

U S Task Force on Federal Flood
Control Policy.

A UNIFIED NATIONAL PROGRAM
FOR MANAGING FLOOD LOSSES

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AUG 2 1966

COMMUNICATION

FROM

THE PRESIDENT OF THE UNITED STATES

TRANSMITTING

A REPORT BY THE TASK FORCE ON FEDERAL FLOOD
CONTROL POLICY



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AUGUST 10, 1966.—Referred to the Committee on Public Works, and
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LETTER OF TRANSMITTAL

THE WHITE HOUSE,
Washington, August 10, 1966.

HON. JOHN W. McCORMACK,
Speaker of the House of Representatives,
Washington, D.C.

DEAR MR. SPEAKER: On many occasions, I have expressed my concern for the need to manage wisely America's water resources. For all our people, this country's inland streams and coastal waters are a source of well-being, both material and spiritual.

But they are also the source of great personal hardship. Despite our flood control achievements in the past 20 years, which have averted an untold number of disasters, our river system and coastal waters are still dangerous friends. They still cost us, every year, more than a billion dollars of our wealth.

It need not continue this way.

For three decades we have been engaged in a continuous effort to control flood losses. Over \$7 billion has been invested since 1936 by the Federal Government in flood control projects. Each year these projects save lives and prevent hundreds of millions of dollars in property damage throughout the country. Clearly we must and will continue to support these established programs.

But a Great Society cannot rest on the achievements of the past. It must constantly strive to develop new means to meet the needs of the people.

To hold the Nation's toll of flood losses in check and to promote wise use of its valley lands requires new and imaginative action.

Nature will always extract some price for use of her flood plains. However, this Nation's annual flood damage bill of more than \$1 billion per year is excessive, even in a growing economy. Beyond the dollar loss the accompanying toll in personal hardship cannot be calculated. In addition, opportunities are being lost to use flood plain lands effectively for recreation and wildlife purposes.

I believe that we can and must reduce these losses. At the administration's request, a special task force has submitted a report drawing upon the combined experience and judgment of the Corps of Engineers, Department of Agriculture, Department of the Interior, Tennessee Valley Authority, State and local agencies, and outside experts for providing guidance in dealing with flood losses by a wide variety of means.

The Federal interest in this matter is beyond doubt. The Federal effort to cope with the problem will be unsparring. But I cannot overemphasize that very great responsibility for success of the program rests upon State and local governments, and upon individual property owners in hazard areas. The key to resolving the problem lies, above all else, in the intelligent planning for and State and local regulation of use of lands exposed to flood hazard.

The task force report lays stress on actions which can and should be immediately undertaken—

To improve basic knowledge about the flood hazard;

To coordinate and better plan for new developments on the flood plain;

To initiate a program of technical information and services to managers of flood plain property;

To move ahead with studies aimed at a practical national program for flood insurance;

To adjust, through executive action and legislation, Federal flood control policy to sound criteria and changing needs.

I commend the consultants' report to the attention of the Congress and to the public at large. I strongly support its basic approach to the problem of curbing flood damage waste. Some of its recommendations can be carried out immediately. Others will require further study.

As a first and immediate step to carry out the recommendation of the task force report, I am today issuing an Executive order directing Federal agencies to consider flood hazard in locating new Federal installations and in disposing of Federal land.

A great deal can be accomplished within the scope of existing authorities. I am asking, through the Director of the Bureau of the Budget, that agencies of the executive branch begin immediately taking additional action and conducting studies in accord with the task force recommendations.

Some of the task force proposals would require legislation. I am requesting the appropriate Federal agencies to study these proposals and make recommendations to me for later submission to the Congress.

There is a role for each level of government in a successful flood damage abatement program. There is likewise a responsibility on all participants, from the individual citizen through many elements of Federal establishment, to contribute to the program's success. Let us begin today a renewed and cooperative effort to attack this problem.

Sincerely;

LYNDON B. JOHNSON.

A UNIFIED NATIONAL PROGRAM FOR
MANAGING FLOOD LOSSES
AUGUST 1966

(A Report by the Task Force on Federal Flood Control Policy, by James E. Goddard, Irving Hand, Richard A. Hertzler, John V. Krutilla, Walter B. Langbein, Morton J. Schussheim (Dave Lowery, alternate), Harry A. Steele (Gary Taylor, alternate), Gilbert F. White, Chairman, John R. Hadd, Secretary)

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I. SUMMARY OF FINDINGS AND RECOMMENDATIONS

The Nation needs a broader and more unified national program for managing flood losses. Flood protection has been immensely helpful in many parts of the country—and must be continued. Beyond this, additional tools and integrated policies are required to promote sound and economic development of the flood plains.

Despite substantial efforts, flood losses are mounting and uneconomic uses of the Nation's flood plains are inadvertently encouraged. The country is faced with a continuing sequence of losses, protection, and more losses. While flood protection of existing property should receive public support, supplemental measures should assure that future developments in the flood plains yield benefits in excess of their costs to the Nation. This would require a new set of initiatives by established Federal agencies with the aid of State agencies to stimulate and support sound planning at the local government and citizen level.

Statutory Federal policy dealing with cost sharing, land acquisition, and loan authority would need to be modified, but most of the measures would be taken by the Corps of Engineers, the Department of Agriculture, the Department of Housing and Urban Development, the Geological Survey, and the Environmental Science Services Administration under existing authority. Modest additional expenditures over the next 10 years and reorientation of Government effort would greatly reduce flood losses and demands for Federal relief.

The specific actions recommended by the task force may be summarized as follows:

To improve basic knowledge about flood hazard

1. A three-stage program of delimiting hazards should be initiated by the Corps of Engineers, the Geological Survey, and other competent agencies (pp. 31–32, 37–39).

2. A uniform technique of determining flood frequency should be developed by a panel of the Water Resources Council (pp. 32–33, 39–40).

3. A new national program for collecting more useful flood damage data should be launched by the interested agencies, including a continuing record and special appraisals in census years (pp. 33–36, 40–41).

4. Research on flood plain occupancy and urban hydrology should be sponsored by the Department of Housing and Urban Development, the Department of Agriculture, and the Geological Survey (pp. 41–44).

To coordinate and plan new developments on the flood plain

5. The Federal Water Resources Council should specify criteria for using flood information and should encourage State agencies to deal with coordination of flood plain planning, and with flood plain regulation (pp. 46–48).

6. Under the following Federal programs steps should be taken to assure that State and local planning takes proper and consistent account of flood hazard:

Federal mortgage insurance (pp. 48-49).

Comprehensive local planning assistance (pp. 49-51).

Urban transport planning (pp. 51-52).

Recreational open space and development planning (pp. 52-53).

Urban open space acquisition (pp. 53-54).

Urban renewal (p. 54).

Sewer and water facilities (pp. 54-55).

(Many of the necessary coordinating actions were accomplished during final preparation of this report.)

7. Action should be taken by the Office of Emergency Planning, the Small Business Administration, and the Treasury Department and other agencies to support consideration of relocation and flood-proofing as alternatives to repetitive reconstruction (pp. 55-58).

8. An Executive order should be issued directing Federal agencies to consider flood hazard in locating new Federal installations and in disposing of Federal land (pp. 58-59).

To provide technical services to managers of flood plain property

9. Programs to collect, prepare, and disseminate information and to provide limited assistance and advice on alternate methods of reducing flood losses, including flood plain regulation and floodproofing, should be undertaken by the Corps of Engineers in close coordination with the Department of House and Urban Development, and the Department of Agriculture (pp. 60-67).

10. An improved national system for flood forecasting should be developed by the Environmental Science Services Administration as part of a disaster warning service (pp. 67-70).

To move toward a practical national program for flood insurance

11. A five-stage study of the feasibility of insurance under various conditions should be carried forward by the Department of Housing and Urban Development (pp. 71-74).

To adjust Federal flood control policy to sound criteria and changing needs

12. Survey authorization procedure and instructions should be broadened in concept (pp. 75-77).

13. Cost-sharing requirements for federally assisted projects should be modified to provide more suitable contributions by State and local groups (pp. 77-81).

14. Flood project benefits should be reported in the future so as to distinguish protection of existing improvements from development of new property (pp. 81-83).

15. Authority should be given by the Congress to include land acquisition as a part of flood control plans (pp. 83-84).

16. Loan authority for local contributions to flood control projects should be broadened by the Congress (pp. 85).

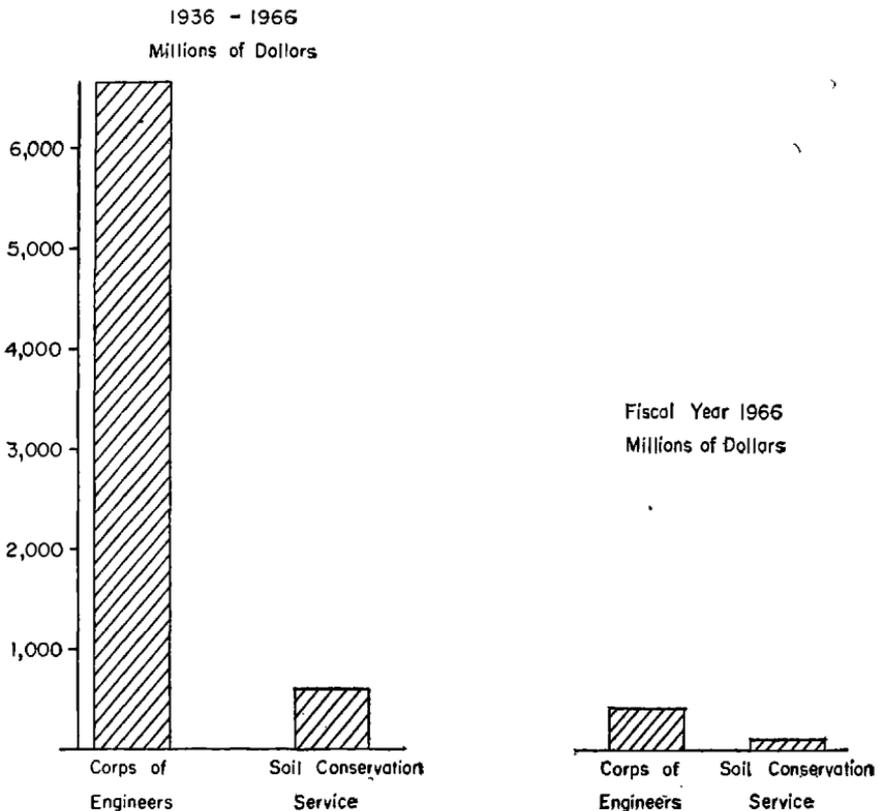
II. WHAT IS HAPPENING ON THE NATION'S FLOOD PLAINS

Lands subject to floods are the setting for much urban growth in the United States and for a substantial part of the Nation's agricultural production. When floods strike developed coastlines and

stream valleys, the life of cities is disrupted, their productive capacity is impaired, strategic transportation lines are cut, property and crops are destroyed, and soils are eroded. Some of these vulnerable lands now receive a degree of protection from federally constructed engineering works. Larger areas remain unprotected.

Federal investment in flood protection and prevention through the Corps of Engineers and the Soil Conservation Service has amounted to more than \$7 billion since a national flood control policy was adopted in 1936. The current rate for such expenditures is approximately \$500 million per year and is increasing (see fig. 1). Despite this massive investment estimated annual losses from floods have shown an upward trend since 1936 (see fig. 2). Data on national flood losses are rough at best and probably underestimate the real losses, but there is no doubt that the mean annual toll has been increasing. The current estimate of annual loss, downstream and upstream, exceeds \$1 billion.

EXPENDITURES BY THE CORPS OF ENGINEERS AND
SOIL CONSERVATION SERVICE FOR FLOOD CONTROL *



* Includes flood prevention and watershed protection by S.C.S.

FIGURE 1

UNITED STATES ESTIMATED ANNUAL FLOOD LOSSES 1903-1958

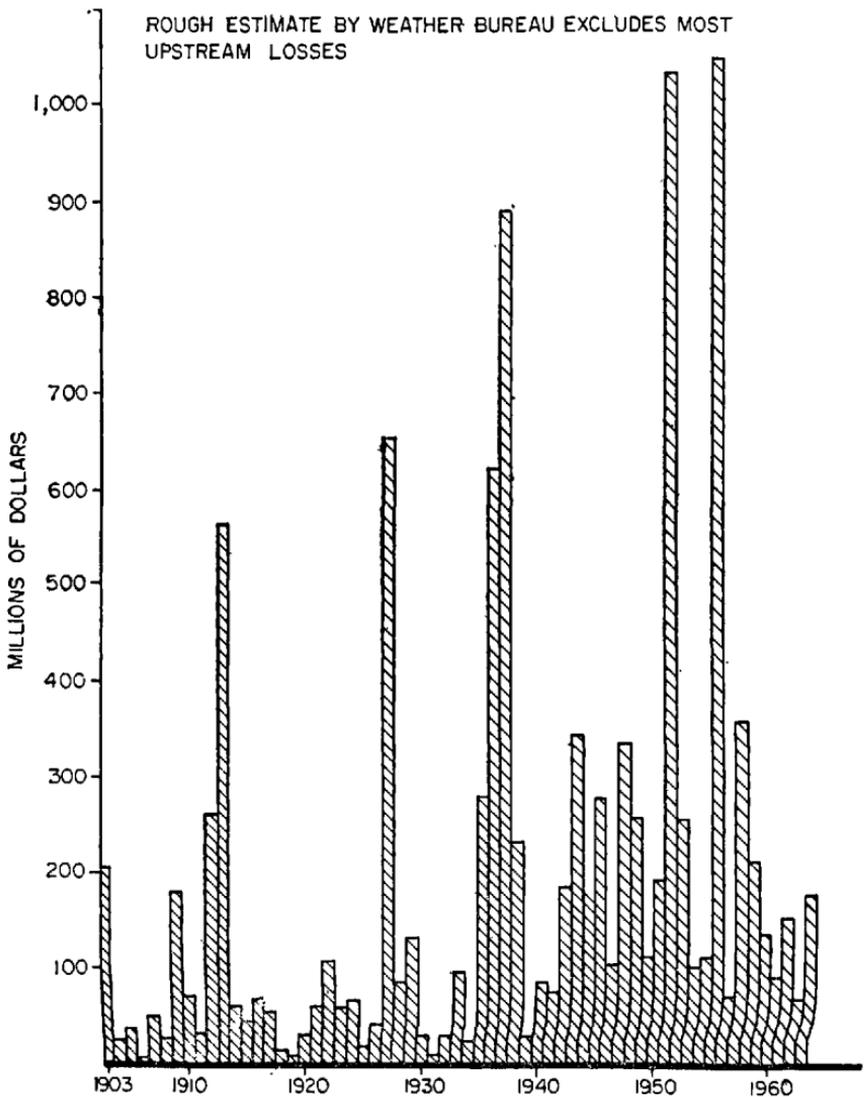
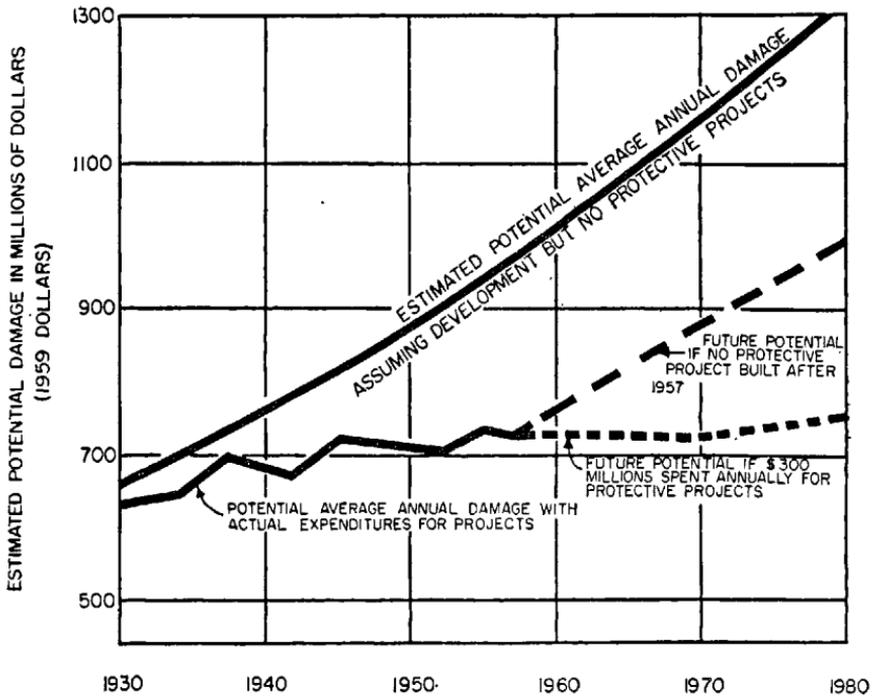


FIGURE 2

Flood projects have prevented very large amounts of damage and losses. However, national and regional studies of downstream property subject to flood point to increasing damage potential under existing policies, even with continuing investment in protection structures (see fig. 3). If flood plain lands are to be efficiently developed in the future and the chance of catastrophe limited, it will be necessary to carry out a revised, unified program to which the Federal Government must give leadership on a national scale.

ESTIMATED GROWTH OF POTENTIAL AVERAGE FLOOD DAMAGE



POTENTIAL DAMAGE - AVERAGE ANNUAL DAMAGE THAT WOULD OCCUR DURING PERIOD OF NORMAL FLOOD EXPERIENCE WITH NO CHANGE IN FLOOD PLAIN USE (NOT ACTUAL DAMAGE IN YEAR INDICATED)

FIGURE 3

Present programs offer little hope either of avoiding waste or of preventing occasional catastrophes. The following major factors characterize the present situation and support the conclusion that more of the same will not alone succeed.

Where protection is provided by levees, channel improvements, reservoirs, or other engineering works, flood losses clearly are prevented from floods not exceeding the project design flood. All types of projects reduce the frequency of damaging overbank flow; without this degree of protection damages would be much larger. This was the situation anticipated when the Flood Control Act of 1936 was passed (see fig. 4). However, the projects do not prevent damage from great and infrequent floods that exceed the design flood.

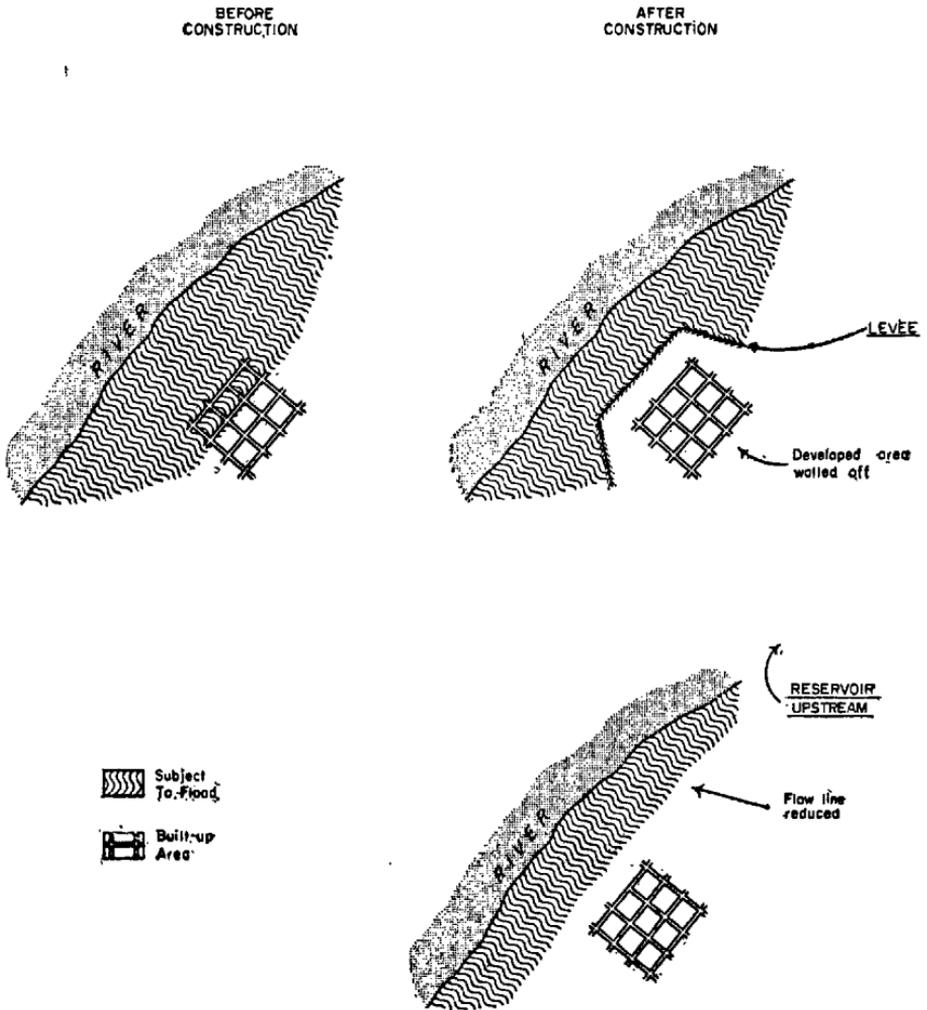
EFFECT OF CONVENTIONAL FLOOD CONTROL PROJECTS

FIGURE 4

Flood protection or, more properly, minimizing flood damage, occurs in a dynamic setting. The more significant changes are in urban areas or in the urbanization of rural areas. It is misleading to think that an area is ever completely protected. Nor is it true that the damage potential and the benefits from protection remain unchanged. The flood control construction agencies have had little control over events which have caused flood damage potential and losses to continue to mount. Typical situations include the following:

(a) New construction occurred within areas which had not been protected because of lack of feasibility or of local cooperation (see fig. 5). Many small towns, suburban areas, and seashore resorts are in this class.

(b) Flood-prone lands adjoining protected areas were built up (see fig. 6). A typical example is the unprotected South Platte flood near Denver, which has occupied more intensely following protection of the adjacent Cherry Creek area.

CHANGES IN UNPROTECTED AREAS

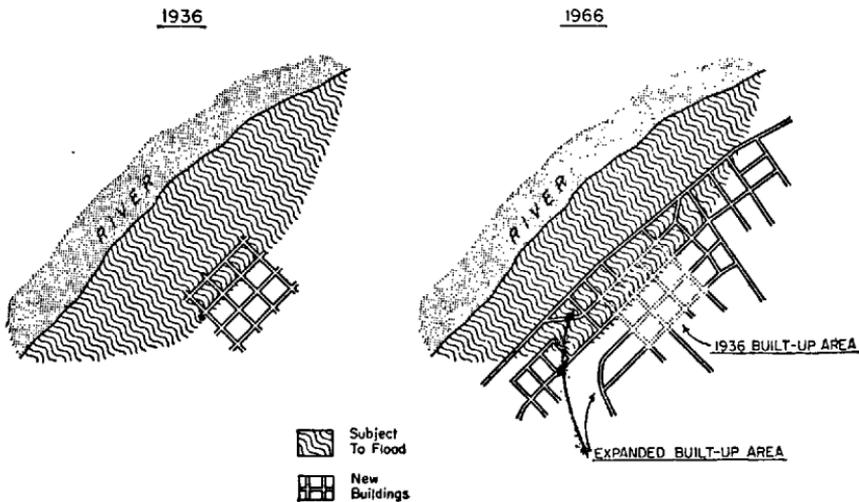


FIGURE 5

CHANGES IN AREAS ADJOINING PROTECTION PROJECTS

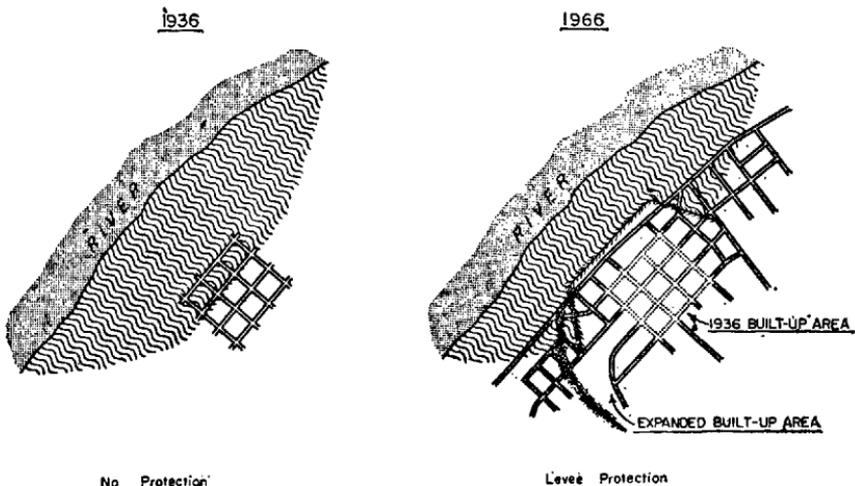


FIGURE 6

(c) Similarly, along rivers where some portion of the flood plain has been provided protection by reservoirs, adjacent but vulnerable lower lying lands have been developed (see fig. 7). For example, although partial protection was given Chattanooga by building reservoirs upstream, the city pushed farther down into the flood plain beyond the projects' protective reach. Consequently, a relatively low level flood could now inflict serious damage in the newly developed flood plain area.

CHANGES IN VALLEYS HAVING RESERVOIR PROTECTION

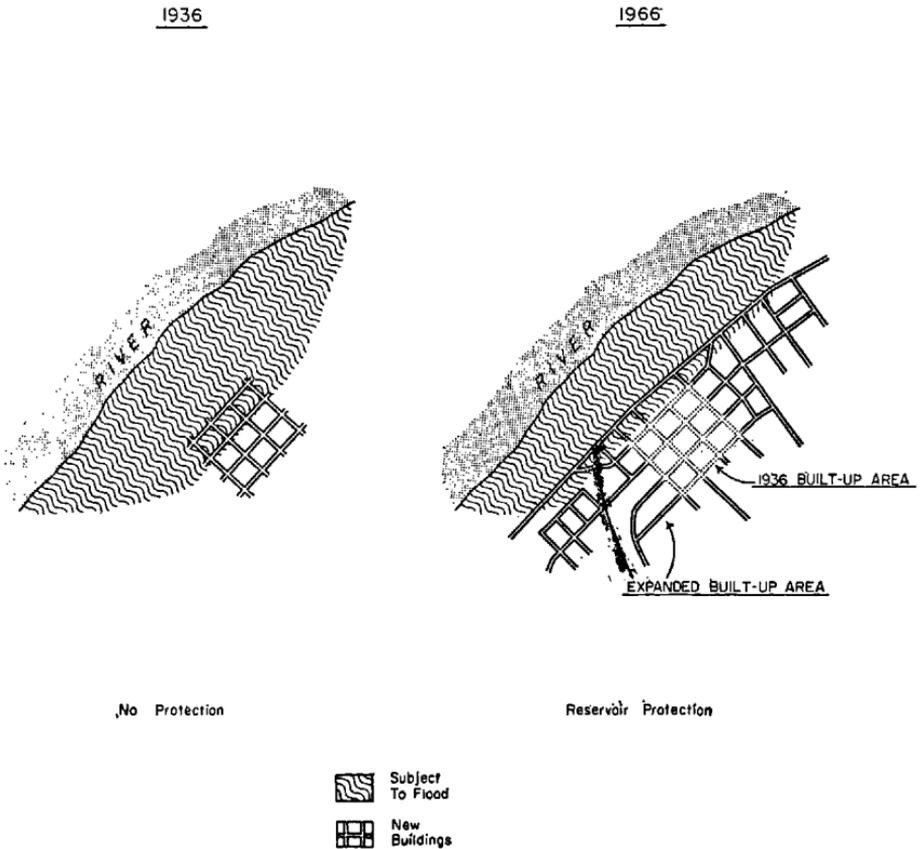


FIGURE 7

(d) Lands which were protected according to efficient physical and economic criteria, were visited by catastrophic floods exceeding the design flood (see fig. 8). As an unfortunate illustration, Kansas City, with an unwarranted degree of confidence, suffered the heaviest loss in the Nation's history when its old levees were overtopped in 1951.

CATASTROPHIC FLOODING OF PROTECTED AREAS

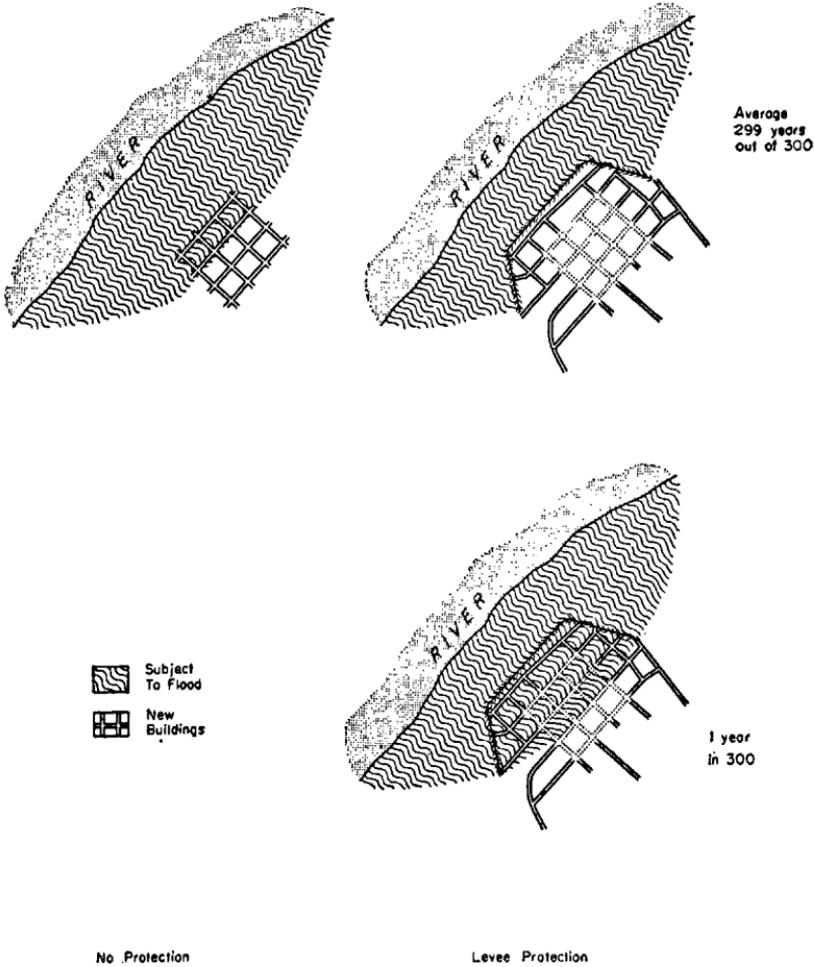


FIGURE 8

The major purpose of engineering projects is changing from the protection of established property to the underwriting of new development. Increasingly, Federal funds are used to support projects justified on the basis of protection of lands for future use. This is illustrated by the contrast in the benefit base between Corps of Engineers projects authorized in the Flood Control Act of 1941 and the Flood Control Act of 1965 (see fig. 9). A similar trend is found in approval Soil Conservation Service flood prevention and watershed protection projects (see fig. 10).

COMPARISON OF ESTIMATED BENEFITS FROM REPRESENTATIVE CORPS OF ENGINEERS PROJECTS AUTHORIZED IN 1941 AND 1965

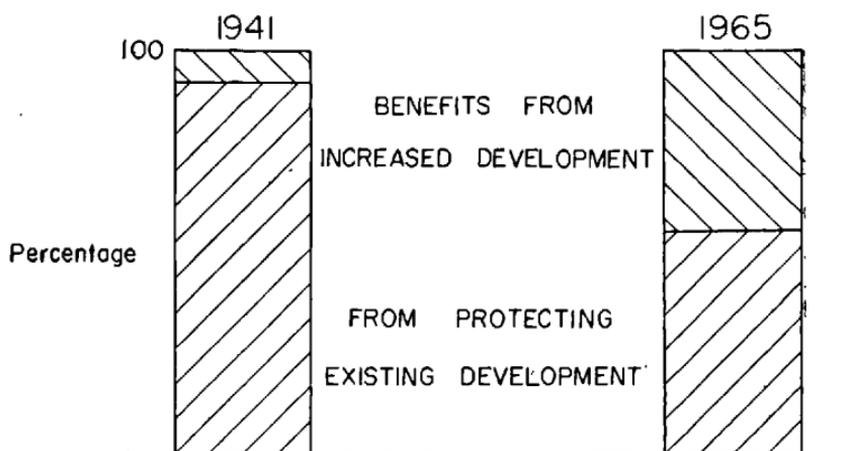


FIGURE 9

COMPARISON OF ESTIMATED BENEFITS FROM WATERSHED PROTECTION PROJECTS AUTHORIZED IN 1962 AND 1965

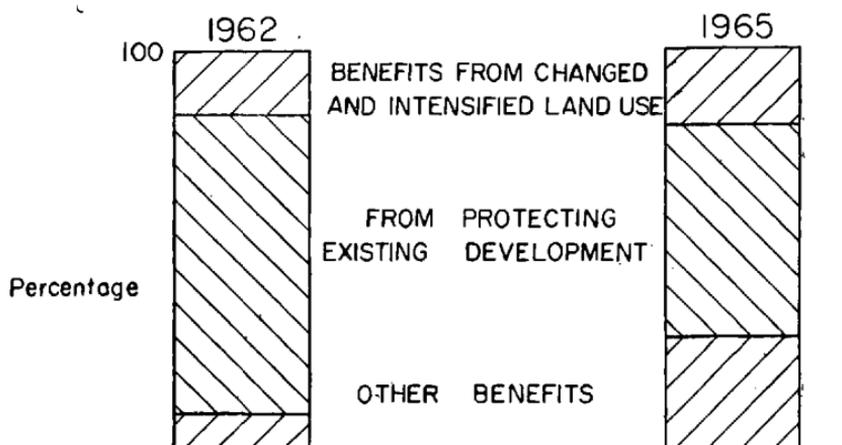


FIGURE 10

Reservoirs of more than 12,500 acre-feet capacity, and occasionally Corps of Engineers units of smaller size, are built entirely at Federal expense. Levees, floodwalls, and channel improvement projects require only local contributions of lands, damages, rights-of-way, and maintenance. Flood control structures in Soil Conservation Service flood protection and watershed protection projects have similar requirements. Hurricane protection works built by the Corps of Engi-

neers require a fixed local contribution of 30 percent of total costs, though the local contribution varies on similar Soil Conservation Service projects.

Studies of flood plain use show that some flood plain encroachment is undertaken in ignorance of the hazard, that some occurs in anticipation of further Federal protection, and that some takes place because it is profitable for private owners even though it imposes heavy burdens on society. Even if full information on flood hazard were available to all owners of flood plain property (a service now conspicuously lacking) there still would be conscious decisions to build in areas where protection has not been feasible, for the private owner may not perceive the hazard in the same way as the hydrologist and he does not expect to bear all the costs of his use of hazardous property. Moreover, the chief encouragement he now receives under Federal programs is the prospect for relief or future Federal protection. Technical assistance in developing alternative ways of dealing with flood losses, as by floodproofing, is not provided. Consequently such means receive little attention. Similarly, alternative uses for flood plains are not thoroughly canvassed. Insurance against flood losses is not generally available. The Tennessee Valley Authority has encouraged flood plain regulation generally and floodproofing in several towns as a partial substitute for more costly protection. The Corps of Engineers has initiated flood information studies in which alternative adjustments to floods are mentioned. However, the alternatives apparent to the general public remain either building new protection works or suffering larger losses.

The Federal Government is also assuming larger obligations to remedy flood losses and to coordinate emergency efforts during floods. When a flood strikes, the Federal agencies in cooperation with National, State, and local groups move quickly to supplement volunteer efforts through provisions for emergency relief and to offer aid for repairs and rehabilitation. The number of Federal agencies involved has expanded and central coordination has been provided by the Office of Emergency Planning (see fig. 11). While complete financial data are lacking, the extent of Federal involvement is illustrated by a sampling of figures for fiscal year 1965. They show the Office of Emergency Planning having allocation requirements of \$116 million for participant Federal and State agencies. Additionally, the Corps of Engineers committed \$14 million to emergency preparations, flood fighting and restoration of projects; the Bureau of Public Roads invested a record \$76 million in flood repairs; the Small Business Administration loaned \$6 million for flood rehabilitation purposes.

In recent years, the Federal Government has enlarged its support of activities of private citizens and local governments in using both protected and unprotected parts of flood plains. However, investigation of flood projects and related planning for flood plain use do not adequately recognize the expanded and varied interests. When the Flood Control Act of 1936 was passed, flood projects were seen chiefly in terms of whether or not to build protection, with little regard for other land use plans. Today, local planning of urban development, highway transport facilities, and open space receive strong Federal encouragement. Preservation of natural beauty is an explicit aim. Financial support is provided to city planning, urban renewal, highway construction, open space acquisition, and construction of sewer, water, and waste-disposal facilities.

These changes have had two important results. First, Federal agencies other than those with traditional flood control responsibilities have a more intensive interest in decisions that are made to guide use of land in flood plains. Second, citizen groups such as those concerned with urban renewal and preservation of open space may voice their preferences for alternative flood plain uses through emerging public programs for land development and acquisition.

Conclusions

In summary, the Nation's citizens and policymakers have not recognized the inherent limits of established statutes and prevailing policy to curtail excessive flood damages. Large numbers of soundly conceived, economically justified flood projects have been built. As a result, vast flood damages have been prevented. However, vital actions needed to complement the structural protection effort have been absent. In consequence, the Nation faces continuation of a dismal cycle of losses, partial protection, further induced (though submarginal) development, and more unnecessary losses. Action should and can be taken to change this situation, based on the best use of our knowledge of hydrology and economics. The time for change is auspicious because of the growth in number of agencies which can assist.

FIGURE 11

PRINCIPAL FEDERAL AGENCIES PARTICIPATING IN FLOOD RELIEF AND RECONSTRUCTION

Coordination

OFFICE OF EMERGENCY PLANNING

Warning service:

Weather Bureau.
Coast and Geodetic Survey.

Flood fighting: Corps of Engineers.

Emergency loans:

Farmers Home Administration.
Small Business Administration.

Income tax deductions: Internal Revenue Service.

Rescue and direct relief:

Army,
Navy,
Coast Guard,
Public Health Service,
Food and Drug Administration,
Consumer Marketing Service,
Agricultural Stabilization and Conservation Service,
American Red Cross.¹

Grants or assistance in rebuilding public works.

Office of Emergency Planning.
Corps of Engineers.
Bureau of Public Roads.
Community Facilities Administration.

¹ Under national charter.

III. PRINCIPLES BEARING ON THE PROBLEM OF FLOOD DAMAGES

A large percentage of the Nation's population and tangible property is concentrated in flood prone areas. These areas are comprised of flood plain land and thin coastal strips, and total at least 5 percent of the Nation's territory. Public policy should seek to foster efficient use of the bottom lands for the common good but it will fail in this so long as it is out of harmony with certain principles. These princi-

ples relate to the unalterable characteristics of geographical location and hydrologic events, conditions of economic efficiency, and the recognition of individual, as well as social, responsibility in managing flood plains. The salient points are outlined as background for suggested changes in policy and program.

Physical

A streambed and the flood plain lands immediately adjacent to it are integral parts of every natural watercourse. The flood plain is formed from sediment deposits or removal accompanying the natural, intermittent overflow of the stream above its ordinary bed.

Overbank flows are not abnormal. The flood plain acts as a natural reservoir and temporary channel for the excess water. In the economy of nature, the channel efficiently conveys the day-to-day flow and calls upon its flood plain only when needed.

Coastal lands such as bars, ridges, and deltas that are formed by the coastal current occupy a position relative to the sea that flood plains do to rivers.

Typically, a river uses some portion of its flood plain about once in 2 to 3 years. At average intervals of, say, 25, 50, or 100 years, the river may inundate its entire flood plain to a considerable depth.

Although records of floods permit estimation of frequency of flooding, it is not possible to forecast the year a flood will occur on any given watercourse.

Flood records suggest that the frequency of natural overbank flows in the United States has not changed significantly in the years since flood losses became so large as to justify a Federal effort to control them.

Flood hazard lands are not restricted to broad alluvial plains. Passive, usually dry, streambeds in arid regions become, on cloudburst occasions, conveyors of flows capable of inflicting major flood damages.

Manmade development may so encroach upon a natural watercourse as to retard its capacity to pass flood flows. Silt deposits in the stream channel may have a similar effect. Flood heights are raised, velocities are increased, and additional areas are subjected to damage. Unless encroachment lines are enforced by public agencies or such encroachments are made clearly uneconomical to the individual developer, these constrictions will continue.

The configuration of a flood plain has a bearing on the economic and engineering feasibility of flood protection works. The layout of many areas render it impossible to provide adequate flood protection through physical works such as dams, levees, channel improvements, and upstream land-treatment measures.

Even a perfectly designed engineering project on streambank or coast may be subject to damage from a flood exceeding the expected maximum.

For these reasons, so long as flood plains are occupied, the Nation will be faced with problems of flood damages.

Economic

Use of flood plains involving periodic damage from floods is not, in itself, a sign of unwarranted or inefficient development. It may well be that the advantages of flood plain location outweigh the intermittent cost of damage from floods. Further, there are some kinds of activity which can only be conducted near a watercourse.

Principles of national economic efficiency require, however, that the benefits of flood plain occupation exceed all associated costs, not merely those borne by the individual or enterprise which so locates. Total associated, or full social, costs include—

Immediate expenses of development,

Damages to be endured by the occupant or the expense of protective measures undertaken to reduce the frequency and extent of flood damage,

Damages forced on others as a result of encroachment, and public costs involved in disaster relief and rehabilitation.

Flood plain occupation in which benefits do not exceed the estimated total costs, or which yields lower returns than other uses such as recreation and wildlife conservation, is undesirable, because it causes an eventual net loss to society. Any public policy which encourages submarginal development adds to those losses.

The 1936 Flood Control Act and current executive branch standards, published as Senate Document 97 of the 87th Congress, recognized the need for considering projects in terms of their economic feasibility. The act required that flood project benefits exceed costs. It also set forth the purpose of protecting the lives and security of people adversely affected. In the interest of economic efficiency, flood projects are normally designed so as to provide the greatest excess of protection benefits over protection costs. It is not uncommon, however, for the construction agencies to propose exceptions to this standard; "oversized" projects are justified as being necessary to protect the lives and social security of people and to avert future catastrophe. While the merits of that concern are beyond question and deserve continuing consideration, the shortcomings of the practice must be recognized. First, construction of larger projects—larger than warranted by a measure of maximum potential net benefits—is inevitably less efficient. Second, no project, regardless of physical size, can offer full security against the most unusual occurrence. No protective works can be designed which will not permit some damages, perhaps of catastrophic proportions, to occur when a flood far exceeds the expected, or design maximum.

Individual and social responsibility

Flood damages are a direct consequence of flood plain investment actions, both private and public. Floods are an act of God; flood damages result from the acts of men. Those who occupy the flood plain should be responsible for the results of their actions.

The Federal Government clearly is responsible for Federal establishments that invade the flood plain. The authority and responsibility for guiding and controlling other land use lies exclusively with non-Federal entities. To the degree that State and local governments sanction unfettered flood plain development, including new construction of Public facilities, they share responsibility for excessive flood damages. In this regard, Federal activity unintentionally nurtures apathy with respect to the most economic solutions for avoiding or abating flood damages. It cannot be overemphasized that the mere supply of information as to where the water has reached and when, does not necessarily lead decisionmakers to avoid the flood threat. In the absence of clear and present danger, the typical citizen is not easily persuaded to protect himself from the flood hazard.

In its concern for the general welfare, the Federal Government has a proper interest in measures to hold flood damages to an economic minimum. It has a responsibility to discourage flood plain development which would impose a later burden on the Federal taxpayer, which would benefit some only at the expense of others, and which would victimize unsuspecting citizens. It does not follow, however, that the Federal Government should be held solely responsible for success of a program to make wise use of flood plains.

Attempts to resolve the problem of rising flood losses within the framework of the Nation's traditional value system should focus on promoting sound investment decisions by individuals, local governments, and States. They should concentrate on bringing the moral, legal, and fiscal responsibilities of all parties involved into effective alignment.

To coordinate the use and development of the flood plain while furthering meaningful flood damage prevention requires effective participation of the Federal, State, and local governments in programs directed to these concerns. Each level of government must see its respective responsibilities as part of a total effort. Continuing community planning now is recognized as an imperative for rational land use and development. Flood plain planning and appropriate consideration of water resources should be regarded as an integral part of that process and reflected in the resulting community action.

Policies now governing the national flood control program fail to achieve the necessary integration and equitable apportionment of responsibilities. Principal shortcomings are—

(a) There is inadequate recognition of the nature of the flood threat and the limitations of engineering works;

(b) A river control approach is championed to the virtual exclusion of other applicable means such as flood proofing and land regulation which must be applied in the main by non-Federal interests in conformity with community plans, and which should be practiced whether or not protection is available, but particularly when it is not feasible; and

(c) Individual beneficiaries from engineering protection works do not, in many instances, bear an adequate share of the costs. This latter factor, combined with the bias in favor of river control alternatives, has relieved many individual flood plain occupants of responsibility, in a fiscal sense, for the consequences of their actions. Under existing policies flood plain property owners in unprotected areas may bear only a portion of the cost, their price being exacted when damage occurs. Some shoulder the full losses; others rely on public relief and assistance in rehabilitation. No matter how serious their encroachment on the watercourse, the occupants bear few of the costs resulting from encroachment. They bear a minor fraction, through payment of general taxes, of the public cost of relief and rehabilitation. The general public, by bearing all or a major part of the cost of flood protection works and lessening the individuals' damage costs, further subsidizes their use of the flood plain. Principles of economic efficiency and social equity thereby are violated.

Means for preventing further excessive flood losses

Public policy should distinguish between the problem of minimizing damage to existing flood plain developments and the problem of achieving optimum future use of flood plains. The first problem

centers on protecting an investment already made. The second is concerned with choosing the best investment alternative from the myraid possibilities available.

Current Federal flood control policy is partially effective in protecting existing development and preventing damage thereto. Unfortunately existing policy creates incentives for submarginal future flood plain development. There are a number of ways by which Federal policies could be changed to discourage needless occupation of hazard areas.

It is well to recognize at the outset the collective nature of the benefits from flood control measures. Most forms of flood protection, like national defense, can be provided for one citizen only by providing them for all. For this reason, free market institutions alone cannot provide an appropriate incentive structure to cope effectively with flood problems. Collective action, through appropriate public policies, is required.

In principle, an effective approach would employ public policy to alter the price signals received by potential flood plain developers. Following is a brief description of the application and potential effect of such a concept.

The full costs of flood plain occupancy would be shifted to the prospective occupants themselves through the imposition of mandatory, risk-related, annual occupancy charges. The charge would be equivalent to the occupant's estimated annual damages plus any costs his occupancy causes others. These payments would be made to an indemnification fund which would be used to compensate those suffering flood damages.

The annual occupancy charge would represent an investment of a portion of flood plain location benefits. Such a system would provide a means for budgeting inescapable flood losses. However, the primary gain would be to discourage flood plain development that detracts from the total social income and to encourage only investment that clearly is warranted by the net benefits gained. New development would not be precluded. It would, however, be limited to that for which real and sufficient advantage was anticipated.

As flood plain occupants grow in number, or possibly at the outset, a flood control measure might be proposed to reduce flood damages. A comparison of preproject and postproject expected damages for the properties affected would provide the basis of assessing project benefits. If the reduction, reflecting the lesser degree of risk, exceeded project cost, a flood protection project would be recommended.

Construction of a flood control project would not eliminate the need for an indemnification fund. Occupants would still require protection against the risk of residual damages occurring when the protective works are overtaxed.

To the extent that new flood plain occupancy is subsidized by indemnities or protection at less than cost, greater use of flood plains is encouraged than is warranted by the economies of flood plain location. The effect of subsidy is to start a round of unwarranted investment. Damage potential is needlessly increased. Unnecessary losses accumulate. Then, if the development is to be salvaged, further subsidy is required.

The conditions which would be embodied in a comprehensive system of occupancy charges would, in contrast to those present programs of subsidized flood control, act as a positive incentive for efficient flood

plain development. They would provide a gage of the propriety of development while indemnifying residual damages.

An integrated flood loss management program which would satisfy the requisites of economic efficiency and social equity and make a realistic division of responsibility would entail:

(a) Federal responsibility for collection and dissemination of needed data; provision of technical services to assist in intelligent application of data in local planning; construction of flood control projects; management or supervision of an actuarially sound indemnification program; and provision of credit, where needed, for local contributions to flood project construction.

(b) State responsibility for establishing flood plain encroachment lines; granting of authority to assure conspicuous demarcation by State of local planners of flood hazard areas; and assisting local planning and project financing efforts.

(c) Local responsibility for guiding desirable expansion and avoiding, to the fullest possible degree, use of high hazard areas for uneconomic activities; organizing flood project beneficiaries to pay for services rendered.

(d) Individual responsibility for careful weighing of the costs and advantages of developing and occupying alternative sites; willingness to assume financial responsibility for new locational decisions.

Program reorientation—First steps

A comprehensive program for occupancy charges and indemnification is at this time only a concept. Although a key element in a unified approach to managing flood losses, it could not be implemented before adequate study of the actuarial basis and until means of administration have been developed. With or without such a program, there are improvements which can be accomplished immediately and which are highly desirable in their own right. Indeed, in the absence of an occupancy charge program, other needed changes in public policies affecting flood plain development become even more important.

The recommendations in the following section point the way toward a unified program of Federal activity affecting flood plains in which rational use of each reach of our river and coastal lands would be encouraged. One part provides for earnest experimentation with national flood insurance. While that moves ahead, no time should be lost in making the other changes.

A caution on flood insurance

A flood insurance program is a tool that should be used expertly or not at all. Correctly applied, it could promote wise use of flood plains. Incorrectly applied, it could exacerbate the whole problem of flood losses.

For the Federal Government to subsidize low premium disaster insurance or provide insurance in which premiums are not proportionate to risk would be to invite economic waste of great magnitude. Further, insurance coverage is necessarily restricted to tangible property; no matter how great a subsidy might be made, it could never be sufficient to offset the tragic personal consequences which would follow enticement of the population into hazard areas.

I would not be improper to subsidize flood loss insurance for existing property. That might be done, provided owners of submarginal development were precluded from rebuilding destroyed or obsolete structures on the flood plain. However, to the extent that insurance were used to subsidize new capital investment, it would aggravate flood damages and constitute gross public irresponsibility.

IV. RECOMMENDED ACTION

A. IMPROVING OUR BASIC KNOWLEDGE ABOUT FLOODS AND FLOOD HAZARDS

Flooding has been an important stimulus to collection of hydrologic data. While much useful knowledge now is available there are four obstacles to an integrated program of flood loss management which should be remedied promptly by Federal action. These relate to (1) definition and outline of hazard of major flood areas, (2) improving methods of flood frequency analysis, (3) revising means for collection of flood damage data and (4) research on flood plain occupancy and urban hydrology.

Definition and outline of the flood hazard

Data on the heights and discharges of rivers during floods are obtained at each of about 8,000 river gaging stations operated by the Geological Survey. In addition, more than 4,000 crest-stage stations are operated by the Geological Survey solely to record flood heights and 300 such stations are operated by the Environmental Science Services Administration (ESSA). Special surveys are made during large floods to provide data on the magnitude and height of flooding on streams not otherwise gaged. Levels of coastal waters are recorded by the ESSA, the Corps of Engineers, and the Geological Survey.

These primary flood data as published in raw form are used mainly in the design and operation of flood control works, highway bridges and culverts, and land drainage works. The collection and publication of data is especially adapted to the design of structural works largely because those responsibilities have been lodged in Federal agencies having close contacts with construction. Other methods of flood damage reduction which command increasing attention involve many sectors of government—Federal, State, and local—and create a need for information directed to those wider uses.

Any of the diverse methods of flood damage abatement depends upon identification of the flood hazard. By this is meant information on the past and probable degree of flooding for specific areas. Examples of the use of flood hazard information are the following:

Flood plain regulation.—Establishment of reasonable controls over development of flood plains by local, regional, or State authorities requires information outlining the extent and degree of flood problems. Controls must be based on sound, impartial definition of the facts if they are to stand up in court as reasonable and fair.

Mortgage lenders and underwriters.—Efforts by private lenders, as well as Federal Housing Administration, Farmers Home Administration, and Veterans' Administration personnel, to consider flood hazard sometimes falter because of the lack of proper information.

Flood insurance.—In order that premium rates may be set with knowledge of actual degree of risk it is necessary to have accurate information concerning area, frequency, and depth of inundation.

Flood warning.—Local authorities, civil defense workers, corporations, and individuals require precise advance information if they are to obtain benefits from flood warnings. When, for example, there is a forecast that a flood will crest at 18 feet, it must be known precisely what homes, factories, and other structures may be affected.

Determination of flood frequencies

Floods often are compared or reported in terms of their frequency, or average interval of recurrence. Techniques for determining and reporting the frequency of floods used by the several Federal agencies are not now in consistent form.

This results in misunderstanding and confusion of interpretation by State and local authorities who use the published information. Inasmuch as wider, discerning, use of flood information is essential to mitigation of flood losses, the techniques for reporting flood frequencies should be resolved.

Collection of flood damage data

Information on damages caused by floods also is inadequate for the task. Because there has been no sound national basic data plan as in the case of hydrologic data, a new start is necessary to provide essential information to an effective program of flood plain management.

There are four persuasive reasons for collecting information on flood damages. First, it is important to know how much the Nation as a whole is losing because of floods. Second, data on individual floods, and especially large ones, are of value in evaluating contemplated flood control works. Third, a continuing record of actual flood losses at a few selected points would provide a useful check on the stage-damage relations used in the evaluation of projects. Fourth, the most important use of flood damage data in the future will be for planning the use of flood plain lands, establishing land-use regulations, and developing flood insurance programs. A national program for the collection of such data should be designed with all these uses in mind.

The ESSA (Weather Bureau) has for many years compiled any flood damage data reported to it. Lacking facilities for appraising the reliability of the information submitted, for determining its completeness, or for filling in any gaps, the annual totals reported by the Bureau are known by it to include only a part of the flood damages suffered in the United States.

Studies made of contemplated flood control and prevention projects by the Corps of Engineers, the Department of Agriculture, the Tennessee Valley Authority, and other agencies provide useful information on areas subject to flood damage, frequency of flooding, and average annual damages suffered under the conditions existing at the time the studies are made. In some instances, the damages are synthesized without subsequently checking them against the actual damages. These studies, however, cover only those areas which would be protected by a specific project or system of projects. They are of little value in drawing conclusions as to the magnitude of the overall flood problem. Nevertheless, much useful information is collected and

could be of great value for periodic evaluations of the magnitude of the Nation's flood problem.

Flood plain hazard reports are compiled by the Corps of Engineers and the Tennessee Valley Authority, and the U.S. Geological Survey prepares hydrologic atlas maps showing areas that have been flooded. These are used increasingly by State and local agencies in planning wise occupancy of flood plains. They are developed with care and can be of value in flood damage inventories and in designing a flood insurance program.

After flood disasters the Corps of Engineers, the Soil Conservation Service, and to a lesser degree other agencies, including local interests and newspapers, make estimates of losses. The Corps of Engineers, within a short period after each such event, assembles the available data, makes independent though limited damage surveys, and develops an estimate of the total flood damage. The Soil Conservation Service often assembles such disaster data for the headwater tributaries. Disaster losses are of value in the project studies which usually follow great floods. They also can be of value in periodic assessments of the Nation's flood problem.

The Corps of Engineers attempted a nationwide appraisal in 1957 in which it estimated potential average annual flood damage for conditions existing at that time and projected such damages into the future, making allowance for expected future development. Use was made of all available data, including estimates of upstream damage by the Soil Conservation Service. This appraisal was carried out quickly at low cost and the results admittedly constituted only crude approximations. Nevertheless, it provided a much better estimate of the magnitude of the flood problem than had been previously available. More important, it verified what some had long suspected, that the flood problem was growing despite the large sums spent for flood control works. Finally, this effort demonstrated that nationwide appraisals, made at appropriate intervals, could constitute a practical means for providing the Nation with information on the magnitude of its flood problem.

A new start should be made toward an efficient national program for collection of flood damage data. Several alternatives are open.

One obvious solution would be to have data on all floods as they occur collected by a designated agency. This continuing record concept is that underlying the present Weather Bureau program. To yield dependable results, it would be costly and time consuming. The results would be of little more value than those yielded by a periodic appraisal.

A second possibility would be to maintain a continuing record of damages for reaches of streams and coastal areas constituting a stratified sample of the Nation's rivers, hydrologic environment, and land use. This would be worthwhile as a means of testing flood damage estimates arrived at by the synthetic methods in evaluation of contemplated projects. However, it would not yield useful estimates of the actual damage suffered each year throughout the United States unless combined with data on the larger floods.

A variation would be to determine the damages from the larger flood disasters. These would be of value in subsequent project evaluations and in preparation of flood hazard reports. To be effective, such special estimates would need to be made by an established, uniform procedure.

It would be possible to abandon any attempt to maintain a record of nationwide losses and to make damage studies only as needed for project evaluation and preparation of flood hazard reports. This would not yield information on the flood damages suffered year by year. Also, inasmuch as the data utilized in project evaluation are largely derived by synthetic methods, there would be no check on the procedures used, and after a period of years the differences between synthesized and actual flood damages might become very large.

A more satisfactory solution would be to make, at appropriate intervals, a nationwide appraisal of the average annual flood losses and of the composition of the losses (classified as to location and type of damage) that could be expected in the future on the basis of conditions existing at that time. This is the approach taken by the Corps of Engineers in its 1957 inventory. This periodic appraisal would yield results by which the magnitude of the Nation's flood problem and the effectiveness of its flood damage prevention programs could be adequately assessed. If carried out systematically by the several agencies using uniform methods, the results would provide the most precise estimate of average annual flood damages that it seems possible to obtain at reasonable cost.

Recommendation 1. A three-stage program to delimit major flood hazards should be initiated by the Corps of Engineers, the Geological Survey, and other competent agencies

The delineation of flood-hazard areas requires a three-phase program, progressing from a rough national survey through rapid flood-plain mapping to detailed flood-hazard reports. Each stage would be compatible with the others. The first two stages offer a rapid approach to national coverage. Neither is adequate to meet the full need but each should be helpful to people and agencies requiring information in advance of a complete report.

(a) *Listing of towns and streams with flood problems.*—This list should be prepared from topographic information and brief, personal inspection, where necessary. Nearly every community has a flood problem and there are more than 5,000 places of 2,500 population or more. The order of magnitude of the flood problem could be estimated and rated in three general classifications. A note "coastal" could be shown when appropriate. Notations of flood control works, if any, should be included. The resulting list would be distributed to all Federal, State, and local agencies which should be aware of flood hazards in planning their other operations.

The Department of the Army, Department of Agriculture, Department of the Interior, Tennessee Valley Authority, ESSA, and other Federal agencies treating floods or flood problems should collaborate in the work to be completed in 6 months. The Corps of Engineers should be given primary responsibility for this program. No added appropriations would be needed for this task. The immediate utility of the list would justify the necessary interruption of regular duties in order to prepare it promptly.

(b) *Outlining the flood plain on maps or aerial photographs.*—This would delimit areas occasionally inundated by river or coastal waters without definition of the frequency and magnitude of flooding. All available aerial photographs, maps, flood information, and gaging-

station data would be utilized. Soil survey maps may be useful adjuncts in defining the alluvial flood plain.

The primary responsibility for this work should be assigned to the Geological Survey as a 2-year project. The cost would be about \$3 million.

(c) *Accelerating the present program of flood hazard information reports.*—These reports would contain maps, profiles, charts, tabulations, graphs, and a narrative description. They would show extent, depth, frequency, and duration of flooding; water velocities; rates of rise and fall of floods; and other pertinent hydrologic and hydraulic information. Data on past floods and estimates of those to be expected along with notes on alternate ways of dealing with flood losses. They are needed for all areas where intensive development has taken place or is anticipated.

The less than 300 localities that have been covered by the full reports of the Corps of Engineers and TVA represent a rate of progress that is less than the rate of growth in the flood plain. The rate of preparing flood plain and coastal hazard reports should be increased by these agencies so as to complete at least 250 communities annually over the next 10 years. This would cover all areas where floods are of major economic importance and include rural areas subject to urban and industrial development. Priority should be given those areas in greatest need.

To accomplish this program in an orderly and efficient manner, the Corps of Engineers should be given the major responsibility for preparation and distribution of reports and for appraisal of their usefulness. The coordination of procedures, criteria, and degree of accuracy and detail for flood plain reports prepared by the Corps of Engineers and TVA should be determined through consultation between them and with Federal and State agencies which use the information. The cost of this 10-year program is estimated to be about \$60 million, an increase of about \$4 million per year over the present rate of financing.

Consistent flood frequency analyses

A study is needed to simplify use and comparison of reports on flood frequency prepared by different agencies, and to make available objective reasons for choice of method that are based on the nature of the local problem to be solved.

Recommendation 2. A uniform technique of determining flood frequency should be developed by a panel of the Water Resources Council

The Water Resources Council should establish a panel to be chaired by a scientist from outside Government and composed of persons knowledgeable in hydrology, mathematical statistics, and economics, selected from but not to serve as representatives of Federal and non-Federal organizations. Those who are asked to do this job should be familiar with the probability methods involved, as well as the socio-economic decisions that are based on frequency analyses. The panel should be directed to examine methods of frequency analyses with regard to their sufficiency for applying various techniques of flood damage abatement. After this review the panel should present a set of techniques for frequency analyses that are based on the best of known hydrological and statistical procedures. It should describe

the circumstances in which each method might be most suitable and would delineate the assumptions and consequences that are involved in the use of each. Consideration should be given to the likely effects of urbanization. Its report should describe those procedures among the suitable methods which, in its judgment, should be standardized in Federal practice. The panel report should be composed in language most helpful to the project engineer.

This study should be completed as soon as practicable but within 1 year. Funds should be provided for fees and expenses for the non-Federal members and for needed analytical work. Total cost is estimated to be about \$40,000.

Recommendation 3. A new national program for collecting more useful flood damage data should be launched by the interested agencies, including a continuing record and special appraisals in census years

A continuing record of actual flood damages experienced in every part of the Nation would cost more than it would be worth. The incomplete tabulation of the Weather Bureau should be discontinued concurrently with completion of a new national program. This should be organized along the following lines:

(a) *Decennial appraisals.*—At 10-year intervals, concurrent with the national census, the Corps of Engineers and the Department of Agriculture with the cooperation of other agencies, should make a joint nationwide appraisal of the potential average flood damage under the conditions existing at that time. The cost of one such appraisal is estimated at \$2 million.

(b) *Sample reaches.*—A continuing record should be made by those agencies of flood damages in selected reaches of stream valleys and coastal areas that constitute a statistically efficient sample of the hydrologic and land use characteristics of river valleys and the coasts. These data would offer detailed information on methods of reducing losses and provide checks on the synthetic methods that are used for the design of flood control works and that are employed in the 10-year appraisals of potential damage. The annual cost of the sample would be about \$150,000.

(c) *Special surveys.*—When unusually damaging floods occur anywhere in the Nation, studies should be made immediately afterward by the Corps of Engineers and the Department of Agriculture, with appropriate assistance of other agencies, to determine the areas inundated and the resulting damages. These records will be useful for many purposes, including disaster relief, flood insurance, and flood plain management. The cost of such surveys would be highly variable, but are estimated to average about \$100,000 per year.

(d) *Methods and reports.*—The results of all studies of flood damages should be summarized and disseminated in forms specified by the Water Resources Council. In order to assure sound and uniform procedures for future appraisal of flood losses, the Water Resources Council should develop methods to be used by all agencies participating in appraisals.

Research on flood plain occupancy and urban hydrology

Progress has been highly uneven in the broad gamut of research on floods and flood problems. Significant progress has been made in the continuing study of the hydrology and related physical aspects of

floods. Yet this research has been dominantly directed toward problems inherent in the traditional Federal program of flood control. Neglect of the study of flood plain occupancy and of the study of urban drainage leads to a major imbalance in a Federal program for flood loss management.

It is increasingly clear that nonstructural measures should receive greater consideration in national programs for reducing flood losses. However, the "Water Resources Research Catalog" compiled by the Science Information Exchange and published in 1965 by the Office of Water Resources Research, discloses not a single project on the subject of the management of flood plains among those classified under the heading of "Floods" or "Flood Control." Only three projects are funded by OWRR in fiscal year 1966.

Improper design of drainage works spreads flood losses to places where these otherwise would not occur. In contrast to long-supported research of the drainage of agricultural lands, relatively little attention has been given to city drainage, chiefly because Federal agencies have had little to do with urban water problems. These traditionally have been the responsibility of the cities themselves who rarely launch sustained observations and research. The basic data program of the Geological Survey contains only negligible data on flow in or from city drainage works. Indeed, the necessary techniques are lacking to collect such data on a routine basis. The ongoing research as reported by the OWRR in its 1965 catalog, shows less than 10 projects in urban drainage. In view of the large diversity among city environments and drainage conditions, this number stands in sharp contrast to more than 50 projects dealing with agricultural land drainage. Considering that investment in municipal drainage works averages about \$1,200 per acre and involves annual expenditures exceeding the Federal flood control program, their efficiency is of national importance.

Recommendation 4: Research on flood plain occupancy and urban hydrology should be sponsored by the Department of Housing and Urban Development, the Department of Agriculture, and the Geological Survey

Recognizing that cities have related problems of water supply and of water quality, urban drainage should be studied more carefully with a view to possible storage, infiltration, and reuse.

(a) *Flood plain occupancy.*—The Department of Housing and Urban Development should make a major attack on problems of flood plain occupancy, to include study of: Building design to withstand flooding; appraisal and design of flood plain regulation, particularly model flood plain zoning ordinances; geographic factors that affect decisions to occupy the flood plain; evaluation and improvement of nonstructural measures of flood damage abatement, such as emergency evacuation; methods of putting information on flood hazard to better use in flood plain management; and who pays for flood losses.

A reasonable initial program for study of primarily urban problems would cost \$250,000.

The Department of Agriculture should at the same time direct its research program to deal with comparable problems in rural areas, including floodproofing designs for farm structures; land uses in rela-

tion to flood damage potential; land use regulation and watershed protection; and residual damage potential as related to flood insurance.

An annual cost of the studies of primarily rural problems would be \$200,000.

(b) *Urban hydrology.*—The Department of Housing and Urban Development should sponsor a research program into urban hydrology and related water resources problems through grants and contracts of about \$500,000 annually. The Geological Survey should undertake the design of improved instruments for measuring water flow in drainage conduits, sewers, and streets and in collaboration with ESSA a study of extending its basic data program to urban areas, at an annual cost of about \$200,000.

B. COORDINATING AND PLANNING NEW DEVELOPMENTS IN THE FLOOD PLAIN

Planning and coordinating the development of the flood plain is required as part of any significant effort to break the pattern being fostered by present Federal policies concerning flood damage prevention, namely "The continuing sequence of losses, protection, and more losses." This requires leadership of the Federal Government in a fashion that will gain effective participation by the State and local governments. Although the Federal agencies can exercise direct control over Federal installations in the flood plain, the far greater number of decisions affecting new development are made by private individuals and corporations within the limits set by State and local plans and regulations. Even if occupancy charges were now available as a guide to investors, they would be constrained by land use regulations and plans, by financing conditions, and by the layout of utilities planned by local agencies. In much of this activity Federal agencies have an indirect part.

In moving toward the planning, coordination, and regulation which will have meaningful application, it is essential to identify those Federal policies and programs affecting flood plain use and to suggest ways in which allocation of responsibilities, adequate staffing, and requisite communication between and among the Federal, State, and local agencies may be assured. The following recommendations focus on desirable action by Federal agencies so as to assist State and local planning efforts. They may be expected to encourage enabling legislation or enhanced agency operation at the State level, and the effective administration of capital programs, regulations, codes, and ordinances at the local level. They assume that steps will be taken at the same time to improve the basic knowledge of flood hazard. As time goes on it may be desirable to consider the effects of other Federal programs. For the present, the chief Federal programs having a bearing on the use and development of the flood plain are noted. Numerous changes in administrative directives are recommended. As a result of the task force activity, some changes are already in course of being made by the responsible administrative officers, and their current status is noted.

Water Resources Planning Act

The Water Resources Council, now beginning operations under the Water Resources Planning Act, has unprecedented opportunity to guide river basin commissions and State planning agencies to consider

all reasonable alternatives in water resource development. This includes identification of flood plain areas, preparation of data on local flood hazards, and arrangements for the participation of State and local governments in flood loss reduction plans through land use regulation and other nonstructural alternatives.

Comprehensive river basin planning is fostered by this act, with the respective river basin commission serving to coordinate Federal, State, interstate, local and nongovernmental plans. Appropriate emphasis can be directed to the need for State prevention of encroachments on natural stream beds, for local regulation of uses of the flood plain, and for relating State and local implementing actions to the construction of flood control projects. Federal financial assistance is provided to assist the States in preparing comprehensive water and related land resources plans.

The Council includes membership from principal Federal departments concerned with flood problems except the Department of Housing and Urban Development. Because of its deep involvement in urban planning affecting many aspects of water and land use, that agency ought to have regular representation on the Council.

Recommendation 5: The Federal Water Resources Council should specify criteria for using flood information and should encourage State agencies to deal with the coordination of flood plain planning and with flood plain regulation

(a) *Regulation.*—Increasingly, reports reviewed by the Water Resources Council incorporating alternative plans for water development, will be prepared according to criteria specified by the Council. To the extent that they recommend flood control projects, provision should be made for State regulation of flood plain encroachment and, where appropriate, for local land use regulation as conditions for the construction of Federal and federally assisted projects. With the collaboration of the Advisory Commission on Intergovernmental Relations it should encourage preparation of model State enabling legislation.

(b) *State agencies.*—The Water Resources Council should use its powers to encourage States to build staffs and organizations capable of dealing with the coordination of flood plain planning in their areas.

(c) *Membership.*—The Department of Housing and Urban Development should become a member of the Water Resources Council.

(d) *Uniform criteria and procedures.*—In the interest of obtaining uniform treatment of flood plain problems, the Water Resources Council should be assigned responsibility for establishing criteria and procedures for interpretation and application of the available flood information. In doing so it may be expected to work through the Corps of Engineers, with HUD dealing with urban planning problems, Agriculture with rural planning situations, the Geological Survey with hydrological analysis, and the Tennessee Valley Authority in its area.

(e) *Annual conference.*—The Council, or an agency designated by the Council, should schedule an annual conference to bring together the organizations which provide flood plain studies and other flood data with the Federal, State, and local agencies, and other groups which use that information in order to review uses of the data, possible revisions to meet needs, and future plans for providing data.

The above suggestions have been discussed with the Executive Director of the Council.

The Council also is authorized to give attention to ways of linking comprehensive water plans with public plans for land use and transportation. It, therefore, has a direct interest in seeing that suitable action is taken on the following recommendation.

Recommendation 6. Under the following Federal programs steps should be taken to assure that State and local planning takes proper and consistent account of flood hazard

Federal mortgage insurance, loans, and assistance to private lenders

Under current policy and practices, the Federal Housing Administration takes flood hazard into account in the examination of property for mortgage insurance, but not all applications receive detailed site analysis. The Veterans' Administration is less searching in its review of applications for mortgage guaranties. The Farmers Home Administration expects its appraisers will consider floods along with other hazards.

Savings and loan associations are the Nation's leading mortgage lenders. The financing they make available can wield an important influence on the home developments that may be constructed on the flood plains.

(a) *Examination of mortgage applications.*—All land development proposals in connection with Federal mortgage insurance and loan programs should receive full site planning and site engineering analyses to insure that uniform professional consideration is given to potential drainage and flooding problems and in furtherance of land uses that will be harmonious with the degree of flooding exposure. This would require increased coordination between VA and FHA field offices in dealing with valley sites. The Farmers Home Administration should be directed to take specific account of flood hazard in its rural housing insured loans.

(b) *Costs paid from fees.*—The additional workload for the Federal Housing Administration to make full analysis of sites for proposed mortgages would call for additional professional staff but probably entail only a minor increase in administrative expenditures. There would be no significant increase in Federal budget expenditures as all costs of FHA site analysis activities are recovered from applications fees and premiums.

(c) *Savings and loan associations.*—The Federal Home Loan Bank Board should encourage to the maximum extent possible the financial institutions with which it deals to give proper and consistent consideration to the flood hazards in making home loans in flood plain areas.

Housing Act, urban planning assistance program, section 701

The urban planning assistance program in its general support of comprehensive planning throughout the Nation at the State and local levels of government already has facilitated the completion of more than 100 local or regional studies which include consideration of flood plain uses and their regulation. This program's support of comprehensive planning should be strengthened so as to define its concern for water resource and flood problems and to enable the planning work to be related more directly to requirements of Federal water planning.

(d) *Planning agency letter.*—The Department of Housing and Urban Development should prepare a planning agency letter for local, metropolitan, regional, and State planning organizations emphasizing water resources planning as part of comprehensive planning, and enumerating the specific water resources planning activities that would be eligible for urban planning assistance. This is underway.

(e) *Planning program guide.*—The urban planning program guide dealing with the urban planning assistance program should be amended in accordance with the foregoing statement. This is underway.

(f) *Technical information service.*—The Department of Housing and Urban Development should develop in cooperation with the Corps of Engineers a technical information service to distribute regularly to local, metropolitan, regional, and State planning agencies: examples of flood plain planning reports of exemplary quality; sample regulations, codes, ordinances, hazard markers, or other material concerned with guiding the use and development of the flood plain; information from various sources dealing with pertinent aspects of flooding. This technical information service does not now exist.

(g) *Clearinghouse.*—The Department of Housing and Urban Development should serve as the focal point for information concerning urban areas and flood plain use, providing this service to local and State agencies and arranging, where lacking, for coordination of their planning with Federal agencies.

Federal Aid Highway Act, section 134

The Federal Aid Highway Act of 1962 requires a "continuing, comprehensive, transportation planning process in urban areas" where population exceeds 50,000. The instructional memorandums issued by the Bureau of Public Roads on the subject of urban transportation planning under the act have been silent on ways of relating this activity to flood hazard. If uneconomic uses of the flood plain are to be discouraged and if the occasionally heavy and mounting Federal expenditures to repair highway flood losses are to be curbed, greater harmony must be achieved between the location and design of highway facilities and the use of the flood plain. This would conform to recognition by the Bureau of Public Roads and the State highway departments that their mission "to build roads" is related to the responsibility of those Federal agencies concerned with National, State, and local development, including the Bureau, "to build better communities."

(h) *Instructional memorandums.*—Instructional memorandum No. 50-2-63(1) should be amended to reflect more adequately consideration of flood problems within the context of coordinated transportation and land use planning:

Item 3, *land use*, to the effect that the inventory of vacant land should take account of land subject to flood. In addition, the general examination of land use should reflect the quality of the land for development. Such factors as slope, flooding, and soils should be examined and the resulting information recorded and mapped.

Item 10, *Social and Community Value Factors*, to the effect that the location of transportation facilities should be selected with particular care relative to areas subject to flood and their possible later use, if any, and with respect to the provision of adequate drainage channels.

These amendments are being drafted.

(i) *Information and related activities.*—State and local agencies concerned with urban transportation planning should be informed of related instructions being sent out on water resources planning and of the guides concerning the urban planning assistance program as administered by the Department of Housing and Urban Development. These have not been prepared.

Open space and recreation area planning

Under the Land and Water Conservation Fund Act of 1965, the Bureau of Outdoor Recreation supports the preparation by States of statewide outdoor recreation plans as a prerequisite to financial assistance for State and local recreation land acquisition and development projects. It is drawing up a nationwide outdoor recreation plan under authority of its organic act of 1963. In these efforts the State and Federal planning is taking shape with lively recognition of the possibility that in some reaches the development of flood plains for recreation may be their most efficient use and that flood plain regulation may be an important part of a recreation program. A few aspects of the Bureau's procedure have not fully emphasized the opportunities for use of flood plains, and the Bureau currently is strengthening its instructions as follows:

(j) *Statewide outdoor recreation plans.*—Where State plans indicate they have not taken adequate account of the possibilities of flood plain regulation they are being asked to do so.

(k) *Outdoor land acquisition and development projects.*—In making grants-in-aid for State outdoor recreation acquisition and development projects, one of the criteria to be considered in assigning priorities will be location on flood plains.

(l) *Nationwide outdoor recreation plans.*—In preparing the nationwide plan careful attention is being given to the ways in which cities and towns may act promptly to preserve open space by acquisition or control of flood plains.

(m) *Technical assistance on outdoor recreation.*—The Bureau's technical assistance program will include information on flood plain regulation.

Open space land acquisition, title VII, Housing Act of 1961

Under the Housing Act of 1961 as amended in 1965, Federal grants are made to assist communities in acquiring permanent open space for conservation, recreation, and other purposes. The proposals are required to be linked with a program of comprehensive planning, and the acquisition of open space and its use are required to include consideration of flood hazard.

The Department, in its planning agency letters and other information concerning open space acquisition, and in its research on acquisition programs, is calling attention to opportunities for flood plain acquisition.

(n) *Open space acquisition.*—Further research and information services on open space acquisition should expand the interest in flood plain use, and should place increased emphasis upon cooperation with the administration of the Land and Water Conservation Fund Act.

Urban renewal

Urban renewal activities and public housing projects under the direction of the Department of Housing and Urban Development

have a profound effect upon the reuse of blighted areas in the flood plain. Urban renewal plans are sometimes carefully integrated with protection plans, and sometimes not. Interagency coordination is needed, however, in order to avoid inconsistencies, if not outright conflicts, between Federal programs.

(o) *Urban renewal projects.*—Urban renewal projects should implement comprehensive community plans and should consistently give explicit consideration to treatment of flood areas and flood hazards. The Corps of Engineers and Urban Renewal Administration have worked out an operating agreement in recognition of this need.

Sewer and water facilities (HUD, USDA, HEW, AND EDA)

The provision of these facilities under the auspices of Federal loan and grant programs in themselves may involve new capital investment which may be in the flood plain, and by their location may affect the construction of new residential or commercial buildings. The procedures of Federal agencies is to require some kind of conformity to local plans, but unless more specific reference is made to flood hazard there is the possibility that Federal aid to new sewer and water facilities will encourage construction that another Federal agency then will be expected to protect from floods at Federal expense. Their location in some cases may require subsequent relocation as part of a flood control project. Interagency coordination of policies and programs would reduce those difficulties.

(p) *Instructional materials.*—Guides and other instructional materials issued in connection with the water and sewer facilities programs administered by the Department of Housing and Urban Development, Farmers Home Administration, the Department of Health, Education, and Welfare, and the Economic Development Administration should require consideration of flood hazard and other available flood information in the design of projects located in areas which may be affected by floods. HUD has adopted such guides. The other agencies have not.

(q) *Relation to comprehensive community planning.*—The planning of water and sewer facilities receiving Federal financial support should proceed within the context of comprehensive planning as set forth by Public Law 89-240. This will be specified in the Community Facilities Administration guide for local public agencies, and in the procedures of the Farmers Home Administration.

Relief and rehabilitation assistance

It is only a matter of time before occupancy of coastal areas and flood plains necessitates expenditures for relief and rehabilitation. The Office of Emergency Planning is authorized to call upon any Federal agency to assist, primarily, in restoration of public facilities, with agency costs reimbursable pursuant to Public Law 875. The Bureau of Public Roads plays a special role in repair of Federal-aid highways. The Small Business Administration does a brisk business in providing individuals and businesses with rehabilitation loans on favorable terms. Elements of the Department of Agriculture operate a variety of relief programs. The American Red Cross provides large numbers of flood sufferers with assistance in the form of outright grants. The Internal Revenue Service allows deductions for flood damages on income tax returns, and there is no limit to the number of times such claims are permissible for any given property.

Continuance of intermittent damage and repair costs may be economically wise in some instances. A good example are beach areas where the exposure of service facilities is difficult to avoid but where the locational advantages outweigh the costs of repair and rebuilding.

Conversely, there is much development in hazard areas which when destroyed by floodwaters could be relocated more efficiently elsewhere. The present technologies of communication, transportation, and water supply have modified earlier advantages to waterside location. Refurbishing obsolete development adds to the flood damage problem and can only invite future relief expenditures.

Oftentimes a damaged structure can be restored with little or no additional cost so as to minimize future flood damages. Floodproofing may be an economic alternative to bearing the loss.

The minimum objective of public policy should be to assure consideration of the advantages and disadvantages of floodproofing and of relocation before action is taken to restore damaged property. Present policy, which concentrates almost wholly on assisting flood victims at-site, works against this objective. Experience during 1964 and 1965 on California's Eel River illustrates the problem where people return to the same hazardous sites expecting Federal help in rehabilitation.

As floods recede, public and private attention concentrates on early restoration of normal activity. Therefore, the possibilities for and problems attendant on relocation and floodproofing must be considered prior to the disaster. Many areas already are cognizant of their flood threat; all will be when recommendation 1 is implemented.

Recommendation 7. Actions should be taken by the Office of Emergency Planning, the Small Business Administration, the Treasury Department and other agencies to support consideration of relocation and floodproofing as alternatives to repetitive reconstruction

(a) *Consistent Federal policies for relief and rehabilitation:* The Office of Emergency Planning should initiate a study leading to a series of guides and consistent administrative policies to be followed in all Federal relief and rehabilitation programs. Special attention should be given to assistance policies which, inadvertently or otherwise, encourage rehabilitation of uneconomic public service facilities in hazard areas.

(b) *Small Business Administration loans.*—The Small Business Administration should modify its regulations to require consideration of possible relocation as a qualification criterion for loans and attention being given to structural floodproofing or other measures which would reduce water damage potential.

(c) *Income tax deductions.*—The Treasury Department should prepare legislation leading to amendment of the tax code so as to provide incentives to relocation of obsolete or hazardously located property and to floodproofing. The substance of the legislation would have to be developed in concert with the recommended OEP study (item (a), above) but should include, as appropriate, limits on the number of times flood damage deductions may be claimed for properties located in hazard areas.

(d) *Red Cross relief.*—In keeping with the above, the American Red Cross should play an active role in developing and implementing policies designed to prevent uneconomic recurring disaster losses.

Location and disposal of Federal installations

It is relatively common for Federal agencies such as the General Services Administration, the Post Office Department, and the Department of Defense to consult with the Corps of Engineers as to flood hazard before building in the flood plain. There are exceptions, and it sometimes is difficult for the agencies to withstand pressure to develop sites which will later require unwarranted Federal repairs or protection under other appropriations. Federal investment may encourage new construction by others. It also may happen that surplus Federal land, including parts of the public domain, are hazard areas which pass into private management and then become a base for claims for public protection. As in the case of waste disposal from Federal installations, it would be helpful to formally state the policy and procedure which should guide the executive agencies in those cases. The appropriate time to issue such a directive would be when the recommended listing of towns and streams with flood problems is circulated (as per recommendation 1).

Recommendation 8. An Executive order should be issued directing Federal agencies to consider flood hazard in locating new Federal installations and in disposing of Federal land

(a) *New construction.*—An Executive order should be issued directing all agencies responsible for construction of Federal installations to take account of flood hazard in choosing sites and to refrain from construction unless the gains will offset the social costs.

(b) *Land disposal.*—The same order should direct that where public land subject to flood hazard is disposed of to non-Federal agencies or private owners consideration should be given to attaching restrictions to future uses which would impose uneconomic public costs for relief or protection.

C. PROVIDING IMPROVED TECHNICAL SERVICES TO MANAGERS OF FLOOD PLAIN PROPERTY

To supplement the improved data programs and planning of new developments, the technical services available to engineering consultants and to private, local government and State government managers of flood plain property should be expanded and improved. Such services are also needed by Federal agencies administering programs related to flood plain development.

Construction of works for flood control is better known and understood than the alternative and supplementary measures for reducing flood damages. Use of zoning, subdivision regulations, building codes, planned extension of utilities, tax assessment adjustments, floodproofing, warnings in the form of signs and notices in news media, acquisition of land for open spaces, and other measures to control and guide developments in flood plains is relatively new. Flood forecasting and evacuation is older but still not fully utilized. Information concerning the advantages of all measures and how they can be applied should be made available to provide that understanding and encouragement.

Local governments and private citizens by themselves generally do not have the ability and experience to cope effectively with their flood problems. Limited technical assistance and guidance is needed to

demonstrate the range of adjustments available and to assist and stimulate action. Basic technical information should be provided primarily by the Federal Government because of its ability to draw upon collective national experience. It properly should come through the State governments, as they have the authority and potential ability to aid local planning and to extend information to engineering consultants and citizen groups. Such action would lead to a more economical approach to flood plain use and reduce the subsidy that is inherent in straight relief and flood control projects.

Recommendation 9. Programs to collect, prepare and disseminate information and to provide limited assistance and advice on alternative methods of reducing flood losses, including land regulation and flood-proofing, should be undertaken by the Corps of Engineers, in close coordination with the Department of Housing and Urban Development and the Department of Agriculture

Dissemination of flood data and flood loss management report information

Many Federal and State agencies as well as special commissions or other groups conduct water resource development studies that include consideration of flood damage abatement. Numerous agencies collect and evaluate basic hydrologic and hydraulic data that are important to solutions of flood problems. Although such data are coordinated under Bureau of the Budget Circular A-67, the same is not true of studies on flood loss management. Brief reports are often prepared, but distribution is generally limited and the more detailed studies and basic data are found only in the files of the agency that made the study. Availability and source of all such data and reports should be known to all those working in this field. Detailed data and reports need not be distributed, but in lieu thereof lists of reports and data that are available should be furnished those local and State agencies designated by the respective States, as well as to the various Federal agencies having responsibilities in this field.

(a) *Flood loss management data:* Primary responsibility for collecting and disseminating information on flood loss management and related water resource development studies should be assigned to the Corps of Engineers. General procedures, criteria, and the degree of detail should be determined in concert with interested State and Federal agencies. It is believed that these services should in time be incorporated in the regular data-collection work of the corps, although the annual cost for the first few years would be in the order of \$750,000.

Preparation and dissemination of guides and pamphlets

Use of alternate measures such as flood plain regulations and flood proofing is growing slowly, and there is urgent need for assistance and guidance in order that they be used properly and to a far greater extent. Guides or pamphlets concerning alternate approaches to flood damage prevention should be prepared. These should be in understandable and useful format and language for the use of laymen, technical people, and officials. These and examples of flood plain regulations, plans for floodproofing, criteria for extending utilities, ordinances for adjusting tax assessments, and other alternates and pertinent literature, should be given wide distribution to engineers,

planners, architects, local officials, and citizen groups that may be related to such planning.

(b) *Guides and pamphlets.*—The Corps of Engineers under the guidance of the Water Resources Council should be given primary responsibility for disseminating technical advice on alternate measures and should depend upon the Department of Agriculture for technical information on agricultural aspects and upon the Department of Housing and Urban Development for information on urban aspects. It would prepare a few of the guides and arrange for others to be prepared by appropriate agencies. While one agency would need to take initiative in organizing the flow of advice, getting it into the hands of State agencies, and helping the States to build the competency to handle it, the task should be shared by Federal agencies concerned with agricultural and urban planning. There is no neat administrative path for circumventing the fact that flood loss management comprises engineering works as well as many aspects of land planning.

The estimated annual cost is \$750,000 for the first few years; costs later should diminish.

Application of flood data to regulations and other local measures

Cities and other communities need to review their plans for expansion in light of flood plain information made available through Federal, State or other sources. Limited technical assistance must be provided by the Federal Government if the State and local people are to understand and wisely apply the flood data in the development or revision of flood plain encroachment lines, zoning ordinances, subdivision regulations, building codes, and other regulations. Thus, assistance in estimating the effects of floodways of various sizes upon the height of floods and interpretation of data will aid planners and local officials in relating floodway limits to their plans for community growth. Guidance also is needed in the selection of elevations for controlling construction in flood plains. Information pertaining to measures that can be taken, the methods for determining the best type of regulatory controls, and limited assistance from technical specialists would encourage quicker action on the part of communities confronting flood hazards.

Under the Flood Insurance Act of 1956 the adoption of appropriate land use regulations would be a prerequisite for participation in any Federal flood insurance program.

Formal revisions of ordinances, regulations, and codes are not the only beneficial uses of flood data. Through the proper application of flood data, many municipal, industrial, commercial, and residential buildings have been located or planned so they will be reasonably free from flooding. Warnings to the public, such as signs and notices in newspapers or other news media, also are effective. But officials and individuals need guidance in interpretation of flood data and its application to decisions as to alternate plans for locating and designing major structures. Understanding of the flood hazard and of alternate methods of overcoming that threat must reach into the local governments and major corporations planning new developments. The resultant benefits of such a service may rival those resulting from official regulation.

(c) *Regulation of land use.*—Limited technical assistance and encouragement should be given State and local planners and officials and individuals in the preparation of flood plain regulation and the

application of flood data for assessing flood plain location. Preliminary reports should be prepared for guidance in areas where assistance is needed before a full flood hazard information report can be prepared or where a full report is not scheduled. A closer relationship should be established between the Federal regional offices and those of the respective States and local communities. The Corps of Engineers under the guidance of the Water Resources Council should have the primary responsibility for this and should establish criteria and guides in cooperation with the Department of Agriculture and the Department of Housing and Urban Development. The annual cost of the service covering requirements of all participant agencies is estimated at \$3,750,000.

Flood proofing

Many thousands of structures, and unfortunately far too many public buildings, are located in areas susceptible to flooding. Flood control projects have protected some of these and have reduced the flood threat to others. However, the residual threat and the total threat to the remaining sites remain as major problems to the respective communities. Effects on exposed water supply and sewage disposal plants cannot be measured in terms of dollars alone but involve the health, safety, and welfare of thousands of citizens.

Experience and studies show that flood proofing warrants consideration as a possible alternative among the various adjustments to flood. It has special promise in situations where: moderate flooding with low-stage, low velocity, and short duration is experienced; the traditional type of flood protection is not feasible; individuals desire to solve their flood problems without collective action or where collective action is not possible; activities which demand riverine locations to function need some degree of protection; or a resource manager desires a higher degree of protection than that which is provided by a flood control project.

Flexibility is inherent in this approach. It can be used in conjunction with flood control projects, flood plain regulation, and flood insurance in order to reduce flood losses. It also can be used separately for partial or interim loss reduction.

(d) *Floodproofing of Federal buildings.*—Federal agencies should floodproof their public buildings in the flood plain to protect them from flood hazards and to serve as a demonstration of the feasibility of floodproofing.

(e) *Information on floodproofing.*—Limited architectural and engineering information with respect to floodproofing, including regular issuance of printed material, should be provided by the Federal Government to State and local governments. The latter should be encouraged to provide additional detailed assistance and advice to individuals, architects, and engineers and to floodproof their own buildings. The Corps of Engineers, under the guidance of the Water Resources Council, should be assigned primary responsibility for providing limited technical assistance on floodproofing as part of a national program. It should be assisted by research and information from the Department of Agriculture and the Department of Housing and Urban Development. The annual cost of the service is estimated to be \$750,000.

Training of personnel for technical services

There may be a shortage of trained personnel for preparing flood plain information studies and for providing technical and other assistance at a satisfactory rate to meet the demands.

(f) *Training personnel:* Should there develop need for training of additional personnel for the conduct of these activities, seminars should be arranged at strategic locations throughout the country to provide such training. This should be the responsibility of the Corps of Engineers in cooperation with other interested agencies.

A national flood forecasting service

Reliable, accurate, and timely forecasts of floods and flood stages can be coupled with temporary evacuation to save lives and reduce property losses. The forecasting service provided primarily by the Environmental Science Services Administration and by others during the past has saved countless lives and dollars. But there are too many areas for which forecasts are not available and too many areas for which accurate or timely forecasts cannot now be provided. Also, too few cities and communities have adequate plans to effectively disseminate the information, help with evacuation, and provide for those temporarily displaced and distressed.

The success of a flood warning service hinges upon the immediate detection of impending weather events and the observation of hydro-meteorological factors associated with floods. As in any warning service, time is at least as important as accuracy and, therefore, all required information must be transmitted to a forecast center by rapid communications. Having all necessary information at hand, the preparation of forecasts encompasses the matching of manpower, techniques, and computer capability.

The predicted flood heights and consequent warnings must then be widely distributed to those in a position to minimize the losses through evacuation and other actions.

The program for acquiring data should be flexible enough to permit modification in order to make effective use of new sensing equipment and measuring techniques, and to deal with additional data as the need becomes apparent. Weather radar, even now, is providing valuable information on the quantity and areal distribution of precipitation, but it will be necessary to have point measurements of precipitation to calibrate radar intelligence, and provision must be made for combining the two types of information. Recent experiments with communications satellites hold out promise that relay of data by synchronous satellite may prove to be the most economical and reliable means of collecting the necessary reports.

At river forecast centers an ever increasing demand for flood forecasts for use with flood proofing, evacuation, and rescue requires additional staff and computer capability. Flood forecasts normally are based on reported storm rainfall. Precipitation forecasts have been improved during recent years, but research should be pursued with increased emphasis to achieve greater improvement.

Hundreds of communities subject to flooding cannot be served adequately by the regular flood warning system. These are located in the headwaters of flashy streams where it has not been possible to collect observations, transmit them to a forecast office, prepare the forecast, and relay the warning to the threatened area in advance of flooding. One solution has been to establish cooperative community

warning systems. The community maintains a network of rainfall and river observing stations, and a warning representative is appointed to collect the reports and issue the warning. Only 80 communities now are served by local warning services.

A reliable communications system is essential to the timely and widespread dissemination of forecasts and warnings. Use should be made of whatever nationwide telecommunications network would serve to provide TV, radio, and newspaper outlets with copy of forecasts for further dissemination to the public.

Communities, groups, and individuals should be able to quickly relate the flood forecasts to their individual flood problems. The preparation of local plans is primarily a local responsibility, but there are similarities which favor national assistance in the development of plans. Information pamphlets, brochures, model plans, and audio and visual material should be made available by the Weather Bureau in cooperation with the Office of Emergency Planning to assist communities in preparing and maintaining effective plans to disseminate forecasts and cope with flood disasters.

Recommendation 10. An important system for flood forecasting should be developed by the Environmental Science Services Administration as a part of a disaster warning service

(a) *Flood forecasts.*—The Environmental Science Services Administration should be assigned primary responsibility for the making and dissemination of flood forecasts. It should establish criteria and guides for other appropriate agencies that may properly assist.

(b) *Expansion of system.*—Means should be provided the ESSA (Weather Bureau) to: automate reporting networks; take advantage of improved technology to keep abreast of changes in channel regime; extend the system, including flash flood forecasts, to meet requirements in all areas of the Nation; provide prompt and reliable dissemination of forecasts through a nationwide warning communications system; provide assistance, in cooperation with the Office of Emergency Planning, to individuals, groups, and communities in developing preparedness plans. A program with these aims and methods currently is in course of development under a national disaster forecasting system. The flood forecasting aspects cannot now be separated out for cost purposes.

Improved technical services: responsibility and coordination

An effective technical services program must have many facets and involve a wide range and level of interests. As earlier noted, there is no simple administrative arrangement.

It is recommended that the Corps of Engineers assume primary responsibility for development and dissemination of technical service information, excepting flood forecasting. The corps has in being a geographically balanced, nationwide organization. Equally important, the majority of citizens regard it as the natural point of contact for action or information bearing on downstream flood problems.

While the corps should be responsible for distribution of informative material, it will have to consult with and rely heavily on the Department of Housing and Urban Development and Department of Agriculture for data and specialized competence. The technical services assignment will require a rapidly broadening perspective on the part

of all agencies. In this regard, Washington-level officials must be prepared to strongly support and closely supervise field activity.

D. STEPS TOWARD A NATIONAL PROGRAM FOR FLOOD INSURANCE

The concept of flood plain occupancy charges and indemnification of flood losses constitutes a theoretically ideal procedure for using economic incentives to adjust flood plain use optimally in taking into account the hazards imposed by nature. If each new development were required to pay an annual charge in proportion to its hazard (in return for indemnification for loss) plus any associated cost the occupancy causes others, then, in the long run, the following would result:

(a) Society would be assured that occupants of new developments were assuming appropriate responsibility for locational decisions.

(b) New development in the flood plain would be precluded unless the advantages were expected to equal or exceed the total social (public and private) cost.

(c) There would be incentive to undertake all those flood damage reduction measures, public and private, the costs of which are less than the consequent reduction in damage potential since they would result in a greater reduction in occupancy charges (total social costs) than the outlays for such measures. Moreover, if the cost of occupancy charges were taken into account in the benefit-cost analysis of flood protection works, it would help to determine the economics of any such undertaking and of any increment in scale of such undertaking.

(d) There would be support for appropriate regulation of flood plains to help, where possible, reduce the costs of flood plain occupancy.

(e) In sum, an occupancy charge indemnification fund or flood loss insurance could be used in lieu of an uneconomic structural or other type of measure, and to complement an economic flood protection measure.

Design and management of a national flood insurance fund involves many unknowns. It is worth repeating that if misapplied an insurance program could aggravate rather than ameliorate the flood problem. Offers to insure or indemnify damages to new developments in the flood plain at a cost to policyholders less than the actual risk would promote rather than discourage unwarranted flood plain occupancy. There is particular hazard in a "postage stamp" premium that would mix the bottomland with the upland in a single rate. Such a program would afford a windfall benefit to the owners of flood-prone lands and would impose additional demands on Federal and other resources for flood protection. It would also add to the difficulty of State and local governments in regulating these lands and would remove incentives for flood proofing and other measures designed to reduce damage potential.

Objectives of any degree of flood insurance should be to achieve flood damage abatement, an efficient use of the flood plain, and to provide financial relief at times of flooding. Achieving a sensible use of flood plain lands would be equally or more important than the indemnification of loss. High among the considerations of any insurance scheme should be assessment of its effect upon the national effort to abate damages, and upon State and local governments' efforts to achieve good planning in the use of flood plain lands.

Recommendation 11. A five-stage study of the feasibility of insurance under various conditions should be carried forward by the Department of Housing and Urban Development

To undertake a flood insurance program that would achieve the theoretical advantages stated above raises many questions to which answers must be sought through study and experiment, in both urban and agricultural areas, by the Department of Housing and Urban Development and in cooperation with other interested Federal agencies. The following stages must be completed before solid judgment can be reached on the design of a national flood insurance program:

(a) Hydrological and statistical studies should be made to evaluate average annual damages and their variance, geographic distribution, and required rates. These also should investigate differences in land use, age of structures, type of hazard, local planning, and other factors as they affect the feasibility of insurance coverage.

(b) A limited experimental test program should be designed, taking into consideration the results of studies described in stage "a".

(c) The experimental program should be tried with a range of areas, types of structures and other conditions that constitute a stratified sample of the national situation. It would include alternatives with respect to partial, compared with complete, participation among flood plain occupants and with respect to different rates for new versus existing developments.

(d) Results of the experimental program should be evaluated.

(e) A course of action then should be recommended with respect to a national program of flood insurance with whatever coverage and features seem warranted by the experimental program.

The prior steps necessary to design and implement a sound national flood insurance program are critical. The results will indicate the extent to which it can serve as an integrative mechanism for (1) discouragement of unwarranted flood plain development, (2) promotion of optimal adjustment among flood management measures, and (3) provision of indemnification for residual damages suffered after all economic measures for coping with the flood hazard have been instituted.

Public Law 89-339, recently enacted, authorizes the Secretary of Housing and Urban Development to undertake a study of alternative programs which could be established to help provide financial assistance to those suffering property losses in flood and other natural disasters. The authorization for the study does not permit adequate time for investigation. To properly accomplish this initial study would require 18 months, or at least a 9-month extension over the present deadline. The executive branch should urge the Congress to extend the time allocated to accomplish this undertaking and to provide needed additional study funds, estimated at \$500,000. Beyond this, provision should be made for continuing studies of all aspects of an insurance program.

It is strongly recommended that the studies outlined above be undertaken before any proposal is made to the Congress for initiating a national program of flood insurance. An incomplete study would raise false hopes, invite hasty decisions, and perhaps subvert the long-range potential of the insurance concept.

E. CHANGES IN POLICY FOR FLOOD CONTROL PROJECT SURVEY AND COST SHARING

The foregoing recommended actions should contribute significantly toward improving the Nation's flood loss reduction control program. To be fully effective they should be supplemented by changes in the Federal policies affecting survey method, cost sharing, land acquisition, and financing of local contributions.

Survey authorization

The Corps of Engineers conducts flood control surveys or reviews and updates previous reports on the basis of individual directives from the Congress. The directives are in the form of either a resolution of the Public Works Committee of the Senate or the House or separate line items in a public works authorization bill. Both types of authority are viewed as directives from Congress to conduct a study and to report to the Congress recommendations for or against a program or project. Over the years the procedure for obtaining a resolution has become perfunctory; and the response to them, in the form of a survey report, is a recommendation that certain engineering works are or are not feasible, and if they are feasible that the proposed project be authorized for construction. As already noted, experience has shown that the flood problem cannot be solved by this limited approach.

The Soil Conservation Service has broad authority to undertake studies for watershed protection. Its reports deal primarily with means of reducing floodflows.

Both the legislative and executive branches of Government should be aware of the need for considering solutions other than the traditional ones for reducing flood damage. The objective of a flood loss reduction program should be to make wise use of flood plain lands, and the actions recommended in this report are aimed at reorienting the program. One of the first requirements is to assure the study of alternatives to structural measures during the process of flood control or flood prevention surveys. This is advised in Senate Document No. 97, but few survey reports thus far have dealt fully and specifically with the opportunities.

Survey reports should present, along with other information, the results of studies of—

- (a) The effect on flood plain use of alternative measures such as regulation, improved forecasting, flood proofing, and public acquisition;
- (b) Nearby areas suitable for development as an alternative to flood plain development;
- (c) Alternative structural measures for protection against flooding; and
- (d) Combinations of measures and degrees of protection which maximize the net benefits.

In the 1965 Rivers and Harbors and Flood Control Act, the Congress gave the Corps of Engineers specific authority for a broad study of the flood problems of the St. Clair area in Michigan. Similar authorizations for all surveys would permit the same latitude to consider alternatives.

Recommendation 12. Survey authorization procedure and instructions should be broadened in concept

The executive branch should urge the concerned committees of Congress to broaden survey authorizations and assist in preparing resolutions to achieve the desired objective. On the other hand, the executive branch has authority, within reasonable limits as embraced in Senate Document No. 97, to require studies of alternatives. Under the Water Resources Planning Act, study methods can be specified for areas covered by river basin commissions.

(a) *Study of alternatives.*—Executive authority should be exercised to direct the agencies conducting surveys to present in survey reports alternative solutions, as well as recommendations, for decision by the Congress. An Executive order or an agreement among the members of the Water Resources Council would strengthen the effect of present directives. These interim actions should be taken promptly.

(b) *Continuing planning process.*—The executive branch should submit legislation to expand the objectives of flood control studies and to obtain congressional authority for Federal agencies to investigate and plan for flood loss reduction on a continuing basis with State and local authorities. Such studies should be linked wherever practicable with comprehensive basin surveys.

Cost sharing

When the beneficiaries of flood protection bear little or no part of the cost imposed upon society, principles of economic efficiency and of equity are violated and local development is distorted. Cost sharing, therefore, is a key feature in advancing national efforts to manage flood losses. It stimulates local and State participation in planning of investment and land use. Informed and intelligent action by those groups in considering alternative solutions to flood hazard in the framework of community planning is likely to be strengthened by requirements that they share the costs.

A modification of present cost sharing policy is timely for several reasons. As already shown, the major share of benefits claimed for flood protection have shifted from those resulting from protection of existing property to those stemming from future development of land. Increasingly, the Federal investment is in reclamation rather than in preservation of established buildings. In these circumstances the chances increase that a few large landowners will be the chief beneficiaries.

Current policies with regard to local flood protection mean that local interests may contribute as little as 5 percent of total cost in some projects and as much as 60 percent in others. The average is about 25 percent. For major reservoirs no contributions are required.

The trend toward Federal-State river basin organizations holds possibilities for using these organizations for operation of programs and for managing the financial aspect of water development. Such organizations eventually should be in position to assess charges and to collect reimbursement for the benefits of reservoir operations, including flood protection. A Federal-State river basin commission could deal with the problem of communities that hold out on paying their fair share. The combined powers of the Federal and State Governments seem adequate to solve the holdout problem. In comprehensive river basin development it will be important to make sure that basin plans

are authorized, installed, and operated in such a way that the full benefits of comprehensive planning are achieved.

A more equitable sharing of local flood control protection costs could be instituted without waiting for these major changes, but this should not defer active consideration of the powers that river basin commissions would need in order to achieve equitable sharing of costs of major river basin activities.

Recommendation 13. A modification in the cost-sharing requirement for federally assisted projects

Five points should be prominent in considering a new policy.

The more widely the beneficiaries share in costs, regardless of the type of project, the more likely the programs will promote efficient and socially desirable use of flood plains.

The larger the proportion of costs that are repaid the greater the check on uneconomic investments.

There is special advantage to any policy which identifies beneficiaries and charges them some portion of the cost of achieving economic future development in the flood plain.

There is no reasonable basis for differing cost-sharing requirements for salt water protection as contrasted with fresh water protection projects or for varying requirements between regions.

Fifth, and absolutely essential, cost-sharing policy should be consistent for all Federal construction agencies.

The Federal Government has open to it a wide variety of possible arrangements for cost sharing in flood control. At the one extreme is payment by the Federal Government of the entire cost of all programs, a policy which would encourage inefficiency and inequity. At the other extreme is full payment by beneficiaries. Between these two extremes are numerous options.

One approach would be to assign benefits to one of two categories of benefits: First, those accruing from protecting existing property, and secondly, those resulting from future land development. For the first type of benefits, alternative cost-sharing arrangements could require non-Federal interests, whether in the city or on the farm, to pay a specified portion of the costs of providing protection to existing property. For the second type of benefits, the beneficiaries could be required to pay a fixed, but larger, portion of the costs allocated to future land development. A step in the right direction might include (1) establishing a 25-percent reimbursement requirement for project costs allocated to existing development and (2) requiring a non-Federal contribution of one-half of costs allocated to estimated benefits of future development. The suggested contribution for existing development would be comparable to the current average value of local contributions to local protection projects, and would eliminate current disparities among areas. Payment could be made through contribution of lands, relocations, damages, maintenance, cash transfers or some combination of these; allowance could also be made for local expenditures for flood proofing.

While the Federal Government could deal directly with the States in cost-sharing matters, there is no objection to working with local interests as at present so long as the non-Federal entity responsible for the project assesses costs equitably among the beneficiaries. As

pointed out above, the Federal Government should encourage Federal-State river basin commissions to assume more financial responsibility. Other ancillary actions should include an extension of loan assistance to local interests, as recommended elsewhere.

Cost-sharing legislation.—It is recommended that the matter of flood project cost sharing be given early attention by the executive branch and the Congress. Modification of Federal policy, consistent with the above principles, is urged strongly. The precise formula is a matter of political adjustment and equity rather than a problem of technical judgment. The difficulties, stemming chiefly from exceptional circumstances, should not be allowed to impede essential action and establishment of sound, general rules for cost sharing.

Classification of benefits

As shown in figures 9 and 10, many Federal flood projects are now justified by anticipation of benefits in forms such as flood damage reduction to prospective development, drainage of agricultural land and land enhancement. In contrast, past justifications were based largely on reducing damage to existing property. Thus, at present the Federal Government inadvertently may encourage unwise flood plain occupancy by offering protection to future development, without adequate showing of economic merit and without serious examination of alternative sites. In the process, land developers may be enriched at public expense.

In future reports on flood projects it would be in the public interest to define the benefit categories in such manner as to distinguish clearly between benefits from present and projected development. The ground would be prepared for equitable cost sharing. Public recognition of the beneficiaries from Federal investment would be sharpened. Obviously, if benefits such as navigation, hydropower, and recreation are provided by a project, costs also should be allocated to these purposes.

The proposed categorization would be applicable to both rural and urban situations and would be consistent with the cost-sharing proposal just discussed. To illustrate, protecting land with an established cropping pattern would produce benefits equivalent to protecting existing urban development. However, draining or protecting woodland to permit it to be cleared and cultivated would represent a type of future development. In the urban case, protection of existing occupants would fall under the first category while projected expansion of presently used areas would represent future development. Likewise, protecting pastureland in anticipation of subdivision development would represent future development.

There are difficulties in establishing a solid economic basis for estimating future benefits. They are questionable if alternative locations for prospective development have not been considered and benefits adjusted to represent only the net location advantage, or if it has not been shown that construction of a project is the least costly way to produce the anticipated benefits. However, to the extent that future development benefits are calculated, they merit special and separate attention in any cost-sharing formula. Cost sharing for those benefits from new development is a key feature in limiting flood losses.

In addition to these problems of definition and measurement is the problem of cost allocation. Federal agencies are not using consistent procedures for allocation at this time. There is a tendency for reim-

bursement policies to influence cost allocations. For example, main stem multipurpose reservoirs are likely to carry a heavy allocation for flood control and navigation, both of which are nonreimbursable. Uniform procedures for applying the principles of cost allocation, currently under study by the Water Resources Council, are needed.

Recommendation 14. Flood project benefits should be reported in the future so as to distinguish protection of existing improvements from development of new property

(a) *Two classes of benefits.*—The administrative procedures of Federal agencies should be changed to classify flood project benefits in two classes: (1) reduction of damages to existing property, and (2) benefits anticipated from future land development. This could be implemented by the Water Resources Council without awaiting legislation on cost sharing.

(b) *Allocation of costs.*—The Council also should take action to insure uniformity among Federal agencies in the allocation of costs of multiple-purpose projects.

Policy for public acquisition of flood plain lands

The most economic and wise solution to a flood problem in some situations may be to purchase either an easement or fee title to the property subject to flood damages. This applies to developed as well as undeveloped lands. Under existing procedures it is possible to recommend property acquisition as a flood loss reduction measure. If the Congress then authorizes a project proposal containing such a recommendation, it can be implemented. However, if this measure is to gain general acceptance there should be a legislative base defining the conditions under which it is to be used.

Recommendation 15. Authority should be given by the Congress to include land acquisition as a part of flood control plans

Land acquisition should be available as an additional measure for flood plain management. There should be increased assistance to States and local public bodies for the acquisition of land in flood plains as authorized under open-space land programs of the Department of Housing and Urban Development and the Land and Water Conservation Fund Act of 1965 administered by the Department of the Interior. Where States or local public bodies are unable or unwilling to acquire land in accordance with a community program, authority should be made available to the Corps of Engineers and other Federal agencies to acquire land that is essential to implement the community flood plan.

During the initial period after Federal acquisition, all agencies having an interest in land use for public purposes should work to define wise use of the property and to transfer it to non-Federal agencies to serve that purpose. Examples of such uses are open space, recreation, and parks. Transfers should be accomplished within 10 years.

If the acquired property is not used for a public purpose within 10 years it should be declared excess and disposed of through normal Government procedure, but under restraints which will control future damage from floods.

Establishing authority for land acquisition.—The executive branch should submit legislation which would establish clear authority and principles for acquiring and disposing of flood plain lands when such action is found to be part of a practical solution for a feasible flood project.

Authority for loans to pay for flood control projects

Loans can now be made available to local organizations to pay for certain flood prevention or flood control programs. However, these are restricted to loans through the Farmers Home Administration for Public Laws 534 and 566 projects, to loans for local projects through the Tennessee Valley Authority, and loans to local governmental agencies in depressed areas through the Department of Commerce.

Flood problems warrant extension of such loan authority to cover all cases of demonstrable financial need. There seems to be no logical reason for the current restrictions. Local capacity to undertake financial obligations would become more important with a revision in cost-sharing policy.

Recommendation 16. Loan authority for local contributions to flood control projects should be broadened by the Congress

Establishing a consistent credit policy.—The executive branch should submit appropriate legislation extending Federal loan authority for contributions to flood control projects to any responsible local beneficiary which cannot obtain funds in the private market at reasonable rates.

F. IMPLICATIONS FOR FUNDING, ORGANIZATION, AND PERSONNEL

The effect of these recommendations over the long run would be to reduce the annual bill which the Nation pays for flood losses and to curb uneconomic Federal expenditures for flood control. This would be achieved without setting up new Federal organizations, and without placing a heavy burden upon Federal personnel.

There is no need to establish new national agencies. The responsibilities of several agencies, particularly the Corps of Engineers, the Department of Agriculture, and the Department of Housing and Urban Development, would be expanded modestly, but many of the recommendations can be carried out by a reorientation or strengthening of activities under present authority. At the Federal level, the Water Resources Council would be expected to exercise new leadership.

Greater changes may be expected in the character of work by local agencies and property owners. These would come about under the combined stimulus of operating policies of the whole set of Federal agencies dealing with floods and flood plains. However, adequate coordination and flow of information cannot be expected unless the local groups are served by State agencies having the authority and staff to promote planning in cooperation with the Federal programs. Heavy emphasis, therefore, should be placed upon building up appropriate State agencies to take part in the water and land planning efforts noted above.

Demands upon personnel will be of two types. For a few years there would be need for additional technical staff to carry out the program for flood hazard reporting; this would be largely complete within 10 years. The nucleus and much of the staff would have to

be drawn from employees of the Geological Survey, the Corps of Engineers, and other agencies making water resources studies. Many of the remainder will not require long training and can be recruited specially.

A longer term need would be for people who would share in Federal, State, and local planning for flood loss abatement. That work would draw upon training in economics, engineering, geography, hydrology, law, planning, and public administration. Initially, there would be acute need for a few seasoned people to initiate new activities in the Corps of Engineers, Department of Housing and Urban Development, Department of Agriculture, ESSA, and Geological Survey. Their staffs would be likely to grow slowly enough to permit a good deal of the training of additional needed skills. The most crucial need would be in the State agencies, where staffs are small.

The estimated costs of the activities recommended in this report may be summarized as shown on the following page. They are rough and should be reviewed as the program develops, but they do give an order of magnitude for the needed expenditures.

There can be no doubt that each of the items, even including those for collecting data on flood damages, would reduce the national flood toll by a far greater amount than its cost. The total annual expenditures for each of the next 10 years, exclusive of installation of equipment for improved flood forecasting, would be approximately \$13 million. This is modest by comparison with current Federal expenditures for relief alone. While increases in appropriations to individual agencies would follow implementation of these recommendations, they could be accommodated at only a minor increase in overall expenditures or with marginal sacrifice to existing programs.

Redirection of available funds would have symbolic value as well as practical merit. It would give recognition to the fact that by a different deployment of available funds and personnel the Federal Government can initiate action to reverse the current trend in flood losses and reduce the claims upon the public purse to underwrite uneconomic use of hazardous areas. In the process, the citizenry would be better served and, simultaneously, resources would be freed for application to the continuously emerging new needs of a growing society.

CATEGORY I.—*Continuing requirements*

Recommendation No.		Estimated annual costs	
		Present level	Recommended level
1c.....	Flood hazard information reports.....	\$2,000,000	\$6,000,000
3b.....	Sample surveys of flood damages.....		150,000
3c.....	Special surveys of large floods.....	50,000	100,000
3d.....	Dissemination of flood damage data.....	(¹)	(¹)
4a-4b.....	Research on flood plain occupancy, urban hydrology.....		900,000
5a-5e.....	Supervisory responsibilities of Water Resources Council.....	(¹)	(¹)
	Coordinating the planning of new developments in the flood plain:		
6a-6b.....	Federal mortgage insurance.....	(¹)	(¹)
6c-6f.....	Urban planning.....	(¹)	(¹)
6g-6h.....	Highway planning.....	(¹)	(¹)
6i-6l.....	Open space and recreation planning.....	(¹)	(¹)
6n.....	Urban renewal planning.....	(¹)	(¹)
6o-6p.....	Sewer and water facilities planning.....	(¹)	(¹)
7a-7d.....	Revision of relief and rehabilitation policy.....	(¹)	(¹)
8.....	Location and disposal of Federal installations.....	(¹)	(¹)
	Provision of flood loss management data and technical assistance:		
9a.....	Distribution of hydrologic and report information.....		750,000
9b.....	Disseminating technical advice and guides.....		750,000
9c.....	Assisting flood plain regulation and management.....		3,750,000
9d-9f.....	Assistance with flood proofing.....		750,000
10a-10b.....	National flood forecasting system.....	(²)	(²)

¹ No additional appropriations required.² Part of national disaster warning system.CATEGORY II.—*Special or intermittent requirements*

Recommendation No.		Estimated cost	Time span or frequency
1a.....	Listing of towns and streams with flood problems.....	(¹)	Complete in 6 months.
1b.....	Outlining flood plains on maps or aerial photographs.....	\$3,000,000	Complete in 2 years.
2.....	Flood frequency analysis.....	40,000	Complete in 1 year.
3a.....	Appraisal of flood damage potential.....	2,000,000	Decennial.
11.....	Initial study of national flood insurance program.....	² 500,000	Complete in 18 months.

¹ No additional appropriations required.² In addition to present appropriation.