REPORT ON A REVIEW OF FEDERAL POLICY IN GRANT, LOAN, AND CONSTRUCTION PROGRAMS IN AREAS OF HIGH RISK OF NATURAL DISASTER DAMAGE

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October 31, 1965

Mr. John C. Green, Director
Analysis and Research Office
Office of Emergency Planning
Executive Office of the President
Washington, D. C.

Dear Mr. Green:

We are pleased to submit herewith our report on A Review of Federal Policy in Grant, Loan, and Construction Programs in Areas of High Risk of Natural Disaster Damage, prepared under Contract No. OEP-SE-65-5, dated May 18, 1965.

The field inquiry was conducted and the report prepared by Charles J. Fiss, Jr., under the supervision of Ralph E. Spear, both of our staff.

For the generous cooperation furnished by you, the OEP staff, and the eighty-odd individuals interviewed both within and outside the Federal Government, we are deeply grateful.

Sincerely yours,

G. M. Morris

G. M. Morris
Associate Director

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I. INTRODUCTION

In its report, Response to Disaster, the Federal Reconstruction and Development Planning Commission for Alaska recommended, among other things:

> "Review Federal aid policies for hazardous areas. It is impossible and often undesirable to avoid private or public construction in all areas in which there may be some slight risk of a future disaster. However, in those areas which engineers or scientists regard as particularly hazardous, Federal policies ought not to encourage further development. To do so is to help perpetuate an unnecessary risk to life and property."[1/]

The recommendation was assigned for action to the Office of Emergency Planning, which entered into a contract with Public Administration Service on May 18, 1965, to conduct the review. This report is submitted in fulfillment of that contract.

While the recommendation stemmed from the Commission's work in connection with the Alaskan earthquake, it was clear that it reflected concern for federal policy in areas affected, with some degree of predictability, by other natural disasters as well. Accordingly, attention has been directed in this review to policy in areas subject to flood, hurricane, and earthquake damage. (Such hazards as fires and tornadoes were excluded because of the impossibility of predicting hazardous areas.)

Not always true, as we know from Japan.

Emphasis in the review has been on those programs and policies which tend to encourage development generally, as distinguished from those which offer relief and assistance to victims of disaster. The latter are considered only to the extent that they offer reconstruction aid in areas of continuing or recurring hazard.

1/ Response to Disaster. Federal Reconstruction and Development Planning Commission for Alaska. Washington, D. C., Sept. 1964. The cited recommendation is 1g, p. 39.

It was deemed essential also to include for consideration those federal programs which, while not offering aid and assistance, are designed to increase our knowledge of the causes and impacts of floods, hurricanes, and earthquakes and to explore possibilities of attenuating their effects This report presents first a discussion of pertinent federal research and engineering programs as a backdrop against which to consider the findings of our review of federal policies governing grants, loans, and direct construction in areas of predictable hazard.

Note should be taken of the fact that "policy" is often an elusive quarry in a review such as the present one. In some cases, a broad statement of policy is found in the basic legislation; in others, policy is stated in manuals, regulations, and other published materials. Frequently, however, effective policy exists in correspondence, memoranda, and critiques which have been accepted as guiding precedents. Sometimes pertinent policy on matters such as are involved in this review are to be found only in routines of practice or procedure, or in professional disciplines involved in such practices or procedure. Where written sources of policy were discovered, they are cited. Frequently, however, written policy on the questions involved in this review has been lacking; but interviews with responsible officials have revealed that program procedures follow unwritten policies that are apparently as consistent and effective as written ones. In such cases, the interviews are relied upon as the source of information on agency policy.

II. FEDERAL RESEARCH AND ENGINEERING PROGRAMS

Research and engineering attention has been directed in varying degrees and in different ways to learning more about floods, hurricanes, and earthquakes and to finding ways of attenuating their effects on people and property. This section of the report will touch briefly on the nature of each of these disaster-producing forces and indicate the ways in which federal support has been directed to research and engineering efforts to counter them.

Floods

Major emphasis in federal research and engineering programs has centered on the flood. Throughout the country generally the flood hazard is the most widespread of the three under consideration. Floods result from certain conditions of hydrology and topography in the different river basins of the country. A flood damage problem did not arise until settlement began in the river valleys. The flood plain areas adjacent to a main river channel are actually a part of the river's natural course, and settlement in these areas provided the potential for the problem of flood damage. A general definition of a flood, then, is the "overflow of lands which, although they are adjacent to water, are not normally covered by it, and hence used (or usable) in the same way that other lands are used."[1/]

There were, of course, many reasons for the utilization and development of the flood plain areas. Access to water transportation was advantageous for industrial and commercial firms and for general communication

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[1/] U. S. Senate Committee on National Water Resources, Committee Print No. 15, Water Resources Activities in the United States--Floods and Flood Control, 1960. For purposes of discussion, the floods treated in this section are those occurring in river basins as a result, at some time, of heavy precipitation. The flooding by wind-driven tides created by hurricanes is treated later in the report.

between localities. When the railroad and highway systems of the country were built, it was economical in terms of construction costs to use the flat flood plain areas where possible. Community growth likewise flourished because of the proximity to employment opportunities and because development costs were less in such areas. However, in the light of present economic resources and technological skill, these reasons may no longer be valid.[2/]

Knowledge of the Flood Problem

A great deal of information about the problems of flood plain use exists today. Much of it has been produced since 1930 and is the result of various federal programs. The U. S. Geological Survey, for instance, has partially completed a series of studies of the magnitude and frequency of future flooding in river basin areas. A general definition of the flood problem in many urban areas has been accomplished by the Corps of Engineers. The recently enacted program of Flood Plain Information Studies, administered by the Corps, is providing detailed information about the flood problem in those jurisdictions requesting studies and engineering advice for use in planning. The Soil Conservation Service Watershed Program has produced information about the flood problem in rural areas. Extensive knowledge of the problem in the Tennessee Valley area has been gained as a result of the efforts of the Tennessee Valley Authority.

Studies have been conducted of the adjustments made by individual property owners to the flood problem in selected areas.[3/] As a part of this effort, investigations were also made into agricultural occupance of flood plain areas, the regulation of flood plain land, and related subjects.[4/] Possible methods of flood protection and a review of individual river basin problems, including plans for reducing damage, have been analyzed.[5/]

[2/] Gilbert F. White, Human Adjustment to Floods, University of Chicago, 1945.

[3/] Gilbert F. White, Choice of Adjustment to Floods, University of Chicago, 1964.

[4/] Ian Burton, Types of Agricultural Occupance of Flood Plains in the United States. University of Chicago, 1962.

[5/] William G. Hoyt & Walter B. Langbein, Floods, Princeton University Press, 1955.

Flood Control Policy--Federal Approach to the Flood Problem

Federal flood control policy, as reflected in the following programs, has mainly supported the planning and construction of engineering (or protective) works to reduce flood damage.

The Tennessee Valley Authority was established in 1933 to develop The Tennessee River system for navigation and to alleviate conditions resulting from the frequent floods in that area. The Authority's initial approach to reducing flood damage was a system of multiple-purpose dams and reservoirs. For a proposed project to qualify, anticipated benefits had to exceed anticipated costs.

The Flood Control Act of 1936 further expanded federal participation in flood control. The Act outlined two approaches to reducing flood damage: (1) the development of engineering plans and subsequent construction of engineering works by the Corps of Engineers; and (2) the development and implementation of land treatment plans by the Department of Agriculture (Soil Conservation Service). Again, for a project to qualify, anticipated benefits had to exceed anticipated costs.

Since all areas susceptible to flooding could not qualify under the requirement of economic justification (benefits versus costs), federal policy was subsequently expanded to include the development of a flood warning system and the provision of financial assistance to flood victims. Still later, and not directly in conjunction with flood control per se, a program to delineate flood areas was instituted.[6/]

Before reviewing the practical effects of the measures resulting from this policy, it is necessary to mention briefly certain significant changes which have occurred since the various flood control programs were adopted by Congress. The Tennessee Valley Authority has expanded its program of flood prevention to include cooperative efforts with states and communities in determining possible ways to utilize various land use adjustments to reduce the damaging effects of floods.

6/ The development of the federal highway assistance program spurred the establishment of the U. S. Geological Survey Nationwide Flood Frequency Study program. It must be pointed out that although studies conducted under Corps of Engineers programs were not primarily intended for this purpose, they did, to a certain extent, serve to delineate areas of flood occurrence.

The Soil Conservation Service early discovered that land treatment measures were not sufficient to cope with flood problems in its particular geographic areas of responsibility. It was subsequently empowered to construct flood control protective measures where the need was evident and anticipated benefits would exceed anticipated costs.

Policy Implications

The implied objective of federal policy has been to prevent the occurrence of floods or to diminish their destructive forces thus, reducing damage. To some extent policy accomplishment is difficult to assess as there has not been an adequate effort to assess accurately annual flood damage. The Weather Bureau records information made available to it by state and local officials and other sources. But the methods of collection and classification of data lack uniformity, with the result that the figures are less than accurate or comprehensive. Yet Weather Bureau figures are the most extensive among those published by federal agencies. Thus, it is not possible to present a complete and accurate inventory of past flood damage in the United States.

With this caveat, however, some indication of accomplishment may be derived from the Weather Bureau statistics. Table 1 below shows the trend of annual average flood damages over the past twenty-five years.

Table 1

AVERAGE ANNUAL PROPERTY LOSSES FROM
FLOODS FOR FIVE-YEAR PERIODS, 1940 THROUGH 1964
(Derived from U.S. Weather Bureau data.)

1940-44	$ 95,862,000
1945-49	166,566,000
1950-54	337,580,000
1955-59	355,998,000
1960-64	217,897,000

During the period 1940-1950, the Corps of Engineers expended an average of approximately $140 million a year for flood control projects; during the period of 1950-1960, approximately $220 million. These figures

indicate that, despite increasing federal expenditures for engineering works, flood damages have continued to increase with what may be only a momentary decline in the early 1960's.

Hurricanes

The hurricane has been defined as "a storm of tropical origin with a cyclonic wind circulation (counter-clockwise in the Northern Hemisphere) of seventy-four mph or higher."[7] Most hurricane damage occurs in the Atlantic and Gulf Coast areas of the United States. Unlike the flood, hurricane origin is far removed from the country itself, and its size and intensity make it the most destructive of natural disasters. Although exact measurements are not available, hurricanes may extend to 50,000 feet or more in height and over 100 miles in diameter.

Knowledge of Hurricanes

Detailed information about hurricanes has been very difficult to obtain. The science of meteorology, which studies atmospheric forces, did not receive much recognition in the U. S. until World War II when military demands created an urgent need for weather information. Because of their size and because most of them originate in the tropical area of the Azores, hurricanes must be actually observed by plane, which is at best a difficult task.[8]

Although the destructive forces of a hurricane are well recognized by their effects, exact information about them has been difficult to accumulate because of storm intensity. Maximum wind data, for example, are very difficult to determine. The process for measuring wind velocity has involved the three- and four-cup anemometers, with no uniformly acceptable procedure for exposure to the actual force. When winds have reached one hundred mph, the cups have quite often been torn off, or the structure supporting the anemometer has been toppled.

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[7] William Dunn & Banner Miller, Atlantic Hurricanes, Louisiana State University, 1960.

[8] Ibid.

This factor, together with a lack of uniform procedure for actual collection and recording of data, results in an accumulation of wind data less accurate and uniform than are required for true scientific analysis.

Information about the rainfall contribution to hurricane flooding is also difficult to record. It is a product of rainfall, wind, and physical characteristics of the land area. Some success has been achieved in measuring rainfall normally through the use of a dense network of rain gauges located throughout a river basin area. With respect to a hurricane, however, experience indicates that when winds exceed fifty mph, less than fifty per cent of actual rainfall is measured by such gauges.

Federal Approach to the Problem

There are two programs which represent the federal approach to the reducing of the destructive effects of hurricanes: the National Hurricane Research Center in Miami, which has undertaken an extensive research effort; and the construction of protective works by the Corps of Engineers, an extension of the federal flood control program.

In June, 1955, the Congress expanded the scope of the Federal Flood Control Program. Specifically, the Corps of Engineers was directed to conduct studies of the eastern and southern coastal areas affected by hurricanes. These surveys were to include consideration of "the behavior and frequency of hurricanes, determination of methods of forecasting their paths and improving warning services, and of possible means of preventing losses of human lives and damage to property. . . ." With regard to the latter, the Corps was to consider such protective works as breakwaters, sea walls, and dikes.

In order for the Corps to construct protective works, the survey conducted had to show that anticipated benefits would exceed anticipated costs, the same requirement as is applied to other flood control works. The Corps has since conducted a number of these hurricane studies, many of which have resulted in the construction of protective works.

Part of the National Hurricane Research Center's work is to develop an adequate system for tracing hurricanes in order to improve the preciseness of the Weather Bureau's hurricane warning system. It also is attempting to develop a system for forecasting the height of floods generated by hurricanes.

Testifying before Congress with respect to this latter system, a Weather Bureau official explained some of the problems it has encountered:

> "The problem of predicting inundation, erosive wave action, and damaging wind along the coast is a complex one. It is basically a meteorological problem involving the development and movement of atmospheric storms. However, the problem embraces a spectrum of related oceanographic factors, including the process of interaction between ocean and air which generates large waves and astronomical tides. The height and frequency of wave strength and duration of strong winds, and the fetch or distance over which the generating winds follow the waves without change of wind direction. For example, the waves generated by a small circular storm are not as damaging to the coastline as those from an oval-shaped storm in which strong winds blow from the same direction for several hundreds of miles. And in the same way the waves generated by a rapidly moving storm are generally less damaging than one which is stationary or slow moving, since the wind in any one locality changes its direction continually as the storm moves by."9/

Dunn and Miller conclude that meaningful prediction is dependent upon a number of factors yet unrefined. "Thus it is virtually impossible at this time to forecast the level of flooding that will accompany a hurricane."

The problems of tracking a hurricane have been dramatically demonstrated quite recently by the erratic behavior of hurricane Betsy. After apparent danger to southern Florida had passed, the hurricane paused off the East Coast and virtually reversed its direction, inflicting severe damage on the Miami area and the Florida keys and proceeding with mounting intensity into the Gulf of Mexico, taking an extensive toll of life and property in New Orleans and southern Louisiana. As reported by Dunn and Miller, the Weather Bureau has usually been able to provide twenty-four hour advance warning, but occasionally a storm's course alters so erratically that less than this amount of time may be available before the storm strikes.

9/ U. S. House of Representatives Subcommittee on Oceanography, Improvement of Storm Forecasting Procedures, April, 1962.

Earthquakes

The destructive forces loosed by an earthquake are (1) extensive ground motion and, on occasion, (2) tsunamis, or seismic sea waves, which are gravity waves in water caused by underwater disturbances associated with earthquakes. They often result in extensive coastal flooding.

Knowledge of Earthquakes

Two agencies are responsible for most of the federal research into earthquake phenomena--the U. S. Geological Survey, Department of the Interior, and the U. S. Coast and Geodetic Survey, Department of Commerce.

The former, in its program of engineering geology, seeks among other things to identify areas of the United States which are susceptible to earthquakes. Beyond that, prediction of the effects of an earthquake in an area involves several factors, two of the most significant of which are: (1) the response of the particular soil types, and (2) the distance from the epicenter. Softer ground, especially when wet, results in the greatest damage from earthquakes because of greater amplitude of ground motion, a longer shaking period, and the possibility that the ground may even disintegrate and cause landslides, differential subsidence or lurching.

As a result of the 1964 earthquake in Alaska, the Survey is now involved in two different studies. One is a series of detailed geological investigations of all coastal communities in Alaska. The Survey has received an appropriation to start this work in Fiscal Year 1966, and expects to complete it in three to five years. The other study is a ten-year geologic and geophysical investigation of the San Andreas fault which cuts across the two largest population centers in California. The Survey has received an appropriation to start this study in Fiscal Year 1966. Its present estimate for completing the work is ten years.

The Coast and Geodetic Survey endeavors to coordinate efforts in collecting all types of earthquake information and issues a variety of reports and bulletins which present such information as the date, time of day, location of epicenter, magnitude, intensity, and narrative comments

on reported seismic disturbances. Its two-volume, Earthquake History of the United States, presents data on the stronger earthquakes since June 1638.

As indicated above, damage far from the epicenter of the earthquake may result from the tsunamis, or seismic sea waves, set in motion by underwater disturbances. The Coast and Geodetic Survey has developed a tsunami warning system to serve the Pacific area, where tsunamis are chiefly generated.

Federal Policy

Despite the existence of foregoing programs, federal support of research into all aspects of earthquake phenomena has not kept pace with that given to flood and hurricane research. This may be attributable to the fact that major earthquake disasters are less frequent in the United States, since most of the major disturbances have occurred in the less populated areas of the country. As we know, however, there is always the possibility of a major disaster in some of our larger urban centers.

The development of federal research and engineering policy with respect to earthquakes has been stimulated by the occurrence of the Alaskan earthquake. Fresh impetus has been given to efforts in this area by the strong manifestations of Presidential and Congressional interest in and concern for the individuals and communities affected.

There is as yet no known way to predict when the next earthquake is likely to occur, but it is possible to indicate which areas are most susceptible and how various types of ground will respond to strong earthquake shock. There are indications that significant advances are being made in geological investigations in urban areas, but the effort is in need of greater support in the form of more money and additional competent people.

One area in which progress has been made over the past sixty years is the growing acceptance of the requirement for earthquake-resistant construction in areas of important seismic activity. This is of course not a peculiarly federal advance, but has been reflected in state and local codes governing all construction in such areas.

III. POLICIES GOVERNING FEDERAL LOAN, GRANT AND CONSTRUCTION PROGRAMS IN AREAS OF RISK OF NATURAL DISASTER

The Federal Government conducts a variety of programs designed to assist institutions and individuals in the construction, rehabilitation, or acquisition of capital items such as homes, hospitals, schools, libraries, highways, airports, bridges, etc.--all of which play a role in the development of the areas in which they are located. It also conducts impressive construction programs on its own account. The thought underlying the recommendation of this review was that if the policies governing all of these programs were to avoid placing property at risk of flood, hurricane, and earthquake damage, the long-range influence of such policies would be considerable. The ultimate sanction, of course, is to be found in the zoning and land use regulatory powers of state and local governments, but the widespread involvement of the federal grant, loan and mortgage guaranty programs is such that a consistent, firm policy of avoidance of such risks would unquestionably result in a lessening of the potential hazard to life and property.

There are, of course, practical limits to the feasibility of such an approach. These are discussed in the next chapter. This chapter is addressed simply to a summary consideration of the policies which at present guide federal personnel in the administration of the programs. (A program-by-program review will be found in Appendix I.)

Loan and Grant Programs

Housing and Urban Development

The written regulations governing most federal programs for loans (including loan guarantees) and grants for housing and urban development do specifically recognize the risks of natural disaster damage and prescribe inhibiting procedures or standards with respect to site selection

or protective construction, or both. Notable in this respect are the requirements of the mortgage insurance program of the Federal Housing Administration with respect to acceptable minimum finished grades and first-floor elevations being such as to offer protection against flooding of estimated 50-year frequency. Construction standards are designed to offer resistance to hurricane and earthquake forces where appropriate.

Similarly, the Public Housing Administration's program for public low-rent housing is controlled by explicitly protective policies with respect to both site selection and construction standards. Policy governing the Veterans Administration's loan guaranty program also contains requirements for developments, where it is anticipated that five or more homes will be purchased by veterans, which call for consideration of the hazards of natural disasters. While the criteria are stated less explicitly than in the Federal Housing Administration's regulations, agency officials consider the data submission requirements to be sufficiently detailed to permit the review process to take the hazard adequately into account.

The Urban Renewal Program is, of course, a more varied one, involving planning for large community areas. A proposed project, to win approval, must contemplate land uses for areas of high risk of natural disaster such as would minimize loss or damage.

In the case of the Farmers Home Administration programs, there are no specific requirements for making judgments with respect to disaster hazards, although agency officials expect that such judgments would be involved in the appraisal process.

The Area Redevelopment Administration also lacks explicit requirements, but its officials state that reliance is placed on the state and local zoning and land use restrictions for protection against such hazards. The Small Business Administration similarly lacks disaster protection policies, but its officials see substantial protection in the fact that local lending institutions usually participate in its loans for construction, conversion, or expansion of small business facilities, and they may be expected to protect their investment through a site selection

Not supported by the Alaskan experience

review. (See below for a discussion of the special problem of the Small Business Administration's disaster loan program.)

Institutional and Public Works Development

In the programs for institutional and public works development, federal policy is generally less explicit with respect to safeguards against natural disaster hazards, particularly where site selection is concerned. This is understandable, since such projects are usually designed to meet needs of established developed areas, and where such areas are subject to hazards, location of the proposed project in some other area would fail of its purpose. In many such cases, however, protective construction is a requirement of federal approval. In others, reliance is placed on applicable state and local codes.

For example, the programs of the Department of Health, Education, and Welfare of grants to assist in the construction of water supply and pollution control facilities, community hospitals (Hill-Burton program) and libraries all involve reliance on state and local requirements for protective construction in areas of risk of disaster damage. In the case of school construction on non-federal lands to serve federally-impacted areas the same is true; while construction on federal lands in the same program involves a review of construction plans in which protective design standards must be met.

The Community Facilities Administration of the Housing and Home Finance Agency also reports that there are no explicit policies to prevent the development of projects of public works construction, college housing, and housing for the elderly and handicapped in areas of high risk of natural disaster. The protection in these cases is that provided by state and local regulations and standards.

Two programs involving slightly different considerations are those of the Bureau of Public Roads and the Federal Aviation Agency. In the first case, the policies governing grants to states for highway construction specifically require consideration of natural disaster risks. The leeway allowed in site selection, while meeting the primary requirement, may be somewhat less than is permitted in the case of a new housing

development, and the final judgment is one agreed to with state officials after considering such variables as possible rights-of-way, design standards, differential engineering standards, and costs.

The Federal Aviation Agency administers the federal program of aid for airport construction. This is one of the few cases where the law makes specific reference to natural disaster hazards by requiring that the Administrator must receive, among others, a satisfactory written assurance that "such airport and all facilities thereon or connected therewith will be suitably operated and maintained, with due regard to climate and flood conditions." The written policies of the Agency do not, however, include specific requirements with respect to natural disaster hazards. It is pointed out by agency officials that there are many other considerations, such as location, drainage, airspace requirements, cost, and safety of approach, and that the detailed engineering and review involved in airport projects is such as to provide prudent safeguards. In a few cases where it has been necessary to locate airports where there is some risk of occasional flooding, protective dikes have been incorporated into the plan.

While not involved in grants in the usual sense, the Federal Power Commission issues licenses for the planning, construction,and operation of nonfederal hydroelectric power projects on waters or lands under federal jurisdiction. In reviewing applications, the Commission applies requirements for the "structural safety and adequacy" of the facility which its officials consider sufficient protection against natural disaster hazards. Site selection, of course, is determined by considerations of cost and function.

Construction Programs

Federal construction programs are concentrated chiefly in a very few federal agencies, the major civilian one being the General Services Administration. Its policies with respect to the hazards of natural disasters are the most explicit encountered in the course of this review.

The hazards of flooding, high winds, and earthquakes must be specifically taken into account in both site selection and design and engineering.

Sources of information are prescribed which would disclose pertinent disaster damage histories or threats, and these must be reported by site selection teams. If it is necessary in the final site selection to accept such hazards, the design and engineering must compensate for them.

The Office of the Chief of Engineers, Department of the Army, is responsible, among other things, for the planning, engineering, and construction of facilities for the Army, the Air Force, and other governmental agencies as assigned. The Office has developed a policy guide specifically designed to counter the effects of natural disasters. Emphasis is on the required design and engineering standards to resist disaster forces, since latitude for alternative site selections is frequently lacking if the installation is to serve its military purpose. Where such latitude exists, however, it is employed.

A construction program currently of much smaller compass is found in the hospital construction program of the Veterans Administration. The written regulations do not contain specific requirements with respect to the hazards of natural disasters, but there is of course a general requirement that structural design shall conform to local codes and regulations governing problems peculiar to the particular community. Review of individual project files indicates that hospitals in earthquake- and hurricane-prone areas have been the object of specific local code reference, and that officials responsible for the review of plans are in fact alert to such hazards.

Federally owned Post Office buildings are constructed under and subject to the requirements of the General Services Administration cited above. Buildings constructed for lease to the Post Office Department must conform to department design and construction requirements, which rely on local standards and regulations for protection against unusual hazards.

In summary, it may be said that policies applicable to most direct federal construction are reasonably responsive to the risks of natural disaster damage.

Disaster Assistance Programs

Possible the weakest provision is to be found generally in those few programs designed to assist victims directly in recovering from the damages of disaster. While it is easy to understand a desire to be of help, and to avoid unseemly contention with individuals whom tragedy and loss have recently visited, a review of policy would be remiss if it neglected to note the humanitarian efforts that tend, to at least some degree, to perpetuate the hazard.

The Small Business Administration, for example, administers a special loan program to assist natural disaster victims to repair homes, businesses, and other properties. In cases where the loss has been sustained in an area of predictably recurring hazard, officials reportedly try to counsel with applicants, offering larger loans if necessary, to reestablish in safer locations. If, however, the applicant does not perceive the hazard of recurrence, if he insists that he wishes to rebuild or repair the property on its former site, the Small Business Administration must grant the loan if he is eligible in other respects, since it lacks authority to deny a loan on the grounds that there is a recurring risk of natural disaster. This has reportedly resulted in "repeat business" with applicants who have suffered similar losses earlier.

The American Red Cross, while not a federal agency, occupies a unique position as a national disaster relief agency and as such exerts some influence, however inadvertent, on the perpetuation of hazards. Among other things, it offers assistance to disaster victims on the basis of need for the restoration of living quarters and family-operated businesses. Meeting the minimum needs of assistance for the repair of damaged structures where they are located naturally tends to perpetuate the hazard in areas where that hazard is a predictably recurring one.

Finally, an indirect program of assistance is found in the provisions of the Internal Revenue Code that permit uninsured property losses to be taken as a deduction from income subject to tax. While it cannot be sensibly argued that this is an incentive to court the risks of natural

disaster damage, it does represent a form of premium-free insurance, or loss-sharing, that may dull to at least a small degree an incentive to avoid such risks at all costs, and it offers little incentive to incur greater expense to avoid the hazard in the future, unless the loss is total.

State and Local Activities

While the current review did not call for consideration of state and local efforts in reducing disaster damage, it is clear than an effective program must be an intergovernmental one, involving federal, state, and local cooperation. The above discussion has indicated that in several program areas reliance is placed by federal officials primarily on state and local requirements and regulations. Most such regulations have to do with protective construction, rather than with clearly thought-out land use plans that would contemplate development of hazardous areas along lines that would minimize damage in the event of flood, hurricane, or earthquake.

good point

While federal influence can be substantial in improving the situation, it is the state governments which possess the power to regulate land use. Local political subdivisions exercise such authority when granted the power by the states. Methods for regulating the use of land to minimize the hazard of flood damage, for example, include channel encroachment or floodway statutes, zoning ordinances, subdivision regulations, building codes, miscellaneous codes such as plumbing and electrical codes, urban renewal, government acquisition of land, and warning signs. As of 1962, with the exception of Hawaii, states generally were not effectively utilizing these tools.[10/]

Table 2, taken from Morse's study cited below, sets forth a summary of state water resource agency activities related to flood damage.

10/ Hanry F. Morse, Role of the States in Guiding Land Use in Flood Plains. 1962. Georgia Institute of Technology and the Tennessee Valley Authority.

In only 15 states is the responsibility lodged in a single agency. While all states but 1 collect flood data, only 18 have programs for distributing them. Scanning the Table makes clear that the predominant interest is in flood control works; in only nine states is the over-all water resource activity concerned with land use controls.

In his study, Morse concludes that, despite progress in building flood control works, the absense of land use regulations for flood plain areas has caused the national flood damage potential to increase. He suggests that in the states, broad water resource programs, developed under the aegis of statewide planning agencies, should include concern for flood problems.

Several states were reported to be developing programs for the reduction of flood damage. These efforts involve a wide variety of activities that are similar to those that comprise the Tennessee Valley Authority's local flood relations program. The activities include (1) compilation and dissemination of flood information, (2) review and execution of flood control projects, (3) development and adoption of flood plain regulations, and (4) comprehensive planning programs.

Although many states do collect flood information, they do not generally have adequate procedures for presenting such information in useful format for the use of state, local, and private agencies and individuals. It is usually published in such manner as to be useful primarily to engineers and hydrologists. The information is generally maintained in the files for technical reference pruposes.[11/]

[11/] Henry F. Morse, Role of the States in Guiding Land Use in Flood Plains. 1962. Georgia Institute of Technology and the Tennessee Valley Authority.

Table 2

SUMMARY OF AUTHORIZED STATE WATER RESOURCE AGENCY ACTIVITIES
RELATED TO FLOOD DAMAGE PREVENTION

State	General Functions												Statewide Plans and Policies		
	Number of Agencies	Collect Flood Data	Distribute Flood Data	Provide Technical Assistance on Local Flood Problems	Establish Floorways or Encroachment Lines	Construct and Operate Flood Control Works[a]	Make Grants and Loans for Local Flood Works[a]	Review Corps of Engineers Projects	Review SCS Projects[a]	Review Bureau of Reclamation Projects	Review Design of Water Control Structures	Coordinate State Water Resource Agency Programs	One Agency Has Authority for Over-All Water Resource Plan	Over-All Water Resource Planning Activity Concerned With	
														Flood Control Works	Land Use Controls
Alabama	2	X							X						
Alaska	1	X													
Arizona	4	X				C O		X	X	X	X				
Arkansas	2	X	X					X	X		X				
California	1	X	X	X		C O	G L	X		X	X	X	X	X	
Colorado	2	X						X	X	X	X				
Connecticut	1	X			X			X	X		X	X	X	X	X
Delaware	3	X						X	X						
Florida	3	X		X		C O		X	X			X	X	X	
Georgia	2	X							X						
Hawaii	1	X	X								X	X	X	X	
Idaho	1	X						X	X	X	X	X	X	X	
Illinois	4	X	X			C O		X	X		X	X	X	X	
Indiana	1	X	X	X	X	O		X	X		X	X	X	X	X
Iowa	3	X	X		X			X	X		X		X	X	X
Kansas	4	X						X	X	X	X	X	X	X	
Kentucky	1	X	X		X			X	X				X	X	X
Louisiana	2	X	X			C O	G	X	X		X				
Maine	2	X							X		X				
Maryland	2	X	X					X	X		X				
Massachusetts	2	X			X	C O		X	X			X	X	X	X
Michigan	3	X	X					X	X						
Minnesota	3	X	X			O		X	X		X	X			
Mississippi	3	X						X	X				X	X	
Missouri	2	X						X	X			X	X	X	
Montana	3	X						X	X	X	X	X			
Nebraska	2	X						X	X	X	X				
Nevada	1	X						X	X	X			X	X	
New Hampshire	3	X				C O		X	X		X	X			
New Jersey	1	X	X	X	X	C O		X			X	X	X	X	X
New Mexico	1	X				C		X	X	X	X		X	X	
New York	4	X				O		X	X		X		X	X	
North Carolina	2	X		X				X	X			X	X	X	
North Dakota	2	X				C O	G	X	X	X					
Ohio	1	X	X	X		C		X	X			X	X	X	X
Oklahoma	3	X	X					X	X	X		X			
Oregon	2	X						X	X	X		X	X	X	
Pennsylvania	1	X	X	X	X	C O		X	X		X	X	X	X	X
Rhode Island	3	X		X				X	X		X	X			
South Carolina	1								X						
South Dakota	3	X						X	X	X	X				
Tennessee	2	X	X					X	X				X	X	
Texas	2	X						X	X	X	X				
Utah	3	X	X				G	X	X	X			X	X	
Vermont	1	X				O		X					X	X	
Virginia	2	X						X	X		X				
Washington	1	X		X	X		G	X	X	X	X		X	X	X
West Virginia	3	X							X		X		X	X	
Wisconsin	3	X	X					X	X		X				
Wyoming	3	X					G L	X	X	X	X		X	X	

Source: Handbook and Directory of State Water Resource Agencies, The Council of State Governments, Chicago, Illinois, ecember 1960, 73 pages, and correspondence with state resource agency directors. This table does not include state stream ollution and game and fish agencies or activities.

[a] C--Constructs O--Operates
G--Grants L--Loans
SCS--U. S. Soil Conservation Service

IV. SUMMARY AND CONCLUSIONS

This review has been directed to problems of federal policy governing programs, primarily of a developmental nature, in areas of high risk of floods, hurricanes, or earthquakes. The original recommendation clearly implied that such policy is remiss in its failure to use the powerful influence of federal loans, grants, and direct construction to avoid placing at risk additional property and more lives in such areas. The review reveals that there is room for improvement in this respect, but also that federal officials in most programs have made some progress toward the objective.

In the formulation of some judgments in this area, it was found useful to build a conceptual framework in the form of a matrix of measures (however incomplete) employed or employable in efforts (1) to prevent, (2) to lessen the force of, or (3) to limit the damage and loss of life resulting from floods, hurricanes, and earthquakes. (See Appendix II.) In no case has there been a breakthrough that gives promise of preventing the occurrence of any of these destructive natural forces. In the case of floods, any hope that reforestation and flood works would contain the destructive forces to the point where damage would be negligible has given way to an objective of reducing the destructive force of flood waters. The force of hurricanes and earthquakes remains unimpaired. Yet it would be a brash person in this day of rapid scientific and technological advance who would flatly deny the possibility that continued research in these areas may be fruitful.

Efforts to reduce the delivered force of water in floods and hurricanes have met with some success, however minimal. The use of protective works has reduced the area of damage, even though total damage has been increasing as a result of continuing development in hazardous areas. It is the contention of most students of flood, hurricane, and earthquake damage that the only feasible way to reverse this trend is by a combination

of protective works and restrictions on land use in the most hazardous areas. This view supports the objective of the basic recommendation on which this present review is based.

It must be recognized, however, that there are practical limits to the restrictive land use policies that can be applied. Given the vulnerability of virtually the entire Atlantic and Gulf coasts to the force of hurricanes, it cannot be seriously proposed that the coastal areas be abandoned in order to avoid the risk. Clearly, in such case, the avoidance of the lowest-lying, most vulnerable areas, combined with protective construction where it is necessary to build, would represent a reasonable and prudent compromise with the risk. In the last analysis, neither complete avoidance of risk nor the complete ignoring of risk makes much sense. It is in the area between these extremes where difficult judgments must be made with respect not only to what is most desirable, but to what is acceptable in a free society.

Findings

The present review has resulted in the following findings, which are accompanied by brief discussions:

1. Those federal agencies operating loan and grant programs that may spearhead development (i.e., housing and urban development) have generally adopted policies that seek to avoid areas of high risk.

2. Those federal agencies operating programs of direct construction have adopted policies that seek to avoid areas of high risk, or, where such avoidance is impossible or infeasible, to incorporate protective construction to counter the anticipated hazards.

3. Those federal agencies operating loan and grant programs involving facilities serving existing communities (i.e., water and sewerage systems, schools, hospitals, highways, airports, and the like) see less latitude for policies of avoidance of high risk areas, and, in cases where such policies seem infeasible, generally require protective construction.

4. <u>When federal programs operating to furnish relief to disaster victims involve repair and rehabilitation of damaged facilities, considerations of immediate relief outweigh consideration of avoidance of future risks.</u>

These first four findings are discussed in some detail in Chapter III. It is worth pointing out here, however, that the involvement of the representatives of the agencies concerned in the work of the Federal Reconstruction and Development Planning Commission for Alaska may well have resulted in a more favorable posture than was the case before the Alaskan earthquake. It was observed in the course of the review that some of the explicit provisions in manuals and regulations concerning approvable sites appeared on pages that carried revision dates of some months after the Alaskan earthquake.

The further point should be made that the generally favorable finding is based in some cases upon policies that were described rather than produced in writing. While there is no reason to doubt that such policies exist, their incorporation in explicit written form into the program literature of the agencies would serve the further useful purpose of attracting attention to the problems of hazardous areas and advertising the agencies' official position on the issues. It would also serve to emphasize the importance attached to site selection to avoid hazards if at all possible, and might result in a more diligent search for a more favorable site in the early stages of development of a project proposal.

There is, of course, interaction between the public works protective approach of dams, dikes, etc., and the site selection approach to minimizing the flood damage potential. The construction of protective works in a river system may create a false sense of security on the part of both local officials and real estate developers, with the result that more lives and property are placed at risk in the event of recurrence of the most serious floods experienced in the area. As discussed below, it is important that the limitations on the expected protection offered by protective works be made as clear to laymen as they are to engineers.

With respect to finding Number 4 above, it is probably to be expected that relief considerations will be predominant in the period immediately following a disaster.

If there is to be a serious effort to avoid repeating the placing of lives and property at risk, it should probably involve something like contingent planning for hazardous areas looking to their acquisition for recreational or other open-space uses immediately following a disaster. Any such contingency program should be one which will commend itself to the public on grounds of generosity to the disaster victims. Public opinion would not support it on any other grounds at a time when the sympathy of the American people has been aroused.

5. Federal program and policy determinations alone cannot produce satisfactory solutions. Federal-state-local cooperation is needed if desirable land use restrictions are to be effective.

One point on which virtually all students of the problem are agreed is that selective uses of land will be required if we are to avoid placing more and more lives and property at risk in hazardous areas. The Federal Government, through policy and regulation, can exercise an important influence in this direction, since its various grant and loan programs are extensive; but if the states, by exercise of their traditional zoning and land use regulatory powers could be induced to mount a concerted attack on the problem, the solution would be more extensive and satisfactory.

An example of effective federal-state-local cooperation is found in the local flood relations program of the Tennessee Valley Authority. It took the approach that (a) a comprehensive flood damage prevention program required the joint efforts of federal, state, and local governments, and (b) such a program must combine measures for correcting present flood problems with those necessary to prevent the development of future flood damage potential. The idea was discussed with state and local planning officials, and a decision reached to begin the program in 1953.[12/]

An informal framework already existed for the implementation of such a proposal as the Authority had worked with state and local planning agencies on many problems during the preceding 20 years.

12/ U. S. Senate Committee on National Water Resources, Committee Print No. 16, Flood Problems and Management in the Tennessee River Basin, 1960.

Action under the program begins with a local jurisdiction requesting information from the Authority through the state planning agency. The Authority then provides information about the flood hazard in that area.

The information is presented in reports that are written in layman's terms for the use of the general public. The reports do not propose specific solutions to the flood problems, but attempt to promote an understanding of the nature and magnitude of the community's flood problem. Data usually included are (a) a record of past floods, and (b) a description of future floods that might occur based on the most extensive recorded floods and the major storms which have occurred in the particular area as well as throughout the eastern United States.

Copies of the report are made available to both the local and state planning agencies. These agencies usually make copies available to operating department and agencies, banks, newspapers, real estate agencies, and other private and public agencies and organizations. The Tennessee Valley Authority on its part makes copies available to such federal agencies as the Federal Housing Administration, Urban Renewal Administration, and others. Finally, the Authority provides whatever technical assistance it can, when so requested, to assist jurisdictions with the implementation of subsequent plans developed from flood information reports.

It is probably even more important that such cooperative relationships be developed in the case of the earthquake hazard. It is not nearly so widespread as the flood hazard, and the Federal Government, through the Coast and Geodetic Survey and the Geological Survey, is probably in a position to furnish a greater proportion of the scientific and technical guidance to the states. Certainly a central point of expertise is to be desired in this case.

6. Solutions to the problems of flooding are likely to be found in the larger area of water resource management.

Flood control is a part of the larger problem of a water resource management. The nation is becoming more sensitive each year to the critical role that water plays in our ecology, economy, and national well-being. We are seeing more and more evidence of determination to find cooperative, constructive solutions to pollution and other wasteful practices.

As indicated in Chapter III, most states have fragmented programs for water resource administration, divided among two or more state agencies. It is predictable, by the very nature of the problem, that the Federal Government will become more deeply involved in the water resource problems of the nation. As it does, it should seek to influence the states to place responsibility for state water resource administration, including flood control programs, in a single state agency. Such an arrangement will not only provide a focal point for determining state needs and resources, but it will also make more effective the state role in regional and national programs and activities. In the particular field of flood control, it will provide a point of technical and informational leadership.

7. Vastly increased public knowledge and understanding of the nature and extent of recurring risks are needed; and programs of "information" must somehow be vitalized to produce such knowledge and understanding.

There is no dearth of information on the hazards of the flood plains in this country. The Geological Survey and the Corps of Engineers have amassed a great deal of information on the history of flooding and the potential for future floods. Physical and social scientists in our universities have conducted numerous studies of floods and of the adjustments of people to the hazards of floods. The information studies of the Tennessee Valley Authority have been alluded to earlier. Generally, however, while these studies have added importantly to the body of technical knowledge, they have not increased public understanding and knowledge of the recurring nature of the hazard.

A recent program of some promise is the Flood Plain Information Study program of the Corps of Engineers. On request of a public agency, following prescribed channels, the Corps will prepare a study of the flood hazard in a local area. One of the requirements for such service is that the requesting agency must agree to publicize the study upon its completion. If the resulting public information activity can be made truly meaningful, in lay terms, it can do much to translate "information" into useful public knowledge. The task is not an easy one, as it involves capturing public attention, serving that public attention with easily understood language, and achieving a constructive impact on local public opinion. The task is worth a substantial effort, however, since public consensus

is probably the most effective way of achieving sensible land use regulations to the end of decreasing the flood damage potential of the nation. As suggested above, the placement of responsibility for water resource administration, including flood control, in a single agency can be a powerful influence in this respect.

It may be suggested also that the emergence of a strong central voice within the Federal Government in this area would be an important asset. As the federal water resource management role develops, as it unquestionably will in the period ahead, an effective public information program should be a part of it.

8. The rationale of federal policy in this area should be a consistent one, but this goal does not imply uniformity of policy.

Among the federal agencies whose policies have been reviewed as a part of the present project, there is no justification for seeking identical operating policies. An agency whose program provides stimulus for settlement in and development of new areas can justify much more stringent requirements for the avoidance of increased hazard than can one whose program provides needed services for existing communities. Thus the Federal Housing Administration can properly take a hard line in refusing to guarantee mortgages for a project in an area susceptible to periodic flooding, while the Office of Education might find it indefensible to disapprove a library project for an institution already located in an area of similar hazard. In the latter case, however, protective construction should be required, and its adequacy should be evaluated against the most complete information available with respect to the hazard.

Thus, federal policy should be consistent in seeking to minimize risks in ways appropriate to the individual program goals. There should probably be created a forum in which the several agency policies can be discussed and judged for consistency. The federal policy should not be avoidance of risk at any cost; there are other goals in our society which must be served within the present framework, and constructive value judgments will be required.

9. Various federal agencies are now involved in the delineation of hazardous areas, and such involvement is necessary and desirable.

There are compelling reasons, as well as ample precedents, for involving the Federal Government in the delineation of hazardous areas. In the first place, most of the basic source data on which such delineation would need to be based has been developed by federal agencies. The Corps of Engineers, the Tennessee Valley Authority, the Geological Survey, the Coast and Geodetic Survey, the Soil Conservation Service--these are some of the agencies which have been most active in gathering data on areas of recurring flood, hurricane, and earthquake damage.

Furthermore, it is doubtful whether the judgments of 50 state agencies would add up readily to a technically acceptable delineation of hazardous areas without a common referent or single judgment to which to react. The hazards referred to are not bounded by state lines, and judgments about them must not be so limited.

It is, of course, possible for the Federal Government to seek the involvement of one or more prestigious scientific groups in the delineation of hazardous areas. In fact, it is quite likely that, if such delineation is accepted as a required element of federal leadership, a broadly based advisory group, involving scientific and technical leadership and the participation of "statesmen" from among the special interest groups, will be organized to make recommendations. While the use that will be made of such delineations may well vary from state to state, it is important that the basic judgments in formulating them be central and uniform. It is difficult to think of any satisfactory point of judgment on such a question other than the Federal Government.

Precedents are to be found in the work of the aforementioned federal agencies in delineating the flood-prone areas and in both the past efforts and the research undertakings being initiated in the current fiscal year by the U. S. Geological Survey which will hopefully define the areas of continuing earthquake hazard.

10. Increased federal support of research is required.

A review of policy in this subject matter area leads inevitably to the conclusion that increased support of research is essential. While much has been accomplished, particularly since the military requirements for weather research came to the fore in World War II, there are a great many promising and essential areas for further inquiry.

For example, techniques and instrumentation for improved data collection on wind intensities can be improved. The whole field of weather modification research, including the development of more extensive basic knowledge of the flood, hurricane, and earthquake phenomena, offers promise of major environmental improvement for mankind. While the promise is dim and far-fetched at the moment, if research can unlock the mysteries of these phenomena in ways that make possible the elimination or substantial attenuation of the force of these natural hazards, the implications for policy in the development of areas that now must be judged hazardous are tremendous.

As the nation continues to become more urbanized, and less wasteful uses of urban land become more critical, the importance of more refined knowledge of urban geology increases. While the Geological Survey conducts some such studies and tries to stimulate others to conduct them, there is good reason to believe that the total effort is inadequate and that more adequate support of the studies and of the training of competent people to conduct tham are needed.

Another area in which some research has been undertaken, but much more is needed, is that of human adjustment to the threat of recurring disaster, and effective ways of achieving true perception and acceptance of the fact that the hazard is a continuing or recurring one.

While more sophisticated judgments would be required to determine whether such efforts offer promise of useful results, it is clear that policy makers would be in a stronger position in adopting protective policies if more were known about the periodicity of earthquakes, if any. Furthermore, it is not inconceivable that future research may offer clues to the prediction of earthquakes.

Furthermore, it may be worthwhile to undertake economic studies of disaster losses. We should not be afraid to examine the economic strength or weakness of the oft-repeated assertion that a destructive disaster "is the best thing that has happened to this community." The argument is advanced that the elimination of obsolete structures and manufacturing processes stimulates the creation of modern plants, resulting in improved living conditions, and of increased productivity. This view would place emphasis on measures to protect life, but not necessarily property, against the longer-term natural hazards. While few people support this view in positive terms, there is reason to suspect that failure to support protective measures represents a kinf of negative acquiescence in the argument. Studies of the true economic cost of disaster damage might serve to resolve the question.

It should be understood that no comprehensive effort was made in the present review to identify needed areas of research. The review did, however, result in a conviction that increased support is needed. The above are intended to serve as a few examples of many needed lines of inquiry.

Alternative Courses of Action

There are, of course, a number of alternative courses of action open to the Federal Government, in an effort to deal with the problems of development in areas of recurring hazard. Some of these have been suggested earlier in this chapter. For summary purposes, they will be presented in this final section. It is obvious that almost any innovation will encounter political, social, psychological, or economic resistance in some quarters. No attempt is made to assess the nature or likely intensity of the common phenomenon of resistance to change. The addressees of this report are more experienced in forming such judgments than its authors.

Pursuit of the Present Policy

Advocacy of the present lines of policy to guide action is by no means outrageously unreasonable. In general, this would involve

gradually developing policy statements and review requirements on the part of federal agencies administering grant, loan, and direct construction programs that would result in wider acceptance of restrictive land use policies and protective construction to minimize the placing of peoperty and life at risk. In general, the present line of policy development advances in response to major disasters--and even that advance is hesitant and partial, however. There is good reason to believe that the net of such advances would lag behind the pressures of population growth and community development, and that property losses from floods, hurricanes, and earthquakes would continue to increase in absolute, if not in relative amounts.

Initiation of Policies of Extreme Restriction

At the other end of the spectrum, some might advocate the adoption of policies of extreme restriction of land use in federal programs of grants, loans, and direct construction. This would involve a prompt effort on the part of the Federal Government to delineate areas of high risk of damage from floods, hurricanes, and earthquakes, and thereafter automatic rejection of projects or loan guarantees on properties constructed in such areas. This would undoubtedly provoke attention-getting controversy, and might result in greater public awareness of the hazard. It would also be likely, however, to spark substantial resistance and opposition not only from those whose economic interests are adversely affected, but also from those who sincerely feel that objectives of such efforts as improving education, health, and highways should not be completely subjected to the goal of avoiding hazards at any cost. The complete avoidance of risk might well be politically, socially, psychologically, and economically insupportable.

A Posture of Federal Leadership

It seems likely that the optimum results feasible can be achieved by the development of a position of strong federal leadership involving the selective adoption of reasoned measures such as the following:

1. A Presidential directive to the agencies administering appropriate grant, loan, and construction programs to develop consistent, but not necessarily uniform, written statements of policy covering the acceptability of projects in areas of high risk of floods, hurricanes, and earthquakes.

2. The development, under federal auspices, of delineations of such areas of high risk, for federal program purposes.

3. The creation of a coordinating mechanism such as an interdepartmental committee, to facilitate the consistent application of policy by federal agencies and to review the possible need for legislative change to achieve it.

4. The assignment of the leadership role in flood control problems and programs to the federal agency having primary responsibility for water resource administration.

5. The development by such agency of a simplified, coordinated, and effective public information program dealing with the recurring nature of major floods and the utility of both protective works and restrictions of land use in countering their destructive effects.

6. Substantially increased support of research, in both physical and social sciences, on the nature of damaging weather phenomena and the problems of human adjustment to them, as well as research in the earth sciences generally.

7. Sustained cooperative efforts with the states designed to achieve consistent practice in the permissible uses of lands subject to flood, hurricane, and earthquake damage of a predictable nature.

8. Consideration of the feasibility of developing in cooperation with the several states, contingency plans for the acquisition of areas of high risk of recurring natural disaster after such disasters occur, on terms that will be favorable to disaster victims, in order that such areas may be devoted to recreational or other open space uses and so that the disaster sufferers do not reoccupy the area in continuing jeopardy.

Such measures as the above do not, of course, exhaust the list of measures available to the Federal Government. In a review of the limited scope of the present effort, it has been impossible to explore all the constructive ideas that might be followed. The whole area of disaster insurance, for example, is being explored by another agency, and the timing

of that undertaking was such as to prevent the close collaboration that might have been desirable.

To the product of the limited purposes and scope of the present review should be added the findings and recommendations of the several other groups conducting related inquiries as a result of the work of the Federal Reconstruction and Development Planning Commission for Alaska. Furthermore, the program planning mechanism for the development of any improved effort in this field should be designed to enlist the participation and constructive ideas of the individuals in the academic field who have served as both students of the problem and crusaders for improved concepts for many years.

Finally, it is just possible that the political climate has been sufficiently modified and the resource problems of the nation have increased suffieiently in complexity during the past quarter century to render acceptable the notion of a National Resources Planning Board, with advisory functions, in the Executive Office of the President. Such a body could perform extremely useful functions in advising on constructive ways in which the many scattered resource activities of the Federal Government could be related to each other in pursuit of useful goals.

Appendix A

PROGRAM AND POLICY SUMMARIES

PROGRAM AND POLICY SUMMARIES

Set forth in this part of the report are brief summaries of the appropriate federal programs and the pertinent general policies which guide the administration of each.

Since project emphasis is on a review of the policies governing federal grant, loan, and direct construction programs in areas of high risk of certain natural disasters,[1] the summaries of these programs are presented together in Group I below. Since the federal programs designed to study the characteristics of such disasters and to minimize their effects inevitably interact with other considerations in policy determination, they are summarized in Group II.

Group I

Department of Agriculture: Farmers Home Administration

The Farmers Home Administration provides credit and needed technical assistance on farm and money management problems. This involves administering a variety of loan programs. Applicants for loans must be unable to obtain adequate credit from other sources at reasonable rates and terms. These programs are:[2]

Operating Loans. Loans are available to operators of "not larger than family farms" to assist in making improved use of land and labor resources, and to make necessary adjustments for successful farming. Federal funds may be used to purchase equipment, livestock, feed, seed, fertilizer; to refinance chattel debts; to provide operating credit to fish farmers; to carry out forestry purposes and to develop income-producing recreation enterprises.

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[1] The flood, hurricane, and earthquake.

[2] Program Notes published by Farmers Home Administration.

Farm Ownership Loans. Loans are made for the purchase of farms or of land to enlarge farms; to construct or repair buildings and facilities; to improve land and develop water, forestry, and fish farming resources; to establish recreation enterprises to supplement farm income; and to refinance debts. Loans are made to farmers who operate "not larger than family farms."

Loans for Water Systems and Shifts in Land Use. Loans are made to farmers, ranchers, and rural residents to develop water supply systems, drain farm land, and carry out soil conservation measures. Funds are also available for shifts in land use to develop recreation facilities, grazing areas, and forest lands.

Rural Housing Loans. Rural housing loans are available to farm owners and owners of non farm tracts in rural areas. Loans are made for the construction and repair of homes and essential farm buildings. Loans also are authorized for the purchase of building sites and previously occupied buildings. Special provisions apply for elderly people who live in rural areas.

Emergency Loans. These loans are available to farmers in designated areas where natural disasters have brought about a temporary need for credit not available otherwise. Loans may be made under this program for any of the purposes authorized for loans under programs described above.

Watershed Loans. These loans are available to local organizations to assist in financing watershed projects designed to protect and develop land and water resources. Loans are made only to the sponsors of watershed work plans approved for operations by the Soil Conservation Service. Federal funds may be used to pay the cost of water base recreational facilities, water supply reservoirs, drainage works, and lands and rights-of-way for project purposes.

During fiscal year 1965, the Farmers Home Administration provided service to 1,800,000 people through loans totaling $798,000,000.

Agency officials stated that program policies guiding review and approval of loan applications for the first four programs described above do not specifically require a determination of the possibility that

a natural disaster might occur during the life of the loan, causing damage to property purchased with loan funds. However, such a risk is one of the many items generally considered during the property appraisal which is required before a loan application can be approved. Responsibility for appraisal supervision and evaluation rests with the directors of the various Farmers Home Administration state offices. There are no central guidelines as to the types and sources of information to be used as background in making such an appraisal.

Department of Commerce: Bureau of Public Roads

The Bureau, administers, among others, the federal program for the development and improvement of roads comprising the primary, secondary, and interstate highway systems, and the urban extensions of these roads. Grants-in-aid are made to the states to carry out this work. The annual federal appropriation is apportioned among the states on a formula basis. Matching provisions for individual projects are:

> "Primary, secondary, and urban extension projects: Federal, 50%; State, 50%, except that for those States having large public land areas (exclusive of national forests and national parks and monuments) which exceed 5% of their total land area, the Federal share shall be increased by a percentage of the remaining cost equal to the proportion of public lands to total State area.
>
> "Interstate highway projects: Federal, 90%; State, 10%, except that for those States having large public land areas, the Federal share may be increased up to 95%, depending upon the ratio of such public lands to total State area."[3/]

Program policies as cited in the Program Policy Manual by agency officials specifically require consideration of the risk of a natural disaster. Variables which enter into the equation designed to recognize such risks are: (1) right-of-way selection, (2) design standards, (3) differential engineering standards, and (4) costs. The mix arrived at in

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[3/] U. S. Code Annotated, Title 23, Sections 101-131.

any specific situation is a judgmental one developed jointly by the Bureau and the state.

Department of Commerce: Area Redevelopment Administration[4/]

This unit of the Department is charged with the economic redevelopment of those areas affected by persistent and substantial unemployment. Loans and grants are made to create new employment opportunities in such areas through the development of new industry, business, and other resources or the expansion of existing facilities.

Loans are made not to exceed 65 per cent of the aggregate cost for land and/or facilities acquisition, and construction and alteration costs in an individual project. Grants, which are not to "exceed the difference between the funds which can be practicably obtained from other sources" and what is necessary to complete the project, are available for the development of needed public facilities. Grants are also available for public works projects according to specific matching provisions.[5/]

There is no explicit policy designed to prevent the development of projects in areas of high risk of natural disaster. The only formal protection in these cases is such as may be found in state and local regulations and standards which would be applicable to all projects in such areas.

Department of Defense: Office of Chief of Engineers

The Chief of Engineers has responsibility for the provision of general specialized engineering services for the Army, Department of Defense, and for other agencies as assigned. This includes the planning, engineering, and construction of required installations and facilities.

[4/] Under Public Law 89-136 the Area Redevelopment Administration was abolished on August 31, 1965, and on September 1, 1965, the newly created Economic Development Administration assumed its responsibilities.

[5/] U. S. Code Annotated, Title 42, Sections 2505, 2506, and 2507.

A policy guide[6/] for combatting the effects of natural disasters has been developed by the Office of the Chief of Engineers. Generally, this policy is to design and build, on the basis of current design and engineering standards, in order to withstand the type of natural disaster that might affect the particular facility or installation.

Federal Aviation Agency

As part of its function of furthering the development of civil aeronautics, the Federal Aviation Agency conducts a program of federal aid for airport construction. It provides grants-in-aid to projects which are in conformity with the National Airport Plan and sponsored by a public agency.

Proposed projects must be "in accordance with standards established by the Administrator, including standards for site location, airport layout, grading, drainage, seeding, paving, lighting, and safety of approach." Legal requirements also specify that the Administrator must receive, among others, a satisfactory written assurance that "such airport and all facilities thereon or connected therewith will be suitably operated and maintained, with due regard to climate and flood conditions. . . ." Finally, consideration is given to the factors of airspace requirements and cost.[7/]

These, of course, are general requirements which recognize not only the risk of natural disaster, but other matters as well. The written policies of the Agency do not include specific requirements dealing with the risks of natural disaster. Agency officials advise that these risks are, however, taken into account in project development, and that final determinations are reached through a judgmental process involving both agency personnel and representatives of the sponsoring public agency.

[6/] ER 110-345-100, 30 November 1961.

[7/] U. S. Code Annotated, Title 49, Sections 1108, 1110, and 1112.

Federal Power Commission

The Federal Power Commission regulates the interstate aspects of the electric power and natural gas industries. Such regulation involves the issuance of licenses for the construction and operation of nonfederal hydroelectric power projects on government lands or on navigable waters of the United States, supervision of rates and other aspects of interstate wholesale transactions in electric power and natural gas, and issuance of certificates for gas sales to and from interstate pipelines and construction and operation of pipeline facilities.

The Commission's major functions include issuance and administration of permits and licenses for planning, construction, and operation of nonfederal hydroelectric power projects on waters or lands under federal jurisdiction. In reviewing applications for such licenses, the Commission applies criteria for the "structural safety and adequacy" of a hydroelectric facility. It is the view of agency officials that risk of natural disaster must be met by such structural considerations in the main, as site selection is determined generally on the basis of cost and function.

General Services Administration

The General Services Administration was established to manage federal properties, traffic and communications, and records, to construct and operate federal buildings, and to procure and distribute supplies. This agency also disposes of federal surplus property and manages the stockpiling of certain strategic materials.

Procedures prescribed for the planning and construction of federal buildings explicitly require that the hazards of flooding, high winds, and earthquakes be taken into account in both site selection and design and engineering.[8/] When the general area in which a building is to be constructed has been designated, a site selection team is sent out from the

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8/ Manual of Site Selection Procedures and the Handbook for Structural Engineering.

regional office, including at a minimum an engineer, a geologist, and a real estate man. (Some teams may include other specialists and representatives, to a total of a dozen or so.)

The prescribed procedure involves checking sources of information which would disclose histories of flooding, experienced wind velocities, and data on soil stability. These factors are reflected in the recommendations forwarded, in order of preference, by the site selection team.

When a final selection has been made, the design and engineering requirements are such as to recognize and meet such degree of hazard as it has been necessary to accept in the site selection process. Recognized structural standards are followed in such cases.

Department of Health, Education, and Welfare: Public Health Service, Bureau of State Services, Division of Water Supply and Pollution Control

Public Law 660, which the Division administers, provides federal grants-in-aid to the states for the purpose of preventing and controlling water pollution. In addition to grants for water pollution control projects, the Division develops cooperatively with other agencies comprehensive programs for the elimination or control of pollution in interstate waters. It also encourages cooperative activities among the states in pollution control, and supports a continuing program of research, training, and data publication involving causes and problems of the control of water pollution.

Federal legislation governing these programs recognizes the primary responsibility of the individual states. Thus, an agency official stated that, as a matter of policy in approving water pollution projects, the Division does not impose its judgment on design and engineering matters upon the states. While there are, therefore, no federal criteria dealing with the risk of natural disaster, adequate protection in the opinion of Division personnel, results from the fact that virtually all state laws require local units of government to utilize licensed professional architects and engineers, who may be expected to take cognizance of the risk factor.

Department of Health, Education, and Welfare: Public Health Service, Bureau of State Services, Division of Hospital and Medical Facilities

The Division has responsibility for administering what has come to be known as the Hill-Burton (the Hospital and Medical Facilities Survey and Construction Act of 1946).

The Hill-Burton program provides loans and grants to assist in constructing and equipping public and other types of nonprofit hospitals and other health facilities for which a need is established. This may include the alteration, major repair, or renovation of existing buildings.

Federal legislation governing this program likewise recognizes the primary responsibility of the individual states for hospital planning and development. Thus the policy position, as described by Division personnel, is the same as stated above.

Department of Health, Education, and Welfare: Office of Education, Division of Library Services

The Division administers the Library Services and Construction Act of 1956. This act provides federal grants to assist with the expense of salaries, books and other library materials, library equipment and other operating expenses. Grants are also available to assist with the construction of new public library buildings, the expansion or alteration of existing buildings for use as public libraries, and the initial equipping of such buildings. Architects' fees and land acquisition costs are included too.

Again, federal legislation recognizes the primary responsibility of the state in the development of library services. Thus the policy position, as described by Division personnel, is the same as stated above.

Department of Health, Education, and Welfare: Office of Education, Bureau of Educational Assistance Programs

Public Laws 815 and 874 are administered by the Bureau. This legislation provides federal grants to local educational agencies in federally impacted areas to assist with school construction, maintenance, and operating costs.

Agency representatives stated that where the facility is to be constructed on nonfederal property, site selection is the prerogative of the school authority; where the facility is to be constructed on federally-owned land, the choice of possible sites is usually so limited as to be an ineffective tool. Review of the construction plans, however, does include in all cases consideration of the risk of natural disaster, as pertinent engineering data must accompany the plans. Where indicated, protective design standards are required.

Housing and Home Finance Agency: Federal Housing Administration

The Federal Housing Administration administers a program of mortgage insurance designed to encourage the improvement of housing standards and conditions, to promote home ownership, and to provide a stabilizing influence on the mortgage market.

At the present time, the total program encompasses 11 different mortgage insurance programs. These involve: property improvement loans, home mortgages, rental housing trailer courts and parks, cooperative housing, low and moderate income housing for urban renewal and other areas, housing for the elderly, nursing homes, experimental housing, condominium ownership housing, and land development insurance.

There are established policies concerning the risk of natural disaster. One of the requirements for approval is that "the minimum finished grade at the house should be such that it will not be affected by storms equivalent to a 50-year frequency and first floor elevations should be such that they will be free of high water at all times."[9/] (The word "storms" is interpreted to include flooding from whatever natural cause.) Agency officials also stated that standards exist for the construction of residential units to withstand the effects of a hurricane or an earthquake.

Housing and Home Finance Agency: Urban Renewal Administration

The Urban Renewal Administration has administrative responsibility for a number of programs under the National Housing Act of 1949, three of which are discussed here.

9/ Underwriting Handbook--Home Mortgage, 1960, paragraph 70437.4.

First, the Urban Renewal Program provides federal loan and grant assistance to local governments for the elimination and prevention of slums and blight, whether residential or nonresidential, and the removal of those sources which create slums and blighting conditions. Grant assistance is available for the preparation of full-range renewal programs on a community-wide basis, and development of tentative schedules. Financial aid is also given for planning and carrying out urban renewal projects involving the rebuilding or conservation of blighted and deteriorating urban areas. This assistance is provided for specific projects and for planning general neighborhood areas to be renewed over a period of years. Finally, grant assistance may be given for comprehensive planning either in metropolitan or other urban areas or in smaller communities for which comprehensive planning aids are usually inadequate.

Federal aid requirements include a Workable Program for Community Improvement which ties individual urban renewal projects to an extensive and systematic attempt to eliminate blight and prevent its recurrence through: (1) codes and ordinances, (2) a comprehensive community plan, (3) neighborhood analyses, (4) administrative organization, (5) financing the program, (6) housing for displaced families, and (7) citizen participation. To meet the requirements, a project involving areas of high risk of natural disaster must contemplate uses of likely affected areas such as would minimize loss or damage.[10/]

The Urban Renewal Administration also administers the Urban Planning Assistance Program which makes federal grants available to supplement state and local funds for financing comprehensive urban planning activities.

The Open-Space Land Program is also administered by the Urban Renewal Administration. This program provides matching federal grants for the acquisition of title or, in some instances, permanent interests such as easements to open-space lands which will be developed for park, recreation, conservation, historic, or scenic purposes. Program policies, as set forth

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10/ Urban Renewal Manual, Sections 10 and 11, which set forth planning and engineering requirements.

in the Urban Renewal Manual and regional office directives, do not require specific consideration of the risks of natural disaster. Generally, reliance is placed on the state and local sponsoring agencies. Agency officials indicated that, while there is no systematic way of monitoring the coverage of such risks, a federal official reviewing a plan that was obviously deficient in this respect would be expected to raise objections.

Housing and Home Finance Agency: Community Facilities Administration

The Community Facilities Administration administers a number of programs including (1) advances for public works planning, (2) loans and grants for the construction of public facilities, (3) loans for college housing construction, and (4) loans for the construction of housing for the elderly and handicapped.

Agency personnel explained that there are no explicit policies designed to prevent the development of projects in areas of high risk of natural disaster. The only formal protection in these cases is such as may be found in state and local regulations and standards.

Housing and Home Finance Agency: Public Housing Administration

The Public Housing Administration's basic responsibility is to administer the federal program of assistance for construction and operation of low-rent public housing units. Both loans and grants are made available for these programs.

There are established policies governing site selection which require specifically that areas susceptible to natural disaster be avoided as possible sites.[11/] Policies stated in the Low Rent Housing Manual concerned with the design and construction of housing units are likewise explicit as to the precautionary measures necessary to protect against the effects of a natural disaster.

11/ Low Rent Housing Manual, Section 205.1, September 1963.

Post Office Department

The Post Office Department operates one of the largest nationwide networks of physical facilities. Local post offices are either federally owned or leased on varying terms up to a maximum of 30 years. Provisions governing construction of federal buildings are set forth in the summary of GSA activities and policies. An agency official explained that buildings constructed for lease to the post office must conform to department regulations for design and construction, which rely to a large extent upon local standards and regulations for protection against any unusual hazards or natural disaster damage.

Small Business Administration

The Small Business Administration was established to "aid, counsel, assist, and protect the interests of small business concerns." To further these objectives it provides (1) loans to assist in the relief of small businesses that have sustained substantial losses from a natural disaster; (2) loans to victims of natural disasters to repair homes, businesses, and other properties; and (3) loans to small business for construction, conversion, or expansion of facilities.

The Small Business Administration, as stated by one of its officials, does not have a written policy on review of site selection under the program of loans for construction, conversion, or expansion of small business facilities. However, some safeguard may be found in the fact that a local lending institution usually participates in this program, and to protect its investment, conducts a site selection review. Loan agreements require that local codes and standards be adhered to in construction work.

In its program of natural disaster loans, the Small Business Administration has no authority to refuse a loan solely on the ground that reconstruction is on the same site. While it attempts to convince disaster victims of the wisdom of rebuilding on safer sites, and offers additional loan funds as an inducement, the fact that it cannot base a denial on a refusal to do so undoubtedly results in some loans supporting construction in obviously unsafe areas.

Department of the Treasury

Within Treasury certain policies of the Internal Revenue Service are designed to reduce the economic impact of natural disasters on individuals. Businessmen and homeowners may use uninsured property losses as a deduction from income subject to the federal income tax. This has the effect of providing for federal sharing of disaster losses, thus dulling to at least a small degree the individual's incentive to avoid such losses where they are avoidable.

Veterans Administration

Among the programs administered by the Veterans Administration is one involving the construction and operation of veterans hospitals. While its regulations governing this program do not contain requirements that are explicitly related to the hazards of high-risk areas, agency officials point out that there is a general requirement that, at a minimum, designs shall conform to local codes and regulations governing special problems in the locality. There is evidence in the documentation of individual projects that such risks as those of earthquakes (e.g. the Los Angeles hospital) and hurricanes (e.g. the Puerto Rico hospital) are taken into account, and that pertinent design requirements are specifically referenced in local codes.

Another program involves the guaranty of loans made to veterans for the purchase of homes, farms, or businesses. Over 90 per cent of the loans guaranteed are for the purchase of homes.

An agency representative explained that a review is conducted of the site and building plans for those housing developments where it is anticipated that five or more homes will be purchased by veterans. The requirements which must be met are designed, among other things, to consider the risk of natural disaster. While the criteria to be met are stated in the VA Manual, M4A-8 less explicitly than in the Underwriting Handbook of the Federal Housing Administration, the engineering data that must be presented for review are considered sufficient to permit judgments on the adequacy of protection.

The American Red Cross

The American Red Cross serves as the nationwide agency through which voluntary assistance is extended to persons in need as a result of disasters.

While it is a private agency, it operates under a federal charter (Public Law 4, 1905, "An Act to Incorporate the American National Red Cross") and it plays such a prominent role in disaster relief that its policies and practices have relevance to the objectives of the present review.

Most of its relief activities occur after the initial impact of the disaster. Assistance is given on the basis of need--need being established through a casework process. Assistance for which funds may be expended are:

1. Food, clothing, and maintenance (loss of income, payment of expenses for injuries suffered, and similar items).
2. The rebuilding and repair of owner-occupied homes.
3. Purchase of household furnishings including furniture, kitchen equipment, etc.
4. Payment of medical, nursing, and hospital expenses.
5. The reoccupation, supplying and equipping of family-operated businesses such as family-owned grocery stores, family-owned painting or plumbing businesses, etc.

It is clear that, in a program of outright assistance grants for restoration of living quarters and family-operated businesses, the meeting of need on a casework basis runs the risk of perpetuating the hazard of recurrence by meeting the minimum needs of repair of damaged facilities where they are located.

Group II

Department of Agriculture: Soil Conservation Service

The Soil Conservation Service administers the Watershed Protection and Flood Prevention Act of 1954 (Public Law 566). Loans and grants are

made available to "legally qualified local organizations" for the planning and execution of projects designed to prevent "erosion, floodwater, and sediment damages in the watersheds of the rivers and streams of the United States," and to further "the conservation, development, utilization, and disposal of water" and thus to preserve and protect "the Nation's land and water resources."

In addition to flood prevention, a project may include measures for agricultural water management, public recreation development, public fish and wildlife development, development of municipal or industrial water supply, and improvement of water quality.

Federal funds may be expended for: (1) technical assistance for planning and applying land treatment measures on nonfederal land; (2) a part of the cost, not to exceed the rate provided under other agricultural programs, for certain land-treatment measures when specifically authorized by the SCS Administrator; (3) installation of land-treatment measures on federal land; (4) all construction allocated to flood preventing; (5) engineering and other services (including engineering services associated with the administration of contracts) allocated to flood prevention, agricultural water management, and public recreation or fish and wildlife development; (6) not more than 50 per cent of the construction allocated to agricultural water management and public recreation or fish and wildlife development; (7) not more than 50 per cent of the engineering and other installation services required for minimum basic facilities for public recreation or fish and wildlife development; (8) not more than 50 per cent of land rights required for public recreation or fish and wildlife development; and (9) administering contracts on federal land when awarded by a federal agency for works of improvement for flood prevention.

Loans may be made to the local organization to assist in meeting its share of project costs. The maximum loan which can be made to one project is $5 million for a 50-year period.

The Forest Service, Farmers Home Administration, Fish and Wildlife Service, and Bureau of Outdoor Recreation cooperate when appropriate

with the Soil Conservation Service in the planning and execution of watershed projects.

In recent years amendments to Public Law 566 have greatly expanded program objectives. Operating policy reflects these changes and emphasis is currently being placed upon the development of multi-purpose projects which benefit both rural and urban areas. Seventy per cent of all approved watershed projects are multi-purpose in scope.

Originally, program intent centered on the planning and construction of flood protection structures. Flood control remains one of the purposes which can be incorporated in a project. Generally flood control structures, which protect land used for agricultural purposes only, are designed to withstand a flood of 5- to 10- year frequency; while those structures which protect land developed for urban purposes are designed to withstand a flood of 100-year frequency.

Department of Commerce: Coast and Geodetic Survey

The Coast and Geodetic Survey develops charts and related information for the safety of marine and air commerce. It is also charged with the development of basic geodetic, geophysical, and oceanographic data of the United States. As part of this latter responsibility, it carries on a number of programs which are concerned with the occurrence of earthquakes in the United States.

One of these programs is designed to coordinate activities in collecting earthquake information with the special purpose "of correlating instrumental earthquake locations with noninstrumental reports received from epicentral areas." This is accomplished through interviews which are conducted by "collaborators in seismology"--usually professors of seismology or related disciplines who utilize forms developed for this purpose.

A publication program furnished information about earthquakes occurrence throughout the country on a weekly, monthly, quarterly, and annual basis. Another product of this program is a two-part publication entitled "Earthquake History of the United States" which presents basic

details of the more important earthquakes which have occurred in the country from earliest times.

The Coast and Geodetic Survey carries on a limited test program to determine the natural period of buildings in various parts of the country. (Natural period is the amount of sway a building experiences under various types of wind conditions.) The tests are often conducted jointly with other interested organizations or persons, and the results are usually published in engineering trade journals. At present, a cooperative program with the state of California is in progress to determine the relative amplitude (extreme fluctuating quality) of the different soil types.

The Coast and Geodetic Survey also operates a seismic sea wave warning system serving the Pacific area. Seismic sea waves (or tsunamis) are set in motion by underwater disturbances associated with earthquakes.

There is now underway an effort to develop a map which will delineate areas of the country most susceptible to extreme seismic activity. The work involves relating pertinent geologic data to seismological information which the Coast and Geodetic Survey accumulates as part of its basic responsibility.

Department of Commerce: Weather Bureau

As part of its responsibility for providing national meteorological services, the Bureau issues warnings and forecasts of floods, hurricanes, and other weather conditions that affect the safety, welfare, and economy of the country.

The Bureau is engaged in a multi-purpose research program concerning various aspects of the hurricane. Projects involved in this program, as described by Dunn and Miller in Atlantic Hurricanes, include:

1. The National Hurricane Research Project which is using specially-instrumented aircraft to investigate at first-hand the internal mechanisms of the hurricane and later its environmental problems.

2. The development of experimental prediction models for use with electronic computers in forecasting hurricane

3. Use of coastal radar to analyze hurricane structure and hurricane micromovements and to improve short-term forecasts.

4. Investigations of the nature and cause of coastal inundations resulting from hurricanes, and development of forecasting techniques.

5. Further studies of the role of planetary circulations in the development and recurvature of hurricanes.

6. Studies of the variation in the incidence of hurricanes along coastal areas and the relation of these variations to possible climatic changes.

7. Correlation of hurricane characteristics with excessive rainfall and development of improved quantitative rainfall forecasting.

8. Statistical studies of regional frequencies of hurricanes and of selected hurricane characteristics and correlation of these with the probabilities of occurrence in various regions.

Department of Defense: Office of the Chief of Engineers (Corps of Engineers)

The Chief of Engineers has responsibility for the construction, operation, and maintenance of works designed to improve rivers, harbors, and waterways for navigation, flood control, shore protection, and related purposes.

The Corps is directed by law to cooperate with the states and their political subdivisions in developing flood control projects. Before a project can qualify, the benefits attributable to it must exceed the cost of the project. Projects are recommended in survey reports, but cannot be constructed until specifically authorized by law.

Other purposes in addition to flood control may be included in a project. Finally, projects are to be planned "on a basis of comprehensive and coordinated development."

A project may involve the construction of a reservoir, levee, or channel improvements. The Federal Government assumes the entire cost of both reservoir and channel improvement projects.

The Flood Plain Information Studies program is also administered by the Corps of Engineers. Under this program, the Corps, at the request of a state or eligible local government agency, develops and disseminates information about the flood problem in the applicant's area. The information includes identification of areas subject to flooding and engineering advice for use in planning to combat the flood hazard. No state or local financial support is required.

Department of Interior: United States Geological Survey

The Survey has, among others, responsibility for (1) the conduct of topographic surveys and development of maps which set forth the physical features of the United States; (2) the conduct of geologic and mineral resources surveys and the development of maps showing the geologic characteristics of the country and the mineral, mineral fuel, and land resources of the country; and (3) the appraisal of water resources throughout the country.

In meeting these responsibilities the Survey conducts a nationwide program of flood-frequency studies. Reports produced present (1) the results of flood-frequency analysis which can be used in estimating magnitude and frequency of floods for most sites on streams in the area, and (2) an accumulation of flood data collected at gaging stations in the area. These studies are financed jointly by the states and the Survey. In addition, the Survey performs, upon request and at their expense, flood-frequency studies for local governments, metropolitan governmental units, and other jurisdictions below the state level.

As part of its continuing work in conducting geologic surveys of the country the Survey will, upon the request of an urban area and partially at the expense of such an area, conduct a detailed study of the area's geological character. Such a study could include review of the types of damage that would occur should the area be affected by an earthquake.

This year the Survey is starting a long-range research program in earthquake geology and geophysics. One part of this program concerns the

coastal communities of Alaska. Investigations are planned to assess under strong earthquake shock the stability of the ground materials on the land and of offshore materials. It is expected that the study will be completed in three to five years.

The second part of the program is a 10-year study of active faults--particularly the San Andreas Fault which passes through California and cuts through the 2 main population centers, Los Angeles and the San Francisco Bay areas. Investigations are planned to provide data needed to determine the earthquake hazards in different geologic environments and to provide fundamental geologic and geophysical data that will lead to an understanding of the cause of earthquakes and, hopefully, will lead to the development of methods of earthquake prediction.

Department of Interior: Bureau of Reclamation

The Bureau was established to construct and operate works designed for the development of water resources for the arid- and semi-arid lands of the western United States. In meeting this general responsibility, the Bureau plans and develops a variety of projects. Many of the projects planned may involve the construction of reservoirs, and a part of the storage space provided may be reserved for flood control storage. In such cases, the need for reservoirs and flood control storage is determined by the Corps of Engineers as part of their program of flood control surveys. The Corps also develops rules and regulations governing reservoir operations for flood control purposes.

Tennessee Valley Authority

This agency has responsibility for the development of the Tennessee River system for navigation purposes, alleviating those conditions which result from the frequent floods in the area, and the economic development of the area.

To achieve its flood-control objectives, the Tennessee Valley Authority has developed an extensive program which includes the construction of reservoirs, levees, etc., flood forecasting, and, most

recently, cooperative activities with area states and local communities where the greatest potential for prevention of damage appears to be in adjusting land use through community planning and development.

Appendix B

SOME MEASURES DESIGNED TO PREVENT OR REDUCE NATURAL DISASTER DAMAGE

SOME MEASURES DESIGNED TO PREVENT OR REDUCE NATURAL DISASTER DAMAGE

	Flood	Hurricane	Earthquake
Measures to prevent the hazard	Dam and reservoir Levee and floodwall Channel improvement and maintenance Land treatment measures[a/]	Research Cloud seeding Reordering of internal forces	Research
Measures to lessen the destructive force of the hazard	Dam and reservoir Levee and floodwall Channel improvement and maintenance Land treatment measures[a/]	Dam, bulkhead, jetty Seawall, breakwater Revetment, dike, drainage canal Land treatment measures[b/]	Research
Measures to reduce the destructive effects of the hazard	Dam and reservoir Levee and floodwall Channel improvement and maintenance Land treatment measures[a/] Channel encroachment statute Comprehensive land use planning, urban and rural Zoning ordinances Subdivision regulations Public information Building and related codes Warning signs Flood proofing Structural changes Open space development Redevelopment Tax adjustments Insurance Financing of construction (controls) Forecasting Warning systems Evacuation Relocation	Dam, bulkhead, jetty Seawall, breakwater Revetment, dike, drainage canal Land treatment measures[b/] Comprehensive land use planning, urban and rural Zoning ordinances Subdivision regulations Public information Building and related codes Fresh water reservoirs Open space development Redevelopment Insurance Financing of construction (controls) Forecasting Warning systems Evacuation Relocation	Comprehensive land use planning, urban and rural Zoning ordinances Subdivision regulations Public information Building and related codes Soil investigations and other geologic studies Open space development Redevelopment Insurance Financing of construction (controls) Tsunami forecasting Tsunami warning systems Evacuation Relocation

[a/] Reforestation, erosion control, vegetation development, strip cropping, etc.

[b/] Beach erosion control, sand dune building and stabilization, reforestation, etc.