CHAPTER VIII

STRATEGIES FOR THE 1980s

Chapters I through VII detailed progress and problems with floodplain management in the 1970s. This chapter deals with strategies for the 1980s to improve the effectiveness of regulations in combination with other management techniques not only to reduce flood losses but also to achieve broad economic and social goals. The first section describes overall strategies, including measures to reduce costs. The next section covers recommendations for specific local, state, and federal actions. The final section discusses subjects that need further research.

Overall Strategies

In the 1970s, federal, state, and local governments made progress in developing an overall policy to reduce future flood losses by requiring that new development and redevelopment be protected from flooding and applying hazard reduction measures to existing uses. Judicial support for these floodplain regulations was overwhelming. Even so, serious gaps and deficiencies remain in mapping, technical assistance, and regulations. Program coordination is incomplete and much work to implement policies remains.

If the thousands of state and local programs already under way are to be implemented, federal philosophy must shift during the 1980s. To date, FEMA has primarily encouraged local adoption of regulations by providing insurance incentives and generalized maps, standards, guidelines, and information. Now, technical assistance, more specific flood studies, wider application of federal expertise, and more flexibility in standards and criteria are needed to support state and local implementation of site-specific aspects of floodplain management. To do this, federal technical assistance, training, education, mapping, and standard-setting

should be geared to the differing needs of each area but within a continued framework of overall standards (e.g., the 100-year flood standard). For example, metropolitan flood hazard regulations should include provisions for stormwater management. As far as possible, federal support should encourage rather than discourage a tailoring of programs.

All levels of government should focus on ten types of action.

(1) Improving flood studies not only to reflect actual hazards (wave heights, erosion, future watershed conditions) but also to delineate topographic contours, existing structures, roads, and other features;

(2) Upgrading interim regulations and resolutions to avoid legal problems, reduce delays in permit processing, and provide certainty to landowners;

(3) Improving the administration, monitoring, and enforcement of floodplain regulations by increasing state and local expertise in planning, assessment of hazards and natural values, regulation, acquisition, relocation, flood warning systems, flood control works and flood insurance;

(4) Developing predisaster and postdisaster plans to guide public investment and reduce losses to existing private and public uses;

(5) Combining regulations and nonregulatory measures to reduce the damage potential of existing uses and to serve multipurpose community goals;

(6) Guiding public works projects and public investment in the floodplain to avoid floodways and high hazard areas and to incorporate floodproofing measures;

(7) Educating public officials, floodplain occupants, bankers, local governmental officials and architects in the details of flood loss reduction measures;

(8) Coordinating or integrating floodplain plans with broader community and regional planning to serve multipurpose goals;

(9) Revising federal, state, and local subsidies for flood insurance, disaster assistance, and floodplain regulations in order to provide incentives to floodplain occupants and local governments to develop their own self-help techniques for reducing flood losses;

(10) Testing, documenting, and publicizing the long-term effectiveness of alternative flood loss reduction methods.

Reduced federal, state, and local spending in the 1980s may severely strain personnel, resources, and the implementation of flood damage reduction measures. High capital outlays and maintenance costs will make structural measures particularly difficult to implement. Funds to implement nonstructural measures may also be reduced. However, if governmental response to flood disasters over the last 50 years is any guide, arguments that regulations should be reduced to save government funds and that floodplain occupants be permitted to bear flood losses as they see fit are unrealistic. Once a flood occurs, public opinion or concern for flood victims forces Congress and state legislatures to appropriate monies for disaster relief, rebuilding, and flood control measures. An "ounce of prevention" is needed.

The combination of nonstructural floodplain measures along with regulations supports the cost-effective objective that those who occupy the floodplain should be responsible for the results of their own actions.[1] This type of management can also support cost-effective, multipurpose community goals such as less expensive municipal services (roads, sewers), optimum use of natural resources (water supply, agricultural land, timber, fish, and wildlife), renewal of blighted areas, and protection of the tax base, which is usually lowered when flood damage occurs.

Even though proponents of free market decision making usually fail to address the principal problem of uncontrolled floodplain activities--their long-term external costs--regulations will continue to be challenged during the next decade on philosophical grounds and as restraints to private and local government decision making. The alternative--piecemeal dismantling of regulations--would permit continued landowner irresponsibility. The floodplain landowner has little incentive to consider the external costs of increased flood heights and velocities, or the damages to other property caused by fill, dams, or buildings. Instead

of relaxing regulations, planners and managers should focus on improving the quality of regulations, thereby reducing landowners' objections. Acquisition can also be used to minimize problems and reduce ultimate costs.

Floodplain regulations can be simplified and streamlined. More specific floodplain standards offer landowners more certainty about their use of the land. If states and localities adopt joint procedures for regulating floodplains and wetlands they can reduce the total time required for project review. Regulatory standards can be better tailored to special problems and needs and tax incentives can be coordinated to support regulations. Regulations can be incorporated into broader packages of floodplain management techniques to improve their quality and effectiveness.

Several strategies are available to improve floodplain management in spite of tight budgets.

- Program priorities should be carefully established. All levels of government should focus their mapping, planning, regulations, education, and technical assistance on areas subject to the most severe flood hazards and development pressures. Good examples are barrier islands and inland areas subject to flash floods.

- Funds should be reallocated to floodplain management techniques that have the greatest long-term cost effectiveness. For example, the federal grants to improve state floodplain management capability (now at a total level of $3 million) may be a better federal investment than the construction of a single small dam. In the long run, public acquisition of damage-prone properties may cost federal taxpayers less than repeated payment of flood insurance claims.

- Multipurpose programs should be encouraged. For grants in aid, technical assistance, and mapping, preference should be given to states and localities with multiobjective floodplain planning and management programs. This will not only reduce flood losses but also support urban renewal, open space protection, and other social and environmental programs.

- Those who benefit from flood loss reduction measures should be made to bear a larger portion of the costs of such measures. Consistent federal policies are needed to require state, local, and private cost-sharing in flood control works, disaster assistance, acquisition, and other hazard reduction measures.

This will reduce federal outlays and encourage states and localities to assume their share of the responsibilities.

- State and local floodplain management roles should be enhanced. State and local training and education, monitoring, permit processing, and acquisition are often more cost-effective than comparable federal programs because their staffs are closer to the problems, their pay scales are generally lower, duplication of work is reduced, and the personnel can be shared more easily with ongoing programs.

- Executive orders and state and local guidelines for public uses should be enforced. The Floodplain Management Executive Order and similar state and local guidelines for public uses that require either avoidance of flood hazards or flood protection should be carefully enforced. Their implementation can not only reduce future losses to the uses but also discourage private development which is often attracted by public services in the floodplain.

- The Disaster Assistance Act of 1973 requirements that hazard mitigation measures be adopted as a condition to federal disaster assistance should be consistently and vigorously enforced to reduce continued losses in frequently flooded areas.

- Flood loss reduction measures with long-term cost effectiveness and built-in safety factors should be emphasized. It is often more cost-effective to acquire and relocate structures than to support repeated flood losses at public and private expense. Elevation provides a greater built-in safety factor than levees and channeling. Acquisition or regulation to maintain open floodplains or floodways to protect their flood storage and natural conveyance capacities will often cost less than construction of flood control works.

- More flexible federal mapping criteria should be adopted. Managers should compare the costs of developing accurate and detailed area-wide flood studies with those for conducting case-by-case analyses of individual permits.

- Flood insurance rates should reflect the total risk. This will increase revenues for the flood insurance program and remove the present incentive to develop in areas where it is economically unjustified to do so.

- Government incentives for private self-help should be increased. Flood insurance rates and income tax or other economic incentives should be revised to motivate private floodplain occupants to assume responsibility for reducing flood damage. Instruction should be provided to private landowners (residential, commercial, industrial) on how to establish flood warning systems, install floodproofing, and develop other loss-reducing measures. These measures can simultaneously support other goals such as energy efficiency. The public can be educated through brochures, workshops, or one-on-one consultations. Bankers, lawyers, architects, engineers, and others

who advise landowners or finance, design, or build structures in the floodplain should be educated on the nature of flood hazards and on the economic value of flood protection measures.

- To facilitate evaluation of flood loss reduction measures on a national basis, a quantified national goal of holding flood losses to no more than a fixed average figure per year or reducing losses (e.g., $2.5 billion per year through 1990) might be adopted. The effectiveness of regulations and other public and private flood loss reduction programs could be measured against such a quantified standard. This would facilitate the setting and balancing of federal budgets.

Local, State, and Federal Roles

The federal, state, and local partnership for floodplain management set forth in A Unified National Program for Flood Plain Management was tested during the 1970s. The partnership reflects a workable hierarchy of efforts which should continue to be implemented in the 1980s. State and local regulation, acquisition, and other floodplain management measures should be the basic elements of a unified program. The federal government should set standards, establish incentives, and provide technical assistance to support state and local programs. Implementation of the working partnership will require that the federal government understand and be responsive to state and local needs; and that states and local governments, in turn, accept greater responsibility for floodplain management.

Local Programs

With state and federal help, the 17,000 local floodplain management programs that have already been initiated should be fully implemented. Implementation of local floodplain management, tailored to local problems and needs, is the key to cost-effective flood loss reduction. Local governments are in the best position to implement comprehensive floodplain management: they are closest to the problems, and have broad powers to regulate, acquire, zone, and tax property. In addition, they are rou-

tinely involved in comprehensive land use planning and day-to-day management. Moreover, they have the greatest incentive for packaging and coordinating programs since flooding most seriously affects their residents, jobs, and tax base.

For some communities, implementation will be relatively straightforward--adoption of zoning and subdivision regulations consistent with maps provided by FEMA, NOAA, TVA, SCS, the Corps, USGS, or the states. Others need maps and regulations tailored to local conditions and combinations of regulatory and nonregulatory approaches.

Specific recommendations for local governments are:

Local governments should carefully formulate management goals for public and private use of floodplains. These goals can then be translated into site-specific plans and implementation measures. In setting goals, community leaders should view floodplain management as an opportunity to achieve a community's economic, social, and environmental objectives, not simply as a means to reduce flood losses. Through relocation or floodproofing, the community can correct past land use mistakes. In formulating goals, the community should also evaluate the severity of flood problems; the natural floodplain capacities and the cost of replacing those capacities at upland sites if the land is developed; the availability of other sites in the community for development; the costs of public services; and state and local standards.

Local governments should form special work groups or obtain the help of statutory bodies such as conservation commissions to develop policies and advise them on floodplain problems. These groups can ensure broad-based community involvement in policy and plan formulation. Local planners and engineers and state floodplain management personnel can often provide expert assistance. Private con-

sultants and federal agencies such as the Corps, FEMA, TVA, and SCS can also provide guidance.

Some communities need to prepare more detailed studies of flooding or natural resources to assist policy formulation and planning and to provide the basis for later implementation. Communities generally need more detailed studies for areas that are under intense development pressures or that are candidates for redevelopment. Such areas usually require maps at scales of 1"=100' to 1"=400'. For urbanizing and urban areas, maps should show topographic contours and existing uses, as well as flood, floodway, and wetland boundaries.

Communities should integrate or carefully coordinate floodplain management with management of wetlands, wild and scenic rivers, prime agricultural lands, and mineral resources. This may be accomplished in part through maps showing floodplains and broader resource areas (e.g., Sanibel, Florida). Resource protection standards may be incorporated into floodplain regulations and, vice versa, floodplain standards may be incorporated into resource protection regulations. Acquisition and tax incentives can be combined with regulations to achieve multipurpose goals.

Communities should adopt floodplain regulatory standards that are appropriate to their multipurpose needs rather than rely on minimum NFIP and state standards. For example, if a community is guiding all new development to upland sites, it can present losses not only to the users themselves but also to public facilities that serve them. This strategy will avoid the potential residual problems of

floodplain development that will lead to future flood losses (e.g., deterioration of pilings or of structural floodproofing). Development may be guided to upland sites through zoning and other regulations, but also by educating the public, marking hazard areas, and providing density bonuses and real estate tax incentives. Guiding all new development to upland sites is often feasible in areas where there is little or no development in the floodplain or where the floodplain is narrow.

Communities should emphasize flood adjustment measures with built-in safety factors such as elevation on fill instead of on wood pilings. Regulations should be specifically tailored to the hazard at the given location, including combined storm surge, wave, and erosion problems in coastal areas; high velocity flows in mountain areas; and fluctuating water levels near lakes. To avoid increased flood damages to existing floodplain development and to lands presently beyond floodplain boundaries, communities should implement strict floodway and flood storage regulations.

Communities in the emergency program of the NFIP should upgrade the "resolutions" they adopted to join the regular program. More permanent regulations requiring case-by-case analysis of flood hazards may be appropriate if there are no maps to show 100-year flood elevations, floodways, or coastal velocity zones. Communities in the regular program should upgrade their regulations as needed. This is particularly important for coastal and barrier island communities that have not evaluated wave heights and erosion problems and for inland communities that have high velocity flows and long-term fluctuations in water levels.

Local governments within metropolitan areas should cooperate to integrate their stormwater management and floodplain regulations to provide regional hazard reduction and reduce the effects of urbanization on flood flows.

Communities should improve their own monitoring of development and enforcement of regulations by performing field checks before and after construction. They should inventory nonconforming uses. Citizens and members of interest groups should be encouraged to report violations.

Local governments should educate and train floodplain landowners and other decision makers in flood loss avoidance and reduction. Education techniques can include distribution of flood maps and brochures; marking flood hazard areas; workshops; television, radio, and newspaper ads; and one-on-one discussions. Communities can distribute floodplain management information to individual property owners with tax information (as in Avalon, New Jersey).

Local governments should carefully tailor nonconforming use regulations to local flood conditions and the impact of existing uses upon such conditions. Either before or after a flood, communities should survey existing damage-prone uses to determine the types and degree of nonconformity and the floodproofing and relocation potential. This information can form the basis for more specific regulation and short- and long-term plans for urban renewal, floodplain management, and postdisaster response.

Based on such surveys, communities can tighten "substantial improvement" criteria in their building codes, zoning, or other regulations to control repair or rebuilding in excess of 30% or 40% of preflood values for fill and structures in floodways. Amortization provisions with short- or long-term repair or termination dates can also be adopted.

Public education programs and workshops could also encourage voluntary floodproofing and relocation. Such programs may be particularly effective for industrial and commercial uses.

With this information, communities can also prepare flood warning systems and flood evacuation and emergency preparedness plans. Corrective measures such as ring dikes, levees, or channel modifications may also be applied.

After a flood, local governments can often adopt temporary moratoria on rebuilding until flood mitigation plans and policies are completed (as in Rapid City, South Dakota). Flood insurance payments, disaster grants and loans, and other financial measures can be combined with regulations to encourage or require relocation or floodproofing (as in Lake Elsinore, California). Relocation can often serve multipurpose objectives, including stormwater management, urban renewal, and energy conservation (as in Soldiers Grove, Wisconsin).[2]

State Roles

State legislatures and agencies should also strengthen the state role in floodplain management, especially along the coasts and in inland rural areas that lack maps and have little or no local floodplain manage-

ment expertise. Even though some states need improved programs, it is unclear whether they wish to or will assume added responsibility for floodplain management without federal support, including technical assistance, mapping, and grants in aid.

Specific strategies are:

Legislatures should adopt new legislation or amend existing regulatory powers to clarify those powers and authorize nonregulatory measures such as acquisition (e.g., as in Arizona) to supplement regulations. Although direct state regulation may be generally appropriate for floodway and coastal high hazard areas, state standard-setting for local regulation is often most appropriate for flood fringe areas. State standard-setting for local regulations builds on both state and local capabilities. The state can assist localities by coordinating state, local, and federal programs; providing maps; assisting with evaluation of individual permits; assisting with the design of flood control projects; advising on local monitoring and enforcement of regulations; and training and educating local officials, landowners, and lenders.

States should develop their own standards and guidelines rather than rely on minimum NFIP standards where needed to meet multipurpose land and water management goals. These include standards for mapping; nonconforming uses; floodproofing; and special flood problems such as high velocity flow areas, floodways, lakeshores, alluvial fans, and erosion areas.

States should either develop more detailed maps or initiate cooperative state, local, and federal mapping on a watershed basis if federal maps are inadequate. Maps should show existing uses, topo-

graphic contours, wetlands, and other pertinent resources. To facilitate or carry out mapping, states may act as study contractors to FEMA (e.g., as in Maryland and New Jersey), undertake their own independent mapping (e.g., as in California), or financially and technically assist local governments in mapping (e.g., as in Wisconsin).

States should strengthen their clearinghouse and coordination function for local, state, and federal activities that affect floodplains. These activities include public works projects, permits, subdivision proposals, local ordinances, grants in aid, and disaster assistance payments. Such functions can be performed pursuant to state A-95 review procedures, environmental impact review procedures, floodplain management acts and executive orders, permitting and subdivision review powers, disaster preparedness and response, and civil defense powers. States should also help federal agencies and localities "package" grants in aid, technical assistance, and other measures (e.g., flood control works) to facilitate multipurpose floodplain management.

States should apply or encourage communities to apply innovative combinations of nonregulatory as well as regulatory techniques. They can do this through guidebooks, workshops, grants in aid, and education.

States should carry out additional public education and technical assistance. Such activities may include preparing and distributing model ordinances and brochures on flood preparedness and response and floodplain management; conducting workshops and training

sessions for local officials, lawyers, architects, planners, lenders, engineers, and landowners; marking flood hazard areas; distributing maps; and conducting one-on-one meetings with developers, local government officials, and the public.[3]

Federal Roles

Although state and local initiative and responsibility are essential to sound floodplain management in the 1980s, many local governments lack the expertise, funds, and size (i.e., they often encompass only part of the watershed) to carry out programs without help. Insufficient personnel and funds also constrain state programs. States and communities will need continued federal technical, mapping, and other assistance. However, federal monies should be spent only where states and communities are willing to make positive efforts to reduce flood problems. The test for federal programs should be, "How can the federal government reduce its own losses and best help floodplain occupants, local governments, and states help themselves?" To this end, FEMA, OMB, and other federal agencies should vigorously enforce the Floodplain Management Executive Order to reduce public investment that is proposed for floodplain areas and to set hazard mitigation examples for states and local governments. As discussed above, the federal government should respond to state and local needs with greater specificity in mapping, standard-setting, technical assistance, and training and education. Other strategies are:

Congress, OMB, FEMA, and other agencies should help states to enhance their floodplain management capability. To achieve this, Congress and OMB should continue FEMA grants in aid (State Assistance Program) to states that are willing to build their floodplain management programs and assume some of the responsibilities currently carried out by federal agencies, e.g., monitoring

community compliance with the NFIP. Congress and federal agencies should also involve states more fully in establishing federal policies for water resources projects, flood insurance rates, disaster assistance, and other flood-related measures.

Federal agencies should encourage states and communities to adopt innovative, multipurpose floodplain management programs for pre- and postflood situations[4] by

- Stressing the minimal nature of federal standards and maps;
- Providing increasingly specific technical assistance and standards, including upgraded flood studies;
- Developing "how-to" manuals and guidebooks with examples of innovation and distributing them to local governments;
- Funding floodplain acquisition, flood warning systems, and other measures to supplement regulations;
- Streamlining ways to "package" federal grants for multipurpose projects such as community development block grants and open space funds, with special bonuses to communities proposing multipurpose projects;
- Coordinating federal programs and policies with state and local programs for flood insurance, land acquisition, disaster assistance, wetland protection, and public land management. Coordination can be improved through postdisaster assessment teams (now required), interagency review of projects pursuant to Executive Order 11988 procedures, joint processing of permits, joint research projects, and dissemination of research and program status information.

Congress, OMB, and FEMA should revise subsidy and cost-sharing policies to provide incentives for state, local, and private self-help by

- Revising subsidized NFIP rates to reflect the actual costs of floodplain occupancy;
- Clarifying and enforcing conditions for disaster assistance in order to require improved predisaster planning and adoption of mitigation measures after a disaster;
- Modifying federal criteria for water resources projects to balance structural with nonstructural floodplain

management. This should be done by disallowing land enhancement benefits for new development behind flood control works where alternative sites are available;

- Requiring consistent state and local cost-sharing in flood control measures, disaster assistance, and flood insurance. This would remove the present bias toward flood control works and encourage balanced state and local floodplain management;

- Monitoring state and local regulations and other hazard reduction measures to ensure that the federal investment in flood insurance, disaster assistance, flood control works, and other measures achieves desired results.

FEMA, the Corps, USGS, SCS, and NOAA should upgrade federal or joint federal, state, and local flood studies and maps to facilitate land use management.[5] The agencies should develop the studies in cooperation with the states and localities for selected priority areas. Although arguments for uniformity in federal studies were once used to justify the present system of nationwide mapping, those arguments lose force as specific and unique implementation needs arise. Costs might be shared for studies reflecting state and local needs such as alternative floodway definitions.

Upgrading of studies should involve:

- Improved criteria for defining the 100-year flood elevation, floodway, and coastal high hazard areas. The criteria should include wave heights, wave runup and erosion for coastal areas, and flood velocities for inland high-velocity flow areas. New regional hydrologic information that includes changing flood conditions is needed for large urban and metropolitan areas. Maps should also show data on erosion areas, wetlands and existing uses. More detailed flood studies that include smaller contour intervals and larger map scales are needed. However, a partial trade-off between flood study and map scale versus accuracy and technical assistance may be appropriate where state, local, or private expertise is available to evaluate floodplain projects on a case-by-case basis. Developing urban areas need map scales of 1"=200' to 1"=400' with one- to four-foot contour intervals. This information should be placed on an orthophoto or topographic base.

- Improved storage of flood data. FEMA should make an immediate and concerted effort to retrieve information gathered for its studies since study contractors may

discard the data after five years. The raw data used in the preparation of existing floodplain maps must not be lost: it may be needed to evaluate individual permits, upgrade maps, or defend floodplain regulations in court. Either the states or the federal government should be the repository for this information.

- Improved dissemination and interpretation of data. Dissemination should be streamlined and increased rather than decreased. The long-term cost effectiveness of the $900 million already spent on federal mapping will largely depend on the dissemination and interpretation of the data to potential users, including local government, lenders, insurance agents, and developers.

FEMA, OMB, the Corps, SCS, NOAA, and other agencies should continue to improve measures to prevent and respond to flood disasters and to reduce the loss potential of existing uses. Agencies should first identify communities with potential for catastrophic loss of life or property from inland flash flooding, hurricane storm surge and wave action, tsunamis, or other sudden flooding. This identification could be based on existing FEMA flood insurance claims, and disaster assistance information, and National Weather Service data showing areas of high-intensity rainfall. Agencies could then focus mapping, technical assistance, predisaster planning, flood warning systems, and acquisition on these areas. Preflood floodproofing and relocation could be encouraged through education and insurance incentives. After a disaster, federal teams should prepare hazard mitigation plans (as now required by an OMB directive of July 1980) with state and local assistance. These plans could be implemented through a combination of monies from Community Development Block Grants, FEMA constructive total loss insurance payments, disaster assistance grants and loans, open space funds, and state and local bonds or general revenues.

FEMA, SCS, NOAA, and other agencies should revise and expand education on the severity of flood hazards and the "nuts and bolts"

of hazard reduction techniques. To be effective, education must reach the decision makers. Federal agencies could begin by training their own staffs in Washington, D.C. and at federal regional centers in the specifics of regulation, acquisition, floodproofing, flood warning systems, postdisaster response, implementation of the executive orders, and resource evaluation. FEMA and other agencies could also educate state agency personnel and train engineers, lawyers, and architects. Most training of local officials and landowners should be at the state or local level, but with federal assistance. Agencies could improve landowner awareness by disseminating flood information along with flood insurance policies.

Research

Research to improve the quality and effectiveness of floodplain regulations in the 1980s should focus not only on regulations per se but also on broader techniques of floodplain management.[6] Research should not duplicate subjects that have already been given adequate treatment such as general floodplain zoning ordinances.

Results, including those of completed research, should be broadly disseminated by all levels of government. The National Science Foundation (NSF), the Corps, SCS, or other federal agencies should fund or carry out supplemental implementation-oriented floodplain management research, with the following topics as priorities.

Establishment and Implementation of a Flood Damage Monitoring System

FEMA, in cooperation with other agencies, should establish a comprehensive federal/state/local flood damage monitoring and reporting system for public and private flood losses. This system should monitor and report on the types and magnitudes of flood damages and public payments to floodplain occupants by type of use, location, method of protection, and other factors. The monitoring program would provide the basis for

readjusting flood insurance rates and determining the effectiveness of various approaches such as elevation on fill and open works, and wet and dry floodproofing.

Evaluation of Flood Loss Reduction Techniques

FEMA, the Corps, NSF, or other agencies should investigate the short- and long-term effectiveness of elevation, flood control, and floodproofing under various flooding frequencies, including rare events such as the 500-year flood. Research should include an analysis of "safety factors" (i.e., the ability of various methods to withstand flooding greater than the design flood). This information would help to evaluate how effective floodplain regulations are in reducing flood losses; establish standards for particularly vulnerable or critical facilities; and establish flood insurance rates reflecting actual risk. Elevation of structures on fill should be compared to elevation on open works and also to floodproofing.

Evaluation of Incentives and Disincentives for Private Self-help

FEMA, OMB, and NSF should carefully examine the incentives and disincentives to private landowners, bankers, and local government officials presented by the flood insurance program, flood control works, disaster assistance, and regulations. Measures should be identified for encouraging self-help by those contemplating building or rebuilding in the floodplain or by those who are modifying structures to reduce flood damage susceptibility.

Identification of Communities with Special Flood Problems

FEMA, in cooperation with other agencies and the states, should make a nationwide analysis of community flood problems so that FEMA, the Corps, USGS, SCS, NSF and other federal and state agencies can tailor federal and state mapping, technical assistance, and other loss-reduction efforts to those communities in greatest need. The analysis should survey[7]

- Cities with chronic flood problems such as Johnstown, Pennsylvania; Houston, Texas; Soldiers Grove, Wisconsin; and Mobile, Alabama, which have been flooded as frequently as once in 10, five or even three years. They are either particularly ripe for corrective action or have already initiated active floodplain management programs. The total number of these communities is estimated to range from 150 to 250. These communities are particularly good candidates for detailed mapping, predisaster planning, training and education, technical assistance, floodplain acquisition, and floodplain monitoring.

- Cities like Jackson, Mississippi; Rochester, Minnesota; and Gulf Shores, Alabama, which had recent severe floods and are faced with flood losses that had been vaguely anticipated in the past but are now presented in stark dimensions. After a disaster there is often a period of at least a few days and at most a couple of years, when the public will support drastic readjustments in floodplain use. The communities in this category change annually. The number of communities suffering a disaster may average 30-100 over several years, but may exceed 500 in a year of major rains combined with rapid spring snowmelt or a major hurricane. These communities are candidates for postdisaster assessments and planning, mapping, technical assistance, floodproofing, and relocation.

- Communities with a high potential for disaster. These include areas like Boulder, Colorado, where planning and civic groups are aware of the prospect of a major disaster but have not experienced one recently. Other areas with continuous potential for disaster include many barrier islands and flash flood regions. The estimated number of these communities is 500 to 1,000. Communities anticipating disaster are prime candidates for predisaster planning, technical assistance, training and education, detailed mapping, flood warning systems, and evacuation plans.

- Partially protected areas. Many communities are partially protected by dikes, levees, and dams, so residents in certain areas assume they are protected from floods of designated magnitude and frequency. Few of these communities have complete protection. Levees and channel improvements can fail. Detention reservoir flows can exceed the projected design flow. Development outside of protected areas may also occur. Inadequate drainage may also cause flood damages within the protected areas. If flooding exceeds design standards, losses may be catastrophic, as in Jackson, Mississippi. Some of these communities are candidates for training and education, predisaster planning, and development of monitoring projects.

- Special flood problems. An estimated 2,000 to 3,000 communities are subject to special flood problems not adequately addressed by NFIP regulations and other standards. These include areas subject to erosion, fluctuating groundwater levels, supercritical inland flows, subsidence, mud flows, and alluvial fan flooding.

Development of Manuals and Ordinances for Specific Flood Problems

FEMA, NOAA, other agencies and states should prepare floodplain manuals and ordinances that deal with special flood problems. A separate manual and model ordinance should be developed for each of the following:

- Inland supercritical flow areas common in the mountain states of the East and West. Manuals should address study techniques, delineation of areas, and protection standards.

- Barrier islands and beach areas. An ordinance or manual should address combined storm surge, wave height and runup, and erosion problems. The manual should explain the natural forces at work, options for dealing with them, and the strengths and weaknesses of each option.

- Flooding behind dikes and levees and below dams, where perhaps one-third of the nation's floodplain structures are located. A description of short- and long-term risks and techniques for dealing with them is needed. The manual should address ponding, evacuation, and perception of risk.

- Alluvial fans and mudslide areas. A discussion of the problems, data gathering needs, sources of data, and regulatory and nonregulatory methods is needed.

- Fluctuating lake levels due to runoff and changes in groundwater levels. The manual should cover prediction of fluctuations and adjustments to problems, including long-term remedies such as relocation.

- Combined wetland protection and floodplain management needs. Assessment of floodplain and wetland natural values, regulations, standards, and options for integrating or coordinating standards should be addressed.

Development of Improved Mapping Techniques

Improved map criteria and cost-effective techniques for generating map data and preparing maps should be developed. Techniques should also be developed for forecasting future runoff in urbanizing watersheds so that flood studies will not become quickly outdated and so that landowners and governments can rely on the long-term accuracy of published elevations. Techniques should also be improved for accurately forecasting coastal erosion recession rates and for establishing setback lines.

In summary, the progress of the 1970s in reducing future flood losses through nonstructural approaches with regulations as one component

must be continued in the 1980s with emphasis on increased specificity and creativity at all levels of government.

CHAPTER VIII

Footnotes

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

2. See Appendix B to this report for more detailed recommendations.

3. See Appendix A to this report for more detailed recommendations.

4. *Id.*

5. Approaches to improve FEMA map criteria and techniques are the subjects of several studies including one by Anderson-Nichols, Inc. for FEMA entitled, "Promising Methods and Procedures for Performing Riverine Flood Insurance Restudies," and one by the National Academy of Sciences now in press.

6. For additional discussion of research needs see National Science Foundation (1980); National Wetlands Technical Council (1979); and White *et al.* (1975).

7. See White (1974).

REFERENCES

Anderson, R.
1968 American Law of Zoning, Volume I. Rochester, New York: Lawyers Co-operative Publishing Company.

Abeles, Schwartz, Haeckle and Silverblatt, Inc. and Ralph M. Field Associates, Inc.
1981 Evaluation of Alternative Means of Implementing Section 1362 of the National Flood Insurance Act of 1968. Washington, D.C.: Federal Emergency Management Agency.

Binder, D.
1979 "Dam Safety: The Critical Imperative." 14 Land and Water Law Review 341.

Bresenhan, T. P. (ed.)
1979 Proceedings of the Flood Warning and Flood Proofing Seminar for Industry. Harrisburg, Pennsylvania: Pennsylvania Department of Community Affairs.

Burby, R. J. and S. P. French
1981 "Coping with Floods: The Land Use Management Paradox." American Planning Association Journal (July) 289.

Council on Environmental Quality
1976 Untaxing Open Space. Washington, D.C.: U.S. Government Printing Office.

Ericksen, N. J.
1975 "A Tale of Two Cities: Flood History and the Prophetic Past of Rapid City, South Dakota." 51 Economic Geography 4:305.

Federal Emergency Management Agency
1981 Flood Hazard and Mitigation: Handbook of Common Procedures for the Interagency Regional Hazard Mitigation Teams. Washington, D.C.: Federal Emergency Management Agency.

Fosberg, F. R.
1971 "Mangroves Versus Tidal Waves." 4 Biological Conservation 1:38.

French, S. P. and R. J. Burby
1981 Managing Flood Hazard Areas: The State of Practice. Chapel Hill, North Carolina: University of North Carolina Center for Urban and Regional Studies.

Grant, R. R., and R. Patrick
1970 "Tinicum Marsh as a Water Purifier." In Two Studies of Tinicum Marsh. Washington, D.C.: The Conservation Foundation.

Greeson, P. *et al.* (eds.)
1979 Wetland Functions and Values: The State of Our Understanding. Minneapolis, Minnesota: American Water Resources Association.

J. A. Kusler Associates
1975 Statutory Land Use Control Enabling Authority in the Fifty States. Washington, D.C.: U.S. Department of Housing and Urban Development, Federal Insurance Administration.

Johnson, R. and J. McCormack
1979 Strategies for Protection and Management of Floodplain, Wetlands and Other Riparian Ecosystems. Proceedings of a Symposium. Washington, D.C.: U.S. Department of Agriculture.

Kaufman, W. and O. Pilkey
1979 The Beaches Are Moving. New York: Anchor Press/Doubleday.

Kusler, J. A.
1978 Strengthening State Wetland Regulations. Washington, D.C.: U.S. Fish and Wildlife Service.

1979a Emerging Issues in Wetland/Floodplain Management. Washington, D.C.: U.S. Water Resources Council.

1979b Floodplain Acquisition: Issues and Options in Strengthening Federal Policies. Prepared for the U.S. Water Resources Council. Springfield, Virginia: National Technical Information Service.

1980 Regulating Sensitive Lands. Cambridge, Massachusetts: Ballinger Publishing Company.

Leatherman, S. P.
1979 Barrier Island Handbook. National Park Service Special Publication. Amherst, Massachusetts: University of Massachusetts.

1981 "Barrier Beach Development: A Perspective on the Problem." 3 Shore and Beach (April) 3.

Miller, H. C.
1977 Coastal Flood Hazards and the National Flood Insurance Program. Prepared for the National Flood Insurance Program. Washington, D.C.: Department of Housing and Urban Development.

1980 Application of Substantial Improvement Criteria in Scituate, Massachusetts After the Winter Storm of February 6-7, 1978. Unpublished paper prepared for the Federal Insurance Administration. Washington, D.C.: Federal Emergency Management Agency.

Murphy, F. C.
1958 Regulating Flood-Plain Development. Department of Geography Research Paper No. 56. Chicago: University of Chicago.

National Oceanic and Atmospheric Administration
1977 Some Devastating North Atlantic Hurricanes of the 20th Century. Washington, D.C.: U.S. Government Printing Office.

1978 National Flash Flood Program Development Plan FY 1979-1984. Washington, D.C.: U.S. Department of Commerce.

1980 Program Development Plan, NOAA Coastal Hazards Program. Office of Oceanic and Atmospheric Services, National Ocean Survey. Washington, D.C.: U.S. Department of Commerce.

National Science Foundation
1980 Flood Hazard Mitigation Study. Draft. Washington, D.C.: National Science Foundation.

National Wetlands Technical Council
1979 Workshop Report on Research Priorities for Wetland Ecosystem Analysis. Report of a conference held at the Institute of Ecology, University of Georgia, Atlanta.

Newcombe, C., J. Morris, P. Knutson and C. Borbies
1979 Bank Erosion Control with Vegetation, San Francisco Bay, California. Miscellaneous Report No. 79-2. San Francisco: U.S. Army Corps of Engineers Coastal Engineering Research Center.

Nordstrom, K. F. and N. P. Psuty
1979 Coastal Dune Dynamics: Implications for Protection of Shorefront Structures. New Brunswick, New Jersey: Rutgers University Center for Coastal and Environmental Studies.

Office of the Chief of Engineers, U.S. Army Corps of Engineers
1973 Flood-Proofing Regulations. Washington, D.C.: U.S. Government Printing Office.

Owen, J.
1977 Guide for Flood and Flash Flood Preparedness Planning. Prepared for the National Weather Service. Silver Spring, Maryland: U.S. Department of Commerce.

Penland, S., D. Nommedal and W. E. Schram
1980 "Hurricane Impact at Dauphin Island, Alabama." In Edge, L. (ed.) Coastal Zone '80. Proceedings of the Second Symposium on Coastal and Ocean Management. New York: American Society of Civil Engineers.

Platt, R.
1979 Options to Improve Federal Nonstructural Response to Floods. Washington, D.C.: U.S. Water Resources Council.

Platt, R. *et al.*
1980 Intergovernmental Management of Floodplains. Boulder, Colorado: University of Colorado Institute of Behavioral Science.

Ralph M. Field Associates, Inc.
1981 State and Local Acquisition of Floodplains and Wetlands. Washington, D.C.: U.S. Water Resources Council.

Savage, T.
1972 Florida Mangroves as Shoreline Stabilizers. Professional Paper Series No. 19. Tallahassee, Florida: Florida Department of Resources Marine Research Laboratory.

Sheaffer, J.
1977 Economic Feasibility of Flood Proofing: An Analysis of a Small Commercial Building. Chicago, Illinois: Sheaffer and Roland, Inc.

Sheaffer, J. *et al.*
1976 Flood Hazard Mitigation Through Safe Land Use and Construction Practices. Prepared for the Department of Housing and Urban Development. Chicago, Illinois: Keifer and Associates, Inc.

Sheaffer and Roland, Inc.
1978 Alternatives for Implementing Substantial Improvements Definitions. Report to the Department of Housing and Urban Development. Chicago, Illinois: Sheaffer and Roland, Inc.

1980 Elevating to the Wave Crest Level. Washington, D.C.: Federal Emergency Management Agency.

1981 Barrier Island Development Near Four National Seashores. (Draft). Washington, D.C.: Council on Environmental Quality.

Strauss, E. and J. Kusler
1976 Statutory Land Use Control Enabling Authority. Washington, D.C.: U.S. Department of Housing and Urban Development.

Swanson, G. (technical coordinator)
1979 The Mitigation Symposium: A National Workshop on Mitigating Losses of Fish and Wildlife Habitats. General Technical Report RM-65. Fort Collins, Colorado: Rocky Mountain Forest and Range Experiment Station.

Task Force on Federal Flood Control Policy
1966 A Unified National Program for Managing Flood Losses. House Document 465. 89th Congress, 2nd Session.

Teal, J. and M. Teal
1969 Life and Death of a Salt Marsh. Boston: Little, Brown and Company.

Toner, W.
1978 Saving Farms and Farmland: A Community Guide. Chicago: American Society of Planning Officials.

1981 Zoning to Protect Farming: A Citizen's Guidebook. National Agricultural Lands Study. Washington, D.C.: U.S. Government Printing Office.

Tressler, E.
1979 "Sprout-Waldron Flood Preparedness Program." In Industrial Flood Preparedness: Proceedings of a Flood Warning and Flood Proofing Seminar for Industry. April 16-17, 1979. Harrisburg, Pennsylvania: Pennsylvania Department of Community Affairs.

U.S. Department of the Interior
1978a National Urban Recreation Study. Washington, D.C.: U.S. Government Printing Office.

1978b Report of the Barrier Island Work Group. Washington, D.C.: U.S. Government Printing Office.

1979 Alternative Policies for Protecting Barrier Islands Along the Atlantic and Gulf Coasts of the United States and Draft Environmental Statement. Washington, D.C.: U.S. Department of Interior.

U.S. Library of Congress
1978 Preservation of Agricultural Land: An Annotated Bibliography. Washington, D.C.: Congressional Research Service.

U.S. Water Resources Council
1976 A Unified National Program for Flood Plain Management. Washington, D.C.: U.S. Water Resources Council.

1979 A Unified National Program for Flood Plain Management. Washington, D.C.: U.S. Government Printing Office.

U.S. Water Resources Council *et al.*
1970 Regulation of Flood Hazard Areas to Reduce Flood Losses. Volume 1. Washington, D.C.: U.S. Water Resources Council.

1971 Regulation of Flood Hazard Areas to Reduce Flood Losses. Volume 2. Washington, D.C.: U.S. Water Resources Council.

Wayne, C. J.
1974 "Effect of Artificial Sea-Grass on Wave Energy and Nearshore Sand Transport." 24 Transactions--Gulf Coast Association of Geological Societies 279.

White, G. F. (ed.)
1974 Natural Hazards: Local, National, Global. New York: Oxford University Press.

White, G. F. *et al.*
1975 Flood Hazard in the United States: A Research Assessment. Boulder, Colorado: University of Colorado Institute of Behavioral Science.

1976 Natural Hazard Management in Coastal Areas. Washington, D.C.: U.S. Department of Commerce, National Oceanic and Atmospheric Administration, Office of Coastal Zone Management.

Wright, S. K. *et al.*
1976 Neighborhood Flash Flood Warning Program Manual. Mechanicsburg, Pennsylvania: Susquehanna River Basin Commission.