Empty gas storage tanks, Austin, Minnesota. During floods, gasoline and propane tanks may float free, causing fire and pollution problems as well as increased flood damages.

Photo source: Patricia Bloomgren

structures. Many of the flood-related deaths at Rapid City, Buffalo Creek, and during Hurricane Agnes were due to occupancy of mobile homes in the floodplain. Inadequate regulation is common.

Legal and administrative inadequacy of emergency regulations. Regulations adopted by many of the smaller towns and rural communities that remain in the emergency program of the NFIP are often inadequate both in substance and administration. Many communities have adopted only a "resolution" stating their intent to adopt detailed regulations when base flood information becomes available. Such resolutions require only that permits be secured for construction in the floodplain. In some jurisdictions the resolution has limited enforceability. Equally serious, administration of emergency program provisions is limited by lack of maps or case-by-case project evaluation procedures to identify 100-year flood elevations, floodways, and coastal velocity zones. The completion of an additional 4,000 floodplain studies in 1981-1982 and the conversion of these communities into the regular program will help to solve this problem. The NFIP's efforts to convert the remaining 6,000 communities into the regular program through "emergency conversion" procedures should also help, but only if the communities are required to adopt and monitor more effective regulations as a condition to the conversion. For example, the NFIP could require communities to make a case-by-case evaluation of flood hazard for all development permits.

Inadequate expertise in program development and administration. Inadequate expertise in floodproofing techniques, map interpretation, flood warning systems and acquisition procedures continues to be a problem, despite gains in the 1970s. It is particularly serious in rural areas.

Floodplain maps not designed to meet land use management needs. FEMA mapping is more responsive to insurance needs than to land use

management. Consequently, scales are often too small for management purposes, topographic information is lacking, and existing development and other useful information is omitted. Maps are rarely detailed or accurate enough to provide the basis for sophisticated floodplain management before and after disasters, although they have been relatively satisfactory for floodplains under light development pressures. More detailed flood studies and maps on a topographic or orthophoto base are needed.

Inadequate map data storage and dissemination. From a management perspective, raw map data and other data in flood insurance studies are often equally or more important than the map itself. Storage of raw data has been and continues to be unsatisfactory. FEMA study contractors (usually private engineering firms) are required to maintain the data for five years from contract completion. After this period, the data may be discarded. The unavailability of such data may seriously undermine the legal acceptability of regulations. In addition, updating will be very difficult, if not impossible. More satisfactory methods must be found to retrieve and store data for future use. The distribution and interpretation of maps has also been spotty and unsatisfactory in some instances.

Inconsistent administration of floodplain regulations. When development is proposed, many communities issue variances or amend regulations without compliance with minimum regulatory standards.[52] Structures and fill may be permitted in floodways. First floors may be permitted at elevations far below the 100-year flood elevation. Sometimes failure to comply with standards is due to lack of flood data or expertise in evaluating permits. In other instances, federal, state, and local standards are ignored.

Inadequate coordination. Despite the executive orders and other measures of the 1970s, coordination is often poor for floodplain regulation, flood control, disaster assistance, flood insurance, park planning, capital improvement planning (roads, sewers), and other land and water management activities. Floodway delineation and watershed management policies of one community are often not coordinated with activities of upstream, downstream, or adjacent communities.[53] Floodplain regulations often fail to take into account resource protection and broader community land use planning activities.

Lack of specificity. In the 1970s, federal and state authorities applied relatively uniform standards for floodplain mapping, regulations, and technical assistance. These uniform, generalized approaches were necessary in light of available program budgets and to avoid charges of favoritism. Although this policy provided valuable minimum standards, the need to tailor program standards became apparent, especially for areas subject to waves, high velocity flows, flash floods, combined flooding and erosion, long-term fluctuations in water levels, or mud flows. Lack of specificity in program standards has also hindered attempts to deal with rural, urban, and metropolitan areas where density, existing uses, land use planning goals and levels of expertise differ.

Federal program bias for flood control works. Criteria for cost/benefit ratios of federal water resources projects permitted agencies to claim benefits for dams and other flood control measures to enhance undeveloped floodplain lands for structural uses, even though unflooded sites were available in the communities.[54] Nonstructural alternatives for maintaining an open floodplain are assigned minimal benefits in these calculations. This bias toward flood control is also reflected in large federal subsidies for flood control projects but minimal funding for floodplain acquisition, regulations, and flood warning systems.

Flood losses encouraged by subsidized insurance. The NFIP has provided the major incentive for state and local adoption of regulations and has been a positive influence in most situations. However, heavily subsidized insurance (60% to 90%) has also apparently encouraged some unwise floodplain and wetland development, particularly in coastal areas and on barrier islands.[55] This high subsidy lowers the risks to banks of making mortgage money available, and reduces the burden of losses for property owners. Subsidized insurance also acts as a disincentive to private floodproofing or relocation of existing structures. Low, subsidized flood insurance rates can be perceived by the public to imply a small chance of damage from floods.

FEMA is now addressing these problems by including wave elevations in coastal flood maps and accelerating the conversion of emergency program communities into the regular program. Flood insurance rates are being revised to reflect risk more accurately.

Inadequate monitoring of floodplain uses. Floodplain development has not been carefully monitored at federal and state levels. Each year FEMA carries out about 200 community field monitoring studies (CAPEs)* to determine whether communities have adopted and are properly administering regulations.[56] These studies typically involve a site visit to a community, discussions with local government officials, and a tour of the floodplain. The visits do provide some measure of monitoring and deter blatant violations by other communities. However, FEMA has done little to monitor damages to individual structures after flooding and has completed only about 600 CAPEs for the 17,000 communities in the NFIP. CAPEs are not being carried out in all 10 FEMA regions. Rarely has FEMA suspended a noncompliant community from the flood insurance program. FEMA

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*Community Assistance and Program Evaluation Reports.

lacks a staff sufficient to perform detailed followup on violations. Because of inadequate staff size and funds, state floodplain monitoring has also been generally unsatisfactory. In fiscal year 1981, state monitoring has been strengthened through the use of FEMA State Assistance funds.[57]

Most monitoring of development is at the local level. Communities do not typically have formal monitoring systems to assess floodplain development on a regular basis, so they depend instead on complaints from citizens or random building inspections.

Addressing Problems

The remaining chapters of this report address these and other problems in greater depth including work done in the 1970s to address them and possible strategies for the 1980s to: reduce losses to future uses (Chapter II); reduce losses to existing uses (Chapter III); combine hazard mitigation and resource protection (Chapter IV); regulate uses at the state level (Chapter V); and regulate uses at the local level (Chapter VI). Judicial reaction to regulations is outlined in Chapter VII. The report concludes with a discussion of floodplain management strategies to reduce flood losses in the 1980s.

Footnotes

1. Statistics provided by the Federal Disaster Assistance Administration.

2. See National Oceanic and Atmospheric Administration (1978).

3. For example, the consumer price index lists the cost of cement at $17.69 per short ton in 1970 and $46.24 in 1979.

4. This information was derived in part from National Oceanic and Atmospheric Administration (1977).

5. Flood Disaster Protection Act of 1973, P.L. 93-234 (codified at 42 U.S.C.A. §§ 4001-4128 (West 1977)).

6. Section 1362, National Flood Insurance Act of 1968, P.L. 90-448 (codified at 42 U.S.C.A. §§ 4001-4128 (West 1977)).

7. Memorandum, Office of Management and Budget, July 10, 1980.

8. See Platt (1979).

9. *Id.*

10. Task Force on Federal Flood Control Policy (1966).

11. *Id.*

12. Flood Disaster Protection Act of 1973, P.L. 93-234 (codified at 42 U.S.C.A. §§ 4001-4128 (West 1977)).

13. Housing and Community Development Act of 1977 (P.L. 95-128).

14. Disaster Relief Act of 1970, 15 U.S.C.A. § 636 (West 1976).

15. Flood Disaster Protection Act of 1973, P.L. 92-234 (codified at 42 U.S.C.A. §§ 4001-4128 (West 1977)).

16. Flood Disaster Relief Act of 1974, P.L. 93-288, Section 406 (codified at 42 U.S.C.A. § 5131(c)(d) (West 1977).

17. These regulations became effective on December 10, 1979, more than five years after the act was signed. 44 C.F.R. § 205.400-205.411 (1981). 44 C.F.R. § 9 (1981).

18. National Flood Insurance Act of 1968, P.L. 90-448 (codified at 42 U.S.C.A. §§ 4001-4128 (West 1977)).

19. Water Resources Development Act of 1974, P.L. 93-251 (codified at 33 U.S.C.A. § 701b-11, 701c (West Supp. 1981)). According to § 701c, cost-sharing provisions for nonstructural alternatives should be comparable to cost-sharing for structural alternatives with a maximum local share of 20%.

20. See Binder (1979).

21. Federal Dam Inspection and Safety Act of 1972, P.L. 92-367 (1972).

22. See discussion in Chapter III and Bresenhan (ed.) (1979).

23. 42 U.S.C.A. § 4012 (West 1977) requires, in effect, that lending institutions regulated by the federal government not make real estate loans unless flood insurance (if available) is purchased. The statute also directs agencies regulating banks, savings and loan associations and similar institutions to adopt regulations requiring institutions to notify a purchaser of property of special flood hazards or to obtain assurances that the seller or lessor has notified the purchaser.

24. U.S. Water Resources Council (1976). An updated version was sent to Congress in January, 1980.

25. See Chapter IV.

26. 33 U.S.C.A. §§ 401-466, 1251-1376 (West 1970).

27. See Chapters II and III.

28. See, for example, the Flood Disaster Protection Act of 1974, footnote 29, which requires flood insurance as a condition to disaster assistance.

29. Flood Disaster Protection Act of 1974, P.L. 93-251 (codified at 33 U.S.C.A. § 701b-11 (West Supp. 1982).

30. The President's Water Resources Council, Procedures for Evaluation of National Economic Development Benefits and Costs in Water Resources Planning. 18 C.F.R. § 713 (1981).

31. 18 C.F.R. § 711 (1981) (Principles and Standards for Water and Related Land Resources Planning).

32. See publications listed in the bibliography of this report.

33. *Id.*

34. See the bibliography for a partial listing.

35. See footnote 8. See also Abeles, Schwartz, Haeckle & Silverblatt, Inc. and Ralph M. Field Associates, Inc. (1981).

36. Office of Management and Budget Memorandum, July 10, 1980.

37. See Chapter II for discussion of Baltimore County, Maryland; Alexandria, Virginia; Howard County, Maryland, and several other programs.

38. For studies concerning floodplain management in coastal areas see White *et al.* (1976) and National Oceanic and Atmospheric Administration (1980).

39. Velocity zones or coastal high hazard areas are defined by regulations (24 C.F.R. § 1909.1 (1981)) to include:

the area subject to high velocity waters, including but not limited to hurricane wash or tsunamis. The area is designated on a FIRM as Zone VI-30.

40. See references on barrier islands in the bibliography of this report.

41. See Kaufman and Pilkey (1979), Leatherman (1979), and Leatherman (1981).

42. U.S. Department of the Interior (1979).

43. *Id.* See also Sheaffer and Roland, Inc. (1981). This report concluded that (using an average purchase price of $5,000 per acre) recent estimates indicate that acquisition costs could be one-fifth or less of the costs to the federal government of continuing its current development program on the undeveloped barrier islands. See also footnote 55.

44. An analysis of damages caused by Hurricane Frederic by Sheaffer and Roland, Inc. (1980) revealed that 322 houses out of a total of 442 in the first tier along 22 miles of coast from Fort Morgan through Gulf Shores, Alabama, were destroyed. One hundred seventeen out of 130 were destroyed in a 16-mile portion of the 22 miles. Of the 1,059 structures in the first three tiers along the 22 miles, 534 were destroyed--over 50%. First tier houses were generally 200-300 feet from the shoreline; second or third tier setbacks were generally 800-1,000 feet from the shoreline. Wave elevations at the shorefront were approximately 18 feet while the still water storm surge elevation was 11 feet.

45. See Penland *et al.* (1980).

46. See National Oceanic and Atmospheric Administration (1977).

47. See National Science Foundation (1980), which concluded that, "[u]rbanization increases peak flow rates from two to six times for the more frequent floods on small streams with less relative effects on larger events and larger streams." It recommended that "[p]lanning for urban storm run-off involving prediction of future probabilities of flooding should include consideration of future changes in land use." (p. 213)

48. See National Oceanic and Atmospheric Administration (1978). This total may (it is not clear from the report) include coastal communities.

49. See Chapter II.

50. *Id.*

51. See discussion accompanying footnote 5 in Chapter VIII.

52. This conclusion is based upon discussions with state floodplain management personnel (See Appendix A), FEMA staff, and examination of approximately 600 FEMA field reports (CAPEs) evaluating individual local programs. Although variances are routinely granted in some communities, many other communities are apparently "holding the line" in administration of regulations.

53. See Platt *et al.* (1980).

54. See Sheaffer and Roland, Inc. (1981). In analyzing criteria or federal water projects this report concluded that,

> With regard to existing development, the economic evaluation of nonstructural measures such as flood proofing, rehabilitation, and evacuation can compete with structural measures on a reasonably equal footing. For new development, however, the deck is stacked in favor of structural measures. Unless the policies and evaluation procedures are changed to provide the proper consideration of alternative locations for new development, there is not much hope for greater success in the implementation of nonstructural measures....
>
> There are always practicable alternative locations for new development, but potential for elimination of flood risks on the floodplain often causes floodplain owners to expect large economic gains through use of their lands for high-intensity development. Thus organized, they present a powerful economic and political force, usually successful, in opposition to any significant nonstructural uses of the floodplain (p. 8).

55. Whether federally subsidized flood insurance has encouraged floodplain development has been widely disputed. There has been little field study concerning development in insured and uninsured areas. In addition, it is difficult to separate the importance of insurance, regulation, recession, and other factors in encouraging or discouraging development in a particular circumstance. Nevertheless, most state and local officials interviewed by the author were of the belief that the insurance had encouraged some development although how much was unclear. Researchers who had addressed the topic generally showed this belief. Miller (1977) concluded after conducting a field survey of 15 communities, that once flood insurance became available, lending institutions in Westerly, Charlestown and South Kingston, Rhode Island and Galveston, Texas (1/3 of the communities studied) reversed earlier restrictions on mortgages in coastal high hazard areas.

Burby and French (1981) concluded, based upon a survey of 1,203 local jurisdictions (see description of this survey in Chapter V) that:

> It often appears that the NFIP induces increased flood plain development because the same factors which lead communities to participate in the NFIP are also associated with continuing floodplain invasion. These factors include past invasion of the floodplain and a need for insurance and the potential for new construction in the hazard area because of its attractiveness for development. (p. 294)

State and local officials interviewed by the author suggested a stronger correlation. They argued that bank financing would not have been available for much of the new development without flood insurance. During the last five years, interest rates have been high, money has been scarce in most areas, and banks have carefully screened mortgagees. Due to the widespread availability of flood maps, bankers have been well aware of hazards (unlike the 1950's and 1960's). Would banks have provided mortgages with knowledge of such hazards, a tight money situation, and lack of meaningful private flood insurance? Probably not. Of course, other factors may also have contributed to floodplain development ranging from income tax write-offs for interest, favoring purchase of second homes in barrier islands and other high amenity areas by high income city-dwellers to federal subsidies for roads, water supply systems and the like.

The General Accounting Office is presently studying the effect of the National Flood Insurance Program in coastal development.

56. Regional Offices of the Federal Emergency Management Agency have prepared an estimated 600 Community Assistance Program Evaluation reports (CAPEs) to serve two principal and often complementary purposes: (1) monitor enforcement, and (2) provide technical assistance to communities. These reports include a field visit to the community, discussion with community officials (and in some instances banks and insurance agents) examination of files and field inspection of the floodplain. Monitoring efforts have been focused on areas where there have been complaints of noncompliance with federal regulations or severe flood problems and continued developed (e.g., Monroe County, Florida--the Florida Key; Ocean City, Maryland). Technical assistance efforts have focused on past disaster communities, (e.g., Scituate, Massachusetts) and communities requesting or needing assistance. Regionally, CAPE preparation has been uneven with most CAPE preparation in the mid-Atlantic states and the Midwest. Only a small number of CAPEs have been prepared for New England, the West and the South.

57. In 1981 and 1982 a number of states conducted systematic community monitoring efforts with help from FEMA state assistance funds. These include efforts by New Jersey to conduct CAPEs for all 270 New Jersey municipalities in the National Flood Insurance Program and efforts by California to monitor all regular program communities.