

# Cooperative Planning in Use of Flood Plains

## *Corps of Engineers Information Studies Program*

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•THE FLOOD PLAINS of this country are an important part of the land resource. There has been some discussion as to whether the best use is being made of it. Areas where additional effort will contribute to the best use of this resource include: awareness of the hazards concomitant to the use of flood plains; technical information that can be used to determine the degree of risk of using the flood plain; and cooperative planning of the use of the flood plain.

### IMPORTANCE OF FLOOD PLAINS

The Corps of Engineers has estimated that there are about 109 million acres of land in the 48 contiguous States that are in the flood plains of rivers and streams (approximately five percent of the land area). In addition, there is the land that is subject to lake and ocean overflow that probably amounts to another one percent.

It is safe to assume, however, that flood-plain land represents more than six percent of the value of all land in the United States because it has natural advantages which include fertility, levelness, and closeness to centers of activity. Its nearness to water attracts men who want to use the water for human consumption, industrial processing, waste disposal, and often as a base for transportation.

Flood-plain land will be even more important as the demand for land in the United States increases. Landsburg, Fischman, and Fisher (1) made a projection of land requirements for the 48 States, wherein each use was considered separately. For the year 2000, the requirements add up to 50 million acres more than the 1,900 million acre area total of the 48 contiguous States. This projection shows that increasing attention will need to be given to multiple land use. It does suggest, however, that flood-plain land will become even more significant. The same projection showed an increase in urban land (including city parks) from 21 million acres in 1960 to 45 million in 2000.

As with any other resource, maximum contribution from flood-plain land can only be achieved through proper use. Certain uses are more adaptable for unprotected land than others. For example, automobile parking areas, ball parks and other recreational areas are less subject to damage than others. Of course, in many cases, the land need for certain developments even though subject to damage is so great that the cost of protective works is justified.

However, the water that created the flood plains puts a burden on those who use them and too often it appears as a hidden enemy. Man should not develop the flood plain until he understands this natural opponent and has determined how to cope with it.

### CONSEQUENCES OF IMPROPER USE OF FLOOD PLAINS

When improvements, which are subject to damage when inundated or washed away, are placed on flood plains, losses must be expected. These losses may consist of physical damage to property such as furnishings, buildings, equipment, communication and transportation facilities, and crops. Property classes include agricultural, residential, commercial, industrial, communication and utilities, transportation, and waterways and waterway facilities. The resultants include the necessity to repair and

replace the property, and also the interruption of normal activities such as industrial production, business, and movement of people and goods. Concurrent problems appear in the form of flood fighting, disaster relief, and emergency services such as increased police and fire patrol. The losses may also be in the form of lives and human suffering. The present average rate of damages from floods in the United States that can be measured in monetary terms is estimated to be over 900 million dollars annually (2) or over 5 dollars per year per person living in this country.

The consequences of using the flood plain are (1) to suffer the flood losses or (2) build flood control works. In this country prior to 1936 most flood control consisted of individuals' work protecting only their own property; most often, however, a more economical solution is a joint effort protecting many properties.

Congress, in 1936, saw the need for and authorized countrywide Federal participation in flood control works. Since then about six billion dollars have been expended, mainly by the Corps of Engineers, to reduce flood damages and make flood-plain land available for higher use. Corps of Engineers' projects by 1963 had prevented damages totaling nearly 12 billion dollars, including 553 million dollars during fiscal year 1963. The annual rate of expenditure for flood control by all agencies, Federal and non-Federal, is now approaching 500 million dollars; and because of the rapid development in unprotected flood plains it must be augmented if flood damages are to be decreased.

It has been estimated that another 11.5 billion dollars worth of flood control works will be required to protect developments now in unprotected flood plains or expected by 1980 (2). Many of these will be developments that could be put on nonflood-plain sites at less cost than for building flood protective works. The flood plains are usually ideal for other desirable uses that are not subject to much damage. Open spaces, in demand for urban areas, recreational parks and automobile parking areas are examples.

Much flood plain development has been and will be through ignorance. Because people move on the average of once every five years, they are not likely to be aware that the home they are about to buy or the commercial site on which they are about to build is a flood plain. Community planners often do not know the full extent and frequency of flooding expected on land. The awareness of the need for a reexamination of attitudes toward the use of flood plains is growing. It started as early as 1936 when Gilbert White wrote that

Land planning has additional importance as it relates to the feasibility of reducing flood wastage by means other than protection. It seems entirely possible that in some flood plains change in location and structure of buildings or modification of farming system may yield net gains greater than those from control or preventive works.  
(3)

### CORPS OF ENGINEERS FLOOD PLAIN INFORMATION PROGRAM

In 1960, the Congress in recognition of the need for more widespread knowledge of flood hazards authorized the Corps of Engineers in Section 206, of PL 86-645, to compile and disseminate information about flood problems, damages, and measures for their amelioration. The program has been under way since October 1961.

The specific objectives of the Corps of Engineers' program, as stated in the manual for the program are as follows:

1. To compile in a clear and useful form and to disseminate to States and local governmental agencies specific information on floods and potential flood hazards, including identification of areas subject to inundation by floods of various magnitudes and frequencies.
2. To encourage optimum and prudent use of the Nation's river valleys by providing to State and local governmental agencies a factual basis for:
  - (a) Reducing future flood damages and hazards through carefully considered and well-planned State and local regulation and use of the flood plains;
  - (b) Developing land use plans, which may include consideration of justifiable flood protective works;
  - (c) Preserving adequate floodway and channel rights-of-way and channel clearances.

3. To publicize available information for the guidance of private citizens and interests on use of and hazards of using the flood plains.

4. To reduce future expenditures for Federal projects to protect developments which, in the absence of the information program, would have taken place, or for alleviation of flood problems arising from improper flood plain development.

The Corps of Engineers has for many years been collecting flood-plain information for use in its study program for determining the advisability of flood control work. Essentially the same information is required to determine the economic feasibility of a flood control project. However, the information collected has not always been in a form readily usable by others.

Because the States are in the best position to encourage proper use of flood plains, the Corps of Engineers work with them closely on this program. At the request of the Corps of Engineers each State also has designated a coordinating agency to work with it on this program.

### Application for a Study

Although a State may apply, usually the local governmental agency (a city or a county) prepares an application for a study and submits it to the State for approval. Any responsible local governmental agency including properly authorized planning agencies are eligible. The most important requirement for local cooperation is that the study information will be publicized and used. Also information and data in the hands of the applicant are to be furnished the Corps of Engineers. If requested, a representative of the Corps of Engineers will discuss the program with the prospective applicant and assist in preparing the application. After the State coordinating agency reviews the application, it is forwarded to the appropriate District Office of the Corps of Engineers. A recommendation for its priority within the State is included in the State's letter to the Corps of Engineers.

When the application is received by the Corps, the information already available is reviewed and a plan for the study is outlined. At this time a Corps representative may call on the applicant to discuss the technical data to be included in the report enabling optimum results to be obtained with the manpower and funds available. When possible a representative of the State will participate. At times, information in the files can be made available for later use as the study progresses.

The application is forwarded to the Office of Chief of Engineers where it is reviewed, and if approved, a study fund allotment is made when available.

### The Study

The work involved in making flood-plain information studies is aimed at providing technical data such as the extent of inundation, depths, velocities, and duration of floods of various magnitudes and frequencies.

First, of course, a review of the existing data is made. For some studies, most of the information needed is already available. This is usually true where studies have been made to examine the feasibility of flood control works. It was observed that most of the study applications were for areas where the least information was available.

Where most of the data must be collected, the following work is performed: (1) Ground surveys to determine existing cross-sections and profiles of stream beds. (2) A search for information about past floods including location and determination of elevation of high water marks. (3) Determination of the size of potential floods based on watershed characteristics, taking into account information on past floods. This generally includes the estimating of the size of the standard project flood (the largest flood considered for land use planning). (4) Estimate the frequency of floods of various sizes. (5) Estimate the profile of the floods chosen for depicting the flood hazard. This step also provides estimates of velocities. (6) Preparation of maps showing the information. Maps with the largest scale and smallest contour interval practicable are desirable. However, existing maps must be used, where practicable. Sometimes aerial mosaics will serve the purpose. Where the applicant desires the information on larger scale

maps than can be prepared under the law authorizing this program, he is encouraged to arrange for the maps through some other means. (7) Locating the outlines of the inundation which would be experienced for each of these floods. From the profiles and the topography shown on the maps, depths can be determined.

### The Report

The reports are prepared in two parts: (1) a technical report that may include appendices for engineers, planners, and the like; and (2) a summary report, written in laymen's language, for distribution to the public. The technical report presents the findings of the study and details that may be of value to the technical people.

The contents of the typical report include: (1) introduction; (2) flood history; (3) flood control improvements, existing or authorized, if any; (4) existing flood plain management controls, if any; (5) flood problem (present and future); and (6) guidelines for reducing future flood damages. The "flood problem" section deals with channel and flood-plain conditions that aggravate flood damages and describes floods of three sizes (small, intermediate, and great) that may be expected in the future. Where practical, these are tied to the recurrence of floods of record under present and future conditions, but they may be hypothetical floods such as the standard project flood.

The reports also set forth "guidelines for reducing future flood damages" emphasizing the need for planning the best use of flood plains, and include descriptions of the various methods of regulating and managing their use. Possibilities of flood control works are not omitted.

The summary reports cover the flood history, a word picture of potential future flooding, what can be done to reduce future flood damages, and the maps showing the area that would be inundated by floods of various sizes.

### The Follow-Up

When the reports have been delivered, representatives of the Corps of Engineers will be available to explain the information and to provide supplemental data that may be needed. For example, an additional profile might be computed where the planning showed that a flood, different from any furnished with the report, should be the basis for regulation.

### Status of Program

Status of the program as of January 1, 1964 is as follows: applications approved—90, States involved (includes Puerto Rico)—32, studies covered by approved applications—183, reports completed—9, studies under way—77, and approved studies not started—97.

The reports that have been completed are American River, Morrison Creek, and Snodgrass Slough, all in the vicinity of Sacramento, Calif.; South Platte River at Denver, Colo.; Chicopee and Conant Brooks, Monson, Mass.; Farmington, Mich.; West Fork of Trinity River, Tarrant County, Tex.; and Yakima River near Richland, Wash., and Stillaguamish River. About 50 more are scheduled for completion by June 1964, 14 of these by February 1964.

## PROGRAMS OF OTHER FEDERAL AGENCIES

In addition to the Corps of Engineers and U. S. Geological Survey, the Tennessee Valley Authority explicitly provides flood-plain information in the form of "local flood reports." The procedures used and the data furnished are essentially the same as for Corps of Engineers' studies.

The Tennessee Valley Authority has been furnishing these reports for communities within its geographical area since 1953, 108 have been delivered. All of them have been used to guide the development of flood plains, and 36 communities have adopted flood-plain regulations.

## USING FLOOD-PLAIN INFORMATION TO CHOOSE THE BEST USE OF THE FLOOD PLAIN

The best use of the flood plain cannot be determined without taking into account other land that is available and the future needs of the many interests in the community or region involved. Therefore, the study should begin with the preparation of a land-use plan that takes into account both the social and economic needs of the people. Inasmuch as monetary values cannot be assigned to social advantages or disadvantages, the best choice will be made when a primary plan is prepared that optimizes monetary values, and is then modified if judgment indicates that the social values would be worth the additional cost.

The steps which the planner should follow in developing such a plan are as follows:

(1) Estimate future land needs, listing the quantities and qualities desired for each of the various uses. (2) Make a survey of all potential sites—quantity and quality for each use. (3) Estimate the advantages and disadvantages of each potential site. For the flood-plain sites, this should include the cost of suffering flood losses or building flood protection. (4) Array the uses over the available sites in a way that will produce the greatest economic return. (5) Modify the array where judgment indicates that social values justify the additional cost.

The costs of developing a flood plain include, besides the normal site development costs, the cost of flood losses, or the cost of reducing flood damages by flood proofing or flood prevention works construction.

To estimate the cost of flood losses, detailed information about the flood hazard is required. Information may be obtained through one of the Federal programs previously discussed. This flood hazard information must be applied when estimating the flood damages for various developments considered for the flood-plain site.

Potential flood damages may be reduced by flood proofing. It includes closing openings, either permanently or temporarily, by bulkheads over windows and doors; putting check valves in sewers; and raising floor levels and roadways.

Although Congress has established a Federal interest in flood protection and provides funds for flood prevention works, their cost should not be overlooked when estimating the costs of flood-plain development.

The least expensive alternative or combination of alternatives for developing in the flood plain can be compared with the cost of developing in the nonflood-plain site, for each use. When costs of the alternatives have been determined, the best combination from an economic viewpoint will be obvious.

## IMPLEMENTING THE PLAN FOR FLOOD PLAIN USE

A community plan for flood-plain use is not likely to be followed unless legal controls are adopted and enforced. Such controls will receive better acceptance if the plan is well based and its advantages can be shown by facts and figures.

The controls may be in the form of (1) Zoning ordinances that specify the kind of use that can be made of each area; e.g., residential, commercial, and parks. The flood plain may be divided into zones reflecting the different degrees of flood damage risk based on depths of flooding, flow velocities, and frequency of inundation. One of the zones may be designated as a floodway, and controls may be specified that would prevent restrictive actions regarding the free flow of flood waters. Its lateral limits would be identified as encroachment lines and no structure or fill would be permitted between them. A floodway, either by construction or by development regulation, is needed to keep flood heights from being increased in the other portions of the flood plain. The minimum size of openings under bridges, consistent with the specifications for the selected floodway, should be established. (2) Subdivision regulations may accomplish the same purpose as zoning ordinances by applying restrictions regarding use and elevation requirements regarding roadways, structures, and the design of structures. (3) Building codes likewise may include standards for construction that will reduce or eliminate flood damages. Any of these controls may include requirements for flood proofing measures in new developments or during improvement of existing developments.

## CONCLUSION

Flood plains are an important part of the land resource. The greatest gain from them can be achieved by cooperative planning that takes into account their advantages and disadvantages for various purposes. The advantages include locations near centers of activity and water. The disadvantages include risk of flood damages or the cost of providing flood protection.

The programs of the U. S. Geological Survey, the Tennessee Valley Authority, and the Corps of Engineers for providing information that can be used to identify and evaluate the flood hazards will make it possible to accomplish such planning.

## REFERENCES

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3. White, G. F., "The Limit of Economic Justification for Flood Protection." The Jour. of Land and Pub. Util. Econ., Vol. XII, No. 2, pp. 133-148 (May 1936).