, which damaged over 275 homes and forced the temporary evacuation of 200 families.

The northeastern corner of Louisa County sustained the most damage from the Mississippi River flooding in 1993. The area is a natural valley of fertile farmland, protected from flooding along the Mississippi by a levee system that was constructed in the 1930s. In the 1960s and 1970s, a series of subdivisions were developed in the County. By the summer of 1993, over 300

families had moved into the area, many of them to the Reggie Myers and Spitznogle subdivisions. The majority of houses were ranch style, between 900 and 1200 square feet in area, with a median assessed value of \$52,000 (1993). Most of the houses were situated on two-acre lots with wells and septic systems.

The levee system in Louisa County is designed to provide protection from a 500-year flood event. The porous and unstable condition of the levee system, combined with a high water table, contributes to seasonal drainage problems in Louisa County. When the levees are saturated for extended periods of time, the flood waters permeate the earthen levees, and “seepage” occurs. Seepage has caused problems in a majority of homes in the Reggie Myers and Spitznogle subdivisions, including high levels of harmful bacteria from flooded septic tank systems, contamination of wells, and the presence of mold.

When the Mississippi River reached flood stage in April 1993, the seepage increased significantly and approximately 120 homes in the two subdivisions were flooded. An additional 100 homes in other locations in Louisa County sustained flood damage. In all, two hundred households were temporarily evacuated due to the flooding.

LOUISA COUNTY COMMUNITY PROFILE

Louisa County, a rural community of 12,000 on the Mississippi River in southeast Iowa, was created out of a strip of land known as the Black Hawk Purchase in the winter of 1836. The community of Wapello, the County seat, was chartered by the State legislature in 1856. In the late 1800s, Wapello served as a trading center for homesteaders of the highly fertile countryside. At the turn of the century, the community boasted a brewery, a wagon and carriage factory, an opera hall, a theater, and the State’s oldest newspaper.

Today, Wapello is the center of a large hog- and grain-producing region. The County’s agriculturally based economy sustained a 5.1 percent growth rate from 1990 to 2000, comparable to the growth rate of the State (5.4 percent).

Population (2000)	12,183
Per Capita Personal Income (1998)	\$39,200
NFIP Participant?	Yes (1978)
Community Rating System (CRS)	No
Declared Disasters since 1990	4
Repetitive Loss Properties*	6

* Repetitive Loss Properties are currently insured properties that have incurred two or more National Flood insurance Program losses of at least \$1000 within 10 years

Flood Recovery Strategy After the 1993 Flood

The recovery effort from the 1993 flood was led by the IEMD and FEMA, in coordination with the Southeast Iowa Regional Planning Commission (SEIRPC), based in Burlington. Because flooding and/or seepage affected almost all

SECTION TWO: MEASURING MITIGATION SUCCESS— A PROFILE OF FOUR IOWA COMMUNITIES

of the homes in the Reggie Myers and Spitznoggle subdivisions, the IEMD, FEMA, and SEIRPC needed a coordinated strategy to address the long-term health and stability of the community. The strategy was guided by three goals: 1) to reduce or eliminate the risk from flooding; 2) to provide safe, affordable housing for disaster victims; and 3) to eliminate or minimize the exposure of Louisa residents to health and safety problems posed by flooded septic systems. In partnership with FEMA and the SEIRPC, the IEMD identified over 200 properties that were eligible for acquisition and demolition or relocation. These properties were located in the northeastern corner of the County, stretching south along County Road X61, adjacent to the Mississippi River and Lake Odessa.

Louisa County – like other rural Iowa communities – continues to experience a shortage of affordable housing. Following the 1993 flood, there were only three available houses in the County in the \$40,000 to \$60,000 range. Simply acquiring and demolishing up to 176 houses to address the flood problems would result in the temporary displacement of nearly five percent of the County's population.

Instead of demolishing the flood-damaged homes and eliminating a supply of affordable housing and possibly pushing residents to move outside the County, the Muscatine Center for Strategic Action (MCSA), a non-profit organization whose mission is to assist rural Iowa families with housing and related needs, took the lead in developing a strategy to acquire and relocate flood-prone houses in Louisa County. The focus of the relocation program was the Reggie Myers and Spitznoggle subdivisions. These dwellings were structurally sound, with an average assessed value of \$55,000, yet were located in the floodplain and susceptible to seepage and flooding. A majority of the homes in these flooded subdivisions sustained less than \$10,000 in damages from the 1993 flood. The damage that was sustained was primarily to the foundations, septic systems, and household contents (Louisa County Tax Assessor).

After acquiring the homes, Louisa County sold them to the MCSA for \$1 each. MCSA, working with the County, initiated an outreach campaign to find potential buyers of the 109 homes. The MCSA assumed the responsibility of managing the relocation of the homes out of the floodplain at an average cost of \$12,500. To be eligible, a buyer had to meet the following conditions:

- § Be a resident of Louisa County
- § Have a household income that was at or below the median household income for the County
- § Secure a suitable lot that was not in the floodplain
- § Build a foundation to support the relocated house
- § Obtain a letter of credit from a bank to cover the costs of building the foundation and moving the house to the new site

The aggressive outreach effort by MCSA generated considerable interest in the housing relocation program. Within a three-month period, applications were filed for 99 homes. Local banks provided loans to the applicants, with an average loan of \$41,000. These loans were used to purchase a lot, build a foundation, move the house, and tie the house to the foundation, completing the “rehabilitation” process.

Demolition versus Relocation: Implications for Louisa County

When the Louisa County buyout program was completed in 1996, a total of 77 homes had been acquired and demolished and a total of 99 houses were acquired and relocated. An analysis of the relocated houses determined that their total assessed value in 2001 was \$7,920,000, an average of \$80,000 per house. The property tax revenue from these 99 relocated houses was \$118,000 (Louisa County Tax Assessor). All of the relocated houses were sited

SECTION TWO: MEASURING MITIGATION SUCCESS— A PROFILE OF FOUR IOWA COMMUNITIES

in Louisa County, a condition of the loan agreement. Of the 77 recipients of FEMA funds for acquisition and demolition, only nine households used the funds to build new housing in Louisa County, with a total assessed value of \$495,000, or an average of \$55,000.

In light of the increased assessed value of the relocated homes and the retention of residents and associated property taxes, the housing relocation initiative had a positive, measurable impact on Louisa County. Ninety-nine homes, previously subjected to periodic flooding, were acquired, refurbished, and relocated to safer areas throughout the community. By rehabilitating and relocating the flood damaged houses versus demolishing them, Louisa County preserved and upgraded nearly 100 houses. Thus, the HMGP project addressed two community goals – maintaining the stock of affordable housing and increasing the local tax base.

Losses Avoided Following the Flood of 2001

In early May 2001, the flood pattern of 1993 repeated itself. The Mississippi River and its tributaries flooded Louisa County, rising to their third highest level on record. Levees became saturated, the water table in the County rose significantly, and seepage and flooding occurred in the low-lying areas in the southeastern and northeastern corners of the County.

The Spring 2001 flooding in Louisa County in the spring of 2001 presented an opportunity to assess the losses that were averted because of the mitigation action taken after the 1993 flood. Analysis of just 69 of the 176 flood prone structures shows that these acquisitions resulted in \$1,256,815 in avoided losses. This amount includes:

- § avoided costs of repairing damaged dwellings
- § avoided costs of replacing damaged contents
- § avoided displacements costs (lodging, food and other associated costs that are incurred while the flood-damaged residence is repaired or replaced)



Figure 2-1: Ninety-nine homes in the flood-prone Reggie Myers subdivision were acquired and relocated. A question posed in this study asks what losses were avoided as a result of these mitigation actions.

Section Three contains a more detailed explanation of the losses avoided methodology, and the findings from the analysis of Louisa County.

A Comparison of Flood Recovery in 1993 and 2001

One objective of this study is to evaluate the response and recovery efforts of Louisa County following the 2001 flood to gauge the impact of post-1993 mitigation measures. In the 1993 flood, an estimated 200 families in Louisa were forced to evacuate their homes because of flooding and seepage. According to the Red Cross, a total of 800 “cases” were opened in the aftermath of the 1993 flood, reflecting the number of individuals who sought assistance for necessities like cleaning supplies, food, shelter, and household items. FEMA expended nearly \$600,000 on Disaster Housing Assistance to provide help to victims for minimal home repairs, rent, and other costs related to temporary housing assistance. Conversely, in the 2001 flood, only 11 families were displaced because of flooding and seepage, and only three families requested assistance from the Red Cross. No FEMA Disaster Housing Assistance was needed. The significant reduction in the number of individuals who requested assistance from the Red Cross after

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the 2001 flood and the reduction in Disaster Housing Assistance are directly attributable to the removal of 176 families in the identified flood hazard areas.

Public Assistance Expenditures

Beyond the reductions in emergency shelter and family care services following the 1993 flood, there were reductions in two other categories: 1) debris removal; and 2) emergency services. Following the 1993 flood, it cost an estimated \$542,215 (2001) to demolish 77 homes and dispose of the debris. The costs under Emergency Protective Measures, which includes overtime for local emergency services officials, was \$44,367 (2001) in 1993, but \$0 in the 2001 flood. One conclusion that can be drawn is that the removal of 176 houses from the flood hazard area in Louisa County directly contributed to the significant reduction in costs related to Debris Clearance and Emergency Protective Measures. There were 176 fewer houses in the floodplain, and 176 fewer households that potentially required assistance following the 2001 flood.

Table 2-1: Emergency Shelter and Family Assistance in Louisa County (2001 values)		
	1993	2001
Number of families evacuated and temporarily sheltered due to displacement	200	11
Number of Red Cross cases (individuals requesting post-disaster assistance)	800	3
Disaster Housing Assistance (FEMA)	\$742,500	0

Source: Red Cross, Des Moines Chapter; FEMA

Table 2-2: Public Assistance Expenditures, 1993 and 2001 (2001 values)			
		1993	2001
A	Debris Clearance	\$542,215	\$0
B	Emergency Protective Measures	\$44,367	\$0
C	Roads and Bridges, Culverts, Ditches	\$2,941	\$0
D	Water Control Facilities & Levees	\$0	\$0
E	Public Buildings & Contents	\$0	\$0
F	Utility Distribution Systems	\$0	\$0
G	Public Parks	\$0	\$0
H	Total Public Assistance	\$589,524	\$0

Source: FEMA

Summary and Conclusions

Of the four communities that are reviewed in this study, Louisa County experienced the most significant changes in the aftermath of the floods of 1993 and 2001. In the 1993 flood, the resources of the County were overwhelmed. Local officials were not equipped to effectively address the needs of 200 families. The widespread nature of the flooding and seepage, which covered the eastern third of the County, caused an estimated 800 individuals (or about six percent of the County's population) to seek assistance from the Red Cross in the aftermath of the 1993 flood.

The pattern is clear-- as a result of the acquisitions and demolitions or relocations following the 1993 flood, there were documented savings to Louisa County and the State of Iowa after the 2001 flood. By removing 176 houses from the floodplain after the 1993 flood, Louisa County experienced a significant reduction in requirements for federal and State assistance in the following areas: evacuation and sheltering of flood victims, Red Cross assistance to families, disaster housing, debris clearance, and emergency protective measures. When the estimated savings (\$1,256,815) in repair costs, contents replacement costs and displacement costs from the acquisitions are included, the total losses avoided by implementing the HMGP buyout project in Louisa County approaches an estimated \$2 million.

CITY OF DAVENPORT: PROMOTING THE ACQUISITION OF FLOOD PRONE PROPERTIES AS PART OF A COMPREHENSIVE APPROACH TO FLOOD HAZARD REDUCTION

The Flood Hazard in the City of Davenport



The City of Davenport's flood problems are related to overflow of the Mississippi River and its tributaries within the City and throughout Scott County. Often, the most severe flooding events on the Mississippi occur during the late spring as a result of rapid snow melt in conjunction with warm, heavy rains. Sometimes, the flooding is further aggravated by ice jams.

Flooding in downtown Davenport occurs at a river gage height of 15 feet. As reflected in Table 2-3, the City experienced 26 floods from 1951 to 2001, including five "10-year events" and three "100-year events" (defined as a flood

that has a one-percent chance of occurring in any given year). For each flood event, the table shows the river elevations (gage height), and the number of days that the flood event remained at these elevations.

Historically, creek flooding in Davenport was not a concern until the early part of the twentieth century, when development to the north and east infringed upon the Duck Creek and Black Hawk Creek floodplains. While no flood gauge records are available for Duck Creek, the City of Davenport records indicate that at least fifteen floods of varying magnitude have occurred along the creeks since 1921. Planning documents from as early as 1918 identify land use problems associated with flooding along Duck Creek. Despite recommendations to avoid development along Duck Creek, many homes have been built in relatively close proximity to the creek. In 1965, following a 100-year flood event on the Mississippi, the City constructed a levee around the Garden Addition subdivision in east Davenport to provide residents and businesses with increased protection from flooding on the Black Hawk Creek and Duck Creek.

CITY OF DAVENPORT COMMUNITY PROFILE

Since it was first settled in 1836 on the banks of the Mississippi River, the City of Davenport has experienced periodic flooding. As a center of trade and commerce during the mid-1800s, the City went through a period of rapid growth and development. Much of this development occurred in flood prone areas on the banks of the Mississippi River.

During the 1960s and 1970s, a spurt of new development in Davenport took place on land adjacent to Duck Creek and its tributaries, a growth pattern that has compounded the City's flood problems.

Today, Davenport is the commercial and population center of Eastern Iowa. The downtown riverfront area continues to be the focal point of commercial and community activity. As one of the few elements of the urban landscape that spans the entire City, the river's edge has become an integral part of Davenport's identity. For this reason, flood hazard mitigation and community planning are closely linked with efforts to enhance and maintain the riverfront area of the City.

Population (2000)	98,300
Per Capita Personal Income (1998)	\$44,600
NFIP Participant?	Yes (1978)
Community Rating System (CRS)	Yes (1995)
Declared Disasters since 1990	4
Repetitive Loss Properties	30

* Repetitive Loss Properties are currently insured properties that have incurred two or more National Flood Insurance Program losses of at least \$1000 within 10 years

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Table 2-3: River Flood Levels and Duration for Davenport: 1950 to 2002							
Year	Peak Stage	Number of Days Above Flood Stage					Frequency
		15 ft	17 ft	19 ft	21 ft	22 ft	
1951	18.2	22	14	-	-	-	10-Year
1952	18.6	20	14	-	-	-	10-Year
1954	15.5	5	-	-	-	-	< 10-Year
1960	15.2	3	-	-	-	-	< 10-Year
1965	22.5	27	20	13	8	4	100-Year
1966	19.0	12	6	1	-	-	10-Year
1967	17.4	6	6	-	-	-	< 10-Year
1969	19.3	19	13	4	-	-	10-Year
1971	15.5	6	-	-	-	-	< 10-Year
1973	18.8	37	23	-	-	-	10-Year
1974	17.0	6	1	-	-	-	< 10-Year
1975	19.2	17	12	3	-	-	10-Year
1979	16.3	31	-	-	-	-	< 10-Year
1982	15.9	6	-	-	-	-	< 10-Year
1983	17.0	11	2	-	-	-	10-Year
1986	19.2	40	21	4	-	-	10-Year
1993	22.6	92	44	25	17	7	100-Year
2001	22.3	38	19	11	8	3	100-Year

Source: City of Davenport, Department of Community and Economic Development; U.S. Army Corps of Engineers, Rock Island District

The most devastating episode of local creek flooding took place on June 16, 1990. Heavy rainfall throughout May and June of 1990 saturated the ground. An intense 24-hour period of rainfall followed, with totals of up to ten inches. Stream levels rose rapidly, and flash flooding occurred along the Black Hawk Creek and Duck Creek and their tributaries. The U.S. Army Corps of Engineers determined that the flooding in Davenport and other parts of Scott County exceeded the 100-year event. The City of Davenport documented \$19 million in damages to the community. This total includes 70 single-family homes and 15 mobile homes with major damage, and an additional 7,000 single-family homes with minor damage.

Table 2-4: Flood Frequencies and Flood Levels in the City of Davenport	
10-Year Flood	17.0 feet river stage (approximate)
50-Year Flood	20.2 feet
100-Year Flood	21.5 feet
500-Year Flood	24.0 feet
Note: At River Stage 15.0 feet, the Mississippi River leaves its banks in Davenport's downtown area	

Source: City of Davenport, Floodplain Management Plan (1995)

The City of Davenport's Hazard Mitigation Strategy

The City of Davenport undertook a study in 1990 and determined that there were 1,510 primary structures in the City of Davenport's 100-year floodplains, including 631 structures in the Mississippi River floodplain, and 879 in the floodplains of the creek systems. Approximately two-thirds of the structures were residential, with 30 of these classified as repetitive loss properties defined by NFIP as currently insured properties that have incurred two or more losses of at least \$1000 within 10 years.

Following the 1990 flood, the City of Davenport implemented the Residential Acquisition Program in an effort to reduce the number of flood prone properties in the City. The voluntary, City-administered program targets homeowners who are willing to sell their flood prone residential properties at pre-flood fair market value. A step-by-step process was established to administer the program.

1. Eligible homeowners submit applications for residential acquisition and clearance to the City of Davenport's Office of Planning and Land Use, Department of Community and Economic Development. The applications are reviewed and prioritized, based on the location and flood history of the property.
2. The Office of Planning and Land Use submits a list of recommended properties for acquisition to the City Council for review and approval.
3. Upon Council approval of the application, purchase agreements with the sellers are established, the acquisitions are completed, solicitation of demolition bids are accepted, the properties are secured (and boarded up), and demolition is completed.
4. The properties are maintained as open space by the Public Works Department.

The Residential Acquisition Program has become an important tool in Davenport's strategy to reduce its exposure to future floods. Since 1994, the City's Residential Flood Acquisition Program has resulted in the acquisition and demolition of 45 flood prone residential structures, and the return of these properties to open space. Funding for the initiative under the City's Capital Improvement Program has averaged \$165,000 per year.

The City has adopted several other programs that limit or modify development in the floodplains and other environmentally sensitive areas. In 1978, the City adopted a *Flood Damage Prevention Ordinance*, which establishes floodplain development regulations to minimize public and private losses due to floods. Through the ordinance, the City maintains higher regulatory standards than the minimum requirements of the NFIP, including the requirement that all new construction or substantial improvements be elevated or flood proofed so that their lowest floor is one foot above the 100-year flood elevation. The City also launched an aggressive *Creek Inspection and Maintenance Program* in a focused effort to clear debris from the Duck, Black Hawk, and Robin Creeks.

Consideration of a Floodwall for the City of Davenport

The flood hazard in Davenport and strategies for minimizing the effects of flooding have been a public policy issue since the 1970's. In 1970, Congress authorized funding to construct the Davenport Flood Protection Project – a floodwall stretching along the Mississippi River – which would offer flood protection to the downtown area from a 500-year event. A final design plan was completed in 1982 for \$33.9 million, with a benefit-cost ratio of 1.17 (which meant that for every dollar spent on the project, there would be \$1.17 return on investment).

In May 1984, due to prevailing economic conditions, and the cost of the project (Davenport's share would be 35 percent of the total), the City declined to participate in the project. Following the 2001 flood, which flooded the baseball stadium and portions of the downtown area, the City of Davenport elected to re-evaluate the Flood Protection Project to determine whether it was still economically justified, environmentally acceptable, technically appropriate, and adequately supported by non-federal interests.

While the negotiations continue between the U.S. Army Corps of Engineers and the City of Davenport on the feasibility and desirability of the Flood Protection Project, the State of Iowa and community officials are pursuing a flood hazard mitigation strategy that is guided by a mutually agreed upon priority: to acquire and remove residential properties from the floodplains of the Mississippi River and its tributaries.

SECTION TWO: MEASURING MITIGATION SUCCESS— A PROFILE OF FOUR IOWA COMMUNITIES

Another approach to managing flooding is the City's adoption in 1990 of the *Stormwater Management Ordinance*. The purpose of the ordinance was to establish procedures to control surface water runoff in developing areas. This ordinance is also designed to establish maximum discharge rates of surface waters into various streams where detention facilities have been determined to be beneficial in reducing flooding of downstream development.

The Flood of 1993

Excessive rainfall during the months of April through July in 1993 produced record flooding along the Mississippi and Missouri Rivers, including the highest crest ever recorded in Davenport - at 22.6 feet, or 7.6 feet above the normal river level of 15 feet. The extent of flooding in the City of Davenport was unprecedented. The City administered a survey of 300 businesses located within Davenport's Mississippi River floodplain and determined that 15 businesses sustained damage or disruption due to the flood, with damage estimates placed at \$3.4 million. Of the 330 residential properties in the Mississippi River floodplain, 89 sustained at least moderate damage, totaling \$1.6 million. Damage to infrastructure was also significant, with estimates placed at \$3.1 million for damage to roads, bridges, and public buildings.

The 1993 flood was the turning point in Davenport's flood hazard mitigation program. The disaster spurred State, local and federal coordination in the acquisition of flood prone residential structures in the floodplains of the Mississippi River and its tributaries. Following the flood of 1993, the IEMD, in cooperation with FEMA and local officials, targeted five properties in the City of Davenport for acquisition and removal from the 100-year floodplain. An additional house was selected for elevation above the 100-year flood event. The total project cost was \$156,092.

Losses Avoided following the 2001 Flood

With the five property acquisitions and one elevation completed in 1996, the flood of 2001 (FEMA DR-1367) presents an opportunity to estimate the losses avoided as the direct result of these mitigation measures.

The total losses avoided for the 2001 flood event are \$41,392, attributable primarily to two of the six residential mitigation projects. These two projects were located on Duck Creek. The four remaining projects located in the Garden Addition near Black Hawk Creek did not sustain any flooding during the 2001 flood. The results of the analysis, including the calculations that were used to arrive at the results, are contained in Section Three.

A similar analysis was carried out for the City of Davenport's Residential Acquisition Program to estimate the losses avoided as a result of the acquisition of 45 houses since 1995. Table 2-5 depicts the results of the analysis. In one flood event, the acquisition and demolition of 45 homes at a cost of \$1.1 million resulted in avoided losses of approximately \$396,000. Most of the flooding in 2001 occurred in the floodplain of Duck Creek, where 30 of the 45 of the acquired and demolished houses had been located.

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Table 2-5: City of Davenport's Residential Acquisition Program: Losses Avoided in the Spring, 2001 Flood (DR-1367) as a Result of 45 Acquisitions

Depth of Flooding (Feet)	Number of Structures	Building Losses Avoided	Contents Losses Avoided	Displacement Costs Avoided	Total
0	33	\$57,310	\$25,790	-	\$83,100
1	10	\$247,474	\$116,666	\$33,000	\$397,140
2	2	\$24,035	\$10,816	\$6,600	\$41,451
Total	45	\$328,819	\$153,272	\$39,600	\$521,691

A Comparison of Flood Recovery in 1993 and 2001

The flood of 1993 was a slow rising event that produced flood conditions that lingered for nearly three months, flooding many of the tributaries of the Mississippi River. The scope of the flooding accounts for the significant debris clearance operations that included the tributaries as well as the floodplain of the Mississippi River.

The 2001 flood was characterized by a rapid onset of floodwaters in the northern Iowa counties that are located on the Mississippi. The velocity of the floodwaters, and the rise and fall of flood levels caused more damage and scouring to culverts, roads, bridges and sewer systems than the 1993 flood.

Public Assistance Expenditures

As reflected in Table 2-6, the total expenditures for Public Assistance were significantly higher for the 1993 flood. The significant differences in individual categories – including Debris Clearance (A), Roads and Bridges (C), and Utility Distribution Systems (F) – can be attributed in part to differences in the nature of the two flooding events.

Table 2-6: Public Assistance Expenditures, 1993 and 2001 (2001 values)

		1993	2001
A	Debris Clearance	\$1,108,646	\$44,800
B	Emergency Protective Measures	\$1,577,524	\$1,382,755
C	Roads and Bridges, Culverts, Ditches	\$42,761	\$317,963
D	Water Control Facilities & Levees	\$13,482	\$50,008
E	Public Buildings & Contents	\$80,233	\$21,000
F	Utility Distribution Systems	\$42,761	\$317,963
G	Public Parks	\$496,787	\$434,000
H	Total Public Assistance	\$3,362,194	\$2,857,018

The substantial reduction in Public Assistance funding necessary for debris clearance after the 2001 flood, shown in the table below, suggests that the City of Davenport's Creek Inspection and Maintenance Program, administered by the Public Works Department, has been effective. Through the program, the City has aggressively addressed its stormwater management issues by cleaning up public and privately owned creeks within the City's boundaries. While the flood events of 1993 (slow-rise, long duration) and 2001 (rapid-onset, short duration) had different characteristics and thus different impacts on generating debris, it is clear that the City's *pre-disaster* debris cleanup efforts contributed to a *post-disaster* reduction in debris removal requirements following the 2001 flood.

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The significant increase in Public Assistance expenditures in the 2001 flood for Category C-- Roads and Bridges— is attributable to the high velocity of the floodwaters, which caused major damage to sidewalks, streets and sewers in the downtown area. Asphalt streets were particularly vulnerable to the strong currents of the floodwaters, creating uplift and “sunken streets.”

Comparing the flood response and recovery efforts (and expenditures) in the City of Davenport for the two events, the most significant change was the absence of any flood damages and losses to the Public Works Department (PWD) facility in the 2001 flood.

In 1993, the PWD facility was severely flooded. Located in the floodplain of the Mississippi River, the PWD was closed in June and July 1993, at the height of the flood. Over 200 employees were temporarily displaced, many of whom were responsible for the PWD’s primary mission during a flood – the construction of temporary dikes around the City to protect it from Mississippi River flooding. Total insured damages to the PWD buildings and contents were estimated to be \$1.1 million. The uninsured damages were estimated to be about \$80,000, which were covered under category E of Public Assistance.

In 1995, the City of Davenport decided to relocate the PWD to safer grounds. A new complex was constructed at a cost of \$18 million. All key divisions were consolidated – Building Inspection, Engineering, Facilities Maintenance, Street Maintenance, Transportation, Stormwater Management, and Fleet Management.

When the Mississippi River reached flood stage in April 2001, the original site of the PWD once again flooded. This time, there was no interruption of emergency services (dike construction, building inspections, road closures, pump operations), and there were no damages to the new complex.

Emergency Shelter

As in other eastern Iowa communities, the City of Davenport experienced far fewer demands for shelter, feeding, and other family assistance programs in 2001, as compared with 1993. The reduction in 2001 can be attributed in large part to the localized nature of the flooding in 2001, and the shorter duration of the event (in 2001 the flood stage was equaled or exceeded for 40 days, in 1993 the flood stage was equaled or exceed for 92 days). However, it is clear that the acquisition and demolition of 51 homes (45 through the Davenport Residential Acquisition Program and six through the HMGP Program) played a role in reducing the number of families who had to be evacuated and sheltered in the 2001 event.

Table 2-7: Emergency Shelter and Family Assistance (2001 values)		
	1993	2001
Number of families evacuated and temporarily sheltered due to displacement	245	18
Number of Red Cross cases (individuals requesting post-disaster assistance)	725	45
Disaster Housing Assistance (FEMA)	\$1,103,045	\$0

Source: Red Cross, Des Moines Chapter; FEMA

Summary and Conclusions

The City of Davenport is taking an incremental yet comprehensive long-term approach to flood hazard mitigation. The challenge for local leaders is to capitalize on the community’s biggest asset (and potential liability) – the Mississippi

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River – in a balanced approach to land use planning and development that incorporates flood mitigation practices with efforts to revitalize the riverfront, promote tourism and spur economic development.

The success of the mitigation planning program in the City of Davenport is attributed to at least two factors: 1) the network of cooperating organizations that have been involved in mitigation planning in the City for the past two decades; and 2) the commitment of the City to establish locally funded programs that can be leveraged with State and federal dollars in an incremental, long-term strategy to reduce flood losses.

Davenport serves as a model for other Iowa communities on how to effectively engage with State and federal partners in a closely coordinated approach to flood hazard assessment and flood hazard reduction. At the federal level, the U.S. Army Corps of Engineers, FEMA, and the Natural Resource Conservation Service have been actively involved in flood hazard mitigation efforts in Davenport and Scott County. IEMD has assumed the lead role among State agencies in working with the City to develop a local mitigation plan and implement mitigation projects through the HMGP and other programs. A good example of IEMD and City of Davenport collaboration is the use of HMGP and City funds to develop and implement a carefully coordinated Acquisition Program that is managed by the City's Department of Economic and Community Development.

The analysis carried out in this report determined that the losses avoided through the HMGP funded mitigation measures after the 2001 flood amounted to \$41,392, or about 22 percent of the original investment of \$191,307. For the City of Davenport's Residential Acquisition Program, the savings after the 2001 flood are estimated to be over \$500,000 – or about 45 percent of the total amount invested by the City in the program to date. It should be emphasized that the results of the losses avoided analysis for the City of Davenport *are for only one event* – the 2001 flood. Acquisition and demolition of flood prone properties is a permanent solution to eliminating the risk of flooding in residential areas of the City. As future floods occur in Davenport, the return on investment in hazard mitigation will continue to increase.

THE CITY OF MCGREGOR: REDUCING THE VULNERABILITY OF A CRITICAL PUBLIC FACILITY

Flooding in McGregor



Like many other communities along the Mississippi River, the City of McGregor, Iowa often experiences flooding in the spring, as rainfall and snowmelts increase. During the past half century, major flood events have occurred in 1951, 1952, 1965, 1967, 1969, 1973, 1975, twice in 1986 (spring and fall), 1993, 1996 and 2001. Acknowledging the vulnerability of lifelines, like water, sewage treatment, electric power, and telephone services, to floods, snow and ice, high winds and other natural hazards, Iowa communities are giving higher priority to mitigation projects that reduce the risk to these facilities. Lifeline services are essential to the economic well-being of a community, and are often vulnerable to the effects of natural hazards. The flood of 1993 in Des Moines provides an example of how a lifeline failure can cause substantial disruption to business and residential customers. When the

levee that protects the Des Moines Water Works facility was over-topped, floodwater entered the facility and resulted in a shutdown of operations. Over 250,000 customers were without water service for 11 days. Direct costs associated with the damage to the Des Moines Water Works facility totaled over \$12 million. Beyond property damages and business interruption, costs were incurred for emergency restoration of water services and the provision of immediate measures to protect the facility from additional flooding. The costs for these measures, which included debris removal, emergency sandbagging, pumping and levee repair, totaled just over \$2 million.

McGregor’s Mitigation Strategy – Protecting the Municipal Power Plant

Following the 1993 flood, the City of McGregor, in coordination with the IEMD, developed a local mitigation strategy that gave priority to protecting a critical public facility – the McGregor Municipal Utility – to ensure continuity of electric power following a major flood. The McGregor Municipal Utility, built in 1942, provides electricity to the City’s 261 residential and 89 commercial customers, as well as a nursing home, a medical clinic, the public water supply facility, the wastewater treatment plant, the local school system, police and fire services, and other critical facilities. The plant has three diesel generators, and a substation. Currently, the majority of electricity delivered by the facility is generated from outside sources. The total value of the plant is \$1.2 million (2001).

CITY OF MCGREGOR COMMUNITY PROFILE	
The City of McGregor, located on the Mississippi River across from Prairie du Chien, Wisconsin, is an historic town of 874 inhabitants (2000 census). The community is a destination for visitors who wish to take advantage of the small town atmosphere, the bed and breakfast establishments along the river, and the many antique and specialty shops. While the population remains under 900 people, the City is home to over 50 small businesses.	
Population (2000)	874
1998 Per Capita Personal Income	\$41,225
NFIP Participant?	Yes (1978)
Community Rating System (CRS)	No
Declared Disasters since 1990	4
Repetitive Loss Properties*	-
* Repetitive Loss Properties are currently insured properties that have incurred two or more National Flood insurance Program losses of at least \$1000 within 10 years	

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As reflected in Table 2-8, the municipal power plant has sustained flood levels of at least 18 feet on 21 different occasions. The floodwaters typically reach the facility through the sewer lines and subterranean channels that permeate the floodplain, eventually ponding around the plant. Historically, local officials have relied on sandbagging and other emergency measures to protect the plant from flooding.

Table 2-8: Flood Frequency and Impacts to the McGregor Municipal Plant, 1950 to 2001

River Level (feet)	Elevation (feet)	Number of Flood Events	Flood Frequency	Impact/Protective Measures
16	621	6	5-year	Flood stage at the plan. Water begins to “back into” low area around the plant; situation is closely monitored
17	622	7		
18	623	8	10-year	Critical level for the plant; sand bagging and other emergency actions are triggered
19	624	5		
20	625	3		
21	626	2	50-year	
22	627	1 (1993)	100-year	Significant backwater flooding; floodwall built in 1996 to protect the plant from 500-year event
23	628	1 (2001)	100-year	Backwater flooding; floodwall provided protection.
25	630	1 (1965)	100-year	Significant backwater flooding; extensive sandbagging and other protective measures are carried out
27	632	-	500-year	

Source: McGregor Municipal Utilities; U.S. Army Corps of Engineers, St. Paul District

The Flood of 1993

In the 1993 flood, the Mississippi peaked at elevation 22.75 feet. Twenty-five of the 50 businesses in McGregor were closed for two weeks, primarily because of a lack of access to the business sites (City Clerk, McGregor).

The McGregor Municipal Utility was operational at all times during the 1993 flood. However, the first sandbag levee failed and a “back-up” sandbagging effort was required. To protect the McGregor Municipal Utility from flooding, approximately 4,000 sandbags were used, with an additional \$6,741 (2001) expended for equipment, material, and extra labor charges for municipal personnel. Additionally, the sandbagging operation involved 23 volunteer firemen, who contributed a total of 125 hours at an estimated cost of \$1,226 (2001). During the flood, the majority of the plant staff’s time was diverted to emergency efforts, including splitting shifts to monitor the emergency sandbag levee. This commitment of staff time amounts to approximately \$4,290 (2001) for the two-week event (McGregor Municipal Utility).

Based on the emergency costs associated with the 1993 flood event, it is estimated that emergency efforts to protect the McGregor Municipal Utility in a major flood event can be valued at \$12,256 (2001), which includes about \$6,741 (2001) for sandbags and other materials, and \$5,515 (2001) for labor.

Losses Avoided through Mitigation Following the 2001 Flood

Following the 1993 flood, the decision was made to construct a floodwall around the utility to provide protection for a 500-year event. Through this investment, the City is assured of having a reliable source of electric power for the

**SECTION TWO: MEASURING MITIGATION SUCCESS—
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community's critical facilities, businesses and residences. HMGP funds were used, with a total project cost of \$212,424.40 (2001). The funds were used to construct a floodwall and earthen berm around the McGregor Municipal Utility facility to provide protection from a 500-year flood.

Estimated Costs Should Emergency Measures Fail

Before the floodwall and berm were built, emergency-sandbagging efforts succeeded in keeping the floodwaters from entering the basement of the municipal power plant. To compare whether the mitigation action of building a floodwall helped avoid losses at the utility, the project team asked a key hypothetical question— what were the potential consequences to the municipal plant if the emergency sandbagging measures had failed during the 1993 flood?

Table 2-9 shows the elevations of the basement and ground floor in the McGregor Municipal Utilities, and the equipment that is located at each level. Some of the most critical (and heaviest) equipment is located in the basement, including three diesel engines, the electrical switchgear, substation equipment, and fuel pumps. The total estimated cost to repair or replace this equipment in the event of a flood is \$135,000 for one event. If the emergency measures failed and the ground floor was flooded (at elevation 630 feet, equal to the flood level of the 1965 flood on the Mississippi River), other critical equipment would be flooded, including the transformer and tank pumps. Under this scenario, the plant officials have determined that it would be necessary to construct a temporary substation at a cost of \$135,000.

Table 2-9: Estimated Direct Losses from Flooding to McGregor Municipal Utilities (2001 values)			
Location	Elevation	Equipment	Estimated Costs if Flooded
Ground Floor	630.1 (100-year flood)	Transformer	\$31,000
		Tank pumps office equipment Construction of a temporary substation (assuming plant shutdown) to deliver electricity to McGregor	\$135,000
			\$166,000 total
Basement	621.1 (624.4 - point of entry for floodwaters) (627.2 - peak elevation of 1993 flood)	(3) Diesel engines	\$43,000 labor/repair
		Electrical switch gear	\$25,000 repair/replace
		Substation equipment	\$31,000 repair/replace
		Fuel pumps Tool shop and misc. equipment	\$12,000 repair/replace \$12,000 clean/repair \$12,000 general cleanup
			\$135,000 total

Source: McGregor Municipal Utilities; U.S. Army Corps of Engineers, St. Paul District

The Spring 2001 Flood – An Opportunity to Assess the Losses Avoided as a Result of Implementing the Flood Control Project

On Friday, April 20, 2001, the Mississippi River crested at 23.75 feet, the second highest level on record. The flooding conditions on Main Street and River Road once again forced about 15 businesses to close due to lack of access. The City used 645 tons of sand and 290 tons of clay to fill sand bags to build a temporary dike to protect the

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downtown business district. Several pumps were operated 24 hours a day for nearly a month to remove floodwater from behind the dike. The total expenditures for these protective measures under FEMA's Public Assistance program were about \$50,000.

The total expense for the McGregor Municipal Utilities in the 2001 flood was \$926, which included overtime pay for maintenance personnel. The 1993 flood event cost the utility \$12,000 (2001). As a direct result of the construction of the floodwall around the McGregor Municipal Utilities, the losses avoided from the flood in 2001 are estimated at \$11,000. This includes sandbagging costs (equipment and manpower) that were avoided because of the mitigation project.

In evaluating the losses avoided through mitigation, it is important to factor the availability of the local fire service to carry out their duties because they were not involved in sandbagging and other flood protection measures at the electric utility. In the 1993 flood, 23 volunteer fire personnel devoted 125 hours to emergency sandbagging at the plant. Because of the floodwall, these same personnel were available in the 2001 flood to assist local officials with other protective measures.

A Comparison of Flood Recovery in 1993 versus 2001

The floods of 1993 and 2001 were comparable in terms of the number of days that the Mississippi River was at or above flood stage in the City of McGregor – 39 days in 1993, and 45 days in 2001. In evaluating the flood response and recovery operations in the two events, two interrelated factors have been identified that contributed to reduced losses in the 2001 flood and an expedited recovery: 1) the fact that that the Municipal Utilities was a “trouble free zone” in the 2001 flood (McGregor City Clerk), enabling local flood fighters to concentrate their efforts on other priorities; and 2) the improved level of preparedness of local officials and community volunteers, who learned from mistakes made in the 1993 flood.

During the 2001 flood, McGregor’s downtown business area remained open for business for the entire 45 days that the river was at or above flood stage. As previously noted, flooding on Highway 18 – which provides access to the downtown area – resulted in the closure of approximately 25 businesses for two weeks. The total loss of revenue to the 25 small business owners during this period is estimated between \$50,000 and \$60,000 (City Clerk).

As reflected in Table 2-10, Public Assistance expenditures in the 2001 flood were more than twice the level of 1993. This is attributed to the expenditures for sandbags and the operation of pumps. The sandbagging and pumps were instrumental in protecting the downtown business district during the 2001 flood.

Table 2-10: Public Assistance Expenditures, 1993 and 2001			
		1993	2001
A	Debris Clearance	\$0	\$3698
B	Emergency Protective Measures	\$3745	\$34,839
C	Roads and Bridges, Culverts, Ditches	\$0	\$5766
D	Water Control Facilities & Levees	\$0	\$0
E	Public Buildings & Contents	\$0	\$0
F	Utility Distribution Systems	\$0	\$5668
G	Public Parks	\$15,475	\$0
H	Total Public Assistance	\$19,221	\$49,971

Summary and Conclusions

The City of McGregor is a typical Iowa river community that has progressively adapted to the cycle of flooding on the Mississippi. Since the 1993 flood, the City’s flood hazard preparedness plan has been guided by two objectives: 1)

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protect the Municipal Utilities during floods to ensure continued operation; and 2) improve flood protection for the business district during a flood event. The HMGP project that was implemented after the 1993 flood has directly contributed to both objectives. The berm protected the McGregor Municipal Utility plant in the 2001 flood, resulting in a savings of \$11,000 in reduced overtime and lowered costs for acquisition of sandbags. In the process, the local resources (manpower and materials) that were previously devoted to protecting the Municipal Utilities were made available for the protection of the downtown business district.

DES MOINES COUNTY: A PARTNERSHIP APPROACH TO FLOOD HAZARD MITIGATION

Characteristics of the Flood Hazard



Des Moines County's location on the Mississippi River has shaped the region's exposure to floods and other natural hazards. The County is relatively flat, and in many places the terrain is lower in elevation than the Mississippi River. From 1930 to 2001, Des Moines County experienced 13 floods, or about one flood every five years. The most vulnerable parts of the County are the Tama Area, which lies along the Mississippi River, and the Flint Creek Area.

Like many other Iowa river communities, Des Moines County has relied on a levee system to protect local residents and businesses from the effects of flooding on the Mississippi. Following the flood of 1965, a 100-year flood event, a sand levee was constructed along the river to provide protection from a 50-year flood event.

The levee system has been relatively effective in keeping the Mississippi from overtopping its banks in the area, but levee conditions continue to present problems for Des Moines County: 1) the porous and unstable condition; 2) the high waters in the spring, which saturate the levees; 3) the presence of animal burrows, which gives the water a direct route through the levee; and 4) the erosion of the levee's foundation, which results in a "boil" (an area on the dry side that begins to slide away from the base). In order to slow the erosion process, sandbags are used to hold the boil in place.

Flood of 1993

The 1993 flood was the largest flood of record in Des Moines County. The river level reached 25 feet, or ten feet above flood stage, and remained above flood stage for 41 days. The City of Burlington, situated on the Mississippi, sustained the most damage in the County. The Memorial Auditorium, with five feet of water inside the building, suffered \$1.4 million in losses. Buildings, critical facilities, utilities and infrastructure along the riverfront were most vulnerable to the Mississippi flooding, with losses to public property alone totaling \$5.1 million.

Besides the City of Burlington, the 1993 flood caused the greatest damage in an area to the north of the City, adjacent to the Mississippi River. Approximately 200 homes were flooded, with an estimated 30 homes sustaining substantial flood damage ("substantial flood damage" is defined as losses equaling 50 percent or more of the value of the house).

DES MOINES COUNTY COMMUNITY PROFILE

Located on the Mississippi River in southeast Iowa, Des Moines County's history, economy, and development patterns are tied to the river. During the 1840s, steamboats traveled the Mississippi transporting goods and passengers into and out of the County. In 1854, the County gained its first railroad service, and by 1868 a railroad bridge spanned the Mississippi at Burlington, the County seat. As a transportation and commercial hub for the westward migration, Des Moines County experienced its greatest growth rate from 1850 to 1890, when it had a population of 35,392. After losing population from 1970 to 1990, the County experienced a 4.5 % growth rate, and by 2000 the County grew to over 42,000 residents.

One by-product of the early boom in building in Des Moines County is that 41 percent of all housing in the County was built before 1930, prior to the Uniform Building Code, zoning, and the National Flood Insurance Program.

Population (2000)	42,351
1998 Per Capita Personal Income	\$41,900
NFIP Participant?	Yes (1993)
Community Rating System (CRS)	Yes (1993)
Declared Disasters since 1990	4
Repetitive Loss Properties*	-

* Repetitive Loss Properties are currently insured properties that have incurred two or more National Flood insurance Program losses of at least \$1000 within 10 years

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The houses in the flood-damaged area are located on both the “river side” of the levee, and the “land side.” The residential structures at risk from flooding in this area range from river cabins, which are typically 800 square feet or less in area, to wood-framed houses that are between 1000 and 1,500 square feet in area, typically built with crawl space or on piers. The assessed cost of the homes at risk of flooding ranged from \$12,000 to \$105,000.

A Coalition Approach to Flood Recovery

The 1993 flood response efforts in Des Moines County were dominated by three major activities:

1. emergency sandbagging along the levee system, downtown Burlington, and other vulnerable locations-- an emergency protective measure that lasted over one month;
2. evacuation, sheltering and feeding of approximately 140 families who were forced to temporarily leave their homes because of the flooding; and
3. disaster assistance to an estimated 800 families who were directly or indirectly impacted by the disaster.

Table 2-11: Damages In 1993 in City of Burlington (2001 values)	
Memorial Auditorium and Garage	\$1,470,763
Market Street Sewer Lift Station	\$183,841
Wastewater Treatment Plant	\$183,841
Port of Burlington	\$306,401
Police Department (basement flooding)	\$147,073
Fire Department (basement flooding)	\$91,920
Landscaping at Port of Burlington	\$122,561
Riverfront Parking Damage	\$367,682
Waterworks plant	\$1,041,765
Public roads	\$2,451,211
Total	\$5,141,452

Source: City of Burlington

A coalition of twenty organizations was formed under the leadership of the United Way, Red Cross and Salvation Army to coordinate the delivery of temporary shelter, food, counseling, medical aid, help in filling out forms, distribution of cleaning supplies, and other assistance to the estimated 800 area families that were affected by the flood disaster.

Flood Hazard Mitigation

The flood losses in Des Moines County from the 1993 event provided the impetus for adopting new flood mitigation measures. A Hazard Mitigation Committee was formed in 1993, bringing together elected County leaders, County government officials – including the emergency management director, county engineer, land use administrator, and county conservation director – and two key organizations that have played a prominent role in shaping hazard mitigation in Des Moines County: the Southeast Iowa Regional Planning Commission and the Two Rivers Levee and Drainage Association.

Two early products of the Hazard Mitigation Committee were the *Des Moines County Hazard Mitigation Plan* and the adoption of the *Floodplain Management Ordinance* (July 19, 1993). The Ordinance requires that all new or substantially improved residential structures have the lowest floor elevated at least one foot above the 100-year flood level. The Ordinance also addressed flood protection for utility and sanitary systems, factory-built homes, and flood control structures – including levees.

Two Rivers Levee and Drainage Association

A unique partner in the mitigation planning process in Des Moines County is the Two Rivers Levee and Drainage Association, created in the aftermath of the 1993 flood to improve the coordination between the Iowa River-Flint Creek Levee District, which is responsible for maintaining the levees along the Mississippi River, and three drainage districts, which are responsible for maintaining hundreds of miles of drainage ditches.

The Association operates six large pumps – capable of pumping 400,000 gallons of water per minute – that are used to pump excess water from the ditches into the Mississippi River. These pumps have been instrumental in maintaining water flow through the drainage ditches and in minimizing the flood hazard in parts of Des Moines County.

Hazard Mitigation Grant Program

In the aftermath of the 1993 flood, Des Moines County's mitigation priority was for acquisition and demolition of the most flood prone houses in the Edgewater Beach and Tama Road area north of the City of Burlington. A total of 46 homes were acquired, and three homes were elevated. The total cost of the HMGP project was \$ 2,857,370 (2001).

Losses Avoided following the 2001 Flood

In April and May of 2001, a combination of heavy rains and rapid snowmelt in the northern Mississippi River basin created flood conditions in southeast Iowa, including Des Moines County. As in previous floods, there were two principal factors that contributed to the flooding in Des Moines County in the spring of 2001:

- 1) the elevation of the Mississippi River, the duration of the high water, and the pressure that the river placed on an already saturated levee system in Des Moines County; and
- 2) the problem of silted and clogged drainage ditches in the Flint Creek floodplain, which impeded the flow of water from the ditches into the Mississippi River. The flooding in 2001, however, was not of the same magnitude in terms of *flood levels* (1993 – 10 feet above flood stage; 2001 – 7 feet above flood stage), nor *duration of flooding* (1993 - 89 days above flood stage; 2001 - 38 days above flood stage) as the 1993 flood.

An analysis of losses avoided as a result of the 46 property acquisitions and three elevations determined that the savings in the one event – the 2001 flood – were \$193,346. Section Three contains a more detailed examination of the calculations involved in making these estimates.

A Comparison of Flood Recovery in 1993 and 2001

In simple terms, the flooding in the City of Burlington and Des Moines County in 1993 was considerably worse than in 2001. As noted earlier, the river levels in 2001 did not reach the levels experienced in 1993, and the duration was much shorter.

While there were differences in 1993 and 2001 flood events, there were other important factors that contributed to reduced losses in the 2001 flood. These include:

- 1) the acquisition and elevation of 49 flood prone properties in the Tama Road Area of Des Moines County;

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- 2) the significant increase in the pumping capacity of the Two Rivers Levee and Drainage Association, which enabled the Association to “pump water 24-7” during the height of the flood;
- 3) improved maintenance of the hundreds of miles of drainage ditches under the supervision of the Two Rivers Levee and Drainage Association; and
- 4) the adoption of the Countywide Floodplain Management in 1993, which led to improved floodplain management practices.

Public Assistance Expenditures

A review of Public Assistance (PA) expenditures in 1993 and 2001 reveals a sharp drop during the latest flood in four PA categories: 1) Debris Clearance; 2) Emergency Protective Measures; 3) Roads and Bridges; and 4) Utility Distribution Systems.

The decrease in Debris Clearance expenditures in 2001 is partially attributed to the acquisition and demolition of 46 houses in the Tama Road Area, which was completed in 1997. The removal of 46 families from the flood hazard area also contributed to the 50 percent reduction in expenditures for Emergency Protective Measures following the 2001 flood. Finally, the Burlington Water Works HMGP project (see Part Two), which involved the construction of a retaining wall to provide flood protection for this critical public facility, is clearly a factor in the reduced PA expenditures under Category F, Utility Distribution Systems.

In comparing the recovery in Des Moines County following the 1993 and 2001 flood disasters, the most striking difference is in the category of emergency shelter and family assistance, as reflected in Table 2-13. In the 1993 flood, the Red Cross was one of 20 agencies that provided assistance to more than 800 flood victims. A clearinghouse was established to provide donated goods, including cleaning supplies, furniture, clothing, and building materials. FEMA provided \$694,918 in Disaster Housing Assistance, which included rental assistance and funding to support minimal repairs to flooded residences.

In the 2001 flood, the requirements for emergency response, evacuation, sheltering, and family assistance were a fraction of the totals for 1993.

Table 2-12 : Public Assistance Expenditures, 1993 and 2001 (2001 values)

		1993	2001
A	Debris Clearance	\$224,090	\$6,166
B	Emergency Protective Measures	\$70,668	\$25,264
C	Roads and Bridges, Culverts, Ditches	\$23,146	\$7,089
D	Water Control Facilities & Levees	\$1,226	\$0
E	Public Buildings & Contents	\$0	\$8,700
F	Utility Distribution Systems	\$57,358	\$15,265
G	Public Parks	\$60,527	\$0
H	Total Public Assistance	\$437,014	\$62,484

Source: FEMA

Table 2-13: Emergency Shelter and Family Assistance

	1993	2001
Number of families evacuated and temporarily sheltered due to displacement	143	4
Number of Red Cross cases (individuals requesting post-disaster assistance)	800	8
Disaster Housing Assistance	\$694,918	0

Source: Red Cross, Des Moines Chapter,

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There are two explanations for the significant differences in the number of families who were evacuated and sheltered in the two flood events: 1) the significant level of flooding that occurred in 1993, which lasted longer, and impacted a greater portion of the population in Des Moines County than the 2001 event; and 2) the more people exposed to the flood hazard in 1993. By the 2001 flood, there were 50 fewer households that resided in the flood hazard area on Tama Road.

Summary and Conclusions

Des Moines County continues to pursue a multi-agency strategy to reduce flood losses through a “coalition of cooperating organizations” that include the County government, the U.S. Army Corps of Engineers, the Two Rivers Levee and Drainage Association, the Red Cross, and the IEMD . This coalition is guided by three objectives: 1) to continue a vigorous enforcement of the Floodplain Management Ordinance in order to “not add to the problem” of additional residential and commercial exposure to the flood hazard; 2) to accelerate the acquisition of the most vulnerable residential structures in the flood hazard area of Tama Road; and 3) to build additional local capacity to effectively respond to floods and other hazards through a network of agencies that is led by the Red Cross and the Des Moines County Emergency Management Agency. In essence, the County has effectively adopted a coalition approach to managing the flood risk, an approach that is currently being adapted to address technological and man-made hazards in the County.

SECTION THREE: ANALYSIS OF HAZARD MITIGATION GRANT PROGRAM: PROJECTS IN EASTERN IOWA

The 1993 flood was the catalyst in developing a comprehensive, statewide, all-hazards mitigation program in the State of Iowa. Under the leadership of the Iowa Emergency Management Division (IEMD), the goal of the program is to assist Iowa communities in planning and developing hazard mitigation projects in a long-term effort to reduce future disaster losses. Through the State Hazard Mitigation Team (SHMT), the IEMD has created a framework for interagency cooperation to carry out mitigation projects across the State.

The primary vehicle for funding hazard mitigation projects in Iowa is the Hazard Mitigation Grant Program (HMGP). Since 1990, the State of Iowa has implemented 1,344 HMGP projects, totaling \$9.4 million. Part One of this report highlighted the mitigation strategies of four eastern Iowa communities following the 1993 flood, and the impact of the HMGP projects and other initiatives in reducing losses following the 2001 flood.

Part Two of *Hazard Mitigation in Iowa: Measuring Success* provides additional detail and analysis of these four HMGP projects, plus three other HMGP projects that were implemented in eastern Iowa communities following the 1993 flood: 1) Flood Control Project for Burlington Water Works; 2) Acquisition Project in the City of Muscatine; and 3) Acquisition and Elevation Project in the Muscatine County (the City and County projects are presented together).

The analysis includes: 1) a brief description of the project; 2) a review of losses avoided as a result of implementing the project; 3) the calculations that were used to estimate losses avoided; and 4) a summary of how the HMGP project – and the spin-offs from the project – have contributed to community's flood mitigation strategy.

The seven HMGP projects that are examined in the following section are organized into two mitigation categories:

- 1) Acquisitions, Relocations or Elevations; and
- 2) Flood Protection for Critical Public Facilities.

Estimating Losses Avoided: A Step-by-Step Process

In this study, *losses avoided* from the implementation of mitigation measures is the sum of: 1) Building Repair costs that were avoided; 2) Contents Replacement costs that were avoided; and 3) Displacement Costs that were avoided. A step-by-step process was used to estimate losses avoided:

1. Determine the *replacement value* of the flood-damaged structures at time of disaster (2001). Replacement value is the cost of the livable area, and does not include land and auxiliary buildings (detached garages, sheds, etc).
2. Adjust the replacement value to take into account inflation and local conditions.
3. Estimate the losses avoided to the *building* as a result of the mitigation measure. Building loss avoided = *replacement value* of the structure (current year) x *building damage percentage* for the building type under consideration.
4. Estimate the losses avoided to the building's *contents* as a result of the mitigation measure. Contents losses avoided = *replacement value* of the structure (current year) x *contents replacement percentage* x *contents damage function*.
5. Estimate the monthly *displacement costs* for each household that was flooded based on rental costs, furniture rental, extra meal costs, one-time utility hook-ups, etc.
6. Add the total losses avoided from each of the three categories.

SCOTT COUNTY: FOUR ACQUISITIONS AND TWO ELEVATIONS

Project Description



With nearly 160,000 residents, Scott County is eastern Iowa's most populous County. Since 1990, the County has experienced flooding on the average of every three years, with a total of four presidential disaster declarations from flooding since 1990. In the 1993 flood, a total of 46 homes in Scott County were destroyed, with an additional 536 homes sustaining minor to major damage (Bi-State Regional Commission). Many of the homes that sustained major damage are located in Bettendorf and Pleasant Valley, north of Davenport on the Mississippi River.

The homes were primary residences, with assessed pre-flood values that ranged between \$20,000 and \$60,000 (1993). Most of the homes were flooded during the 1965 and 1990 floods which were 100-year events.

Following the 1993 flood, the IEMD – in coordination with FEMA and Scott County – identified six properties in the flood hazard area for acquisition and elevation, as reflected in Table 3-1. The total project cost was \$207,473 (2001).

SCOTT COUNTY COMMUNITY PROFILE	
Population (2000)	159,000
Population of Unincorporated Area	15,000
Per Capita Personal Income (1998)	\$42,900
NFIP Participant?	Yes (1978)
Community Rating System (CRS)	Yes (1995)
Declared Disasters since 1990	4
Repetitive Loss Properties*	29
* Repetitive Loss Properties are currently insured properties that have incurred two or more National Flood insurance Program losses of at least \$1000 within 10 years	

Table 3-1: Scott County HMGP Project (2001 values)

Property Address	Mitigation Measure	Replacement Value (2001)	Damage in 1993 Flood (% value of structure)	Flood Events (1980 – 1996)
24759 179 th Street, Pleasant Valley	Elevation	\$43,999.24	66%	2
24790 Valley Dr., Pleasant Valley	Acquisition	\$29,105.68	38%	2
18617 317 th St., Long Grove	Acquisition	\$27,583.48	93%	2
22735 Great River Rd., LeClaire	Elevation	\$75,433.57	36%	2
18650 317 th St., Long Grove	Acquisition	\$27,583.48	93%	2
2505 Captains Rd., Bettendorf	Acquisition	\$35,138.11	38%	2

Source: Individual Housing Data, 1993 Flood Damage Assessment, FEMA, HMGP project records

Losses Avoided in the 2001 Flood

In the 2001 flood, two of the six HMGP project sites were flooded:

- 1) 24790 Valley Drive, Pleasant Valley, which contained a house that was acquired and demolished in 1996, and thus did not sustain damages to the structure or contents in 2001; and

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- 2) 24759 179th Street, Pleasant Valley, which was elevated approximately four feet above the base flood elevation after the 1993 flood, and therefore did not sustain flood damages in 2001.

An analysis of the losses avoided following the spring 2001 flood estimated that the savings from the one event is about \$34,511. While this represents only 17 percent of the total cost of the mitigation project (\$207,473), it is important to remember that the savings are for *one flood event* only. As future floods occur in Scott County, the savings from the acquisitions and elevations will continue to accrue.

Table 3-2: Losses Avoided Through Mitigation Measures in Scott County – Aggregated by Building, Contents, Displacement and Total for the Spring, 2001 Flood (DR-1367)

			Buildings ²		Contents ³			Avoided Displacement Costs	
Depth of Flooding	Number of Structures	Building Replacement Value ¹	Depth/Damage % for Single Story Structure	Avoided Losses to Buildings	Contents Replacement % (% of building value)	Contents Depth/Damage %	Avoided Losses to Contents	Displacement ⁴	Total
0	4	\$36,000	1%	\$360	30%	1.5%	\$162	\$0	\$522
1	1	\$36,096	14%	\$5,053	30%	21%	\$2,274	\$3,300	\$10,627
2	1	\$54,560	22%	\$12,003	30%	33%	\$5,401	\$5,500	\$22,904
Total	6	\$126,656	14%	\$17,732	30%	21%	\$7,979	\$8,800	\$34,511

Calculations:

1. Replacement value of the structure in 2001 adjusted for inflation and local conditions. This assumes that home values rose 52% between 1993 and 2001 (source: OFHEO Housing Price Index, which applies to the entire State of Iowa).
2. Losses avoided to buildings as a result of mitigation measures are calculated with the replacement value of the structure multiplied by the depth/damage percentage for a single story structure without a basement. (Source: Flood Insurance Administration (FIA) Flood Depth Damage Curves).
3. The total estimated value of contents in 2001 is calculated by the FIA as a percentage of the replacement value of the structure (30% for one-story residential structures). Content vulnerability is 150% of structure vulnerability; therefore, to calculate the potential losses/losses avoided to contents, the depth-damage function for contents equals the depth-damage function of the structure multiplied by 1.5. The contents replacement percentage is multiplied by the contents damage function.
4. Displacement costs follow the algorithm in the FEMA full data software for flood. These costs are based on: 1) *displacement time* (a function of building damage percentages) and 2) *estimated monthly displacement costs* (including rental costs, furniture rental, extra meal costs, one-time utility hook-ups). Using the FEMA full data flood module criteria, the monthly displacement costs are estimated at \$1,100 per month for the study area. Displacement time for houses with 1' of water is estimated at 3 months (or \$3,300 per household), and for houses with 2' of water the displacement time is estimated at 5 months (or \$5,500 per household), based on the criteria used in the FEMA full data flood module.

Summary

The elevation and acquisition projects analyzed in Scott County were scattered around the County. The observed losses avoided with these sites suggest that the benefits of mitigation can be multiplied where mitigation efforts are concentrated. The opportunities for continued mitigation action in Scott County are numerous. With an estimated \$2 million in damages after the 2001 flood, Scott County officials realize that there still remain recurrent property damage and potential threats to the health and safety of its residents. As the County works to identify properties suitable for mitigation and to educate homeowners about the benefits of mitigation to generate interest, it is striving toward greater disaster resistance in the future.

CITY OF DAVENPORT: FIVE ACQUISITIONS AND ONE ELEVATION

Project Description



While the City of Davenport has garnered national publicity from the flooding along the Mississippi River, much of the damage caused in 1990, 1993, and 2001 has been attributed to the overflow of the tributary creek system. The majority of the City's 30 repetitive loss properties are located in the floodplains of Duck Creek and Black Hawk Creek.

One of the most flood prone areas of the City is the Garden Addition, a neighborhood of nearly 300 single-family dwellings located in the 100-year floodplains of Black Hawk Creek and Duck Creek. These residential structures are wood-frame, averaging 800 square feet in area, with pre-flood fair market values that average \$36,900

(1993). It is estimated that flooding has occurred in these areas an average of every five years since 1860 (USACE, Rock Island District).

Against this backdrop, the City of Davenport has given priority to the acquisition and demolition of properties in identified flood hazard areas in the City. Since 1994, Davenport has acquired 45 properties under the City's Residential Acquisition Program.

CITY OF DAVENPORT COMMUNITY PROFILE	
Population (2000)	98,300
Per Capita Personal Income (1998)	\$46,600
NFIP Participant?	Yes (1978)
Community Rating System (CRS)	Yes (1995)
Declared Disasters since 1990	4
Repetitive Loss Properties*	30
* Repetitive Loss Properties are currently insured properties that have incurred two or more National Flood insurance Program losses of at least \$1000 within 10 years	

Following the 1993 flood, the IEMD, in partnership with the City of Davenport, used HMGP funds to acquire five properties, and elevate one property, as reflected in Table 3-3.

Table 3-3: City of Davenport HMGP Project				
Property Address	Mitigation Measure	Replacement Value (2001)	Damage in 93 Flood (% value of structure)	Number of Floods (1980 – 1996)
3108 Keota	Acquisition	\$40,200	36%	2
127 E 32 nd Street	Acquisition	\$56,071	66%	3
3115 Keota	Acquisition	\$40,139	66%	3
128 E 32 nd Street	Acquisition	\$52,456	93%	2
3128 Pansy Ave	Acquisition	\$39,219	66%	3
3203 S. Keota	Elevation	\$50,250	36%	3

Source: Individual Housing Data, 1993 Flood Damage Assessment, FEMA, HMGP project records

Losses Avoided in the 2001 flood

In the 2001 flood, the properties in the Garden Addition (Keota and Pansy) did not flood, partly due to the levee that that was constructed after the 1965 flood.

The properties on 32nd Street did flood, with flood elevations on the site reaching approximately one foot above the lowest floor elevation of the demolished residential structures. As described in Section Two, the losses avoided from this one flood event are estimated to be \$41,392. This represents 22% of the total HMGP project cost of \$191,307 (2001). When the flood frequency of this area (one flood every five years) is factored into the analysis, it becomes apparent that the acquisitions and elevations will continue to pay dividends in the form of savings in rebuilding costs from future floods.

Table 3-4: Losses Avoided Through Mitigation Measures in Davenport – Aggregated by Building, Contents, Displacement and Total for the Spring, 2001 Flood (DR-1367) (2001 values)

			Buildings ²		Contents ³			Avoided Displacement Costs	
Depth of Flooding	Number of Structures	Building Replacement Value ¹	Depth/Damage % for Single Story Structure	Avoided Losses to Buildings	Contents Replacement % (% of building value)	Contents Depth/Damage %	Avoided Losses to Contents	Displacement ⁴	Total
0	4	\$173,188	1%	\$1,732	30%	1.5%	\$623	\$0	\$2,511
1	2	\$164,600	14%	\$23,044	30%	21%	\$8296	\$6,600	\$40,014
Total	6	\$337,788	7%	\$23,645	30%	11%	\$8919	\$6,600	\$41,392

Calculations:

1. Replacement value of the structure in 2001 adjusted for inflation. This assumes that home values rose 52% between 1993 and 2001 (source: OFHEO Housing Price Index, which applies to the entire State of Iowa).
2. Losses avoided to buildings as a result of mitigation measures are calculated with the replacement value of the structure multiplied by the depth/damage percentage for a single story structure without a basement. (Source: FIA Flood Depth Damage Curves for 2001 Benefit Cost Analysis Software)
3. The total estimated value of contents in 2001 is calculated by the FIA as a percentage of the replacement value of the structure (30% for one-story residential structures). Content vulnerability is 150% of structure vulnerability; therefore, to calculate the potential losses/losses avoided to contents, the depth-damage function for contents equals the depth-damage function of the structure multiplied by 1.5. The contents replacement percentage is multiplied by the contents damage function.
4. Displacement costs follow the algorithm in the FEMA full data software for flood. These costs are based on: 1) *displacement time* (a function of building damage percentages) and 2) *estimated monthly displacement costs* (including rental costs, furniture rental, extra meal costs, one-time utility hook-ups). Using the FEMA full data flood module criteria, the monthly displacement costs are estimated at \$1,100 per month for the study area.

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Displacement time for houses with 1' of water is estimated at 3 months (or \$3,300 per household), based on the criteria used in the FEMA full data flood module.

Summary

The coordination between the IEMD and the City of Davenport can serve as a model for other Iowa communities on how to collaborate to develop and manage a community-based program for the acquisition, relocation, and elevation of properties that are in designated flood hazard areas.

There are three important elements in the IEMD – City of Davenport collaborative approach to managing the flood risk in the City:

1. A local mitigation database, administered by the Department of Economic and Community Development, with information on the flood hazard in the City, repetitive loss structures and their attributes (e.g., lowest floor elevation, square footage, assessed value), and the attributes of other residential and commercial structures that are in identified flood hazard areas. The mitigation database is important in at least two respects. First, it can be used to quantify losses avoided as a result of implementing acquisitions and elevations. Second, the IEMD and the City can access the data in analyzing the benefits and costs of future HMGP-funded projects, and thus develop an integrated strategy to reduce the flood risk in Davenport.
2. Policies and criteria to guide the selection of properties for acquisition, relocation and elevation; and
3. A locally funded and managed program (Residential Acquisition Program) that begins to institutionalize the acquisition of flood prone properties in Davenport – including annual funding to support the program.

With these three components in place, the IEMD is well positioned to leverage HMGP funding to augment a locally managed, long-term program to reduce the flood vulnerability of residences and businesses in the City. The City of Davenport can become a model for other Iowa communities in how to: 1) establish a mitigation database of HMGP and locally administered projects; 2) use this data to establish quantifiable mitigation goals and objectives; and 3) to use this data to conduct post-disaster losses avoided analysis, which is a key component of enhanced mitigation planning under the Disaster Mitigation Act of 2000.

**MUSCATINE COUNTY:
TWO ACQUISITIONS AND TWO ELEVATIONS**

**CITY OF MUSCATINE:
SIX ACQUISITIONS**

Project Description



For many communities on the Mississippi, the river and its tributaries have been both a resource for economic development and a threat to the health of the community. The City and County of Muscatine are no different. Established as a center for the lumber and milling industry, the County of Muscatine has grown around the river with citizens using the water for transportation, industry, agriculture, and recreation.

But Muscatine has also had its troubles with the water. Muscatine County has had four federal disaster declarations since 1990 for flooding. In the 1993 flood the water reached a record 25 feet, about 9 feet above flood stage, and the 2001 flood crested at 23.5 feet. Although Muscatine, down river from the City of Davenport, had days of warning before

the river crested in Muscatine, its homes, public infrastructure, and businesses still suffered from the flooding. Since the flood of 1993, the County of Muscatine, along with the City, which holds the County seat, has been striving to mitigate the affects of flooding. For example, the County and City spent \$8 Million to reinforce the levee system to protect against a 200-year flood event.

Following the 1993 flood, four homeowners in the County and six homeowners in the City agreed to have their houses acquired. The houses acquired in the City were located in the northeast quadrant and were not protected by the levee.

MUSCATINE COUNTY COMMUNITY PROFILE	
Population (2000)	41,722
Per Capita Personal Income (1998)	\$36,482
NFIP Participant?	Yes(1978)
Community Rating System (CRS)	Yes(1995)
Declared Disasters since 1990	4
Repetitive Loss Properties*	9
* Repetitive Loss Properties are currently insured properties that have incurred two or more National Flood insurance Program losses of at least \$1000 within 10 years	

CITY OF MUSCATINE COMMUNITY PROFILE	
Population (2000)	16,340
Per Capita Personal Income (1998)	\$38,420
NFIP Participant?	Yes (1978)
Community Rating System (CRS)	Yes (1995)
Declared Disasters since 1990	4
Repetitive Loss Properties*	4
* Repetitive Loss Properties are currently insured properties that have incurred two or more National Flood insurance Program losses of at least \$1000 within 10 years	

**SECTION THREE: ANALYSIS OF HAZARD MITIGATION GRANT PROGRAM:
PROJECTS IN EASTERN IOWA**

Table 3-5: Muscatine County HMGP Project				
Property Address	Mitigation Measure	Replacement Value (2001)	Damage in 93 Flood (% value of structure)	Flood Frequency (1980 – 1996)
2400 River Road	Elevation	\$23,041	49%	1
3680 Dismore	Acquisition	\$9,714	134%	2
2006 River Road	Elevation	\$84,874	42%	1
1875 Jones Cabin Lane	Acquisition	\$19,414	36%	2

Source: Individual Housing Data, 1993 Flood Damage Assessment, FEMA

Table 3-6: City of Muscatine HMGP Project				
Property Address	Mitigation Measure	Replacement Value (2001)	Damage in 93 Flood (% value of structure)	Number of Floods (1980 – 1996)
327 Palm Street	Acquisition	\$25,738	38%	2
314 Canon Ave.	Acquisition	\$21,448	66%	2
2611 River Road	Acquisition	\$23,899	93%	2
319 Palm Street	Acquisition	\$23,287	93%	2
312 Canon Ave	Acquisition	\$9,192	93%	2
323 Palm Street	Acquisition	\$15,565	36%	2

Source: Individual Housing Data, 1993 Flood Damage Assessment, FEMA, HMGP project files

Losses Avoided in 2001 Flood

On April 15, 2001, the Mississippi River reached flood stage (15 feet) in Muscatine, and remained above flood stage for the next 36 days. Unlike some floods of the past, many emergency management officials considered the 2001 flood to be a “nuisance flood”. The citizens and officials had plenty of warning—about two weeks in advance of the flooding. Much of the flooding was localized in areas not protected by the levee, for instance, the low-lying Palm Street area. Having learned from past flood events, particularly the 1993 flood, Muscatine had about 5000 sandbags on hand, so areas not protected by the levee were sandbagged. Some homes did suffer flooding and seepage, and five businesses were affected, but they were able to protect the structures with sandbagging and by moving vulnerable stock and supplies to higher ground. Furthermore, no streets were closed in this event.

Table 3-7 illustrates the losses avoided for the County of Muscatine. The two elevations and two acquisitions in Muscatine helped to avoid nearly \$35,000 for one event.

SECTION THREE: ANALYSIS OF HAZARD MITIGATION GRANT PROGRAM:
PROJECTS IN EASTERN IOWA

Table 3-7: Losses Avoided Through Mitigation Measures in Muscatine County – Aggregated by Building, Contents, Displacement and Total for the Spring, 2001 Flood (DR-1367)									
			Buildings ²		Contents ³			Avoided Displacement Costs	
Depth of Flooding	Number of Structures	Building Replacement Value ¹	Depth/Damage % for Single Story Structure	Avoided Losses to Buildings	Contents Replacement % (% of building value)	Contents Depth/Damage %	Avoided Losses to Contents	Displacement ⁴	Total
0	2	\$29,625	1%	\$296	30%	1.5%	\$133	0	\$430
1	2	\$133,750	14%	\$18,725	30%	21%	\$8,426	\$6,600	\$33,751
Total	4	\$163,375	12%	\$19,605	30%	17%	\$8,332	\$6,600	\$34,537

Calculations:

1. Replacement value of the structure in 2001 adjusted for inflation. This assumes that home values rose 52% between 1993 and 2001 (source: OFHEO Housing Price Index, which applies to the entire State of Iowa).
2. Losses avoided to buildings as a result of mitigation measures is calculated with the replacement value of the structure multiplied by the depth/damage percentage for a single story structure without a basement. (Source: FIA Flood Depth Damage Curves for 2001 Benefit Cost Analysis Software)
3. The total estimated value of contents in 2001 is calculated by the FIA as a percentage of the replacement value of the structure (30% for one-story residential structures). Content vulnerability is 150% of structure vulnerability; therefore, to calculate the potential losses/losses avoided to contents, the depth-damage function for contents equals the depth-damage function of the structure multiplied by 1.5. The contents replacement percentage is multiplied by the contents damage function.
4. Displacement costs follow the algorithm in the FEMA full data software for flood. These costs are based on: 1) *displacement time* (a function of building damage percentages) and 2) *estimated monthly displacement costs* (including rental costs, furniture rental, extra meal costs, one-time utility hook-ups). Using the FEMA full data flood module criteria, the monthly displacement costs are estimated at \$1,100 per month for the study area. Displacement time for houses with 1' of water is estimated at 3 months (or \$3,300 per household), based on the criteria used in the FEMA full data flood module.

The Table 3-8 below details the losses avoided in the City of Muscatine in 2001 after the acquisition of six properties and elevation of one property damaged in the 1993 flooding. The analysis shows that the acquisitions and elevation did have the desired affect of avoiding some losses, about \$31,268 for the one event.

SECTION THREE: ANALYSIS OF HAZARD MITIGATION GRANT PROGRAM:
PROJECTS IN EASTERN IOWA

Table 3-8: Losses Avoided Through Mitigation Measures in City of Muscatine – Aggregated by Building, Contents, Displacement and Total for the Spring, 2001 Flood (DR-1367)

			Buildings ²		Contents ³			Avoided Displacement Costs	
Depth of Flooding	Number of Structures	Building Replacement Value ¹	Depth/Damage % for Single Story Structure	Avoided Losses to Buildings	Contents Replacement % (% of building value)	Content Depth/Damage %	Avoided Losses to Contents	Displacement ⁴	Total
0	5	\$95,250	1%	\$953	30%	1.5%	\$429	\$0	\$1,381
1	1	\$31,875	14%	\$4,463	30%	21%	\$2,008	\$3,300	\$9,771
Total	6	\$127,125	4%	\$5,085	30%	6%	\$22,883	\$3,300	\$31,268

Calculations:

1. Replacement value of the structure in 2001 adjusted for inflation. This assumes that home values rose 52% between 1993 and 2001 (source: OFHEO Housing Price Index, which applies to the entire State of Iowa).
2. Losses avoided to buildings as a result of mitigation measures is calculated with the replacement value of the structure multiplied by the depth/damage percentage for a single story structure without a basement. (Source: FIA Flood Depth Damage Curves for 2001 Benefit Cost Analysis Software)
3. The total estimated value of contents in 2001 is calculated by the FIA as a percentage of the replacement value of the structure (30% for one-story residential structures). Content vulnerability is 150% of structure vulnerability; therefore, to calculate the potential losses/losses avoided to contents, the depth-damage function for contents equals the depth-damage function of the structure multiplied by 1.5. The contents replacement percentage is multiplied by the contents damage function.
4. Displacement costs follow the algorithm in the FEMA full data software for flood. These costs are based on: 1) *displacement time* (a function of building damage percentages) and 2) *estimated monthly displacement costs* (including rental costs, furniture rental, extra meal costs, one-time utility hook-ups). Using the FEMA full data flood module criteria, the monthly displacement costs are estimated at \$1,100 per month for the study area. Displacement time for houses with 1' of water is estimated at 3 months (or \$3,300 per household), based on the criteria used in the FEMA full data flood module.

Summary

The City and County of Muscatine continue to pursue an acquisition and elevation strategy. While the City undoubtedly benefited from the levee system, sandbagging, and warning systems during the 2001 flood, the acquisition and elevation of structures not protected by these methods also had demonstrable benefits. In the short term, removing these structures from the hazard area freed emergency responders to work with sandbagging operations and other emergencies. The avoided losses of about \$66,000 for the City and County in just one flood event demonstrate that, in the long run, acquisition and elevation mitigation measures can be cost-effective ways to alleviate flood damage.

LOUISA COUNTY: 176 ACQUISITIONS

Project Description



As a rural County with limited resources, Louisa was arguably impacted more by the 1993 flood than any other eastern Iowa County. About 800 residents registered for assistance with the Red Cross. Over 200 families were evacuated from their homes.

A partnership of the IEMD, FEMA, Louisa County, and the Southeast Iowa Regional Planning Commission (as project administrator) formulated an acquisition strategy that ultimately targeted 176 homes. When the acquisition program was completed in 1996, a total of 77 homes were acquired and demolished, and a total of 99 homes were acquired and relocated. The total cost of the Louisa County acquisition project was \$9.7 million.

Losses Avoided in the 2001 Flood

The most serious flooding in Louisa County in 2001 occurred in the northeastern part of the County, including Odessa Court, a subdivision of detached residential structures and manufactured houses that are located in the floodplain of the Mississippi River. Of the structures eventually acquired in the Odessa Court area, 23 had flood levels of two feet above the lowest finished floor elevation and 25 had flood levels of one foot above the lowest finished floor elevation.

Flood levels during the flood of 2001 in the area of the 1993 acquisition program were such that 25 homes— with a combined replacement value of \$1.8 million (2001) – would have experienced flood levels of one foot above the lowest finished floor the 2001 flood and 23 homes – with a combined replacement value of \$1.4 million (2001) – would have experienced flood levels of two feet above the lowest finished floor, had they not been acquired and demolished or relocated.

Table 3-9 presents the findings of the analysis of losses avoided from the 2001 flood for 69 of the 176 acquired structures with available data. It is estimated that the losses avoided in one event is \$1,256,815. This includes the avoided costs of repairing damaged dwellings; avoided costs of replacing damaged contents; and avoided displacements costs (lodging, food and other associated costs that are incurred while the flood-damaged residence is repaired or replaced).

LOUISA COUNTY COMMUNITY PROFILE	
Population (2000)	12,183
Per Capita Personal Income (1998)	\$39,200
NFIP Participant?	Yes (1978)
Community Rating System (CRS)	No
Declared Disasters since 1990	4
Repetitive Loss Properties*	4
* Repetitive Loss Properties are currently insured properties that have incurred two or more National Flood insurance Program losses of at least \$1000 within 10 years	

SECTION THREE: ANALYSIS OF HAZARD MITIGATION GRANT PROGRAM:
PROJECTS IN EASTERN IOWA

Table 3-9: Losses Avoided from Acquisition of Flood prone Properties in Louisa County – Aggregated by Building, Contents, Displacement and Total for the Spring, 2001 Flood (DR-1367)

			Buildings ²		Contents ³			Avoided Displacement Costs	
Depth of Flooding	Number of Structures	Building Replacement Value ¹	Depth/Damage % for Single Story Structure	Avoided Losses to Buildings	Contents Replacement % (% of building value)	Contents Depth/Damage %	Avoided Losses to Contents	Displacement ⁴	Total
0	21	\$2,467,245	1%	\$24,672	30%	1.5%	\$11,103	\$0	\$35,775
1	25	\$2,282,375	14%	\$319,533	30%	21%	\$143,790	\$82,500	\$545,822
2	23	\$1,758,545	22%	\$386,880	30%	33%	\$174,096	\$126,500	\$687,476
Total	69	\$6,508,165	11%	\$715,898	30%	17%	\$331,916	\$209,000	\$1,256,815

Calculations:

1. Replacement value of the structure in 2001 adjusted for inflation. This assumes that home values rose 52% between 1993 and 2001 (source: OFHEO Housing Price Index, which applies to the entire State of Iowa).
2. Losses avoided to buildings as a result of mitigation measures is calculated with the replacement value of the structure multiplied by the depth/damage percentage for a single story structure without a basement. (Source: FIA Flood Depth Damage Curves for 2001 Benefit Cost Analysis Software)
3. The total estimated value of contents in 2001 is calculated by the FIA as a ratio of the replacement value of the structure. The contents replacement ratio is multiplied by the contents damage function to calculate the potential losses/losses avoided to contents.
4. Displacement costs follow the algorithm in the FEMA full data software for flood. These costs are based on: 1) *displacement time* (a function of building damage percentages) and 2) *estimated monthly displacement costs* (including rental costs, furniture rental, extra meal costs, one-time utility hook-ups). Using the FEMA full data flood module criteria, the monthly displacement costs are estimated at \$1,100 per month for the study area. Displacement time for houses with 1' of water is estimated at 3 months (or \$3,300 per household), based on the criteria used in the FEMA full data flood module. Displacement costs for houses with 2' of water is assumed to be 5 months, or \$5,500 per household.

Summary

Louisa County is among the few jurisdictions in the State of Iowa to aggressively pursue a strategy of acquisition and relocation of flood prone residential structures. With assistance from the Muscatine Center for Strategic Action, the County was able to salvage and relocate nearly one hundred houses that were susceptible to flooding, seepage, and health-related problems. The total assessed value of these refurbished and relocated properties is \$2.9 million (2001). In the process, the community has benefited from the addition of 99 newly rehabilitated homes that are no longer vulnerable to flooding, occupied by families who otherwise may have relocated to Muscatine and other nearby counties.

SECTION THREE: ANALYSIS OF HAZARD MITIGATION GRANT PROGRAM: PROJECTS IN EASTERN IOWA

In the final analysis, the objective of the acquisition program was to reduce future flood losses by removing houses from the floodplain. In one flood event alone (DR-1367), the losses avoided are estimated to be \$1,256,815 which includes building damages avoided, contents losses avoided, and displacement costs avoided as a result of the mitigation measures. In addition, the acquisition and removal of 176 properties from flood prone areas in Louisa County along the Mississippi River resulted in savings from: 1) lower costs for emergency response, sandbagging, feeding and sheltering of evacuated victims, and other emergency protective measures; and 2) lower costs for debris removal and disposal, environmental clean-up, and other measures related to flood recovery.

DES MOINES COUNTY: FORTY-SIX ACQUISITIONS AND THREE ELEVATIONS

Project Description



Historically, one of the most flood prone areas of Des Moines County is the Tama Road Area, to the north of the City of Burlington on the Mississippi River. This part of the County has a mixture of river cabins, with replacement values of between \$15,000 and \$25,000 (2001), and single-family homes that range from \$60,000 to \$100,000 in replacement value.

In the 1993 flood, an estimated 43 homes in the Tama Road Area sustained substantial flood damage, defined as damage that equaled 50 percent or more of the assessed building value. In 1993, an estimated 140 families in Des Moines County, many of them from the Tama Road Area, had to temporarily evacuate their homes because of the flooding.

In an effort to reduce the vulnerability of this part of Des Moines County to flooding, the IEMD, the County, and FEMA initiated the acquisition of 46 flood prone properties following the 1993 flood.

In 1997, the IEMD completed the implementation of an HMGP project to acquire 46 residential structures, and elevate three more. Most of the houses were in the Tama Road Area of Des Moines County. The total cost of the project was \$2.3 million.

DES MOINES COUNTY COMMUNITY PROFILE	
Population (2000)	42,351
Per Capita Personal Income (1998)	\$41,900
NFIP Participant?	Yes (1993)
Community Rating System (CRS)	Yes (1993)
Declared Disasters since 1990	4
Repetitive Loss Properties*	5
* Repetitive Loss Properties are currently insured properties that have incurred two or more National Flood insurance Program losses of at least \$1000 within 10 years	

Losses Avoided in the 2001 flood

The flood of 2001 provides an opportunity to assess the losses avoided as a result of the acquisitions in the Tama Road Area. Four homes – with a combined replacement value of \$183,616 (2001) – would have experienced flood levels of one foot above the lowest finished floor from the 2001 flood, had they not been acquired and demolished or relocated. Three homes – with a combined replacement value of \$259,000 (2001) – would have experienced flood levels of two feet above the lowest finished floor, had they not been acquired and demolished or relocated.

Table 3-10 presents the findings of the analysis of losses avoided from the 2001 flood to 16 of the 46 acquired structures for which data was available. It is estimated that the losses avoided in the one flood event is \$193,346. This includes the avoided costs of repairing damaged dwellings; avoided costs of replacing damaged contents; and avoided displacements costs (lodging, food and other associated costs that are incurred while the flood-damaged residence is repaired or replaced).

SECTION THREE: ANALYSIS OF HAZARD MITIGATION GRANT PROGRAM:
PROJECTS IN EASTERN IOWA

Table 3-10: Losses Avoided from Acquisition of Flood prone Properties in Des Moines County – Aggregated by Building, Contents, Displacement and Total for the Spring, 2001 Flood (DR-1367)

			Buildings ²		Contents ³			Avoided Displacement Costs	
Depth of Flooding	Number of Structures	Building Replacement Value ¹	Depth/Damage % for Single Story Structure	Avoided Losses to Buildings	Contents Replacement % (% of building value)	Contents Depth/Damage %	Avoided Losses to Contents	Displacement ⁴	Total
0	9	\$575,320	1%	\$5,753	30%	1.5%	\$2,589	\$0	\$8,342
1	4	\$229,520	14%	\$32,133	30%	21%	\$14,460	\$13,200	\$59,793
2	3	\$323,750	22%	\$71,225	30%	33%	\$32,051	\$16,500	\$119,776
Total	16	\$1,128,590	10%	\$112,859	30%	15%	\$50,787	\$29,700	\$193,346

Calculations:

1. Replacement value of the structure in 2001 adjusted for inflation. This assumes that home values rose 52% between 1993 and 2001 (source: OFHEO Housing Price Index, which applies to the entire State of Iowa).
2. Losses avoided to buildings as a result of mitigation measures is calculated with the replacement value of the structure multiplied by the depth/damage percentage for a single story structure without a basement. (Source: FIA Flood Depth Damage Curves for 2001 Benefit Cost Analysis Software)
3. The total estimated value of contents in 2001 is calculated by the FIA as a ratio of the replacement value of the structure. The contents replacement ratio is multiplied by the contents damage function to calculate the potential losses/losses avoided to contents.
4. Displacement costs follow the algorithm in the FEMA full data software for flood. These costs are based on: 1) *displacement time* (a function of building damage percentages) and 2) *estimated monthly displacement costs* (including rental costs, furniture rental, extra meal costs, one-time utility hook-ups). Using the FEMA full data flood module criteria, the monthly displacement costs are estimated at \$1,100 per month for the study area. Displacement time for houses with 1' of water is estimated at 3 months (or \$3,300 per household), based on the criteria used in the FEMA full data flood module. Displacement costs for houses with 2' of water is assumed to be 5 months, or \$5,500 per household.

Summary

The HMGP-funded acquisitions and elevations in Des Moines County should be viewed as one element in a long-term, multi-objective flood mitigation strategy that the County is pursuing in partnership with the IEMD, the Two Rivers Levee and Drainage Association, and the Southeast Iowa Regional Planning Commission. The HMGP acquisition program, which is being incrementally expanded, is complemented by other mitigation measures that are underway through the auspices of the Two Rivers Levee and Drainage Association and the U.S. Army Corps of Engineers.

SECTION THREE: ANALYSIS OF HAZARD MITIGATION GRANT PROGRAM: PROJECTS IN EASTERN IOWA

In assessing the cost-effectiveness of the HMGP project, it is important to take into consideration the savings to State and local emergency officials, the Red Cross and Salvation Army, and other organizations that have a role in warning, evacuation and sheltering of disaster victims. As a result of the acquisitions, there were fewer than ten individuals following the 2001 event who had to be evacuated and sheltered because of the flooding. In 1993, the number of households requiring emergency shelter approached 150. In addition to the savings that accrued from not having to evacuate and shelter these families, the County benefited by having additional emergency response resources available for deployment to other areas of the County to support flood response and recovery operations.

Since 1930, the Tama Road Area has flooded an average of every five years. Because of the chronic problem of seepage, and the fragile condition of the levee system, the IEMD and Des Moines County will continue the initiative to remove the most vulnerable residential structures from the identified flood hazard areas.

CITY OF BURLINGTON: FLOOD CONTROL FOR THE MUNICIPAL WATER WORKS-- A CRITICAL PUBLIC FACILITY

Project Description



The City of Burlington, which was founded in 1836 as the first capital of the Wisconsin Territory, is today a thriving community of 28,700 (2000) on the Mississippi River.

Historically, the City of Burlington has experienced flooding from two sources: the Mississippi River and the Flint Creek tributary. Since 1950, floods have occurred an average of every five years, with major floods occurring in 1965 and 1993 – both 100-year events.

The City is served by the Burlington Municipal Water Works, which provides water to 201 commercial and 15,700 residential customers in the Cities of Burlington, West Burlington, Middletown, and Danville. The Water Works also provides water to the nearby Army Ammunition Plant.

During the flood of 1993, the Mississippi River crested at 25 feet (ten feet above flood stage). The high water caused severe erosion to lagoon berms, necessitated removing and replacing fencing, and destroyed ground cover.

To protect the Burlington Municipal Water Works plant (including the electrical equipment, chemical storage, and other key facilities) from flooding during the 1993 flood event, the Water Works personnel resorted to sandbagging and emergency pumping. This operation lasted for 21 days. The cost of the sandbagging and other protective measures was \$18,000. When debris removal, emergency pumping, and road repair costs are added, the total reached \$45,000 for the 1993 flood response operation at the Municipal Water Works. At no time, however, did the plant shut down.

CITY OF BURLINGTON COMMUNITY PROFILE	
Population (2000)	28,700
Per Capita Personal Income (1998)	\$41,900
NFIP Participant?	Yes (1978)
Community Rating System (CRS)	Yes (1995)
Declared Disasters since 1990	4
Repetitive Loss Properties*	2
* Repetitive Loss Properties are currently insured properties that have incurred two or more National Flood insurance Program losses of at least \$1000 within 10 years	

HMGP Project: A Permanent Solution to Flooding at Burlington Water Works

Following the 1993 flood, the management of the Burlington Water Works and City officials concluded that a permanent solution was needed to protect the plant from flooding. At least three factors led to the decision to pursue a “permanent solution” to flood protection: 1) the recurring costs of emergency sandbagging, pumping and other emergency measures (estimated to be between \$20,000 and \$40,000 per flood event); 2) the unreliability of these measures in protecting the plant from flooding; and 3) the potential loss of the City’s water supply in the event that the emergency protective measures failed, and the resulting loss of water for fire suppression in the City of Burlington. With \$800 million in exposed property in the City of Burlington, the driving force in this mitigation project was to ensure the availability of water to suppress fires.

**SECTION THREE: ANALYSIS OF HAZARD MITIGATION GRANT PROGRAM:
PROJECTS IN EASTERN IOWA**

The HMGP project involved constructing retaining walls, stop logs, and three permanent pumps with electrical feed for the Burlington Municipal Waterworks' water plant. The total cost of the HMGP project was \$295,962. The project was completed in 1999.

Losses Avoided in the 2001 Flood

In April of 2001, the Mississippi River crested at 22 feet (seven feet above flood stage), and once again the Burlington Municipal Water Works was threatened. As reflected in Table 3-11, the expenditures for flood protection in the one event were reduced by nearly \$50,000. Only \$4,700 in emergency funds was used by the plant to ensure protection from the flooding, and these were mostly for "backup" measures.

Table 3-11: Comparison of Expenditures for Flood Protection at the Burlington Water Works: 1993 and 2001 (2001 values)

Expenditure	1993	2001
Sandbags	\$22,061	\$3,000
Fence Repairs	\$18,384	0
Protective Measures (pump station operation)	\$12,256	1,700
Total	\$52,701	\$4,700

Source: Burlington Water Works

Summary

The investment of \$295,000 in HMGP funds to construct a flood retaining wall provides flood protection up to one foot above a 200-year flood event (or 8 feet above the 1993 event) to the Burlington Municipal Water Works. As noted by the plant manager, the HMGP project has produced three main benefits:

1. The increased flood protection to the plant will ensure the availability of water supply to suppress fires in the City of Burlington (including the Army Ammunition Plant).
2. The increased flood protection will result in reduced expenditures for emergency protective measures (sandbagging, pumping operations), which have ranged between \$20,000 and \$40,000 per flood event.
3. The increased flood protection will ensure that other plant functions (e.g., water treatment process) are not interrupted in the event of a flood.

The flood of 2001, while not as damaging as the 1993 event, nevertheless served as a reminder of the vulnerability of the downtown area to floods. The Burlington Municipal Water Works initiative is an important demonstration project for the City.

APPENDIX A: INFORMATION SOURCES

City of Davenport and Scott County

Losses Avoided Analysis:	Source:
Flood Hazard Elevations	Federal Insurance Administration
Flood Hazard – Probabilistic	USACE, Rock Island, Scott Pettis
Flood Hazard – 2001 Flood	USACE, Rock Island
Historical Floods	<i>Repetitive Loss Plan</i> , City of Davenport (1995)
Flood Elevations (2001)	USACE, Rock Island; City of Davenport, Dept. of Economic and Community Development
Building Location	HMGP files, IEMD
Building Data	Uniform Residential Appraisal Report
Building Cost	Uniform Residential Appraisal Report
Mitigation Project Cost	HMGP files, IEMD
Flood Hazard Mitigation Planning <i>Repetitive Loss Plan</i> ,	City of Davenport
Emergency Response Analysis:	Source:
Number of families evacuated and sheltered	Red Cross Chapter, Des Moines
Number of Red Cross cases in 1993 and 2001	Red Cross Chapter, Des Moines
Local response/expenses in Scott County	Jeff Bergman, Scott County EMA
Interviewees:	Source:
Clayton Lloyd, Director,	Department of Economic and Community Development, City of Davenport
Dee Breumer, Director,	Department of Public Works, City of Davenport
Wayne Wille, Floodplain Manager,	Department of Economic and Community Development, City of Davenport

Louisa County

Losses Avoided Analysis:	Source:
Flood Hazard Elevations	Federal Insurance Administration
Flood Hazard – Probabilistic	USACE, Rock Island, Scott Pettis
Flood Hazard – 2001 Flood	USACE, Rock Island
Historical Floods	USACE, Rock Island,
Flood Elevations (2001)	USACE, Rock Island; Greg Johnson, County Tax Assessor
Building Location	HMGP files, IEMD
Building Data	Uniform Residential Appraisal Report
Building Cost	Uniform Residential Appraisal Report
Mitigation Project Cost	HMGP files, IEMD
Flood Hazard Mitigation Planning	IEMD, SEIRPC
Relocation of Houses	Mark Patton, Executive Director, Muscatine Center for Strategic Action
Emergency Response Analysis:	Source:
Number of families evacuated and sheltered	Red Cross Chapter, Des Moines
Number of Red Cross cases in 1993 and 2001	Red Cross Chapter, Des Moines
Local response/expenses in 1993 and 2001	Tom Colthurst, Louisa County EMA

Burlington and Des Moines County

Losses Avoided Analysis:	Source:
Flood Hazard Elevations	Federal Insurance Administration
Flood Hazard – Probabilistic	USACE, Rock Island, Scott Pettis
Flood Hazard – 2001 Flood	USACE, Rock Island, Vicky Stollar, Two Rivers
Drainage and Levee Association, Terri Johnson, County Land Administrator	
Historical Floods	USACE, Rock Island
Flood Elevations (2001)	USACE, Rock Island, Vicky Stollar, Two Rivers, Terri Johnson, County Land Administrator
Building Location	HMGP files, IEMD
Building Data	Uniform Residential Appraisal Report
Building Cost	Uniform Residential Appraisal Report
Mitigation Project Cost	HMGP files, IEMD
Flood Hazard Mitigation Planning	IEMD, SEIRPC
Emergency Response Analysis:	Source:
Number of families evacuated and sheltered	Red Cross Chapter, Des Moines
Number of Red Cross cases in 1993 and 2001	Red Cross Chapter, Des Moines
Local response/expenses	Gina Hardin, Des Moines County EMA
Local response/expenses	Kathleen Hemmesch, Director, United Way
Local response/expenses	Allen Otto, Director, Salvation Army, Des Moines County
Burlington Water Works	Alan Borden, Manager

Muscatine City and Muscatine County

Losses Avoided Analysis:	Source:
Flood Hazard Elevations	Federal Insurance Administration
Flood Hazard – Probabilistic	USACE, Rock Island, Scott Pettis
Flood Hazard – 2001 Flood	USACE, Rock Island
Historical Floods	USACE
Flood Elevations (2001)	USACE, Rock Island
Building Location	HMGP files, IEMD
Building Data	Uniform Residential Appraisal Report
Building Cost	Uniform Residential Appraisal Report
Mitigation Project Cost	HMGP files, IEMD
Flood Hazard Mitigation Planning	Jeff Carter, Muscatine County EMA
Emergency Response Analysis:	Source:
Number of families evacuated and sheltered	Red Cross Chapter, Des Moines
Number of Red Cross cases in 1993 and 2001	Red Cross Chapter, Des Moines
Jeff Carter, Muscatine County EMA	

City of McGregor

Losses Avoided Analysis:	Source:
HMGP Project Description	Norm Lincoln, City Administrator
HMGP Application	IEMD

Damages to Utility in 1993 and 2001
Losses Avoided Analysis

Morris Weller, Engineer, McGregor Municipal Utilities
Economic Analysis of Flooding Problems at the
Municipal Power Plant in McGregor, Iowa, USACE, St.
Paul District, 1996

Mitigation Planning

Tom Macy, Director, Upper Explorer Land Regional
Planning, Postville, Iowa

APPENDIX B: GLOSSARY OF TERMS

Acquisition - the mitigation measure in which the owner's interest in the building is purchased and the building demolished. Acquisitions are assumed to be 100% effective mitigation measures at all flood depths. Also known as a "buyout".

Avoided Losses - in this study, avoided losses are the sum of three categories: building repair costs avoided, contents losses avoided, and displacement costs avoided as a result of the implementation of mitigation measures.

Base Flood Elevation (BFE) - the flood elevation having a one-percent chance of being equaled or exceeded in any given year. The BFE is determined by statistical analysis for each local area and designated on the Flood Insurance Rate Maps. The BFE is also known as the 100-Year Flood Elevation.

Building Damage - the estimated damages to a structure, expressed as a percentage of the building's replacement value. Building damages include both structural and non-structural elements (mechanical, electrical, and plumbing systems) but exclude the building's contents.

Building Depth-Damage Function (DDF) - indicates the building's vulnerability to flood damage by showing the estimated building damage for the range of flood depths from -2 to 18 feet above the top of the lowest finished floor.

Building Replacement Value - the cost to provide a functionally equivalent structure of the same size, generally of a more modern construction type. Replacement value does not include recreating historical or archaic materials, finishes or features.

Building Type - building types considered in the model are the six federal Insurance Administration (FIA) building types (1 story without basement, 2 story without basement, and split level without basement; 1 or 2 story with basement, split level with basement; and mobile home) plus an "other" category. The "other" category allows data inputs for building types not covered by the six FIA building types.

Community Rating System (CRS) - is a program under the NFIP that recognizes and encourages community floodplain management activities that exceed the minimum NFIP standards. Under the CRS, flood insurance premium rates are adjusted to reflect the reduced flood risk resulting from community activities that meet the three goals of the CRS: (1) reduce flood losses; (2) facilitate accurate insurance rating; and (3) promote the awareness of flood insurance.

Contents Damage - are the estimated damages to the building's contents, expressed as a percentage of the total contents' replacement value. Contents damages include furniture, office equipment, carpet, and other items specific to individual tenants' usages, but exclude mechanical, electrical, and plumbing systems which are non-structural parts of the building.

Contents Depth-Damage Function (DDF) - indicates the content's vulnerability to flood damage by showing the estimated contents damage for the range of flood depths from -2 to 18 feet.

Contents Value - the estimated total value of the building's contents, including furniture, carpet, equipment, supplies, etc.

Cost of Occupant Displacement - the total cost of displacement after a flood, including rent for temporary quarters, moving, and extra operating costs incurred because of displacement. The total cost of displacement of occupants is calculated from the displacement time and cost per month.

Displacement Costs - the product of displacement costs per month and the expected period for which the building will be unusable due to flood damage. Displacement costs are incurred when owners are displaced to a temporary

site while flood-related damage to the original building is repaired and include costs for rent and other displacement expenses.

Elevation - a type of mitigation measure in which an existing building is elevated to reduce future flood damages. Typically, the building is elevated to a level that the lowest floor is at or above the base flood elevation.

Expected Annual Avoided Damages - the expected annual benefits. In other words, the expected annual avoided damages are the difference between expected annual damages before and after mitigation.

Flood Depth - the flood depth used in the flood depth-damage table is the difference between the flood elevation and the first floor elevation. (See Appendix A)

Flood Depth-Damage Table – a table that displays the estimated damage by flood depth for the six classes of building types plus the "other" classification included in the program. (See Appendix A)

Floodplain – the normally dry land adjacent to a body of water, such as a river; stream, lake, or ocean, that is susceptible to inundation by floodwaters.

Floodway - the central portion of the floodplain that carries the greatest portion of the water in a flood. Obstructions in the floodway will result in increased flood levels upstream.

Lowest Floor Elevation (FFE) - the first floor elevation of the building is the elevation of the top of the finished flooring of the lowest finished floor, as defined by the federal Insurance Administration in compiling flood damage data. (also known as the zero depth elevation)

Mitigation Measure - any project undertaken to mitigate the flood hazard or other peril.

Mitigation Project Cost - the sum of all direct construction costs plus other costs such as architectural and engineering fees, testing, permits, and project management but excludes relocation costs.

National Flood Insurance Program (NFIP) – a voluntary program in which local jurisdictions adopt and enforce floodplain management ordinances to reduce future flood damage. In exchange, the NFIP, administered by FEMA, makes federally backed flood insurance available to homeowners, renters, and business owners in these communities.

One Hundred (100)-Year Flood - the flood elevation that has a one percent chance of being equaled or exceeded in any given year. Known as the base flood elevation.

Relocation Costs - the costs that are incurred when occupants must be relocated for construction of the mitigation project. In such cases, the relocation costs are an integral part of the mitigation project and must be counted in the total mitigation project costs.

Repetitive Loss Properties - currently insured properties that have had two or more NFIP insurance claims of at least \$1000 within 10 years

Substantial Damage - damage of any origin sustained by a structure whereby the cost of restoring the structure to its before-damaged condition would equal or exceed 50 percent of the value of the structure before the damage occurred.