

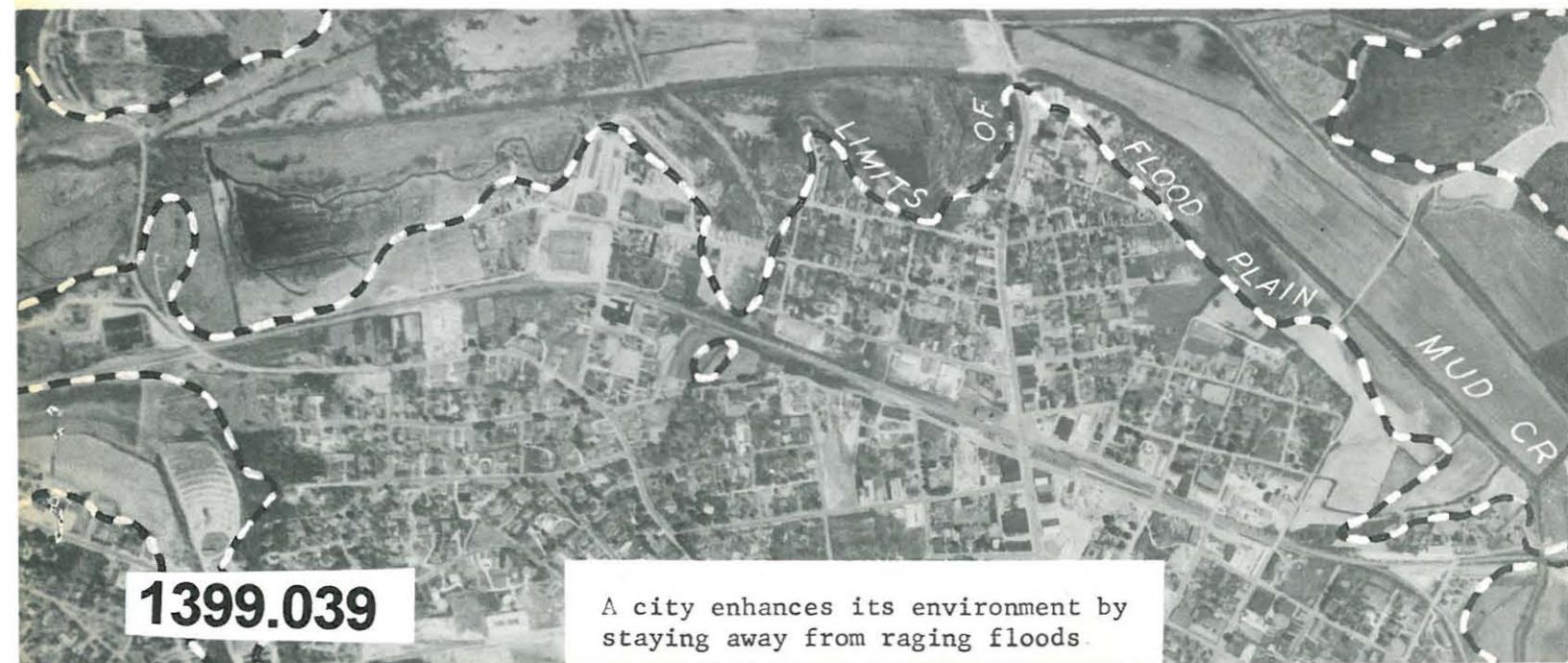
Floods
destroy
property
and
endanger
life



FLOOD DAMAGE PREVENTION AND FLOOD PLAIN MANAGEMENT IMPROVE MAN'S ENVIRONMENT

--By James E. Goddard

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A city enhances its environment by
staying away from raging floods.

FLOOD DAMAGE PREVENTION AND FLOOD PLAIN MANAGEMENT

IMPROVE MAN'S ENVIRONMENT

Paper by James E. Goddard, Chief of Local Flood Relations, Tennessee Valley Authority, before the Atlanta Convention of the American Society of Civil Engineers, Atlanta, Georgia, 26 February 1963.

Since man first appeared upon this earth, water has been a critical factor in his environment. Sometimes there was too little, and he took action to get more. Often there was too much and again he took action, this time to protect himself and his belongings against it. In either case, the problems of water in his environment necessitated research and thought, leading to engineering achievements which in turn have improved the environment.

My concern today is to discuss what man has done and what he should be doing for the control and management of water in his environment as well as what man can do to control his environment when he can't control the waters. His past solutions have been largely through engineering alone; his new approach is a much broader one, involving engineering and public administration working together.

Source of Impetus

The story of flood damage prevention and man's environment reminds me somewhat, although there are differences, of the manner in which many progressive steps have been taken by man. I will mention a few. The wheel was developed in peaceful times, but improvements were rushed by the needs of war. The effect on transportation and in turn on regional economics and trade decidedly changed the environment. Gun powder and explosives were developed under the stimulus of fear and need for war. Nevertheless their application to peaceful uses was a boon to man. Airplanes were invented with peaceful thoughts, but the

pressing needs for survival during war time accelerated their development. Application of this mode of transportation has made the earth much smaller and changed the outlook on life throughout the globe.

I am sure none of you will question the statement that nuclear energy and weapons were made available long before nuclear secrets would have been otherwise learned, due to our need for national defense. The application of nuclear energy to peacetime efforts, including medical, commercial, industrial, and power uses, brought about another surging change in our environment. More recently the developments in missiles and space craft have been sponsored by our need for national defense. However, the effect on transportation and our way of life in this world is not yet clear. Some believe they will open a whole new universe.

All of these engineering and technological advancements were brought about by the respective current status of man's environment and the need to maintain or improve it. The environment did improve each time, bringing another surge upward.

The subject of my paper is another action that, although not as spectacular nor as emotionally appealing, is nevertheless having a strong effect on man's environment. It is not a technological discovery nor a scientific breakthrough, but is the result of a clearer understanding of the problem resulting from research. It is the development and effective administration of a program of flood damage prevention utilizing technical data, knowledge, experience, and judgment along with land-use controls.

Man's Relation to Water

Man in his early environment settled near water for obvious reasons. He needed water to drink, to wash his food, to wash his body, to cook, and as a source of food in the form of fish or game that also came to drink. Other attractions included level ground for villages and fertile land for crops. As man started to move about and continued to travel farther and farther from his initial abode, he learned that water transportation was the easiest way, at that time, to move loads through

the area. Also, other settlements were along the streams and trade generally was limited to those areas. Eventually water power was captured but was used at the waterfront location.

Technological progress tended to gradually reduce the advantages of locating on or immediately adjacent to water. During the past few decades there have remained advantages in often being near the stream, but few for being on it. Water power is converted to electricity, which in turn is economically transmitted great distances. Water can be economically moved both horizontally and vertically. Water transportation can be utilized with the major developments being well back from the water's edge.

Man's Defiance and Battle with Floods

Through the centuries man built great metropolises at the sites of early villages on the water's edge. And he has often paid dearly with great losses from rampaging flood waters. In the United States alone the Corps of Engineers and others estimate that there are 2,000 or more cities subject to flood damage. That is a conservative estimate. There are nearly 150 communities in the Tennessee River Basin.

To maintain his environment, man started flood control for protection of his immense and expanding investment. It is the effort to keep water away from man who had invaded nature's flood plain. Dams, reservoirs, levees, walls, and channel improvements are flood control structures with which all of us and the public are quite familiar.

The water control system in the Tennessee River Basin is an example of how man controls floods. It consists of 25 major dams and reservoirs with 9 on the main river and 16 on the tributaries. In addition there are 3 small acquired projects and 6 belonging to the Aluminum Company of America which are operated in accordance with an over-all plan and agreement. In this system there is a total of at least 11,800,000 acre-feet of flood storage capacity available on 1 January of each year. This reservation may be reduced, as the flood season progresses, to 10,400,000 in mid-March. A total of nearly 2,500,000 acre-feet is held

available for flood control operations during the summer months. Benefits to other water-use programs, both within and outside the Tennessee Valley, include more than 650 miles of 9-foot navigable waterway, huge blocks of hydro-power, improved municipal and industrial water supplies, cooler water for steam plants and industries, and wonderful recreational sites. Low water releases out of the Tennessee River increase the low water flow in the Mississippi River, as much as 20 percent at Baton Rouge.

Nearly \$5 billion has been spent in the United States in less than three decades in this effort to protect man's investments against the floods. It is estimated by the Corps of Engineers that another \$10 billion would be required to provide similar protection for the remainder of the developments now subject to the devastating effects of floods. These expenditures are a noticeable share of our national budget.

The Losing Battle

Realization of man's folly in continued misuse of flood plains spurred research and action. Imminent danger to life and to the immense investments in flood hazard areas brought about reaction and need in a way somewhat similar to those brought on by threat of war as mentioned earlier.

As a military man I have developed some analogies on this reaction. The old idea of war was to hold your position, come hell or high water, and build forts (dams), throw up earthworks (levees) to hold out the enemy (the river). Now, through the U.N., alliances, education, regulations, we try to prevent war and its devastation--we develop a deterrent force. Armaments are still an important factor, but prevention holds much more promise for the future.

During the past 25 years there has been a growing awareness by those working in the field of water resources development that the "flood control" approach did not seem to be the total answer. Studies by the Tennessee Valley Authority, the Corps of Engineers, and especially the Department of Geography at the University of Chicago, verify this concern as they indicate man was losing his battle with nature. There has been

no question or doubt as to the sound engineering in planning, designing and constructing the flood protection structures. Engineers have time after time been commended for their outstanding contributions. Nevertheless, the flood damage potential has been increasing.

These studies have all indicated there was a need for a new look at the over-all problem. Evidence overwhelmingly indicated the need for keeping man away from water. Experience and knowledge through the ages have made man aware of nature's demands on flood plains. It is only common sense to give serious thought to the economics of vying with nature for those areas and plan a sound program for total flood plain management.

Acceptance of Controls

Man gradually realized the need for and then adopted controls over the use of water, air, and especially the land on which he lives. The acceptance of these controls has increased as officials and the public at large realized the growing complexities of social problems. The population explosions and, especially in the United States, the rapid change from rural to urban society have been major factors. These have brought about greater densities in occupancy of certain lands, including flood plains, and those densities are expected to increase. Figure 1 illustrates this.

From the evidence at hand there seems little doubt that in the United States most of the major disasters caused by floods in recent years are the result of urban population, industry, and business expanding into flood hazard areas with little or no regard to the natural conditions known to exist there. This evidence makes it apparent that along with other land use controls there must be controls for the flood plain lands.

Use of Subventions

Expenditures for flood control to protect developments in flood hazard areas are really financial supports or subventions to the owners of those flood plain properties. The flood hazard was there at the time the property was developed or structures erected. This hazard is as natural



PHOTOS SHOWING INCREASED DEVELOPMENTS IN A WESTERN NORTH CAROLINA FLOOD PLAIN

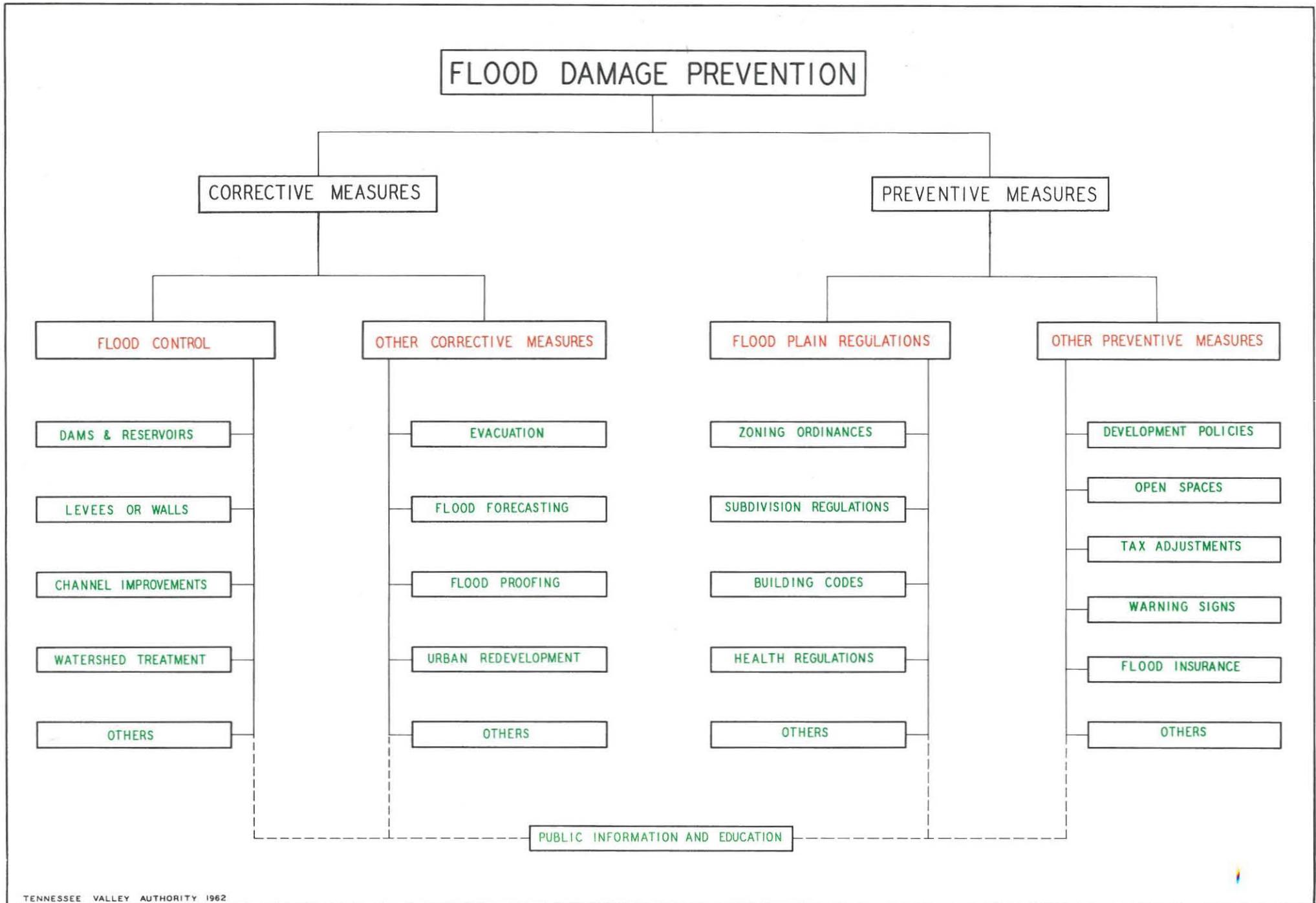
and lasting as that of the steep slopes of mountain sides which are more apparent because they can be seen every day. Yet we are not subvening the removal of mountains or changing them so that man can more fully utilize those areas!

Officials and trained planners have gradually made the Nation aware that for the greatest improvement to man's environment it is necessary to consider the best way to use financial supports. The need for and use of them changes with time. And many considerations affect the choice of the "best way." Large subventions are required to make developments safe in only limited areas of the flood plains. For equivalent or smaller expenditures, much larger areas can be opened to industrial, agricultural, residential, and other uses. An example illustrating this is found at one of the cities on the Tennessee River. Some local interests sponsored a local levee project that would have reclaimed about 400 acres of flood-hazard lands for industry. But subsequent studies indicated that for the same investment a railroad could be extended westward and downstream to open several thousand acres for industrial uses.

The need for open spaces has been recognized by the Federal Government, the states, and the people through programs that are becoming more and more active. There are numerous uses for land that leave the land open. Isn't it reasonable to relate the hazardous flood plains to this need for open spaces? Why not plan to use the areas for purposes that, though necessary, will suffer the least when nature flushes them during flood times?

Elements of Flood Damage Prevention

Officials agree that to maintain and improve man's environment it is necessary to take a comprehensive look at ways of managing our flood plains, including the prevention of flood damages. Let's take a look at some of the elements of managing flood plains to provide the most economical abatement of flood damages. Figure 2 shows those elements and their general relation to one another.



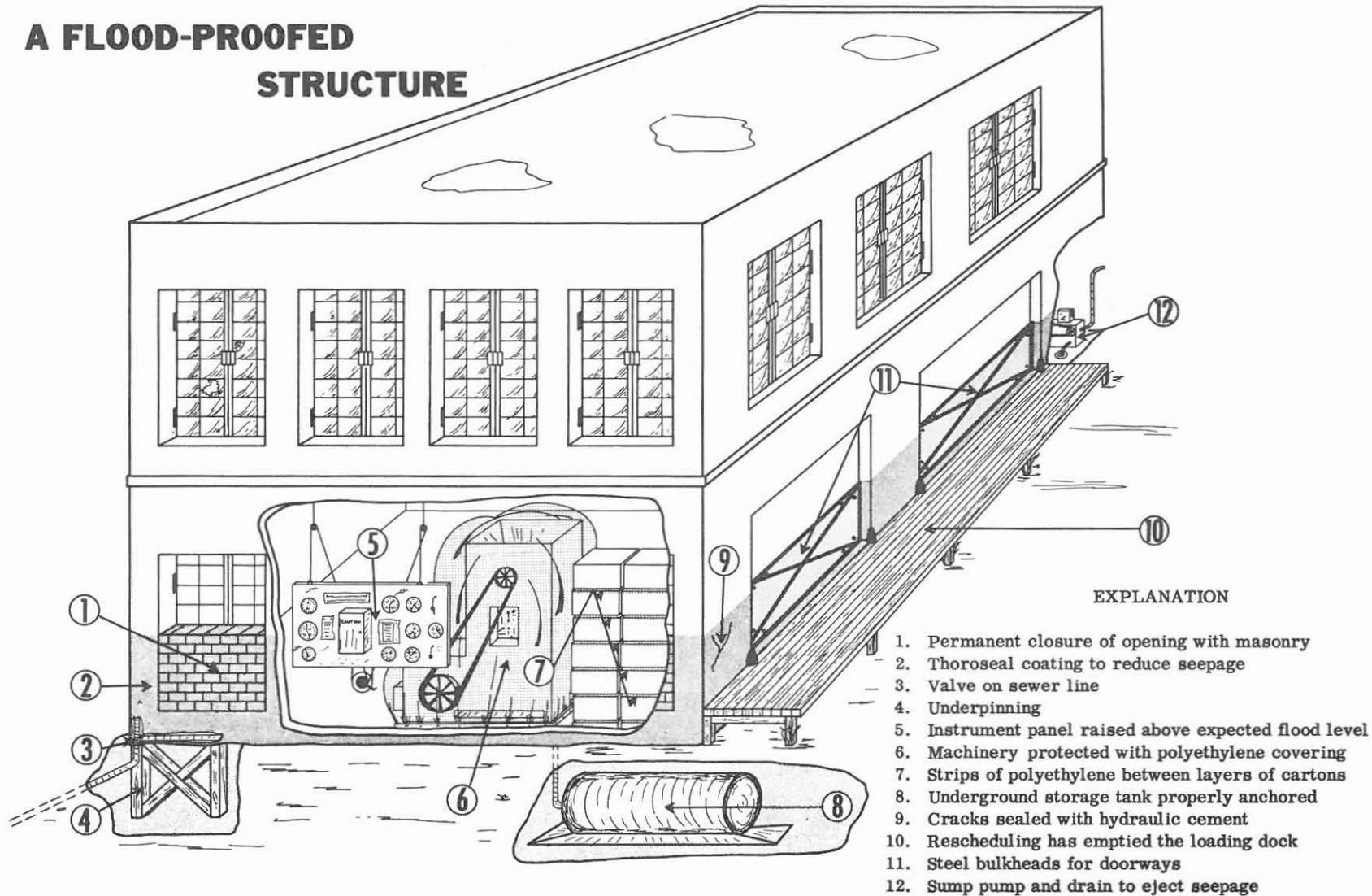
It is divided into corrective and preventive measures for reasons that are quite apparent. However some of the elements such as flood forecasting, flood proofing, and building codes, should perhaps be listed in both groups.

The "flood control" items are familiar to all. These are the activities that have been so well carried out by the Corps of Engineers, Tennessee Valley Authority, Bureau of Reclamation, and the Soil Conservation Service.

In the group of "other corrective measures," all are well-acquainted with flood forecasting and evacuation. These generally are conducted in tandem in order to obtain the greatest benefits. The U. S. Weather Bureau has improved and extended its flood forecasting services immensely during recent years. Use of radar and other technological advances permits forecasts that allow temporary evacuation and protective actions along coastal and inland areas in time to save lives and property.

Flood proofing is an element that only recently has begun to receive the attention it deserves. This involves measures taken to render existing or proposed structures, property, and lands less vulnerable to flood losses. John R. Sheaffer, with the cooperation of the University of Chicago and the Tennessee Valley Authority, studied the feasibility of flood proofing. His report, "Flood Proofing: An Element in a Flood Damage Reduction Program," is published as Research Paper No. 65 of the Department of Geography, University of Chicago. His conclusions indicate it has special promise in situations where: (1) moderate flooding with low-stage, low velocity, and short-duration is experienced, (2) the traditional type of flood protection is not feasible, (3) individuals desire to solve their flood problems without collective action or where collective action is not possible, (4) activities which demand riverine locations to function need some degree of protection, and (5) a resource manager desires a higher degree of protection than that which is provided by a traditional flood control project. The sketch in Figure 3 indicates how 12 of the many possible flood proofing measures can be applied to a structure.

A FLOOD-PROOFED STRUCTURE



Courtesy of John R. Sheaffer

The public is familiar with urban redevelopment programs but many do not realize that flood damage prevention measures can be included. They permit additional and timely opportunities to correct many of the flood problems.

"Flood plain regulations" as well as many "other preventive measures" are tools that can be used only by states and local governments. The authority for ordinances, regulations, and codes is the police power which is vested in the states and in turn passed along by them to local governments. The Federal Government does not have this power. Therefore the success of flood plain regulations programs lies chiefly with the states and local people. This is not to say that the Federal Government cannot and should not do much towards helping those agencies in planning and carrying out the programs.

Gradually, in the past 10 to 20 years, people have become more aware of the need for and learned the meaning of the elements listed under "flood plain regulations." It is important for fairness, reasonableness, and legal requirements that such regulations be a part of over-all ordinances, subdivision regulations, building codes, or health regulations for the city, county, or state involved. For the same reasons they must be integrated into the over-all plan for development of the subject area. Such regulations generally provide for a floodway to permit the safe passage of flood waters, controls to prevent constrictions in the channel and flood plain, and require structures in areas adjacent to the floodway to be above designated flood elevations or flood proofed, structures to be designed to withstand velocities and inundation, and disposal fields and other items directly related to health to be reasonably safe from flooding.

The Flood Control Committee of the Hydraulics Division, ASCE, appointed a Task Force on Flood Plain Regulations to study this general subject. A report entitled "A Guide for the Development of Flood Plain Regulations" was prepared by that Task Force and was printed in the September 1962 issue of the Journal of the Hydraulics Division. It presents engineering principles and techniques involved and discusses the technical

data required for establishing an equitable and reasonable flood plain regulations program. A brief discussion of how regulations are adopted and implemented is also included.

A few of the more common "other preventive measures" are shown in Figure 2. Open spaces and warning signs are fairly self-explanatory. Development policies are those formal or informal policies of a city or other political subdivision dealing with the extension of schools, streets, power, water, and other utilities. These can be extended into areas safe for development rather than into flood hazard areas. Such activities wield a soft-sell, negative influence on flood plain exploitation and a positive leadership toward use of the higher ground.

Tax adjustment is an effective, though little used and heretofore little considered, approach. For example, unless tax concessions are made, rural farmland adjacent to communities will become more valuable each year as residential or commercial developments move into parts of it, causing the tax evaluation of adjacent farmland to rise to the point that the land no longer can profitably be used for farming or open use.

Flood insurance, if established on a sound and equitable basis, could be an effective element. The Congress authorized through its Federal Flood Insurance Act of 1956 a subsidized experimental program, but has not appropriated funds to carry out its provisions. Hurricane and inland flood disasters during recent years have maintained the pressures for some type of flood insurance. The Interstate Conference on Water Problems of the Council of State Governments again discussed this at the September 1962 meeting and reaffirmed an earlier recommendation to revise the Act, so as to provide for a practical and acceptable program.

Public understanding of all elements in flood damage prevention cannot be over-emphasized. A successful program involves the coordination of local, state, and Federal governments. The need for such coordination was the subject of a study by Henry F. Morse in 1961-62. His findings

were reported in Special Report No. 38 of the Georgia Institute of Technology, entitled "Role of the States in Guiding Land Use in Flood Plains."

TVA's Local Flood Relations Program

I would like to tell you briefly about the cooperative program in the Tennessee River Basin that is accomplishing so much in reversing the trend of increasing flood damage potential. This program was started in 1953. The Tennessee Valley Authority cooperates with the seven Valley states and nearly 150 communities. Experience has indicated that in the Valley, as well as elsewhere, probably less than one out of every 20 communities' having a flood problem can solve most of that problem through flood control. But all solutions should include the application of controls over developments in flood plains. For that reason, TVA works primarily through the state planning agencies and with local planning groups.

Flood control and multipurpose project reports by TVA prior to the initiation of this program were similar to those of the Corps of Engineers and others. Their primary purpose was to present the plan, benefits, and costs of the selected project. They contained the minimum of basic flood information required to provide the necessary background for estimating flood control benefits.

For determining acceptable and most economical preventive measures-- as well as to design flood control projects--basic flood data must be available. And there must be an understanding of the problem. Since 1953, TVA has made available and interpreted the wealth of hydrologic data gathered over the past 30 years. That information consists of records of rainfall, runoff, streamflow, flood profiles, and other hydrologic facts. With some supplemental field investigation and administrative staff work, information pertinent to flood problems of individual communities is assembled and analyzed.

These data, couched in terms a layman can understand, are presented in reports for individual communities. The users will be teachers, lawyers, planners, merchants, housewives, and others, as well as engineers. For that purpose a new type of flood report was designed with the style, format, contents, and language to make it reasonably understandable to nontechnical as well as technical people.

Regulations or measures for the abatement of flood damage must be determined on the basis of those data as they relate to the area being studied and the needs of the community, if the regulations are to be sound and fair. Such a sound basis is also needed to insure their reasonableness and approval should they be questioned in court proceedings.

TVA local flood reports include a short summary of the flood problem, a section on historical floods, and a section on floods that may reasonably be expected in the future. The reports do not contain solutions. Supplemental studies are expected to determine solutions.

The reports include data outlining the extent, depth, and period of inundation, rate of rise and velocities of flood waters, historical and future flood elevations, topographic maps and cross sections. These are presented in a simple, straight-forward fashion, using photographs and charts to make them more readily useful.

Floods of the past are listed and a chart prepared to effectively show the heights and dates of occurrence. The chart is more readily understood and is much more useful to nontechnical people.

All areas have not experienced floods of equal magnitude. Over a period of several centuries this situation would probably change, but we do not have records for that length of time. Also, floods of variable magnitudes do not occur at regular intervals or in regular cycles. For these reasons we have studied the maximum floods known to have occurred within 50 or 75 miles of a subject area to determine the general magnitude of a large flood that may be quite reasonably expected to occur on the subject area. We have termed this a Regional

Flood. Figure 4 shows the manner in which the method of determination and data considered are presented in the reports so the local people will understand.

We also determine a Maximum Probable Flood discharge and magnitude which is generally equivalent to that of the Corps of Engineers' Standard Project Flood.

Maps such as that indicated in Figure 5 are used to show the areas that would be inundated by the Maximum Probable Flood and those flooded by the maximum known or some other major flood that has been experienced.

Profiles of the type shown in Figure 6 are prepared to show the bottom of the stream, a low flow, two or more of the major floods that have been experienced, the Regional Flood, and the Maximum Probable Flood. These profiles also indicate major effects of encroachments on the channel and flood plain.

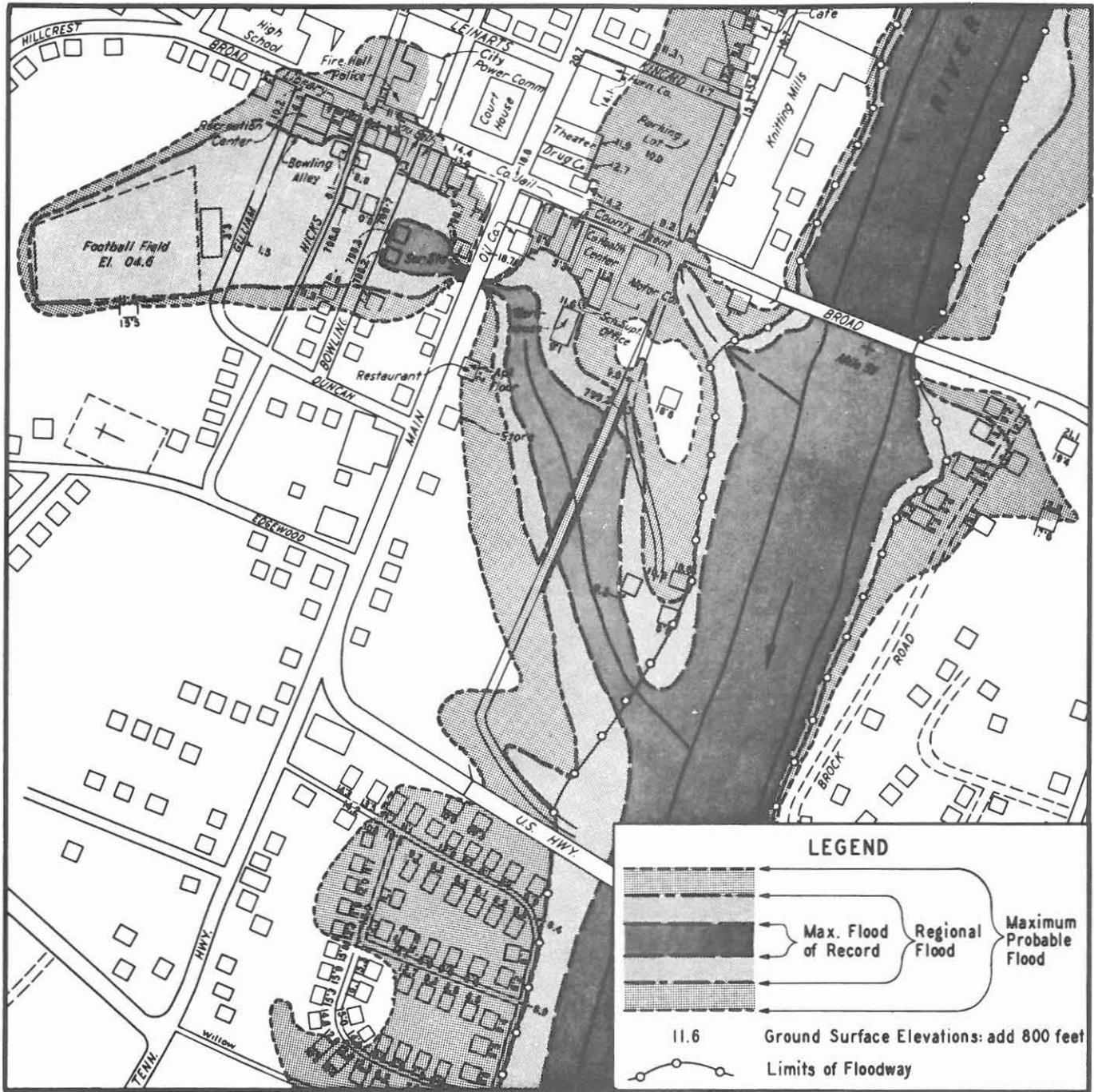
Hydrographs showing stage or elevation and time are used to portray the rate of rise and the duration of flooding.

Selected cross sections are included to supplement the topographic maps and especially to show the relationship between the area of the channel and that of the total flood section during large floods.

Photographs with flood heights superimposed or marked with arrows are shown as they are most useful. These present in an effective although dramatic fashion an understanding of the flood potential that many will fail to derive from the other tables, charts, and data.

Reports of this type have been prepared for 99 communities throughout the Tennessee River Basin as indicated in Figure 7. The reports have been prepared at the rate of about 10 or 12 communities each year, but that rate has been reduced somewhat as greater efforts are now being assigned the follow-up action.

FIGURE 5



PORTION OF MAP SHOWING AREAS INUNDATED BY FLOODS AND LIMITS OF PROPOSED FLOODWAYS

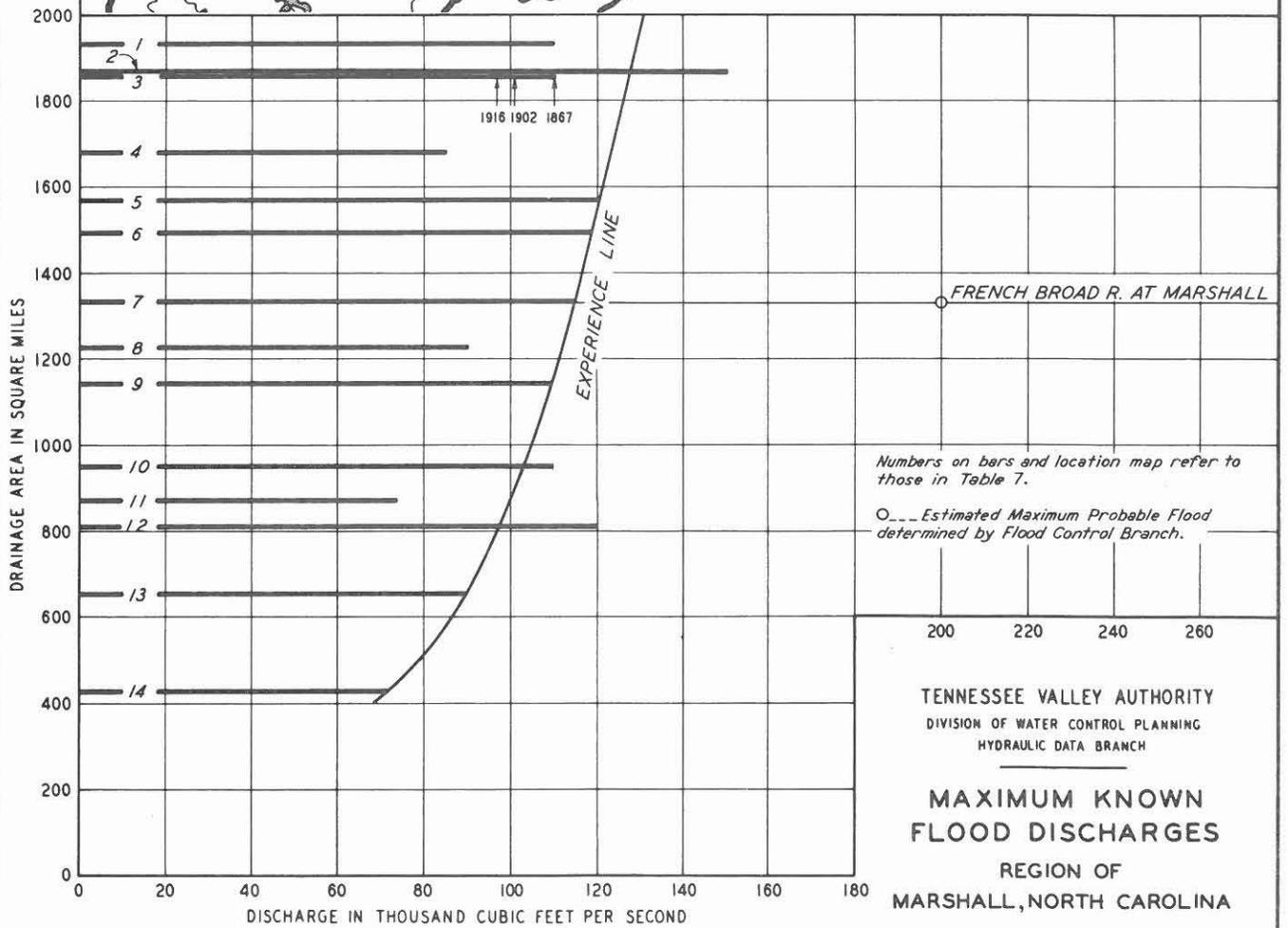
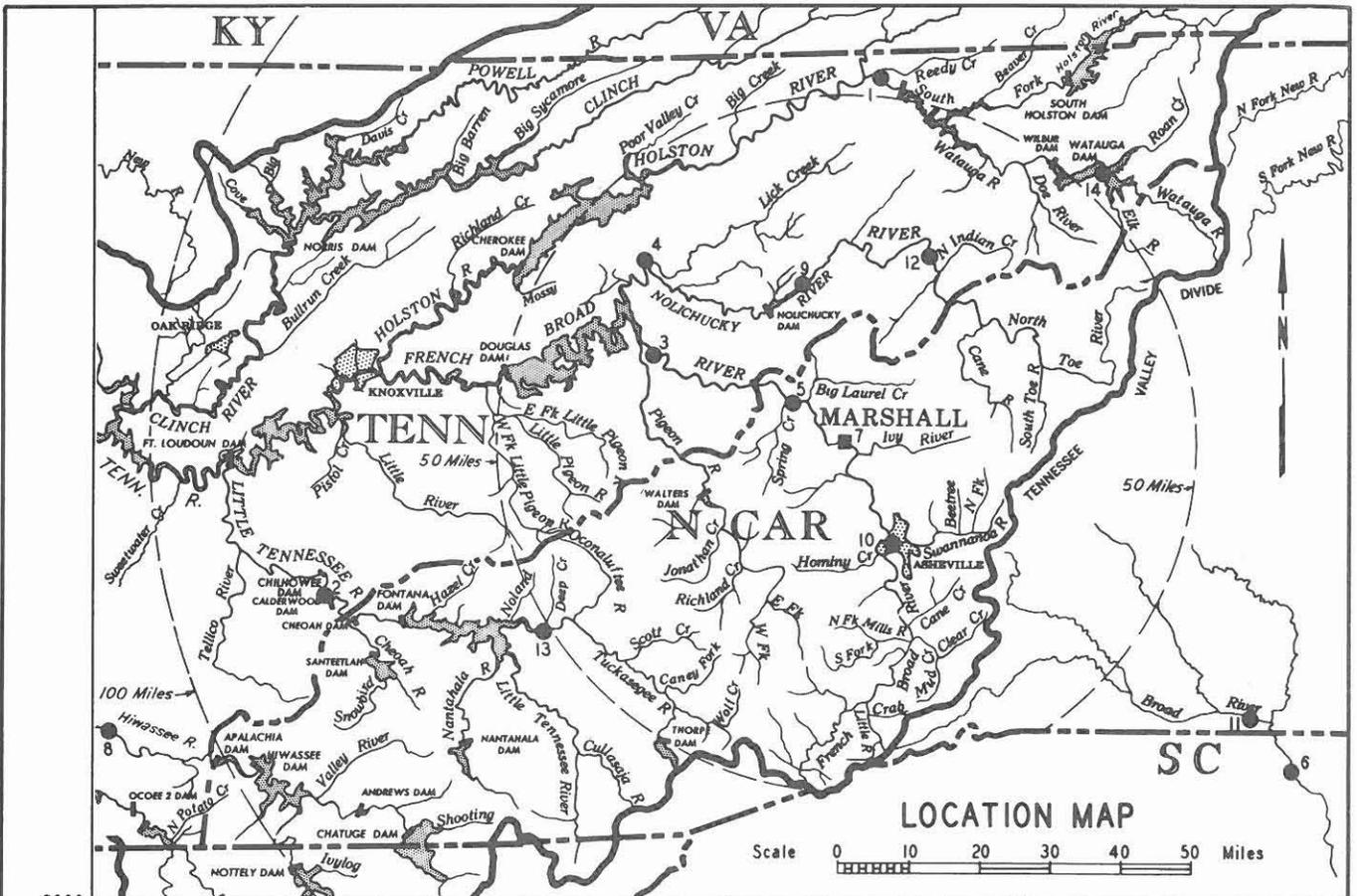
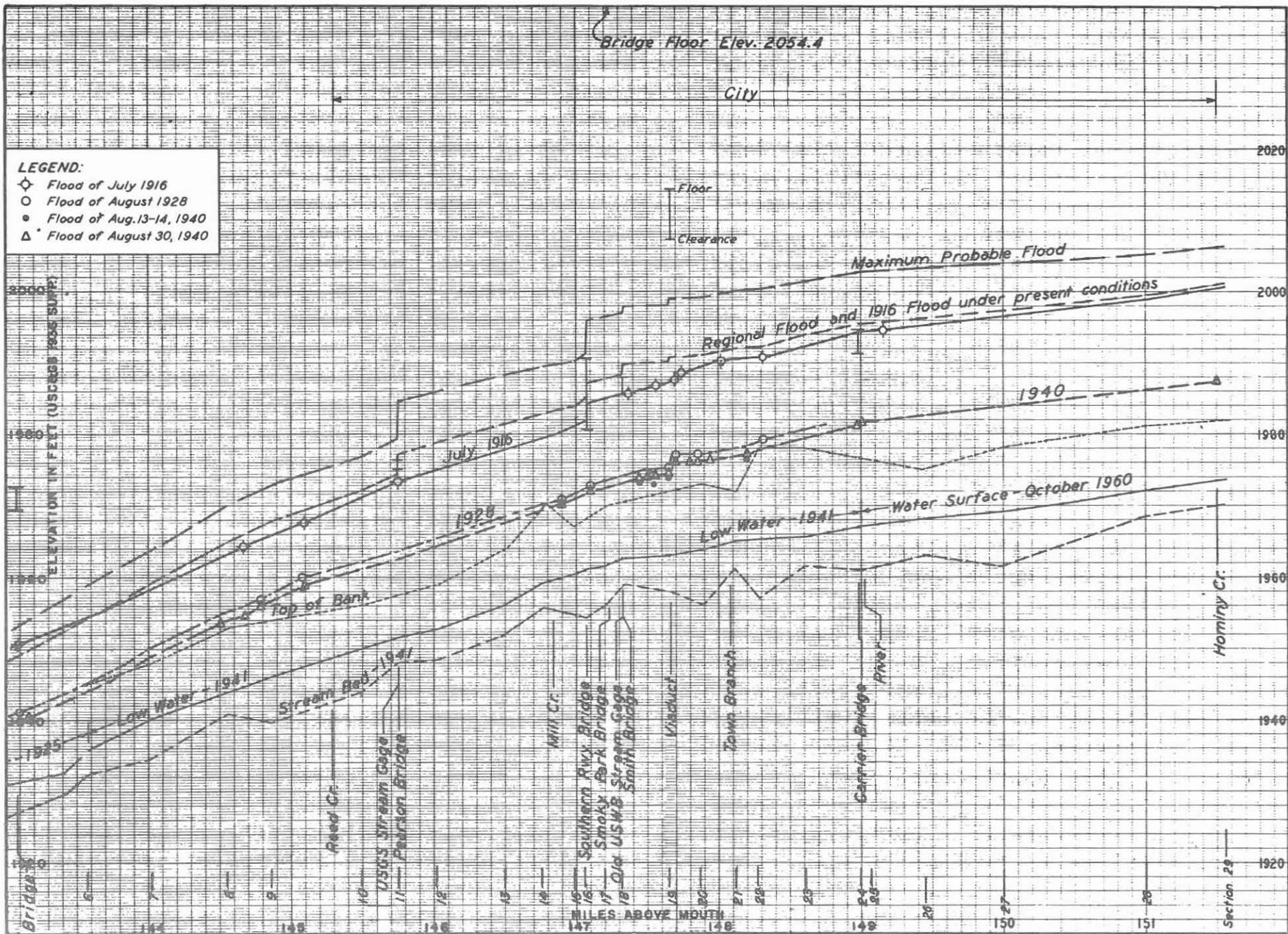
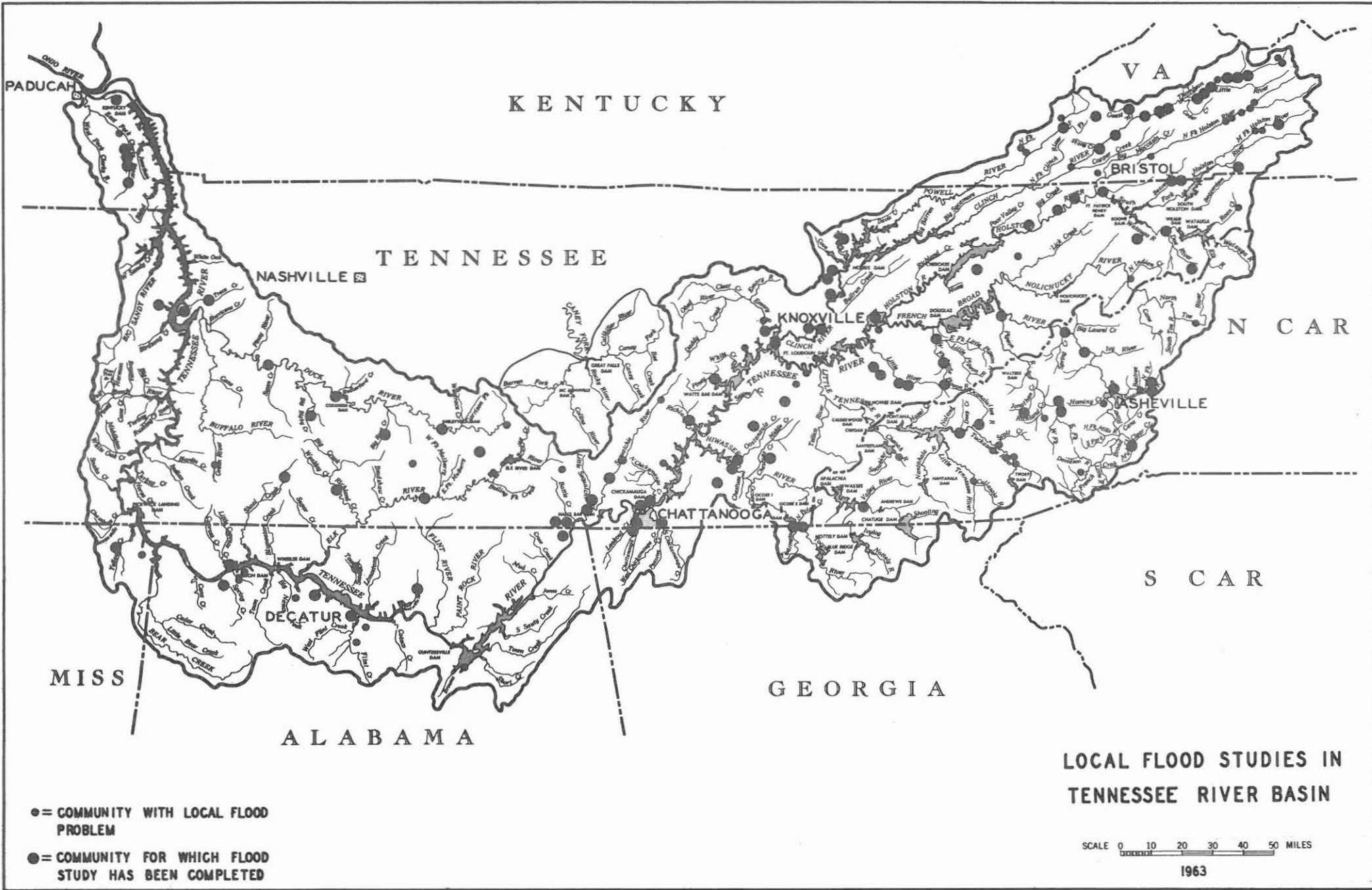


CHART USED IN DETERMINING REGIONAL FLOOD



PORTION OF A PROFILE SHOWING ELEVATIONS OF VARIOUS FLOODS



Studies are prepared at the request of the local communities and the respective state agencies. Reports are made available through the state agency to the local communities. Wide distribution is made locally by the local officials, distribution to state agencies is made by the respective agency with which TVA is working, and distribution to other Federal agencies such as Federal Housing Administration, Public Housing Administration, Urban Renewal Administration, Veterans Administration, Corps of Engineers, U. S Geological Survey, Soil Conservation Service, and others is made by TVA. To be of the greatest use to the greatest number of people, it is important that wide distribution be made.

Local planning studies are made by local communities using flood data in the reports along with other information pertaining to land use and requirements of their community. Flood control and other corrective measures as well as flood plain regulations and other preventive measures are considered. Planning assistance is provided by the local communities and/or the state planning agencies. TVA provides additional engineering assistance as well as limited planning and legal advice when such are requested. The engineering assistance includes the determination of effects of various sizes of floodways, interpretation of data, provision of detailed data not included in the reports, and assistance in obtaining additional field data. But decisions are made by local officials.

Flood plain regulations prepared and adopted generally include floodways for the passage of flood waters and designated elevations for guidance in erecting structures. Figure 5 also shows a floodway that is somewhat typical for a community. You will note that it also shows the area subject to inundation by the Maximum Probable Flood. This is important as many individuals, cities, and firms may wish to take little or no risk from flooding. Practically all of the communities in the Tennessee River Basin that have adopted regulations have used the Regional Flood, as in Figure 6, as the controlling minimum elevation for floor levels. All of the communities for which reports have been prepared have made use of the data. About half of them have started follow-up planning studies and about one-third of them have completed such studies. About thirty of them have formally adopted flood plain regulations.

In addition to the formal action taken by the communities, many, many types of informal public and private action have been taken. At Chattanooga and Dayton, Tennessee, and at Marshall, North Carolina, information in the respective reports was used to revise plans or locations for schools so they would be reasonably free from flooding. Large industries have utilized the information at Calvert City, Kentucky, a major chemical industrial complex, as well as numerous other sites. Individuals have planned and located homes at elevations free from floods. Shopping centers at Chattanooga and Knoxville, Tennessee, and Bristol, Virginia, to name a few, have planned their buildings at elevations above flood levels while utilizing lower areas for parking purposes. Insurance companies have used the flood information in determining whether or not they would help finance proposed developments. Federal agencies, such as the VA, FHA, PHA, and URA use the data in determining whether or not the Federal Government should insure or guarantee financing of developments in low areas.

Comprehensive Flood Damage Prevention for Local Communities

The objective of sound flood plain management is to develop the land to its best use and to meet the flood problem by combining the kinds of activities heretofore described into a comprehensive development program. Several communities in the Tennessee Valley are using this approach.

In these communities the legislative body, such as a city council, officially appoints a Flood Study Committee. The Committee studies flood control, flood proofing, flood forecasting, zoning, subdivision regulations, building codes, city policy in controlling extension of utilities, open spaces, parks, urban renewal, and other elements to determine the combination that will provide the best solution to the local problems. It determines a flood damage prevention program or plan and prepares a report and recommendations. Committee members are leading and respected citizens with varied occupations.

The Committee organizes work groups of other leading citizens to study the general fields of flood control, flood plain regulations, flood proofing, and urban renewal.

TVA, through the state agency, provides engineering and other technical assistance and guidance to the Committee and to each of the work groups. A TVA representative joins with state agency representatives to work with the Committee, arranging for and coordinating the type of assistance needed by each of the groups. He also coordinates TVA's activities with those of the state planning and other agencies that contribute to the Committee's study. Engineering determinations and studies are made by experienced TVA flood control engineers. However, the local communities assist in obtaining additional field information, such as elevations of structures, profiles, cross sections, and estimates of damages, with the guidance of an experienced TVA engineer.

The legislative body of the community considers the report and recommendations of its Flood Study Committee. The report is then forwarded to the Governor of the State and to the Chairman of the TVA Board of Directors, requesting that they undertake those portions of the plan which are appropriately the responsibility of the State and the Federal Government, respectively. Upon receipt of the request, TVA reviews the over-all plan and determines the action TVA should take. Cost sharing and other procedures are worked out with the local officials, and an agreement between TVA and the community is completed.

Such assistance has been given the twin cities of Bristol, Tennessee, and Bristol, Virginia. Similar studies are well under way at two other communities and four others have requested assistance of this type. Similar requests from other communities are expected.

National Program of Flood Plain Information Reports

There are two factors which condition administration and make problems of coordinating water resources development more pressing, noted by Lawrence L. Durisch, Chief of TVA's Government Relations and Economic Staff. One concerns the intergovernmental relations character of water resources and the many problems related to it. The other is the dominance of government in the area of water--no other aspect of our economy is more closely tied into governmental policy and administration than water. He further states that he sees no possibility for less governmental

action in the water field, and believes the prospect is for more. This leads to the conclusion that there must be a national flood damage prevention program.

Based on the successful experience of the cooperative program in the Tennessee Rivr Basin, TVA submitted a report to the Congress in 1959 recommending a national flood damage prevention program. In a subsequent report to the Senate's Select Committee on National Water Resources, TVA repeated the recommendations to the Congress. Public Law 86-645 of the 86th Congress authorized the Secretary of the Army through the Chief of Engineers to compile and disseminate information on floods and flood damages and to provide engineering advice to local interests when requested by a state or a responsible local governmental agency. This put into effect a part of TVA's recommendations for a national program. It makes it possible for the Corps to provide to the remainder of the country substantially the same kind of assistance that communities within the Tennessee Valley receive.

The Corps of Engineers initiated its nation-wide program late in 1961. Studies and reports are prepared in accordance with instructions contained in the Corps manual EM 1165-2-111, "Flood Plain Information Studies." More than 60 studies in 25 states and Puerto Rico are under way with several of them nearing completion. Nearly 50 additional requests for studies in these and other states have been approved and fiscal year 1964 will probably see an expanded program.

The U. S. Geological Survey also provides assistance in this field. That organization prepares flood-hazard maps showing areas inundated and elevations for selected historical floods. While useful guides, the maps do not supply the complete information as found in TVA or Corps reports. Also, the Survey's directive requires that communities must pay for fifty percent of the cost, whereas TVA and the Corps can provide studies to states and local communities without charge.

The Senate's Select Committee referred to above recognized and documented the need for a national, comprehensive program for water resources

development, including flood damage prevention. The Committee's report was printed as Committee Print No. 29 by the Senate of the 87th Congress, 1st Session, in 1961.

State and Local Preventive Actions

States have for years recognized in varying degrees the need for a nationally coordinated program with the states playing a greater role. The Council of State Governments called a special conference in December 1958, discussed it at other meetings, and again considered it in the December 1962 Conference. Conclusions and recommendations favoring an active, coordinated program were adopted.

Connecticut and ten other states have adopted encroachment statutes to preserve floodways for the passage of large flows. Illinois and a few other states have revised their statutes and regrouped their water resource agencies to give greater emphasis to prevention, along with corrective flood prevention measures, and to bring about closer coordination of effort within the state agencies. Tennessee and North Carolina have completed state-wide studies of the flood damage potential, the type of program necessary, and the respective roles of the local, state, and Federal governments in controlling developments in sensitive areas and protecting the freedom of operation of existing and proposed flood control projects. The states of New Jersey and Ohio have made somewhat similar studies and others have probably done so. California, Wisconsin, and Indiana are three other states that are taking action in this field.

Numerous cities and counties from the East Coast to the West and from our Canadian border to the Rio Grande have acted. Their actions vary from a barely acceptable minimum of controls to comprehensive and effective management. The rapidly increasing number of local governments that have become aware of their problems and are planning local programs is very encouraging. Those local programs vary from flood control alone to flood plain regulations alone to a coordinated program, including all elements and assistance by various levels of government.

Other Major Flood Plain Management Activities

Other flood plain management activities must be included in any regional, state, or national program pertaining to water resources development and flood damage prevention. There is a need in our complex urban-industrial society to relate water resources development to over-all development policies. The uses of water are related not only to flood control but to water supply, industry, and recreation. These, in turn, are directly related to highway location, parks, industrial sites, urban development, etc. In this framework the whole horizon of water resources development is broadened and the results of engineering work given greater utility.

An outstanding example of planning for sound development of the shoreline resource is the report, "Melton Hill Reservoir--Comprehensive Plan for Land Use Development," TSPC Publication No. 310. The Tennessee State Planning Commission coordinated this study in which other state and local agencies and TVA participated.

The study identifies the opportunities for industrial, recreational, transportation, and residential development which will be created by the reservoir. It recommends local actions such as zoning and the establishment of port authorities to protect shoreline lands. Counties and cities are already putting into effect some of these recommendations. Anderson County has adopted a zoning ordinance and Clinton has established a port authority.

Locating Highways--The natural conflicts of the gigantic national highway program with other possible uses of the relatively flat and open flood plains is a major problem that can be satisfactorily solved only through coordination at the higher levels of planning. Broad economic studies are needed to compare benefits of proposed highways to users and to the region with benefits of possible reservoirs or other uses.

Preserving Reservoir Sites--Planning and implementation of flood damage prevention projects involving dams and reservoirs generally require an extended period of time. Before the acquisition of lands can be started,

other developments in the proposed reservoir sites, such as industry, utilities, institutions, highways, or subdivisions may have increased the cost of the site so that it is no longer feasible. In many others such action has drastically reduced the benefit-cost ratio and the general value of the project. The Corps of Engineers in 1958 reported more than 35 prospective reservoir projects which had been lost or were in jeopardy for these reasons. The State of Oregon has compiled a list of 16 potential reservoir sites in that state which were not considered feasible due to relocation and acquisition costs at the time of investigation by Federal agencies. This emphasizes the great need for preserving important reservoir sites. A graduate student, George F. Olson, at the University of North Carolina, is conducting a limited research concerning the preservation of such sites. His report when it becomes available in the summer of 1963 is expected to make more people and especially officials aware of this need and such actions that merit further study.

Locating Industry--Industries have experienced the ravages of floods and today many are insisting on complete data which will permit them to select reasonably flood-free sites along navigation channels and elsewhere. Developments during this century have permitted greater latitude in the location of industrial plants.

It is possible for industry to take advantage of navigable waterways and still protect itself from unreasonable danger of floods. Since TVA was created in 1933, about 171 new waterfront industries and terminals have been established along the navigable waterway. These represent an investment of about \$876 million of private capital. Most of these plants have been established on flood-free sites and the remainder have located with full knowledge of the flood risk involved.

Sites uniquely qualified to serve industries requiring waterfront locations must be preserved for such industries. Industries not requiring waterfront sites should find other locations.

Industry is a little slow in making known its needs and as a result many desirable industrial sites along streams and reservoir shorelines are being used for residential purposes. States and others can do much to correct this situation by zoning. Federal, state, or local agencies can control this through ownership whenever they finance and construct a reservoir project. Public Law 86-645 gives the Secretary of the Army, through the Chief of Engineers, the right to convey by quitclaim deed to a state or other agency designated in the Law certain surplus real property in connection with the development of public ports or industrial facilities. This should open the way for other Federal agencies to work more effectively in protecting and making available industrial and port sites.

Recreation and Waterfronts--The continuing trends toward industrialization and urbanization have created new desires--even needs--for outdoor recreation to help relieve the stresses and strains of congested living. The mobility of Americans enables them to travel far afield in search of recreation. Whenever dams are built on the Nation's streams, recreation resources are created. In 1961 TVA issued a report, "Outdoor Recreation for a Growing Nation," telling how the recreation potentialities of TVA's multipurpose reservoir system have been developed for the use and enjoyment of the people of the Tennessee River Basin and of the Nation. It provides experience and suggestions that will be helpful to those people who are concerned as never before with expanding such opportunities throughout the Nation.

A report, "Outdoor Recreation for America," was transmitted to the President and to the Congress in January 1962. It was the culmination of a study by the Outdoor Recreation Resources Review Commission in fulfillment of Public Law 85-470. It surveyed our country's outdoor recreation resources, measured present and likely demands upon them during the remainder of this century, and recommended actions to insure their availability to all Americans of present and future generations.

Developments along the streams and along the shorelines of reservoirs can easily and quickly change the character of a region. Emphasis on recreation has led to rapidly expanding subdivisions along reservoir shorelines. It has also shown that there is generally inadequate access for the public. That is another reason for such studies as that for the Melton Hill Reservoir.

Uniform Federal Standards

The need for greater and more effective coordination in water resources development prompted the President to request a study by the four Secretaries who would comprise the Water Resources Council under the President's proposed Water Resources Planning Act. A report entitled, "Policies, Standards, and Procedures in the Formulation, Evaluation, and Review of Plans for Use and Development of Water and Related Land Resources," was submitted and approved in May 1962. It was printed by the U. S. Senate as Document No. 97 of the 87th Congress, 2d Session. The purpose of the report is to establish executive policies, standards, and procedures for uniform application in the formulation, evaluation, and review of comprehensive river basin plans and individual project plans for use and development of water and related land resources.

Man's Environment is Enriched

Benefits from the existing and proposed flood damage prevention programs and flood plain management include less waste, safer and fuller use of land, and greater funds available for supporting other development. Man's environment is improving as the program of flood damage prevention and flood plain management expands.