

TABLE 3-5

**CHANGE IN TOTAL AVERAGE ANNUAL PRIVATE AND
PUBLIC FLOOD LOSS POTENTIAL, 1976-1985**

City	Estimated Annual Flood Loss Potential (000s)			Percent Change 1976-85
	Total	<u>Added 1976-1985</u>		
	1975	Housing	Other	
Stronger Programs				
Palatine	\$ 262	\$ 0*	\$ 0	0.0%
Scottsdale	149	6	1	4.7%
Fargo	277	56	12	24.5%
Arvada	3,392	0*	5	0.1%
Wayne	<u>2,508</u>	<u>0*</u>	<u>7</u>	2.8%
Total	6,588	63	25	2.1%
Weaker Programs				
Omaha	\$2,800	0*	29	1.0%
Tulsa	3,166	116	184	9.5%
Toledo	1,281	5	3	0.6%
Cape Girardeau	552	2	231	42.2%
Savannah	<u>3,740</u>	<u>13</u>	<u>49</u>	1.7%
Total	11,539	136	496	5.5%
Total	\$18,049	199	521	4.4%

*Less than \$500

TABLE 3-6

**COMPARISON OF PROJECTED INCREASE IN AVERAGE ANNUAL
FLOOD LOSSES WITHOUT FLOODPLAIN MANAGEMENT
WITH LOSSES WITH FLOODPLAIN MANAGEMENT,
1976-1985**

	Estimated Average Annual Flood Losses (000s)*			
City	Without Floodplain Management	With Floodplain Management	Difer- erence	Percent Losses Reduced
Stronger Programs				
Palatine	\$ 423	\$ 262	\$ 161	-38.1%
Scottsdale	1,191	156	1,035	-86.9%
Fargo	761	345	416	-54.7%
Arvada	6,041	3,397	2,644	-43.8%
Wayne	<u>3,171</u>	<u>2,515</u>	<u>656</u>	-20.7%
Total	11,587	6,675	4,912	-42.4%
Weaker Programs				
Omaha	\$ 3,014	\$ 2,829	\$ 185	- 6.1%
Tulsa	6,938	3,466	3,472	-50.0%
Toledo	1,363	1,289	74	- 5.4%
Cape Girardeau	820	785	35	- 4.3%
Savannah	<u>6,118</u>	<u>3,802</u>	<u>2,316</u>	-37.9%
Total	18,253	12,171	6,082	-33.3%
Total	\$29,840	\$18,846	\$10,994	-36.8%

*1977 dollars.

versus an average reduction of 36.8% in the communities with weaker programs (see Table 3-6). Thus, while the stronger programs had only a marginal effect on the diversion of development from flood hazard areas, those programs did result in lower flood damage potential to development in the floodplain.

Because each community allowed some floodplain development, we estimated that potential average annual flood losses (in 1975 dollars) would be greater in 1985 than they were in 1975. The largest percentage increases in potential flood losses were in three communities--Cape Girardeau, Fargo, and Tulsa. In Cape Girardeau, the increase was due primarily to commercial development in the Cape La Croix Creek floodplain. In Fargo, we estimated losses to residential property would increase substantially. Increased losses in Tulsa stemmed from residential and commercial development in the Joe Creek and Mingo Creek floodplains, and the public facilities accompanying that development which were also at risk. Even though there were large percentage increases in potential flood losses in Fargo and Tulsa, we estimate that floodplain land use management in those communities reduced potential losses from what they would have been without the programs. In both communities, for example, estimated potential average annual flood losses were less than half of what they would have been without floodplain management programs. In Cape Girardeau, however, that was not the case because there was a large amount of commercial development between 1976 and 1980 before the community entered the regular phase of the National Flood Insurance Program and enacted stringent building elevation and floodproofing requirements.

Flood Insurance Policies in Effect

One of the two primary purposes of the National Flood Insurance Program was to create a method of sharing the risk of flood losses through a nationwide flood insurance program. Although none of the floodplain land use management programs we studied sought to affect the purchase of flood insurance policies, it is worth noting the extent to which property owners took advantage of available flood insurance because each of the programs allowed an increase in potential flood losses. If a high proportion of flood-prone property was insured, then communities would have been insulated from the devastating financial effects (and some of the mental anguish) that accompany flood disasters.

As stated in the 1968 National Flood Insurance Act, the intent of flood insurance is to serve as a complement to, and encouragement for measures to reduce the susceptibility of new development to flood damage. Specifically,

flood insurance was to:

- Start gradually.
- Expand as experience and knowledge of flooding and flood hazard mitigation measures expanded.
- Be available on reasonable terms and conditions to persons needing protection.
- Be based on reasonable methods of pooling risks, minimizing costs, and distributing burdens equitably among those insured and the general public.

Evidence from the ten cities we studied indicates that the high level of market penetration expected of the flood insurance program has not been attained (also see Chapter 7) and, in fact, that the proportion of property covered by insurance is decreasing rather than increasing.

Flood insurance data for each city are summarized in Table 3-7 and Table 3-8. The total number of policies in force in eight of the ten communities peaked by 1980, in seven of them by 1979. The exceptions are Savannah, where the number of policies peaked in 1982, and Wayne, where -- after declining from 1980 through 1983--policies in force peaked in 1984 following the flood disaster of that year. Furthermore, in six of the ten communities there were fewer policies in force in 1985 than in 1978--Fargo, Omaha, Palatine, Scottsdale, Toledo, and Tulsa. In each the decline in policies was significant (see Table 3-7); in six of the ten communities (Fargo, Palatine, Scottsdale, Tulsa, Toledo, and Savannah), the proportion of dwellings covered by flood insurance actually declined between 1976 and 1985. We suspect the most important cause of the decline in policies and proportion of dwellings covered are increases in the cost of insurance. There were cost increases because of increases in rates, which took effect in 1981, and because of higher property values due to inflation. Also, it is possible that lenders, while initially requiring the purchase of flood insurance as a condition for granting mortgages on new construction, allowed mortgagees to let their insurance policies lapse.

Previous research (Kunreuther et al., 1978) has shown that personal experience with flooding is the most important factor leading to the purchase of insurance; however, the data from the ten cities indicate that the incidence of flooding may have only a temporary effect in stimulating residential flood insurance purchases in a community. In the case of Tulsa, which had a flood of record in 1984, the number of policies on dwellings in 1985 was just 75% of the

TABLE 3-7

**CHANGE IN FLOOD INSURANCE POLICIES IN
EFFECT IN TEN COMMUNITIES, 1976-1985**

City	Number of Policies in Effect			Percent Change
	1976	1980	1985	1976-85
Stronger Programs				
Palatine	219	215	99	-55%
Scottsdale	2124	2711	1203	-43%
Fargo	335	455	211	-37%
Arvada	400	575	451	+13%
Wayne	<u>471</u>	<u>762</u>	<u>821</u>	+74%
Total	3549	4718	2785	-22%
Weaker Programs				
Omaha	192*	526	361	+88%
Tulsa	4838*	5227	3933	-19%
Toledo	1048**	968	794	-24%
Cape Girardeau	119*	372	269	+126%
Savannah	<u>664</u>	<u>1080</u>	<u>798</u>	+20%
Total	6861	8173	6155	-10%
Total	10410	12891	8940	-14%

*1977

**1978

TABLE 3-8

**CHANGE IN PROPORTION OF FLOODPLAIN DWELLINGS
COVERED BY FLOOD INSURANCE, 1976-1985**

City	Percent of Floodplain Dwellings Covered: 1976	Percent of Floodplain Dwellings Covered: 1985
Stronger Programs		
Palatine	27%	15%
Scottsdale	99%	40%
Fargo	23%	4%
Arvada	27%	30%
Wayne	34%	39%
Total	41%	21%
Weaker Programs		
Omaha	9%	17%
Tulsa	76%	50%
Toledo	19%	14%
Cape Girardeau	15%	23%
Savannah	25%	20%
Total	40%	29%
Total	41%	26%

number in 1977, the year following the 1976 major flood.

Population at Risk

In addition to reducing the susceptibility of property to flood damage, floodplain management programs seek to protect public health and safety by minimizing the population exposed to flooding. We estimate 60,826 persons lived in the floodplains of the ten communities in 1975; by 1985, that figure had been reduced by 4% to 58,651, even though the number of floodplain dwellings, as reported earlier, had increased (see Table 3-9). Decreasing household size, rather than floodplain land use management, accounts for the reduction in population at risk; nevertheless, floodplain management programs did divert a sizable number of people--we estimate 21,920--who would have occupied housing located in flood hazard areas. That represents a 27% reduction in the population that would have been at risk in 1985 without floodplain management programs.

The stronger floodplain land use management programs diverted a somewhat larger proportion of potential floodplain occupants (34%) than the weaker programs (24%). In that regard, the programs that had the greatest effect in reducing the potential increase in population at risk were those in Fargo, Arvada, and Palatine, three of the four strongest programs we studied. In Wayne Township and Omaha we projected the market driven floodplain evacuation that was under way in 1975 would continue and lead to a reduction in the population at risk, even without floodplain land use management. In both places, however, the decrease in population did not match our expectations, even with floodplain land use management programs that discouraged residential use of hazard areas. The floodplain land use management programs in Cape Girardeau and Tulsa--two of the weaker programs-- also had little impact on the population at risk from flooding.

Protection of Floodplain Natural Values

Communities derive a number of environmental benefits from floodplains. Vegetation helps screen pollutants, which protects water quality. Open areas also aid the recharge of ground water and help maintain stream flows in dry weather. Open floodplains are often a favored habitat for wildlife, and they provide a break in development that adds an important amenity to urban living. To the extent floodplain land use management programs divert development from flood hazard areas, they contribute to the preservation of the natural values of floodplains. We evaluated that aspect of floodplain land use manage-

TABLE 3-9

**COMPARISON OF PROJECTED FLOODPLAIN POPULATION
WITHOUT FLOODPLAIN MANAGEMENT WITH ACTUAL
POPULATION WITH FLOODPLAIN MANAGEMENT, 1985**

City	Estimated Population Living in the <u>Floodplain, 1985</u>		Percent of "Without" Population Diverted from Floodplain
	Without Floodplain Management	With Floodplain Management	
Stronger Programs			
Palatine	3,033	1,758	42%
Scottsdale	7,590	5,041	33%
Fargo	5,681	2,464	57%
Arvada	6,755	3,752	44%
Wayne	5,284	5,827	0%
Total	28,343	18,842	34%
Weaker Programs			
Omaha	3,968	3,969	0%
Tulsa	15,384	13,904	10%
Toledo	18,114	11,425	37%
Cape Girardeau	1,799	1,567	13%
Savannah	12,963	8,944	31%
Total	52,228	39,809	24%
Total	80,571	58,651	27%

ment by assuming that open space acreage is a reasonable proxy for all of the environmental benefits floodplains provide.

We estimate that floodplain land use management programs in the ten communities conserved 3,513 acres of open space that otherwise would have been converted to urban use between 1976 and 1985 (see Table 3-10). The communities with stronger programs conserved proportionately more open space (32% reduction in loss of open space to urban uses) than the communities with weaker programs (21% reduction in loss to urban uses). Nevertheless, because each community allowed additional development in the floodplain, each lost some open space.

Overall, by 1985 the communities had lost 4% of the floodplain open space acreage that existed in 1975 (a reduction from 19,446 acres to 18,616 acres); proportionately the loss was greater in the communities with stronger programs (5%) than in those with weaker programs (4%). (Note: These and the following calculations are based on data not shown in Table 3-10.) When we take into account what the communities would have lost without floodplain land use management, however, the communities with stronger programs look better; for example, we estimate that without floodplain land use management, 28% of the floodplain open space (rather than the 5% they actually lost) would have been converted to urban uses in the communities with stronger programs. In the communities with weaker programs, 20% of the floodplain open space would have been lost without floodplain land use management programs, compared to 4% that was lost with the programs.

Conclusions

We began this chapter by posing four questions about the effectiveness of floodplain land use management in the ten communities. We now provide answers to those questions.

Question 1: Has floodplain land use management steered potential development to nonhazardous locations?

Yes. Compared with market trend projections of development that would have taken place without floodplain land use management, the ten communities eliminated much--79% of the dwellings and 89% of the commercial acreage in flood hazard areas. However, none of them totally put a halt to further increases in urban development in the floodplain, which increased by 2% in the case of residential land uses and 4% in the case of business uses.

TABLE 3-10

**COMPARISON OF PROJECTED FLOODPLAIN OPEN SPACE WITHOUT
FLOODPLAIN MANAGEMENT WITH ACTUAL OPEN SPACE
WITH FLOODPLAIN MANAGEMENT, 1985**

City	Estimated Open Space Acreage in the <u>Floodplain, 1985</u>		Change in Open Space Acreage with Floodplain Management	
	Without Floodplain Management	With Floodplain Management	Acres	Percent
Stronger Programs				
Palatine	465	547	+62	+13%
Scottsdale	900	1,089	+189	+21%
Fargo	708	1,326	+618	+87%
Arvada	0	269	+269	+
Wayne	1,454	1,436	- 18	-1%
Total	3,527	4,667	+1,120	+32%
Weaker Programs				
Omaha	6,394	6,456	+62	+1%
Tulsa	1,084	2,255	+1,171	+103%
Toledo	1,881	2,220	+339	+18%
Cape Girardeau	1,563	1,985	+422	+27%
Savannah	634	1,033	+399	+63%
Total	11,556	13,949	+2,393	+21%
Total	15,083	18,616	+3,513	+23%

Question 2: Has floodplain management reduced the susceptibility of new development to flood damage?

Yes. Among the ten cities studied, that floodplain land use management programs reduced potential average annual flood losses (in 1975 dollars) by almost \$11 million, from \$29,840,000 without the programs to \$18,846,000 with floodplain land use management in place. Nevertheless, flood damage potential increased in each of the ten cities as they allowed additional floodplain development.

Question 3: Have property owners ameliorated the potential adverse consequences of catastrophic losses from flooding by purchasing flood insurance?

Only to a moderate extent. Less than a third of the structures at risk in the ten communities were covered by flood insurance in 1985. Furthermore, the proportion of structures covered, after peaking in most communities in the late 1970s, had decreased since then. In fact, in six of the ten communities the proportion of dwellings covered by flood insurance actually dropped between 1976 and 1985. We attribute that decline to the increasing costs of coverage as inflation raised the value of structures and the Federal Insurance Administration raised insurance rates.

Question 4: Are stronger floodplain management programs more successful than weaker programs in achieving various objectives?

Diverting development from the floodplain: No.

Protecting the natural values of floodplains: Yes.

Reducing the susceptibility of new development to flood damage: Yes.

Minimizing the population exposed to injury and loss of life: Yes.

The following comparison summarizes aggregate differences between the groups of five stronger and five weaker programs in comparison to our estimates of conditions in those communities without floodplain land use management:

	Five Stronger Programs	Five Weaker Programs
Proportions of residential development diverted from the floodplain, 1976-1985	83%	76%

Proportion of commercial development diverted from the floodplain, 1976-1985	72%	90%
Reduction in potential average annual flood damages, 1985	43%	33%
Reduction in population at risk from flooding, 1985	34%	24%
Increase in open space acreage, 1985	32%	21%

Thus, with the exception of the diversion of commercial development from the floodplain, the five stronger programs as a group tended to be more effective than the five weaker programs, although the differences are not large.

The data summarized in this chapter lead us to three broad conclusions. First, floodplain land use management programs have mitigated the rate of increase in flood loss potential in the ten communities studied. Second, the programs have allowed wise use of floodplains within the market framework of land development in each community. Rather than replacing market decisions with public ones, as would be the case with public acquisition of the hazard areas, floodplain land use management programs allowed floodplain development as long as it was protected, through building elevation, from all but the most catastrophic flood events. Third, communities that invest in developing stronger, more stringent floodplain land use management programs can expect their investments to pay off modestly in terms of more complete achievement of various land use and environmental objectives.