

Flooding Forgotten:
**The State of Missouri's Floodplain Management Ten Years after
the 1993 Flood**

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EXECUTIVE SUMMARY

Flooding takes a huge toll on individuals, the economy and society in general. Annual flood losses in the United States now exceed \$4 billion. The obvious, quantifiable impacts of flooding are tremendous and the subtle effects are difficult to measure. The economic, human health and environmental effects combine to cause true disasters in the communities affected by floods. These effects radiate outward through society to drain individual, social and economic resources from the whole country. Effective floodplain management can minimize these damages.

Floodplain management programs vary widely among Midwestern states. States such as Missouri and Arkansas do not have floodplain management laws, relying instead on the voluntary adoption of local floodplain ordinances. Other states, such as Minnesota and Wisconsin, have laws and regulations requiring permits for floodplain development and restricting the types of development in floodplains. This report describes seven Midwestern states' approaches to floodplain management and provides recommendations for the creation of a comprehensive floodplain management program in Missouri. Background is also provided on the many effects of flooding, annual flood damages in the United States and federal floodplain management programs.

Since flood effects often cross local government boundaries and can cause conflict between states, it is important for state governments to be involved in floodplain management. At a minimum, a comprehensive floodplain management program must include:

- Assertion of state jurisdiction over floodplain development, including a permit program with standards for enforcement and issuance of variances;
- A low flood elevation rise standard for floodway delineation and floodplain development permits – 0.1 feet rise or less – to preserve the stream's storage and conveyance capacity;
- Floodway development restrictions, including requirements for purchase of flowage easements if flow would be restricted by a proposed development;
- Strong technical oversight and assistance programs to help local governments and the public understand the dangers of floodplain development and what is required by the permit program; and
- A state-funded grant or loan program to facilitate pre-disaster, non-structural mitigation projects by county and municipal governments.

Several recent scientific studies have shown that structural flood control projects are actually exacerbating flood stages. This suggests that the regulation of such projects should be included in a state floodplain management program. In addition, an incentive program that encourages communities to participate in the National Flood Insurance Program can help divert the cost of flood recovery from tax dollars to insurance claims.

Missouri currently lacks the legal and administrative infrastructure for an effective floodplain management program. Action by the Missouri General Assembly to enact appropriate legislation is imperative for the reduction of future flood losses. Floodplain development in urban areas is accelerating as local communities compete for commercial and industrial development. Without rapid action by the state to prevent additional at-risk development, these communities will suffer disastrous flood losses in the future.

INTRODUCTION

With annual flood losses in the United States averaging \$4 billion and climbing, effective floodplain management is necessary now more than ever. Much of this damage is preventable. State floodplain management laws, implemented and properly enforced, can slow and eventually reverse this costly trend.

Floodplain management programs vary widely among Midwestern states. States such as Missouri and Arkansas do not have floodplain management laws, relying on federal guidelines and local ordinances. Other states, such as Minnesota and Wisconsin, have laws requiring permits for floodplain development and restricting the types of development in floodplains. This report describes seven Midwestern states' approaches to floodplain management and provides recommendations for the creation of a comprehensive floodplain management program in Missouri. The seven states surveyed are Arkansas, Illinois, Iowa, Missouri, Minnesota, Ohio and Wisconsin. Background is also provided on the many effects of flooding, annual flood damages in the United States and federal floodplain management programs.

TYPES OF FLOODS

Flood events are generally classified in three categories: flash floods, river floods and coastal floods. In flash floods, the water rises extremely rapidly and flows through an area destroying or damaging most objects in its path. River floods are generally longer-term events caused by one or more weather-related factors, including snowmelt, extensive rainfall, frozen soil or other factors. Coastal flooding, often referred to as "storm surge", occurs when a storm or strong, persistent wind pushes water up onto the shores of oceans and large lakes.

This report focuses on various floodplain management strategies employed by different states to reduce river and flash flood damage to human lives and property. The unqualified term "flood" refers to both river flood and flash flood events unless a particular type of flood is specified.

Flash Floods

Flash floods can be caused by a number of factors: intense rain from slow-moving or repeated thunderstorms, dam failures, failure of other stream obstructions and heavy rains from tropical storms or hurricanes. Most commonly they occur as a result of excessive rainfall in an area where the topography is conducive to rapid water flow. Flash floods usually occur quickly, within a few hours after an intense rainfall event. The wall of water caused by an intense storm can be more than 30 feet high and have enough energy to uproot large trees, destroy buildings and wash away bridges.



This photograph shows the extensive damage that can be caused by flash floods.

Though most flash floods are caused by intense, repetitive thunderstorms or heavy rains from hurricanes and tropical storms, floods resulting from dam or levee failures can also act like flash floods. In addition, ice jams or other debris can block the flow of water in a stream at a natural or manmade constriction. When the water pressure bursts through the obstruction, a flash flood can result.

River Floods

In general, the large floods that grab public attention are river floods. River floods result from an excess of precipitation or snow melt in a particular watershed over a period of time. Other complicating factors may include frozen or saturated soil, impervious surfaces in developed or urban areas, and constricted or modified river channels.

River floods are slower to develop than flash floods. Often the flood peaks are far removed from the major precipitation events that cause them, either in time or location. In the case of the Mississippi and Missouri Rivers, this scenario is extremely common. Heavy rains and snow melt in the upper river basin in the spring can cause flooding far south of the areas where the precipitation occurs. A number of other factors affect river flooding, including loss of wetlands, levees and navigation structures.

The National Weather Service can track water levels and issue flood watches and warnings well in advance of severe river floods. They are often able to accurately predict the date and level of a river flood peak days in advance. Despite this ability to predict river floods, reducing the damage caused by river floods has proven difficult.

Coastal Flooding

Coastal flooding occurs due to the strong winds of tropical cyclones and strong, off-shore low pressure systems. Hurricanes and tropical storms are the most common causes of coastal flooding in the southeast and gulf coast of the U.S. Coastal flooding in the northeastern U.S., while occasionally caused by tropical cyclones, is most often due to the so-called "Nor'easters" in the cooler months of the year. The great lakes and northwest U.S. usually suffer from coastal flooding due to large winter storms with high winds. *Tsunamis* or tidal waves are also considered coastal flooding and are caused by offshore earthquakes or underwater landslides.

Coastal flooding is handled separately from flash flooding and river flooding by federal flood insurance regulations and by most coastal states. Coastal flooding hazards and strategies to reduce coastal flooding damages are not considered in this report.

FLOOD EFFECTS

In general, flood effects fall into one of four categories: economic, human life and health, community disruption, and environmental. In some ways, all of these categories are interrelated. For example, the environmental damage caused by a flooded hog factory results in increased potential for human diseases due to contaminated water and economic hardship on the community that loses jobs and income due to disruption of a major industry. However, for convenience, this report examines the various effects of flooding by dividing them into the above categories.

Economic Effects

The National Climatic Data Center (NCDC) has catalogued all weather-related disasters with overall damages and costs of \$1 billion or more from 1988 to 2001. The \$1 billion threshold includes direct and indirect damages, costs and deaths attributed to an event. Of the 52 disasters with damages over \$1 billion, thirteen (or 25%) were floods. In addition, fourteen (or 27%) were hurricanes or tropical storms,

in which a significant portion of the damage is usually due to flooding. The Midwest flood of 1993 is listed as the fourth most costly disaster. Two drought/heat wave events (summers of 1980 and 1988) and Hurricane Andrew in 1992 are the only disasters in the last 22 years that caused more damage in constant dollars.

Annual flood damages continue to rise across the country. Figure 1 shows a plot of the 30-year running average flood damages from 1909 to 1999 in constant 1997 dollars (each point on the graph shows the average damages over the prior 30 years). As of 1999, the 30-year average annual flood damage exceeded \$4 billion. The total of U.S. adjusted flood damages from 1903 to 1999 is \$299 billion in constant 1997 dollars. The line illustrates the continuing increase in flood damages. Flood damages will exceed \$5 billion annually by 2040 if they continue to rise at the same rate.

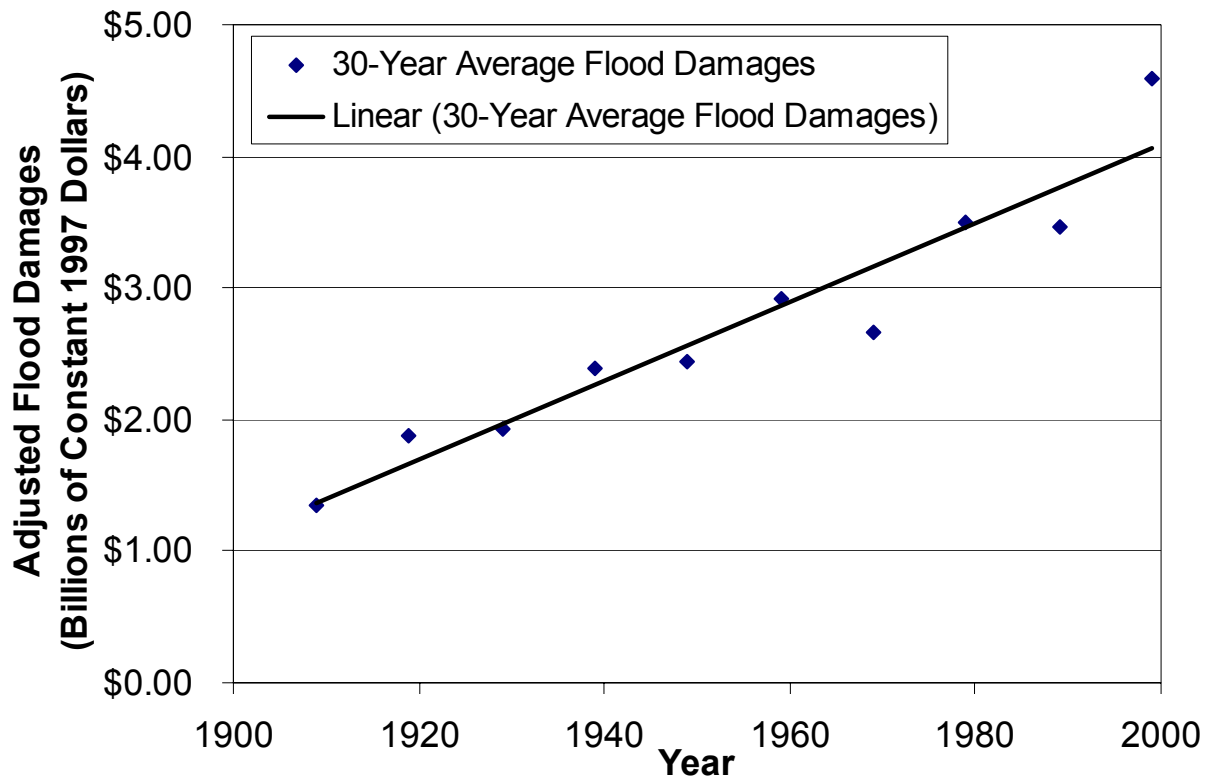


Fig. 1 – Average Annual Flood Damages in the U.S. from 1903 to 1999

There is a lack of reliable flood damage data at the state level. The National Weather Service has compiled rough estimates of each state's flood damages over the past fifty years. Although approximate, this information gives some indication of the flood risks in each state. Of the seven states surveyed in this report, Wisconsin and Minnesota had the lowest annual damage estimates, while Ohio and Missouri had the highest estimates.

The October 1998 Kansas City area flood illustrates the costs associated with an isolated flood event. On October 4, 1998, Kansas City and surrounding areas received between 4 and 11 inches of rain in a matter of hours. Eleven deaths were attributed to the resulting flash floods. Major interstates were closed in the Kansas City area due to standing water. One train derailment and several rail closures were caused by the resulting floods. Missouri and Kansas both declared states of emergency in the Kansas City area.

President Clinton approved federal assistance for the disaster on October 14, 1998. Federal assistance was approved initially for 5 Missouri counties, but was later expanded to include 19 counties. Table 1 gives a summary of the federal aid provided for this single flood event.

Table 1: Summary of federal assistance to victims of the October 1998 flood in western Missouri

Assistance Program	Type of Assistance	Number of Applications	Approved Totals	Program Totals
Disaster Housing Assistance		2,408		\$5,209,641
	Disaster Housing		\$2,507,838	
	Rental Assistance		\$313,288	
	Emergency Repair		\$2,179,619	
	Transient Housing		\$582	
	Mitigation Assistance		\$208,314	
Inspections		2,411		
Small Business Administration			228 SBA loans	\$3,309,200
	Home Loans	633	\$1,991,900	
	Business Loans	77	\$776,800	
	Economic Injury Disaster Loans	79	\$540,500	
Individual & Family Grant Program		1,626	910 Grants	\$1,254,679
Disaster Unemployment Ins.		19	10 approved	\$7,204
Floodplain Community Assistance Visits	NFIP administration assistance	25 municipalities	25 visits	
Public Infrastructure Assistance	Assistance to counties and state		825 projects	\$11,218,064
Hazard Mitigation Grant Program*		32 projects		
	Residential buyouts		30	
	Stream channelization		1	
	Bridge removal		1	
Direct Grant Totals				\$17,680,588
Loan Totals				\$3,309,200

* The Hazard Mitigation Grant Program numbers include properties damaged in the July 1998 and October 1998 flood events.

This cost estimate is incomplete and is likely far below the true cost of the flood event. The above table does not account for any money spent by individuals, businesses, local and state governments as matching funds or independent of federal aid programs. These additional costs are difficult to quantify. The cost to

society of closing major interstates, even for a short period of time, can be extensive. Commodities carried by the trucking industry could be delayed, possibly disrupting factory workers and resulting in loss of perishable items like fresh produce. Business travelers could be stranded, resulting in extended stays at hotels and cancelled or delayed meetings. Further costs that should be considered include extensive debris removal, use of Highway Patrol officers for security and to search for missing people, sandbagging and other flood fighting efforts, and impacts to water treatment plants, sewage treatment plants and parks along the Missouri River.

Human Life and Health Effects

Flooding is historically the most deadly type of natural disaster. According to the National Oceanographic and Atmospheric Administration (NOAA), the average yearly death toll from flooding is nearly 140 lives in the U.S. In addition, a wide range of health hazards are associated with flood waters and flood damaged homes and property.

The mechanical energy of swiftly flowing water is extremely dangerous to humans, both on foot and in vehicles. People drown or are injured after attempting to cross flooded areas on foot. Even more dangerous is attempting to ford a flooded stream in an automobile. The majority of flood-related deaths occur in automobiles. Less than two feet of water is required to float most vehicles and carry them down river. Once taken by the rushing water, the vehicle's occupants are often unable to escape.

Flood waters are often contaminated with chemical and biological hazards. Household chemicals, pesticides and persistent toxins like PCB's can be found in flood waters, especially in urban areas. Human and animal waste – including all of the resulting pathogenic bacteria, viruses and other parasitic organisms – are also common in flood waters. Human waste can be washed out of septic tanks and sewage treatment plants in larger floods. Animal waste comes from the yards of pet owners, traditional farms and the waste collection lagoons of industrial factory farms. Any property that is in contact with flood waters must be cleaned and sanitized to prevent human exposure to pathogens.

Further biological hazards come from a variety of other sources. Toxic mold can grow in flooded buildings that are not properly dried before reoccupation. Certain species of mold, most notably *Stachybotrys chartarum* or similar fungi, can cause bleeding in the lungs because of various toxins. Young children less than six months old are particularly susceptible and the bleeding can be fatal. In addition, common mold spores can cause acute allergic reactions which can be disabling, if not life threatening, in some individuals.

Much of the danger to human health comes from attempting to clean up and rebuild after floods. As mentioned above, mold can be a serious issue. Contact with contaminated water, mud and debris increases the likelihood of exposure to any pathogens or toxic chemicals in the water. Additional hazards include electric shock from flooded wiring, encountering wild animals (such as poisonous snakes) during clean-up efforts, unstable or unsafe structures, airborne asbestos and lead dust, and the fatigue and stress on those participating in a clean-up effort.

Community Effects

The most dramatic effect a flood can have on a community is to cause so much damage that the residents decide the town location is no longer viable. Pattonsburg, in the northwest corner of Missouri, chose a strategy that preserved their community in spite of repeated floods. After flooding twice in July of 1993, residents of Pattonsburg met with local and state officials to determine their options. By 1998, most of the residents of Pattonsburg and 24 of the houses had moved to a new location for the town – approximately 2 miles away on higher ground. In this way the community was preserved, but the town's original location in the floodplain was abandoned.

In the case of Cedar City, Missouri, the residents did not coordinate their relocation to recreate the town in a new location. Nearly all Cedar City residents relocated after the combination of the 1993 and 1995 floods of the Missouri River. After the 1993 flood, Jefferson City coordinated buyouts of flood-damaged residential properties using funds from the State of Missouri and the federal Hazard Mitigation Grant Program (HMGP). In 1995, the number of applications for individual flood disaster assistance was reduced by 90 percent from 1993, even though the flood covered nearly the same area. After the flood of 1995, all but six people had accepted buyout offers – the town had practically disappeared in a matter of two years.

Communities that survive a flood are affected in different ways. Damage to infrastructure, such as bridges, roads, port facilities and power lines, can disrupt community life for weeks or months. In some cases, residents can be isolated by the flood waters and then by lost bridges and damaged roads. More insidious damage occurs when flood waters damage water supply and treatment infrastructure or contaminate wells. This can disrupt the daily lives of all residents, even those not directly affected by the flood waters.

Some effects of flooding are not directly related to flood damage, but to efforts to reduce flood damage with large engineering structures. Levees and floodwalls tend to cut a community off from the river. The community then loses its focus on the natural resource that likely contributed to its foundation and early prosperity.

Environmental Effects

Floods have mixed consequences for the natural environment. Riverine ecosystems evolved in the presence of recurring floods and many plants and animals depend on flood pulses for survival. On the other hand, modern day floods have many negative environmental consequences because of human generated contaminants in their paths.

An unmodified river is in dynamic equilibrium with its channel, banks, floodplain and biota. Flooding is a natural aspect of river ecology to which native aquatic and terrestrial ecological systems are fully adapted. On an engineered river like the Lower Missouri, floods increase habitat for rare and endangered species such as the pallid sturgeon and piping plover by temporarily restoring a more diverse aquatic environment. Due in part to effects of the 1993 and later floods, pallid sturgeon were confirmed to be spawning naturally in the Lower Missouri for the first time in 50 years. Another example is the decurrent false aster – a federally threatened plant – that requires periodic flooding to remove competing plants in its floodplain habitat.

Wetlands are enhanced when a regular cycle of flooding recharges the aquatic system with water and species diversity. The sediment deposited by a natural river on the floodplain is fine, nutrient and organic rich material that enhances the primary productivity of the floodplain. Floodplains that are connected to a natural river retain water after the flood and allow the water to seep into the substrate and recharge groundwater.

The negative environmental consequences of floods result largely from the presence of contaminants in the floodplain. Since municipal wastewater treatment plants are often located in floodplains, larger floods sometimes overtop or breach their protective levees. Some smaller, flash flood events overload the wastewater treatment systems of cities and towns. Raw sewage then pours into the river and pollutes the area with pathogenic bacteria, high levels of nutrients and toxic chemicals. This can happen even more often in areas with the combined sanitary and storm sewers common in older cities like St. Louis.

In addition, floods that impact industrial areas contaminated with hazardous materials will carry these pollutants with the flood water. The pollution can then be deposited in sediments in the floodplain

hundreds of miles downstream. Pesticides can impact beneficial insects and disrupt the food web for other animals as they are carried off by flood waters.

Floods in agricultural areas cause similar environmental problems. Concentrated animal feeding operations have large waste treatment facilities that are susceptible to disruption similar to that of municipal wastewater treatment plants. Flood waters covering agricultural fields can pick up fertilizers and pesticides, contributing to toxic pollution and hypoxia in the lake or estuary receiving the river water. Where levees are breached by flooding, huge quantities of sand can be deposited on previously productive land making it useless for agriculture. Other areas might experience extreme erosion and scour holes from the high energy water.

Some of the environmental damage caused by flooding is indirect, in that it is the result of human attempts to control rivers and flood waters. Wing dams and channelization reduce habitat for indigenous species by filling in side channels and backwater areas. Levees cut the river off from its floodplain, destroying wetlands and increasing the height and velocity of flood waters. New evidence suggests that these effects are even more important than previously suspected, making river engineering a no-win feedback cycle.

CHANGING RIVER DYNAMICS

Human impacts on the major rivers of central North America have radically changed the characteristics of the rivers and their relationships to their floodplains. For much of the lower Missouri River, navigation structures have narrowed the channel to a small fraction of its former width. In addition, agricultural and industrial levees constructed by private interests and government agencies have cut the rivers off from their floodplains. The complex, dynamic, large-river systems of central North America no longer exist.

While human modifications to rivers have allowed for commercial navigation and development of the floodplains, these modifications are not without a price. Scientists have been suggesting at least since the early 1970's that structural modifications to rivers (levees, wing dikes, dams, etc.) are negatively impacting flood frequency and severity.

More recently, Dr. Nicholas Pinter, an environmental geologist at Southern Illinois University-Carbondale, has used the "specific-gage technique" to perform an analysis of flood stage trends on the Mississippi and Missouri Rivers. Pinter concluded that flood stages on these two rivers have increased over time due to the construction of dikes and levees that constrict the river channel and reduce its capacity to convey water.

Other studies have also shown that river stages have increased between 6 and 13 feet for similar discharges at several stations on the Mississippi and lower Missouri Rivers. Recent studies indicate that the stages recorded during the 1993 flood on the Missouri River at Boonville, Missouri, could recur every 15-20 years, instead of the 100- to 500-year interval predicted by older models. No such increase was observed on the far upper Missouri or the Meramec River (in Missouri), neither of which have been subjected to extensive engineering projects.

The changes in river dynamics will continue to have profound impacts on those who live near rivers. For example, the large levees currently under construction in the St. Louis region and those planned in the Kansas City and Jefferson City areas may not give the protection they are purported to provide. In fact, they will likely increase the flood damage potential for surrounding areas and facilitate at-risk development behind the levees.

THE REGULATORY BACKDROP – FEDERAL PROGRAMS

Federal law serves as a backdrop in most states' approaches to floodplain management. The National Flood Insurance Program (NFIP), in particular, provides a regulatory baseline for all communities that agree to participate and also defines the role of federal, state and local agencies. Many states have laws that provide more comprehensive floodplain management programs than the NFIP. These states' laws apply in all communities, regardless of their participation in the NFIP, and often set higher standards than those in the Federal Emergency Management Agency's (FEMA) NFIP regulations.

This report summarizes the role of federal law in floodplain management, but primarily addresses the differing state law approaches in the Midwest.

National Flood Insurance Program

The primary federal program impacting state and local floodplain management decisions is the National Flood Insurance Program administered by FEMA. The NFIP was created by Congress in 1968 in response to rapidly increasing flood damages and is a voluntary, incentive-based program. It operates by offering federally-backed flood insurance in communities that adopt floodplain management ordinances compliant with federal regulations. Through the NFIP, flood insurance is made available to people who own property in communities that participate in the program.

The NFIP defines the roles of federal, state and local governments as they relate to the flood insurance program. However, NFIP requirements for floodplain management, floodway development restrictions and development permits apply only in communities participating in the NFIP. In most states, there remain many communities that do not participate. For example, in Missouri only slightly more than half of the local government entities are participants in the NFIP. The level of participation varies from state to state. States without additional floodplain management laws therefore have areas with no control over floodplain development because of incomplete participation in the NFIP.

NFIP – Federal Role

The primary role of the federal government in the NFIP is to make flood insurance available to participating communities. FEMA issues the general rules for implementing the NFIP, including those governing community eligibility, available policies, property eligibility, insurance application procedures and rate determinations.

FEMA also has the responsibility of identifying flood hazard areas throughout the country. This responsibility includes publication of flood hazard boundary maps (FHBM) and flood insurance rate maps (FIRM). The maps form the basis of the risk zones that are used to determine insurance rates and show the boundaries of special flood hazard areas (SFHA). The FHBM and FIRM delineate the hazard zones that must be regulated by communities in order to participate in the NFIP.

A FHBM is based on approximate data and identifies special flood hazard areas in the community for floodplain management and insurance in the NFIP "emergency" program. During a community's conversion to the "regular" NFIP program, a flood risk assessment is performed and a FIRM is developed from the flood risk assessment. The FIRM usually shows the base flood elevations (BFE). The BFE is the elevation of the water during a flood that has a one-percent chance of being exceeded in any year, commonly referred to as the "100-year flood." In addition, a FIRM will usually show floodway boundaries, floodplain boundaries and insurance risk zones if a detailed flood insurance study was performed.

Development is precluded inside the floodway if it would cause any increase in flood heights. Developments outside the floodway, but inside the flood hazard areas, must obtain a permit from the local authority and be protected from the base flood.

Basic Rules for Participation in the National Flood Insurance Program

Basic rule #1: Communities must use the latest maps and flood data published by FEMA.

Basic rule #2: A local permit is required for all development in the Flood Hazard Areas shown on a community's Flood Insurance Rate Map.

Basic rule #3: Development must not increase the flood hazard on other properties.

Basic rule #4: New, substantially improved or substantially damaged buildings must be protected from damage by the base flood.

NFIP – State Role

Each state designates an agency to act as liaison between FEMA and local governments and to coordinate the NFIP within the state. The state coordinating agency assists communities in developing and adopting the specific floodplain management measures required for NFIP participation. In most states, the department of natural resources (DNR) is responsible for floodplain management and coordination of NFIP activities. In 1995, the Missouri legislature assigned floodplain management duties, including NFIP administration, to the Missouri State Emergency Management Agency (MoSEMA).

The state coordinating agency is responsible for monitoring the compliance of local communities with NFIP regulations and monitoring the enforcement of local ordinances. The state must help communities maintain compliance and assist them in becoming reinstated if the community is placed on probation or is suspended from the program. Additional responsibilities assigned to the state coordinating agencies include mapping assistance, providing workshops and education to local floodplain administrators, and technical assistance to communities that wish to participate in the NFIP Community Rating System.

The state coordinating agency must also ensure that all state agencies comply with national, state and local floodplain regulations and ordinances in all of their activities. Coordination of national, state and local flood protection programs is the responsibility of the state coordinating agency. This includes structural and non-structural flood damage reduction projects undertaken by the Corps of Engineers, the state, municipalities and local levee or drainage districts.

NFIP – Local Role

Cities and counties have primary responsibility for implementing the NFIP. Participating communities must adopt and enforce floodplain management ordinances that regulate new construction and substantial improvement of existing structures in flood hazard areas. Under the NFIP, the regulatory floodway is defined as the area required to convey floodwaters with no more than a one-foot rise in the base flood. The flood fringe is the area outside the floodway that is inundated during the 100-year flood (also called the "base flood").

Local ordinances must prohibit any development in the floodway that would increase flood heights above the one-foot rise contemplated when defining the floodway. The ordinance must also require that all new construction or substantial improvements construct the lowest floor above the base flood level. Participating communities must regulate and keep records of all development in the 100-year floodplain.

It is the responsibility of local communities to issue floodplain development permits and elevation certificates for properties in designated flood hazard areas. FEMA requires each community that participates in the NFIP to complete a biennial report of floodplain development permits and enforcement actions. The report must be submitted to FEMA and the state coordinating agency.

Hazard Mitigation Grant Program

The Hazard Mitigation Grant Program (HMGP) is a FEMA program designed to reduce the vulnerability of communities to natural disasters. A primary component of the HMGP is a 75% federal cost share program that has been heavily utilized to relocate or buy out and remove flood-prone structures. Another critical aspect of the HMGP is its integration of disaster mitigation efforts with post-disaster recovery and reconstruction. Funds from the HMGP allow states to take the initiative to remove people and structures from high hazard areas during the disaster recovery process. The potential for future damages from a similar occurrence is thereby reduced or eliminated.

HMGP – Federal Role

The federal government has two main roles in the HMGP: overseeing the HMGP and providing funding for state hazard mitigation efforts after a disaster. Federal law requires each state to prepare a State Hazard Mitigation Plan (SHMP), which must include an evaluation of natural hazards in the state and identifiable mitigation measures. These mitigation measures are eligible for funding from FEMA disaster relief grants. Up to 75% of the cost of the mitigation activities can be provided by HMGP funds, with the remaining 25% provided by state or local governments or non-profit sources (such as land trusts).

HMGP – State Role

Primary responsibility for management of the HMGP and accountability for use of grant funds is delegated to the state as grantee. Each state is responsible for preparing its SHMP and setting short- and long-term goals for the hazard mitigation program. The state is responsible for keeping its plan up-to-date and adjusting priorities as mitigation measures are implemented and risks to state resources evolve. The SHMP serves as a framework for utilization of HMGP funds when they are made available after a disaster.

The states also provide technical assistance to local government applicants throughout the process from application to closeout. In addition, states are responsible for ensuring local government and individual applicant compliance with program requirements. States might also provide some or all of the non-federal matching funds that can be no less than 25% of the project cost. It is the responsibility of the states to monitor participating properties and ensure that only acceptable open space use of the project occurs.

HMGP – Local Government Role

Local governments have the most direct role in implementation of the HMGP. Local governments must submit an application to the state in order to participate in the HMGP program after a declared disaster. If FEMA and the state approve the application, the local government becomes the subgrantee. The subgrantee is responsible for implementing the project at the local level; complying with all federal, state and local laws; accounting for funds allocated by the state; and maintaining records on the project. The

subgrantee interacts with the individual property owners and negotiates the terms of transfer of title or conservation easement.

The subgrantee takes ownership of any properties or conservation easements acquired with HMGP grant funds, and ensures that all structures are removed from acquired properties within 90 days of closing. Maintenance of the properties as open space is the continuing responsibility of the subgrantee.

BUILDING ON FEDERAL PROGRAMS – STATE LAWS

The federal programs described above provide a base level of floodplain management policy for all states. However, federal programs fall short of providing the comprehensive legal structure necessary to reduce flood damages. It has been widely recognized that the NFIP alone is not sufficient to eliminate unwise development in floodplains. Many communities do not participate in the NFIP and, even though the NFIP regulatory requirements reduce unwise floodplain development, they are not comprehensive enough to prevent flood damages. Many states have therefore passed laws to address floodplain management that both plug the holes in federal law and provide tighter regulation of development in floodplains.

The floodplain management statutes and regulations of seven states – Arkansas, Illinois, Iowa, Minnesota, Missouri, Ohio and Wisconsin – were analyzed for this report. These states were chosen because they are all Midwestern, all have exposure to large rivers, and all include metropolitan areas with flood hazards. In addition, the chosen states exhibit a variety of approaches to floodplain management.

The state programs summarized here include a broad spectrum of strategies. Missouri and Arkansas assert little or no jurisdiction over their floodplains, leaving floodplain management decisions to local governments. In contrast, other upper Midwestern states have comprehensive floodplain management laws. For example, Iowa and Illinois require a permit for floodplain development from the state or a state-approved local program. Minnesota and Wisconsin set forth standards for floodplain development in state law and require that local governments implement these standards through floodplain ordinances.

The following information was obtained from state statutes, regulations and other legal and technical materials. In addition, interviews or written questionnaires were completed by floodplain managers in each state surveyed. Several terms used throughout the following discussion require explanation. Each state defines these terms in its statutes (if applicable) and the definitions vary slightly from state to state. However, for discussion purposes the following definitions are appropriate.

Base Flood Elevation (BFE) – The base flood elevation is defined as the water level during the one-percent chance exceedance event, meaning that there is a one-percent chance this level will be exceeded in any given year. It is also known as the "100-year flood."

Floodway – The floodway is defined as the part of the floodplain, including the river channel, that is required to carry the base flood discharge with a defined maximum rise in base flood elevation. The NFIP regulations allow a one-foot rise in the base flood elevation when delineating the floodway. Some states have specified a smaller rise allowance.

Flood Fringe – The flood fringe is defined as the area of the floodplain that is covered by standing water during the base flood, but that is landward of the floodway boundary. The flood fringe can also be described as the area that can be completely filled (i.e., raised out of the floodplain) without causing the base flood elevation to rise more than the allowed amount.

Regulatory Flood Protection Elevation (RFPE) – the regulatory flood protection elevation is the level of flood protection required for new construction. New structures can be placed on fill, on stilts or behind levees. Most regulations use the base flood elevation, but some add an extra

safety margin (often called "freeboard") to account for wave action or increases in flood elevation due to other floodplain development.

Arkansas

The State of Arkansas has not enacted a detailed floodplain management law, meaning that the state does not generally assert regulatory jurisdiction over floodplains or floodplain development. Arkansas law does, however, authorize cities, towns, counties and the state to enact any land use measures necessary to participate in federal flood assistance and insurance programs. The Arkansas Soil and Water Conservation Commission is tasked with coordinating the NFIP and providing information to the public about floodplain management.

The state statute authorizing local floodplain ordinances provides that such ordinances should discourage development that is prone to flooding and "otherwise improve long-range land management in, and use of, flood-prone areas." Local governments are not offered any additional guidance by state law and most presumably follow NFIP regulations in writing their floodplain ordinances. However, state law does not limit local governments' authority in this area to NFIP standards and they can adopt ordinances more restrictive than federal standards.

In addition, the state statute provides for both public and private enforcement of floodplain ordinances. Structures built in violation of local floodplain ordinances are considered public nuisances and "may be abated by action or suit of any city, town, or county, the state, or any citizen of the state."

Illinois

Illinois law gives the Illinois DNR jurisdiction over activities in and around the waters of the state. The state's floodplain management laws contain various provisions covering different areas of the state. In particular, six counties in the Chicago area are subject to specific regulations that set forth more detailed requirements than those for the rest of the state. Regulations applicable to the remainder of the state assign the DNR permitting authority over construction in the floodway of streams draining 640 acres (1 sq. mile) in urban areas and 6400 acres (10 sq. miles) in rural areas. The DNR's legal authority is limited to the floodway and does not extend to the flood fringe. Regulation of development in the flood fringe is left to local governments.

DNR regulations define the floodway using a 0.1 feet rise in base flood elevation and also require consideration of floodwater storage. These factors widen the floodway, thereby increasing the area subject to state permitting authority. Construction permits are only issued by the DNR if the project in the floodway, when combined with other anticipated development, would not cause unacceptable effects on flood height and velocity. In rural areas of the state, developments may cause up to a 0.5 feet increase in flood height and still obtain a permit. In urban areas, the limit is 0.1 feet. Alternatively, where flood heights would be increased by more than these standards, flowage easements may be purchased by the applicant in order to obtain a permit.

The DNR floodplain manager coordinates the NFIP and serves as the interface between FEMA and local communities. The DNR is charged with preparing manuals and model ordinances to facilitate the adoption of local floodplain ordinances. For developments in the floodway, both state and local permits have to be obtained if a local ordinance is in place. In addition, the floodplain manager is responsible for enforcement, education, flood mitigation, buyout projects and review of flood hazard maps throughout the state. Most enforcement actions are resolved through negotiation without resorting to legal action. The DNR has insufficient resources to prosecute a large number of cases.

Iowa

The Iowa DNR regulates floodplain development through two methods: state-issued floodplain permits and approval of local floodplain ordinances. Local governments with approved floodplain ordinances are delegated permitting responsibility for most floodplain construction, but the DNR maintains oversight authority and must approve any variances to the local ordinance. Certain types of projects, such as levees and channel modifications, may require state approval even if a local ordinance is in place. The criteria used to determine which projects require a permit are largely based on the size of the watershed. In rural areas, projects in drainages of 10 square miles or more usually require a permit. In urban areas, the drainage threshold is usually 2 square miles. Most development projects impacting floodplains in Iowa require a permit from either the state or a local government.

Local floodplain management ordinances, and development in areas without an ordinance, must comply with the criteria outlined in Iowa law. These criteria include establishment of a floodway, minimum standards for floodplain and floodway uses, and guidelines for handling preexisting nonconforming development. Iowa law prohibits many uses in the floodway and requires the elevation of structures in the flood fringe to the 100-year flood level plus one foot. The DNR floodplain management regulations also provide specific standards for particular types of development, including bridges, dams, levees, buildings and wastewater treatment facilities. The state's definition of the floodway and flood fringe largely track that used in the NFIP. Criteria for variances and approval of modifications to local ordinances are outlined in state law. Approximately 15% of local governments have a state-approved permitting program.

Iowa assigns the responsibilities of floodplain manager to the Iowa DNR's Water Quality Bureau Chief. The floodplain manager oversees the state's floodplain development permitting program, the delegation of authority to local governments, and the NFIP. The state's floodplain management program is underfunded and does not have adequate resources to properly monitor and ensure compliance throughout the state. Enforcement of the state permitting program depends largely on citizen complaints, although Iowa DNR field offices do some independent investigations. Most enforcement actions are administrative orders and post-construction applications for permits.

Minnesota

Minnesota has a state floodplain management law designed to discourage development in floodplains and to promote non-structural methods of flood damage reduction. The law requires that all Minnesota communities that contain land subject to flooding adopt a floodplain management ordinance and maintain eligibility in the NFIP. All local floodplain ordinances must comply with standards set at the state level. The Minnesota DNR has the responsibility of administering the state's floodplain management program, managing the NFIP and coordinating with local governments.

Minnesota's floodplain management laws are stricter than the NFIP requirements. State regulations allow only a 0.5-foot incremental increase in surface water elevation when defining the regulatory floodway and a lower threshold may be used if the 0.5-foot rise would result in additional flood damages. Minnesota prohibits most new structures in the floodway, only allowing structures accessory to open space uses that do not cause an increase in base flood elevation. Any structure in the floodway that suffers damage totaling 50% or more of the property's value cannot be rebuilt. New structures in the flood fringe must be elevated to the regulatory flood protection elevation, which state regulations set at the base flood elevation plus the allowable base flood increase of 0.5 feet and one foot of freeboard. Moreover, all additions to structures must be protected to the elevation of the base flood.

Primary enforcement responsibility rests with the local governments. However, local floodplain ordinances must be approved by the DNR before they can be adopted, thereby ensuring consistency with state law. If a local government grants unlawful permits or variances, the DNR may take enforcement action.

Missouri

Missouri lacks comprehensive floodplain management laws and there is no coordinated flood damage reduction strategy for the state. Local government zoning laws and participation in the NFIP are the only mechanisms for controlling floodplain development. In cities and counties that do not participate in the NFIP, there are no regulations governing floodplain development.

The Missouri State Emergency Management Agency is responsible for NFIP administration. MoSEMA coordinates with county governments to try to bring them into the NFIP, which ultimately requires a majority vote of the county electorate. In addition, MoSEMA provides technical assistance, education about the NFIP, public information and assists communities with NFIP compliance.

Missouri's most successful program for reducing flood damages was its participation in the federal HMGP after the 1993 and 1995 floods. Many areas flooded in 1993 were flooded again in 1995, but those that participated in the HMGP suffered no significant damage in 1995 because most structures had been removed.

Ohio

The Ohio DNR is tasked with implementing the state's floodplain management program. Any state agency that funds or permits development in a floodplain must ensure that such development complies with the DNR's floodplain management rules. Such rules "shall be consistent with and no more stringent than" the NFIP. The DNR also has the authority to mark past and probable future flood heights on state structures so as to create public awareness of flood risks. The Ohio law does not govern floodplain development undertaken solely by private parties.

One of the primary functions of the Ohio DNR is to produce model floodplain ordinances and provide technical assistance to communities. The DNR has the initial responsibility to ensure that local governments that participate in the NFIP have complied with its requirements. Findings of noncompliance by the DNR are sent to FEMA, potentially threatening the community's participation in the NFIP. Local governments in Ohio have the ability to go above and beyond the NFIP in their ordinances and many cities and counties have done so.

In addition to these floodplain management provisions, Ohio law gives the DNR broad permitting authority over dams, dikes and levees. The DNR may deny a permit for any such structure that poses a threat to "life, health, or property." A dike or levee may not be built if it would cause more than a one foot increase in the base flood when considering equal encroachment on both sides of the stream.

Wisconsin

The State of Wisconsin has enacted a comprehensive floodplain management law that is administered by the state's DNR. The purposes of the floodplain management program include minimizing expenditures of public money for flood control projects, reducing the occurrence of flood blight areas, and preventing increases in regional flood levels.

The Wisconsin floodplain management law sets standards that all communities must adopt and enforce. The DNR assists communities in adopting and amending the required ordinances, offers technical assistance and performs periodic audits of local floodplain management programs. If a local government fails to adopt an adequate floodplain management ordinance, the Wisconsin DNR is authorized to issue an order specifying the floodplain management standards for the community. Local governments are allowed to set more restrictive standards than the state if they so choose. The Wisconsin floodplain law

initially set up a financial assistance program designed to ensure that all communities had the resources to adequately map their flood hazard areas.

Perhaps the most significant aspect of Wisconsin's state floodplain law is its definition of the floodway. In Wisconsin, the floodway boundary is set using a 0.01 foot rise standard, meaning that a large part of the floodplain is considered to be floodway. This greatly restricts the amount of development that can occur in the state's floodplains.

Wisconsin's comprehensive floodplain management laws contain a number of other important provisions. For example, DNR approval is required for any hydrologic studies used by a local government in administering its floodplain ordinance, and for any change in the floodway delineation that would cause an increase in flood heights. There is also an absolute prohibition on the placement of any structures in the floodway that are not associated with open space uses, or that involve the storage of hazardous materials or the treatment of sewage. Development in the flood fringe must have its lowest floor two feet above the base flood elevation. Finally, DNR has the legal authority to take enforcement action against violators of local floodplain ordinances.

COMPARISON OF STATE APPROACHES ON SPECIFIC FLOODPLAIN MANAGEMENT ISSUES

A comparison of the different state legislative and administrative strategies for dealing with floodplain management is provided below. This report attempts to categorize the various states' approaches for ease of comparison. However, nuances to each state's program require some generalization, and the applicable statutes and regulations should be consulted for definitive guidance.

State Authority

The extent to which states assert jurisdiction over floodplains is a threshold issue when comparing state floodplain management programs. All of the states surveyed have passed the minimum legislation required for local governments to participate in the NFIP. Local governments – cities and counties – that choose to participate in the NFIP must enact floodplain management ordinances. The state role in the NFIP is mostly administrative and advisory.

State programs are partially defined by the role of state agencies in floodplain management. Some states set standards and require local governments to implement the standards through local floodplain ordinances. In other states, floodplain laws retain permitting authority within state agencies, but may allow delegation of this authority to local governments. A few states have no floodplain management program at all.

Missouri and Arkansas assert little or no regulatory authority over development in floodplains. In these states, cities and counties may implement the NFIP program with some assistance and guidance from state agencies. Areas that do not participate in the NFIP have no floodplain management. Ohio also asserts little direct authority over its floodplains, but state agencies are required to follow floodplain management standards when carrying out their own functions.

Illinois law gives the state's DNR jurisdiction over public waters, but restricts the DNR's permitting authority to designated floodway areas. Iowa law gives the state jurisdiction over floodplain development and the ability to delegate that jurisdiction to local governments that adopt compliant ordinances. Minnesota and Wisconsin laws provide those states' DNRs with the authority necessary to carry out a floodplain management program, but implementation of the law is primarily through local governments.

Table 2 gives a comparison of some of the major aspects of state jurisdiction over floodplains.

Table 2 – Comparison of State Involvement in Floodplain Management

REGULATORY ISSUE	AR	IL	IA	MN	MO	OH	WI
State authorizes local governments to enact floodplain management ordinances (required for NFIP participation)	YES	YES	YES	YES	YES	YES	YES
State provides incentives for local governments to participate in the NFIP	NO	NO	NO	YES	NO	YES	NO
State asserts jurisdiction over floodplains in general	NO	YES	YES	YES	NO	NO*	YES
State floodplain management program has more restrictive provisions than the NFIP	NO	YES	YES	YES	NO	NO	YES
State reserves approval authority for local floodplain management ordinances	NO	NO	YES	YES	NO	YES‡	YES
State law defines appropriate uses of floodplains	NO	YES	YES	YES	NO	YES†	YES

* Ohio law requires state funded or permitted development to meet state standards. Ohio does not assert jurisdiction over private development.

‡ Ohio DNR reviews local floodplain ordinances for consistency with NFIP regulations.

† Ohio law specifies a limited number of unacceptable uses of floodplains.

Iowa, Minnesota, Ohio and Wisconsin require some form of state approval of local floodplain management ordinances. Minnesota and Wisconsin actually require that communities with flood hazards adopt a local ordinance that complies with state standards. Ohio provides incentives for communities to participate in the NFIP, such as making disaster relief funds contingent upon having in place a compliant floodplain ordinance. Four of the seven states have floodplain management regulations that are generally stricter than NFIP.

The states with regulatory programs are able to carry out a coordinated floodplain management policy that includes the prevention of unwise development. Without such laws, haphazard development can occur that increases the risk of flood damages, especially in cities or counties not enrolled in the NFIP. Even where the NFIP is implemented, lack of a coordinated statewide program may allow local jurisdictions to permit development that harms those outside its boundaries. For example, in Missouri, a lack of authority over floodplains prevents state agencies from coordinating a flood damage reduction strategy. Cities and counties in Missouri that do not participate in the NFIP are without regulations governing floodplain development, and those communities in the NFIP often do not concern themselves with impacts outside their boundaries. Among the states surveyed, only Arkansas has an equally hands-off approach to the management of floodplains.

Local Governments' Role

Communities that want to participate in the NFIP must pass a floodplain management ordinance that meets minimum requirements. All of the states surveyed authorize local governments to enact ordinances that are stricter than the NFIP standards. Arkansas, Illinois, Missouri and Ohio require nothing more from local governments.

The State of Iowa gives communities the option of being delegated authority over floodplain management if a community adopts an ordinance that is at least as strong as the standards set forth in state law. Minnesota and Wisconsin require local floodplain management ordinances in any county or municipality that has a flood hazard area. The two states also will impose a compliant local ordinance on municipalities that do not follow state requirements.

Table 3 gives a summary of the state requirements for local floodplain management ordinances.

Table 3 – State Requirements for Local Floodplain Management Programs

REGULATORY ISSUE	AR	IL	IA	MN	MO	OH	WI
Local ordinances may be stricter than state or NFIP standards	YES	YES	YES	YES	YES	YES	YES
State requires local floodplain management ordinances in flood hazard areas	NO	NO	NO	YES	NO	NO	YES
State will impose local ordinance if municipality does not adopt or properly enforce compliant ordinance	N/A	NO	NO	YES	N/A	N/A	YES
Local building codes and subdivision regulations must be included in floodplain management program	NO	NO	NO	YES	NO	NO	NO

Missouri does not require that local governments adopt floodplain management ordinances. This allows completely unfettered development in the floodplains of many Missouri communities, much of which is detrimental to the community and its neighbors. The widespread lack of local floodplain management and the absence of state oversight often lead to "levee wars" along rivers, especially the Missouri and Mississippi. Each community attempts to build a higher levee than its neighbors in an effort to make sure investments in the floodplain do not flood even if it will increase the risk of flooding in other areas. This creates a dangerous situation facilitating heavy investment of capital in risky development behind levees. Evidence of this trend is especially prevalent along the Missouri and Mississippi Rivers in the St. Louis area.

Defining the Floodway

The definition of the regulatory floodway is a key component of floodplain management regulations. FEMA defines the regulatory floodway using a one foot elevation increase, which means that the floodway is mapped to allow a one foot rise in the water level if the discharge associated with the 100-year flood is completely confined to the floodway by levees, floodwalls or fill. Thus, the cumulative

effects of development in the floodplain are not allowed to cause a base flood elevation increase of more than one foot in NFIP participating communities.

Some states specify a smaller rise in flood stage than the NFIP when determining the floodway boundaries. The smaller the allowed base flood elevation increase, the larger the regulatory floodway, which means that development restrictions apply to a larger area. Wisconsin allows only a 0.01 feet rise in base flood elevation when defining the floodway. Illinois allows a 0.1 feet increase in base flood elevation, and Minnesota generally allows a 0.5 feet rise. These three states all have much wider floodways along their rivers than do the other states that simply follow the NFIP standards, or do not define the floodway at all.

Table 4 summarizes the state laws on the delineation of the regulatory floodway.

Table 4 – State Laws Concerning the Delineation of the Regulatory Floodway

REGULATORY ISSUE	AR	IL	IA	MN	MO	OH	WI
Floodway defined using 100-year flood	N/A	YES	YES	YES	N/A	N/A	YES
Floodway definition more restrictive than NFIP	N/A	YES	NO	YES	N/A	N/A	YES
Floodway designation based on equal encroachment on both sides of waterway	N/A	YES	YES	YES	N/A	N/A	NO

N/A: State law does not require delineation of the floodway.

The more tightly a river is constricted with levees and floodwalls, the greater the likelihood of disastrous flood events in the future. Therefore, how states define the regulatory floodway has a large impact on the effectiveness of their floodplain management programs. Smaller rise allowances can greatly expand the floodway boundaries, especially on the broad floodplains of the Midwest. This removes development from harm's way and allows adequate area for floodwater conveyance. In contrast, communities that follow the NFIP often protect only a relatively narrow strip of land along the river channel for floodwater conveyance. Communities that have no floodplain management regulations run the risk of allowing development up to the water's edge. Such development will be put at risk in future floods and will probably exacerbate damages in neighboring communities by causing increased flood heights.

Floodway Development Restrictions

Development in the floodway is strictly regulated under both the NFIP and state floodplain management programs. Nevertheless, there are often requests to develop in the floodway, especially for uses that are dependent on being near a river. There are also many areas where the floodway has not yet been mapped, requiring that site-specific hydraulic analyses be performed for many floodplain development proposals. Many states have in place a system for addressing development proposals in the mapped or unmapped floodway.

Floodway development restrictions allow states to preserve the carrying capacity of streams and prevent increases in flood heights. Illinois, Iowa and Minnesota have threshold watershed sizes that must be exceeded before floodway restrictions are applicable. All of the states with floodplain management laws prohibit activities in the floodway that would obstruct flood flows. Some states also specify the type of

uses that may be allowed in the floodway. This can help industries that require a riverside location as well as regulators who have clear criteria for floodway development permits.

How the impact of development on flood heights is measured is another important factor when considering the effectiveness of floodplain management programs. Site-specific hydrologic and hydraulic analyses are required whenever there is a proposal to build in a mapped or unmapped floodway. Three of the states surveyed require site-specific analyses to account for future development on neighboring lands. Taking into consideration future land use conditions is a forward-looking method of accounting for changes in hydrology that occur when open land is developed.

Table 5 summarizes the floodway development restrictions for the seven states.

Table 5 – State Laws Concerning Development within the Regulatory Floodway

REGULATORY ISSUE	AR	IL	IA	MN	MO	OH	WI
Drainage area for stream affects floodway development restrictions	N/A	YES	YES	YES	N/A	N/A	NO
Activities in the floodway that reduce its capacity to discharge floodwaters are prohibited by state law	N/A	YES	YES	YES	N/A*	N/A	YES
Structures permitted in floodway must have low flood damage potential	N/A	NO‡	YES	YES	N/A	N/A	YES
Structures not associated with open space uses or dependent on waterfront location prohibited in floodway	N/A	NO‡	NO	YES	N/A	N/A	YES
Calculation of a development's impact on flood levels must consider future development on nearby lands	N/A	YES	YES	NO	N/A	N/A	YES
Different base flood elevation increase requirements apply depending on location or damage potential	N/A	YES	YES	YES	N/A	N/A	NO

N/A: State law does not require delineation of the floodway.

* Missouri law prohibits denial of county floodplain development permits issued under the NFIP if the development does not raise the base flood elevation more than one foot.

‡ Tighter restrictions on floodway uses apply in the six-county Chicago area.

Arkansas, Missouri and Ohio are the only states that do not limit activities in the floodway. Without a regulatory definition of the floodway and basic protections for its discharge capacity, it will be difficult for these states to reduce flood losses on a statewide basis. Communities that do not participate in the NFIP in these states are not required to regulate development in the floodway. Missouri law even prevents counties from adopting a floodplain ordinance that utilizes a more expansive definition of the floodway than the NFIP. Under this law, Missouri counties may not deny a floodplain permit application if the proposed development will not raise the base flood elevation more than one foot. This provision appears designed to actually facilitate floodplain development.

Flood Fringe

The flood fringe is the area that contains relatively shallow, standing water during the base flood. The flood fringe generally has fewer restrictions on development than the floodway. Communities participating in the NFIP must require permits for all development in the flood fringe and ensure that such development is protected from the base flood.

Arkansas, Illinois, Missouri and Ohio have no flood fringe definition or development requirements beyond the NFIP, although Illinois' broad definition of the floodway encompasses much of the area that is considered flood fringe under the NFIP. Iowa, Minnesota and Wisconsin have varying degrees of restrictions and state permit requirements for development in the flood fringe. States such as Minnesota and Wisconsin that require structures in the flood fringe to be elevated above the base flood level (the "freeboard" requirement) will be better able to avoid future flood damages if changing hydrology causes an increase in flood heights. Adding this margin of error to a floodplain management program is wise practice considering the unpredictable nature of human development patterns and climate.

Table 6 summarizes the flood fringe development requirements in each state program.

Table 6 – State Laws Concerning Use of the Flood Fringe

REGULATORY ISSUE	AR	IL	IA	MN	MO	OH	WI
Construction in flood fringe that will cause increase in flood heights or velocity prohibited	N/A	N/A	NO	YES	N/A*	N/A	YES
Construction in flood fringe must be protected to base flood elevation	N/A	N/A	NO‡	YES	N/A	N/A	YES
Construction in flood fringe requires permit from state or local regulators	N/A	N/A	YES	YES	N/A	N/A	YES

N/A: State law does not require delineation of the flood fringe.

* Missouri prohibits denial of county floodplain development permits if the development does not raise the base flood elevation more than one foot.

‡ Buildings with "moderate" damage potential only require 50-year flood protection. Higher levels of damage potential require protection to at least the 100-year flood level.

Permit requirements for flood fringe development are an important part of any comprehensive floodplain management program. All NFIP participating communities must require protection of development in the flood fringe to the base flood elevation or higher. Minnesota and Wisconsin have state requirements for flood fringe development that apply to all communities. In states without flood fringe development requirements, large areas of the floodplain remain open to unregulated, flood-prone development.

Flowage Easements

The floodway of a river serves as a common resource for the conveyance of floodwaters from upstream areas. Floodway-constricting development, such as a levee or a building, interferes with the river's capacity to carry floodwaters and can cause increases in flood elevations upstream of the restriction.

Flowage easements are a legal mechanism that can be used to mitigate for a loss of conveyance capacity due to a floodway obstruction. The party responsible for the obstruction can be required to acquire flowage easements upstream or across from the obstruction to maintain the floodway or eliminate the possibility of future flood damage.

Table 7 summarizes the flood or flowage easement acquisition programs for each state.

Table 7 – State Law Concerning Flood Easement Acquisition

REGULATORY ISSUE	AR	IL	IA	MN	MO	OH	WI
Parties benefited by the protection of existing uses are required to purchase flowage easements	NO	NO	YES	YES*	NO	NO	NO‡
Compensating measures, including purchase of flowage easements, are authorized by state law	NO	YES	YES	YES	NO	YES†	YES

* Minnesota DNR can require easement purchase on a case-by case basis.

‡ Wisconsin regulations require that the consent of affected property owners be obtained for agricultural levees if flood heights would be increased. This presumably could lead to flowage easements acquisition.

† Mitigation measures such as flowage easements must be specifically approved by Ohio DNR when a planned dike or levee encroaches on a regulatory floodway.

Iowa and Minnesota may require parties that benefit from flood protection measures for existing uses to purchase flowage easements or implement other mitigation measures in order to maintain an adequate floodway. Illinois, Iowa, Minnesota, Ohio and Wisconsin authorize the purchase of flowage easements and other mitigation measures only for public benefit structures such as bridges. States with no provision for flowage easements may not be able to mitigate for unavoidable encroachments in the floodway.

Floodplain managers interviewed in several states expressed reservations about flowage easement programs. Their reservations focused on the difference between avoidance and mitigation, and a concern that the allowance of easements may encourage flood-prone development. Redirecting flow around an artificial obstruction can still slow discharge of flood waters when compared to the natural channel. Despite these reservations, most floodplain managers agreed that a system that requires flowage easements for unavoidable floodway encroachments might be helpful in reducing the impact on flood heights.

Floodplain Land Acquisition Programs

Public acquisition of land in the floodplain may be the most permanent and effective way to prevent flood damage. All of the surveyed states have laws that support state or local acquisition of floodplain property for hazard mitigation purposes. Often the acquired land is converted to public use in the form of a park designed for active use (such as ball fields and picnic pavilions) or passive use (such as nature reserves). Four of the states surveyed also had an explicit mechanism for providing state funds for flood hazard mitigation. However, these programs are only as valuable as the appropriations they receive from state legislatures.

Table 8 shows a summary of the state land acquisition programs.

Table 8 – State Laws Concerning Public Acquisition of Floodplain Land

REGULATORY ISSUE	AR	IL	IA	MN	MO	OH	WI
State or local governments authorized to acquire lands in flood hazard areas to convert to public use	YES	YES	YES	YES	YES	YES	YES
State provides loans, grants or cost share for local non-structural projects and property acquisition (separate from matching funds for HMGP)	YES	YES	NO	YES	NO	NO	YES

One bright spot in Missouri's management of its floodplains has been its use of federal buyout programs, especially after the floods of 1993 and 1995. Even though Missouri does not have a proactive mitigation funding program, after these two major floods the state facilitated and provided matching funds for many federal buyout projects. MoSEMA has published a report titled *Stemming the Tide of Flood Losses* highlighting the major successes of the buyout program. However, this is a reactive program that is only funded after a federal disaster declaration. Missouri could greatly benefit from a program that empowers local communities to address hazards before a disaster occurs.

Pre-existing Structures and Uses

Non-conforming structures are those within the floodplain that are not in compliance with floodplain management laws. The NFIP was created by Congress in 1968 and most state floodplain management programs were initiated after the NFIP. Therefore, floodplain development was not regulated in most areas before the late 1960's.

Many older structures exist in the floodplains of all seven states that do not conform to even the minimum NFIP standards. These structures are often damaged and repaired repeatedly, and have been labeled "repetitive loss" properties. In the most egregious cases, flood insurance payouts for such properties have exceeded their market value. NFIP participating communities must address non-conforming structures in their floodplain management program by requiring compliance with NFIP standards whenever repairs or improvements are made that exceed 50% of the property's value. FEMA estimates that nearly one-third of all flood insurance claims can be attributed to non-conforming, repetitive loss properties.

Many states have their own standards for non-conforming structures. A summary of these policies is provided in Table 9.

Table 9 – State Laws Concerning Pre-existing Uses of Floodplain Land

REGULATORY ISSUE	AR	IL	IA	MN	MO	OH	WI
Pre-existing uses and structures allowed to remain even if non-conforming	N/A	YES	YES*	YES*	N/A	N/A	YES
Additions or modifications to pre-existing structures must comply with floodplain management regulations	N/A	YES	YES	YES	N/A	N/A	YES

N/A: State does not have a floodplain management program applicable to private development.

* Iowa and Minnesota do not allow continued use of non-conforming uses that contribute to significant increase of flood damage potential.

Four of the states surveyed have provisions in their floodplain management programs dealing with non-conforming structures. These provisions in state law fill the gaps left by the incomplete coverage and minimal requirements of the NFIP. Bringing non-conforming structures into compliance with floodplain management regulations is an important hazard reduction strategy. An active program to bring structures into compliance will reduce repetitive disaster and insurance payouts.

Flood Damage Reduction Structures

Flood damage reduction structures (i.e. levees, floodwalls, dams, etc.) are a necessary component of any comprehensive floodplain management strategy. There is little alternative to protecting historic districts and older urban centers with levees and floodwalls. However, it is impossible to prepare for extraordinary events and all areas protected by structural systems retain some flood risk. The inherent danger of structural flood damage reduction strategies must be considered in a state's floodplain management program.

Moreover, there is evidence that flood damage reduction structures are actually exacerbating flood heights. The recent work of several academics implicates levees and navigation structures as the cause of increased flood heights observed over the past century. The effects of flood damage reduction structures reach far beyond their immediate surroundings, and the cumulative effects of such projects are not well understood. State oversight of structural flood control projects may serve to alleviate the cumulative impact of such projects. In contrast, local jurisdictions rarely have an incentive to consider impacts on other communities, and are more prone to permit flood control structures that contribute to increased flood heights.

Table 10 gives a summary of state statutes and regulations addressing flood damage reduction structures.

Table 10 – State Laws Concerning Flood Damage Reduction Structures

REGULATORY ISSUE	AR	IL	IA	MN	MO	OH	WI
State approval is required for construction of all flood damage reduction structures	NO	YES	YES	YES*	NO	YES	YES
Interior drainage must be provided in conjunction with levee projects	NO	YES	YES	YES	NO	YES	YES

* The Minnesota DNR has limited approval authority over flood damage reduction structures.

Arkansas and Missouri are the only states in this study that do not regulate flood damage reduction structures. As a result, massive new industrial levees are planned or are under construction near St. Louis, Jefferson City and Kansas City along the Missouri River. Increases in flood heights along the Missouri River in the last 100 years can be attributed in part to past levee construction. Future levee construction will serve to compound the mistakes of the past.

Illinois, Iowa, Minnesota, Ohio and Wisconsin require state approval of flood damage reduction structures. Interviews with state floodplain managers found that these five states have not seen the same proliferation of levees as has occurred in Missouri. In fact, with the possible exception of Illinois, these states have very few significant levees along their rivers.

Permits, Variances and Enforcement

An effective floodplain management program must provide for floodplain development permits, variances and enforcement. Some floodplain development, that which is functionally dependent on riverside location, may be appropriate. A permitting program helps to screen out these projects from those that have high damage potential and are prohibited by floodplain management laws. Enforcement provisions must be strong enough to ensure compliance.

States agencies in Illinois and Iowa have permitting authority over floodplain development, but can delegate permitting to local governments. In Iowa, however, the state must approve variances to local floodplain ordinances even if the permitting function has been delegated. Minnesota and Wisconsin mandate that local governments require permits for developments in areas affected by the base flood.

Although Arkansas does not have state-level permitting authority, state law does provide for enforcement of local floodplain ordinances. Missouri law does not address floodplain development permits, variances or enforcement of floodplain management ordinances. States such as Missouri that lack any permitting or enforcement authority play virtually no role in regulating floodplain development.

A summary of state permit programs, variance and enforcement provisions is provided in Table 11.

Table 11 – State Laws Concerning Permits, Variances and Enforcement

REGULATORY ISSUE	AR	IL	IA	MN	MO	OH	WI
State agency has permitting authority for floodplain development	NO	YES	YES	NO	NO	NO	NO
State authorized to delegate permitting authority to local governments	N/A	YES*	YES	N/A	N/A	N/A	N/A
Variances to local ordinance must be approved by state agency	NO	NO	YES	NO‡†	NO	NO	NO†
State has explicit authority to enforce local floodplain ordinances	YES	YES	YES	YES	NO	NO§	YES
Structures in violation of floodplain regulations or ordinances are considered public nuisances and subject to abatement of construction, maintenance or removal	YES	YES	YES	YES	NO	NO	YES
State law authorizes fines against persons violating floodplain management regulations, with each day constituting separate offense	YES	YES	YES	YES	N/A	NO	YES

*Floodway permitting program for Chicago area may be delegated to local governments.

‡ Minnesota requires local governments to provide Minnesota DNR 10-day advance notice of the public hearing for variances to allow state input and oversight.

† Minnesota DNR and Wisconsin DNR reserve the right to appeal variances that do not meet state criteria.

§ The Ohio DNR only has enforcement authority over other state agencies that violate floodplain ordinances.

It is important for the state to be involved in floodplain management for several reasons. The state can ensure that policies designed to reduce the risk of flood damage are consistent across local jurisdictions. In addition, state oversight removes the ability of local governments to compete for development by instituting lax floodplain management regulations or even providing tax incentives to develop in the floodplain. Finally, state laws can require floodplain permits in areas not participating in the NFIP.

DISCUSSION AND RECOMMENDATIONS

Flood damages continue to rise in every state, despite the variety of floodplain management programs. Some possible causes of this trend are common to all of the states studied. These problems involve both state and federal programs. A number of conclusions and recommendations can be drawn from this study of floodplain management programs. Missouri and other states that have no state floodplain management regulations can use these recommendations as a basis for legislation and policy change. Other states can revise or enhance their floodplain management programs using some of the recommendations below.

Among the states surveyed, Missouri and Arkansas stand out as the two most in need of stronger state programs. This finding is borne out by observations of large-scale development in the floodplains of Missouri, even in areas that were deep under water during the 1993 flood. The findings of this report document in comparative form the near complete lack of floodplain management by the State of Missouri.

Problems Common to All States

Outdated Flood Hazard Maps

Outdated flood hazard maps were the main problem mentioned in interviews with floodplain managers from the surveyed states. One-sixth to one-half of the counties in each state, except Ohio, have never been mapped. The maps that do exist average 15-20 years old, meaning that changes in hydrology as a result of more recent development have not been accounted for. Non-existent or outdated floodplain maps make it nearly impossible to have an effective floodplain management program. Without accurate maps, development is allowed to occur in areas thought to be safe from flooding, but which actually are at high risk.

Both FEMA and the states realize that the maps need to be modernized. However, FEMA estimates that it will need \$750 million to complete a map updating program. Moreover, even if the maps are updated, problems still exist with the NFIP maps. The maps are created to support the insurance program and are not intended for regulatory purposes. The FEMA maps are also prepared using current conditions and do not account for the impact of future development. A long-term program focused on map accuracy is needed to address these problems.

Lack of Flood Damage Data

None of the interviewed floodplain managers had ready access to historical flood damage data. Policy decisions and mitigation planning are made more difficult by the lack of comprehensive records of flood damages. In addition, the data that does exist often is inaccurate. Smaller flood events are often overlooked when tabulating long-term damages, and many localities do not have the resources to compile such data. Problems are also caused by overlapping agency responsibility and inconsistent methods of damage assessment.

Better flood damage information would be useful in evaluating mitigation strategies and floodplain management programs. In addition, a comprehensive understanding of historical flood damages will help justify adequate funding of floodplain management programs and enforcement of permit requirements.

Inadequate Resources

All of the state floodplain managers felt that they had insufficient resources to support at least part of the state's floodplain management program. In particular, lack of staff and funding often hinders investigation and enforcement efforts for those states that have permit programs. States also do not have adequate funds to support floodplain mapping.

Floodplain management programs may not be given a high priority in times of tight budgets. It is difficult to gauge the importance of a program when success is the lack of a disaster. If the job is done well for a period of time, or if weather conditions do not generate a large and damaging flood, elected officials might decide the floodplain management program is unnecessary since there have been no disasters.

Recommendations

Flood damages continue to rise despite the best efforts of floodplain managers. This is true in all of the surveyed states regardless of the structure of the state floodplain management program. However, there is anecdotal evidence and a strong belief by the floodplain managers that state programs are having an effect on flood damages. There is also abundant evidence that Missouri is experiencing more risky development in its floodplains than other Midwestern states due to the near complete lack of floodplain management laws.

Strong state floodplain management laws, such as those found in upper Midwestern states, clearly have an impact on where development occurs. Unwise investment in flood hazard areas is being prevented by permit requirements and floodway development restrictions. Moreover, mitigation programs are removing at-risk buildings from the floodplains.

Any effective floodplain management program requires adequate funding for implementation and administration. Strong partnerships between federal, state and local governments are essential. Laws and regulations must be clear and understandable with strong incentives for compliance. Enforcement programs should be adequately funded and regulations must be enforced consistently.

The bottom line requirement for an effective state floodplain management program is the ability to influence development and land use decisions. The following sections describe the main aspects of an effective state floodplain management program.

Assert Jurisdiction Over Floodplain Development

State jurisdiction over floodplain development is a basic requirement to ensure adequate floodplain management. A state permit program reaches areas that are not participating in the NFIP and eliminates the ability of localities to make land use decisions that adversely impact neighboring communities. Delegation of state permit authority to local governments can be a viable component of a state permit program. However, the state should set minimum requirements for local ordinances, require state approval of the ordinance and variances, and retain the ability to take enforcement action.

Redefine the Floodway

The NFIP sets the boundaries of the floodway using a one-foot rise standard. Generally speaking, this means that development can be permitted so long as it does not result in more than a one-foot increase in flood heights. In communities that do not participate in the NFIP, there is no limit to the impact a development can cause to neighboring properties unless standards are set forth in state law. The floodplains in the Midwest are relatively flat and even a one-foot increase in the base flood elevation can inundate large areas. A smaller rise allowance standard reduces the risk that existing development will be endangered by future land use decisions. The smaller the rise allowed, the more area covered by floodway development restrictions. A 0.1-foot rise limit for floodway determination, as used in Illinois, is recommended.

Enact Floodway Development Restrictions

Restrictions on development in floodways are of great importance to wise floodplain management. States should prohibit any activities in floodways that reduce the conveyance capacity of the stream, or that would suffer significant damage if flooded. Non-obstructive development, such as parks and trails, can be permitted as long as floodplain functions are protected. A carefully monitored flowage easement program could be implemented to mitigate for unavoidable intrusions into the floodway.

Enact Flood Fringe Development Requirements

Ensuring that development in the flood fringe is adequately protected from future flooding is another key provision for a state floodplain management program. A requirement that flood fringe development be elevated above the base flood level (the "freeboard" requirement) will protect it from future increases in flood heights. Floodplain management is an inexact science. Building in a margin of error through freeboard requirements will lessen a state's exposure to future flood damages.

Technical Oversight and Assistance

Education and technical assistance are the tools that will help communities integrate effective floodplain management into everyday practice. If a state allows delegation of permitting authority to local governments, a strong technical assistance program is essential. This is especially important for small towns that have limited technical capabilities. States should retain enough technical expertise and oversight authority to ensure that local governments and private consultants are adequately performing hydrologic and hydraulic studies. Finally, technical expertise at the state level can reduce the complications caused by the nonexistence, or outdated nature, of floodplain maps.

Pre-Disaster Mitigation Program

A pre-disaster mitigation program can help communities reduce the vulnerability of existing development to flood losses. A new FEMA program, the Pre-Disaster Mitigation Program, provides funds to implement hazard mitigation activities in communities that participate in the NFIP and have a comprehensive hazard mitigation plan. A complementary state program can help local governments meet cost matching requirements and prioritize mitigation projects.

Structural Flood Damage Reduction Projects

Structural flood damage reduction projects include levees, floodwalls, dams and river channelization. These structures are a necessary part of most floodplain management programs, but they have been over utilized in the past. Recent evidence on the Missouri and Mississippi Rivers suggests that levees and other river obstructions are greatly exacerbating flood heights. States should have oversight authority over flood damage reduction projects to ensure that they do not negatively impact upstream areas.

Additional Recommendations

A comprehensive floodplain management program should account for natural floodplain values, reduce risks and protect floodplain functions. Urban stormwater management can mitigate increased flows that result from new development. Public ownership of open space in flood hazard areas will ensure long-term protection of the floodplain. In addition, a state program that provides incentives for communities to participate in the NFIP can help divert the cost of flood recovery from tax dollars to insurance claims.

Flood recovery efforts should not return people and businesses to flood hazard areas. Buyout opportunities should be provided quickly to reduce the impact on flood victims and avoid repair of flood damaged structures. Structures that are repaired should be brought into compliance with floodplain management regulations.

CONCLUSION

The obvious impacts of flooding are tremendous and the subtle effects are difficult to measure. The economic, human health, community and environmental effects combine to cause true disasters for those affected by floods. The effects radiate outward through society to drain individual, social and economic

resources from the whole country. Effective floodplain management can minimize these damages. Our society could use four billion dollars each year in a more constructive way than repairing flood damages.

Since flood effects often cross local government boundaries and can cause conflict between states, it is important for state governments to be fully involved in floodplain management. At a minimum, a comprehensive floodplain management program must include:

- Assertion of state jurisdiction over floodplain development, including a permit program with standards for enforcement and issuance of variances;
- A low flood elevation rise standard for floodway delineation and floodplain development permits – 0.1 feet rise or less – to preserve the stream's storage and conveyance capacity;
- Floodway development restrictions, including requirements for purchase of flowage easements if flow would be restricted by a proposed development;
- Strong technical oversight and assistance programs to help local governments and the public understand the dangers of floodplain development and what is required by the permit program; and
- A state funded grant or loan program to facilitate pre-disaster, non-structural mitigation projects by county and municipal governments.

Several recent scientific studies have shown that structural flood control projects are actually exacerbating flood stages. This suggests that the regulation of such projects should be included in a state floodplain management program. In addition, an incentive program that encourages communities to participate in the National Flood Insurance Program can help divert the cost of flood recovery from tax dollars to insurance claims.

Missouri currently lacks the legal and administrative infrastructure for an effective floodplain management program. Action by the Missouri General Assembly to enact appropriate legislation is imperative for the reduction of future flood losses. Floodplain development in urban areas is accelerating as local communities compete for commercial and industrial development. Without rapid action by the state to prevent additional at-risk development, these communities will suffer disastrous flood losses in the future.

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