FLOOD DAMAGE ABATEMENT STUDY FOR VIRGINIA

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PREFACE

Floods and flood losses strike not just at the immediate victims, but at the entire economy of Virginia and at every Virginia taxpayer. Floods are a state problem, and for that reason this research was undertaken. This study gives a quick review of the national flood problem, a comprehensive review of the state problem, an identification of various programs which have attempted to ameliorate flood damages, and two major pieces of legislation which must be adopted if further progress is to be made in flood damage abatement. Floods are too big a problem to be handled piecemeal. Only when we shift from simply reacting to them to actually planning for them can we expect to make headway in reducing flood damage losses.

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. Flood plain occupation in which benefits do not exceed the estimated total costs (direct, indirect, and social) is undesirable, because it causes an eventual net loss to society. Any public policy encouraging submarginal development adds to those losses.

Nature will always extract some price for use of her flood plains. However, Virginia's annual flood damage bill is excessive, even in a growing economy. Direct damages from the August 20, 1969, flood were in excess of $90 million. Beyond the dollar loss, the accompanying toll in lives lost and personal hardship cannot be realistically calculated. In addition, opportunities are being lost to use flood plain lands effectively for recreation and wildlife purposes. To hold Virginia's toll of flood losses in check and to promote wise use of its valley lands requires new and imaginative action. The key to resolving the problem lies, above all else, in intelligent planning for state and local regulation of the use of lands exposed to flood hazards.

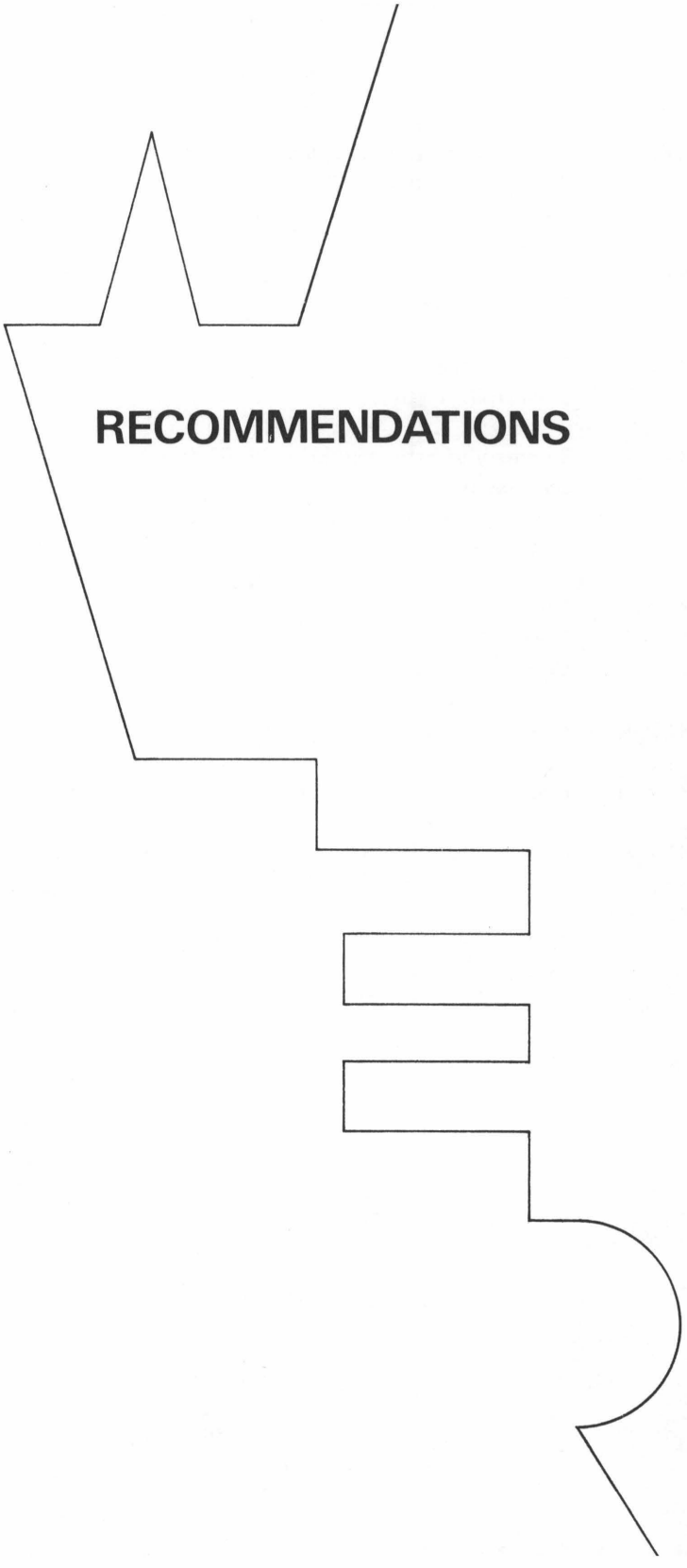
Two general recommendations are included in this report as initial steps to help achieve this objective. Appendices IV and VIII suggest a general outline of the legislation necessary for implementing the recommendations. These two measures may be controversial; however, the purpose is to boldly point out the path of progress for the public good without regard to special interests or inadequate but popular suggestions.

William R. Walker

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES



RECOMMENDATIONS

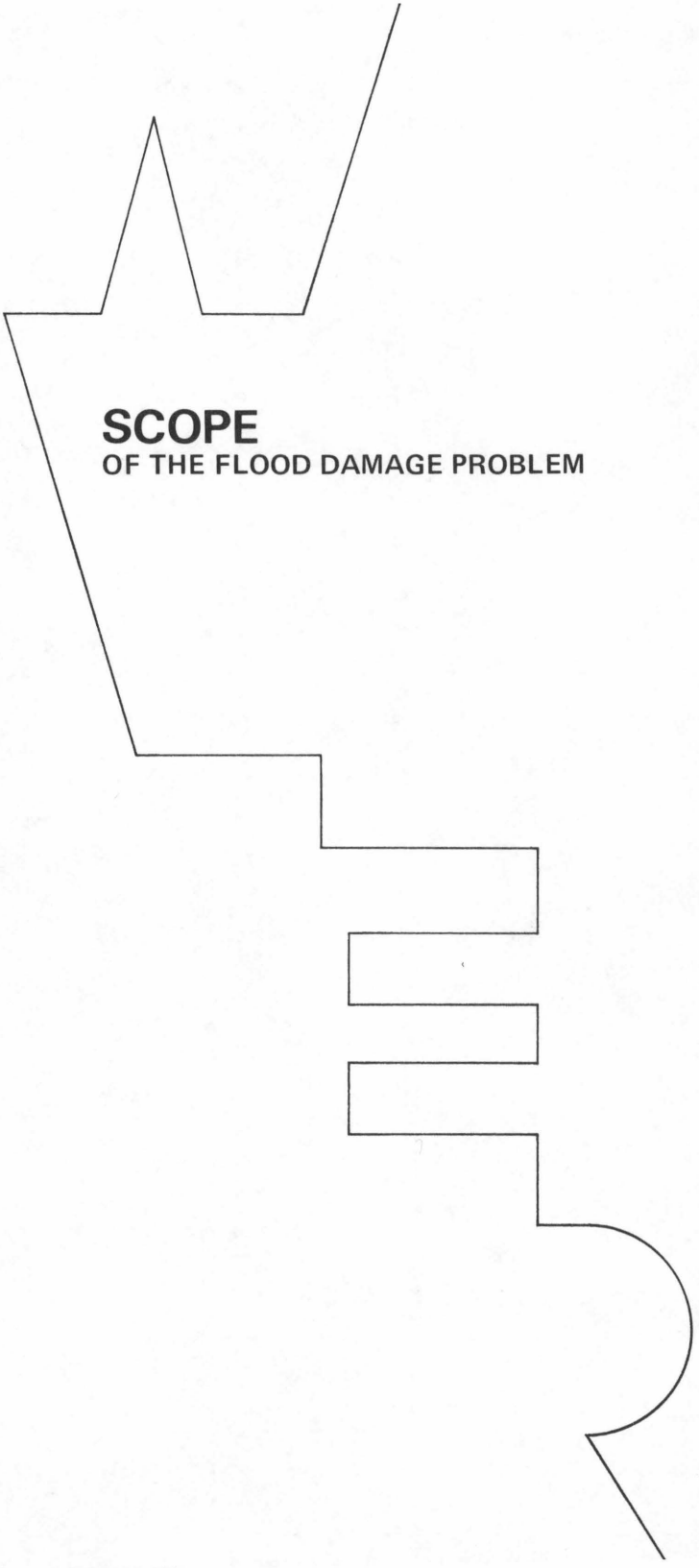
RECOMMENDATIONS

Virginia's response to the ever present flood damage problem has been to seek relief through federal agencies utilizing structural measures—dams, dikes, levees. As flood losses continue to rise, it becomes readily apparent that greater emphasis must be placed on preventive measures—land use controls, subdivision regulations, better building codes—if increased losses are ever to be reduced. The responsibility for implementing these corrective measures has been with local governmental units. They have not responded in the past and there is nothing to suggest that many will be responsive to the needs of the future.

The state is a unit of government with an overview of the total flood problem, with financial resources available to implement change, and with significant insulation from local pressures to carry out a program designed to benefit all the citizens of the Commonwealth.

The first step in a statewide program should be the enactment of appropriate encroachment legislation. Encroachments on the floodway significantly increase flood damages by raising the height of the water and increasing its velocity. The mere curtailment of further encroachment on the floodway and the elimination of some existing obstructions would significantly reduce Virginia's flood losses in the future. Appendix IV provides the format for basic legislation designed to control encroachment on the floodway. In addition, it contains discussion of the relevant issues which should have the attention of the General Assembly in formulating specific wording of the act.

The second item of legislation urgently needed by Virginia is a "Flood Hazard Area Management Act." Specific recommendations as to the form of this legislation is contained in Appendix VIII. The proposed legislation authorizes a state agency to study, plan, and regulate selected classes of uses in all flood hazard areas, to assist local units in developing regulatory programs, and to regulate general development in flood hazard areas if local units of government fail to adopt satisfactory regulations.



SCOPE
OF THE FLOOD DAMAGE PROBLEM

INTRODUCTION

Floods are natural phenomena and are said to occur when water flowing in a well-defined channel exceeds its banks, or when a body of water, such as an ocean or bay, experiences high tides as a result of severe storms or hurricanes. 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. Typically, a river uses some portion of its flood plain about once in two to three 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.

Floods become a problem to man only when he competes with rivers for the use of flood plains. This competition between man and the rivers has been long and costly.

Damages caused by flooding may be classed into four major groups: (a) direct damages accruing to inundated property, (b) indirect damages accruing to property not itself inundated, (c) secondary damages stemming from economic linkages, and (d) intangible damages for which a monetary value cannot be readily assigned. The results of flood damage include not only the necessity to repair and replace the property, but also the interruption of many normal business and social activities. Concurrent problems are flood fighting, disaster relief, and increased police and fire patrol. The losses may include deaths and human suffering.

To better understand the intensive use made of the flood plain, it must be put into historic perspective. When the first settlers reached the North American continent, they found themselves between the sea and a vast wilderness. The earliest interior settlements were located along the larger rivers because these constituted the only commercial highways down to the sea. Even after roads and wagons replaced rivers and boats as the main mode of transportation, valley bottoms remained the preferred locations for new settlements. Even today, cities retain their commercial importance because they are located on inland waterways over which freight can move at low costs. The increased fertility of the low lands was easily recognized over the uplands and agriculture flourished along the river bottoms. River bank locations became even more important with the development of manufacturing because of access to water power and lowered building costs afforded by the level terrain. The value of rivers and streams for the disposal of waste cannot be

overlooked. Railroad transportation again used the level terrain of the flood plain because of the significant cost advantages. By the time that highway transportation became important, it was committed to the flood plain to a considerable extent because the plains connected cities. The possibility of a change in the sites of cities becomes negligible after they have been settled.

A clear understanding of the flood plain occupancy is not complete without investigating the thinking of the people who reside on the lowlands. People are by nature traditional. This is particularly true with the lower income groups represented by farmers and factory workers, many of whom reside in flood plains. Such a situation is probably more realistic in the eastern part of the United States than in the more recently settled West. As most everyone tends to rationalize at one time or another a particular action, so also are the flood plain dwellers prone to justify short-term gains by seeking to minimize long-term losses.

It is interesting to note the reasons given by individuals for their continual use of the flood plain. A report by Burton and Kates[1] gives some of the common responses. These responses can be categorized into two general headings, eliminate the hazard of eliminate the uncertainty. Under the first category, people denied its existence--"We have no floods here, only high water," "It can't happen here," or they denied its recurrence--"lightning never strikes twice in the same place," "It's a freak of nature." Those people who rationalize their action in terms of eliminating the uncertainty (the second category) tended to make the uncertainty determinable or knowable--"Seven years of great plenty...after them seven years of famine," "Floods come every five years," or they would transfer uncertainty to the higher power--"It's in the hands of God," "The government is taking care of it." It was Josh Billings who said, "the trouble ain't ignorance, it's that so many people know what ain't so."

White, in a 1958 report[2],summarized the reasons for occupants utilizing the flood plain. It is because of (I) ignorance of the hazards and their actuarial costs, (2) over estimation of the degree of protection even a fully completed structural protection program can be expected to provide, (3) their ability to shift all or a substantial portion of the cost their occupancy of the flood plain entails either to taxpayers generally, to other members of the community ignorant of the risks assumed, and/or to subscribers to relief programs for their benefit, and (4) reception of benefits in some other way without the associated costs of a flood plain location being assumed.

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.

Considering the need to deal with the problem of flood damage prevention, two general points need to be made. First, we now live in a complex urban society, and the problems of floods are no longer the concern of one agency or of one level of government. Second, it is important to recognize that "flood control" and "flood protection" seldom provide complete protection. Structures afford a degree of protection only for a flood of a given magnitude and reduce the height or frequency of floods or both. Also, economic considerations frequently limit the degree of flood protection provided. Thus, there is generally a residual flood problem.

The traditional ways of reducing flood losses by public action are to reduce the area subject to overflow by engineering works and land treatment. The chief methods which technology provides are: (1) reducing flood runoff by land treatment, although this alone is effective only to a limited degree and in very rare situations; (2) reducing peak rates by storage of the flood runoff in reservoirs; (3) decreasing peak stages by increasing the channel capacity; and (4) confining the flow of water through the construction levees and walls. An engineering project may involve all four of these means or some combination of two or more of them.

The heavy emphasis upon engineering works for flood protection seems to have prevented, for a time, wider attention to the alternative of decreasing the flood damage by nonstructural measures. Studies of flood hazard areas also show that unless public policy is altered suitably, it may make it extremely difficult for a property owner to resort to other promising methods of flood-loss reduction. Indeed, as the society becomes more industrialized, there is a tendency to concentrate on a few solutions rather than the wide range, and it thus may follow that a rapid period of urbanization and industrialization may lead to a great increase in flood-loss potential, even though at the same time, public agencies devote large resources to flood control.

Flood protection can seldom be complete. There is always a probability that a greater flood will occur than has been experienced in recorded history. The provision of even a degree of flood prevention invites continued and increased use of the protected area; people tend to confuse a degree of protection with

complete protection. For example, the general public is sometimes badly misled because of the interpretation they give to a structure designed to protect against a 100-year flood. It is perfectly possible for 100-year floods to occur in successive years, or that a record kept for a century may not contain a true 100-year flood. The expression, "a one-hundred-year flood," means that if a record were kept for centuries, and the intervals between all floods exceeding that given size were determined and averaged, the average would be 100 years. Then when a flood occurs in excess of that for which protection has been provided, damage may be greater than if there had been no protection.

NATIONAL DAMAGES

The experience of the federal government in the building of flood control structures has not been a satisfactory one in terms of reducing total damages incurred from floods. This is extremely unfortunate since flood control was not considered one of the prime responsibilities of the central government, and upon entering the field, state governments and private citizens almost completely abdicated their responsibility.

With the adoption of the Federal Constitution and the creation of the Federal Government, it was generally considered that the latter would assume no responsibility for "internal improvements." Later, the Federal Government, under the Commerce Clause, assumed responsibility for improving navigability of rivers to encourage commerce among the states. With the passage of time, the problem of flood control became increasingly important and in 1917, the Congress authorized federal construction of flood protection works along the lower Mississippi and Sacramento Rivers. In 1928, with the construction of levees along the lower Mississippi, the Federal Government for practical purposes, assumed full responsibility for the control of the river. In 1936, the first general flood control legislation was enacted. This was the first of a series of acts commonly referred to as the Flood Control Acts--under which the U.S. Government has assumed responsibility for flood control on a national scale.

Congress stipulated in 1936 that the federal government would participate only in projects designed to protect cities and communities against catastrophic floods. But subsequent flood control acts become progressively broader in scope and now these acts constitute part of the main body of federal law dealing with development, utilization, and conservation of the nation's water resources.

An extremely important consequence of assumption by any central government of responsibility for protecting flood plain lands from overflow became evident soon after the United States adopted this policy. Since those who found it advantageous to utilize flood plain lands had been relieved of the necessity of bearing either flood damages or the cost of preventing these damages, there was a large increase in flood plain investment.

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.[3] In 1964 and 1965, estimated losses from inland floods were $652 million and $788

million respectively. The upward trend of such flood damage since 1903 can be calculated in a graduated scale as about 5.5 percent annually (an upward trend in real output per capita, also of somewhat less than 2 percent annually). There is considerable reason, however, to believe that even these estimates of inland flood damage are too low for the kinds of damage included. It is highly probable that the hundreds or thousands of very small floods each year are not fully reported, yet the aggregate damage from this type of flooding may be considerable.[4] Despite this massive investment, estimated annual losses from floods have shown an upward trend since 1936, as shown in Table I. 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.[5]

Although similar data are not available for damages due to unusual tides and waves resulting from hurricanes and other storms, evidence does exist to suggest a similar upward trend in the number of damaging coastal storms. Damages from Hurricane "Betsy" alone, in September 1965, ran to over $1 billion.

Available data also understate the full economic loss to society resulting from flood damage. When floods strike developed urban areas, regular activities are disrupted, productive capacity is impaired, and strategic transportation facilities cannot be used. Large, uncalculated losses of productivity and income--not fully reflected in reported flood losses--have undoubtedly occurred.[6]

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.

In 1957, the Corps of Engineers of the Department of the Army undertook a nationwide inventory of flood damages in the United States[7] estimated trends of flood plain development, and on the basis of these data, made a projection of "potential"[8] flood damage to the year 1980. The results of this study are shown in Figure 1. The uppermost curve indicates roughly how the potential average annual damage would have increased over the 50-year period 1930 to 1980, had no reservoir, levee, channel improvement, or similar projects been undertaken to reduce flood damages on portions of the nation's flood plains. To eliminate the effect of changing price levels, all values are expressed in terms of the value of the dollar in 1959.

TABLE I

Loss of Life and Property in the United States from Floods[a]

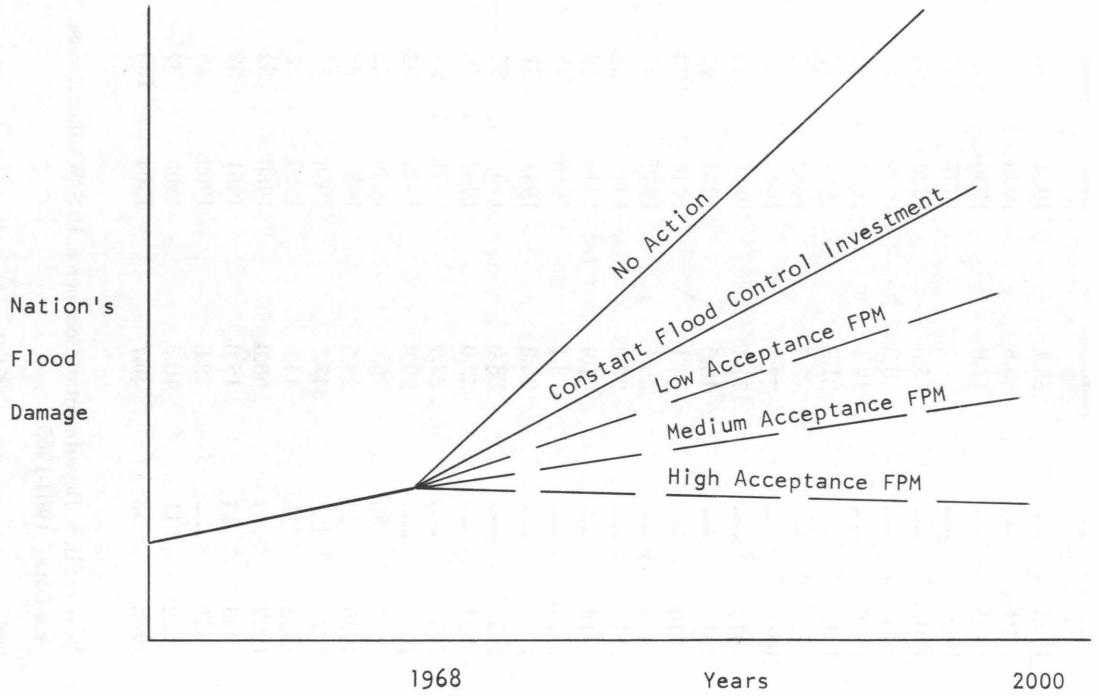
Year	Life	Property[b]	Year	Life	Property[b]
1903	—	53.1	1934	88	10.4
1904	—	6.5	1935	236	127.1
1905	—	11.0	1936	142	282.5
1906	—	.4	1937	142	440.7
1907	—	15.6	1938	180	101.0
1908	—	8.3	1939	83	13.8
1909	—	49.1	1940	60	40.5
1910	—	21.2	1941	47	39.5
1911	—	7.7	1942	68	98.5
1912	—	77.6	1943	107	199.7
1913	—	171.4	1944	33	101.0
1914	—	18.0	1945	91	165.8
1915	—	14.1	1946	28	70.8
1916	—	26.1	1947	55	272.3
1917	—	27.3	1948	82	230.0
1918	—	7.9	1949	48	93.9
1919	—	3.1	1950	93	176.0
1920	—	24.8	1951	51	1028.7
1921	—	28.6	1952	54	254.1
1922	—	52.0	1953	40	122.2
1923	—	33.9	1954	55	106.8
1924	—	29.8	1955	302	995.5
1925	36	9.9	1956	42	64.7
1926	16	23.5	1957	82	360.3
1927	423	347.7	1958	47	218.3
1928	15	44.6	1959	25	141.3
1929	89	68.0	1960	32	93.0
1930	14	15.8	1961	52	154.0
1931	—	2.8	1962	19	75.2
1932	11	10.3	1963	39	175.6
1933	33	36.7	1964	100	651.6

[a]Source: U. S. Department of Commerce, U. S. Weather Bureau, "Climatological Data," 1964-1965.

[b]Property loss in millions of dollars. Not adjusted to present price index, and excludes most upstream losses.

FIGURE 1

STRUCTURAL AND NON-STRUCTURAL ADJUSTMENTS TO FLOOD HAZARD



The lower curve indicates the approximate effect of engineering projects, constructed mainly by the Corps of Engineers, on the potential damage. This curve shows that the damage potential increased slightly, despite the expenditure by 1957 of over $3 billion for flood control projects (about 4.5 billion by 1959). The horizontal branch of the lower curve indicates that to hold the damage potential about constant would require an annual expenditure in the future of more than $300 million for new flood control works. The upper branch of the lower curve shows how the potential damage would increase if for some reason the federal flood control program had been stopped in 1957, but flood plain development had continued at previous rates.

The curves of Figure 1 reveal that, in terms of flood losses, the heavy expenditures being made by the U.S. Government are more than cancelled out by the effect of more intensive utilization of unprotected flood plains. Under 1938 conditions, the average annual economic loss to the nation was about $700 million. In 1980, it will be about $769 million if by that time a total investment of $11.5 billion (1959 dollars) has been made in flood control projects. This means that if future flood control efforts are confined to the construction of engineering works, while the nation's citizens continue to develop its flood plains without regard for the effect on flood losses, expenditures of federal funds will have to exceed $300 million annually, on the average, to keep flood losses from increasing. In other words, the cost to the nation of permitting uncontrolled development of flood plain lands averages more than $300 million annually.

One report notes:

> ...that while there has been a marked reduction in the frequency of loss of life from floods, the frequency of major property damage from floods has increased substantially. Floods causing damages of $50 million or more (based on 1959 dollars) were experienced during the period 1900-1940 on an average about once every six years. Since 1940, floods causing damage in this order of magnitude have occurred on an average of once in 2 years. Since there is no evidence that floods themselves are increasing in magnitude and frequency, this increase in occurrence of major property damage seems indicative of the rapid development and use of flood plains.[9]

At the national level, the increasing trend in flood damages is more clearly recognized than the "cause" factors involved. Studies made today in most areas would probably reveal much larger average annual damages, although in recent years there have been fewer large floods. Hoyt and Langbein offer the following explanation for the increase in property damages from floods:

> Of the increase in reported property damages by flood, we may ascribe about 45 per cent to the increase in property values, 25 per cent to an increase in the amount of flooding, and 30 per cent to an increase in building and other uses on flood-hazard lands.[10]

When the federal flood control program was first proposed, the economic argument advanced in its support was that such a program would eliminate a serious drain upon the nation's economy. Regardless of the causes of this drain, its reduction was, from an economic standpoint, obviously desirable if it could be accomplished at a cost less than the loss. But as indicated above, the economic loss to the nation has not been reduced. This calls into question the basic economic justification for the great investments the nation has made; for from the economic standpoint, it is one thing to eliminate a loss, and it is quite a different thing to invest a nation's wealth in a program which by encouraging continuation of the practices which gave rise to that loss, fails to stop the drain upon the economy. If present policies and programs continue, the more than $11 billion expected to be invested in federal flood protection projects by 1980 will have no more economic effect than would the simple transfer of that amount from the public treasury to the profits of those who have continued to develop flood plain lands.

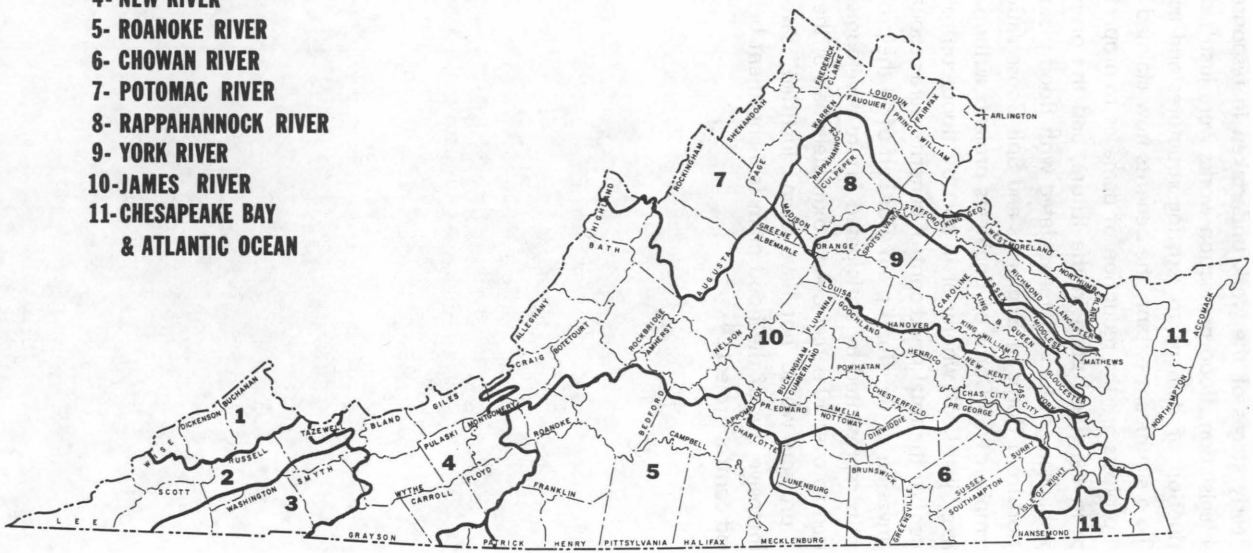
It will be obvious from the foregoing that a nation suffers an economic loss when it uses its flood plains to achieve an increase in production which could have been obtained at a lesser cost by the use of its uplands. But the owners of flood plain lands can gain even though the nation is losing. Moreover, communities located on flood plains can become better off economically while the nation is becoming worse off. In other words, there is, in general, a basic conflict between the national interest and both local community and private interests. It is because of this that the problem of flood plain regulation is so intractable from the standpoint of national policy. For, within limitations of whatever system of political principles a nation has adopted, it must find ways of bringing about such use of its flood plains as may best serve the national interest, and under any system, this is going to mean that it must thwart the aspirations of the few for the benefit of the many.

In the early stages of the work undertaken in response to the basic flood control legislation, flood protection works were justified in large measure by the reduction of damage to existing structures and activities in the flood plain. To a significant extent, the benefits now claimed in "justifying" flood control projects are the reduction of damages to properties anticipated to be in place in the flood plain in the future, and the projected increased land rents (enhancement benefits) associated with flood plain parcels that receive protection from Corps of Engineers and Soil Conservation Service programs. For example, of 59 Corps of Engineers projects authorized by the 1965 Act that were "justified" wholly or in part by flood control benefits, from 3 to 85 percent of the total flood control benefits were accounted for by expected future invasion of the flood plain. For half of all the projects, the proportion of benefits represented by anticipated future development in the flood plain amounted to over 40 percent. Approximately half of the single-purpose flood control projects would not have been "justified" save for the anticipated more intensive use of the flood plain (enhancement benefits) stimulated by the flood control projects.[11]

FIGURE 2

MAJOR RIVER BASINS

1 - BIG SANDY RIVER
2 - CLINCH RIVER
3 - HOLSTON RIVER
4 - NEW RIVER
5 - ROANOKE RIVER
6 - CHOWAN RIVER
7 - POTOMAC RIVER
8 - RAPPAHANNOCK RIVER
9 - YORK RIVER
10 - JAMES RIVER
11 - CHESAPEAKE BAY & ATLANTIC OCEAN



VIRGINIA DAMAGES

In Virginia, yearly flood damages have not been collected by any particular agency. Some work has been done by the Corps of Engineers, U.S. Weather Bureau, and Tennessee Valley Authority, but it has usually been limited to large floods. It is difficult, therefore, to analyze the damages and ascertain the presence of a definite trend. The estimated flood damages for Virginia for the years 1936 through 1963 are summarized in Tables II and III.

The flood prone areas of Virginia are not necessarily confined to particular regions, but are scattered throughout the state. An area is considered "flood prone" if it has experienced past floodings sufficient to be reflected in governmental reports submitted by the Corps of Engineers, Tennessee Valley Authority, Soil Conservation Service, U.S. Geological Survey, or U.S. Weather Bureau. The large losses are incurred in regions with cities and towns located on major rivers, along coastal areas or in small mountain valleys.

Potomac River Basin

The Potomac River has a fan-shaped basin covering portions of Maryland, West Virginia, Pennsylvania, and Virginia, and all of the District of Columbia. The basin area is 14,670 square miles, of which 5,690 square miles are in Virginia. The Potomac is formed by the confluence of its North and South branches which rise in West Virginia. Its largest tributary is the Shenandoah River (3,054 square miles drainage area) formed by the union of its North and South Forks at Riverton, Virginia.

The Potomac watershed lies in a region of comparatively high rainfall and on two of the paths followed by the great cyclonic storms. Since most of the area is mountainous or hilly with steep slopes and thin soil, conditions are favorable for rapid concentration of runoff. As a result, flash floods are frequent. At Great Falls the "flood stage" was exceeded 36 times in the 54-year period preceding 1932.[12]

March 1936 Flood

The March, 1936 flood was the largest of record on the main stem of the Potomac River and many of its tributaries. Two lives were reported lost at Washington as a result of the flood, and substantial damages were inflicted on agricultural land, industrial plants, commercial and residential establishments, and transportation and communication facilities.[13]

TABLE II

Property Loss Estimates in Virginia[a]

1936-1963

Year	Property Loss[b]	Year	Property Loss[b]	Year	Property Loss[b]
1936	$5,300	1945	$1,540	1954	$ 63
1937	1,400	1946	---	1955	10,695*
1938	460	1947	---	1956	---
1939	22	1948	---	1957	139
1940	4,000	1949	2,320	1958	---
1941	---	1950	1,203	1959	28
1942	4,100	1951	2	1960	211
1943	20	1952	---	1961	231
1944	2,000	1953	60	1962	---
				1963	5,937

[a]U.S. Weather Bureau, "Climatological Data, Virginia Section", 1936-1963.

[b]Property loss in thousands of dollars

[c]Figure is large due to Hurricanes Connie and Diane.

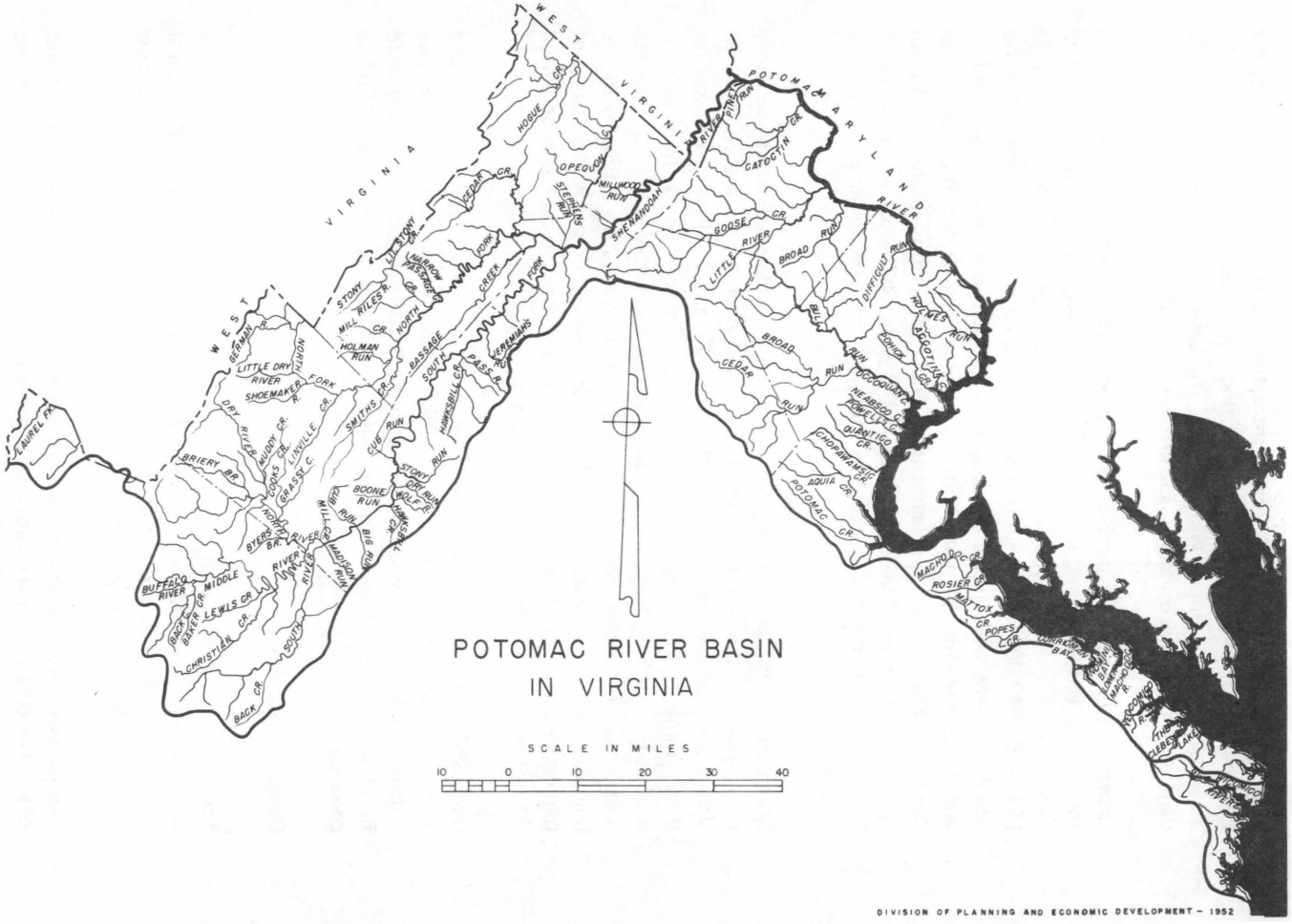
TABLE III

Significant Property Loss Estimates in Major River Basins of Virginia[a]

Floods	Rappahannock[b]	James[b]	Potomac[b]	Roanoke[b]
1936, March	---	$2,808	$2,271	---
1937, April	$1,401	---	---	---
1940, Aug.	---	943	---	$1,100
1942, Oct.	2,517	---	1,500	---
1944, Sept.	---	---	1,982	---
1949, June	---	8	3,100	---
1955, Aug.	2,832	202	6,719	---

[a]Figures derived from correspondence with U.S. Army Corps of Engineers, District Offices.

[b]Property loss in thousands of dollars.


WEST VIRGINIA
VIRGINIA
POTOMAC RIVER
MARYLAND
POTOMAC RIVER BASIN
IN VIRGINIA
SCALE IN MILES
10 0 10 20 30 40
DIVISION OF PLANNING AND ECONOMIC DEVELOPMENT - 1952

The U. S. Department of Agriculture estimated agricultural losses in the Potomac Basin to be $4,300,000. The flood occurred in the spring, so only 20 percent of the damage was to crops. The balance was in loss of livestock, damage to farm improvements, soil erosion, and sedimentation.[14]

Urban losses were extensive and large. Sixty-eight cities and towns throughout the watershed suffered monetary losses, and 29 communities had losses in excess of $10,000. Cumberland, Maryland sustained the largest single loss -- $2,047,000, exclusive of relief expenditures. Many municipal water supply systems were forced to suspend operation as a result of inundation, and some communities were without adequate water facilities for several days. The State Health Department innoculated persons in the flood areas against typhoid and thereby minimized the possibility of an epidemic.[15] Table IV shows the flood losses to the urban areas in Virginia that exceed $10,000.

Communications and travel throughout the watershed were seriously interrupted by the flood. Railroad companies operating in the Shenandoah Valley had damages which exceeded $331,000, and total railroad losses for the Potomac River basin ran to $1,510,000. Damage to roadway systems included everything from minor washouts on secondary roads to complete destruction of bridges on primary highways. Conservative estimates of the highway losses were placed at $2,020,000. Most all of the river crossings of telephone and power lines were washed out and many localities experienced disruption of service for sustained periods of time.[16]

Over 350 families were forced to leave their homes during the flood. Relief was provided by the Red Cross, Salvation Army, and local welfare organizations.[17] Table V shows the accumulated damages caused by the 1936 flood and Table VI gives an analysis of the damages in several Virginia counties.

October 1942 Flood

The October, 1942 flood exceeded the height of the 1936 flood in the Shenandoah River and its tributaries, but produced flows lower or identical to those in 1936 in the rest of the Potomac Basin. Three lives were lost during the flood and extensive property damages resulted.[18]

Almost every community in the Shenandoah Valley sustained some flood losses. The greatest concentration of urban damage was at Waynesboro, where the water was five feet deep in the main street. Damages at Washington were

TABLE IV
March 1936 Flood Losses to Urban[a]
Areas in Virginia

Urban Area	Stream	Flood Loss
Great Falls	Potomac	$35,000
Alexandria	Potomac	11,000
Riverton	South Fork Shenandoah	26,000
Waynesboro	South River	112,000

[a]U.S. Congress, House, Potomac River and Tributaries, Maryland, Virginia, West Virginia, and Pennsylvania, 79th Congress, 2d session, 1946, House Doc. 622, Table 12, p. 32.

TABLE V

March 1936 Flood Losses in the Potomac River Basin[a]

Stream	Area Inundated, Acres	Flood Losses (in thousands of dollars)					
		Crops	Other	Communi-cations and Utilities	Urban	Relief Expendi-tures	Total Flood Loss
Main Potomac	29,640	$169	$497	$1,384	$1,256	$ 59	$3,365
North Branch	9,280	54	156	424	2,532	160	3,326
South Branch	15,460	99	515	566	93	10	1,283
Shenandoah	4,800	29	185	106	16	5	341
North Fork	8,390	56	516	120	1	1	694
South Fork	9,190	55	370	128	29	---	582
South River	4,190	28	62	28	119	---	237
All other streams	62,250	391	1,121	1,168	116	7	2,803
Total	143,200	$881	$3,422	$3,924	$4,162	$242	$12,631

[a]U.S., Congress, House, Potomac River and Tributaries, Maryland, Virginia, West Virginia, and Pennsylvania, 79th Congress, 2d session, 1946, House Doc. 622, Table 13, p. 34.

TABLE VI

March 1936 Flood Losses in Virginia[a]

County	Area Inundated, acres	(Flood losses in thousands of dollars) Agricultural Crops	Agricultural Other	Railroads	Highways	Utilities	Residential	Commercial	Industrial	Public	Relief expenditure	Total flood loss
Alexandria (city)	30	--	--	--	--	--	--	6	5	--	--	11
Augusta	9,210	62	234	9	51	--	9	50	54	3	--	472
Clarke	2,490	15	96	--	9	--	--	--	--	--	--	120
Fairfax	550	3	10	--	5	--	5	30	--	--	--	53
Frederick	470	4	6	--	--	--	--	--	--	--	--	10
Loudon	5,730	25	72	--	12	--	--	--	--	--	--	109
Page	4,350	26	177	2	31	--	--	--	1	--	--	237
Rockingham	6,510	72	555	35	28	1	8	--	3	2	--	704
Shenandoah	6,230	10	91	--	65	42	--	--	--	--	--	208
Warren	4,930	31	218	6	49	--	10	8	24	--	1	347
Total	40,500	248	1,459	52	250	43	32	94	87	5	1	2,271

[a]U. S. Army Corps of Engineers, Potomac River Basin Report, 1963, Vol. IV, p. 45, Table 17.

greater than in the 1936 flood due to the concentration of temporary buildings and other war activities along the waterfront.[19] Table VII shows urban areas in Virginia with damages in excess of $10,000.

Agricultural losses were concentrated along the lower Potomac and Shenandoah Rivers. Estimates were placed at $1.8 million, 50 percent being attributable to crop damage. The crop damage was substantially larger than during the 1936 flood because it occurred later in the growing season.

Communications were also interrupted by the 1942 flood. The main railroad lines along the Potomac below Harper's Ferry were again out of service, and branch lines along the Shenandoah and its tributaries were damaged. Highway damage was extensive along the Shenandoah where many washouts of secondary roads occurred. Highway damage along the Potomac was small because many of the crossings which had been destroyed by the 1936 flood were reconstructed at considerably higher elevations.[20] Table VIII gives the accumulated damages caused by the 1942 flood to the Potomac Basin.

Other Floods

A flood in June, 1949 seriously affected the North River Basin and caused heavy damage in Bridgewater and Stokesville with each sustaining losses in excess of $1 million. So complete was the devastation at Stokesville that it has never been rebuilt.[21] Later that same year (August, 1949) Blacks Run Creek near Harrisonburg flooded causing $220,000 in damage.[22]

Determination of Future Flood Damage

The probable frequency of occurrence of various flood stages has been used in projecting the future monetary damage to property located on the flood plains of the Potomac Basin and is summarized in Table IX. Table X provides an approximation of property values located on the flood plains as of 1946. The Corps of Engineers has estimated average annual damages of $8,597,800 for a 50-year study period beginning in 1956, based on the frequency of flood discharge and the trends of flood plain development.[23]

James River Basin

The James River is formed by the junction of the Jackson and Cow Pasture Rivers four miles east of Clifton Forge. It flows easterly for a distance of 340 miles across the state (draining 10,060 square miles) and empties into the Hampton Roads arm of the Chesapeake Bay at Newport News.

TABLE VII

October 1942 Flood Losses to

Urban Areas in Virginia[a]

Urban Areas	Stream	Flood Loss
Alexandria	Potomac River	$16,000
Waynesboro	South River	149,000
Riverton	Shenandoah River	56,000
Elkton	South Fork Shenandoah	11,000
Front Royal	South Fork Shenandoah	59,000
Broadway	South Fork Shenandoah	19,000
Harrisonburg	Blacks Run	12,000

[a]U.S. Congress, House, Potomac River and Tributaries, Maryland Virginia, West Virginia, and Pennsylvania, 79th Congress, 2d Session, 1946, House Doc. 622, Table 14, p.35.

TABLE VIII

October 1942 Flood Losses in the Potomac River Basin[a]

Stream	Area Inundated, acres	Flood losses (in thousands of dollars)					
		Agricultural		Communications and Utilities	Urban	Relief Expenditures	Total flood losses
		Crops	Other				
Main Potomac	22,470	269	349	908	915	5	2,446
North Branch	170	0	0	30	144	14	188
South Branch	5,380	84	30	2	0	0	116
Shenandoah	5,000	67	60	54	81	1	263
North Fork	8,390	80	168	92	23	1	364
South Fork	9,190	78	77	146	92	2	395
South River	4,190	88	36	23	149	0	296
All other streams	20,210	267	176	0	38	2	483
Total	75,000	933	896	1,255	1,442	25	4,551

[a]U.S., Congress, House, Potomac River and Tributaries, Maryland, Virginia, and West Virginia, 79th Congress, 2d session, 1946, House Doc. 622, Table 15, p. 36.

TABLE IX

Flood Frequency, Potomac River Basin[a]

Flood Hazard Average Chance Of Occurrence (% per yr)	U. S. Geological Survey Stream-Gaging Stations						Average Occurrence Interval Years
	Cumberland, Md. Damage Stage, 17 Feet		Shepherdstown, W. Va. Damage Stage, 26 Feet		Washington, D. C. Damage Stage, 15 Feet		
	Gage Height (ft)	Discharge (cfs)	Gage Height (ft)	Discharge (cfs)	Gage Height (ft)	Discharge (cfs)	
100	15.1	17,900	16.8	63,400	10.9	102,000	1
50	18.8	27,100	21.8	95,700	14.0	154,000	2
20	22.6	42,600	28.7	151,000	18.5	242,000	5
10	24.8	55,300	32.4	186,000	21.9	314,000	10
5	26.7	68,300	35.9	242,000	24.9	388,000	20
2	28.9	86,000	40.2	304,000	28.2	488,000	50
1	30.2	99,700	43.0	353,000	31.4	566,000	100

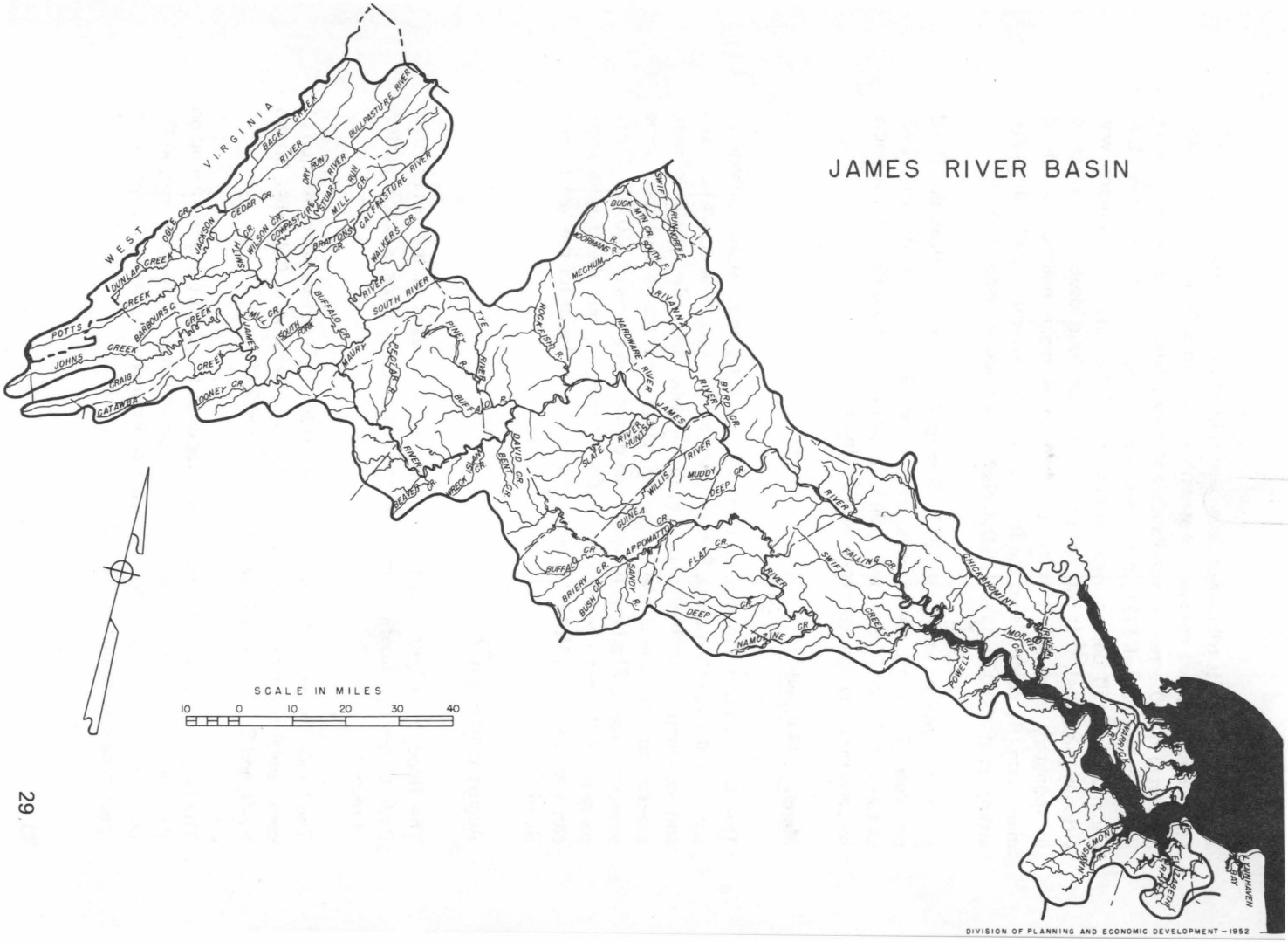
[a]U. S. Congress, House, Potomac River and Tributaries, Maryland, Virginia, West Virginia, and Pennsylvania, 79th Cong., 2d Session, 1946, House Doc. 622, p. 28, Table 9.

TABLE X

Property Values on the Flood Plain of the Potomac River and Tributaries[a]

River	Industrial	Commercial	Residential	Communications	Public Structures	Total
Potomac	$ 6,697,000	$ 4,735,000	$ 509,000	$130,830,000	$89,252,000	$232,023,000
North Branch	2,444,000	22,861,000	3,422,000	6,126,000	2,285,000	37,138,000
South Branch	297,000	287,000	190,000	855,000	306,000	1,935,000
Shenandoah and tributaries	26,368,000	1,552,000	291,000	3,477,000	262,000	31,950,000
Total Potomac and principal tributaries	35,806,000	29,435,000	4,412,000	141,288,000	92,105,000	303,046,000

[a]U.S., Congress, House, Potomac River and Tributaries, Maryland, Virginia, West Virginia, and Pennsylvania, 79th Congress, 2d session, 1946, House Doc. 622, Table 17, p. 41.


JAMES RIVER BASIN
VIRGINIA
WEST
SCALE IN MILES
10 0 10 20 30 40
DIVISION OF PLANNING AND ECONOMIC DEVELOPMENT - 1952

James River and its tributaries have been subject to many destructive floods. The oldest recorded comment was with respect to a flood in 1667 which inundated 6,300 acres of woodlands and swamplands. Many references are made to the flood of 1771, and it would appear to be the worst of record. A minimum of 150 persons were drowned and the city of Richmond was virtually destroyed.[24] It was not until 1936 that flood losses were expressed in monetary terms, but some old references make mention of flood magnitude. By comparison, the flood of 1771 in Richmond had a discharge estimated at 350,000 cfs to 175,000 cfs for the flood of March, 1936.[25]

In the ten year period, 1934-1944, Richmond averaged one damaging flood per year. The most severe ones occurred in March, 1936; August, 1940; October, 1942; and September, 1944. In two of these floods, five lives were lost and property damage exceeded $2 million.

March 1936 Flood[26]

This flood caused the loss of three lives and did considerable damage to agricultural and urban areas. Particularly hard hit were large industrial plants and commercial establishments. Both highway and railway traffic were interrupted for several days. Sixteen cities and towns sustained some monetary losses. Eight communities had damages in excess of $10,000. Forty percent of the total losses occurred in Richmond, but the biggest single casualty was Buena Vista. Table XI summarizes the losses for the James River Basin.

August 1940 Flood[27]

The flood of August, 1940 inundated the lower areas of the James River Basin below Lynchburg. Damage on the Appomattox River was the greatest of record.

The largest monetary losses occurred at Richmond with its concentration of commercial and industrial plants ($112,000). The towns of Columbia, Bremo Bluff, and Scottsville had losses in excess of $22,600.

The largest agricultural losses occurred between Lynchburg and Richmond on the Appomattox River. The flood occurred late in the growing season, so the crop damage was especially high. Damage from erosion, however, was not as great as caused by the 1936 flood.

TABLE XI

March 1936 Flood Losses in James River Basin[a]

Stream	Cleared Area Inundated, Acres	Flood Losses				
		Agricultural	Communications and Utilities	Urban	Relief Expenditures	Total flood losses
James River	29,100	$286,000	$741,000	$1,340,000	$50,000	$2,417,000
Jackson River	1,100	9,000	17,000	18,000	---	44,000
North River	1,100	29,000	21,000	154,000	3,000	207,000
Rivana River	1,200	12,000	---	2,000	---	14,000
Appomattox River	1,500[b]	16,000	4,000	---	---	20,000
All other streams	4,400	30,000	169,000	7,000	---	206,000
Total	38,400	$382,000	$952,000	$1,521,000	$53,000	$2,908,000

[a]U.S. Army Corps of Engineers, Survey Report on James River, Va., U.S. Engineers Office, Norfolk, Va., Vol. I, Sept., 1954, p. 36.

[b]6,300 acres of swampland and a woodland were also inundated.

Several highways on the flood plain of the James River were inundated, and sections of the Chesapeake and Ohio Railroad tracks were submerged preventing traffic movement. Near Richmond, the approaches to the Southern and Seaboard Railway bridges were inundated. Several hydroelectric plants were forced to suspend operation for several days due to the high water. Table XII shows losses for the James and Appomattox Rivers.

September 1944 Flood[28]

Two lives were lost in the flood of 1944 which was concentrated on the James River and its tributaries below Lynchburg. All of the communities along the James River between Buffalo River and Richmond sustained damages. Property loss was largely due to higher stages, a more rapid rise of the river, and a swifter current than in other floods. Flood warnings by the United States Weather Bureau and assistance from Army troops kept damages at Richmond to a minimum. Significant agricultural losses were sustained since the flood occurred during the crop season. Table XIII summarizes the losses on the James River.

Other Important Floods

The James River Basin did not experience another serious flood until 1950. During this flood major damage occurred on the western tributaries of the Maury River, especially on Kerrs, Buffalo, and Whistle Creeks. All gages on the James River below Lynchburg reported water above flood stage.

Some flooding occurred in 1955. Flood stages were exceeded at several points, including Scottsville, Bremo Bluff, Columbia, State Farm, and Richmond. River traffic was halted for a day and approximately 30 houses in the Richmond and Lynchburg area were washed away.

Serious flooding in the basin was reported in 1961, 1965, and 1966. In the 1961 flood, the James River overflowed its banks downstream from Scottsville, causing loss comparable to that experienced in 1955 and approaching the damages incurred in 1942 and 1944. Flooding during 1965 and 1966 was on the James River from Scottsville to Richmond and on the Rivanna and Jackson Rivers.

Table XIV expresses the probability of occurrence in any one year and the occurrence interval of certain river stages at various communities located along the James River. These flood hazards were determined by statistical analyses of the records of past floods in the James River Basin. All values in

TABLE XII

August 1940 Flood Losses in James River Basin[a]

Section of Basin	Cleared Area Inundated, Acres	Flood Losses				
		Agriculture	Communications and utilities	Urban	Relief Expenditure	Total Flood Loss
James River	24,400	$555,000	$ 72,000	$135,000	$27,000	$789,000
Appomattox River	3,500[b]	50,000	66,000	38,000	---	154,000
Total for basin	27,900	$605,000	$138,000	$173,000	$27,000	$943,000

[a]U.S. Army Corps of Engineers, Survey Report on James River, Va., U.S. Engineers Office, Norfolk, Va., Sept., 1945, p. 38.

[b]23,200 acres of swamp land were inundated in addition to cleared land.

TABLE XIII

September 1944 Flood Losses in James River Basin

Section of Basin	Cleared Area Inundated, Acres	Flood Losses			Relief Expenditures	Total Flood Losses
		Agricultural	Communications and Utilities	Urban		
James River	22,400	$757,000	$144,000	$142,000	$12,000	$1,055,000
Tributaries	1,400	27,000	818,000	82,000	---	927,000
Total for basin	23,800	$784,000	$962,000	$224,000	$12,000	$1,982,000

TABLE XIV

Flood Hazards in the James River Basin[a]

Flood Hazard, percent[b]	100	50	20	10	5	2	1	0.5	1936
Flood Hazard, year[c]	1	2	5	10	20	50	100	200	Stage
River stages in feet at:									
Covington above Dunlap Creek[d]	---	-8.2	-3.2	-0.5	1.5	4.1	5.9	7.8	0
Covington below Dunlap Creek	---	-5.9	-1.2	1.1	3.0	5.4	6.9	8.3	0
Lick Run[e]	14.8	17.5	21.1	23.8	26.5	30.1	32.7	35.5	25.6
Buchanan[e]	14.7	15.9	18.6	21.3	24.6	30.0	34.3	39.0	26.8
Holcombs Rock[e]	19.5	20.7	23.4	26.2	29.4	34.3	38.2	42.2	30.8
Lynchburg[f]	13.0	15.0	18.9	21.8	24.8	28.9	31.9	35.0	24.7
Bent Creek[e]	14.3	15.3	17.3	19.3	21.5	24.6	26.8	29.1	23.0
Scottsville[e]	17.7	19.2	21.6	23.7	26.0	28.7	32.2	35.0	25.5
Cartersville[e]	19.1	21.7	24.6	26.7	28.7	31.4	33.3	35.2	28.8
Richmond[f,g]	11.7	14.5	18.3	21.4	24.3	28.0	30.8	33.2	25.7
Buena Vista[e]	---	---	-4.0	01.3	+0.9	+3.7	5.6	7.3	0
Petersburg[e]	---	11.0	13.0	15.4	17.2	19.5	21.5	23.5	18.2[h]

[a]Based on current work being done by U. S. Army Engineers, Norfolk, District Office, as of July, 1967

[b]Average chance of occurrence in percent per year

[c]Average interval chance of occurrence in percent per year

[d]Referred to crest stage of 1936 flood in community named

[e]Referred to heights on U. S. Geological Survey Gage

[f]Referred to heights on U. S. Weather Bureau gage located at city lock since 1957

[g]For future navigation channel conditions expected

[h]Stage of August 1940 flood

the table indicate probable gage heights measured above the gage datum, with the exception of those given for Covington and Buena Vista. The values given for these localities are the difference between the probable river stages and the 1936 stage.

Roanoke River Basin

The Roanoke River Basin is located in the southern part of Virginia and the northern part of North Carolina. The basin is approximately 220 miles long and from 10 to 100 miles wide. It has a drainage area of 9,580 square miles, 6,160 square miles being in Virginia. The Roanoke River rises on the eastern slope of the Appalachian Mountains west of Roanoke, Virginia, and flows in a generally southeastern direction until it empties into Albemarle Sound near Plymouth, North Carolina. The principal tributary is the Dan River.[29]

Virginia historians have made mention of major flooding conditions when they occurred, the earliest reported being in August, 1650.[30] However, little data concerning damages which resulted from these floods are available.[31]

The Roanoke River is subject to frequent and intensive flood discharges at all seasons of the year. The chief characteristics of floods occurring in this basin are their rapid rise, short duration, and rapid subsidence. These features are caused by the fan shape of the upper watershed promoting the rapid collection and concentration of runoff.

Three distinct types of flood-producing storms occur over the basin. General winter rains occur during the months of December through March. These winter rains cover large areas and often include the entire watershed. Summer storms, including those of the thunderstorm type, make up the second category. This type is usually restricted to limited areas of the basin and occurs during the months of April through July. The third type, late summer and fall storms, occurs during the months of August through November. These storms, often caused by hurricanes, are likely to produce heavy rates of runoff, high stages of flow, and cause the greatest damage to crops.[32]

Flood damages occur throughout the watershed, but the major flood losses are confined to the basins of the main stems of the Roanoke, Dan, and Smith Rivers. The largest losses are agricultural and have occurred in the lower part of the Basin in North Carolina.[33] Damages to urban areas have been confined mainly to the lands along the Smith River. The urban areas in the Roanoke and Dan River valleys are affected mainly by floods of major magnitude.[34]

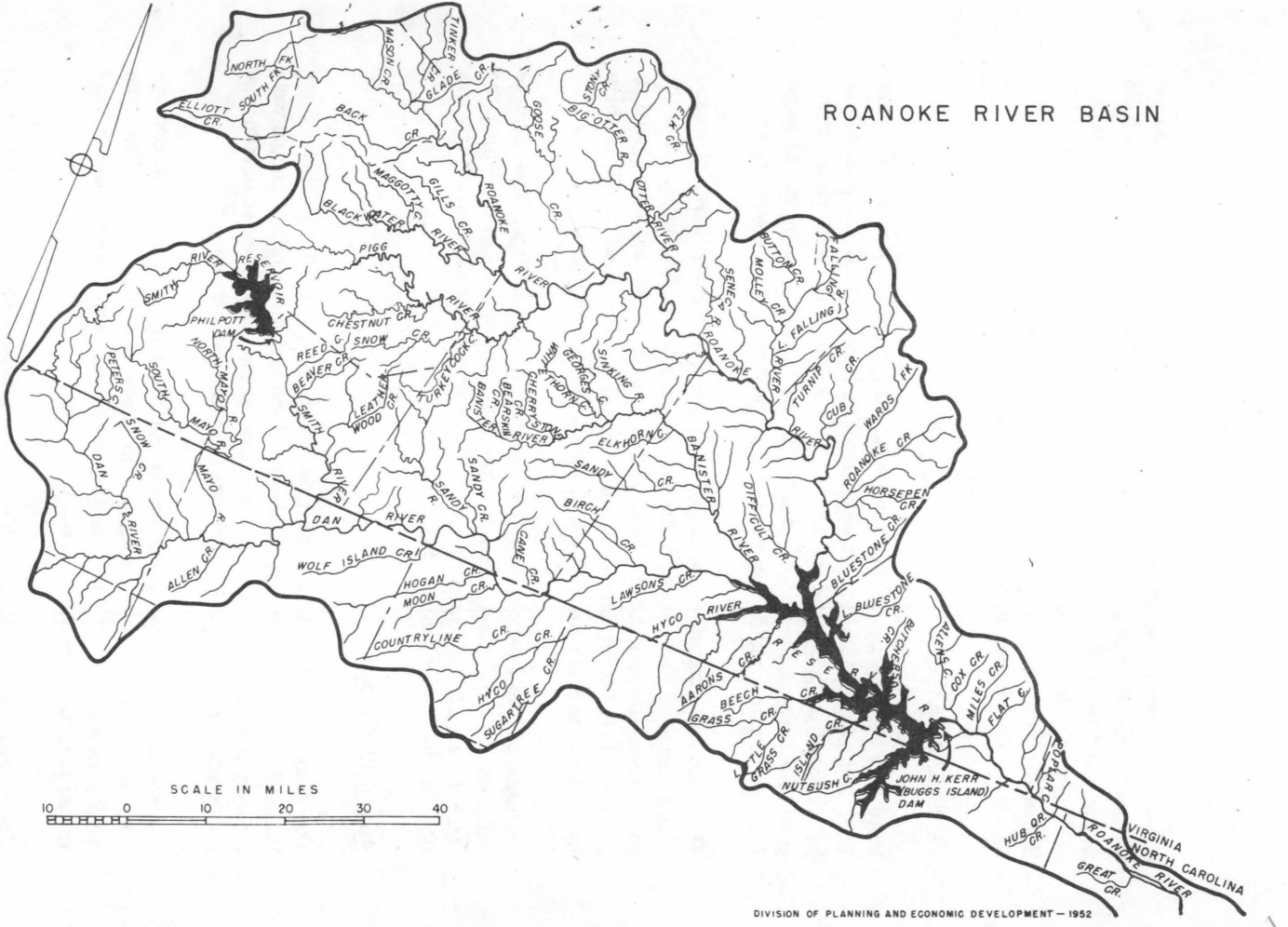

ROANOKE RIVER BASIN
SCALE IN MILES
10 0 10 20 30 40
DIVISION OF PLANNING AND ECONOMIC DEVELOPMENT — 1952
VIRGINIA
NORTH CAROLINA
ROANOKE RIVER
JOHN H. KERR (BUGGS ISLAND) DAM
PHILPOTT DAM
RESERVOIR
SMITH RIVER
NORTH FK
SOUTH FK
ELLIOTT CR
BACK CR
MASON CR
TINKER CR
GLADE CR
GOOSE CR
STONE CR
BIG OTTER R
ELK CR
OTTER RIVER
BLACK WATER
MAGGOTTY CR
GILLS CR
ROANOKE RIVER
PIGG RIVER
CHESTNUT CR
REED CR
SNOW CR
BEAVER CR
FEATHERWOOD CR
KARETOOK CR
BRANSTER CR
BEARSKIN CR
CHERRYSTONE CR
MILL THORP CR
GEORGES CR
SINKING R
SENECA
ROANOKE
BUTTON CR
MOLLEY CR
FALLING R
L. FALLING R
TURNIP CR
CUB
WARDS FK
ROANOKE CR
HORSEPEN CR
BLUESTONE CR
L. BLUESTONE CR
BLUESTONE
BLUE STONE CR
COA CR
MILES CR
FLAT CR
BEECH CR
GRASS CR
AARONS CR
LITTLE GRASS CR
ISLAND CR
NUTBUSH CR
POPLAR CR
HUB OR CR
GREAT CR
DIFFICULT CR
BANISTER RIVER
SANDY CR
SANDY R
ELKHORN CR
BIRCH CR
CANE CR
LAWSONS CR
HYCO RIVER
HYCO
SUGARTREE CR
COUNTRYLINE CR
MOON CR
HOGAN CR
WOLF ISLAND CR
ALLEN CR
DAN RIVER
DAN
MAYO R
SOUTH MAYO R
NORTH MAYO R
SNOW CR
PETERS CR

Table XV shows the estimated losses for the ten floods causing the greatest damage in the Roanoke River Valley, both upstream and downstream from Buggs Island from 1899 to 1928. The values for damage given in the first part of Table XV include only the damage occurring along the main stream. Damages occurring in the Dan and Smith River valleys as a result of these floods are given in the second part of the Table.

October 1937 Flood

More data are available on the damage resulting from the floods of October, 1937 and August, 1940 than from others. The flood of 1937 was precipitated by a warm front storm typical for the fall months of the year. However, the great intensity of the rainfall caused the small tributaries of the Roanoke River to overflow rapidly before drainage could alleviate the swelling waters.

The flood was especially destructive along the Smith River. Seven cities and towns sustained damage, with Bassett, Virginia being the hardest hit as the entire town was inundated. Many of the citizens of Bassett were forced to evacuate their homes, and food and clothing was furnished to 150 of these families by the Red Cross and the Civilian Conservation Corps.[35]

Damages on the Roanoke and Dan Rivers were not as large. Small damage occurred in two urban areas on the Dan, but municipalities along the Roanoke were not affected.[36] Table XVI depicts the damage inflicted by this flood to the various centers of damage.

August 1940 Flood

The flood of 1940 was the most severe on record for the Roanoke River Basin. Three lives were lost during the flood and thousands of people were made homeless. Large tracts of agricultural land, and numerous industrial plants and commercial establishments were overrun with water.[37]

Twenty-four cities and towns throughout the watershed sustained damage, varying from a few hundred dollars to almost a million dollars. The water supply systems of 10 cities were affected, and several municipalities were forced to suspend service for a week.[38]

Communication and transportation were disrupted for several days due to heavy flooding along highway and railroad bridges. Eight hundred telephones in Roanoke were put out of service, and power lines were washed out at Altavista, Brookneal, and Clarksville.[39]

TABLE XV

Estimated Losses from Past Floods[a]

Roanoke River Valley (main stream only)

Date of flood at Weldon, N. C.	Headwaters to Buggs Island			Buggs Island to Mouth		
	Crops	Other	Total	Crops	Other	Total
Aug. 18, 1940	$231,000	$547,000	$778,000	$1,027,000	$2,088,000	$3,115,000
May 25, 1901	(b)	---	---	399,000	130,000	529,000
Aug. 28, 1908	---	---	---	419,000	77,000	496,000
July 23, 1919	---	---	---	387,000	64,000	451,000
March 18, 1912	---	---	---	---	445,000	445,000
Aug. 16, 1928	148,000	96,000	244,000	351,000	54,000	405,000
Oct. 7, 1929	53,000	2,000	55,000	299,000	72,000	371,000
July 28, 1938	---	---	---	326,000	42,000	368,000
Oct. 8, 1902	---	---	---	280,000	64,000	344,000
Oct. 24, 1937	76,000	2,000	78,000	270,000	60,000	330,000

[a]U. S. Congress, House, Roanoke River, Virginia and North Carolina, 78th Cong., 2d session, 1944, House Doc. 650, pp. 38-39, Table 16.

[b]Necessary data for estimating damages not available.

TABLE XV Continued

Estimated Losses from Past Floods[a]

Dan and Smith River Valleys

Date of flood at Weldon, N. C.	Dan River Valley			Smith River Valley		
	Crops	Other	Total	Crops	Other	Total
Aug. 18, 1940	$206,000	$145,000	$351,000	$22,000	$182,000	$204,000
May 25,1901	---	---	---	---	---	---
Aug. 28, 1908	---	---	---	---	---	---
July 23, 1919	---	---	---	---	---	---
March 18, 1912	---	---	---	---	---	---
Aug. 16, 1928	42,000	5,000	47,000	18,000	63,000	81,000
Oct. 7, 1929	20,000	13,000	33,000	---	---	---
July 28, 1938	31,000	1,000	32,000	---	---	---
Oct. 8, 1902	---	---	---	---	---	---
Oct. 24, 1937	28,000	35,000	63,000	27,000	620,000	647,000

[a]U. S. Congress, House, Roanoke River, Virginia and North Carolina, 78th Cong., 2d session, 1944, House Doc. 650, pp. 38-39, Table 16.

TABLE XVI

October 1937 Flood Losses in the Roanoke River Basin[a]

Section of Basin	Damage Center	Cleared area inundated, acres	Flood Losses			
			Agricultural	Urban	All other property	Total
Roanoke River:						
Headwaters to Cub Creek	Rural area	6,200	$ 40,000	---	$ 2,000	$ 42,000
Cub Creek to Buggs Island	do	6,900	36,000	---	---	36,000
Buggs Island to Weldon	do	5,000	36,000	---	---	36,000
Weldon to mouth	do	15,000	292,000	---	2,000	294,000
Entire stream		33,100	$404,000	---	$ 4,000	$408,000
Dan River:						
Headwaters to mouth	Danville, Va.	100	---	$ 4,000	---	4,000
	S. Boston, Va.	80	---	1,000	--	1,000
	Rural area	10,000	45,000	---	13,000	58,000
Entire stream		10,180	$ 45,000	$ 5,000	$13,000	63,000
Smith River:						
Headwaters to mouth	Philpott, Va.	10	---	1,300	---	1,300
	Bassett, Va.	220	---	361,500	---	361,500
	Stanleytown, Va.	10	---	72,300	---	72,300
	Fieldale, Va.	50	---	105,100	---	105,000
	Koehler, Va.	40	---	23,600	---	23,600
	Martinsville, Va.	10	---	12,000	---	12,000
	Spray, N. C.	20	---	30,700	---	30,700
	Rural area	1,310	26,600	---	13,600	40,200
Entire stream		1,670	$ 26,600	$606,500	$13,600	$646,700
Total for Roanoke, Dan, and Smith River Valleys		44,950	$475,600	$611,500	$30,600	$1,117,700

[a]U.S., Congress, House, Roanoke River, Virginia, and North Carolina, 78th Congress, 2d session, 1944, House Doc. 650, p. 37.

Practically the entire agricultural crop on the flood plains of the upper Roanoke, Dan, and Smith Rivers was destroyed by the flood. These damages were not of major consequence, since the farm enterprise in this region is mainly situated above the flood plain and is not dependent for its continuity on the crops raised on the bottom lands. Agricultural damage was much more severe in the lower section of Roanoke where most of the farms are located entirely on the flood plain.[40]

Relief assistance required in the reaches of the Roanoke River above Weldon, North Carolina was small. Twenty families in Altavista received aid, but no relief services were required in the Dan and Smith River Basins.[41] Flood losses are given in Table XVII.

The estimated average annual flood losses in the Roanoke River are given in Table XVIII. They are based on the 1944 estimated value of all property located on the flood plains of the Roanoke, Dan, and Smith Rivers as shown on Table XIX. These values would not be representative for the present because of the construction of flood control works since 1944. In the event the prevention structure was not sufficient to prevent flooding, the damages would be accentuated because of the extensive development on the flood plains.

New River Basin[42]

The New River has its headwaters in Watauga County, North Carolina. From the North Carolina-Virginia state line, it flows northeasterly to Radford and then northwesterly to Glen Lyn where it enters West Virginia. At the West Virginia border, it turns northward and empties into the Gauley River to form the Kanawha, a tributary of the Ohio River.

The drainage area in Virginia is 3,070 square miles, with the maximum width (70 miles) at Rural Retreat, Virginia. Many of its banks are precipitous bluffs, and the side slopes are all steep. Because of this terrain and the steep gradient of the stream, the basin has a fast runoff, and the river has high velocities. From the confluence of the North and South Forks to Pearisburg, a distance of 157 stream miles, the river has an average fall of 6.3 feet per mile.

The main tributaries are Little River, Big Reed Island Creek, Wolf Creek, Reed Creek, and Walker Creek, located in 11 southwest Virginia counties. Due to the nature and presence of the underlying limestone, there is considerable seepage of water into the streambeds of these tributaries.

TABLE XVII

August 1940 Flood Losses in the Roanoke River Basin

Section of Basin	Damage Center	Area Inundated, Acres		Flood Losses	
		Cleared	Total	Agricultural	Communications and Utilities
Roanoke River:					
Headwaters to Cub Creek	Salem	190	190	---	---
	Roanoke	230	230	---	21,100
	Altavista	110	110	---	---
	Rural area	7,700	15,600	136,000	54,200
Cub Creek to Buggs Island	Randolph	10	10	---	---
	Clarksville	40	40	---	---
	Rural area	8,200	18,500	144,000	57,800
Buggs Island to Weldon	Roanoke Rapids	140	140	---	138,000
	Weldon	150	150	---	---
	Rural area	5,900	18,700	75,000	91,000
Weldon to Mouth	Williamston	250	250	---	---
	Jamesville	10	10	---	---
	Plymouth	80	80	---	---
	Rural area	44,000	208,800	1,476,000	185,000
Total		67,010	262,810	$1,831,000	$548,100
Dan River:					
Headwaters to Mouth	Madison	20	20	---	---
	Leaksville	40	40	---	---
	Danville	110	110	---	---
	S. Boston	100	100	---	---
	Rural area	14,200	28,700	244,800	73,200
Total		14,470	28,970	$244,800	$73,200

TABLE XVII CONT'D

Section of Basin	Damage Center	Area Inundated, Acres		Flood Losses	
		Cleared	Total	Agricultural	Communications and Utilities
Smith River:					
Headwaters to Mouth	Bassett	80	80	---	---
	Stanleytown	10	10	---	---
	Fieldale	20	20	---	1,000
	Koehler	20	20	---	---
	Martinsville	10	10	---	---
	Spray	20	20	---	---
	Rural area	1,200	1,660	22,000	2,000
Total		1,360	1,820	$22,000	$3,000
Smaller Streams:					
Headwaters to Mouth	Saxe	30	30	---	---
	Windsor	30	30	---	---
	Stuart	10	10	---	---
	Mayodan	10	10	---	---
	Rural area[a]	33,620	62,060	705,700	116,500
Total		33,700	62,140	$705,700	$116,500
Total for Basin		116,540	355,740	$2,803,500	$740,800

[a]Damage to rural areas on 32 small tributaries as estimated by the U.S. Department of Agriculture.

TABLE XVII CONT'D.

August 1940 Flood Losses in the Roanoke River Basin

Section of Basin	Damage Center	Flood Losses: Urban Areas: Domestic	Municipal	Commercial	Industrial	Relief Expenditures	Total Loss
Roanoke River:							
Headwaters to Cub Creek	Salem	3,300	200	200	1,000	---	4,700
	Roanoke	1,900	3,100	44,400	172,500	---	243,000
	Altavista	800	600	2,200	106,300	2,000	111,900
	Rural area	---	---	---	---	700	190,900
Cub Creek to Buggs Island	Randolph	200	---	2,600	---	---	2,800
	Clarksville	---	100	1,200	--	---	2,300
	Rural area	---	---	---	---	300	202,100
Buggs Island to Weldon	Roanoke Rapids	1,200	3,100	3,000	815,700	---	961,000
	Weldon	8,600	4,000	9,300	90,100	---	112,000
	Rural area	---	---	---	---	2,000	168,000
Weldon to mouth	Williamston	2,200	2,000	1,100	92,700	---	98,000
	Jamesville	---	---	1,000	2,000	---	3,000
	Plymouth	---	200	7,400	50,400	---	58,000
	Rural area	---	---	---	---	52,000	1,173,000
Total		18,200	13,300	72,400	1,330,700	57,000	3,870,700
Dan River:							
Headwaters to mouth	Madison	---	---	500	---	---	500
	Leaksville	100	---	---	---	---	100
	Danville	---	9,200	4,400	5,900	---	19,500
	S. Boston	1,600	300	3,400	7,500	---	12,800
	Rural area	---	---	---	---	---	318,000
Total		1,700	9,500	8,300	13,400	---	350,900

TABLE XVII CONT'D.

Section of Basin	Damage Center	Flood Losses Urban Areas: Domestic	Municipal	Commercial	Industrial	Relief Expenditures	Total Loss
Smith River:							
Headwaters to mouth	Bassett	11,000	4,000	6,000	11,000	---	32,000
	Stanleytown	---	---	---	12,000	---	12,000
	Fieldale	2,000	---	---	7,000	---	10,000
	Koehler	1,000	---	5,000	---	---	6,000
	Martinsville	---	---	---	1,000	---	1,000
	Spray	---	---	1,000	118,000	---	119,000
	Rural area	---	---	---	---	---	24,000
Total		14,000	4,000	12,000	149,000	---	204,000
Smaller Streams:							
Headwaters to mouth	Saxe	3,100	---	13,900	3,500	---	20,500
	Windsor	---	---	1,300	700	---	2,000
	Stuart	---	---	4,200	---	---	4,200
	Mayodan	---	---	---	3,000	---	3,000
	Rural area	---	---	---	---	---	822,200
Total		3,100	---	19,400	7,200	7,200	851,900
Total for Basin		37,000	26,800	112,100	1,500,300	57,000	5,277,500

TABLE XVIII
Estimated Average Annual Damages[a]

River Valley	Computed Annual Damages		
	To Crops and Farm Improvements	To All Other Developments	Total
Roanoke	$229,300	$93,950	$323,250
Dan	31,300	15,950	47,250
Smith	7,500	146,800	154,300
Roanoke, Dan and Smith	268,100	256,700	524,800

[a]U.S. Congress, House, Roanoke River, Virginia and North Carolina, 78th Congress, 2d session, 1944, House Doc. 650, Table 14, pp. 34-35.

TABLE XIX
Values of Property on the Flood Plains of the
Roanoke, Dan, and Smith River Valleys[a]

River Valley	Value of Property[b]						
	Industrial	Commercial	Residential	Communications and Utilities	Public Structures	Farm Improvements	Total
Roanoke[c]	$35,601,000	$1,552,000	$966,000	$7,312,000	$2,417,000	$1,111,000	$48,959,000
Dan[d]	5,284,000	91,000	27,000	2,646,000	1,097,000	218,000	9,363,000
Smith[e]	8,664,000	1,030,000	658,000	855,000	841,000	---	12,048,000
Roanoke, Dan, and Smith	49,549,000	2,673,000	1,651,000	10,813,000	4,355,000	1,329,000	70,370,000

[a]U.S. Congress, House, Roanoke, Virginia and North Carolina, 78th Congress, 2d session, 1944, House Doc. 650, Table 14, pp. 34-35.

[b]Land values not included

[c]Property values within area inundated by 1940 flood

[d]Ibid.

[e]Property values within area inundated by 1937 flood

DIVISION OF PLANNING AND ECONOMIC DEVELOPMENT — 1952

The Virginia Division of Water Resources has calculated on the basis of past records that a flood on the main stem of the New River, causing minor damages (less than 20 percent of the highest known flood damage in New River), has a frequency of occurrence of once in 30 to 40 years. Floods causing greater than 60 percent of highest known flood damage to the River have a frequency of occurrence of once in 100 to 130 years. The mean, or 2.33-years flood, will probably not cause any damage along the main stem of the New River. From the standpoint of flood frequency, the need for flood control measures on the main stem of the river is questionable. For floods exceeding one-in-five-years frequency on the tributaries of New River, see Table XX.

Flood Damages[43]

The average annual damages from floods in the New River Basin of Virginia approximate $471,000. Of this amount $57,000 to $69,000 occurs along the main stem and $414,000 on the tributaries. The major portion of the flood damages on the main stem of New River occurs between Radford and Glen Lyn. Although a highly developed area, the average annual damage near Radford is only $15,446. The infrequency of damaging floods seems to indicate that there is not a serious flood damage problem in this area which cannot be corrected with good basin planning. Tables XXI, XXII, and XXIII summarize these damages.

The flooding problem at Bluefield is caused by the high flows in the Upper Bluestone River and Beaver Pond Creek. Records indicate that damaging floods occur every two or three years. The flood losses are high for this area because most of the land suitable for development lies in the flood plain and has, in fact, been substantially developed.

The town of Pulaski, divided by Peak Creek and its tributaries, has many problems. However, the losses are not as large as at Bluefield, West Virginia, because less of the land on the flood plains has been developed, and major floods have not been as frequent.

Tennessee River Basin

The Tennessee River Basin covers 3,167 square miles of Virginia and includes all or parts of ten Virginia counties. This area is drained by four main streams, the North and South Forks of the Holston River, and the Clinch and Powell Rivers. Important tributaries of these streams include the Middle Fork of the Holston River, Cooper Creek, Moccasin Creek, and Guest River.

TABLE XX

Floods Exceeding One-In-Five-Year Frequency
Tributaries to New River in Virginia[a]

Tributary and location of stream gaging station	[b]Discharge for one-in 5-year flood - cfs	Years in which one-in-5-year flood has been equaled or exceeded
Chestnut Creek at Galax, Va.	2,000	1940, 1947, 1949, 1950, 1952, 1954, 1959
Reed Creek at Grahams Forge, Va.	8,200	1913, 1916, 1935
Big Reed Island Creek near Allisonia, Va.	9,000	1916, 1940, 1947, 1950, 1952 1954, 1959
Peak Creek at Pulaski, Va.	2,750	1927, 1929, 1954, 1955, 1957
Little River at Graysonton, Va.	9,500	1929, 1932, 1934, 1937, 1940, 1945, 1950, 1957, 1959
Walker Creek at Bane, Va.	9,600	1940, 1944, 1946, 1949, 1955, 1957
Wolf Creek Near Narrows, Va.	7,600	1913, 1916, 1944, 1948, 1955, 1957, 1961, 1963

[a]Virginia Department of Conservation and Economic Development, Division of Water Resources. New River Basin Comprehensive Water Resources Plan, IV, Planning Bull. 204 (July, 1967) p. 122.

[b]From Volume III, Plate 56.

TABLE XXI
Flood Damages - Main Stem New River[a]

Stretch of River Gaging Station in Parenthesis	Miles above Mouth of New River	Year of Flood	Damage in 1964 Dollars	Flood Frequency	Annual Probability	Annual Damage Probability	Totals
W. Va. line to Glen Lyn (Glen Lyn)	87-94	1878	---	1:103	.00971		
		1916	---	1:100	.01000	---	1,460[b]
		1940	---	1:114	.00877		
		other	---	---	---		
Glen Lyn to Cowan (Eggleston)	94-130	1878	925,000	1:110	.00909	8,410	
		1916	725,000	1:105	.00952	6,900	29,216
		1940	1,350,000	1:120	.00834	11,250	
		other	---	---	---	2,656[c]	
Cowan to Claytor Dam (Radford)	130-151	1878	535,000	1:112	.00893	4,780	
		1916	517,500	1:107	.00935	4,840	15,466
		1940	567,500	1:128	.00782	4,440	
		other	---	---	---	1,406[c]	
Claytor Dam to Jackson Ferry (Allisonia)	151-184	1878	22,500	1:67	.01493	336	
		1916	44,000	1:96	.01042	459	1,447
		1940	67,500	1:130	.00770	520	
		other	---	---	---	132[c]	
Jackson Ferry to Rt. 221 Crossing (Ivanhoe)	184-211	1878	115,000	1:70	.01430	1,645	
		1916	270,000	1:99	.01111	3,000	8,805
		1940	420,000	1:125	.00800	3,360	
		other	---	---	---	800[c]	
Rt. 221 Crossing to N.C. line near Mouth of Wilson (Galax)	211-247	1878	---	1:65	.01539		
		1916	---	1:95	.01053	---	880[d]
		1940	---	1:120	.00834		
		other	---	---	---		

[a]Estimated 15,000 acres of floodplain.

[b]Estimated total annual damage as 5% of next upstream stretch.

[c]Estimated annual damage as 10% of that from 3 major floods.

[d]Estimated total annual damage as 10% of next downstream stretch.

NOTE: This table based on stage-damage curve prepared by Huntington Corps of Engineers using March 1964 data and on frequency analysis developed by the Division of Water Resources.

TABLE XXII
AVERAGE ANNUAL FLOOD DAMAGES - NEW RIVER BASIN

Based on Years of Record & Recorded Flood Levels

	River Stretch Numbers						Total	[a]Annual
Year	1	2	3	4	5	6	Damages	Damages
1878	46,250	925,000	535,000	22,500	115,000	11,500	1,655,250	18,600
1916	36,250	725,000	517,500	44,000	270,000	27,000	1,619,750	18,200
1940	67,500	1,350,000	567,500	67,500	420,000	42,000	2,514,500	28,200
All other years	-0-	-0-	363,800	725	-0-	-0-	364,525	4,100
								$69,100

[a]Annual damage based on 88 years (1878-1965) of record and in 1964 dollars.
Explanation:

Stretch 1 - West Virginia line to Glen Lyn, gaging station at Glen Lyn used for control.
Stretch 2 - Glen Lyn to Cowan, gaging station at Eggleston used for control.
Stretch 3 - Cowan to Claytor Dam, gaging station at Radford used for control.
Stretch 4 - Claytor Dam to Jackson Ferry, gaging station at Allisonia used for control.
Stretch 5 - Jackson Ferry to Route 221 crossing, gaging station at Ivanhoe used for control.
Stretch 6 - Route 221 crossing to N. C. line near Mouth of Wilson, gaging station at Galax used for control.

Note: Damages computed from Huntington Corps of Engineers stage-damage curves for stretches 2-5 and from estimates on stretches 1 and 6.
Ibid., p. 124.

TABLE XXIII
Average Annual Flood Damages
Tributaries to New River in Virginia
Courtesy of U.S. Department of Agriculture
Soil Conservation Service

TRIBUTARY NAME[a]	PRELIMINARY ESTIMATE[b] OF AVERAGE ANNUAL FLOOD DAMAGES IN 1966 DOLLARS[c]	
Peach Bottom Creek	2,100	
Upper Bluestone River	79,500[d]	
Wolf Creek	22,300	
Little Stony Creek	8,700	
Stony Creek	4,900	
Walker Creek	22,500	
Sinking Creek	5,500	
Little Walker Creek	2,500	
Reed Creek	18,800	
Peak Creek	65,500	
Toms Creek	10,300	
Claytor Lake Area	13,900	
Cripple Creek	23,100	
Fox-Wilson Creek	16,400	
Elk Creek	9,900	
Chestnut Creek	1,400	
Crooked Creek	4,400	
Little Reed Island Creek	15,700	
Big Reed Island Creek	16,500	
Little River	12,500	
Laurel Fork	27,000	
Mill Creek	11,200	
Other Watersheds	$394,600	TOTAL
Estimated as 5% of Total[e]	+19,730	
	$414,330	GRAND TOTAL

[a]Those tributaries listed represent approximately 15,000 acres of floodplain.

[b]This data is from a U.S.D.A. interim report for the Upper New River Sub-Basin of the Kanawha River Comprehensive Study. The data is preliminary and is subject to change in the final report for the Kanawha River Basin.

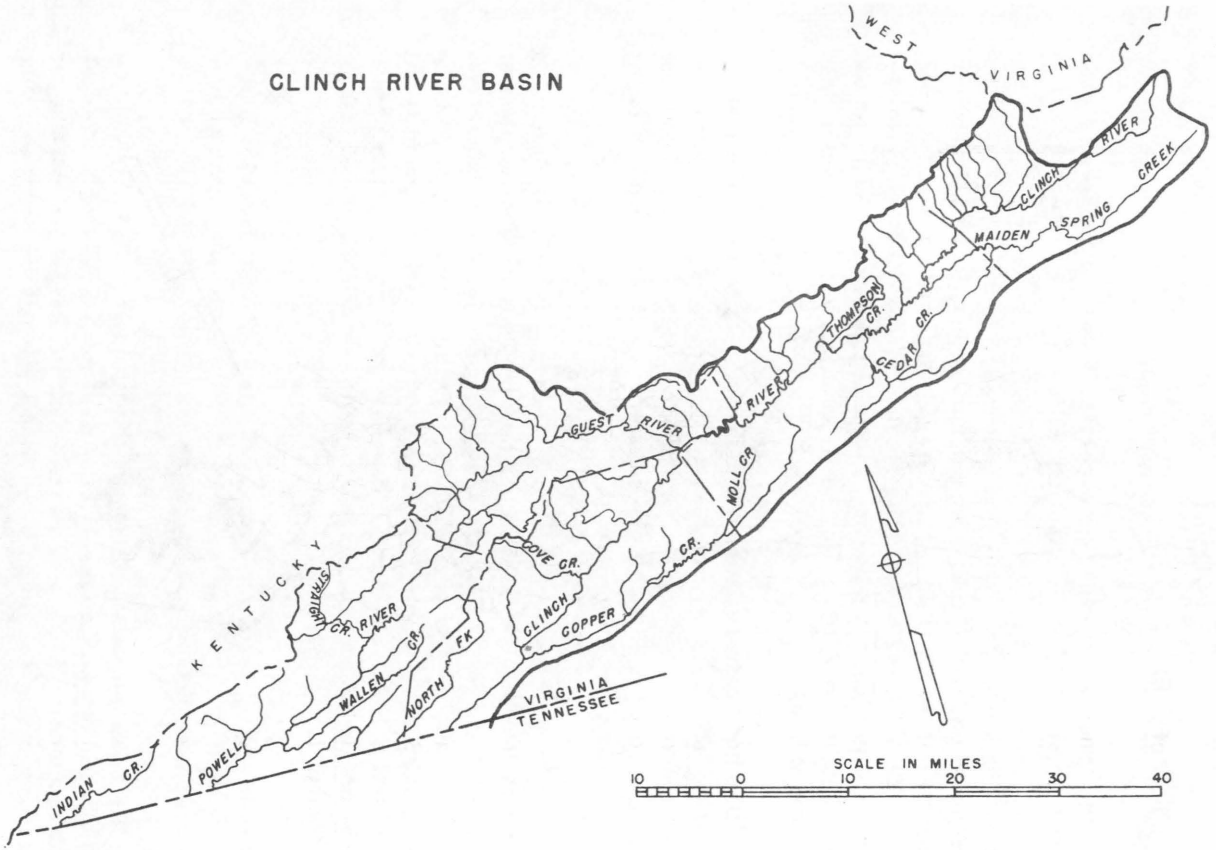
[c]Price Base: Long-term projected A.R.S. Price Projection, September, 1957.

[d]Corps of Engineers annual flood damage estimates added.

[e]Other watersheds contain an estimated 5000 acres of floodplain.


POSSUM CR
BIG MACCRAY CR
NORTH FORK HOLSTON RIVER
TENNESSEE
HOLSTON RIVER
BOONE LAKE
SO. HOLSTON LAKE
MIDDLE FORK HOLSTON RIVER
SOUTH FORK HOLSTON RIVER
LAUREL CR
NORTH CAROLINA
N
HOLSTON RIVER
AND TRIBUTARIES
SCALE IN MILES
10 0 10 20

CLINCH RIVER BASIN



DIVISION OF PLANNING AND ECONOMIC DEVELOPMENT—1952

The damages in Virginia resulting from past floods are not very extensive. Some estimate of flood damage is given in the descriptive material which follows.

South Fork of Holston River

This fork and its tributaries are subject to frequent flooding. The main damages occur in Marion, Damascus, and Bristol.

Marion[44] is located on Middle Fork, a tributary to the South Fork of the Holston and on Staley Creek, which is in turn a tributary to the Middle Fork. The most notable floods in recent years have occurred on August 4, 1947; January 29, 1957; and May 12, 1961. In the 1947 flood, water rose two feet in some houses, but the residential damage was confined to 40 houses and about $1000. Damages to industrial and commercial businesses were estimated at $6000.

The 1957 flood caused relatively light damage and was concentrated at the Brunswick-Balke Collender Company plant where the personnel office and cafeteria were damaged and the parking lot flooded. The 1961 flood rose about one foot higher and caused considerable damage. Operations at the plant were suspended for three days.

Damascus,[45] located on Laurel and Beaverdam Creeks, is subject to occasional flooding. The Washington County News reported damages at $50,000 for the flood of March 18, 1955. Damage to private property was relatively minor, but damage to streets, water lines, and railroad property approached $30,000. Route 58 between Damascus and Konnarock sustained damages of $15,000, and Route 91 was damaged in the amount of $3,000. The Bristol Herald Courier estimated damages from $50,000 to $75,000 for the flood of January 31, 1957.

Bristol is situated at the confluence of Mumpower Creek and Beaver Creek. The latter flows through the heart of the Bristol business district, and has produced severe flooding problems in the past.

The first flood with damage estimates occurred January 12, 1879. An article in the Bristol News of January 14 listed damages of $300 to $500 to a dam, $200 to a tannery, $100 to an individual and $50 to fences. It also reported that another dam was swept away, another tannery damaged, and some bridges damaged.[46]

Very heavy rain north of Bristol caused extensive damage to the city in 1905. The Knoxville News Sentinel for August 17, 1905, reported that in many places dwelling houses were partly submerged and a number of business houses flooded with two to three feet of water.[47] The flood of June 14, 1917, drove several hundred people from their homes and caused $150,000 in damages. The Bristol Herald Courier predicted that the crop loss would probably exceed the damage in the city.[48]

Mumpower Creek flooded August 18, 1921, doing considerable damage to the property of Bristol Gas and Electric Company. Twenty-four tons of coke were swept away and damage to the facilities ran into the thousands of dollars. Eight years later (1929) the second highest damages due to flooding were incurred--$315,000.[49] The business district was marooned and the city was without power and lights for many hours.

North Fork of Holston River[50]

The flood plain is undeveloped and floods have caused little damage along this stream. No sizeable communities are located close to the river, but some homes in the outlying areas of Saltville, Broadford, Plasterco, Gate City, and Mendota have been flooded.

Floods along the Clinch River and its tributaries have been responsible for extensive damage to the communities of Richlands, Cleveland, St. Paul, Coeburn, and Norton.

The highest known flood on the Clinch River occurred in the Richlands[51] vicinity on June 22, 1901 as the result of a very intense thunderstorm. Several articles in the Bluefield Daily Telegraph placed losses to homes and personal property, farmlands, crops, stock, mill property and woolen mills at $500,000 to $700,000 and ascertained the number of deaths at 12.

Indian Creek and small tributaries of the Clinch River flooded basements of 30 houses in Richlands in June of 1939. The water caused numerous slides on hillside lands bordering streams, blocked highway and railroad traffic, and inflicted crop damage. Total damages were put at $17,000.

The second largest flood at Richlands occurred on January 29, 1957. Hundreds of homes were damaged and losses were put at $250,000. Red Cross relief expenditures amounted to more than $46,000. In 1963, 100 families were forced to leave their homes because of rising flood waters. Several bridges in the immediate area of Richlands were washed away or damaged.

The highest flood in the history of Cleveland occurred January 31, 1957. Water was reported to heights of five feet in stores and houses along Cleveland's main business section. Damages on the main street were placed at $50,000.[52]

The flood causing the most damage to the town of St. Paul occurred January 30, 1957. A large flood occurred at this site in 1862, but this was 30 years before the formation of St. Paul. The 1957 flood caused damage to homes and businesses, and it "knocked out" the St. Paul water system. A survey team reported that 25 homes on the south side of the river were damaged to the extent of $60,350; 23 homes and one trailer were damaged on the north side of the river--$23,000; and damage to 23 businesses amounted to $93,900.[53] Again on March 12, 1963, St. Paul experienced a flood of only slightly smaller magnitude (0.9 feet lower than the 1957 flood) causing damage to 29 houses and 4 businesses--$150,000.[54]

Coeburn is located on the Guest River, tributary of the Clinch, and on Toms Creek, tributary of the Guest. The greatest known flood in this area occurred on January 28, 1919. This flood inundated the business district to depths up to three feet, and much of the residential section of Riverview was flooded.[55] Again in 1939, the main business section was inundated with two feet of water from the swollen Guest River, causing damage estimated at $15,000.[56]

The general flooding in Southwest Virginia in 1957 was felt in Coeburn. Merchants estimated that damages approached $20,000.[57] Coeburn experienced three separate floods in the month of March, 1963. The highest caused the water to rise 4.5 feet on Front Street. The Red Cross reported that 15 residences received major damage, and 146 received minor damage. Damages to the business community extended to 40 establishments being flooded and total damages of $430,000.[58]

The main sections of Norton are generally out of reach of flood waters, but the East Park Avenue and Ramsey sections lie along the Guest River, and are subject to flooding. In 1918, flood waters reached a depth of four feet in these sections.[59] The 1963 flood also caused damage to the low-lying areas. The city manager of Norton reported damage to 47 homes ($17,500), 9 businesses ($32,500), and to city streets and water lines ($15,000).[60]

Powell River

The Powell River is a tributary of the Clinch River, but the two do not join in Virginia. The principal damage centers are Appalachia and Big Stone Gap. One of the largest floods on the Powell River occurred January 28, 1918, as

the result of a special combination of factors. Snows had accumulated during the severe winter of 1917-1918 to a depth of 20 to 25 inches in the upper part of the drainage area. The ground was frozen to a considerable depth and the river frozen over. On January 26, a rain (2.5 to 4 inches) occurred, accompanied by a 20-degree rise in temperature, causing the snow to melt rapidly. The frozen ground was incapable of absorbing much of this water, and the flood resulted. Although no damage figures were reported, The Big Stone Gap Post noted it to be the most damaging flood in history. Callahan Creek, tributary of the Powell River, which flooded in 1963, caused damages approaching the losses of 1918.[61]

The flood of January 28, 1918, was also one of the highest ever to occur at Big Stone Gap. Damages to a tannery and extract plants were estimated to be in the thousands of dollars. Railroad traffic was halted and telephone and telegraph wires were reported down in all directions. Losses during this flood approached those occurring in the 1957 and 1963 floods. The town manager estimated 1957 losses at $50,000.[62]

Rappahannock River Basin

The Rappahannock River has its source on the eastern slope of the Blue Ridge Mountains in the northwest part of Fauquier County from whence it flows southeasterly until it empties into the Chesapeake Bay. Three physiographic regions, the Blue Ridge Mountain, the Piedmont Plateau, and Coastal Plain are represented in its drainage basin of 2,700 square miles. Tributaries include the Rapidan River, Robertson, Hazel, and Mountain Run.

The major flood damage center is at Fredericksburg, where high business losses result from their location near the river front. Lesser centers are at Remington and Falmouth.

Losses on the Rapidan are largely agricultural.[63] Estimates are available for only some of the floods that have occurred in the basin. The major floods occurred in June, 1889; April, 1937; and October, 1942. Detailed estimates of the losses from these floods are shown in Table XXIV. A tabulation of losses resulting from the floods of October, 1942, and April, 1937 are given for Fredericksburg in Table XXV and for Falmouth in Table XXVI. In 1934 and 1935 floods occurred of less consequences. Direct and indirect damages to agricultural property, highways and railroads were $600 and $100,000 for 1934 and 1935, respectively.


RAPPAHANNOCK RIVER BASIN
JORDAN R.
CARTER RUN
THORNTON R.
HUGHES R.
HAZEL RIVER
MOUNTAIN RUN
ROBERTSON RIVER
SOUTH RIVER
CONWAY R.
RAPIDAN RIVER
MOUNTAIN RUN
BLUE RUN
RAPPAHANNOCK
MASSAPONAX RIVER
WARE C.
MOUNT CR.
GOLDENVALE CR.
MILL CR
PORT TOBACCO RIVER
RUN
OCCUPACIA CR.
CAT POINT CR.
LANDING CR.
HOSKINS CR.
PISCATAWAY CR.
TOTUSKEY CR.
FARNHAM CR.
LANCASTER CR.
CORROTOMAN RIVER
SCALE IN MILES
10 0 10 20 30 40
DIVISION OF INDUSTRIAL DEVELOPMENT— 1960

TABLE XXIV

Total Flood Losses - Rappahannock Watershed[a]

Type	October 1942			April 1937			June 1889		
	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total
Residential	$ 165,650	$ 53,000	$ 213,650	$ 48,300	$ 17,200	$ 65,500	$ 65,000	$ 26,000	$ 91,000
Business	782,250	415,300	1,197,550	362,050	97,500	459,550	112,000	78,000	190,000
Utilities	61,700	16,400	78,100	26,500	6,000	32,500	102,000	125,000	227,000
Highways, bridges	190,250	190,250	380,500	178,000	178,000	356,000	---	---	---
Agriculture	492,800	123,200	616,000	406,000	82,000	488,000	72,000	72,000	144,000
Railroad	3,200	5,500	8,700	---	---	---	125,000	25,000	150,000
Navigation channel	13,900	4,200	18,100	---	---	---	24,000	24,000	48,000
Total	$1,709,750	$807,850	$2,517,600	$1,020,850	$380,700	$1,401,550	$500,000	$350,000	$850,000

[a]U.S. Army Corps of Engineers, Review Report for Flood Control, Rappahannock River and Tributaries, Virginia, Washington, D.C., July 31, 1944, p. 48.

[b]Consideration of comparative values of the dollar in 1889, 1937, and 1942 have not been included.

TABLE XXV

Total Flood Losses - Fredericksburg, Va.[a]

	October 1942			April 1937		
	Direct	Indirect	Total	Direct	Indirect	Total
Residential	$108,500	$ 44,100	$ 152,600	$ 10,000	$ 4,000	$ 14,000
Business	659,400	298,800	958,200	319,400	88,800	408,200
Utilities	32,500	7,500	40,000	25,000	6,000	31,000
Highways	7,600	7,600	15,200	3,000	1,000	4,000
Railroad	2,100	3,100	5,200	---	---	---
Total	$810,100	$361,100	$1,171,200	$357,400	$99,800	$457,200

[a]U.S. Army Corps of Engineers, Review Report for Flood Control, Rappahannock River and Tributaries, Virginia, Washington, D.C., July 31, 1944, Table 8, p. 49.

TABLE XXVI

Total Flood Losses - Falmouth, Va.[a]

	October 1942			April 1937		
Type	Direct	Indirect	Total	Direct	Indirect	Total
Residential	$33,400	$4,000	$37,400	$25,000[b]	$10,000	$35,000
Business	8,600	3,100	11,700	5,000	3,500	8,500
Highways	2,500	2,500	5,000	2,000	1,000	3,000
Total	$44,500	$9,600	$54,100	$32,000	$14,500	$46,500

[a]U.S. Army Corps of Engineers, Review Report for Flood Control, Rappahannock River and Tributaries, Virginia, Washington, D.C., July 31, 1944, Table 9, p. 49.

[b]Includes $3,000 for an item classified as public.

Chowan River Basin

The Chowan River Basin is located in Virginia and North Carolina. The part in Virginia lies in 14 southeastern counties and has a drainage area of 3,682 square miles. The main tributaries are the Meherrin, Nottoway, and Blackwater Rivers, all of which rise in Virginia.

Most of the available flood damage information on the basin concerns the Meherrin River. Table XXVII shows the total losses by floods from 1929 to 1940, as determined by field investigations and office computations of the Corps of Engineers. More detailed information concerning flood damage caused by the August 1940 flood is given in Table XXVIII.

York River Basin[64]

The York River and its tributaries drain an area of 2,663 square miles centrally located in the state. The principal tributaries are the Mattaponi and Pamunkey Rivers which join at West Point to form the York River. From West Point, the York River flows generally southeastward for 40 miles and empties into the Chesapeake Bay. The York River is tidal throughout its length and tidal cycles extend for many miles upstream on the Mattaponi and Pamunkey Rivers.

Detailed data concerning flood damages in the York River Basin are not available. The principal damages from floods have been to highways, highway bridges, railroads, and small areas of agricultural lands in the river bottoms. The municipalities in the basin are situated so as not to feel the effects of floods.

The 1928 flood, apparently second in magnitude only to that of 1889, is reported to have caused damage to the Richmond, Fredericksburg, and Potomac Railroad between Guinea and Coleman--$190,000. The total damage to highways and highway bridges in the basin from this flood is estimated at less than $8,000. No other damage was reported.

Although agricultural losses are highest for the basin, they have not been extensive. Much of the bottom land along the Pamunkey, Mattaponi, and tributaries of these rivers is not actively cultivated, but is covered with timber which sustains little, if any, damage. In the past, agricultural lowlands have been abandoned in several localities because of the flood menace, thus reducing the return from these lands.

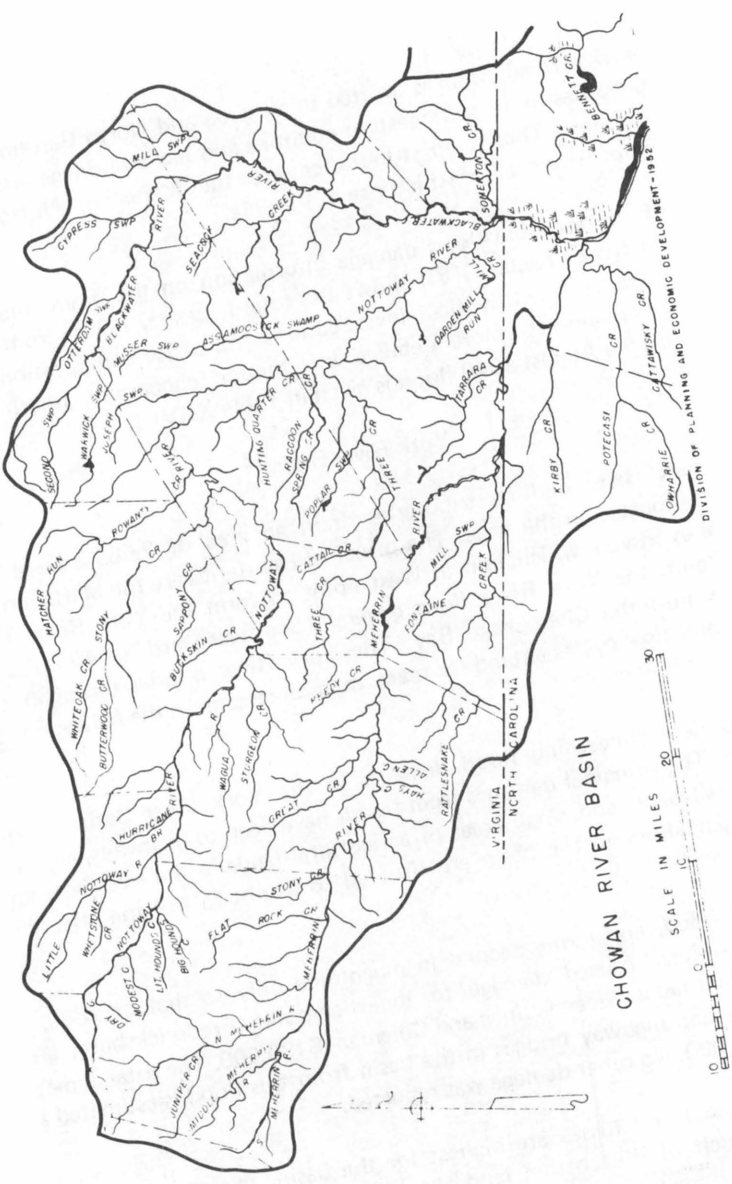

CHOWAN RIVER BASIN
SCALE IN MILES
10 0 10 20 30
DIVISION OF PLANNING AND ECONOMIC DEVELOPMENT-1952
VIRGINIA
NORTH CAROLINA
BLACKWATER
NOTTOWAY RIVER
MEHERRIN
BENNETT CR.
SOMERTON CR.
CYPRESS SWP
SEACOCK CREEK
ASSAMOOSICK SWAMP
MUSSER SWP
JOSEPH SWP
WARWICK SWP
SECOND SWP
ROWANTY CR
STONY CR
HATCHER RUN
WHITEOAK CR
BUTTERWOOD CR
SAPPONY CR
BUCKSKIN CR
HURRICANE RIVER
RACCOON
SPRING CR
POPLAR SW
HUNTING QUARTER CR
THREE CR
CATTAIL CR
TARRARA CR
DARDEN MILL RUN
FONTAINE CREEK
RATTLESNAKE CR
KIRBY CR
POTECASI CR
CATTAWISKY CR
WAQUA
STURGEON CR
GREAT CR
FLAT ROCK CR
STONY CR
LITTLE
WHITSTONE CR
NOTTOWAY R
NOTTOWAY C
MODEST C
LIT. HOUNDS C
BIG HOUNDS C
DRY C
N MEHERRIN R
MIDDLE MEHERRIN R
MEHERRIN R
JUNIPER CR

TABLE XXVII

Flood Losses in the Meherrin Valley, 1929, 1940[a]

Date of Flood	Mouth to Emporia	Town of Emporia	Emporia to Middle Meherrin River	Total
October 1929	$ 51,400	$ 0	$ 11,700	$ 63,100
April 1931	11,900	0	0	11,900
March 1932	10,400	0	1,800	12,200
April 1933	14,800	0	0	14,800
March 1934	9,900	0	0	9,900
December 1934	0	0	2,400	2,400
September 1935	44,000	0	15,800	59,800
April 1937	35,000	200	14,600	49,800
July 1938	120,800	0	40,900	161,700
August 1939	50,000	0	4,400	54,400
August 1940	311,300	26,500	53,500	391,300
Total	$659,500	$26,700	$145,100	$831,300
Approximate average annual losses for 12 years	$ 55,000	$ 2,200	$ 12,100	$ 69,300

[a]U. S. Army Corps of Engineers, "Review Report for Navigation and Flood Control, Meherrin River, Virginia and North Carolina," Norfolk, Va., April 1, 1941, p. 35.

TABLE XXVIII

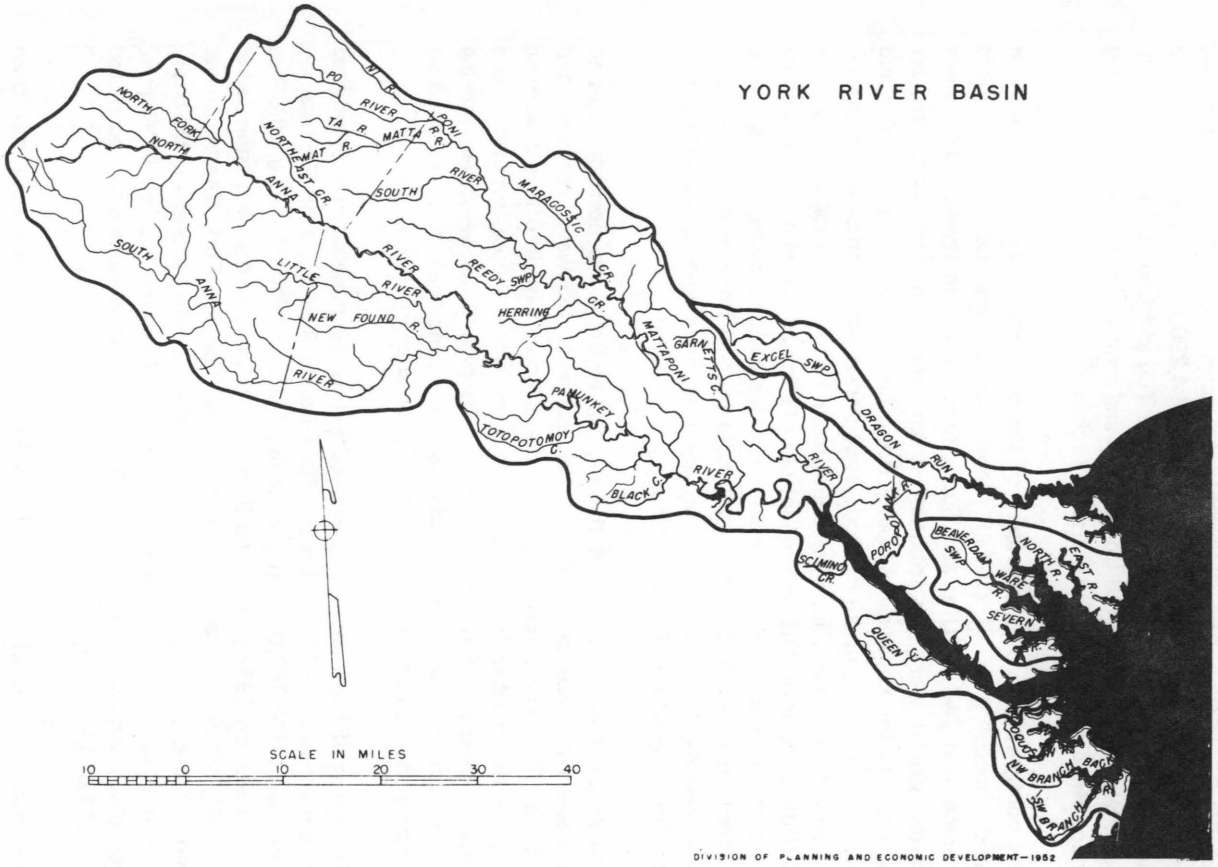
1940 Flood Losses, Meherrin River Valley[a]

Damage Zone	Area Inundated		Losses to					
	Total	Cultivated	Crops	Farm Improvements	Communications	Towns	Relief Expenditures	Total Loss
Mouth to Emporia, Va.	51,800	10,100	$237,000	$15,500	$31,500	$25,400[b]	$1,900	$311,300
Town of Emporia, Va.	100	---	---	---	1,500	25,000	---	26,500
Emporia, Va. to mouth of Middle Meherrin River	9,100	2,800	38,000	2,000	13,500	---	---	53,500
Totals	61,000	12,900	$275,000	$17,500	$46,500	$50,400	$1,900	$391,300[c]

[a]U.S. Army Corps of Engineers, Review Report for Navigation and Flood Control, Meherrin River, Virginia and North Carolina, Norfolk, Virginia, April 1, 1941, p. 34.

[b]Murfreesboro, N.C.

[c]Exclusive of damages in Potecasi and Fontaine Creek drainage areas.


YORK RIVER BASIN
NORTH FORK
NORTH ANNA
SOUTH ANNA
PO RIVER
NI R.
TA R.
MATTA R.
PONI
NORTHEAST CR.
LITTLE RIVER
NEW FOUND R.
SOUTH RIVER
MARACOSSIC CR.
REEDY SWP
HERRING CR.
MATTAPONI
GARNETTS C.
EXCEL SWP
DRAGON RUN
PAMUNKEY
TOTOPOTOMOY C.
BLACK C.
RIVER
PORPOTANK R.
BEAVERDAM SWP
NORTH R.
EAST R.
WARE R.
SEVERN R.
SCIMINO CR.
QUEEN C.
PIANKATANK R.
NW BRANCH
SW BRANCH
SCALE IN MILES
10 0 10 20 30 40
DIVISION OF PLANNING AND ECONOMIC DEVELOPMENT—1952

Big Sandy River Basin

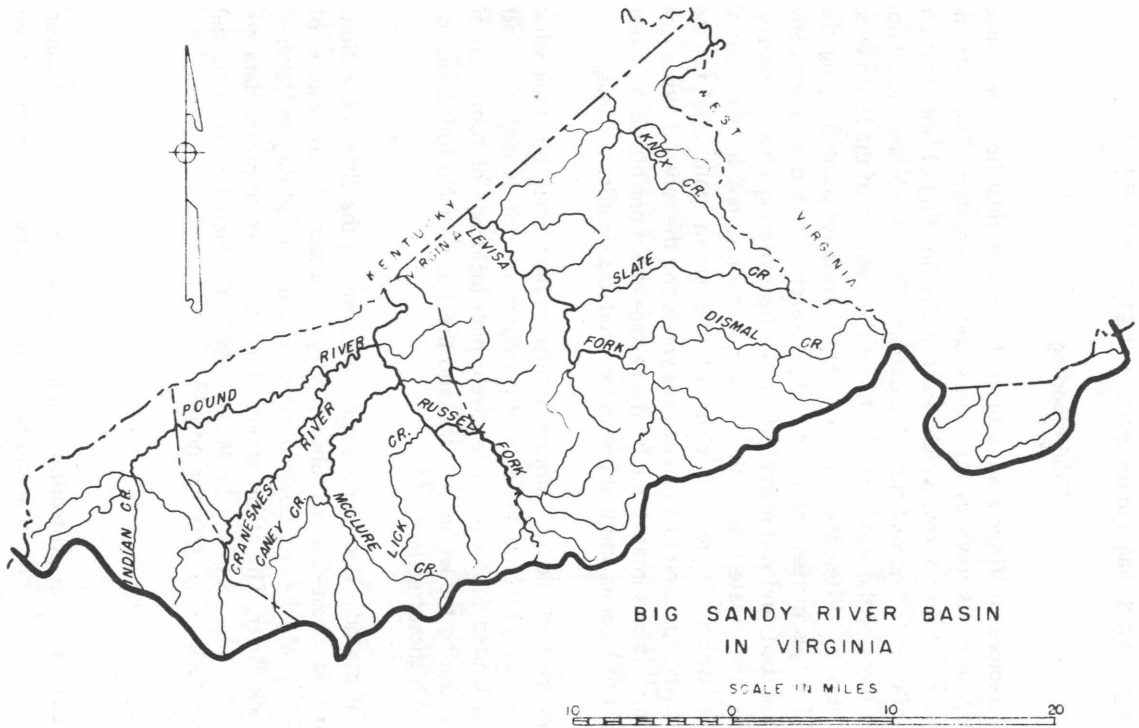
The Big Sandy River Basin lies within the states of Kentucky, West Virginia, and Virginia, and has a total drainage area of 4,290 square miles. None of the Big Sandy River, which is formed by the Tug and Louisa Forks at Louisa, Kentucky, is in Virginia; but Louisa Fork and some of its tributaries including Pound River and Russell Fork, rise in Virginia.[65]

The configuration and topography of the tributary basins are conducive to rapid concentration of rainfall runoff which gives rise to flash floods characterized by swift, erratic fluctuations in stream levels. Coal mining wastes, placed along the tributary streams during mining operations, are carried into the streams by rapidly rising flood waters. The difficulty and expense in cleaning up after floods is aggravated because these fine materials, mixed with salt and sand, when deposited in buildings, streets, and yards, are difficult to remove. The large quantities of earth and vegetation displaced by the surface mining operations employed in the basin have caused obstructions to form in some streams that contribute to local flood problems.[66] Roads and railroads along the valley floors are often inundated, paralyzing business activities in areas not directly affected.

The major flood problem in the Big Sandy Basin has been damages to improvements such as buildings, their contents, highways, railroads, and utilities. The inundations from many floods occur with insufficient warning to permit removal of business stocks and equipment, house furnishings, and personal property. Extreme floods produce high water velocities, moving buildings from foundations or otherwise damaging them to an extent that causes repairs to be of a major nature or impossible.[67]

The extent of flood damages is exemplified by the monetary losses inflicted by the January, 1957 and March, 1963 floods. The flood of 1957 caused damages of $32,707,000 on the Louisa Fork and $6,085,000 on the Tug Fork, based on 1957 prices. The flood of 1963 caused damages estimated at $17,761,000 on LeVisa Fork and $2,190,000 on Tug Fork. These damages were reduced by the operation of several flood control projects in the basin. One of these projects, the John W. Flannagan Reservoir Project, in Virginia, was only partially completed at the time, but prevented an estimated $15,113,000 in damages.[68]

The damages caused by the floods in 1957 and 1963 have not been completely separated on the basis of the states where the damage occurred, but specific damages occurring at certain localities in Virginia are available for



DIVISION OF PLANNING AND ECONOMIC DEVELOPMENT — 1952

the 1957 flood. At Grundy, Virginia, direct and indirect damages amounted to an estimated $800,000. Haysi, located on Russell Fork, experienced $200,000 in direct and indirect damages. Pound, located on the Pound River, received the greatest damages in the amount of $1,085,000.[69]

Tidal Flooding

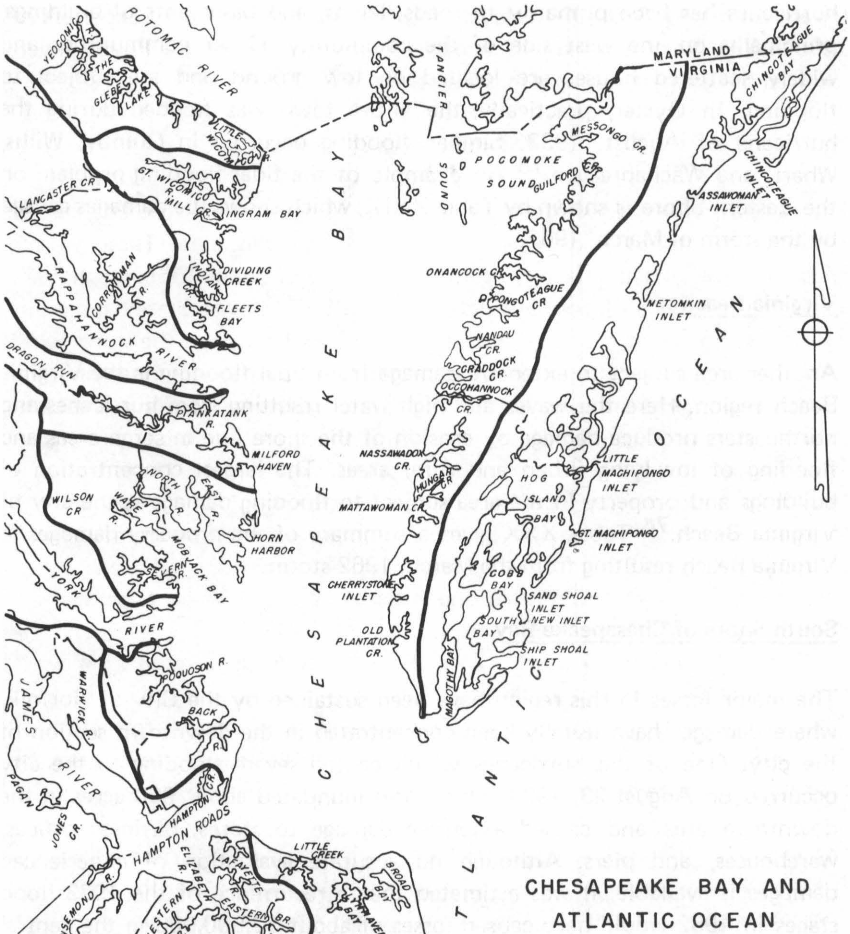
The coastal regions of Virginia are subjected to severe tidal flooding caused primarily by storms known as hurricanes and northeasters. These storms produce waves and tidal surges which result in the flooding of lands that are above the influence of normal tidal fluctuations. Tidal surges are caused not only by the force of the wind and the forward movement of the storm wind field, but also by differences in atmospheric pressure accompanying the storm. Tidal surges increase as the storm approaches land over a gradually shoaling ocean bed, and will magnify further when entering a bay or estuary. Tidal surges are greatest and the flooding more severe in the coastal communities which lie to the right of the storm path due to the counterclockwise spiraling of the hurricane winds and the forward movement of the storm.[70] It is estimated that on the average about one hurricane a year poses a threat to Virginia and that one in ten produces significant damage.

Northeasters are cyclonic-type storms, similar to hurricanes, but their wind speeds are not as great and the central pressures are not as low. The East Coast of the United States has a relatively high incidence of formation of these storms during the winter months, and the area near Norfolk is one of the centers of highest frequency.[71]

The extent of the tidal flooding problem varies among the different sections of the Virginia coast--Eastern Shore, Virginia Beach, South Shore of Chesapeake Bay, Middle and Lower Peninsulas, and Coastal Region North of Rappahannock River. The storm about which the most complete data are available is the one occurring in March, 1962. Estimated damage to the Virginia coastal region was $34,175,000.[72]

Eastern Shore

This area receives some protection against tidal flooding on the Atlantic Ocean side from a generally uninhabited strip of lowlands and islands, from two to nine miles wide, existing along the western side of the peninsula. Lands bordering the Chesapeake Bay side are generally subject to direct attack by waves from the Bay. Some houses located on high ground near the Bay have been undermined by wave erosion. Cape Charles, the largest


CHESAPEAKE BAY AND
ATLANTIC OCEAN
BASINS
SCALE IN MILES
10 0 10 20
DIVISION OF PLANNING AND ECONOMIC DEVELOPMENT – 1952
MARYLAND
VIRGINIA
NORTH CAROLINA
POTOMAC RIVER
YEOCOMICO
THE GLEBE
LAKE
LITTLE WICOMICO R.
GT. WICOMICO R.
MILL CR.
INGRAM BAY
LANCASTER CR.
RAPPAHANNOCK RIVER
CORROTOMAN R.
INDIAN CR.
DIVIDING CREEK
FLEETS BAY
DRAGON RUN
PIANKATANK R.
MILFORD HAVEN
NORTH R.
EAST R.
WARE R.
WILSON CR.
SEVERN R.
MOBJACK BAY
HORN HARBOR
YORK RIVER
POQUOSON R.
BACK R.
WARWICK R.
JAMES RIVER
PAGAN R.
JONES CR.
HAMPTON CR.
HAMPTON ROADS
NANSEMOND R.
WESTERN BR.
ELIZABETH R.
SOUTHERN BR.
EASTERN BR.
LAFAYETTE R.
LITTLE CREEK
BROAD BAY
LYNNHAVEN BAY
A. & C. CANAL
N. LANDING R.
DISMAL SWAMP
DISMAL SWAMP CANAL
CYPRESS SWP.
LAKE DRUMMOND
NORTHWEST R.
BACK BAY
CHESAPEAKE BAY
TANGIER SOUND
POCOMOKE SOUND
MESSONGO CR.
GUILFORD CR.
CHINCOTEAGUE BAY
CHINCOTEAGUE INLET
ASSAWOMAN INLET
ONANCOCK CR.
PUNGOTEAGUE CR.
METOMKIN INLET
NANDAU CR.
CRADDOCK CR.
OCCOHANNOCK CR.
NASSAWADOX CR.
HUNGARS CR.
MATTAWOMAN CR.
LITTLE MACHIPONGO INLET
HOG ISLAND BAY
GT. MACHIPONGO INLET
COBB BAY
SAND SHOAL INLET
NEW INLET
SOUTH BAY
SHIP SHOAL INLET
CHERRYSTONE INLET
OLD PLANTATION CR.
MAGOTHY BAY
ATLANTIC OCEAN

municipality, is located on fairly high ground, and damage from past hurricanes has been primarily to roads, lawns, and basements of buildings, principally on the west side of the community. Other communities and widely scattered houses are located on low ground and are subject to flooding. In Oyster, practically the entire town was flooded during the hurricane of August, 1933. Similar flooding occurred in Quinby, Willis, Wharf, and Wachapreague.[73] An example of the tidal flooding problem on the Eastern Shore is shown by Table XXIX, which shows the damages caused by the storm of March, 1962.

Virginia Beach

Another area subject to extensive damage from tidal flooding is the Virginia Beach region. Here the waves and high water resulting from hurricanes and northeasters produce damage by erosion of the shore line in some areas and flooding of low-lying urban and rural areas. The largest concentration of buildings and property in the area subject to flooding damage is the city of Virginia Beach.[74] Table XXX gives a summary of the property damages in Virginia Beach resulting from the March, 1962 storm.

South Shore of Chesapeake Bay

The major losses in this region have been sustained by the City of Norfolk, where damages have usually been concentrated in the downtown section of the city. One of the hurricanes which caused severe flooding to the city occurred on August 23, 1933. This storm inundated about 600 acres in the downtown area and caused extensive damage to stores, business offices, warehouses, and piers. Although no accurate evaluation of experienced damages is available, it was estimated that a recurrence of the 1933 flood stages in 1962 would have caused losses of about $2,500,000 in the central business district, $860,000 in the Hague area, and $70,000 in the Tidewater Drive area of Norfolk.

Norfolk had tidal flooding in 1954, 1956, and 1962. Hurricane "Hazel" (October 15, 1954) caused damage in excess of $3,500,000, but this was primarily a result of the winds rather than flooding. The northeast storm of April 11, 1956, inundated the heart of the central business district with one to three feet of salt water. Tangible damage due to inundation in this storm was estimated at $423,000 in the central business district and $128,000 in the Hague area of Norfolk. In a second flood in 1956 (September 27), Hurricane "Flossy" caused damages to the central business district of $198,000.[75] The storm of 1962 produced estimated damages of $1,950,000

TABLE XXIX

Summary of March 1962 Storm Damages to Eastern Shore, Virginia[a]

Item	Damages
Agricultural losses, including livestock	$ 246,000
Residences and contents	5,487,000
Commercial buildings and contents	225,000
Transportation losses:	
boats	1,012,000
roads	334,000
Utility losses	17,000
Miscellaneous losses:	
wharves, docks, and piers	105,000
oyster grounds and clam beds	1,000,000
public property	419,000
navigation channels	250,000
erosion of sand dunes	750,000
NASA installation	1,000,000
Other losses:	
combating health hazard	7,000
debris removal	14,000
evacuation and relief to flood victims	138,000
Total	$11,022,000

[a]U. S. Army Corps of Engineers, March 1962 Storm on the Coast of Virginia, 1962, Norfolk, Va. (unpublished)

TABLE XXX

Summary of Estimated March 1962 Storm Damages by Property Classes in Virginia Beach[a]

Item	Sandbridge	Virginia Beach Borough	N. Virginia Beach to Cape Henry	Cape Henry to Little Creek	Lynnhaven River System	Other	Total
Residences and contents	$236,000	$ 400,000	$1,020,000	$110,000	$85,000	$ 114,000	$1,965,000
Commercial buildings and contents	---	500,000	165,000	$158,000	---	---	823,000
Transportation losses roads	---	1,020,000	---	---	---	125,000	1,145,000
Utility losses	---	116,000	---	---	---	6,000	122,000
Miscellaneous losses:							
Replacement of sand and bulkheads	---	---	---	32,000	---	---	32,000
Beaches and dunes	---	---	---	---	---	2,300,000	2,300,000
Concrete seawall, board walk, beach, dunes	---	2,175,000	---	---	---	---	2,175,000
Public property	---	75,000	---	---	---	140,000[b]	215,000
Other losses:							
Combating health hazard	---	1,000	---	---	---	---	1,000
Debris removal	---	18,000	---	---	---	75,000	93,000
Evacuation and relief to flood victims	---	---	---	---	---	23,000[c]	23,000
Total	$236,000	$4,305,000	$1,185,000	$300,000	$85,000	$2,783,000	$8,894,000

[a]U.S. Congress, House, Virginia Beach, Virginia, 89th Congress, 1st Session, 1965, House Doc. 268, Table 3, p. 15.

[b]Damage to revetment at Ft. Story

[c]Includes Virginia Beach Borough

to downtown Norfolk.[76] The estimated average annual tidal flood losses, based on 1962 conditions, are given in Table XXXI. These estimated average annual damages were based on 1962 development in the area subject to flooding.

Table XXXII shows the estimated value of property located on the tidal flood plain of the downtown section of Norfolk as of 1962. The concentration of property in the Norfolk area subject to damage from tidal flooding has been judged to be of sufficient value to warrant federal participation in the construction of tidal flood protection works. Other areas on the south shore of the Chesapeake Bay are also subject to serious tidal flooding. The Willoughby section of Norfolk is exposed to the open waters of the Chesapeake Bay and has been subjected to the sweep of hurricanes and northeasters across the narrow peninsula, which isolates houses from the mainland. The city of Portsmouth, located across the Elizabeth River from Norfolk, has had extensive areas of its downtown section inundated in past storms. The town of Chesapeake is also subject to tidal flooding.

Although tidal flooding does exist in these other areas on the south shore of Chesapeake Bay, the damages that have resulted usually have been less extensive than damages inflicted in the downtown section of Norfolk.[77] The damages inflicted on the south shore of the Chesapeake Bay by the March 1962 storm are given in Table XXXIII.

Middle and Lower Peninsula

The Middle Peninsula (made up of the area between the lower portions of the Rappahannock and York Rivers), and the Lower Peninsula (the area between the York and James Rivers), are subject to tidal flooding. On the Lower Peninsula a serious tidal flooding problem exists for Hampton, Poquoson, and Newport News. Land above the mouth of the James River is generally high and not subject to tidal flooding since maximum tides normally diminish upstream. The few buildings and facilities subject to tidal flooding are generally not of high value, and resulting damages are small. Land above the mouth of the York River is generally high, and tidal flooding damages are correspondingly low. An erosion problem does exist along the south shore of York River at Yorktown where the banks are directly exposed to waves originating in the wide reaches of the Chesapeake Bay. The construction of stone protective works by the National Park Service and individual landowners has helped to control some of the erosion.[78]

TABLE XXXI

Estimated Average Annual Tidal Flood Damage to Norfolk, Virginia[a]

Area	Estimated Average Annual Damage	
	To 8 ft. MSL Stage	To 10 ft. MSL Stage
Central Business District	$115,000	$178,000
Hague Area	33,000	59,000
Tidewater Drive Area	1,400	5,000

[a]U.S. Congress, House, Norfolk, Virginia, 87th Congress, 2d session, 1962, House Doc. 354, Table 5, p. 26.

TABLE XXXII

Property Values on the Tidal Flood Plain
of Norfolk, Virginia[a]

Area	Estimated Value of Property within Limit of Area Inundated by 10-foot M S L stage ($1.000)			
	Building and Land	Equipment	Stock	Total
Central Business District	$38,500	$4,000	$13,100	$55,600
Hague	22,200	4,500	4,700	31,400
Tidewater Drive	3,300	NA[b]	NA[b]	NA[b]

[a]U.S. Congress, House, Norfolk, Virginia 87th Congress 2d session, 1962, House Doc. 354, Table 6, p. 26.

[b]NA - Not Available

TABLE XXXIII

Summary of Estimated March 1962 Storm Damages by Property Classes--South Shore of Chesapeake Bay from Hampton Roads to Little Creek[a]

Item	Norfolk			Chesapeake		Portsmouth	Total
	Ocean View, Willoughby Beach	Downtown Norfolk	Other	South Norfolk	Western Br & Gr Bridge		
Residences & contents	$1,546,000	$ 92,000	$200,000	$114,000	$110,000	$1,150,000	$3,212,000
Commercial buildings and contents	17,000	1,758,000	---	150,000	17,000	100,000	2,042,000
Transportation losses:							
roads and streets	2,000	25,000	---	---	---	79,000	106,000
boats	---	---	---	---	8,000	---	8,000
Utility losses	6,000	55,000	25,000	---	15,000	17,000	118,000
Miscellaneous losses:							
wharves, docks, and piers	7,000	---	---	---	12,000	---	19,000
replacement of sand and bulkheads	490,000	---	---	---	---	---	490,000
beaches and dunes	560,000	---	---	---	---	---	560,000
public property	---	10,000	---	---	75,000	38,000	123,000
Other losses:							
combating health hazard	---	---	1,000	---	---	---	1,000
debris removal	21,000	10,000	10,000	---	10,000	26,000	77,000
evacuation and relief to flood victims	6,000	---	4,000	---	---	---	10,000
Total	$2,655,000	$1,950,000	$240,000	$264,000	$247,000	$1,410,000	$6,766,000

[a]U.S. Congress, House, South Shore of Chesapeake Bay, 88th Congress, 2nd session, 1964, House Doc. 215, Table 3, p. 13.

Tidal flooding is common to much of Mathews County on the Middle Peninsula. The situation is aggravated in the Garden Creek community of this county as salt water is trapped behind the barrier beach. The salt water creates both immediate and long term damage to crops and woodlands. Additional damage is caused by the fact that the heavy rainfall accompanying the storm causing the tidal flooding cannot run off because the natural basin of Garden Creek is usurped by the entrapped tidal flood. In addition to the damage to cropland and woodland, residences, farm buildings and equipment, small business enterprises, retail stores, wells, septic tanks, and other sanitary facilities all sustain water damage. Highway flooding introduces indirect damages and inconvenience by interrupting trade, school, bus travel, mail service, and by isolating areas from medical services.[79] The estimated damage to this area caused by the March, 1962 storm is given in Table XXXIV.

North of Rappahannock River

The communities north of the Rappahannock River generally are located above the storm tide level, but there are some summer residences and permanent-type structures at the lower level. The high tide and wave action cause bank and beach erosion problems, produce extensive damage to piers, wharves, small commercial and pleasure craft, and increase the amount of shoaling in the existing navigational channels. Hurricane "Hazel" (October 15, 1954) caused about $250,000 in damages to boats in Monroe Creek at Colonial Beach, Virginia.[80]

No detailed information is available regarding damages from tidal flooding in the coastal region of Virginia north of the Rappahannock River. It has been estimated that a recurrence of the August 23, 1933 hurricane would create a combined loss exceeding $5,000,000 in the Patuxent River upstream as far as Lower Marlboro, Maryland; in the Potomac River upstream to the Washington metropolitan area; in the Rappahannock River upstream to Port Royal, Virginia; and along the western shore of the Chesapeake Bay between Cove Point, Maryland, and Wolf Trap Light, Virginia, based on 1964 development of this area. In addition to the above damages, a $5,000,000 loss would be incurred by the Washington metropolitan area, $800,000 by Colonial Beach, Virginia, and $500,000 by Garden Creek, Virginia.[81]

Dismal Swamp Basin

The most unusual coastal drainage basin is that containing the Dismal Swamp. The swamp covers about 360 square miles in southeast Virginia and northeast North Carolina. The Virginia portion is about 18 miles by 20 miles. Lake Drummond, a fresh water body, is the principal feature of the Dismal Swamp,

TABLE XXXIV

Summary of Estimated Damages by Property Classes--
Middle and Lower Peninsulas of Virginia, March 1962 Storm[a]

Item	Hampton	York County	Gloucester and Mathews Counties	Total
Residences and contents	$1,470,000	$ 700,000	$456,000	$2,626,000
Commercial buildings and contents	518,000	50,000	20,000	588,000
Transportation losses:				
roads	580,000	156,000	---	736,000
boats	---	---	1,000	1,000
Utility losses	164,000	14,000	1,000	179,000
Miscellaneous losses:				
wharves, docks and piers	296,000	---	1,000	297,000
replacement of sand and bulkheads	---	---	---	---
beaches and dunes	---	---	---	---
public property	1,000,000[b]	148,000	---	1,148,000
Other losses:				
combating health hazard	1,000	---	---	1,000
debris removal	15,000	4,000	---	19,000
evacuation and relief to flood victims	36,000	4,000	1,000	41,000
Total	$4,080,000	$1,076,000	$480,000	$5,636,000

[a]U. S. Congress, House, Middle and Lower Peninsulas of Virginia, 88th Congress, 2d session, 1964, p. 14.

[b]Damage at Ft. Monroe and Langley Air Force Base.

and is used to maintain the navigational level of the Dismal Swamp Canal. The main damage occurring in the Dismal Swamp Basin is from high tides and is concentrated in the Norfolk area.

Pee Dee River Basin

The smallest headwater area of a major watershed in Virginia is that of the Yadkin River which flows into the Pee Dee River. The area in Virginia drains 115 square miles and lies in parts of two southern counties. No major floods have been reported by the U.S. Weather Bureau in this basin since 1936.

Small Coastal Stream Basins

There are many small streams lying along the eastern coast of Virginia that drain the Coastal Plain, but do not lie in a major basin. These streams drain directly into the Atlantic Ocean or the Chesapeake Bay, and constitute tidal estuaries. Their combined drainage area of approximately 2,354 square miles is located in 13 coastal counties. Over the years, the water damage in these basins has been a result of hurricanes.

FOOTNOTES

Scope of the Flood Damage Problem

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5. U.S. Congress, A Report by the Task Force on Federal Control Policy, A Unified National Program for Managing Flood Losses, H. Doc. 465, 89th Cong. 2d sess., p. 3 (1966).

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7. U.S. Congress, Senate Select Committee on National Water Resources, Floods and Flood Control, Committee Print No. 15, (Government Printing Office, Washington, D.C., 1960).

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21. Id., at p. 49.

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32. Id., at p. 20.

33. Id., at p. 88.

34. Id., at p. 30.

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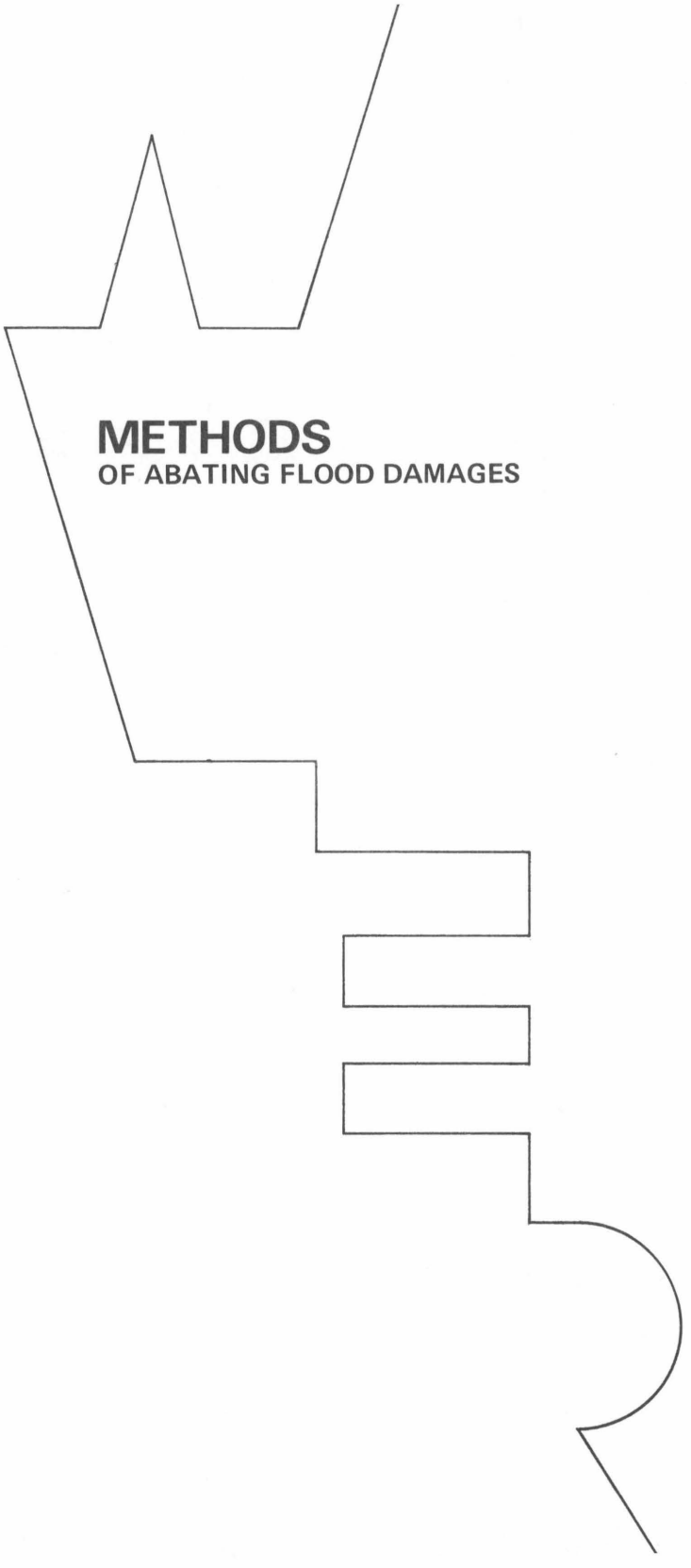
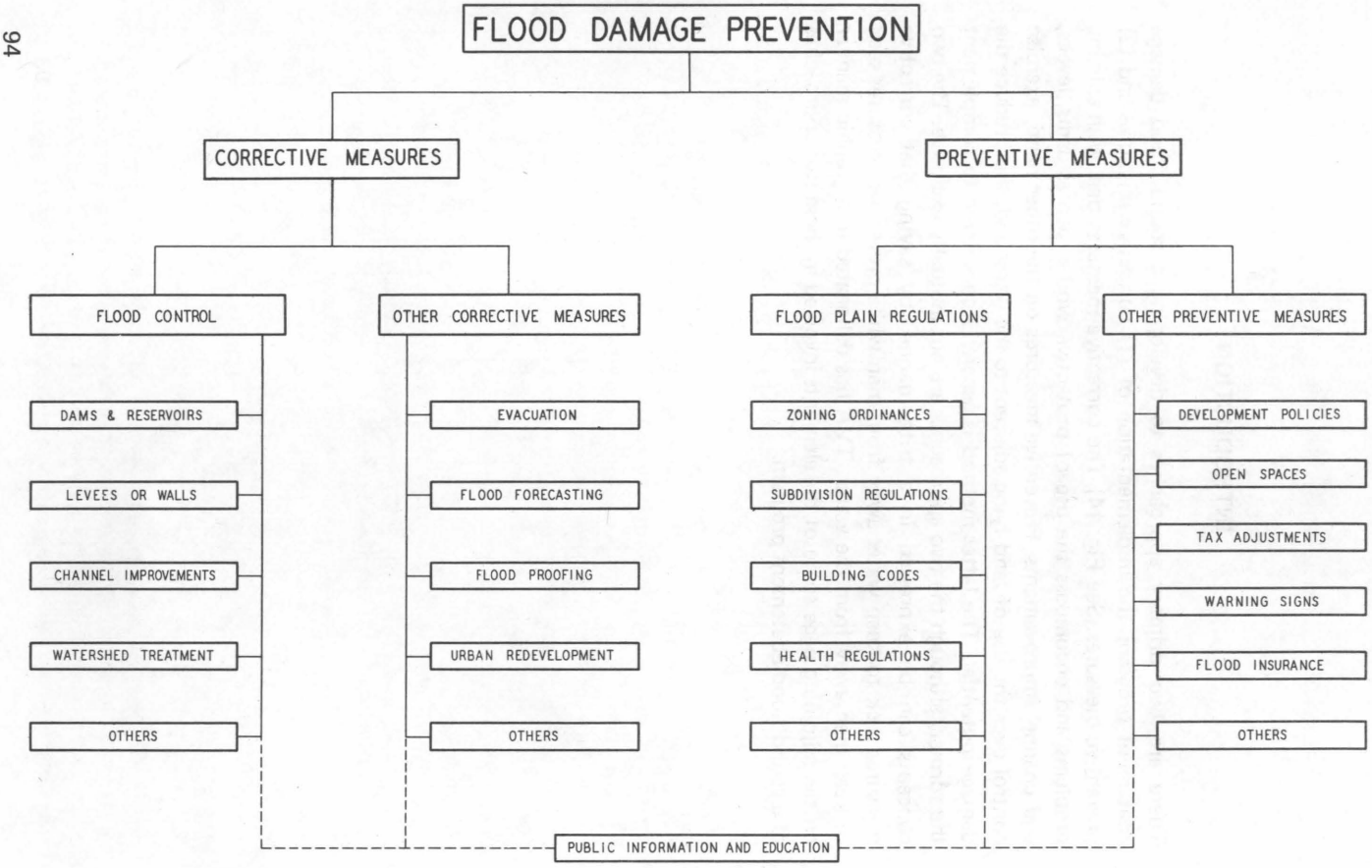


METHODS
OF ABATING FLOOD DAMAGES

INTRODUCTION

There are two primary approaches to developing a sound flood damage abatement program--the implementation of (1) corrective measures and (2) preventive measures.(See Fig. 14) The corrective measures deal with existing problems and encompass the use of protective works such as dams, levees, and channel improvements. Preventive measures on the other hand, exercise control over the use of land lying adjacent to the water and, thus, reduce the damage potential. The latter method is generally considered to complement the former, although the two approaches are not mutually exclusive. The two concepts can be expressed in a trite manner by saying that corrective measures seek to keep water away from man while preventive measures seek to keep man away from the water. TVA has delineated in a graphic manner on the adjoining page some of the elements involved in these two approaches of a sound flood abatement program.

FIGURE 14



TENNESSEE VALLEY AUTHORITY 1962

CORRECTIVE MEASURES

When floods occur, the flood victims first think of solving their problems in terms of physical structures of terrestial improvements since these are the most common means of combating floods. These measures place their emphasis on the control of flood waters by diverting and/or retarding the force of the water from the centers of population and areas with high property values. There is an impressive amount of evidence that structures are not the complete answer to flooding, but if properly understood and used, they may be a significant component in a comprehensive solution. Many of the corrective measures will be examined in depth to better understand their functions and limitations.

Flood Control

Dams and Reservoirs

Flood protection can be achieved by providing reservoirs to retard or delay excessive runoff for the purpose of reducing heights of floods. The function of reservoirs is to store water when streamflow is excessive and to release it gradually after the threat of flooding has passed. Although storage is effective in reducing flood peaks in the reach of streams immediately below the dam, its effect diminishes rapidly with distance downstream. Also, the percentage reduction of peak flow possible by a given amount of reservoir storage is larger for rapidly rising and falling floods than for those in which the flood flow is spread out over a considerable length of time. It should always be borne in mind that reservoirs are not generally designed to protect against the maximum probable flood, and they may not be able to prevent losses from the very rare event.

Large dams on the main stems of rivers do not provide flood protection for the flood plains of its small tributaries. Small dams can be placed on the headwater streams, but the protection afforded is most effective when the rains are of moderate amount. The economics of upstream dams is influenced by the fact that more area is required for water storage than for down stream sites.

Levees or Floodwalls

Levees or floodwalls protect the populace and exposed property by acting as a barrier and confining floodwaters to a floodway area where they would cause little or no damage. Levees are earth embankments, whereas floodwalls are generally concrete walls. To avoid a false sense of security, they should be

constructed against the maximum probable flood rather than a lesser one. If properly constructed and maintained, they provide excellent local protection, but at the expense of downstream sites. Confining floodwaters to a narrow channel tends to increase the depth of flood stages, thus raising the peaks downstream where protection might not be provided. Generally, the unprotected areas are worse off when this happens than if the waters had been allowed to invade the flood plain upstream.

Channel Improvements

Flood stages can be reduced by improving flow conditions within the channel and by increasing the stream's carrying capacity. These improvements have the principal advantage of providing protection in the area where safeguards are most needed. Channel improvements cannot significantly reduce damages in all cases, but they can help in many situations. Channel improvements receive favorable consideration because this is probably one of the least costly of all flood control measures. Methods for obtaining channel improvements include (1) straightening to remove undesirable bendways, (2) deepening or widening to increase the size of the waterway, (3) clearing to remove brush, trees, and other obstructions, and (4) lining with concrete to increase efficiency.

Watershed Treatment

Basically a watershed can be defined as constituting the land area whose runoff goes to a certain stream or river. If the water is collected too fast, the stream has a potential for flooding. Watershed treatment tends to render the soil more capable of absorbing and retaining some of the excessive rainfall until flood heights in the swollen streams have receded.

When the land was in its virgin form, nature in many cases provided some protection from excessive runoff. Plants broke the fall of the rain, roots made the soil porous to allow for water penetration, and the humus layer aided in absorption. The root structures increased the ability for the soil to remain in place as the water moved over the surface. Heavy rains created runoff problems, but in general the natural condition of the ground cover was satisfactory for normal precipitation. Today urbanization in the form of housing, yards, streets, paved areas, etc., and poor agricultural and forest practices have substantially reduced the absorptive capacity of the soil and increased the time of runoff concentration. Some of the more common treatment practices which will help to restore the land's ability to minimize

flood potential in the headwaters are crop rotation, construction of terraces, contour strip cropping, and selective planting or reforestation.

Other Corrective Measures

Evacuation

A little used but effective method of flood damage control is to evacuate permanently those areas which are in present use and subject to flooding conditions. Evacuation may be regarded as one phase of a policy of keeping people away from floods. Provision was made for evacuation in the Flood Control Act of 1938,[1] and this policy should be considered by state or local agencies as well as the Federal Government when plans for flood-damage prevention are adopted. Evacuation may be made compulsory under the power of eminent domain. With federal financial assistance, the municipalities of Leavenworth, Indiana, and Shawneetown, Illinois were relocated on flood-safe townsites after destruction by floods in 1937.

For evacuation to be completely effective, flood-plain zoning should be adopted to prevent the erection of new structures or the repair or rebuilding of old structures in areas where ultimate evacuation is feasible. Costs of an evacuation program may thus be prevented from increasing, meanwhile increased exposure to flood hazard is arrested. A well-laid plan will, of course, include plans for financing the removal and provision of a properly planned site in a new flood-safe area. Such a plan should be in readiness for the anticipated flood if it cannot be carried out before. After the 1938 flood in southern California, the willingness of local citizens and flooded-out residents to move to higher and safer ground was frustrated by failure to have ready a plan of relocation. Settlers were forced to return, albeit unwillingly, to the same sites in which, previously, several lives had been lost.

Flood Forecasting

Reliable, accurate, and timely forecasts of floods and flood stages can be coupled with timely evacuation to save lives and reduce property losses. Warning systems provide a means of reducing a substantial part of the ordinary flood loss. If the flood peak can be forecast in sufficient time to permit occupants of flood plains to take emergency measures, it is possible that from 10 to 30 percent of all losses in urban areas and a substantial amount of losses in agricultural areas may be eliminated.[2] For example, warning of the coming of a flood crest enables a farmer to get his livestock out of the reach of floods or to put them in a position where they will have

adequate forage during the time they are isolated by the flood waters. In an urban area, the issuance of a flood forecast enables owners of movable property to elevate it above the reach of floods or to take emergency protection measures within their own buildings. One of the chief benefits is in reducing the hazard from loss of life. The forecasting service, provided primarily by the Environmental Science Services Administration (U.S. Weather Bureau) and by others, has, during the past, saved countless lives and dollars.[3] 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 flood warning services hinges upon the immediate detection of impending weather events and the observation of gyrometeorological 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. For streams producing broad-crested floods which require several days to reach the peak, the forecasting problem is less difficult. In the case of small drainage areas with sharp flood peaks, the problem is more complex.

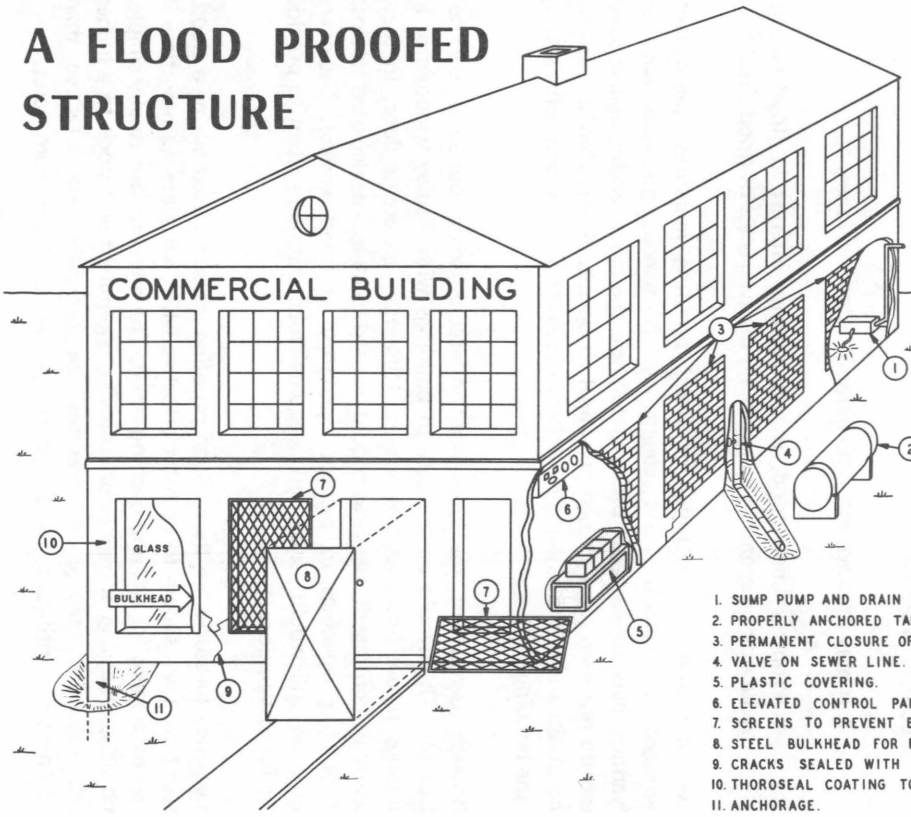
Flood Proofing

Flood control projects have protected against or reduced the threat of flood damages to many buildings. There remain on the flood plain thousands of other structures susceptible to damage. These structures present formidable problems to the communities in which they are located. The proper flood proofing of buildings can mitigate much of this residual damage due to floods. Flood proofing describes those modifications made on buildings or other type of structures for the main purpose of reducing damages caused by flood waters. These alterations can be made in existing buildings during remodeling or can be incorporated into new buildings during construction.(See Fig. 15)

A flood-proofing program should be seriously considered by individuals and/or communities where flood control projects have provided only partial flood protection; where studies have concluded that it is not economically feasible to provide flood control structures; where the necessary local cooperation for construction of control structures is not forthcoming; where

FIGURE 15

A FLOOD PROOFED STRUCTURE



NOTE:
ITEMS NO. 7 & 8 TO BE STORED IN A CONVENIENT LOCATION NEAR OPENINGS.

EXPLANATION

1. SUMP PUMP AND DRAIN TO EJECT SEEPAGE.
2. PROPERLY ANCHORED TANK.
3. PERMANENT CLOSURE OF OPENINGS WITH MASONRY.
4. VALVE ON SEWER LINE.
5. PLASTIC COVERING.
6. ELEVATED CONTROL PANEL.
7. SCREENS TO PREVENT BREAKAGE OF GLASS FROM FLOATING DEBRIS.
8. STEEL BULKHEAD FOR ENTRANCE.
9. CRACKS SEALED WITH HYDRAULIC CEMENT.
10. THOROSEAL COATING TO REDUCE SEEPAGE.
11. ANCHORAGE.

utilities, manufacturing plants; and navigation terminals require riverfront locations to function effectively; and where the availability of flood insurance is tied closely to the reductions of losses by flood proofing.

John R. Sheaffer has suggested that "in addition to its principal values of permitting occupance in flood plains and enabling a building to function during flood periods, flood proofing has some other benefits:

1. It offers an additional tool in a comprehensive flood damage reduction program.

2. It can increase the protection afforded by partial protection flood control projects.

3. It may improve the availability of flood insurance.

4. Properly understood, it can increase interest in flood damage reduction programs by heightening the awareness of flood risk."[4]

There are three major types of flood proofing measures: permanent, contingent or standby, and emergency. Permanent measures have an advantage over other types because they are the most reliable and in some cases do not even need trained personnel to operate them. They are usually incorporated into the building structure or are part of the topographic setting of the building.

Although permanent measures are preferable, some buildings are not adaptable. This would be the case in buildings with display windows or in buildings below flood level which must maintain an access door. In these situations, contingent measures should be used (such as a device used to close off building openings to prevent the entry of flood waters). These are removable and would require an adequate flood warning system to provide time for installation.

Emergency measures are those flood proofing measures used during a flood. These have been shown to be most effective when adequate warning time is given to prepare for the approaching flood. The measures are usually simple, such as sandbagging entrances or removing equipment and stock to a higher level. Although emergency measures are generally less effective than permanent or contingent measures, they may be valuable in many cases.

The U.S. Army Corps of Engineers in a recent publication has enumerated several of the flood proofing measures which have been recognized and studied. These include:

"Seepage Control
Sewer Adjustment
Permanent Closure
Openings Protected
Interiors Protected
Protective Coverings
Fire Protection
Watertight Caps
Proper Anchorage
Underpinning
Appliance Protection
Utility Adjustments
Roadbed Protection
Elevation or Raising
Temporary Removal
Rescheduling
Proper Salvage
Timber Treatment
Structural Design"[5]

A common type of structural adjustment, but one which is not applied as widely as warranted, is in the design of roads, bridges, and earthworks so that they will not experience serious injury at times of high water with the greater velocities and higher saturation surfaces that result from floods. The benefits derived may rise exponentially by using two or more corrective measures in combination to reduce flood damages. Structural changes combined with warning systems is an excellent example. Some of the structural changes, such as the emergency bulkheads, can be put into operation only if given a sufficient period of warning. Experience has shown that adequate flood warnings with structural measures may render a very complex urban area largely free from flood losses. In the "Golden Triangle Area" of Pittsburg, a highly built-up central business district center, it is now possible for certain new buildings in the area to endure up to 15 feet of water without suffering heavy losses. Buildings are watertight, utility lines are so arranged that they are not interrupted by the flood waters, internal waste disposal goes on with the aid of special sump-pumps, and all of this can be put into operation within a few hours notice.[6]

Urban Redevelopment

Urban renewal was first authorized by the United States Housing Act of 1949. Subsequent amendments have broadened the scope of the program. It can be used in flood-blighted areas that are a drain on the economic life and welfare of the community. The program provides substantial assistance to municipalities burdened with such conditions. A redevelopment program should include flood-control works where appropriate and necessary, and should set aside the lower flood-plain areas for parks, open spaces, and other

uses not subject to substantial flood damages. This program affords the opportunity to plan future use of the land in such a way as to reduce flood damages.

PREVENTIVE MEASURES

There appears to be a general concensus among those who "know the facts" that the problem of eliminating or minimizing flood damages cannot be solved by engineering in combination with upstream land management. They see it as engineering plus community planning in the broad sense.

General Herbert D. Vogel, as head of TVA, in 1958 said:

> It is a recognized fact that we are losing ground in our effort to lick the flood problem by control measures alone. We are building in our flood vulnerable areas at a faster rate than we can protect these areas.[7]

General Vogel, in a special report to the President and the Congress in 1959, expanded on his philosophy regarding flood damage abatement:

> Communities throughout the Nation are engaged in a new contest with their rivers and they are losing. They will continue to lose unless steps are taken to provide a new perspective--and a new channel of action--with respect to floods.... The problem arises from the basic fact that there are some floods which cannot be prevented and many cities that cannot be fully protected economically, with artificial works such as dams and levees. Coupled with this fact is the rapid growth of urban communities, creating new pressures to utilize inviting but hazardous flood plains for subdivisions, shopping centers, commercial establishments, and other improvements. This mushrooming trend is creating new flood damage potential faster than construction works can add to existing protection.

Brig. General John L. Person, Assistant Chief of Engineers for Civil Works, in testimony before the House Committee on Public Works in May, 1959, reiterated the need to place greater emphasis on flood prevention:

> While we have made great progress in providing flood control works, many of our river valleys are still subject to destructive floods, and the degree of protection varies widely. Moreover, it will probably not be possible, because of physical and economic limitations to provide full flood protection. This leads to the inescapable conclusion that

> greater attention must be given states, municipalities, and industries, and by federal agencies concerned with development, to come to some form of regulation of flood-plain use. We should be as much concerned with avoidance of creation of future hazard, as with means of correcting the flood damage after it occurs.

Even when all the authorized or proposed federal flood control projects are complete, there will remain a tremendous residual problem of flooding. There will remain a flood problem in many currently developed areas, because it is frequently impossible as well as financially impractical to eliminate all flooding.

> Pragmatic observation indicated that while nature may be a prime cause of floods, the presence and extent of flood damage is caused by man. This conclusion seems to be the necessary consequence of man's encroachment upon the flood plain area and his exploitation of its varied uses. To prevent needless loss, not only must the flow of water be controlled where feasible, but the damage incurred as a result of unpreventable overflow must also be controlled.[8]

Flood Plain Regulations

Land-use controls do not attempt to reduce or eliminate flooding but are designed to mold the flood-plain development in such a manner as to lessen the damaging effects of floods. Flood-plain regulations imply the adoption and use of legal tools, by committees, with which to control the extent and type of future development which will be permitted in the valleys. There are several ways of effecting land-use controls.[9]

Flood Plain Zoning

Flood plain zoning is a legal means to regulate the use of land subject to floodings so as to minimize flood damage and reduce danger to human life. The power of a community to regulate the use of land to promote the health, welfare, and safety of its inhabitants by zoning has been upheld many times in the courts. Flood-plain zoning is one aspect of this general "power to zone" and enables the community to protect its citizens from flood damage by regulating the use of land subject to flooding. Zoning generally affects only the future use of land but there is a growing weight of authority which allows the removal of uses in existence at the time a zoning ordinance was

adopted, if the amortization period is sufficient. Amortization of nonconforming uses is discussed in greater detail in a later section of this report.

In the past, the concept of flood-plain zoning has tended to become identified with the flood insurance program. The Flood Insurance Act of 1956 stated that no flood insurance could be sold in any locality that had not adopted either flood-plain zoning or other restrictions on land use and development required by the administering federal agency. Although this Act never became operational, Public Law 91-448, which is the current flood insurance law, likewise requires adoption of land use regulations as a prerequisite to qualifying for flood insurance.

A national legal authority, Allison Dunham,[10] feels that the three most important justifications for zoning of flood plains are: (1) the prevention of encroachment on flood channels which would increase the height and effect of a flood, thereby causing additional damage to the property of others along the stream, (2) preventing persons from being victimized by the purchase of flood plain property where the full danger of flood damage is not known or cannot be readily ascertained, and (3) promoting the general welfare by reducing the expenditure of public funds for protective works or disaster relief. In other words, the objective of flood-plain regulation is to promote uses of the flood plain so that the benefits derived from its use exceed the flood damage, plus the cost of providing a specified degree of protection. Indiscriminate use of flood plains invites great property damage and human suffering, including loss of life, whereas at the other extreme, complete abandonment of flood plains would be a sacrifice of a valuable national resource.

It must be remembered that the problem is not one of prohibiting any kind of use of the flood plain, but of finding optimum use, taking into account not only the flood losses that would result, but also the benefits that would flow from such use. Land-use regulation can be developed to foster the wise choice of floor plain use, insisting upon careful consideration of the effects on both property owners and the community of permitting the more intensive uses.

Before flood plain zoning can be put into operation in a locality, there must be both a legal and a technical basis. The legal basis would be in the form of appropriate enabling legislation. The technical basis would require:

(1) Calculation of the largest flood that can reasonably be expected in view of topography, potential rainfall, and other factors.

(2) Identification of the "flood way," the area that will be covered by the river if this flood occurs and which waters will be deep enough to reach dangerous velocities.

(3) Identification of the "flood way fringe area," the area which lies outside the open flood way, but within the area which will be inundated by the largest flood that can reasonably be expected. In this fringe area, flood waters "pond," but do not do serious damage by sheer velocity or force.

The various areas are shown pictorially in Figure 16, prepared by TVA in cooperation with Corps of Engineers.

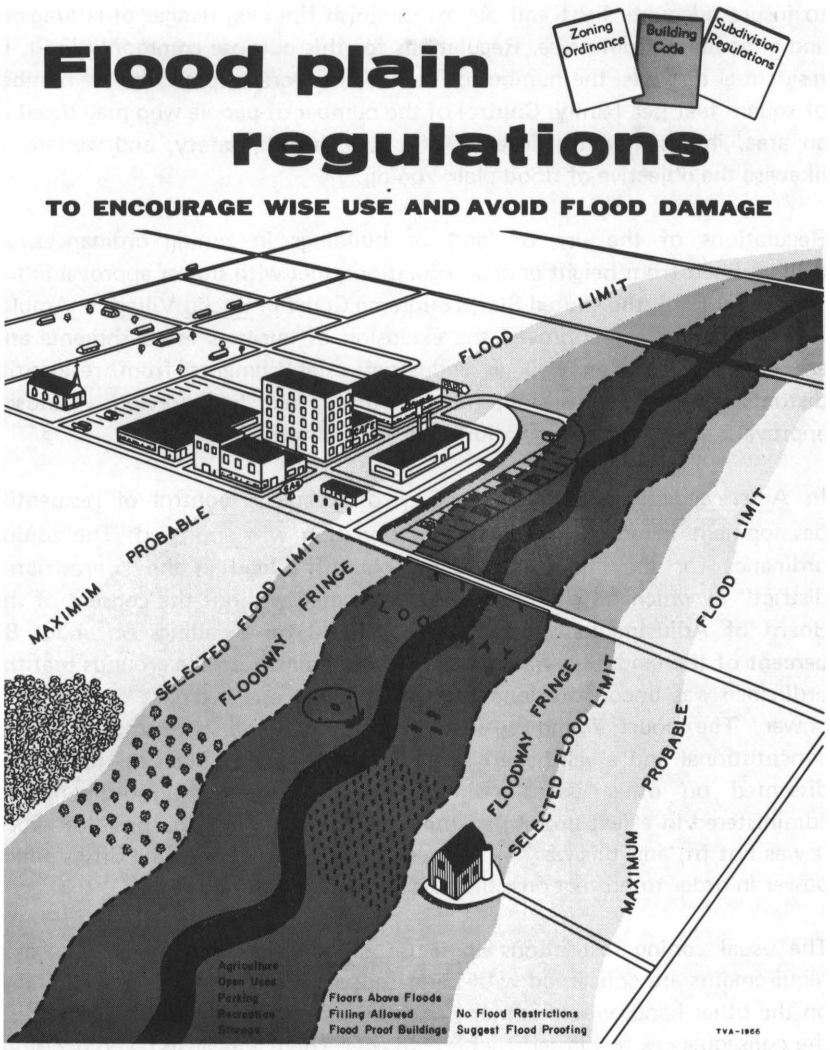
Legality of Flood Plain Zoning

One of the principal obstacles to more widespread application of the principle of restriction or exclusion of occupancy in flood plains is the existence of doubt as to legality. A regulation of this character is an exercise of the police power involving a restriction on the use of private property. Whether regulation of this character will be deemed to violate the Fourteenth Amendment to the Federal Constitution or similar provisions of most state constitutions will depend upon: (1) whether the objectives of such land-use regulation are within the scope of the police power; (2) whether the measure bears a reasonable and substantial relation to the objectives; and (3) whether the particular ordinance is reasonable and not arbitrary.

In view of the decided cases, there are good reasons for believing that such regulations will meet the test imposed, if reasonable in the particular circumstances in which they are applied. Two lines of authority sustain this view. The diminution and/or prevention of damages from floods has been upheld by the courts to be appropriate public purpose and not violative of the Fourteenth Amendment. However, in those cases the use of the police power was to prevent flood damage by measures or procedures other than building control or zoning. In other cases not involving the prevention of flood losses, restrictions and even prohibition of buildings and land use have been sustained by the courts for the purpose for which the regulations were passed.

In addition, the courts have sustained land and building restrictions similar in type to those likely to be used in flood plain zoning in the interest of public health, safety, or welfare. For example, one method of imposing area restrictions has been through requirements of open spaces in front, side, or

FIGURE 16


Zoning Ordinance
Building Code
Subdivision Regulations
Flood plain regulations
TO ENCOURAGE WISE USE AND AVOID FLOOD DAMAGE
FLOOD LIMIT
PROBABLE MAXIMUM FLOOD LIMIT
SELECTED FLOOD LIMIT
FRINGE
FLOODWAY
FLOODWAY FRINGE
SELECTED FLOOD LIMIT
PROBABLE MAXIMUM FLOOD LIMIT
Agriculture
Open Uses
Parking
Recreation
Storage
Floors Above Floods
Filling Allowed
Flood Proof Buildings
No Flood Restrictions
Suggest Flood Proofing
TVA-1966

rear yards. Front-yard requirements are sometimes known as "set-back lines." The analogy between a regulation requiring buildings to be "set back" from streets and a flood plain zoning ordinance requiring a "set back" from the banks of a stream or river to protect the occupants from floods is apparent. Some zoning enabling acts authorized regulation of the density of population to insure adequate light and air, to diminish fire risk, danger of contagion, and annoyance from noise. Regulations for this purpose commonly limit, in residential districts, the number of families per acre or prescribe the number of square feet per family. Control of the number of people who may dwell in an area, imposed in the interest of public health, safety, and welfare, is likewise the objective of flood plain zoning.

Regulations of the use of land or buildings in zoning ordinances, as distinguished from height or area regulations, met with slower approval in the courts. In 1926, the United States Supreme Court in Euclid Village v. Ambler Realty Company[11] approved the exclusion of business establishments and apartment houses as well as industrial establishments from residential districts. After this decision, many courts which had previously refused approval of this type of regulation changed their attitude.

In American Land Company v. City of Keene,[12] control of residential development in an area subject to inundation was approved. The zoning ordinance for the city classified the plaintiff's land in the "unrestricted district" in which no dwelling could be erected without the consent of the Board of Adjustments. Permits were refused for dwellings on about 87 percent of the land. Suit was brought by the plaintiff on the grounds that the ordinance was unconstitutional and was an improper exercise of the police power. The court found against the plaintiff and held the ordinance constitutional and a valid exercise of the police power. Even the judge who dissented on other issues pointed out that the zoning ordinance as administered in effect prohibited the sale of the land for a purpose for which it was not fit, and this was "an eminently proper exercise of the City's police power in order to protect possible purchasers being victimized,...."[13]

The usual zoning restrictions upon use and occupancy or height and area requirements are concerned with harm caused to others. Flood plain zoning, on the other hand, would in many cases be aimed at protecting a man against the consequences to himself by his own acts. There appear to be no decisions expressly sanctioning regulations to prevent one doing something which injures himself directly and others indirectly. It may be urged that there is sufficient public interest in preserving the lives and health of persons to justify restraining individuals from exposing themselves to injury by their

own action. The number of persons protected by restrictions of this character might often be substantial where the area exposed to flood hazard is large. The view that the police power must halt short of protecting people from the consequences of their own action may rest in part upon the assumption that the flood risk is knowingly assumed. In many cases this may be untrue. Full knowledge of the nature and extent of the flood hazard may be unknown or may rest with persons other than a prospective buyer or user. The residences may not be occupied by the original builder. They may be rented or sold, indeed the entire development may be carried on for purposes of disposal rather than the occupancy by the original builder. Action by American Land Company would be a case in point, had they received building permits.

One of the principal reasons advanced for support of rural zoning is economy in public expenditures through prevention of high-cost public services. Flood plain zoning may also avoid the uneconomic expenditures of large sums for public works to prevent flood damages and to reduce the cost occasioned by floods to private property owners and public alike. It is in the public interest to reduce or prevent these losses by all reasonable measures, whether they fall on private persons or the public. This is especially true since expenditures for protective works proposed to reduce them have long been held to be in the public interest. Zoning restrictions, such as "set back" regulations, are designed in part to facilitate fire extinguishment, but are probably imposed as much for the benefit of the property owner whose property is regulated as for the benefit of the adjoining property owners.

In the final analysis, each ordinance or resolution setting up a land-use regulation must in the language of the courts, "be reasonable and not arbitrary," Two questions must be answered in determining the validity of any ordinance which establishes zones or districts in which different regulations are adopted in each district:

> (1) Is the scheme of zoning as a whole sound, that is to say, is the method of classification and districting reasonably necessary to the public health, safety, morals, or general welfare? (2) Has the scheme of classification and districting been applied fairly and impartially in each instance?[14]

If a flood hazard exists, the reasonableness of any restriction will turn upon two considerations: (1) The imminence and magnitude of the flood hazard, and (2) The appropriateness of the control to the hazard involved. The first point involves a policy decision by the legislature or regulating agency. Is it "reasonable" to restrict occupancy in areas likely to be inundated once in

fifty years, twice in fifty years, five times in fifty years? Reasonableness as interpreted by the courts may vary from time to time and to an extent by the recentness of catastrophic floods. There are few guidelines, but there is a judicial tolerance for a wide range of legislative discretion.

With respect to the second point, the particular method of regulation chosen needs to be "substantially" and "reasonably" related to the end in view. But within these broad limitations, the question is a legislative one, and the court will not ordinarily substitute their judgment for that of the legislature. The more serious the hazard, in terms of frequency and magnitude the more justifiable is rigid control.

A zoning ordinance will not be held invalid merely because it results in diminution of the market or use value of the property affected. Mr. Justice Holmes in Pennsylvania Coal Co. v. Mahon stated:

> Government could hardly go on if to some extent values incident to property could not be dimished without paying for every such change in the general law. As long recognized, some values are enjoyed under an implied limitation and must yield to the police power. But obviously the implied limitation must have its limits, or the contract and due process clauses are gone. One fact for consideration in determining such limits is the extent of diminution. When it reaches a certain magnitude, in most if not all cases there must be an exercise of eminent domain and compensation to sustain the act. So the question depends upon the particular facts. The greatest weight is given to the judgment of the legislature, but it is always open to interested parties to contend that the legislature has gone beyond its constitutional powers.[15]

The Dooley v. Town Plan and Zoning Commission[16] is a case point. It also points out other weaknesses that may lead to the defeat of a flood plain zoning ordinance. In refusing to uphold the ordinance of the defendant town, the court found that none of the uses permitted under the ordinance could offer the owner a fair profit on the land in question and no alternative plan of use was specified in the ordinance. The land had been frequently flooded by salt water and was unfit for farming. The remaining permissible uses were also shown to be unsuitable for various reasons. The court noted that some parts of the land in question were at a higher elevation than other parts, but only

one district was established to cover all of the land affected. There was no evidence shown that the defendant had either employed any expert or had established the flood danger on hydrologic data. On the basis of these points, the court found for the plaintiff and allowed damages as estimated by the plaintiff.

This case points out the need for careful consideration of any flood zoning law as to the objective and means of accomplishment since laws have been held to be valid when applied to land with a similar degree of flooding hazard as those in the Dooley case.

Amortization of Nonconforming Uses

It is recognized that the very purpose of zoning is to inject uniformity into a particular district, and this necessarily means eliminating existing nonconforming use. The methods employed may be put into four general categories:

1. Condemnation--This is usually too costly, especially if applied on a broad scale. Some have suggested that the financing problem could be met by assessing each property owner an amount equivalent to the enhancing value resulting from an elimination of nonconformity. The beneficiaries of reduced flood damages would be so widespread as to make this impractical. The costs for flood control projects are non-reimbursable and payable out of the general fund for the same reason.

2. Abandonment--This simply means that if one discontinues the use of a nonconformity for a specified period of time he forfeits the right to continue it at all. The subsequent use must then conform to the permitted uses in the district in which it is located.

3. Prohibiting or Limiting Extensions and Repairs--This method has had limited success and the major criticism is that at best it limits but does not eliminate. In the early days of zoning it was thought that the nonconforming uses would disappear with the passage of time. The favorable, sometimes monopolistic position accorded them, together with municipal requirements that all buildings meet certain standards of fitness, militates against their elimination. Persons locating on the flood plain because of the economic advantage are not likely to surrender it due to prohibition on extensions or repairs.

4. Amortization--This contemplates the compulsory termination of a nonconformity at the expiration of a specified period of time. This method is the least costly, offers the greatest promise, and is the least tried.

There are at least three basic justifications to support amortization as a method to remove nonconformity in the flood plain for purposes of reducing flood damages.

1. A nonconformity during the period when it enjoys such status is in a monopolistic position which should generate extraordinary returns to compensate any losses possibly sustained by virtue of elimination.

2. An amortization period allows more time for recouping the original investment in a nonconforming structure and the owner can make plans for relocating the operation.

3. Where a nonconforming use of land not involving a building or structure must be terminated, the detriment suffered by the owner in most cases will be small and the gain to the public substantial.

To understand zoning with an amortization plan, some discussion of the prevalent theories of the court is necessary. The cases in which amortization provisions were brought into question are divided into two main groups. The first group of cases emphasizes the concept that one of the primary attributes of property is the owner's right to use his land. This approach underscores the "taking" of the right by the ordinance, with the result that the ordinance may be declared invalid. The landowner has a vested right in his prior nonconforming use which cannot be taken without just compensation.

The second group of cases tends to view an amortization provision as a normal exercise of the police power. Whether the amortization period provided is reasonable depends on balancing the social benefits resulting from abatement of the nonconformity against the hardship to the landowner forced to terminate. If uniform, reasonable methods of amortization can be found which treat all nonconforming owners on a similar, equitable basis, the vested rights approach would seemingly be deprived of its major support and amortization could then become an effective yet fair tool of the planner.

The cases even down to the present day show opposing views by courts of various jurisdictions. Those cases decided on the vested rights theory, holding

that the ordinance in question is an unjustifiable exercise of the police power, weaken the impact of the decision in many cases by indicating that the holding is limited to the facts of the case before the court and that another decision might be possible if the facts were different. The majority of courts seem to sustain a zoning ordinance with amortization provisions for eliminating nonconforming uses if the amortization period is reasonable and the detriment to the individual is small in relation to the benefit to the public. However, there is not unanimity among the state courts regarding the constitutionality of such ordinances and to date the U.S. Supreme Court has refused to review decisions where the amortization theory was attacked on constitutional grounds. Review is inevitable, and the decision will be as significant as the Euclid case regarding the constitutionality of basic zoning.

Los Angeles currently has ordinances for the liquidation of nonconforming uses in residential districts in periods of 40, 30, or 20 years, according to the type of structure involved. A Minneapolis ordinance provides for a 30-year period for amortizing wood frame buildings, 40 years for wood and masonry, and 50 years for buildings of other construction with time being figured from date of erection of buildings. The latter ordinance might create some irregular situations by allowing a longer amortization period for a structure representing a low investment while according a much shorter amortization period for a larger structural investment because of materials used in construction.

Considerable uniformity could be attained in flood plain amortization by relating the amortization period to the location on the flood plains and the degree to which the structure had been flood-proofed. Those structures located so as to be susceptible to a once-in-5-years flood would be amortized more quickly than those likely to sustain damage in a once-in-20-years flood. Likewise, a structure with an operation floor at a high elevation would be accorded a longer amortization period than a building with an operating floor at ground level with unprotected openings.

Encroachment

With the passage of time, it has become increasingly apparent to those who have studied flood damages that encroachments upon channels and floodways so constrict their width that flood conditions are aggravated and become even more serious as the population increases and is pressured into locating on less desirable flood plain areas. White in 1958 made the following observation:

> The extent that new occupance encroaches upon natural stream channels so as to increase flood heights and velocities, it adds to the flood hazard. In virtually all of the areas studied, there was evidence of some encroachment, but it carried the most serious consequences in two types of situations. One of these is where bridges and highway fills constrict the channel so as to cause ponding. The other is where new structures, usually residences, are built in the bottom of dry washes or close to the channels of small streams having drainage areas of less than 10 square miles.[17]

Hoyt and Langbein made the following comment with respect to the purposes of flood plain zoning:

> The primary goal of flood zoning must be to prevent unwarranted constrictions that reduce the ability of the channel to carry water and thereby adding to the height of floods. Thus there must be maintained a channel with capacity adequate to carry the discharge of a certain specified flood depending upon local conditions. Where this is to be done "encroachment lines" beyond which no structure can extend, must be established after suitable field surveys. This is not to protect the structure, but so that the structure will not cause damage to other property.... In general, therefore, the practice of setting encroachment limits is a balance between the principle of complete exclusion and no restriction whatsoever.[18]

Before entering into a discussion of statutory regulations, the rights of a private person in the area of common law will be considered. Distinction is made between diffused water and that in a stream. As to diffused water, the jurisdictions have divided sharply. Some adhere to a civil law rule of natural flow: That a landowner cannot alter the manner of flow of diffused water onto the land of another against the objection of that owner. Other states adhere to the so called "common enemy" rule: That the landowner can act in any way which reduces his own damage to a minimum, irrespective of the effect on his neighbor. In Virginia, diffused water is considered to be a "common enemy" which each neighbor may fight off as best he may. However, the right to fight off diffused water may not be exercised wantonly, unnecessarily, or carelessly, but is modified by the maxim that one must so use his property as not to injure the rights of another. The casting back of

diffused water must be a reasonable use of the land for its improvement or better enjoyment, done in good faith, and with such care as not to inflict unnecessary injury. If this standard of conduct is met, resulting injury is without remedy. Although the Virginia courts appear to give lip service to the "common enemy" doctrine, the impact of their decisions is to apply the test of reasonableness in determining rights and liabilities from the modification of diffused water flows.

There is much more uniformity of opinion in the area of riparian rights. The general rule is that the riparian owner has no right to obstruct the streams or to erect a levee or other structure which will throw water onto the land of others to their injury in times of ordinary floods, unless the privilege has been obtained by grant or prescription. One who places an obstruction in or around a natural watercourse which will inflict injury or damage on other landowners by an increase in velocity and/or the amount of water backing upon the land of another, in times of normal flow or in times of ordinary floods, is liable to the injured landowner for the damage so occasioned.

In Crawford v. Rambo[19] the defendent was held liable for injuries to plaintiff's land resulting from the defendant's dike. The dike was built to protect the defendant's land from ordinary flooding, but it caused water to flow over the plaintiff's land with greater velocity than before. The same result was reached in several successive cases where the defendant cast the burden of loss on the plaintiff to protect his own property or where the plaintiff's property was damaged by negligence on the part of the defendant.[20]

The distinction between an ordinary (for which one may be rendered liable), and an extraordinary flood (for which one may escape liability), has been stated as follows:

> An ordinary flood is one the repetition of which, through at uncertain intervals, might, by use of ordinary diligence in investigating the character and habits of the stream, have been anticipated. An extraordinary flood is one of those unexpected visitations whose comings are not foreshadowed by the unusual course of nature, and whose magnitude and destructiveness could not have been anticipated or provided against by the exercise of ordinary foresight.[21]

The rationale behind this exception is that those with buildings or who maintain obstructions are duty bound to anticipate reasonably expected floods, freshets, etc. However, they should not be held responsible for unexpected, accidental and extraordinary floods, often deemed "acts of God." This exception is qualified to some extent. In order to escape liability, there must not have been any initial, intervening, or concurrent negligence on the part of the "obstructor."

The case of Taylor v. Chesapeake & Ohio Railway illustrates this point. The plaintiff alleged that when the news of an approaching flood reached defendant railroad, defendant, in order to protect its railroad bridge and trestles, moved one of its large locomotives out onto the bridge in the course of the approaching water, thereby causing the water to be dammed and backed up, with the result that the water thereby backed up did extensive damage to plaintiff's property. It was conceded that the flood was of such magnitude and constituted an "act of God" for which defendant would not have been liable had it not been for some act of negligence. However, plaintiff alleged that the defendant's forewarned knowledge, and subsequent actions constituted the requisite negligence. Defendant alleged that its action was justified not as an act to retain the floodwaters within their natural boundaries, but to protect and hold in place structures already in the stream. The court stated that the defendant's action did constitute such negligence even in light of the extraordinary nature of the flood as to render it liable for the resulting damage.[22]

In order to establish or impose liability for obstruction of a stream, river, etc., the act of the defendant must have been the proximate cause of the damage. In order to establish that the action of the defendant was the proximate cause of the injury to plaintiff's property as a result of the overflow, it is necessary that it be shown by a preponderance of the evidence that (1) the injury was a natural and probable consequence of defendant's conduct; (2) that the chain of causation was unbroken by any new and independent cause; and (3) that the defendant should have reasonably forseen or anticipated the injury.

In the case of Fort Worth & D. C. Ry. v. Welch, the plaintiff sought recovery for damages caused to the plaintiff's golf course resulting from the flooding of the Pease River, allegedly caused by the defendant's wrongful construction of its roadbed along said River with the result being that the roadbed held back some of the overflow water and caused it to remain on plaintiff's property longer than normal. The court held for the defendant, stating that the jury failed to find the requisite sufficient factor to determine that the defendant's obstruction was proximate cause of plaintiff's injury.[23]

However, in the more recent case of Stafos v. Missouri Pacific R. R., the defendant was held liable for damages resulting from overflow which was precipitated by the accumulation of silt and debris at the base of defendant's bridge. The court stated:

> It is not essential to the railroad's liability that the obstruction of its bridge and ditch be the sole and only cause of the flooding. It is enough if it is one of the probable causes. The degree of negligence is unimportant.[24]

Where two or more causes or two or more defendants, each acting independently, when taken together produce the overflow resulting in damage to plaintiff's property, the defendants are severally and not jointly liable-- e.g., are liable only for the proportional amount of damage deemed to have resulted from their wrong.

William Tachaberry Co. v. Sioux City Serv., Co. held that where several defendants had been negligent in failing to allow a sufficiently adequate channel in time of ordinary flood, the defendants had all acted independently and were severally liable. It was further held that the plaintiff need not prove the precise damage caused by each defendant, but that plaintiff may prove to the best of his ability the proportionate share of liability of each defendant.[25]

In summary, the general rule appears to be pretty well settled that while one may build obstructions such as levees, dikes, embankments, bridges, etc., in or adjoining natural watercourses, he is bound to the duty of a reasonable man to so construct and maintain such obstructions so that they will not cause injury to other landowners in times of high water or ordinary flooding by way of increasing the flow or backing up water on the land of another. If damages occur as the result of the obstruction, he will be liable. The general rule, however, is subject to some qualifications:

> 1. The "obstructor" is not bound to provide for or anticipate "extraordinary" floods. He will not be liable for damage which is caused or contributed to by his obstruction in times of extraordinary flooding when the obstruction would not have caused any injury to others in times of ordinary flooding-- unless, however, the party is contributorily "negligent."

2. Where the injury is the result of several obstructions, the individual defendants are severally and not jointly liable; and thus responsible for only that portion of the damage caused by his particular obstruction.

3. The damage caused by any such obstruction must be "substantial before a suit can be maintained.

The question then arises that if the owner has these rights against one who obstructs his stream, why is there any great need for encroachment legislation. Mr. E. W. Beuchert[26] suggests that there are five compelling reasons. First, it is often extremely difficult to prove, where flood waters have swept over an entire area, exactly what part of the resultant damage may be attributed to an obstruction belonging to a particular defendant. Second, even if a direct casual relation could be shown, floods are typically of such a catastrophic nature that to press a judgment would amount to making the plaintiff a creditor in a bankruptcy proceeding. Third, since a number of jurisdictions allow protective works against "extraordinary" flood waters, and since this may mean any non- annual flood, a private citizen would seem fully helpless in such a situation. Fourth, cases seeking to enjoin obstruction seem non-existant except after damage has occurred. While it may be possible to obtain an injunction before severe damage has occurred where the obstruction is directly within the channel of the stream, it would seem extremely difficult where the obstruction is in the floodway since the damage would only result in times of more severe floods and would really be an attempt to obtain an injunction on a more or less hypothetical situation, even if a neighboring owner could foresee the danger. Fifth, there is a clear social utility in attempting to prevent the situation which will cause injury from arising rather than attempting to seek recovery in a lawsuit after it has occurred.

Some attempts at encroachment legislation have been at the county and city level but there would appear to be considerable advantage in having it on a state-wide basis. Apart from the general availability of funds, enforcement at the local level would seem to be proportionately more expensive since there is a greater likelihood that a new agency would have to be set up instead of being able to put the program within the framework of an existing one. There is also a need to correlate flood data on a fairly wide geographic basis and if the agency must obtain information on its own and pay for technical services, difficulties, especially financial, are likely to be encountered. Moreover, the danger such encroachments cause may not be as local as they seem: ponding

behind a bridge may cause flooding of a wide area, and if structures are swept away by the current, they may cause damming miles downstream with the same ponding results. If one community does pass such a law, it may still be injured if its neighbors do not. Lastly, such legislation, if it is to be effective, will meet opposition from the local populace affected. A state agency will be better able to withstand such pressure than a local governmental unit.

Despite the need for extensive encroachment legislation, relatively few states have enacted such laws. Their effectiveness has varied but generally was not considered satisfactory.

Mr. E. W. Beuchert in analyzing the chief defects of encroachment statutes for the few states with such enactments summarized them as follows:

> (1) Too many aspects of the law are permissive rather than mandatory, both as to the agency (e.g. the establishment of encroachment lines) and the public (e.g. permits); (2) A general lack of clarity, not only in terms used (as to the establishing of the encroachment lines and the granting of permits); (3) Failure to provide flexibility of remedies to the agencies; (4) Failure to have a plan to inform the public of the requirements of the statutes; (5) Limitation of the coverage of the statute to channel-encroachment rather than floodway-encroachment.[27]

Legality of Encroachment Laws

There have been few cases dealing with the validity of encroachment laws. The first was City of Welch v. Mitchell[28] where the City under a charter authorization adopted an ordinance fixing building lines on each side of a stream in order to prevent obstruction of its flow. The court said that this was a valid exercise of the police power, and the owner need not be paid compensation if the restriction is reasonable. However, the court then held that the City could not permit encroachment beyond the line on one side of the stream to the disadvantage of those on the opposite side without compensation. What the City attempted to do was to relocate the building lines, moving one toward the stream on one side in order to permit the completion of a building for which it had negligently issued a permit, and moving the other away from the stream on the other side, farther onto the defendant's land, in order to maintain its 60-foot clearance area. Basically, the case reflects the idea of equal protection of the laws, and emphasizes to

the draftsmen that care must be taken if the legislation sets up standards for permits, or if it is to apply only to certain types of streams, or only to certain types of applicants for permits.

In the next case some 34 years later, Water and Power Resources Board v. Green Spring Company,[29] the defendant increased the height of his dam 17 inches without a permit and the plaintiff sought to enjoin. The court held that the statute giving the Board the power to grant or withhold consent for a permit to construct a dam or water obstruction, was not an invalid delegation of powers since the standards were sufficient (i.e. does the obstruction cause danger to life and property, or will it divert the natural course of the stream).

A Connecticut statute came under attack in Vartelas v. Water Resources Commission,[30] and is perhaps the most significant case in the area. The plaintiff owned land adjacent to a river, and the building which had been located there had been swept away by the 1955 flood. Almost all the land fell within the encroachment line later established by the Commission, and the Commission refused permission to build the type of structure applied for, a retail market, on the grounds that it would "impair the capacity of the channel and result in increased upstream water stages in time of flood." The trial court upheld the contention that it was an unconstitutional taking of property for public use without compensation. This decision was reversed on appeal. The statute authorized the establishment of the encroachment lines, directing the police power to be used where there are no existing structures or encroachments within the line, and directing that the power of eminent domain be used where there were such structures. The creating of classification was held to be within the power of the legislature. It was not unconstitutional on the theory that it worked an illegal discrimination in respect to situations where there were no existing structures, since there is a natural and substantial difference between the two situations. The legislation, with the aim of facilitating channel clearance and improvement, is an exercise of the police power. The police power regulates the use of property because its uncontrolled use would be harmful to the public interest; eminent domain takes private property because it is useful to the public. In addition, just because a plaintiff was refused as to one type of structure did not mean that another type, for example on piers or cantalevers, that would not impair channel capacity, would be refused. It was not shown that the plaintiff had been deprived of a reasonable and proper use of his property. Thus it is seen that there is little question that such channel encroachment laws are a valid exercise of the police power.

Status of Present Zoning Activities

A satisfactory program of flood plain zoning is dependent on comprehensive enabling legislation which provides authority to regulate and power for effective enforcement.[31] Authority for zoning is vested in the state government, and only through the possible delegation of such authority may local governments or agencies enact and enforce zoning laws.[32]

At the present time, the primary responsibility for the preparation and enforcement of flood plain zoning regulations rests upon local governments. Of the communities that have authority to plan and zone, however, not all are taking advantage of the powers available to them;[33] and some are even hostile to their use. Such hostility is usually justified on the theory that community planning, zoning, and other regulations infringe on the right of the individual to exercise free choice in the use of his property and therefore should be opposed for the preservation of individual liberty. This view neglects the harmful effects that improper land use may have on adjoining or neighboring property. It also overlooks the vast amount of general tax dollars expended annually in flood fighting, flood relief, and structural flood control.

The tendency of land-use regulations to expose the true value of an area by recognizing the flood hazard discourages land speculation and generates strong opposition to such regulations. Local authorities have had difficulties in withstanding such pressure. The provision for ultimate responsibility at the state level would enable more uniform application of land-use regulation.

Many local governments do not have and cannot afford to employ competent professional and technical personnel to enable them to relate the flood situation to development problems and to prepare suitable zoning provisions to guide and control land use in the flood plains. Likewise, many cities do not have sufficient trained personnel to administer and enforce such regulations. Here again economies of scale favor the state level program.

Since streams may pass through many areas of differing local jurisdiction, a coordinated approach is required to obtain information and equitable regulation. Poor enforcement at a local level can have a detrimental effect to other communities which may have no control over the cause of the trouble. Awareness of this extra-territorial effect of flood plain zoning administration caused Klar in 1960 to comment:

> Even with the very best of flood-plain zoning, inevitably the streams which may give rise to such flooding in one community passes through other communities first. If suitable measures are not taken upstream, the community which is conscientiously trying to do the best for its citizens may find itself thwarted in its program. This obviously speaks for regional planning--if not regional zoning.[34]

Landowners in unincorporated areas can many times successfully circumvent county zoning ordinances by having their land reclassified to some less restrictive use upon its annexation into an adjoining city or village. Needless to say, this practice, if widely adopted, would vitiate the effectiveness of any conscientious program of county zoning for the reduction of flood damages.

Subdivision Regulations

Subdivision regulations are used by local governments to specify the manner in which a subdivision (a tract of land divided into lots with a purpose of sale or building development) may be divided. The ordinance, usually prepared and administered by the local planning commission, commonly sets up the various requirements and design criteria that the subdivider has to meet if his subdivision is to be accepted by the municipality.[35]

Subdivision regulations are valuable in controlling flood damage, since flood hazards can be reduced by controlling new developments in the flood plain. This is especially valuable in areas outside corporate limits, where most new developments will occur, but where municipal controls are inapplicable.[36] Subdivision regulations are also helpful in developed areas when used as warnings to prospective purchasers.

Obviously, subdivision regulations would be most effective in generally underdeveloped areas, before a developer has started paving streets and laying sewer and water facilities. For this reason, the control of regulating subdivision development should begin with the approval of a plat plan. In this way, no construction would be permitted to begin until adequate flood protection and proper drainage had been provided.

Several types of control to prevent flood damages may be exercised. Approval of the plat may be conditioned upon streets and building lots being laid out or designated so as to minimize the flood hazard by requiring provision of right of way for drainage, or adaptation of streets to natural contours, or reservation of higher ground for building sites. A more drastic control would be to prohibit approval of a subdivision plat where it is proposed to subdivide an area subject to inundation. A third and less drastic type of plat control is to require that the subdivider note on the recorded plat by reference to which the lots are sold, that the property is subject to inundation. While the prospective purchaser often does not see the plat map, title companies, Federal Housing Administration, the State Real Estate Commissioner, and other agencies view the recorded map with considerable care. Another method of warning purchasers would be for the planning commission or flood-control authority to file a map of areas subject to inundation and to take steps to publicize it widely.

Depending upon the provisions of the ordinance, the subdivider may either be prohibited from subdividing that portion of the tract subject to flooding or he may do so provided that certain protective measures are incorporated into his plan. The following items would help prevent further flood damage if added to subdivision regulations: (1) show extent of the flood plain on subdivision maps; (2) show floodway limits or encroachment lines; (3) prohibit fill-in channel and floodway that would restrict flow; (4) require that each lot contain a building site with an elevation above a selected flood level.

Building Codes

Building codes include a collection of regulations adopted by a local governing body establishing standards for the construction of buildings and other structures for the purpose of protecting the health, safety, and the general welfare of the public. A well-written and properly enforced building code can effectively reduce damages to buildings in the flood plain. It is not practical to prohibit the location of buildings in every area subject to inundation, therefore, building codes can establish guidelines for the design of structures against damages from flood waters. A few of the requirements which should be specified in a building code to reduce flood damages include:

1. Prevent flotation of buildings from their foundations by requiring proper anchorage;
2. Establish basement elevations and a minimum first-floor elevation consistent with potential floods;

3. Require structural strength to withstand water pressure or high velocity of flowing water;
4. Restrict the use of materials which deteriorate rapidly when exposed to water;
5. Prohibit equipment that might be hazardous to life when submerged, such as chemical storage, boilers, or electrical equipment.

Health Regulations

Health codes can serve as a developmental control, for subdivisions must have the approval of local governmental officials for water and sewage facilities. The regulation of facilities in the interest of public health should include the review of potentially unhealthy sites such as those subject to flooding.

Other Preventive Measures

Development Policies

Development policies are policies or regulations of a city or some other political subdivision dealing with the development plans of municipal and public systems; namely, schools, streets and highways, power, sewage, water, and other facilities and utilities. Recognizing that such public facilities have an obvious impact on the location of private development, proper development policies could aid the prevention of flood damage.

Open Spaces

Great emphasis is being placed on the growing need for vastly increased areas for recreational and other open space uses. Areas adjacent to streams and other bodies of water have a natural attraction and are readily adaptable to recreation in open areas. Parks, playgrounds, and picnic areas can utilize land which should not be used for facilities requiring permanent structures.

Under the Housing Act of 1961 as amended in 1966, 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 is required to include consideration of flood hazards.

It cannot be questioned that the preservation of open spaces constitutes a legitimate public purpose, results in a public benefit, and thus warrants the

expenditure of public funds. However, the use of the police power for the primary purpose of reducing the amount of such public expenditures would probably be illegal. It is not always clear where the police power ends and the power of eminent domain begins. Land-use zoning has been upheld as an exercise of the police power. Reservoir site acquisition is clearly an exercise of eminent domain power. In between these fair examples are some which are less certain. It is possible, for example, that if land in the floodway is so strictly regulated as to preclude any productive use, the regulation might be considered the actual taking of the land for public purposes. It is also possible that there exist structures where, within the encroachment lines, eminent domain will be the only way of removing them.

Some writers in the field have suggested that with the ever growing use and abuse of the flood plain, expenditures for flood control will ultimately reach 40 or 50 billion dollars. If the present estimates are realistic, it would be wise to use some of this money to purchase development rights and thus avoid the creation or aggravation of the flood problem. This would probably require some form of state action, since it would not appear to be feasible at the local level. It might also provide an opportunity for state-federal cooperation, since, in the past, the federal government has been the largest spender for flood control structures.

Warning Signs

The use of warning signs in a comprehensive flood-abatement program should not be overlooked. The signs are placed in areas which are subject to flooding in an attempt to warn perspective buyers of the potential hazard involved in the improper use of the land. They are used to discourage further building on the flood plain and are a constant reminder to the people of the floods that have previously reached the area. It cannot be overemphasized, however, that the mere supply of information as to where the water has reached and when, does not necessarily lead decision makers to avoid the flood threat. In the absence of clear and present danger, the typical citizen is not easily persuaded to protect himself from flood hazards.

Tax Adjustments

Tax adjustments for land dedicated to agricultural, recreation, conservation, or other open-space uses may be effective in preserving existing floodways along streams. A powerful incentive for adoption of this type of ordinance may be the granting of a reduction of assessment in zoned areas where previous assessments included in their appraisal speculative values for possible

use for residence or other use to be prohibited by the flood plain ordinance. Proper tax deferments to the owner for use of land in accordance with flood-plain regulations would stabilize the value of the property, thereby making it economically feasible for continued agricultural, recreational, or conservational usage. Flood plains would be assessed on their value for farm lands storage areas, open spaces and utilities, rather than on their value for building sites. Unless these concessions are made, farm lands adjacent to communities will become more valuable each year as residential or commercial development moves into part of it. This will cause tax rates of all adjacent farm land to rise to the point where the land no longer can be used profitably for farming or other open uses.

Flood Insurance

The primary objectives of flood insurance should be to abate flood damages and promote effective use of the flood plain, while providing financial relief during times of floods. Achieving a sensible use of the flood plain is probably more important than the indemnification of loss.

With increasing urban growth, much of which occurs in the flood-prone area, the amount of damage caused by floods each year continues to rise. This occurs although natural disasters are no more frequent and despite increased expenditures for protective structures. For this reason the established program of Federal assistance for flood insurance (P.L. 90-448) is coupled with a unified national program for flood plain management. On December 24, 1969, an amendment to P.L. 90-448 was signed into law. P.L. 91-152 was designed as an emergency measure to assist in the implementation of the program.

This program gives preference in providing coverage to those areas which give assurance that they will adopt effective land use and flood control regulations by December 31, 1971, and those which show a positive interest in the program. The act also prohibits the writing of policies after December 31, 1971, unless permanent land use regulations with effective enforcement provisions have been adopted, and prohibits writing policies at any time for property declared to be in violation of State or local land development ordinances.

In addition, the federal government has prohibited the granting of Federal disaster assistance with respect to property which is covered or could under certain circumstances have been covered by flood insurance under the National Flood Insurance Act. Details regarding this Act are included in the appendix, which provides an historical approach to flood insurance.

Bridges and Roadways

Proper planning of roads and highways also may facilitate protection from flood damage by routing residential development away from hazardous areas. Community expansion brings about the desire for more stream crossings. From a construction standpoint, perhaps the most economical method of providing crossings consists of a roadway on earth embankments, with a small ridge or culvert to pass the streamflow. However, this is often the least desirable from a flood-damage point of view. If the structure is kept at low elevation, it is frequently flooded and fails to serve its intended purpose. If the roadway is kept high, above the flood plain, it will act as a dam and increase flood stages upstream unless the waterway opening is adequate. Therefore, all future stream crossings should be designed to provide: (1) adequate waterway openings, (2) adequate bridge clearance above flood flows, and (3) adequate roadway height above flood flows. Flood plain zoning, to be most effective, should be part of the comprehensive city or county plan including plans for highways, parks, and location of various land uses.

FOOTNOTES

Methods of Abating Flood Damage

1. Section 3 provides: "In any case where the construction cost of levees or flood walls included in any authorized project can be substantially reduced by the evacuation of a portion or all of the area proposed to be protected and by the elimination of that portion or all of the area from the protection to be afforded by the project, the Chief of Engineers may modify the plan of said project so as to eliminate said portion or all of said area: Provided that a sum not substantially exceeding the amount thus saved in construction costs may be expanded by the Chief of Engineers, toward the evacuation of the locality eliminated from protection and the rehabilitation of the persons to be evacuated..."

2. White, G. F., and H. L. Cook, "Making Wise Use of Flood Plains," (United Nations Conference on the Applications of Science and Technology for the Benefit of the Less Developed Areas).

3. U.S. Department of Commerce, Floods and Flood Warnings, December, 1966.

4. Sheaffer, John R., Introduction to Flood Proofing, (Center for Urban Studies, University of Chicago, April, 1967).

5. U.S. Army Corps of Engineers, Guidelines for Reducing Floods, p. 5, Army-MRC, Vicksburg, Miss. (1967).

6. White, G. F., Making Wise Use of Flood Plains, pp. 299-212.

7. Vogel, H. D., "Flood Problems in Expanding Urban Areas," Address at the National Conference on Flood Plain Regulation and Insurance, Hotel Shoreham, Chicago, December, 1958.

8. "Flood Plain Zoning for Flood Loss Control," Iowa Law Review, Vol. 50, Note 2, p. 553 (Winter, 1965).

9. U.S. Army Corps of Engineers, Guidelines for Reducing Flood Damages, Army-MRC, Vicksburg, Miss. (1967).

10. Durham, Allison, "Flood Control Via the Police Power," University of Pennsylvania Law Review, 107, p. 1089 (June, 1959).

11. 272 U.S. 365 (1926).

12. 41 Fed. 2d 484 (1930). The Plaintiff in this case had secured 32 acres of land and proposed to develop and subdivide it for residences. A large share of the land (28 acres) was lowland near the river, which is at that point and for some miles below a very sluggish stream. Nearly every spring, ice in this branch breaks up earlier than that in the sluggish river into which the branch empties, and backs up on the land. The result is annual or periodic flooding of much of the lowland with ice and water, making it entirely unfit for residential purposes.

13. Id., at p. 420.

14. Miller v. The Board of Public Works, 195 Calif. 477 (1925).

15. 260 U.S. 293 (1922).

16. 197 A. 2d 770 (Conn. 1964). The defendant town amended its zoning regulations to create a floodplain district in which the only permitted uses of land were those in the nature of parks, boat houses and docks, clubhouses, wild life sanctuaries, farming, and motor vehicle parking.

17. Beuchert, Edward W., "Recent Natural Resource Cases," National Resources Journal, Vol. 4, No. 3, pp. 447-48 (January, 1965).

18. Hoyt W. G., and W. B. Langbein, Floods, Princeton University Press, Princeton, N.J. (1955).

19. 44 Ohio St. 279, 7 N.E. 429 (1886).

20. Hofeldt v. Elkhorn Valley Drainage Dist., 213 N.W. 832 (1927), (dike erected to protect defendant's land from floodwaters); Bellah v. Phoenix Utilities Co., 7 F. 2d 406 (D. Kan. 1924), (defendant's embankment cause floodwaters to back up on plaintiff's land and prohibited their return to the channel); Niccum v. Atchison, T. & S. F. Ry., 147 Kan. 646, 78 P. 2d 1 (1938), (defendant's embankment constructed without culverts backed up floodwaters which were

discharged on plaintiff's property with great velocity when proper culverts were installed); Williams v. Columbia Producing Co., 80 W. Va. 683, 93 S.E. 809 (1917), (defendant's oil rig created an obstruction which diverted the floodwaters out of their normal channel); Winchester Water Works Co. v. Holliday, 241 Ky. 762, 45 S.W. 2d 9 (1932), (damage resulting from break in defendant's "flask dam," creating greatly increased velocity in the river below); Atchison T. & S. F. Ry. v. Herman, 74 Kan. 77, 85 P. 817 (1906), (defendant's action of increasing support of bridge with timbers, etc. created obstruction causing water to back up on plaintiff's land).

21. Jefferson v. Hichs, 23 Okla., 684, 102 P. 79, 80 (1909); McKell v. Spanish Fork City, 6 Utah 2d 92, 305 P. 2d 1097 (1957).

22. 84 W. Va. 442, 100 S.E. 218 (1919).

23. 154 S. W. 2d 896 (Tex. 1941).

24. 367 F 2d 314 (1966).

25. 152 Iowa 563, 132 N.W. 945 (1911).

26. Beuchert, E. W., Legal View of the Flood Plain, Harvard Law School, Cambridge, Mass. (1961).

27. Id.

28. 95 W. Va. 377, 121 S.E. 165 (1924).

29. 394 Penn. 1, 145 A. 2d 178 (1958).

30. 146 Conn. 650, 153 A. 2d 822 (1959).

31. Dunham, Allison, "Flood Control via the Police Power," University of Pennsylvania Law Review, 107 (June, 1959), p. 1117.

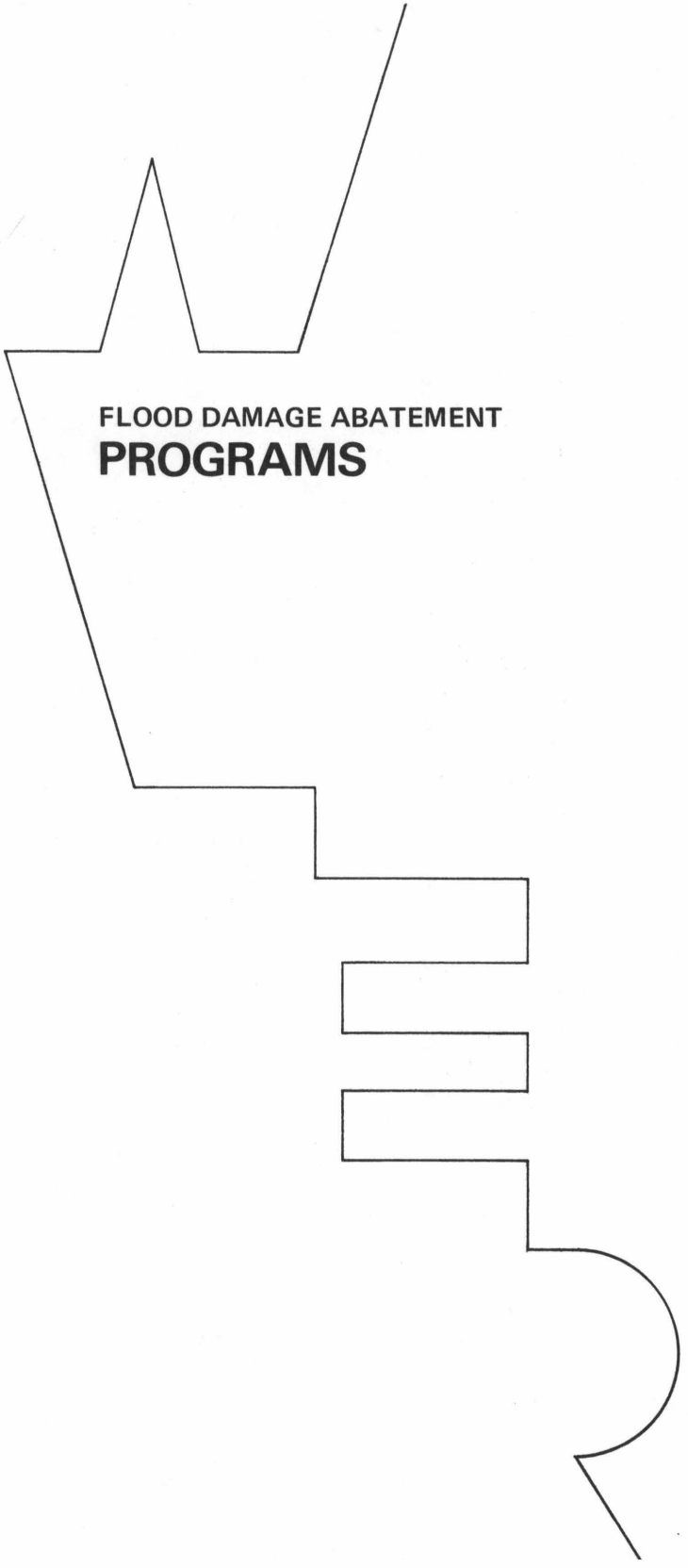
32. Morse, H. F., Role of the States in Guiding Land Use in Flood Plains, Georgia Institute of Technology, Atlanta, Ga. (1962), p. 18.

33. Murphy, F. C., Regulating Flood Plain Development, (Univ. of Chicago, Dept. of Geography, Research Paper No. 56, 1958), pp. 55-59. As of July, 1958, only 49 cities and counties in 15 states had adopted floor-plain zoning ordinances.

34. Klar, "Flood-Plain Zoning in Urban Renewal and Regional Planning Programs" (Paper presented at the 33rd Meeting, Northeastern Resources Committee, Berlin, Connecticut, Sept. 13, 1960), p. 12.

35. Murphy, Francis, C., Regulating Flood Plain Development (Chicago: University of Chicago Press, Department of Geography, Research Paper No. 56, 1958), p. 87.

36. Parker, Francis H., Flood Damage Abatement in Kentucky, Kentucky Division of Planning (Frankfort: Oct., 1964), p. 66.



FLOOD DAMAGE ABATEMENT

PROGRAMS

INTRODUCTION

The services of federal agencies are available to the citizens of Virginia in the formulation of flood damage abatement programs. These agencies are the primary source of funds for the construction of physical works and the principal collectors of hydrologic data. In addition, some agencies have the authority to assist in the coordination of comprehensive programs utilizing both corrective and preventive flood damage abatement measures. The services offered by the Federal Government are invaluable to state and local government and to private organizations seeking to initiate and carry out flood damage abatement programs.

Some of the important federal agencies having flood control responsibilities are: U.S. Department of Agriculture (Forest Service, Farmers Home Administration, Agricultural Conservation Program Service, and Soil Conservation Service); U.S. Department of Commerce (Weather Bureau, Environmental Science Service Administration); U.S. Department of Defense (U.S. Army Corps of Engineers); Federal Power Commission; U.S. Department of the Interior (Geological Survey and Office of Water Resources Research); and the Tennessee Valley Authority.

CORRECTIVE MEASURES

Several federal agencies have played major roles in developing corrective programs in Virginia for abating flood damages. The loss of life and property damage from flooding has been significantly reduced by these corrective measures, but the total damage due to flooding appears to be increasing in spite of the large expenditures for control structures. The corrective programs of the Corps of Engineers, Tennessee Valley Authority, and Soil Conservation Service will be examined in detail.

U.S. Army Corps of Engineers

The Corps has performed a major role in planning and constructing flood control projects in the state. Their activities are organized according to river basins which do not correspond too well with the political boundaries of the state. As a result, the Corps has five district offices doing work in Virginia--Baltimore, Maryland; Huntington, West Virginia; Nashville, Tennessee; Norfolk, Virginia; and Wilmington, North Carolina. The scope of the Corps of Engineers' activities include construction of dams and reservoirs, levees, seawalls, and channel improvements. Tables XXXV, XXXVI, and XXXVII identify the projects completed or under construction, those authorized and not started, and those for which surveys or preliminary work has or is being done.

Tennessee Valley Authority

The scope of TVA's activities is confined to a small area in southwest Virginia. Physical structures constructed by TVA are not numerous because Virginia geographically contains only the headwater streams for the greater Tennessee River Basin. Intensive studies have been conducted in the Clinch and Holston River Basins providing essential information about the flood problems of this area. These studies have resulted in the construction of control measures in and around the cities of Bristol and Coeburn. Other reports have shown that structural measures needed to mitigate flood damages were not economically feasible because of an unfavorable benefit-cost ratio.

Case Studies--Coeburn and Bristol, Virginia

Coeburn, Virginia--In the week preceding March 11, 1963, rains had saturated the ground in and around Coeburn. Between the evening of March 11 and the following morning, an additional 4.5 inches of rain was received, leaving Front Street inundated to a depth of 4.5 feet. Newspaper files and interviews

TABLE XXXV

FLOOD CONTROL PROJECTS (COMPLETED)

Location	Type of Structure	Date of Completion	Cost	Estimated Damages Prevented
Bridgewater, Va. (Baltimore District)	Earth levee	1952	$ 136,500	
North River and Tributaries (Baltimore District)	Farm levees	1950	27,800	
Bluestone Lake, Va. and W. Va. (Huntington District)	Dam and Reservoir	1950	29,200,000	$95,000,000
John W. Flannagan Reservoir (Huntington District)	Dam and Reservoir	1966	19,800,000	24,600,000
North Fork of Pound Reservoir (Huntington District)	Dam and Reservoir	1966	6,300,000	720,000
Galax (Huntington District)	Improved channel, relocation of one highway bridge, extension of one R.R. bridge	1951	665,000	62[illegible],000
John H. Kerr Reservoir, Va. and N.C. (Wilmington District)	Dam and Reservoir	1952	87,545,000	2,487,000
Philpott Reservoir (Wilmington District)	Dam and Reservoir	1951	14,140,000	68,000

TABLE XXXVI

FLOOD CONTROL PROJECTS (UNDER WAY)

Location	Type of Structure	Cost
Downtown Norfolk (Norfolk District)	Flood wall Interior drainage facilities	$ 2,487,000
Gathright Reservoir (Norfolk District)	Dam and Reservoir	23,300,000
Newmarket Creek (Norfolk District)	Dam, Channel improvements	2,094,000

TABLE XXXVII

FLOOD CONTROL PROJECTS (SURVEYS UNDER WAY)

Location	Purpose	Approximate Date To Be Completed
Chesapeake Bay Basin (Baltimore District)	Appraisal of water resources needs, including flood control	Indefinite
Potomac River and Tributaries, D.C., Md., Va., W. Va., Pa. (Baltimore District)	Preparation of plan for flood control and other water uses	Indefinite
Potomac River Streams Draining Alexandria Area, Va. (Baltimore District)	To determine the advisability of flood control along streams flowing through Alexandria, Va.	1969
Big Sandy River and Tributaries, Kentucky, West Virginia, and Va. (Huntington District)	To determine advisability of providing improvements for flood control, hydro-electric power, and water supply	1970
Kanawha River Basin, West Virginia, Virginia, and North Carolina (Huntington District)	Comprehensive study of water resources to formulate a detailed plan for development of water and related land resources	1970

TABLE XXXVII CONTINUED

Location	Purpose	Approximate Date To Be Completed
Moores Ferry Reservoir, New River, Virginia and North Carolina (Huntington District)	To determine the advisability of modifying authorized flood control project	Included in Kanawha River Basin Comprehensive Study
Atlantic Intracoastal Waterway at Great Bridge (Norfolk District)	To determine advisability of reactivating existing project to provide flood protection at and in vicinity of Great Bridge	Indefinite
James River Basin (Norfolk District)	To determine advisability of increased flood control	Indefinite
Lower Roanoke River (Norfolk District)	Flood Control	1969
Mattaponi River, York River Basin (Norfolk District)	To determine advisability of flood control and major drainage improvements	Indefinite
South Boston, Dan River, Roanoke River Basin (Wilmington District)	To determine advisability of flood control at this locality	Indefinite

by TVA representatives with "old timers" showed this to be the highest flood in at least 85 years, producing damages in excess of $430,000. The Red Cross reported that 90 families came for aid, and 146 homes were damaged to a minor degree and 15 homes were damaged severely.

As a result of the extreme flooding which occurred in March of the previous year, a Coeburn Flood Study Committee was organized in 1964 to explore all aspects of the problem on the three streams in and near Coeburn--Guest River, Toms Creek, and Little Toms Creek. The plan adopted by the committee and approved by the Town Council included dredging and enlarging the channels of the three streams, flood-proofing of some existing buildings, and adoption of flood plain regulations to minimize future flood damages. The plan called for channel enlargements and improvements along 1.8 miles of Guest River, one mile of Toms Creek, and about a half-mile of Little Toms Creek, and far less extensive channel improvements by the town upstream on about 0.7 miles of Toms Creek and Little Toms Creek.

Four years after the 1963 flood, almost to the date, March 6, 1967, heavy rains again occurred over the mountains of southwest Virginia with nearly 3.5 inches falling in one day. Again the streams rose rapidly, but the enlarged stream channels through Coeburn carried the flood waters away without appreciable damage. Seldom does nature provide almost identical situations where the impact of a "before and after" program can be observed. Damages averted during this one flood amounted to about $400,000--more than half the $750,000 spent up to that time on the channel improvements. Figures 17 and 18, by courtesy of TVA, show graphically the difference in results attributable to the flood control measures.

Bristol, Virginia--A cooperative flood protection program has resulted in two dams being built near the "twin" cities of Bristol, Tennessee, and Bristol, Virginia, along Beaver Creek. One dam is located on Clear Creek (a tributary to Beaver Creek) about nine miles upstream from Bristol, and the other on the main stem of Beaver Creek, seven miles upstream from the city (Figure 19). Together, these two dams will control the rainstorm runoff from more than half of the Beaver Creek drainage area above Bristol. Total cost approached $2.9 million, of which $120,000 was paid by Bristol, Virginia.

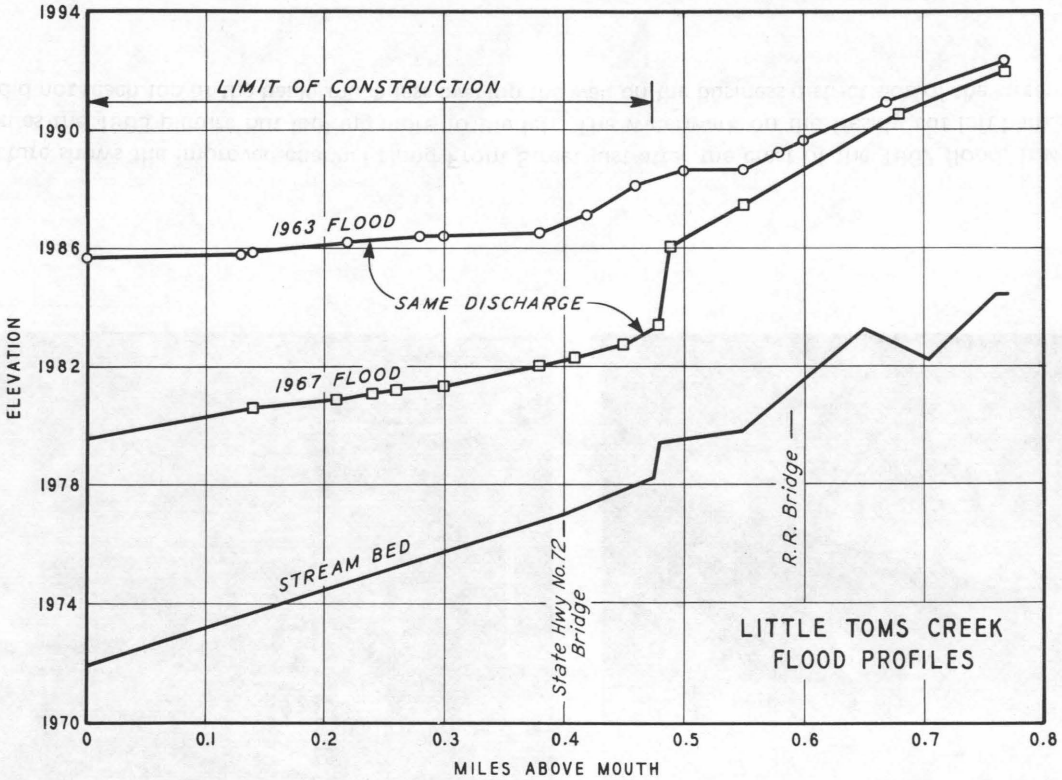
Soil Conservation Service

Another federal agency that provides corrective measures to reduce damages due to minor floodings is the Soil Conservation Service (SCS). The major emphasis of SCS programs is on the control of watershed runoff and the

FIGURE 17

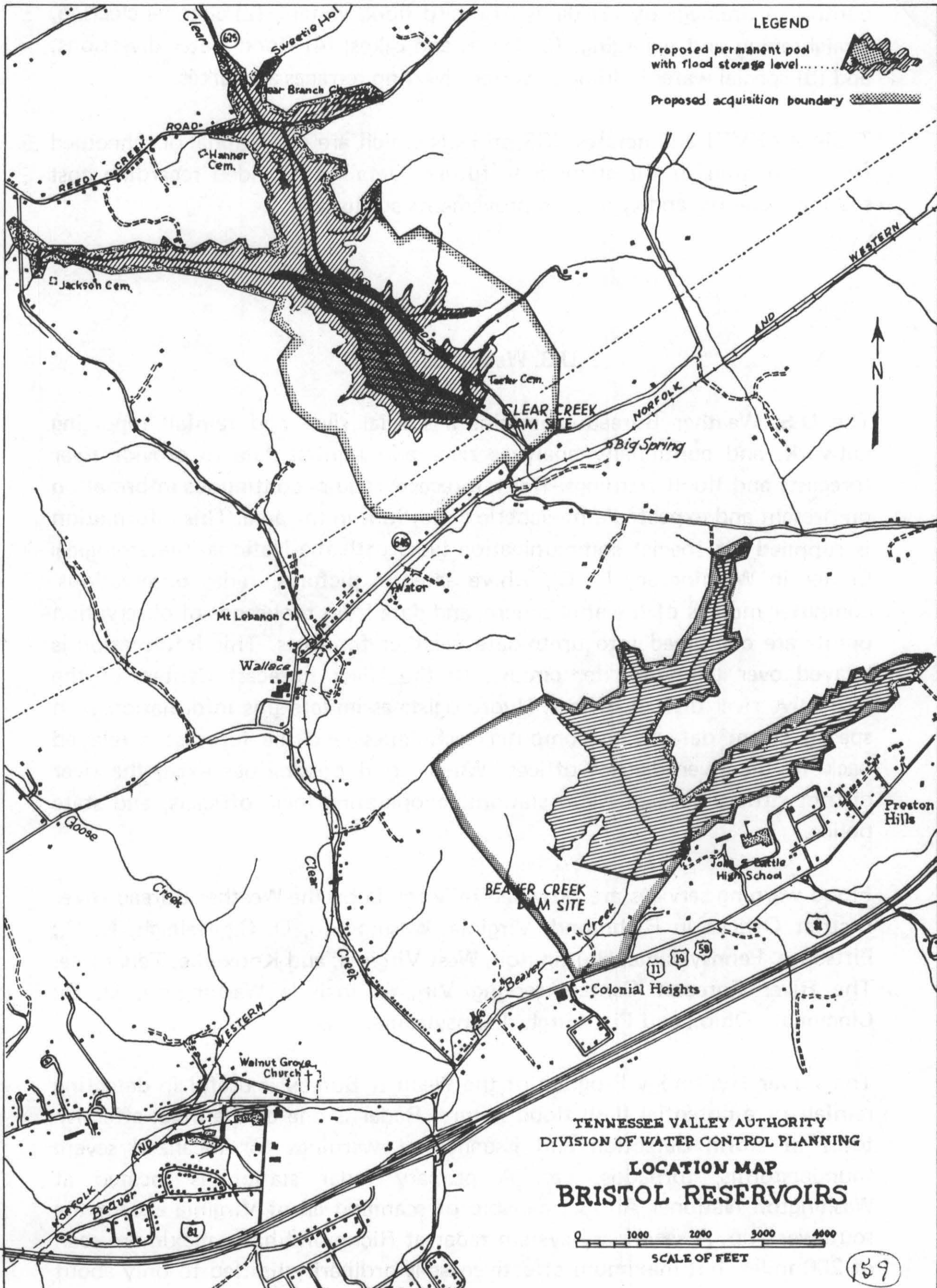
The right picture shows the improved channel along Front Street just after the crest of the 1967 flood. It was taken at the same location as the 1963 picture but looking more to the left. The watermark on the freshly cut left bank shows that the floodwaters did not reach top of the bank, much less overtop the wall on the business district side of the stream channel.

FIGURE 18



The flood-lowering effect of the channel enlargement is shown dramatically by the profiles of the 1963 and 1967 floods above. At mile 0.78 (well upstream from the channel enlargement) the floodmark of the 1967 flood is nearly as high as the flood mark of the 1963 flood. Thus these two floods had about the same peak discharge. The sharp rise in the profile of the 1967 flood near mile 0.49 indicates the point at which channel enlargement stops. From this point down to the mouth of Little Toms Creek, the 1967 flood is about six feet lower than the 1963 flood.

FIGURE 19


LEGEND
Proposed permanent pool with flood storage level........
Proposed acquisition boundary
CLEAR CREEK DAM SITE
BEAVER CREEK DAM SITE
Big Spring
Wallace
Mt Lebanon Ch
Jackson Cem.
Hanner Cem.
Colonial Heights
John S. Battle High School
Preston Hills
Walnut Grove Church
NORFOLK AND WESTERN
TENNESSEE VALLEY AUTHORITY
DIVISION OF WATER CONTROL PLANNING
LOCATION MAP
BRISTOL RESERVOIRS
0 1000 2000 3000 4000
SCALE OF FEET

control of drainage by (1) dams to retard flood waters; (2) channel clearing, straightening and enlarging; (3) levees and dikes; (4) flood water diversions; and (5) special water holding or water diverting terraces and dikes.[1]

Table XXXVIII enumerates SCS projects which are operational or scheduled for completion in the immediate future. Detail is provided regarding cost sharing, benefits, and type of improvements authorized.

U.S. Weather Bureau[2]

The U.S. Weather Bureau maintains a special river and rainfall reporting network, and continually analyzes river and rainfall data to provide river forecasts and flood warnings. River forecasts require continuous information on present and expected atmospheric conditions in the area. This information is supplied via special communication links with the National Meterological Center in Washington, D. C., where satellite pictures, radar observations, computer models of the atmosphere, and data from thousands of observation points are combined into up-to-date weather forecasts. This information is relayed over teletypewriter circuits to the River Forecast Centers of the respective river district offices. Hydrologists assimilate this information with special storm data using computer techniques, and the forecast is relayed back to the river district offices. When flood possibilities exist, the river district offices contact radio stations, cooperating local officials, and state police.

Flood warning services are provided in Virginia by the Weather Bureau River District Offices in Richmond, Virginia; Washington, D. C.; Raleigh, N. C.; Pittsburg, Pennsylvania; Huntington, West Virginia; and Knoxville, Tennessee. The River Forecast Centers serving Virginia include Washington, D. C.; Cincinnati, Ohio.; and Pittsburgh, Pennsylvania.

The Radar Hydrology Program of the Weather Bureau is useful in detecting rainfall of a potential flash flood nature. Radar is one of the most effective tools in storm detection and issuance of warnings for localized severe thunderstorms, tornados, etc. A primary radar station is located at Washington National Airport capable of scanning all of Virginia except the southwest tip. A secondary system radar at Richmond has a maximum scan of 200 miles, but maximum effectiveness is ordinarily limited to only about 100 miles. Significant observations on these radar scopes are available to other Weather Bureau stations in the state.

TABLE XXXVIII

WATERSHED PROJECTS IN VIRGINIA BY SOIL CONSERVATION SERVICE
APPROVED OR COMPLETED (JUNE 1969)

County(s)	Watershed Name/area	Est. Project Cost federal	Est. Project Cost non-federal	AVERAGE ANNUAL BENEFITS Damage Reduction[19]	Other Primary Benefits	Local Secondary Benefits	Total Annual	Average Annual Cost	Cost Ratio	Planned Project Measures
Madison	Beautiful Run/13,800	363,344	232,344	13,925	7,102	1,641	22,668[8]	15,170[8]	1.5:1.0	8 dams and 5 mi. of channel improvements (5 dams are complete)
Charlotte	Roanoke Creek 141,900	2,384,892[9]	1,494,498[9]	123,148[9]	2,075[9]	19,254[9]	144,477[9]	102,168[9]	1.4:1.0	95 miles roadbank erosion control, 14 flood retarding structures, 3 multiple purpose dams, and 57 mi. of channel improvements. (10 flood retarding structures, 3 multiple purpose structures, the roadbank erosion control and 26 mi. of channel improvements are installed.)
Albemarle Louisa Hanover	South Anna River 234,000	2,946,787	2,999,516	68,739	97,798	28,795	195,332	116,133	1.7:1.0	3 multiple purpose structures, 26 flood retarding structures and about 108 mi. of channel improvements. One dam is under construction.
Henry Franklin	Leatherwood Creek/43,800	463,834[6]	250,073[6]	33,177	1	1	33,177	23,199	1.43:1.0	5 flood retarding dams and about 16 mi. of channel improvements. All dams and about 5 mi. of channel improvements have been installed.
Louisa	Little River 30,500	361,354	597,837	24,126	1	1	24,126	17,442	1.4:1.0	4 flood retarding structures and about 9 mi. of channel improvements. One dam is complete.
Henry	Horse Pasture Creek/17,380	267,631	168,705	15,876	1	1,584	17,460	9,142	1.9:1.0	4 flood retarding structures and about 6.5 mi. of channel improvement.
Craig	Johns Creek 65,00	554,637	102,757	21,113	11,532	3,207	35,852	19,655	1.8:1.0	4 flood retarding structures and about 18 mi. of channel improvements. All dams have been constructed.
Buckingham Cumberland	Willis River 176,700	1,289,567	630,169	33,972	10,343	9,087	53,402	42,836	1.2:1.0	11 flood retarding structures and about 15 mi. of channel improvements. One dam has been constructed.

TABLE XXXVIII CONT'D.

County(s)	Watershed Name/area	Est. Project Cost Federal	Est. Project Cost Non-federal	Damage Reduction[19]	Other Primary Benefits	Local Secondary Benefits	Total Annual	Average Annual Cost	Cost Ratio	Planned Project Measures
Madison	White Oak Run/11,130	137,900	202,082	8,299	2,073	1	10,972	8,467	1.3:1.0	one multiple purpose dam and about 5 mi. of channel improvements. The dam has been built and the channel improvements are under construction.
Montgomery Roanoke Floyd	South Fork Roanoke River/88,480	1,950,096	501,247	30,586	36,576	18,804	85,966	66,871	1.3:1.0	4 flood retarding structures and about 7 mi. of channel improvements.
Pittsylvania	Cherrystone 29,400	581,145	289,099	11, 963	15,618	3,287	30,868	21,531	1.4:1.0	one multiple purpose dam, 2 single purpose dams and about 5.5 mi. of channel improvements. Multiple purpose dam complete, one single purpose dam under construction.
Tazewell	Upper Clinch Valley/36,846	1,226,046	632,663	47,004	27,364	5,620	79,998	54,909	1.5:1.0	2 flood retarding structures, 2 multiple purpose structures and about 8 mi. of stream channel improvements.
Carroll (Virginia) Surry (N.C.)[7]	Stewarts-Lovills Creek 72,000	806,814	394,801	43,520	53,555	12,041	109,116	55,360	2.0:1.0	Watershed planned by North Carolina. Land treatment measures and 2 flood retarding structures in Virginia. Remaining measures in North Carolina.
Buckingham	Slate River 98,730	1,015,825	412,389	36,868	15,887	8,120	60,875	35,063	1.7:1.0	6 flood retarding structures, 1 multiple purpose structure and about 9 mi. of channel improvements.
Stafford	Potomac Creek 32,160	656,089	573,685	13,575	23,383	4,894	41,852	30,703	1.4:1.0	one flood retarding structure, 1 multiple purpose structure and about 6 mi. of channel improvements. Two dams are under construction.
Nansemond (Virginia) Gates (N.C.)	Hobbsville-Sunbury 85,500	1,500	6,800	39,856	28,812	9,700	78,368	43,788	1.8:1.0	Land treatment measures and channel improvements for flood prevention and drainage.
Fairfax	Pohick Creek 22,690	1,004,144	4,198,620	38,266	43,830	7,529	89,625	65,750	1.4:1.0	7 flood retarding structures, 1 multiple purpose structure and about 6 mi. of channel improvements.

TABLE XXXVIII Cont'd.

County(s)	Watershed Name/area	Est. Project Cost Federal	Non-federal	Damage Reduction[19]	Other Primary Benefits	Local Secondary Benefits	Total Annual	Average Annual Cost	Cost Ratio	Planned Project Measures
Prince Edward	Buffalo Creek 74,700	874,995	682,584	52,269	1	1	52,269	39,739	1.32:1.0	9 dams and 25 mi. of channel improvements. All dams and about 3.5 mi. of channel improvements have been installed.
Culpepper	Mountain Run/28,700 Supplemented	466,477[10]	553,972[10]	17,771	16,235	2,836	36,842	25,557[10]	1.4:1.0	1 multiple purpose dam, 2 flood retarding structures and about 6mi. of channel improvements. All are installed. Additional plans provide for 1 multiple purpose structure, 1 flood retarding structure and about 3.5 mi. of channel improvements.
Pulaski	Back Creek 22,340	32,017	277,932	1,303	1,303	1,037[2]	2,606	1,375	1.9:1.0	Land treatment measure and channel improvements. All are installed.
Albemarle	Beaver[16] Creek/7,010	134,849[16]	361,887[16]	4,653	4,165	677	9,495	8,726[16]	1.1:1.0	Land treatment measures and 1 multiple purpose dam. All complete.
Henry	Marrowbone 19,300	173,260[5]	150,058[5]	12,095	1	1,065	13,160	9,463	1.39:1.0	Land treatment measures, 1 dam and about 5 mi. of channel improvements. All have been installed.
Buckingham	Muddy Creek/7,450	148,321[15]	63,077[15]	6,216	1,858	1,339	9,413	6,510	1.4:1.0	Land treatment measures, 2 flood retarding structures and about 8 mi. of channel improvements. All installed
Appomattox Campbell Charlotte	Little Falling River/27,700	275,727	148,218	4,619	7,082	1,110	12,811	8,490	1.5:1.0	Land treatment measures and 3 flood retarding structures. All are complete.
Augusta Rockingham	South River 156,700	1,385,347	443,158	81,175[12]	2,516	1	83,691	40,847	2.0:1.0	17 flood retarding structures, 1 multiple purpose dam and about and about 31 mi. of channel improvements. 12 dams and all channel improvements are complete.
Augusta Rockingham	Upper North River 67,961	1,804,886[13]	386,552[13]	79,436[13]	18,748[13]	437[14]	98,621	75,323	1.3:1.0	3 flood retarding structures, 1 multiple purpose structure and about 12 mi. of channel improvements. The multiple purpose dam and 2 flood retarding dams are complete.

TABLE XXXVIII Cont'd.

County(s)	Watershed Name/area	Est. Project Cost Federal	Est. Project Cost Non-federal	Damage Reduction[19]	Other Primary Benefits	Local Secondary Benefits	Total Annual	Average Annual Cost	Cost Ratio	Planned Project Measures
Augusta Rockingham	Lower North River 204,588	4,562,063	1,756,981	121,048	102,607	22,595	246,250	153,282	1.6:1.0	Land treatment measures, 17 flood retarding structures and about 10.5 mi. of channel improvements. 3 dams have been constructed.
Page	Dry Run 9,000	427,974	266,491	19,128	12,632	3,104	34,864	20,394	1.7:1.0	Land treatment measures, 1 multiple purpose dam 1 flood retarding structure and about 0.8 mi. of channel improvements. Both dams under construction.
Rockingham	Gap Run 5,130	21,911	11,525	3,522	1	1	3,522	1,845	1.91:1.0	Land treatment, diversion, drop inlet, grade control structures and channel improvements. All measures complete.
Shenandoah	Tumbling Run/9,514	20,000	15,000	4	4	4	4	4	4	Land treatment and debris removal. All measures installed.
Appomattox Campbell	East Fork Falling River/42,706	11	11	11	11	11	11	11	11	Land treatment, 3 flood retarding dams and 18 mi. of channel improvement. All measures have been installed.

NOTES

1 Not evaluated for this watershed.

2 Not used for project justification.

3 Authorized under authority of Public Law 78-534; formal application to the Virginia Soil and Water Conservation Commission is not required.

4 Installed as an emergency measure to remove flood deposited debris from the channel and adjacent area.

5 As supplemented, March 1967.

6 As supplemented, October 1962.

7 Prepared by North Carolina Watershed Planning Party.

8 As supplemented, January 1969.

9 As supplemented, 1969.

10 As supplemented, April 1969.

11 Developed as a pilot measure prior to enactment of Public Law 83-566.

12 As supplemented.

13 As supplemented, October 1963.

14 Not evaluated for entire watershed.

15 As supplemented, November 1968.

16 Based on installed costs - project complete.

17 Added to list furnished May 29, 1969.

18 Included $10,414 Redevelopment Benefits.

19 Benefits to Structures.

On small streams, especially near the headwaters of river basins, water levels may rise quickly in heavy rainstorms and cause flash floods. This leaves little time before the arrival of the flood crest. Graphs have been prepared for some local communities to show when local flooding will occur under different conditions of rainfall and soil moisture. With these graphs, the forecaster can spread a warning in minutes by radio, television, sirens, and other signals.

PREVENTIVE MEASURES

Land-use controls will not reduce or eliminate flooding, but are designed to mold the flood plain development in such a manner as to lessen the damaging effects of floods. Flood plain regulations imply the adoption and use of legal tools, by communities, to control the extent and type of future development to be permitted in the valleys. Intensive study is required for a local community to develop regulations designed to abate flood damages which will withstand constitutional attack. A large amount of hydrologic information must be gathered, analyzed, and evaluated. Some of this work is beyond the financial capabilities of individual communities. However, several federal agencies have taken the lead in developing programs of intensive studies of localized flood problems, aimed mainly at supplying information needed as a foundation for land use planning and regulation in flood plain areas. The Corps of Engineers, TVA, and USGS have done considerable work in initiating programs using the preventive approach to flood damage abatement.

U. S. Army Corps of Engineers

The Corps of Engineers has been very active in helping control the flooding water of the rivers and creeks in Virginia. Until 1960 their activities were confined to control measures. In that year Congress recognized that preventive measures needed to be coordinated with structural alternatives if significant progress were to be made in flood damage abatement. To stimulate work in this area Congress enacted Section 206, River and Harbor Flood Control Act of 1960 (Public Law 86-645).[3] This legislation authorized the Chief of Engineers, acting for the Secretary of the Army, to provide information to states and local communities, upon their request, to aid them in providing for the use and regulation of flood plain areas.[4]

The major objectives of Section 206 are:

1. To compile in a useful form and disseminate to state and local governmental agencies, 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 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 local regulation and use of the flood

plains, (b) planning such advance protection as may be economically justified for prospective land uses that could not be undertaken without protection, and (c) preserving adequate floodway and channel rights-of-way and channel clearances.

3. To provide publicly available information for the guidance of private citizens and interests on use of the flood plains.

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

A typical flood plain report made by the Corps may include maps, mosaics, or diagrams showing the extent of flooding to be expected under various conditions; graphic material showing how existing land uses affect flood losses; suggestions on ways of building structures which must remain in exposed areas so that they can withstand flooding with minimum damage; and may discuss how zoning ordinances, building codes, evacuation plans, urban renewal programs, subdivision regulations, and other types of local action might be used to reduce flood losses.

Initially, the flood-plain studies or reports by the Corps in Virginia concerned the coastal regions where problems of drainage and beach erosion are under survey. Recently the Corps has completed studies for Henrico County, and the cities of Richmond, Roanoke, and Hampton. A summary of the data in a typical "Flood Plain Information" report follows. Summaries of the other nine studies are included in the appendix.

Meherrin River at Emporia, Virginia (July 1964)

Information regarding the magnitude of the flood problem at Emporia, Virginia, and suggestions concerning remedial measures are included in the report. Data on flood profiles, flood damage reports, flood characteristics, flood frequency estimates, cross sections of the river, bridge sections, zoning plans, high water and bench marks are also part of the study.

Area Studied

The Meherrin River drains an area of 749 square miles. It is long and narrow, and because of its shape, extreme floods are caused by storms that produce rainfall over the entire area for extended periods of time rather than heavy rainfall concentrated in a short period of time over only a portion of the drainage basin.

The watershed is devoted principally to diversified agriculture, but includes a large acreage of cutover woodland. It is not anticipated that change in watershed use, construction of dams, or other improvements will produce a significant change in the flooding pattern of the past.

Flood Problem

During the larger, more infrequent floods, many sections of the developed portion of Emporia are inundated. Since the 1940 flood (largest on record), the number of homes located on the flood plain has doubled. This is probably indicative of the flood plain development to be expected in the absence of effective regulatory controls.

Remedial Measures

The following actions could be taken to reduce damages on flood plain.

1. The flood plain could be zoned to correlate the use of the land with the likelihood of flooding at each level. A revision of the town's zoning plan to emphasize the obvious flood threat is indicated.

2. Building codes could contain clauses covering the minimum elevation for floors, furnaces, machines, and other items related to a flood threat.

3. Structures on the flood plain could be "flood-proofed " (placing future improvements at safe heights, raising existing buildings, sealing openings or cracks to prevent the entry of water, etc.).

4. Subdivision regulations could be enacted to define the degree of protection required for construction of additional homes or roads.

5. In general, whenever applications to build on the flood plain are received by the town, the feasibility of locating the proposed structure or structures at another location should be thoroughly investigated.

Tennessee Valley Authority

The Tennessee Valley Authority has prepared for local governmental units' reports to aid (1) in the solution of local flood problems which are not eliminated by TVA's reservoir system and (2) in selecting the best utilization of lands subject to overflow. TVA has assembled data on rainfall, runoff, historical and current flood heights, and other technical information bearing upon the occurrence and magnitude of floods in localities throughout these regions. In addition, the reports contain maps, profiles, and cross sections indicating the extent of flooding that has been experienced and what might occur in the future.

These reports do not include plans for the solution of flood problems. Rather, they are intended to provide a basis for further study and planning on the part of the various regions in arriving at solutions to minimize vulnerability to flood damages. This might involve (1) construction of flood protection works, (2) local planning programs to guide developments by controlling the type of future use made of the flood plain by zoning and subdivision regulations, or (3) a combination of the two approaches.

A summary of the information contained in the report, Plan for Flood Damage Prevention, Coeburn, Va. (March 1965) is incorporated for example purposes. A summation of the reports by TVA is contained in the appendix.

Plan for Flood Damage Prevention, Coeburn, Virginia (March 1965)

This plan for flood damage prevention was prepared by the Flood Study Committee of Coeburn, Virginia with the assistance of TVA. The report presents detailed analyses and investigations of flood control, flood proofing, and flood plain regulations for the town of Coeburn. Included in the plan are suggested channel improvements, relocations and removals, and provisions recommended for inclusion in the zoning ordinance for Coeburn.

Watershed and Flood Plain

Coeburn is situated in the southeastern part of Wise County, Virginia, on the Guest River. In addition to the Guest River, Toms and Little Toms Creeks

flow through the town. Guest River, a tributary of the Clinch River, drains an area of approximately 65.6 square miles above Coeburn. Toms Creek above Little Toms Creek drains an area of 10.6 square miles, and Little Toms Creek above the Highway 72 bridge in Coeburn drains an area of 4.97 square miles.

The flood plain is well developed. Toms Creek and Little Toms Creek flowing through the heart of the town, subject most of the Coeburn business district and many residential, commercial, and industrial buildings to frequent flooding. Other serious encroachments on the flood plain include houses and commercial buildings occupying a large portion of the natural overflow areas, fills along the banks and within the channel, and buildings across Little Toms Creek near the eastern end of the business district. A large part of this development is so located and so constructed that it reduces the flood-carrying capacity of the flood plain of Toms and Little Toms Creeks.

Floods

The greatest known flood, at least since 1890, on the Guest River and one of the greatest on Toms and Little Toms Creeks, was that of January 1918. The 1963 flood was the second highest on Guest River and equal to the highest on Toms and Little Toms Creeks. During the 1963 flood, floodwaters rose 4.5 feet in the business section of the town and caused $430,000 in direct and indirect damages.

A Regional Flood (derived from consideration of the largest floods known to have occurred on streams of similar physical characteristics in the same general geographical region and within 75 miles of Coeburn) on Guest River would be generally 10 feet higher than the 1963 flood level. On Toms and Little Toms Creeks, a Regional Flood would be about 8 feet higher than the March 1963 flood.

Maximum Probable Flood determinations indicate that the floods could occur on Guest River about 16 feet higher than the 1963 flood crest. Maximum Probable Floods on Toms Creek and Little Toms Creek would be about 12 feet higher than the 1963 flood. Floods of this magnitude on most streams are considerably larger than any that have occurred in the past.

Conclusions and Recommendations

The Flood Study Committee concluded that there is a very serious flood problem at Coeburn which threatens the life, health, security, and property of the citizens of the town. The Committee recommends adoption of the

following plan for preventing or greatly reducing the flood damage potential:

1. Enlarge and improve 1.75 miles of the channel of Guest River, 1.57 miles along Toms Creek, and 0.59 miles along Little Toms Creek.

2. Flood-proof existing and future municipal buildings that are subject to flooding. Organize a program and employ a consultant to encourage and assist owners or occupants of property on the flood plains in flood-proofing structures.

3. Incorporate as a part of the zoning ordinance the subdivision regulations prepared for Coeburn, and include in the present building code, controls over uses of the flood plain areas.

4. In any future urban renewal projects, incorporate plans for flood damage prevention in the redevelopment of the area.

5. In any highway or street projects, incorporate plans for providing adequate bridge or culvert openings.

U.S. Department of Agriculture

The Department of Agriculture has been active in local flood prevention projects through the services provided by the Soil Conservation Service (SCS) and the Forest Service. The latter organization provides technical assistance to landowners: information on forest protection, distribution of planting stock, and other aids in forest management. This agency, in the protection of forests from fires, insects, and diseases under cooperative programs, assists in minimizing the destruction in cases of floods.

Probably the most active program of the SCS is the one dealing with land treatment and land stabilization. These measures include the planting of trees and vegetation, thereby reducing the movement of damaging amounts of sediments to stream channels and lower land. In addition the SCS provides technical assistance to landowners who plan and utilize soil and water conservation measures on their land. These include contour farming, strip cropping, and planting vegetation needed to protect the soil from water erosion.

The SCS makes detailed watershed work plans in cooperation with local soil conservation districts. The plans include both control structures and preventive measures for flood damage abatement. A summary of the watershed work plan for Mountain Run Watershed in Culpepper County shows the detailed analysis which goes into the preparation of these work plans. A summary of other such work plans for Virginia are included in the appendix.

Mountain Run Watershed, Culpepper County, Virginia (March 1958)

This watershed work plan was prepared by the Culpeper Soil Conservation District and the town of Culpeper with the Soil Conservation Service participating. Included in the work plan is a detailed description of the watershed, watershed problems, works of improvement to be installed (costs and benefits), and a list of organizations and their responsibilities for the operation of the plan. In addition, investigations, analyses, and supporting tables and maps are presented as a basis for project formulation.

Summary of Plan

The Mountain Run Watershed, comprising an area of approximately 28,700 acres, is situated centrally in Culpeper County. The municipality of Culpeper, the county seat, is included in its entirety and the villages of Giffensburg, Norman, Catalpa, and Stenensburg are partially included. The present land use distribution is as follows: 7,300 acres of woodland; 11,660 acres of pasture; 7,170 acres of cropland and 2,570 acres of idle and miscellaneous land.

The major problems in the watershed are: erosion from secondary road cuts and fills; flooding and scouring of the flood plain; flooding of the town of Culpeper; and inadequate water supply for the town of Culpeper.

The proposed plan calls for an accelerated land treatment program; three floodwater retarding structures (earth dams), one of which is a dual-purpose structure including 500 acre-feet of municipal water storage for the town of Culpeper; and 6.5 miles of channel improvement. It is anticipated that the plan will be completed in four years at a total cost of $544,870.

U. S. Geological Survey

The USGS conducts programs for the collection and analysis of data concerning water resources. In Virginia there are 160 gaging stations being

operated by state and federal personnel. These stations collect data on runoff, necessary for flood-control research, but in addition, make water quality analysis of samples taken. The USGS publishes many of its research findings in the Water Supply Papers and furnishes these reports to research institutions and interested parties across the nation.

Federal Power Commission

The Federal Commission is preparing a series of Planning Status Reports for major river basins in the United States. These reports constitute the first step in the program of water resource appraisal for hydroelectric licensing. They are prepared by the Bureau of Power of the Federal Power Commission to identify those basins most in need of additional planning studies to provide needed information on hydroelectric licensing and other work. The Planning Status Reports show data on existing water resource developments and known potentials, summarize the license status of nonfederal hydroelectric developments, review past and current planning studies, and identify the need for additional planning. The information presented is abstracted from the available sources and its assembly involves no new studies.

These reports in many cases indicate a need for comprehensive development which include storage of water for pollution abatement, flood control, water supply, navigation, recreation, and fish and wildlife. There are only two basin reports for Virginia and both are summarized herein.

Rappahannock River Basin, Virginia--Planning Status Report, 1965

The area covered by this report encompasses the total drainage area of the Rappahannock and York Rivers plus the intervening coastal area between the Potomac and James Rivers. It consists of a total area of 5,883 square miles. The Rappahannock River Basin is largely agricultural, the two largest centers of population being Fredericksburg and Culpeper. The Area Redevelopment Administration has certified four counties in the basin as being eligible for assistance under Public Law 87-27, Sec. 5 (b)--Westmoreland, Northumberland, Richmond, and Lancaster. The York River Basin has no large industrial center, but nevertheless, industry is an important part of the basin economy. Major industries are paper and allied products, and textile manufacture. Also, along the coastal areas seafood industries are important. Principal cities are Yorktown, West Point, and Ashland. There is only one existing hydroelectric plant within the basin, Embrey, owned by Virginia Electric Power Company (3,150 kilowatts).

Potential Water Resource Developments

In 1955, the House of Representatives passed a bill that would authorize construction of the Salem Church reservoir project. As of the date of this report, no action had been taken on the bill by the U.S. Senate.

Need for Additional Studies

The Corps of Engineers is preparing a study of the Salem Church project to determine the feasibility of installing 150,000 kilowatts generating capacity at Salem Church, and 6,000 kilowatts capacity at the downstream re-regulating dam near Fredericksburg. There are current needs in both basins for comprehensive developments that would include pollution abatement, flood control, water supply, navigation, recreation, and fish and wildlife.

James River Basin, Virginia--Planning Status Report, 1964

The James River drains an area of 10,060 square miles in central Virginia. Important industrial centers have been developing rapidly throughout the basin, but the area along the James between Hopewell and Richmond is the most highly industrialized. Principal cities of the basin are Richmond, Lynchburg, Newport News, Petersburg, and Charlottesville.

Among the basin's major industries are several that place unusual demands upon water resources, either for supply purposes or waste disposal. These include pulp and paper, textiles, chemical, and food processing.

There are 19 existing hydroelectric projects in the basin providing a total of 50,320 kilowatts of generating capacity.

Potential Water Resource Developments

The Gathright reservoir and Falling Springs re-regulatory dam have been authorized for federal construction and are now being restudied by the Corps of Engineers.

Need for Additional Studies

First, there is a substantial undeveloped power potential in the river basin. On the basis of the information available, this potential amounts to more than one-half million kilowatts of additional hydroelectric capacity. Second, there are additional requirements of the James basin's water resources which should be considered with hydroelectric improvements. These requirements will include water pollution control, irrigation, water recreation, fish and wildlife, water supply, and flood control. Third, current basin studies are not available and have not been scheduled. They need to be brought up to date.

FOOTNOTES

Flood Damage Abatement Program

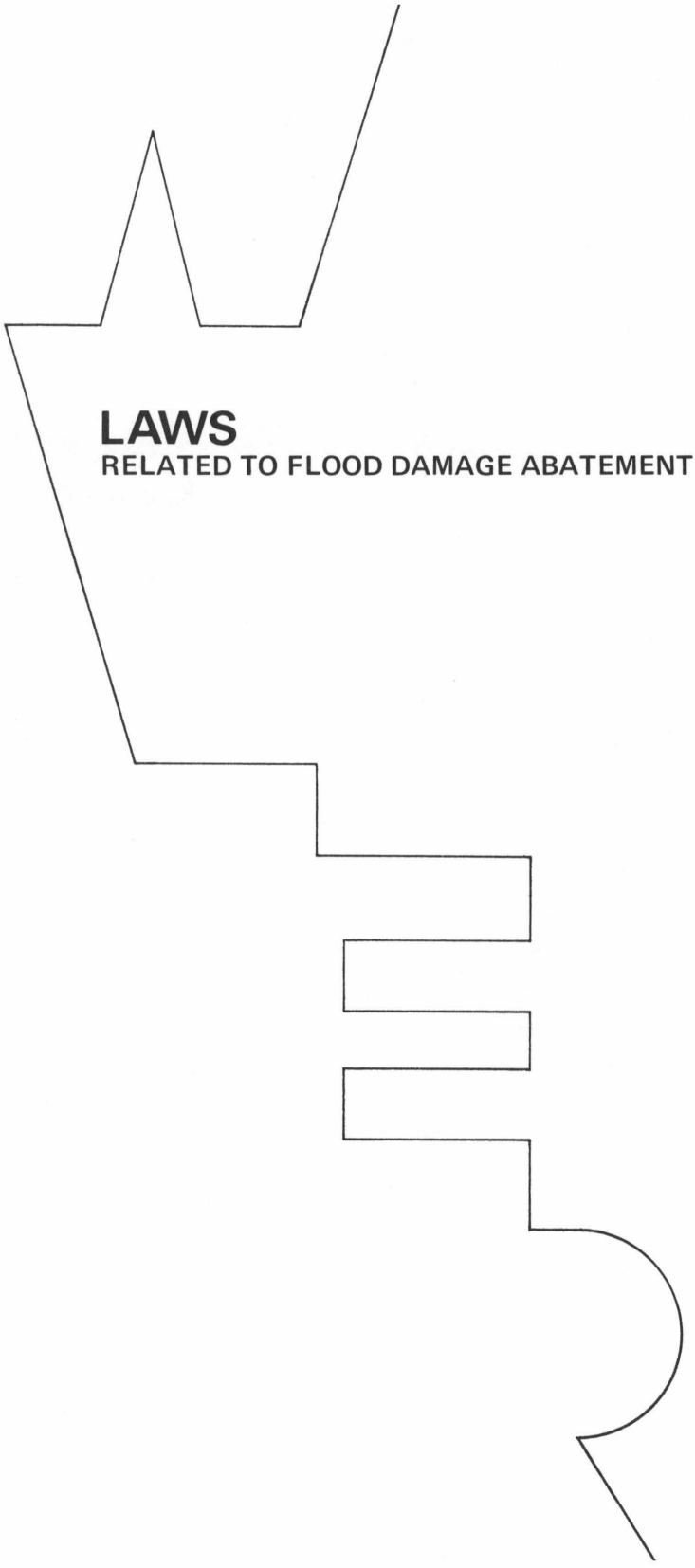
1. U.S. Department of Agriculture, Multiple-Purpose Watershed Projects, May, 1963, p. 5.

2. U.S. Department of Commerce, Floods and Flood Warnings, December, 1966.

3. "...That, in recognition of the increasing use and development of the flood plains of the rivers of the United States and of the need for information on flood hazards to serve as a guide to such development, and as a basis for avoiding future flood hazards by regulation of use by states and municipalities, the Secretary of the Army, is hereby authorized to compile and disseminate information on floods and flood damages, including identification of areas subject to inundation by floods of various magnitudes and frequencies, and general criteria for guidance in the use of flood plain areas; and to provide engineering advice to local interests for their use in planning to ameliorate the flood hazard."

4. U.S. Army Corps of Engineers, Water Resources Development in Virginia, January, 1965, p. vi.

5. U.S. Army Corps of Engineers, Floods in Hampton Virginia -- How to Avoid Damage, (1968).



LAWS
RELATED TO FLOOD DAMAGE ABATEMENT

INTRODUCTION

The basis for action by a state agency or local governmental unit is enabling legislation authorizing certiorari activities. In some jurisdictions lack of authorization or inadequate enabling legislation has prevented local governments from assuming a leadership role.

An examination of the Virginia Code suggests that there now exists appropriate authorization for most of the flood damage corrective measures discussed earlier in the report. Virginia, for the most part, has abdicated its responsibility in this area to the federal government. Participation by the state and local governments has been limited to requirements of local cooperation required by the federal government. To facilitate local cooperation special legislation was enacted, authorizing such participation, in the manner and form generally required by agencies of the federal government. A summary of the statutes designed to supplement corrective measures for flood damage abatement are given in this section.

Enabling legislation authorizing local governments to promulgate land use regulations designed to keep flood damage losses to a minimum appear to be more than adequate. The authority has not been widely used. Lack of activity in this area by local governmental units in Virginia is typical for most parts of the nation. Local government has not responded with zoning and subdivision regulations designed to mitigate damages likely to be incurred on the flood plain during high water. In most cases the pressure is on local government to do nothing or to enact meaningless regulations even after a disasterous flood has occurred. The "track record" for either county or municipal government in the area of land use management of the flood plain is less than satisfactory. It would not be prudent to anticipate any meaningful change in local attitude in the immediate future. A summary of enabling legislation authorizing the enactment of land use regulation by local governments in Virginia is enumerated in this report.

IMPOUNDING STRUCTURES

Virginia law provides specific authorization for the erection of structures to impound flood waters. Approval to capture and store flood waters must be obtained from the Circuit Court of the county or Corporation Court of the city wherein the impounding structure is to be built. After proper approval has been obtained, a riparian owner can capture and store water subject to the following conditions:

(1) As a result of the capture and storage of such waters, there will be no damage to others.

(2) The title to the land on which the impounding structure and the impounded water will rest are in the person or persons requesting the authority.[1]

(3) All costs incident to such impoundment, including devices above and below for indicating average flow, will be borne by the person or persons requesting the authority.

(4) All construction for impoundments with a capacity of more than fifty acre-feet of storage must be approved by a registered civil engineer or a registered agricultural engineer. For those facilities with a maximum storage of fifty acre-feet, construction shall be approved by a registered civil engineer, a registered agricultural engineer, or by some other competent person.

(5) Those seeking the right to store must guarantee that the flow below the impoundment is equal to:

(a) at least the average flow when the flow immediately above the impounding structure is greater than the average flow, or

(b) at least the flow immediately above the impounding structure when that flow is equal to or less than the average flow.

(6) If needed, provision will be made in the impounding structure for an adequate spillway and for means of releasing water to maintain the required flow downstream.

(7) If for purposes of irrigation, the quantity of water stored (exclusive of foreseeable losses) will not exceed that required for a period of twelve months to irrigate the cleared acreage owned by those participating in the undertaking and lying in the watershed of the stream from which the water is taken.

(8) All structures and equipment incident to such impoundment will be maintained in safe and serviceable condition by the owners and all parts thereof in a watercourse will be removed when no longer required for the purpose.

(9) Priority to the right to store flood waters, as outlined, will go to upstream riparian owners.

(10) Those impounding flood waters will, upon request, provide appropriate information concerning the impoundment to the Commissioner and State Water Control Board..[2]

Other laws which might affect the construction of flood impounding structures include the Federal Water Power Act and the Virginia Water Power Act. The Federal Water Power Act has jurisdiction over the placing of obstructions in the navigable streams of the United States. This Act requires that any construction in these streams be licensed by the Federal Power Commission before it commences. The Virginia Water Power Act has a licensing requirement for structures placed in watercourses containing "waters of the State." By statute "waters of the State" are defined as follows:

> The term "waters of the State" as used in this chapter shall mean: (a) Any stream or that portion of any stream in this State which prior to June twenty-first, nineteen hundred and thirty-two has been declared navigable by any unrepealed statute of this State, or (b) any stream or that portion of any stream in this State, the bed of which is owned by the Commonwealth, or (c) those parts of streams or other bodies of water in this State which either in their natural or improved condition, notwithstanding interruptions between the navigable parts of such streams or waters by falls, shallows, or rapids, compelling land carriage, are used or are suitable for use for the transportation of persons or property in interstate or foreign commerce including therein all such interrupting

falls, shallows or rapids, and also any stream or part thereof in this State other than those above mentioned in this subdivision in which the construction of any dam or works as authorized by this chapter would affect the interests of interstate or foreign commerce, or (d) that portion of any river or stream flowing between the high-water mark on the Virginia shore and the low-water mark when such low water mark constitutes the boundary line between Virginia and another state.[3]

EMBANKMENTS AND ARTIFICIAL DRAINAGE

When a landowner attempts to protect his property by construction of embankments or otherwise interferes with the natural flow of water in a stream, he is restrained by the principles of the riparian doctrine. This doctrine requires that his actions must not result in injury to the lands of another riparian proprietor.[4] An exception to this general rule exists when the protective works are constructed by a county, city, or town for the purpose of preventing flooding by surrounding or nearby sea or tidal water. The legislature has given any such county, city or town the right to construct dams, levees, sea walls or other protective devices, and it has withdrawn the right of any person, firm corporation, association, or political subdivision to bring an action at law or suit in equity arising out of the design, operation, maintenance, or existence of such works, except as may be based upon a written contract.[5]

Virginia statutes authorize the creation of special districts for the purposes of levee construction, channel improvement, or other drainage works. The drainage laws of the state[6] give the Circuit Court the power to establish districts or projects according to certain specified terms and conditions. The work is generally financed by assessments of the lands receiving the benefit.

SOIL AND WATER CONSERVATION

The purpose of flood damage abatement is also served by soil and water conservation districts and watershed improvement districts created under the authority of the Soil Conservation Districts Law.[7] Districts created in accordance with this law have the power to develop comprehensive programs and plans for the conservation of soil resources and flood prevention. These programs may include engineering operations and land use regulations as well.

LOCAL COOPERATION ON FEDERAL PROJECTS

Enabling legislation permits counties, cities, and towns to cooperate with the United States in projects for the improvement of rivers and harbors and for flood control. The items of cooperation to which localities may irrevocably bind themselves are as follows:

(1) To provide, free of cost to the United States the fee simple title to lands, perpetual and/or temporary easements, rights-of-way, and other interest in lands for cut-off bends, the laying of pipe lines, erection of dikes, sluiceways, spillways, dams, drains, deposit of dredged materials, and for other purposes;

(2) To alter existing structures on such areas;

(3) To simultaneously dredge designated areas not covered by the federal project when and where required;

(4) To construct and maintain public wharves and public roads leading thereto;

(5) To make contributions in money or property in lieu of providing disposal areas for dredged materials;

(6) To hold the United States safe and harmless against claims for damages arising out of the project or work incident thereto;

(7) To remove sewer pipes and submarine cables;

(8) To construct and maintain marine railways for the public use; and

(9) To provide or satisfy any other items or conditions of local cooperation as stipulated in the congressional document covering the particular project involved.[8]

LAND USE REGULATIONS

Enabling legislation authorizing zoning by local governmental units is the primary source of authority for enactment of flood plain regulations. The purpose for which zoning ordinances can be adopted indicate the regulation of the flood plain to be within its purview.

> Zoning ordinances shall be for the general purpose of promoting the health, safety, or general welfare of the public, and of further accomplishing the objectives of section 15.1-427.[9]

> To these ends, such ordinances shall be designed (1) to provide for adequate light, air, convenience of access, and safety from fire, flood, and other dangers;...and (6) to protect against one or more of the following: Overcrowding of land, undue density of population in relation to the community facilities existing or available, obstruction of light and air, danger and congestion in travel and transportation, or loss of life, health, or property from fire, flood, panic, or other dangers.[10]

The following statutory reference gives further support that flood-plain regulations are a legitimate application of zoning.

> The governing body of any county or municipality may, by ordinance, divide the territory under its jurisdiction into districts of such number, shape and area as it may deem best suited to carry out the purposes of this article, and in each district it may regulate, restrict, permit, prohibit, and determine the following: (a) The use of land, buildings, structures and other premises for agricultural, commercial, industrial, residential, flood plane (sic) and other specific uses;....[11]

Other laws related to the use and development of land suggest further authority for flood plain regulation. Included in this category is legislation concerned with regional planning,[12] local planning,[13] and land subdivision and development.[14]

The enabling legislation for the creation of regional planning commissions provides that a comprehensive regional plan prepared by the governing bodies

of any two or more counties or municipalities may contain provisions for:

> ...(d) Drainage and flood control systems; (e) A general plan for the best utilization of land throughout the region, including the determination of the best over-all locations for industry, business, living areas, recreation, conservation, agricultural, and other uses; ....[15]

Enabling legislation for the creation of local planning commissions provides that flood plain regulation can be a part of the local comprehensive plan:

> The local commission shall prepare and recommend a comprehensive plan for the physical development of the territory within its jurisdiction. Such plan, with the accompanying maps, plates, charts, and descriptive matter, shall show the commission's long range recommendations for the general development of the territory covered by the plan. It may include, but need not be limited to, (1) the designation of areas for various types of public and private development and use, such as different kinds of residential, commercial, industrial, agricultural, conservation, recreation, public service, flood plain and drainage, and other areas, which part of the plan may be known as a Land Use Plan; ....[16]

The legislation authorizing the governing body of any county or municipality to adopt an ordinance to assure the orderly subdivision and development of land states:

> A subdivision ordinance may include among other things, reasonable regulations and provisions that apply to or provide; ...(d) for adequate provisions for drainage and flood control and other public purposes, and for light and air;...[17]

Provision is also made in this statute for the application of municipal subdivision regulations beyond the corporate limits of the municipality.

> The subdivision regulations adopted by a municipality shall apply within its corporate limits and may apply beyond, except as to counties with a population in excess of six hundred per square mile, if the ordinance so provides, within the distance therefrom set out below:

(a) Within a distance of five miles from the corporate limits of cities having a population of one hundred thousand or more;

(b) Within a distance of three miles from the corporate limits of cities having a population of less than one hundred thousand; and

(c) Within a distance of two miles from the corporate limits of incorporated towns.

Where the corporate limits of two municipalities are closer together than the sum of the distances from their respective corporate limits as above set forth, the dividing line of jurisdiction shall be halfway between the limits of the over-lapping boundaries...[18]

Thus, any flood-plain regulation measures exercised by certain municipalities under authority of this legislation within their corporate limits could also be applied to areas outside their boundaries within the specified limits.

Constitutional Restraints

Although the constitutionality of zoning laws have been upheld in the courts,[19] there is little case law concerned with the particular application of a zoning ordinance to the regulation of flood plain use. Any flood plain regulation must not impinge on the property rights of the individual as guaranteed by the Fourteenth Amendment to the Constitution. These guarantees are said to be violated whenever a zoning regulation is unreasonable, arbitrary, confiscatory, or discriminatory.[20]

To be reasonable and, therefore, not arbitrary, a zoning regulation must show a rational relationship between the legitimate end to be achieved and the regulation to attain that end. Reasonableness requires the determination of the areas designated as flood plains to be based upon sound engineering principles.[21]

A regulation is likely to be set aside as confiscatory if it can be shown that the property to which the ordinance applies is not reasonably adapted to the permitted use or uses. However, a mere diminution in the value of property is not necessarily confiscatory within the meaning of the constitutional requirement that private property cannot be taken for public use without just

compensation. The general rule has been stated that the necessity of compensation for diminution of property value arises only when restrictions are placed on property to create a public benefit alone and not to prevent a public harm.[22]

The last requirement for constitutionality is that the regulation not be discriminatory. This guarantee of equal protection of the laws requires that zoning ordinance be applied so that persons similarly situated receive similar treatment.[23]

Since the courts of Virginia have not been called upon to decide the legality of flood plain regulation, the decisions in other jurisdictions take on added significance. Courts in California, Connecticut, Georgia, Missouri, New Hampshire, New York, South Carolina, and West Virginia have held that the regulation of land use in floodable areas is a proper exercise of the police power.[24]

FOOTNOTES

Laws Related to Flood Damage Abatement

1. The bed of any watercourse to which the State has title may also be used for the construction of any impounding structure under the provisions of this law, Va. Code, Sec. 62-94.10, (1950), (1966 Supp.).

2. Va. Code., Sec. 62-94.3, (1950), (1966 Supp.).

3. Id., sec. 62-69.

4. Burwell v. Hobson, 12 Gratt (53 Va.) 322 (1955); McGhee v. Tidewater Railway Co., 108 Va. 508 (1908).

5. Va. Code, Sec. 15-1-31, (1950), (1966 Supp.).

6. Va. Code, Sec. 21-292 through 21-426, (1950), (1966 Supp.).

7. Id., Sec. 21-1 through 21-112.21.

8. Va. Code, Sec. 62-117.2, (1950).

9. Va. Code, Sec. 15-1-489, (1950), (1966 Supp.).

10. Id.

11. Id., Sec. 15.1-486.

12. Id., Sec. 15.1-432 through 15.1-436.

13. Id., Sec. 15.1-437 through 15.1-464.

14. Id., Sec. 15.1-465 through 15.1-485.

15. Id., Sec. 15.1-434.

16. Id., Sec. 15.1-446.

17. Id., Sec. 15.1-466.

18. Id., Sec. 15.1-467.

19. Ribble, F. D. G., "The Due Process Clause as a Limitation of Municipal Discretion in Zoning Legislation," 16 Va. L. Rev. 689 (1930).

20. "Flood Plain Zoning for Flood Loss Control," 50 Iowa L. Rev. 567 (1965).

21. Id. at 568.

22. Id. at 572.

23. Id. at 573.

24. Cooter, Harriet H., "To Stay Out Floods," National Civic Review, Vol. I, No. 10, p. 535-36, (Nov. 1961).

APPENDICES

APPENDICES

APPENDIX I

Cases and Legal Theory on Nonconforming Uses

Zoning is one of the most effective tools for the regulation and management of the flood plain. This method of land use management has been used extensively since the constitutionality of the concept was upheld by the United States Supreme Court in the landmark case of Euclid Village v. Amber Realty Company[1] in 1926.

In the early years following the Euclid case the majority of the courts held that zoning ordinances which made no provision for the continuance of a prior nonconforming use were an arbitrary and unreasonable deprivation of property and as such were a violation of the "due process" and "equal protection" clauses of Federal and State Constitutions. The general rule seemed to be that zoning laws and regulations may not operate to restrict or remove existing buildings and uses not in conformity with the restrictions applicable to the district, at least where such buildings and uses are not nuisances and were in existence prior to the effective date of the zoning law or regulation.

The nuisance theory was one of the earlier concepts used to sustain zoning. In general, a public nuisance is created by any enterprise which endangers the health, safety, or property of a considerable number of persons, such as a power house or slaughterhouse in a populous area which creates general discomfort; or a house of ill fame which shocks the public morals or sense of decency. Many times a nuisance can be construed as a right thing in the wrong place - like a pig in the parlor instead of the barnyard. The application of this doctrine in a U.S. Supreme Court case in 1915 was the basis for sustaining a zoning ordinance. The plaintiff was convicted of violating a zoning ordinance prohibiting the operation of a brickyard within the city. Court held that the brickyard was not a nuisance per se, but that the city could regulate it under police power for protection of health and safety.

The cases usually restrict the application of the nuisance doctrine to those causing "a tangible and material interference with the property or personal well being of others and likely to constitute or become a common law nuisance." Probably this doctrine could not be brought into operation when the sole purpose of the prohibition is to achieve uniformity in the neighborhood. The municipality has to prove that, apart from the ordinance, the use is presently noxious in some specific way to the enjoyment of the surrounding neighbors.

The Dema Realty Company cases[2] are cited as the first cases sanctioning the elimination of nonconforming uses by amortization. These two 1929 Louisiana cases involved suits brought to forbid the continued operation of a drug store and a grocery store in violation of a New Orleans zoning ordinance. Both the drug store and the grocery store had become nonconforming uses when the zone in which they were located and had been operating for many years was zoned as a residential area. The ordinance prohibited the establishment of businesses of any kind in the zone and further provided that all existing nonconforming uses be terminated within a year. The court, using a theory of nuisance law, supported the ordinance with the one-year amortization provision. The court said:

> . . . any business operated or maintained in violation or in defiance of a zoning ordinance is to be regarded as a public or common nuisance.

While it is true that a municipality may forbid continued violations of a zoning ordinance on the grounds it is a nuisance, this does not avoid the necessity of determining whether the ordinance itself is constitutional.

It is clear that municipal corporations possess the authority not only to suppress nuisances, but also to provide legislatively what shall be deemed a nuisance. Even though a particular use was not a nuisance at common law the corporation cannot under the guise of the police power abate that which is not in fact a nuisance.

If the use complained of is a nuisance per se, then without doubt it may be abated summarily. If, however, the use is merely one in fact, the city must show more than mere violation of the ordinance before abatement is proper; it must show that the use is in fact an unreasonable interference with the rights of others. A nuisance per se is generally considered to be a use of property which is a nuisance at all times and under any circumstances regardless of location or surroundings. A nuisance in fact is a use which is not a nuisance per se, which may become a nuisance by reason of circumstances, location, or surroundings.

Although these two cases have been subject to criticism, primarily on the grounds that only one year of grace was granted under the ordinance involved, these cases did provide the cue for the development of a theory which does take into account the landowner's interest in his use by providing for discontinuation of a use within a reasonable amortization period.

These cases are distinguishable from many others because a private individual rather than a municipality was the complaining party. The better course would appear to require a private nuisance in the common law sense be established before a private party has a right of action to compel termination of the use because (1) zoning provision would not then become a method of wreaking retribution for neighborhood grudges; and (2) the administrative problems of terminating nonconforming uses city-wide would be less complex if a systematic method were adopted and carried out by the enforcement agency.

Until recently, the law of nuisance and zoning have existed side by side as merely similar exercises of the police power. There have been few attempts to combine the two in an effort to rid the community of nonconforming uses. True, if the nonconformity was considered a nuisance, it could be abated; but the fact that it was a nuisance did not proceed ipso facto from its being a nonconformity.

It may thus be speculated that in the "gray area" where it cannot with certainty be said that a particular nonconforming use is obnoxious enough to be a nuisance, the court may be willing to hold such a use to terminate on nuisance principles where the use is permitted a reasonable grace period of continued existence.

In 1930, in the case of Jones v. City of Los Angeles,[3] the California Supreme Court held invalid a zoning ordinance requiring the elimination of nonconforming uses as applied to plaintiffs in the action. In 1927, the City of Los Angeles annexed the territory of the Mar Vista district where plaintiffs (four individual businesses) operated four sanitariums for the treatment of nervous diseases. Each sanitarium represented a considerable investment in land, buildings, and equipment. In August of 1927, Los Angeles enacted a zoning ordinance (apart from their comprehensive zoning plan) directed at the sanitariums. The ordinance provided that outside of certain areas, it would be unlawful to operate hospitals, asylums, sanitariums, etc. (The ordinance did not provide for an amortization period). The court found that the sanitariums did not constitute a nuisance, and struck the ordinance down as applied to the sanitariums.

> Our conclusion is that where, as here, a retroactive ordinance causes substantial injury and the prohibited business is not a nuisance, the ordinance is to that extent an unreasonable and unjustifiable exercise of the police power. Whether under our present law, there exists the power to

> eliminate the nonconforming use by payment of compensation for the loss suffered, is a question not presented by this case, and one which we therefore do not attempt to determine.
>
> It follows that the present ordinance is valid in so far as it prohibits the further establishment of businesses of this type in the restricted districts, and is invalid in its application to these plaintiffs.[4]

Legal History

Following the Dema cases little was heard of amortization until 1942, when an article advocating its wider use appeared in the University of Chicago Law Review. Then in the early 1950's began a series of cases involving various types of ordinances calling for termination of nonconforming uses within specified times. Though the United States Supreme Court has not yet ruled on the question, it would seem to be only a matter of time until it grants certiorari or reviews such a case. The state courts have not been uniform in their holdings, perhaps judicially reflecting the uncertainty of zoning officials who themselves cannot agree on what grace periods are reasonable.

In Standard Oil Company v. City of Tallahassee,[5] the U.S. Fifth Circuit Court upheld an ordinance requiring the termination of plaintiff's nonconforming use of its land as a service station within a 10-year period. The Standard Oil Company purchased the subject property in 1938 for the purpose of building a service station, which was subsequently opened in November of the same year. In 1939, pursuant to authority granted to Tallahassee in 1931 by the state, the city passed an ordinance changing the zoning classification of the subject property. The ordinance provided that all existing service stations located in the area were to discontinue their operation within a 10-year period running from 1939. In upholding the ordinance requiring the petitioner to discontinue his business, the court said:

> We find no merit in appellant's contention that enforcement of this ordinance would entail any unjust discrimination, or would be tantamount to depriving it of its property without due process merely because the site was acquired and improved at considerable expense before the zoning ordinance was enacted. . . .

> Here, plaintiff's service station is near the State Capitol and the State Supreme Court Building, as well as several other state office buildings and a public school. It therefore becomes manifest that its discontinuance under the ordinance cannot be viewed as arbitrary and unreasonable, or as having no relation to the safety and general welfare of the community affected.[6]

The court concluded:

> The general rule here applicable is that consideration of financial loss or of so-called 'vested rights' in private property are insufficient to outweigh the necessity for legitimate exercise of the police power of a municipality.[7]

It is to be noted that although an amortization plan was available, the court completely ignores this argument and rests its decision on the reasonableness of the ordinance as a proper exercise of the police power.

In City of Corpus Christi v. Allen,[8] the Supreme Court of Texas held that an ordinance as applied to defendants' junkyards was invalid. The City of Corpus Christi enacted a comprehensive zoning ordinance in 1937, and had amended it several times. An amendment in 1948 placed four separate junkyards on the same street in a "light industrial district." The junkyards, because of the amendment, became nonconforming uses which could only be operated in a "heavy industrial district." The ordinance provided that nonconforming uses would have 2 years in which to convert to uses allowed in the newly zoned district. The court found:

> Since the nonconforming uses here sought to be enjoined are not shown to constitute nuisances, and do not appear to be harmful in any way to public health, safety, morals, or welfare, we conclude that to invoke petitioner's ordinance to compel respondents to cease operating their businesses or to move them to another district would be an unreasonable exercise of petitioner's police power and would constitute a taking of their property in violation of the (Texas) constitution. We hold that to exercise the power attempted here would be unreasonable because any benefit to petitioner (City) would be relatively very small; respondents would be forced to move from a "light" industrial district, where adjoining uses, admittedly legal,

> such as second-hand furniture stores, garages and the like, are not substantially out of harmony with, or different from, the uses petitioner would force respondents to quit; all respondents operate on Agnes Street and fairly close together so that the burden, if any, of their business is confined to a small area while the amount of property in use there is relatively large.[9]

But the court ends:

> Our conclusion is not to be construed as a holding that the ordinance in question may not, under other circumstances, be invoked to terminate a nonconforming use, not a nuisance nor injurious to the public health, morals, safety or welfare.[10]

Thus the court while declaring the ordinance invalid as applied to this particular fact situation, does leave the area clear for the ordinance to operate. However, another case concerning the elimination of nonconforming junkyards, City of Akron v. Chapman,[11] took a contrary view. The defendant or his father had operated the junkyard in question continuously since 1916. In 1922, the City of Akron enacted comprehensive zoning wherein defendant's property was included in a residential area. This enactment provides that nonconforming uses will be discontinued when in the opinion of the zoning counsel the use has been allowed to continue for a reasonable time. In 1950 another ordinance was passed directed specifically at defendant's property with the provision that the use be discontinued in one year. The Supreme Court of Ohio in striking down the statute as applied to defendant said:

> The effect of the provision of the 1922 ordinance and the 1950 ordinance complained of in this case is to deprive the defendant of a continued lawful use of his property and is in violation of the due process clauses of the state and Federal Constitutions.[12]

The Chapman case is categorized by writers as a "vested" rights case. The court spoke of property and the effect of zoning on property ownership:

> What is property? It has been defined as not merely the ownership of and possession of lands or chattels, but the unrestricted right of their use, enjoyment and disposal.

> Anything which destroys any of these elements of property, to that extent destroys the property itself. The substantial value of property lies in its use. If the right of use is denied, the value of the property is annihilated and ownership is rendered a barren right.[13]

The above decision is criticized in Grant v. Mayor and City Council of Baltimore,[14] the Maryland Court of Appeals saying:

> Some courts have refused to distinguish between laws requiring immediate cessation of nonconforming uses and those that demand cessation only after the expiration of a tolerance of amortization period, holding that the latter as well as the former are unconstitutional.[15]

The Grant case involved an ordinance enacted in Baltimore which required the elimination of all signboards situated in residential and office use districts. The amortization period was five years from the date of the ordinance. The plaintiffs (signboard companies joined with individual property owners who leased to the signboard companies) sued to enjoin the city from enforcing the ordinance. The court upheld the ordinance, casting aside a vested rights argument:

> Every zoning regulation, because it affects property already owned by individuals at the time of enactment, effects some curtailment of 'vested' rights, either by restricting prospective uses or by prohibiting the continuance of existing uses. A regulation of the latter variety, however, almost always imposes substantial loss and hardship upon the individual property owner--a loss much greater than that sustained by reason of a prospective use restriction only--and that factor underlies the rule that we are discussing. . . .
>
> There is no difference in kind, either between limitations that prevent the adding to or extension of a nonconforming use, or provisions that the right to the use is lost if abandoned or if the structure devoted to the use is destroyed, or the denial of a right to substitute a new use for the old, all of which are established as constitutional and valid, on the one hand, and a requirement, on the other, that an existing nonconformance must cease after a

> reasonable time. The significance and effect of difference in degree in any given case depends on circumstances, environment and length of the period allowed for amortization. . . .
>
> Zoning as it affects every piece of property is to some extent retroactive in that it applies to property already owned at the time of the effective date of the ordinance. The elimination of existing uses within a reasonable time does not amount to a taking of property nor does it necessarily restrict the use of property so that it cannot be used for any reasonable purpose. Use of a reasonable amortization scheme provides an equitable means of reconciliation of the conflicting interests in satisfaction of due process requirement. . . .
>
> The distinction between an ordinance that restricts future uses and one that requires existing uses to stop after a reasonable time is not a difference in kind but one of degree and, in each case, constitutionality depends on overall reasonableness, on the importance of the public gain in relation to the private loss.[16]

The court went on to find that the signs in the residential section (those to be eliminated) represented only five percent of the total signs belonging to the sign companies. The court reasoned that these signs have a limited life span and could without loss, be relocated. As to the individual property owners, the court said:

> The position of the individual appellants,...are not identical with those of the corporate appellant. We think, however, that any loss or harm that they suffer as a result of Ordinance 711 is not sufficiently substantial compared to the public good to make the ordinance invalid as to them. If the ordinance imposed such restrictions that the land could not be used for any reasonable purpose, it would, of course, be invalid as to it.[17]

Cited as the landmark case which established the constitutionality of amortization provisions is City of Los Angeles v. Gage.[18] The City of Los Angeles brought suit to enjoin defendant Gage from operating his retail plumbing business in a residential area. Gage's business under successive

zoning ordinances had been first, a conforming use, then a permitted nonconforming use, then a prohibited nonconforming use, with the final classification requiring Gage to terminate the business within five years. The California court, recalling the Jones case[19] where the ordinance directed at the operation of four sanitariums was declared invalid, distinguished the Gage case:

> There are other differences between Jones and the present case. There the regulation was one type of commercial use. Here the regulation is of all commercial uses. There the ordinance affected a substantial investment in land and special buildings designed and built for the use to which they were being put. Here the ordinance affects only the use of land and the nonconforming use of a conforming building. The building has been, and may continue to be, used for the purpose for which it was designed and built. There the property could not have been used immediately for other purposes. Here the property can be used immediately for the uses for which it is zoned.[20]

The California court balanced the public's interest with the private loss. Speaking of amortization, the court said:

> As a method of eliminating existing nonconforming uses it allows the owner of the nonconforming use, by affording an opportunity to make new plans, at least to offset any loss he might suffer. The loss he suffers, if any, is spread out over a period of years, and he enjoys a monopolistic position by virtue of the zoning ordinance as long as he remains. If the amortization period is reasonable the loss to the owner may be small when compared with the benefit to the public.[21]

While some courts have drawn a distinction between existing and future uses the California court recognized this as only a matter of degree.

> The distinction between an ordinance restricting future uses and one requiring the termination of present uses within a reasonable period of time is merely one of degree, and constitutionality depends on the relative importance to be given to the public gain and to the private loss. Zoning as it affects every piece of property is to some extent retroactive

> in that it applies to property already owned at the time of the effective date of the ordinance. The elimination of existing uses within a reasonable time does not amount to a taking of property nor does it necessarily restrict the use of property so that it cannot be used for any reasonable purpose.[22]

Since the Gage case, California has reached a different result when the amortization period did not seem reasonable. In City of La Mesa v. Tweed and Gambrell Planing Mill,[23] the defendants had operated a planing mill on the subject property since 1936 when they constructed the building for their operation. The buildings had a life expectancy of 40 years when built. In 1945, a zoning ordinance was passed placing the subject property in a "one-family" residence area. However, the planing operation was permitted to continue. In 1954 and 1955, pursuant to a master zoning plan, the defendant's property was re-zoned into a "multiple dwelling" area. The 1954 ordinance provided that nonconforming uses (which included the planing mill) be discontinued within 20 years or not more than five years if the city council notified the property owner to discontinue the use. In a condemnation proceeding (involving part of the subject property), negotiations broke down between the property owner and the city. Shortly afterwards the city notified the property owner to discontinue his nonconforming use within five years. In declaring the ordinance invalid as applied to defendant's property, the court noted that the building at the time of notification still had a useful life expectancy of 21 years. The court explained that the ordinance, although invalid as to this set of facts, nevertheless remains in operation. This holding simply indicated that the ordinance was inoperable under the circumstances of this case. Other elements involved in the case which may have weighed on the court's decision are: (1) an amortization period that seems too short (the five-year period), (2) a rather large private loss compared to a rather small public gain, and (3) the area zoned for residential purposes presented a question of poor judgement on the zoning council's part. It is important to note that the case was not decided on any vested rights theory.

New York has two cases of importance concerning the elimination of nonconforming uses. In People v. Miller[24] the defendant was convicted of violating a zoning ordinance prohibiting the keeping of pigeons, etc., in a residentially zoned district. The ordinance was passed in 1947 under the name of a building zone ordinance. The defendant had been harboring pigeons, as a hobby, on his land since 1945. The court skips over the nuisance possibility and rests its decision solely upon the power of a zoning regulation

to eliminate nonconformities when the resulting loss is slight and insubstantial to the property owner. It is to be noted that there was no amortization provision in the case, evidently meaning the immediate cessation of the nonconformity. In upholding the validity of the ordinance, the court said:

> In this state, then, existing nonconforming uses will be permitted to continue, despite the enactment of a prohibitory zoning ordinance, if, and only if, enforcement of the ordinance would be rendering valueless substantial improvements or businesses built up over the years, cause serious financial harm to the property owner. This rule, with its emphasis upon pecuniary and economic loss, is clearly inapplicable to a purely incidental use of property for recreational or amusement purposes only. Such an inconsequential use as that here involved--the harboring of pigeons as a hobby--does not amount to a 'vested right,' and 'depriving [defendent] of this pastime does not affect substantially [his] property rights. . . in the use of the premises, which are otherwise undisturbed and unimpaired.[25]

Thus it would appear that if the nonconforming use is an insubstantial one (meaning little financial loss to the owner), then an ordinance requiring elimination is valid and constitutional. Petitioners, armed with this criteria, again called upon the court in 1958 to determine the validity of an ordinance calling for the elimination of a nonconformity. In Harbison v. City of Buffalo[26] the petitioner had operated a "cooperage" (reconditioning steel drums and barrels) since 1936 and had been issued a "junkyard" license by the city each year from 1936 through 1955. In 1953, the city passed an ordinance providing that all nonconforming uses be discontinued within a three-year period (petitioner's business was a nonconformity) and in 1956, the city refused to issue a license to petitioner and further ordered that he discontinue his business immediately. Although held unconstitutional by the two lower courts, the New York Court of Appeals reversed and remanded to the lower court to determine whether the three-year amortization period was a reasonable time in which to terminate the petitioner's business. The court gave guidelines:

> [A] further hearing should produce evidence relating to the nature of the surrounding neighborhood, the value and condition of the improvements on the premises, the nearest area to which petitioners might relocate, the cost of such

> relocation, as well as any other reasonable costs which bear upon the kind and amount of damages which petitioners might sustain, and whether petitioner might be able to continue operation of their businesses if not allowed to continue storage of barrels or steel drums outside their frame building. It is only upon such evidence that it may be ascertained whether the resultant injury to petitioners would be so substantial that the ordinance would be unconstitutional as applied to the particular facts of this case.[27]

Although the majority of the state courts have approved the amortization theory as a means of eliminating nonconforming uses, there are still a number of jurisdictions which have not accepted it. A 1965 ruling by the Supreme Court of Missouri in Hoffman v. Kinealy[28] supported the vested right concept. In the Hoffman case, the petitioners used land for the open storage of lumber, building materials and construction equipment and had been doing so since 1910. In 1950, an amendment to a 1926 comprehensive zoning ordinance, converted petitioner's land into a nonconforming use. The amendment provided for a six-year amortization period from the date of the amendment. Although it seemed that the amortization period was a reasonable one for a relatively minor nonconforming use, the court struck the ordinance invalid as applied to petitioners. The court, instead of weighing the public versus the private interest, spoke in terms of a vested right.

> The amortization provision under review could terminate and take away from instant realtors the right to continue a lawful nonconforming use of their lots which has been exercised and enjoyed since 1910--a right of character to which the courts traditionally have referred as a 'vested right.' To our knowledge, no one has, as yet, been so brash as to contend that such a pre-existing lawful nonconforming use property might be terminated immediately. In fact, the contrary is implicit in the amortization technique itself which would validate a taking presently unconstitutional by the simple expedient of postponing such taking for a 'reasonable' time.[29]

The Supreme Court of Missouri goes on to find that this would be a strange and novel doctrine if a municipality could take land without compensation if the property was not too valuable or the taking was not too soon. It is

interesting to note that the court shares the same view whether the nonconformity is a use of land or a use of a building.

> It has been suggested that perhaps some distinction should be made between the termination of pre-existing nonconforming uses of land and the termination of such uses of buildings, and that it might be constitutionally permissible to terminate uses in the first category but not the second. However, such distinction would be not only illogical but also in utter disregard of the economic realities of modern urban life, for the use of buildings, e.g., older buildings frequently are torn down to make the underlying land available for more profitable uses such as used car lots or parking lots.[30]

Though there are circumstances in the Hoffman case which indicate that the benefit which would accrue to the public from the abatement of the particular nonconforming use would not be very great, the opinion is unsatisfactory because the court does not even purport to balance the conflicting interests of the realtors and the public. The whole opinion is grounded on the theory that the nonconforming use was a vested property right which could not be supressed pursuant to the police power. The decision seems to say that amortization provision suffered under a very strong presumption of unconstitutionality since they operate in derogation of a property right.

The Illinois Supreme Court in the 1965 case of Village of Oak Park v. Gordon[31] also held an ordinance unconstitutional but indicated that amortization might be upheld under different circumstances.

FOOTNOTES FOR APPENDIX I

1. 272 U.S. 365, 1926.
2. Dema Realty Co. v McDonald, 168 La. 172, 121 So. 613 (1929), cert. denied 280 U.S. 556 (1929). Dema Realty Co. v Jacoby, 1968 La. 752, 123 So. 314 (1929).
3. 211 Cal. 304, 295 Pac. 14 (1930).
4. Ibid.
5. 183 F. 2d 410 (5th Cir. 1950).
6. Ibid.
7. Ibid.
8. 152 Tex. 137, 254 S.W. 2d 759 (1953).
9. Ibid.
10. Ibid.
11. 160 Ohio St. 382, 116 N.E. 2d 697 (1953).
12. Ibid.
13. Ibid.
14. 212 Md 301, 129 A. 2d 363 (1957).
15. Ibid.
16. Ibid.
17. Ibid.
18. 127 Cal. App. 2d 422, 274 P.2d 34 (1954); Case is cited in Legislative Techniques for the Amortization of the Nonconforming Use; A Suggested Formula, 12 Wayne L. Rev. 435 (1966).

19. Supra, n. 3.

20. Supra, n. 18.

21. Ibid.

22. Ibid.

23. 146 Cal. App. 2d 762, 304 P.2d 803 (1956).

24. 304 N.Y. 105, 106 N.E. 2d 34 (1952).

25. Ibid.

26. 176 N.Y. S. 2d 598, 152 N.E. 2d 42 (1958).

27. Ibid.

28. 389 S.W. 2d 745 (Mo. 1965).

29. Ibid.

30. Ibid.

31. 32 Ill. 2d 295, 205 N.E. 2d 464.

APPENDIX II

Flood Insurance

General History - If a person has an interest capable of pecuniary estimation, and that interest is in peril of loss, and a second person assumes the risk of loss, this is an example of risk shifting, but not insurance. However, if a large group of persons, each of whom has a similar risk of loss, makes a ratable contribution to a general fund designed to assure that no singular person will incur an excessive loss, this is an example of insurance.

The first known insurance originated in the 13th century, dealing with marine risks. Later, similar insurance was granted under a patent from Queen Elizabeth I in London in 1574. Until recent times, only policies dealing with marine, fire, and life risks were available. Now a large variety of forms of risks are insurable, including risks from floods.

An early move toward protecting the owner of property from excessive monetary loss due to floods came in 1936 with the passage of the Flood Control Act.[1] By this act, flood control was adopted as a national policy, opening the way not only for control projects, but also showing the future trend for government action in all forms of flood legislation including flood insurance.

However, until recently, neither private insurance companies nor the Federal Government have been able to develop a feasible insurance program. One of the primary reasons has been that flood insurance cannot be sold at feasible rates without sizeable government subsidies. Many private fire and casualty insurance companies are opposed to federal insurance programs on the grounds that floods are not a type of natural phenomena that can be guarded against by insurance since they do not have the essential random quality necessary for a sound insurance program. With increasing urban growth, much of which occurs in the flood-prone area, it seems likely that the amount of damage caused by floods each year will continue to rise, despite the construction of many costly protective structures, even though natural disasters become no more frequent.

In the past, private insurance companies have been reluctant to enter the flood insurance field because of the following problem areas which have been the subject of considerable investigation.

(1) How broadly should "flood" be defined? The actuarial rates to be charged for the insurance are dependent on which properties are to be included under the program.

(2) Should high risk areas be excluded from the insurable properties or should prohibitive rates be used for the areas to retard their use?

(3) How can the tendency for the sale of more insurance in high risk areas be overcome?

(4) Will mortgages tend to make flood insurance a requirement if such a policy is available?

(5) How can the tendency for the public to purchase insurance after a period of flooding has occurred and allowing policies to lapse in flood free times be overcome?

(6) Are sufficient hydrological data available to forecast flood frequency without the need for unreasonable expense?

(7) Would a detailed study of each risk be necessary to provide this insurance?

(8) Could rates be set which would both be attractive to the public and result in a profit to the insurer?

(9) Would the state permit the issuance of a blanket natural disaster insurance policy for a premium loaded for risks to which not all purchasers may be subject?

(10) Could a group policy be used which would have the premium paid by taxation, special assessment, or otherwise?

(11) Can the insurer protect himself against bankruptcy in case excessive losses develop in a given period? Here the possibility of reinsurance or temporary assumption of the loss by the Federal Government must be considered.

(12) Should actuarial rates be charged those benefiting or should the rates be fixed in accordance with the ability of the insured to pay?

(13) Should the rates charged be uniform nationally, or should they be graded according to risks?

(14) If the insurance is made available, would those persons who did not choose to avail themselves of the protection be able to receive gift relief from the government in the event they become victims of a flood disaster?[2]

According to the American Insurance Association, the position of stock insurance companies regarding flood insurance may be outlined in the following nine points.

(1) If flood insurance could feasibly be written, insurance companies would be eager to do so.

(2) It is believed that, due to the catastrophic nature and virtual certainty of loss involved in flood insurance, it is not feasible for private companies to offer such policies on nonmovable property.

(3) The public need will not be met by any insurance not covering areas subject to recurrent floods.

(4) Competitiveness of insurance would be lost if policies on fixed location were to include flood protection. Only limited areas have need of this protection.

(5) There is no way in which to make the purchase of flood insurance mandatory and be consistent with free government and competitive selection.

(6) The insurance companies foresee the same difficulties to a government insurance program that would inhibit a private program.

(7) Direct government relief is seen by the insurance companies as a more realistic means of approaching the problem.

(8) Flood control and prevention offer a better opportunity for fruitful use of money and effort in approaching the problem.

(9) If the government were to avoid fixed advance commitments, a most expeditious use of available funds would be accomplished serving to the best advantage when the emergency arises.[3]

The position of many private insurance companies on flood insurance is readily summarized in this statement:

> Because of the virtual certainty of the loss, its catastrophic nature, and the impossibility of making this line of insurance self-supporting due to refusal of the public to purchase such insurance at the rates which would have to be charged to pay annual losses, companies generally could not prudently engage in this field of underwriting.[4]

An opposing view has been expressed by Orieon Spaid. He believes that private companies can justify the issuance of flood insurance policies if prudent use of available techniques in underwriting such insurance are applied.

> The catastrophe exposure that is characteristic of flood insurance underwriting is generally recognized. It arises from the fact that a high volume run-off of a particular river system may cause a plurality of claims. This has happened before, and will happen in the future. Such events are not unaccounted for in the actuarial determination of rates, however, and the real issue is how long a term should the underwriter consider in the chronological distribution of losses.[5]

To reduce the risk of bankruptcy to an individual private insurance company, several means might be available. A reinsurance of part of the liability incurred is possible. Here a policy written by one insurance company would be covered by another or several other companies for some part of the risk involved. This may be accomplished by ceding a fixed percentage of any loss incurred. Another way of reducing the loss potantial to a given company would be by coinsurance. Under this method, two or more insurance companies would write a partial loss coverage on a single property. The approaches differ in that the recourse of the insured in the case of reinsurance is with the original insuring company while the coinsurance, a privity of contract between the insured and the insuring companies exists with all companies concerned.[6]

Although general flood insurance has not been available from private companies, certain types of flood insurance may be obtained. Insurance against flood damage may be obtained on certain personal or movable property. Bridges and tunnels can be covered under existing policies of

private insurers, because of careful selectivity used by carriers in providing such insurance. Merchandise in transit or on consignment may be covered. Other miscellaneous and varied properties may be covered, however, the major source of loss is exempted. Private housing and industrial property is not covered by most private companies.[7] Lloyd's of London continues to write coverage on a selective basis.[8]

It is generally conceded that flood insurance is vastly different from other forms of insurance. It cannot pay off within the working life of an individual, and would, therefore, not be attractive to the stock holder or managers of insurance companies. The very nature of the time involved for pay off of the insurance makes it more practicable for the government to offer this insurance.[9]

The first effort to establish federal flood insurance was undertaken by President Truman on August 20, 1951, when he sent a message to Congress requesting a $50-million revolving fund to finance a federal insurance program, as well as partial indemnity for flood victims, direct and guaranteed loans for homes and businesses, farm land and building, and loans to state and local government participation. No legislation was passed to establish flood insurance at that time.[10]

Later, the Kennedy-Saltonstall bill (1956), related to flood insurance, failed to gain passage. This was followed by two unsuccessful attempts of subsequent bills, of similar purpose, to gain passage. These were submitted as the Carlson Bill (1956), and a bill drafted at the request of Senator Bush (1956).[11]

During the second session of the 84th Congress the Federal Flood Insurance Act of 1956 was enacted. The Act allowed the federal government to provide flood insurance where private companies did not offer such protection at reasonable rates. The act authorized federal flood insurance and reinsurance, and encouraged private insurance companies to assume the responsibility of insuring flood risk. Provision was also made in the act for flood victims to acquire insurance and loans.[12]

This program was established to provide insurance for flood risk property at a premium rate to produce sufficient proceeds to pay all claims for probable losses over a reasonable period of years. Rates were to be established by the administrator so that policies were marketable and carried no less that 60 percent of the rate to cover the estimated risk. On policies carrying less than 100 percent of the estimated risk rate, the participating states in which the

property was located were required to make up one-half of the difference and the administrator of the program to provide a contribution equal to the state's to provide coverage for 100 percent of the estimated risk.[13]

In order for a state to be eligible for participation of its citizens, zoning regulations must be in effect in flood hazard areas as deemed necessary by the program's administrator.[14] Under this federal flood insurance, no individual may hold insurance in excess of $250,000 with any single dwelling being limited to $10,000, and the total face value of outstanding policies cannot exceed $3 billion dollars, unless the President authorized additional insurance. This additional amount cannot exceed $2 billion dollars.[15]

Compensation provided in the Federal Flood Insurance Act exempted the first $100 dollars of damage and five percent of all damage above this amount.[16] This insurance was to be offered by the federal government to the public through private insurance companies as agents. These agents would also adjust claims under the program. The insurance was to be of a non-cancellable type with advance premium payments, thus preventing the purchase of protection in periods of high flood probability with the intention of the insured cancelling the policy following the crisis and obtaining a premium refund.[17] To obtain a pure premium, the government would absorb all administrative cost of the Insurance Act.[18]

"The Federal Flood Insurance Act in its present form is not workable, and it should be amended..."[19] The above statement represents a conclusion of the Council of State Government during a conference on Flood Plain Regulation and Insurance. Some of their recommendations for proposed amendments included:

(1) Encouraging the wise use of the flood plain should be stressed.

(2) The question of subsidies should be examined carefully, and if subsidies are retained, the Act should be amended to allow states greater leeway in the method by which they would share in the financing of the program.

(3) Provision should be made to allow the states an effective voice in policy determination.

(4) The present deadline for flood plain zoning should be removed and only become effective upon participation by a minimum number of states.

(5) A pilot initiation of the program should be conducted before full scale use is effected.

The Conference on Flood Plain Regulation and Insurance also made certain recommendations to the states. These included:

(1) All states should investigate the need for extending encroachment legislation with particular notice to the differentiation between channel encroachment and flood way encroachment. State laws should set minimum standards, but permit local governments to maintain stricter legislation if desired.

(2) Each state should review its existing legislation and administration of flood connected programs to determine what steps are required to permit the use of zoning, subdivision, building codes and other means of land use regulation.[20]

The first nine months of life for the Federal Flood Indemnity Administration consisted of a study period in which plans and policies necessary to offer insurance under the Federal Flood Insurance Act of 1956 were formulated. Following this study period, a request was made of Congress for funds necessary to operate the insurance program for the fiscal year 1958. No appropriations were made and the administration was abolished in July, 1957.[21]

The federal government remained about the only other choice to offer flood insurance in the absence of private underwriting of these risks. The argument for a federal indemnity plan can be summarized as follows:

(1) A sound credit standing of the flood victim could be maintained which would not be true if he were left in debt without assets.
(2) It would quicken the pace of economic recovery after a flood.
(3) With quicker recovery, less tax losses would be experienced.
(4) Reimbursing the victim removes his tax deduction for such losses.
(5) Recovery of sales and, thus recovery of sales tax receipts of a normal amount would be faster.
(6) Reduced spending may be possible as flood control projects.
(7) Relief payments due to floods might be reduced.
(8) If premium rates were adjusted as to risk involved, a bias away from building in hazard areas may be accomplished.
(9) Potential victims would have greater peace of mind and improved morale.

(10) The Federal Government could operate at a break even point and not at a profit as would private companies.

(11) In the event of a disaster, the Federal Government is better able to raise funds than is a private company.

(12) Lower premiums would be possible through a government program as compared to a private enterprise.

(13) Maximum exposure of the government to liability can be controlled by statutory limits.[22]

The program offered by the government raised many unresolved questions regarding flood insurance.

(1) If premiums are set on an actuarial basis, they may be so high as to discourage potential purchasers.

(2) If high premiums are not set, subsidies will be necessary by the government.

(3) If low premiums are used the victims receive a greater return then for what they paid causing a redistribution of money from the general public.

(4) Some conflict with private insurance would result from such a program.

(5) Unless true insurance principles are used, the word "insurance" should not be used to describe such a program.

(6) Due to the untried nature of the program, private companies may hesitate to issue policies in their name, even with federal reinsurance available.

(7) Private insurers cannot believe it profitable to attempt to insure such risks as floods and high water where losses are catastrophic and occur frequently.

(8) Mortgagees will not be inclined to purchase high-cost flood insurance, but instead will be selective in accepting mortgages with the flood risk in mind.

(9) If mortgagees insist on such insurance, they run the risk of losing business to competitors due to the high additional premium required for such protection.

(10) Likewise, insurers adding flood insurance to policies risk losing business to competitors due to the high additional premium required for such protection.

(11) High risk areas excluded from such a program will result in no protection where it is most needed.

(12) Large federal subsidies may be required in indemnifying catastrophic losses.

(13) Await the occurrence and meeting the need as the time arrives, seems to be a more practical method of handling flood damage.

(14) The "brothers keeper" method (when in time of disaster, people not affected are especially generous with money, goods, and services) has worked satisfactorily in the past and should continue to do so.

(15) The money for such a program would be put to better use in building protective works.

(16) Because of the long period of years required for a true appraisal of the program's success or failure, a short term trial may be deceptive in either direction.

(17) Obtaining a large number of policies of high risk is compounding and not spreading the risk.

(18) Under a voluntary program, only the property having the greatest risk will be insured.

(19) In regard to question No. 18, undue encouragement of the use of high risk land will result from such a program.

(20) Those building on high risk land probably gained advantage by low cost of acquisition.

(21) Arbitrary, statutory limits of liability are weak straws against the pressures to increase these limits.

(22) For the same reason, arbitrary, statutory limitation of those eligible for benefits will be swept aside by demands from others showing equal rights for such benefits.

(23) In times not hampered by floods, there is a tendency for policy holders to allow their policies to lapse, thus reducing rather than expanding, the number of policies.

(24) In reference to question No. 23, a similar tendency is shown when extended coverage rates are raised.

(25) A large program will be costly if a failure, but a small program will have difficulty in spreading the risk.[23]

The August 8, 1966 report of the Department of Housing and Urban Development, "Insurance and Other Programs for Financial Assistance to Flood Victims," paved the way for the new flood insurance legislation. In forwarding this flood insurance report to the President, the Secretary of Housing and Urban Development pointed out that:

> ...[T]he study concludes that flood insurance is both feasible and can promote the public interest. Flood insurance will complement other programs of the Federal Government dealing with floods. Flood insurance is viewed both as a means of helping the individual bear more easily the risks of flood damage to which his location often exposes him, and equally, as a means of discouraging unwise occupancy of flood-prone areas. [Emphasis added]

The report envisaged a program of flood insurance of an essentially private character, but with continued large-scale participation of the Federal Government. The government shall have to help in measurement of flood risks in specific locations, in establishing flood insurance premium rates, and in providing financial support to the insurance companies against excessive losses on their part. Moreover, some continuing federal subsidy will also be necessary to a comparatively small number of present occupants of high flood risk areas, otherwise the cost of their flood insurance will be more than they can bear. Such subsidy should not be extended to persons who propose to build new homes in such areas, for this would lead to increased total flood hazard. Subsidies to some present occupants of flood-prone areas should be viewed as a part of a program of land use adjustment, aimed at ultimate reduction in the exposure to flood hazard.

The several forms of federal help outlined in the program include:

> 1. A national program of flood insurance should be established with government assistance or participation to the extent necessary to assure a workable method of pooling risks, minimizing costs and distributing burdens equitably among the property-owners protected by such insurance and the general taxpayers.
>
> 2. The Federal Government should encourage state and local agencies concerned with land use in flood-prone areas in order to restrict future public and private treatment in such areas, and to take advantage of opportunities afforded by disasters, which require new investment, to channel the resulting new investment to other geographic areas.
>
> 3. The federal agency administering the insurance program should be authorized to encourage and assist private

property insurance companies in order to obtain their maximum participation in the insurance program consistent with effective achievement of the objectives of the program.

4. The present flood-related programs and activities of the federal government should be continued, but with modifications necessary to meet the opportunities and needs of the flood insurance program.

5. After insurance becomes available, uninsured victims of flood disasters should remain eligible initially for federal assistance in the form of loans at subsidized rates of interest, but this eligibility should be limited.[24]

This report was designed with the basic idea that private companies should write the flood insurance and only incentives to such a program should be offered by the federal government. It was recommended that initially such a program be limited to dwellings of from one to four families with a later extension to other property.

The most recent federal legislation related to flood insurance is The Housing and Urban Development Act of 1968. It authorizes a national program under which flood insurance can be made available to occupants of flood-prone areas through the cooperative efforts of the federal government and the private insurance industry.

Provision for federal assistance in the form of premium subsidies and reinsurance coverage to compensate for heavy losses, with contributions of risk capital by participating insurance companies is included. This entitles the companies to a certain percentage of profits, and imposes on them the payment of a reinsurance premium to the Government. Other insurance companies are allowed to participate on other than a risk-sharing basis. The act also provides that the property owner will bear part of the cost of flood insurance in the form of a premium.

Under the terms of the act, coverage at subsidized rates in the amount of $17,500 is available for a dwelling, with an added $5,000 at subsidized rates for the contents. An additional $17,500 on the building and $5,000 on the contents is available at actuarial rates. Business properties are eligible for $30,000 insurance at subsidized rates on the structure, and an additional $5,000 on the contents.

FOOTNOTES FOR APPENDIX II

Flood Insurance

1. U.S. Statutes at Large, Vol. 49, Public Law 738, p. 1570, 74th Congress, 2d session, 1936.

2. U.S. Congress, Senate Rept. 1313, Federal Disaster Insurance, 84th Congress, 2d session, 1956, p. 241-3.

3. American Insurance Association, Studies of Flood Damage 1952-1955, New York City, 1956, p. 5-7.

4. Insurance Executives Association, Report on Floods and Flood Damages, 1952.

5. Spaid, Orieon M., "Flood Insurance," Best's Insurance News, March, 1963, p. 123.

6. U.S. Congress, Senate Rept. 1313, Federal Disaster Insurance, 84th Congress, 2d session, 1956, p. 232-3.

7. Ibid. at p. 236-7.

8. Ibid. at p. II.

9. Langbein, W. B., "Flood Insurance," Land Economics, Vol. 29, 1953, p. 323-30.

10. U.S. Congress, Senate Rept. 1313, Federal Disaster Insurance, 84th Congress, 2d session, 1956, p. 15-16.

11. Ibid. at p. 21-22.

12. U.S. Statutes at Large, Vol. 70, Public Law 1016, p. 1078, 84th Congress, 2d session, 1956.

13. Ibid., Section 7, p. 1080-81.

14. Ibid., Section 12, p. 1082.

15. Ibid., Section 10, p. 1081-2.

16. Ibid.

17. Meistrell, F. S., "Federal Flood Insurance," Address by the Commissioner, Federal Flood Indemnity Administration before the Conference of Northeastern States on Floods and Disasters, Roosevelt Hotel, New York City, December 18, p. 4-5.

18. Ibid., at p. 3.

19. Council of State Governments, Conference on Flood Plain Regulation, Chicago, Illinois, December 22, 1958, p. 1-3.

20. Ibid.

21. Parker, F. H., Flood Damage Abatement in Kentucky, p. 51-53.

22. U.S. Congress, Senate Rept. 1313, Federal Disaster Insurance, 84th Congress, 2d session, 1956, p. 268.

23. Ibid., at p. 269-271.

24. U.S. Department of Housing and Urban Development, Insurance and Other Programs for Financial Assistance to Flood Victims, a report from the Secretary of the Department of Housing and Urban Development to the President, as required by the Southeast Hurricane Disaster Relief Act of 1965, Government Printing Office, Washington, D.C., 1966, p. 14-18.

APPENDIX III

Flooding – 1969

On August 20, 1969, one of the worst floods in Virginia's history occurred in the James River Basin. Extreme rain intensities were the result of hurricane Camille and the rapid run-off occurred as the result of ground saturations from the heavy rainfall of the preceding month. In the Tye River Basin gages were swamped and no record is available. In Nelson County, at the confluences of the Piney and Tye Rivers, 31 inches of rain were recorded in five hours (Table I). In the lower basin the rainfall was not so heavy, but the area was severely damaged by the run-off from the upper basin. The flood crested at 13.5 feet above flood stage in Buena Vista, and at the city locks in Richmond the crest was 19.6 feet above flood stage (Table II).

When the waters exceeded their banks in the upper basin on August 20, few people had warning, and losses in both lives and property were heavy. "The rain started that Tuesday....When they went to bed they were not alarmed. Before daybreak many of these same people were dead."[1] By the time the flood reached Richmond on August 22, officials had taken precautions to prevent as much damage as possible. No lives were lost but the property damages to Richmond alone are estimated at $9 million.

As of September 19, 1969, the death toll was 109 with 44 people still missing. Most of the dead and missing are from Nelson County and the area around the Tye River where the flood began.[2] In the Davis Creek Community near Lovingston entire families are either dead or missing. One family of 18 was entirely lost.

Initial estimates made on August 27, 1969, set the total damages at $113 million and officials expected figures to increase as more data became available. The region was declared a disaster area by both Governor Godwin and President Nixon. The damage to agriculture alone was estimated at $21 million. Most of the damages were to businesses along the James River. Richmond had a short time to prepare for the flood, allowing many of the companies to move the most expensive portions of their inventory, but most were affected to some extent. Several tobacco companies are located along the river and much of their inventory was washed downstream. The most serious items washed away were several containers of chemicals containing DDT, pesticides, and propane gas. South of Richmond a drum of sodium cyanide pellets was washed into the river.

The railroads sustained severe damage. Several bridges were completely washed away and miles of track were either washed out or covered by mud slides. All trains had to be rerouted and most ran behind schedule for days.

APPENDIX III
TABLE I[a]

Rainfall Records for James River Basin, 1969

LOCATION	RAINFALL (Inches)
Rockfish	12.50
Buena Vista	---[b]
Montebello	---[c]
Clifton Forge	10.21
Palmyra	8.85
Gordonsville	5.80
Glasgow	6.36
Goshen	6.14
Charlottesville	4.75
Covington	3.65
Bremo Bluff	4.88
Columbia	5.54
Fredericksburg	4.62
Lynchburg	1.44
Buckingham	2.54
State Farm	3.30
Richmond	2.69
Convergence of Tye and Piney Rivers	31.00[d]

[a]"Camille," "Flood '69," Richmond Times Dispatch and Richmond News Leader.

[b]No reading available, all gages were swamped

[c]No reading available, gage overflowed at 10.5 inches

[d]Measurement was made in a 40-gallon drum

APPENDIX III

TABLE II[a]

Flood Crests in James River Basin

LOCATION	FLOOD STAGE (Feet)	CREST 1969 (Feet)	PREVIOUS RECORD 1936 (Feet)
Buena Vista	17	30.5	22.0
Lynchburg	18	28.0	25.5
Scottsville	20	30.5	25.5
Bremo Bluff	19	39.0	32.8
Columbia	18	41.0	35.8
Cartersville	20	35.0	29.3
State Farm	12	25.0	---
Westham	12	22.0	23.4
City Locks (Richmond)	9	28.6	27.5

[a]"The Past," "Flood '69," Richmond Times Dispatch and Richmond News Leader.

State Highway officials reported 200 miles of roads and 133 bridges destroyed at a cost of $19 million. At one time it was reported that no highway in the area could be traveled its entire length. One of the biggest problems in locating and rescuing victims was the lack of access routes to many localities.

Damages to residences were estimated at $10 million. All income levels were affected and in some areas entire communities were destroyed. Most of the people who were interviewed by the press planned to rebuild in the same locality. Many were going to seek funds from the Small Business Administration, while others were unsure of their source of funds.

Areas Sustaining Heavy Damages

Nelson County

The entire county was inundated by the floods. "[M]ore than one man said that he felt lucky that he had lost only one, two, or three members of his family."[3]

Massies Mill was a small town of several buildings; homes, businesses, two churches, and a post office before the flood, afterwards one building was standing. First estimates were 16 dead and 20 missing from this one community.

The Davis Creek Community was cut off by land and 46 people from the community were missing or dead after the flood. Several entire families are either missing or dead. Local inhabitants have renamed it Huffman Hollow because the entire Huffman family of 18 members was killed.

Lovingston was flooded and most of the buildings coated with mud. Electricity was off throughout most of the county and they were without water. Emergency supplies of food, water, and medicine were flown in by helicopter. As the bodies of the victims were found they were brought to Lovingston for identification and then flown to other cities.

Rockbridge County

In Buena Vista flood water reached 30 feet in the downtown area. Its 6500 citizens were cut off from the outside from Tuesday night (August 19) until noon Thursday (August 21). Several industrial plants were hard hit and were not back in operation for weeks. Many of the homes left standing were nothing but shells.

Glasgow, located on the Maury River, flooded on Wednesday morning (August 20) and covered the town with water. Then at 2 a.m. Thursday morning a second flood hit when the James River crested. Parts of the town were without electricity and 7 people from two families were lost.

Albemarle County

In Scottsville and Howardsville property damage was heavy but no lives were lost. The Scottsville business area had water to a depth of 12 feet and damages are estimated at $500,000. In Howardsville the business section was flooded by 30 feet of water and there were $1.2 million in damages.

Fluvanna County

Bremo Bluff, located near Scottsville and Howardsville, experienced considerable damage. No lives were lost but the low-lying residences and businesses were covered with water. The flood crested 20 feet above flood stage. The water supply was off so the families relied on a fresh water spring and water in fire trucks from other towns.

Amherst County

Amherst County was one of the hardest hit areas in the state. First reports listed 10 known dead and 79 persons missing. Flood waters spread out over wide areas of farmland and washed out the Southern Railroad bridge on the Tye River.

City of Richmond

Richmond received some warning of the flood when it first hit the James River Basin on August 20, but damages still were estimated at $9 million. This includes: $5,430,000 to industry, $54,000 to public facilities, $3,350,000 to businesses, and $166,000 to residential areas. There were no injuries or loss of life reported. Part of the city was without power temporarily and many merchants who moved their merchandise did not move it above the high water level. Four of the six bridges that connect South Richmond and the city proper were closed and many boats were lost or washed up on the shore.

The Aftermath

Cleaning and rebuilding operations began in most places as soon as the waters receded. Officials throughout the flood area began studying why it had

happened and what could be done to prevent its happening again. Nelson County Sheriff Bill Whitehead attributed the devastation of the Davis Creek Community to the fact that "[T]he creek falls sharply between the steep sides of the hollow and all the homes in the community were built along the creek."[4]

In some areas houses located on the hillsides were in as bad a position as those along the rivers and creeks. When the rain started the grounds were already saturated by a month of heavy rains, causing torrents of water to rush down the slopes and to uproot trees and rocks.

The highway crews began rebuilding better roads where the others had been and the railroads started repairing their tracks, but both highway and rail traffic were not back to normal for considerable time.

Several state officials began work to obtain better flood protection for the state. Mayor Phil J. Bagley, Jr. of Richmond suggests "a system of flood control dams for the James and its tributaries..." He also feels that "Richmond was prepared with a flood disaster plan and competent city officials moved promptly to implement the plan, or they would have sustained much greater damage."

Senator William B. Spong also suggests a "flood control project" and State Senator Henry E. Howell recommends "a national flood relief appropriations act." J. M. Alexander of the Department of Conservation and Economic Development, in testimony for the Senate Subcommittee on flood control hoped that "Congress will authorize during this session the proposed Verona project for flow regulation on the Middle River in Augusta County."

The Army Corps of Engineers has made a study and developed a plan "to minimize vulnerability to flood damage," but it does not solve the problem because the flood plain is highly developed.[5]

FOOTNOTES TO APPENDIX III

1. Brown, Lawrence, "Flood '69," Richmond Times Dispatch and Richmond News Leader, August 20-22, 1969.

2. Telephone call to the State Police Office, September 20, 1969.

3. "Flood '69," Richmond Times Dispatch and Richmond News Leader.

4. "The Aftermath," "Flood '69," Richmond Times Dispatch and Richmond News Leader.

5. Davis, James E., "Bagley Plea Seeks Flood-Control Dams," Richmond Times Dispatch, September 18, 1969.

APPENDIX IV

Floodway - Encroachment Act

There is general agreement among the serious students of flooding problems that one of the fundamental needs in flood damage abatement is control of encroachments in the floodway. Experience has shown that encroachment legislation by local option can lose much of its effectiveness unless adopted over a total river basin. Several states have adopted encroachment laws and while the statewide approach appears to be very sound, several deficiencies are evident from a close examination of the legislation. The following is a discussion of a possible format for an encroachment statute and suggests those factors to be considered in framing the substantive portions of such legislation.

Section I -- Definitions

(1) "Agency"--This should describe the state agency charged with the responsibility for establishing regulations and their enforcement. Local governmental units should not be authorized to establish their own encroachment regulations or permitted to enforce state law.

(2) "Watercourse"--This should define a depression with water flowing in it a certain period of the year. This definition is necessary in order to identify those depressions for which permits will be issued with respect to location, continuance, or alteration of obstructions. It should always be spelled out that if there is a question as to whether a depression is a watercourse or a drainageway that a presumption should exist in favor of the watercourse. The agency should always have the express power to classify any type of depression as a watercourse if it feels that its condition warrants it.

(3) "Drainageway"--May be described as a depression with water running in it less than the prescribed amount of time as set forth in the definition of a watercourse. The distinction drawn between drainageway and watercourse is on the assumption that the drainageway does not present a serious danger since water does not flow as often thus providing the basis for excluding certain depressions from the impact of proposed legislation.

(4) "Channel"--Should be defined in such a manner as to include both natural or artificial banks.

(5) "Flood"--Should be defined in terms of water above the bank and/or outside the channel of a given watercourse or drainageway.

(6) "Flood Plain"--Should describe the area adjoining the watercourse or drainageway subject to inundation by flood waters.

(7) "Floodway"--Should be described in terms of several types. One type might be one the limits of which are specified by the administering agency. The second type might be specified by the encroachment statute in terms of some distance on either side of the channel. Its purpose would be to prevent major floodway encroachment during the period of time preceding the establishment of the administering agency and the formulation of a floodway as defined by them. It is necessary that the standard set forth in the statute be very precise as construction throughout the state might be delayed since the administering agency would be overrun with applications for permits because the applicants were unable to discern for themselves whether they fell within the coverage of the Act. It would also render unenforceable the criminal penalties if the wording of the standard were too vague. A third type of floodway might be defined in terms of the highest flood of record, maximum probable flood, or a flood of a certain frequency. This would be construed as a "catch-all" floodway provision designed to prevent the construction of a very dangerous obstruction not falling within the preview of the previous defined floodways. Obstructions within this defined floodway would be subject to injunctive relief and not criminal penalties.

(8) "Obstructions"--This should be defined in terms as to make it all inclusive. The definition should be broad enough to include excavations if they change the direction of flow of the water. The latter might occur when an attempt is made to straighten a watercourse. The definition should be broad enough to cover both natural obstructions (located by a non-human cause) and artificial obstructions. This might bear on who might withstand the expense of removing a certain obstruction. The definition of an obstruction should include structures which may be carried downstream to the detriment of either life or property. This forestalls any argument that an object like a storage tank is not an obstruction because a

flood will carry it along as soon as it comes. Such a structure may be just as dangerous as the buildings, as it may be swept downstream and catch on a bridge abutment and restrict the capacity of the floodway at a most critical point.

(9) "Floodway-Encroachment Lines"--These should be defined in terms of the agency's floodway.

(10) The definition section might well include one as to "owner" as related to obstructions and expand the interpretation of the word "persons" to include individuals, firms, partnerships, corporations, etc.

Section II -- Statement of Purpose

(1) Language should be comprehensive enough to prevent any restrictive interpretation by a court. In a Connecticut case,[1] the defendent constructed flashboards on his dam which permitted ice to accumulate and so force water back onto the land of the plaintiff, an upstream proprietor. The court held that the plaintiff could not show that the defendant had not obtained the requisite statutory approval since the purpose of the Act was just to protect downstream proprietors against a dam giving way and not to protect upstream proprietors. The defendant was not within the class that the statute intended to protect.

Section III -- Establishment of Agencies' Floodways

(1) This should provide for a comprehensive program to delineate encroachment lines for every watercourse within the state having a certain minimum drainage area. Drainage areas below this minimum are those which are not likely to give rise to a flooding problem and therefore should be excluded from the coverage of this Act thus minimizing the administrative detail of the operating agency. This section could contain a definite standard (e.g., floodway limits of 50-year frequency floods) upon which encroachment lines are to be established. It is recognized that the unavailability of sufficient flood data may cause undue delay in the establishment of lines, and local conditions may vary so that protection given by an agency should also vary. It could be argued that a certain amount of flood data be required in any case in order to give a rational basis to the lines, but there are a substantial amount of flood data available for the nation

as a whole. While it is clear that only relatively few watercourses have gaging stations or the like, a reasonably accurate extrapolation for individual streams seems quite feasible for frequencies of less than 50 years. Varying local conditions may require flexible standards. It seems advisable, however, that a certain minimum standard should be set by the statute and that additional leeway be given the operating agency to provide for higher flood-frequency standards where the conditions warrant. A definite floodway-frequency standard avoids the possibility of local pressure being able to weaken the force of the Act.

Section IV -- Nuisance

(1) It is important that this section specify that artificial obstructions within a specified floodway without a permit are public nuisances. If this classification can be sustained, there can seem to be little problem about enjoining obstructions existing at the time of the enactment of the statute. It is clear that what was not a nuisance previously can become one and can be enjoined at a later time, even if what caused it to become a nuisance was a legislative act. As a general rule, the legislature may declare anything to be a nuisance which is detrimental to the health, morals, peace or welfare of the citizens of the state. To justify the state in thus interposing its authority in behalf of the public generally, as distinguished from those of a particular class, require such interference, and, second, that the means are reasonably necessary for the accomplishment of the purpose, and not unduly oppressive on individuals. The statute may also enlarge the category of nuisances by declaring acts or things to be nuisances which were not so at common law. However, it cannot declare an activity a nuisance which is not so in fact.[2] At common law, it was clear that a private nuisance would lie where an obstruction was so placed in the watercourse that the lands of the riparian proprietor and other landowners were inundated. Although there are numerous cases finding liability where an obstruction has been placed outside the normal channel area, (in the floodway) there are relatively few discussing such liability in terms of nuisance although it may have been present by implication. In Moore v. Chicago F. & O. Ry.,[3] the defendant so built a culvert that, while it apparently was sufficient for the stream itself, in time of flood when the entire bottom became part of the stream, the plaintiff's lands were more inundated than previously. The court held that this obstruction of flow was a nuisance which could be enjoined. It,

therefore, seems probable that legislation declaring an obstruction of a floodway a public nuisance would be upheld. It is true that most of the cases cited refer to private nuisance. However, the constriction of a floodway may well affect the entire community since generally such ponding is not limited to a narrow area, and the entire community will have to bear the cost of any flood relief program, the burden of which is increased in proportion to the increased damage caused by the floodway encroachment. Moreover, the remedy of a suit for damages or injunction under private nuisance may often be unavailable due to the difficulty of proving special damage or causal relationship between any one obstruction and a particular parcel of land.

Section V -- Unlawful Acts

(1) This section should provide for criminal prosecution and/or an injunction. A distinction should be made between those responsible for locating an obstruction and those who allow an obstruction to remain. It should impose upon the owner a duty to inspect his land and obtain a permit for any artificial obstructions located thereon. A grace period should be specified for the removal of artificial obstructions after the effective date of the Act. A rare case might exist where persons abandon an obstruction within the floodway unknown to the owner of the land and that under the provisions of this Act criminal liability might arise even before the owner receives notice from the agency to remove said obstructions. The probability of such circumstances arising would be extremely remote and would not warrant the inclusion within the Act of special provisions to cover said situation. As a practical matter prosecution would not likely be initiated by the agency except under extreme situations where there was a willful and wanton disregard of the provisions of the Act.

Section VI -- Permits

(1) This should authorize the agency to issue permits for the location, continuence, or alterations of obstructions which would otherwise violate or be enjoinable under the previous section of the Act. The section should set forth the provisions relating to the granting of the permit and should indicate the major features to be considered in passing upon the permit. If the provisions are reasonable and correlated with the "Purpose of the Act" set out in

section 2, they will in all probability be upheld in the event of a test case. Provisions should also be made for the issuance of temporary permits. The purpose of this is to provide the agency with some protection in the event that they are overwhelmed with applications for permits especially in the early stages of the administration of the Act. Temporary permits would then be granted until the agency was able to process and investigate the obstructions properly.

Section VII -- Power of Removal of Obstructions

(I) This section should give the agency the power to remove natural obstructions at its own cost since natural obstructions are there through no fault of anyone, and since channel improvement projects are undertaken most often at the public expense. If the person to be benefited by the removal of obstructions were to bear all or part of the cost, the natural tendency might be to bear the risk of loss and not report the obstruction to the agency. Power should also be given the agency for the removel of artificial obstructions at owners cost in cases where an emergency would not permit time for notice and hearing, or in such cases where the owner refuses to comply with the order for removal or cannot be found or determined. Flexibility of remedies should be provided and thus allow the agency within its discretion to seek either a court injunction or issue one of its own orders as the circumstances dictate.

Section VIII -- Right of Entry on Land and Waters

(1) This section should give the agency the right to enter upon private lands and waters within the state for the purposes of the Act and to provide for mandatory investigation of obstructions under specified circumstances.

Section IX -- Exclusion of Watercourses and Drainageways

(1) In order to keep the Act from becoming too cumbersome and unwieldly to manage, it should be made applicable to only such watercourses and drainageways which drain a watershed of a certain minimum size.

Section X -- Orders and Rules of the Agency

(1) In order to avoid a publicity deficiency, orders and rules of the agency should be filed or recorded at the local level as well as at the

agency headquarters. General provisions should be provided for notice, hearing and appeal provisions in order to satisfy "due process" requirements.

Section XI -- Penalties

(1) Meaningful penalties should be specified, and they should be of a substantial nature to insure compliance with the provisions of the Act.

Section XII -- Effect of Permit

(1) The granting of the permit should be independent of any other legislation, and should not be construed to supercede previous existing legal or equitable remedies. An added inducement to the obtaining of a permit would be the establishment of a rebuttable presumption that an obstruction existing without a permit is the approximate cause of the flooding to other riparian lands in the immediate watershed. Other state agencies and local governmental units should be discouraged from authorizing any activity which has not been previously approved by the agency through the issuance of a permit.

Section XII -- Remedies

(1) This is to provide that the remedies under the Act are not mutually exclusive and that the agency can pursue both criminal and injunctive relief if the situation requires.

Section XIV -- Severability

(1) This should contain the standard severability clause found in most legislation covering situations where part of an Act is declared invalid by the courts.

FOOTNOTES FOR APPENDIX IV

1. The Cox Shops v. Collins Co., 4 Conn. Supp. 374 (1936).

2. In State v. Chicago, M. & St. P. Ry., 114 Minn. 122, the court upheld an ordinance enacted by the City on special state legislative authority, declaring the use of soft coal by locomotives within the City a public nuisance. The court said: "The legislature cannot...declare a certain use to be a nuisance which is not in fact a nuisance. But it is clear that the acts or conditions which are detrimental to the comfort and health of the community may be effectively declared nuisances by the legislature although not so determined at common law.... The scope of the legislative action, when invoked to promote the general welfare, is very great."

3. 75 Iowa 263, (1888).

APPENDIX V

U.S. Army Corps of Engineers Flood Plain Information Reports

James River at Richmond, Virginia (September 1965)

Area Studied

The James River at Richmond has a drainage area of 6,780 square miles which is almost completely developed. Maximum accumulation of floodwaters at Richmond normally occurs two to three days after the cessation of heavy rainfall over the basin.

Flood Problem

The main flood problem stems from the occasional overflow of the James River into the developed sections of the city. Flooding on a lesser scale is caused by the overflow of Shochoe, Gillie, and Goose Creeks. Protection of the filtration plant is of primary concern since it is the source of the public water supply for Richmond and the immediate area.

The March 1963 flood is the largest since 1901. However, incomplete historical records suggest that much higher floods have occurred.

Existing Flood Prevention Measures

In 1927, the city completed a flood protection project for the Shochoe Creek area. In addition, the Navy Department completed a levee to protect the U.S. Naval Training School in 1943. These measures will afford protection to an elevation comparable to the stage of the March 1936 flood. Major channel improvements have also been made in the James River below Richmond reducing the flood heights at Richmond. In addition, the U.S. Weather Bureau from its office at Byrd Airport, Richmond, Virginia, issues flood warnings and expected river levels at the Westham gage and the City Lock gage whenever a flood threat exists.

Ordinances were adopted in 1955 and 1961 to limit the use of the flood plain. Since the entire flood plain is already developed, major changes in flood plain use must necessarily come about through redevelopment processes.

Remedial Measures

The measures that could be taken are general in nature. These have been enumerated in the summary of the report for Emporia, Virginia.

Tuckahoe Creek, Henrico County, Virginia (July 1965)

Area Studied

Tuckahoe Creek drains an area of 63 square miles. Deep Run, a tributary, joins the main stream about 2 1/2 miles above its mouth. Extreme flooding can occur on either Deep Run or the entire Tuckahoe watershed by a storm producing rainfall over a 12 hour period.

Flood Problem

The flood damage problem is not now acute, but development of area suggests that it will not remain so. The growth of the Richmond area is expanding into the Tuckahoe Creek watershed at a rapid rate. The flooding problem which now exists will be aggravated by the replacing of natural pervious areas with streets, roof tops, parking areas, and shopping centers.

Remedial Measures

The suggestions for reducing damage in the basin are much the same as those outlined in the Emporia, Virginia report. It is a matter of applying the general principles to peculiar problems of the watershed.

North Run, Henrico County, Virginia (February 1966)

Area Studied

North Run, and its main tributaries, Thorpe Branch, Rocky Branch, and Hungary Creek, drains an area of about 17 square miles. Extreme floods on the North Run or its tributary watersheds may be caused by storms producing rainfall with a 6-hour duration, or less.

Flood Problem

The flooding problem of North Run is similar to the one for Tuckahoe Creek. The expansion of the City of Richmond into this area of the county will aggravate the flood problem causing the damages to increase exponentially.

The hazard to motorists created by the possible inundation of bridges and sections of highway will be accentuated. As the area develops, main stream channels and waterway openings in railroad and highway fills may not be able to carry the increased water, causing heavier damage.

Gillies Creek, Henrico County, Virginia (October 1966)

Area Studied

The study is confined to the flood plains of the main stream from its mouth at the James River upstream to a point below Oakleys Lane, and two small tributaries, Lawndale Farms Branch and Hechler Village Branch. The watershed comprises 16 square miles, 13 of which are in Henrico County and the remainder within the corporate limits of the City of Richmond. The basin is largely rural with most of the land cleared and occupied by small farms. There is some residential development taking place at the present time and it would appear that this area would be highly susceptible to further development in the future.

Flood Problem

The main stream channels are relatively shallow in most places. Whenever unusual amounts of rainfall occur over the watershed, the channel capacity is exceeded, causing flow to take place in the adjacent overbank area. Flooding in the upper portion of the basin has gone practically unnoticed in the past due to the rural nature of the watershed. Significant flooding of the overbank areas unquestionably does occur and will become more apparent as the watershed develops and the naturally pervious areas are replaced with buildings, streets, sidewalks, and parking areas.

Remedial Measures

The general suggestions contained in the Emporia, Virginia report are contained in this one. In addition, it strongly urges that all applications to build on the flood plain be thoroughly investigated, and that efforts be made to situate the proposed structure at another location.

Roanoke River, Roanoke and Salem, Virginia (July 1968)

Immediate Danger

There are no existing, authorized or proposed flood control or related measures in the study area or upstream in the watershed, nor are there any

flood plain regulations in the Roanoke-Salem area, even though important public utilities, residential, commercial, and industrial establishments are located on the flood plains. In addition, as development continues and available high land becomes scarce, encroachment into the flood plains by housing developments, businesses, and other structures can be expected to occur.

Portions of this land have been inundated by floods of the past, and a much greater area, including residential, is within reach of the potentially greater floods of the future. The downtown business area of the City of Roanoke was almost flooded from the backwater of the Roanoke River during the 1940 flood, the greatest flood known to have occurred in the Roanoke River in the Roanoke-Salem area since 1900.

Remedial Measures

The adoption of flood plain regulations, and "flood-proofing" existing and proposed structures is suggested.

Coastal Flooding, Hampton, Virginia (October 1968)

The report covers tidal flooding associated with the occurrence of hurricanes (intense cyclonic windstorms of tropical origin in which the winds tend to spiral inward toward a core of low pressure, with maximum surface wind velocities that equal or exceed 75 mph for several minutes or longer at some points), and "northeasters" (cyclone which develops near the Atlantic Coast, intensifies and produces high wind, waves, tides, and rainfall along the coast). The flooding is caused by encroachment of ocean water upon the shoreline of the city.

Area Studied

Hampton, Virginia is located on the shore of Hampton Roads and Chesapeake Bay at the southeast end of the area known as the Lower Peninsula of Virginia. Hampton has a land area of 57 square miles and an inland water area of 15 square miles. More than half of the land area of Hampton is below elevation 13 and large areas of the city are below elevation 8. Spot elevations throughout the city indicate some development in areas as low as elevation 5. Flooding of low areas occurs frequently as a result of persistent and strong northerly or easterly winds over Chesapeake Bay and the Atlantic Ocean to the east of the area. Large areas of the city are flooded during "northeasters"

or hurricanes which cause water levels as high as elevation 8. Many areas would be isolated in an extreme storm, presenting a hazard to human life.

The greatest flood known in the Hampton Roads area occurred in August, 1933 as a result of a hurricane. Maximum tide heights during this flood averaged about elevation 8.0 in Hampton. The second largest flood of record occurred in March of 1962. The tide was about 1.2 feet lower than that of August, 1933 and occurred as the result of a northeast storm.

Remedial Measures

As the population increases, there will be an even greater demand for building sites in the city. Unless properly regulated, many of these sites could be on land vulnerable to serious flood damage. Adoption of flood plain regulations would not prevent the use of the area for parks and other open-type facilities that would not be damaged by flooding. Corrective measures could include flood proofing to make existing or proposed structures less vulnerable. This would involve permanently closing lower wall openings, waterproofing walls and floors, installing removable bulkheads over entrances, and other changes.

Mason Creek at Salem, Virginia (January, 1969)

Area Studied

Mason Creek flows through the eastern corporate limits of the City of Salem, Virginia, and drains an area of 31 square miles. The portion of Mason Creek that was studied generally flows in a southerly direction and extends from its confluence with Roanoke River upstream to Virginia State Highway 116, a distance of 4.95 miles.

Existing Flood Prevention Measures

There are no existing, authorized, or proposed flood control or related measures in the study area or upstream in the watershed, nor are there any flood plain regulations in effect in the Salem area.

Remedial Measures

The general suggestions contained in the Emporia, Virginia report are incorporated as part of this study.

Clarke County, Virginia (February, 1969)

This report was prepared for the Board of Supervisors of Clarke County to aid in the solution of local flood problems and in the best utilization of land subject to overflow. The study is based upon information on rainfall, runoff, historical and recent flood heights, and other technical data bearing upon the occurrence and size of floods on the Shenandoah River.

Area Studied

The Shenandoah River watershed covers a total area of 3,054 square miles. The watershed, approximately 195 miles long, varies in width from 9 miles at the mouth to 37 miles at the headwaters. It is bounded by the Blue Ridge Mountains on the east and Appalachian Mountains on the west. The watershed is almost completely rural, with only two percent of the land being developed for roads, parks, or low-density urban areas.

Flood Problem

The main flood seasons for the Shenandoah River are in early spring and the late summer and early fall. However, floods due to heavy, basin-wide rains may occur at any time during the year. Hazardous conditions would occur during large floods as a result of the high velocities and the great depth of flooding.

Existing Flood Prevention Measures

There are no existing, authorized, or proposed flood control or related measures in the study area nor upstream in the watershed which would have any effect on flood elevations in Clarke County. A county subdivision ordinance restricts division of land subject to periodic or occasional flooding.

Remedial Measures

The following measures could be taken to reduce damage on flood plains:

1. The flood plain could be zoned to correlate the use of the land with the likelihood of flooding at each level.

2. Structures on the flood plain should be "flood-proofed," (placing future improvements at safe heights, raising existing buildings, sealing openings or cracks to prevent the entry of water, etc.).

Chickahominy River at Henrico County, Virginia (December, 1968)

Area Studied

The Chickahominy River, with a drainage area of 169 square miles is the boundary between Henrico and Hanover Counties. The largest tributary is Upham Brook, which discharges into the river at mile 14 and has a drainage area of 39 square miles. This area includes the west end of Richmond and parts of the rapidly expanding subdivision and residential areas of Henrico County.

Flood Problem

Flood damages within the Chickahominy Basin could be substantial if development within the flood plain is not controlled by the local governments involved. The velocities during flooding conditions are relatively low, but due to the excessively wide flood plain from U. S. Route I to Bottoms Bridge, a large area would be flooded, thus, causing extensive damages to any development within the basin.

Existing Flood Prevention Measures

There are no existing, authorized, or proposed flood control measures which will give positive protection to property in the study area. An ordinance concerning building upon land subject to inundation is contained in the Henrico County Code.

Remedial Measures

The general suggestions contained in the summary of the Emporia, Virginia report are incorporated into this study.

APPENDIX VI

Tennessee Valley Authority Plans for Flood Damage Prevention

Floods on Beaver Creek, Bristol, Virginia-Tennessee (November 1961)

Watershed and Flood Plain

Beaver Creek, a small tributary of the South Fork of the Holston River, flows through the center of Bristol. Mumpower Creek, a tributary, flows through the northwest portion of the city and joins Beaver Creek at the downstream edge of the business district. Above Mumpower Creek, Beaver Creek has a drainage area of 35.4 square miles. Mumpower Creek adds 8.8 square miles to the watershed.

The flood plains through Bristol are built up largely with substantial commercial buildings. The natural creek channels are greatly constricted by bridges and buildings and by the covered portion of Beaver Creek which is now a section of Piedmont Street. Much of Bristol's central business district is less than 10 feet above the bed of Beaver Creek. Low flow is normally 1 to 2 feet deep, so that rises of as little as 5 feet above low water will flood the intersection at Moore and Sycamore Streets.

Floods

The greatest known flood at Bristol was that of March, 1867, and the most recent large flood was in July, 1929. A Regional Flood on Beaver Creek, based upon floods experienced within about 100 miles of Bristol, would be generally 2 to 13 feet higher than the 1929 flood level. On Mumpower Creek the Regional Flood would be as much as 10 feet higher than the March, 1955 flood levels.

Maximum Probable Flood determinations indicate that floods could occur on Beaver Creek at Bristol 6 to 21 feet higher than the 1929 flood. A maximum Probable Flood on Mumpower Creek could reach stages 7 to 14 feet higher than in 1955. Floods of these magnitudes could be expected to occur only rarely.

Plan for Flood Relief

Of all the structural methods considered for control of Beaver Creek floods at Bristol, reservoirs of the detention type offer the most feasible means of

providing the amount of flood relief that is economically justified at Bristol at the present time. The investigation of the watershed of Beaver Creek above Bristol showed that it would be possible to construct two detention reservoirs that would completely control the runoff from 19.5 square miles during the Maximum Probable Flood. The controlled area is 55 percent of the drainage basin above the mouth of Mumpower Creek.

Plan for Flood Damage Prevention, Bristol, Tennessee-Virginia (July 1962)

This plan for flood damage prevention was prepared by the Flood Study Commission of Bristol, Tennessee-Virginia, with the assistance of TVA and the Tennessee State Planning Commission.

Conclusions and Recommendations

The Bristol Flood Study Committee concluded that there was a very serious flood problem at Bristol which threatens the life, health, security, and property of the citizens of the city and the region. The Committee recommends adoption of the following plan for preventing or greatly reducing the flood damage potential.

1. Construct two flood detention reservoirs, Upper Beaver and Clear Creek, on Beaver Creek and its tributary above Bristol.

2. Complete the channel enlargement of Beaver Creek downstream from the mouth of Mumpower Creek to about mile 13.7, so as to connect the sections being improved by the highway department.

3. Enlarge the channel of Mumpower Creek to a bottom width of 25 feet and I on I.5 side slopes from the mouth of the creek upstream to the Commonwealth Avenue bridge.

4. Encourage and assist owners or occupants of property on the flood plains to flood proof structures.

5. Revise the Zoning Ordinance, Subdivision Regulations, and Building Code to provide controls over uses of the flood plain areas.

6. Incorporate plans for flood damage prevention in the redevelopment of the area.

Floods on Clinch River and Tributaries, Richlands, Virginia (May 1964)

This report on the flood situation in the vicinity of Richlands, Virginia, covers the Clinch River from a point upstream from Cedar Bluff, through Richlands and Doran to a point downstream from Raven, and those portions of Indian Creek and Big Creek which are within the corporate limits of Cedar Bluff and Richlands.

Watershed and Flood Plain

From the upstream corporate limits of Cedar Bluff through Cedar Bluff, Richlands, Doran, and Raven, the Clinch River follows a winding course for 10 miles. The upstream 1.5 miles of the river have a steep slope and narrow flood plains, but the lower 8.5 miles have a rather flat, uniform slope and flood plains that vary in width up to 3000 feet. Many sections of these flood plains are highly developed and in the 10-mile reach of the river over 300 homes, 50 commercial establishments, and one factory are subject to flooding.

Indian Creek, along the 1.2 miles upstream from the mouth, has a relatively flat slope and flood plains up to 500 feet wide. On these plains 42 homes and three commercial establishments are subject to flooding. Along the 1.4 miles of Big Creek within the limits of Richlands the slope of the stream is quite steep and flood plains are narrow but almost 100 homes and 10 commercial establishments line the creek and are subject to flooding. Also in Richlands, approximately 36 homes along Town Hill Creek, and in Raven, 24 homes along Coal Creek, are subject to flooding. The numerous highways and railroad bridges crossing Clinch River have in many instances encroached upon the natural waterway that was once available for flood flows.

Floods

The largest known flood on the Clinch River at Richlands occurred in June 1901, but the flood of January 29, 1957, was less than two feet lower, and at Raven was higher by one-half foot than the 1901 flood. The 1957 flood was also a major flood on Indian Creek and Big Creek but is known to have been exceeded by the 1901 flood on Indian Creek.

The Regional Flood (derived from consideration of the largest floods known to have occurred on streams whose watersheds have similar physical characteristics and are located in the same general geographic region as that of

Richlands, and within 90 miles of Richlands,) would be 2.2 feet higher than the January 1957 flood at Richlands, 2.2 feet higher at the mouth of Indian Creek, and 2.6 feet higher at the mouth of Big Creek.

The Maximum Probable Flood would crest 12.8 feet higher than the January 1957 flood at Richlands, 4.8 feet higher at the mouth of Indian Creek, and 4.6 feet higher at the mouth of Big Creek. Floods of these magnitudes could be expected to occur only rarely.

Floods on Clinch River, Cleveland, Carbo, and Carterton, Virginia (May 1964)

Watershed and Flood Plain

This study was prepared at the request of the Town Council of Cleveland, Virginia. It gives consideration to the plight of two other Russell County communities, Carbo and Carterton, located on or near the narrow flood plain of the Clinch River. These communities are situated at approximately four-mile intervals, some 264 to 272 miles above the mouth of the stream. The river watershed above Cleveland, the farthest upstream of the three, is 528 square miles.

In the 11-mile reach investigated, the tops of the river banks average 15 to 20 feet above the stream bed, although narrow first bottoms overflow in some places at 7 to 10 feet above the river bed. The flood plains shift from one side of the river to the other and they are rarely as much as 500 feet wide. One of the widest flood areas is on the left bank in Cleveland where overflow in 1957 spread out for 400 to 800 feet through the business section in the vicinity of Clinch Avenue and Virginia Highway 82.

Development on the flood plain is largely limited to homes and business places in Cleveland and to the recently completed steam plant of the Appalachian Electric Power Company near Carbo. Past large floods such as the record one in 1957 inundate portions of the business and residential sections of Cleveland and part of the steam plant area. Existing developments in Carbo and Carterton are generally above the level of such floods. The principal obstructions to flood flows in the reach investigated are the buildings in the flood plain at Cleveland, the Clinchfield Railroad bridge, and the Carbo Steam Plant.

Floods

The greatest flood in the past 100 years on the Clinch River occurred above Carterton on January 30, 1957. The Regional Flood on the Clinch River is based upon floods experienced on streams generally within 60 miles of the Cleveland vicinity, many of which are larger than any known flood on the upper Clinch River. This indicates that greater floods than those experienced so far may reasonably be expected on the river. Based on the magnitude of floods that have occurred on the neighboring streams, future floods may occur on the Clinch River in the Cleveland vicinity about 4 to 8 feet higher than the 1957 flood.

Maximum Probable Flood determinations indicate that a flood could occur on the Clinch River at Cleveland and vicinity 12 to 16 feet higher than the 1957 flood. Floods of this magnitude would be expected to occur only rarely.

Floods on Clinch River and Stock Creek, Clinchport, Virginia (March 1966)

This report relating to the flood situation along the Clinch River and Stock Creek in the vicinity of Clinchport, Virginia, has been prepared by TVA at the request of the Council of the Town of Clinchport and the Lee-Norton-Scott-Wise Redevelopment Authority.

Watershed and Flood Plain

Clinchport, Virginia, is located on the Clinch River eleven miles above the Tennessee-Virginia state line. Stock Creek, a tributary with a drainage area of 31.2 square miles, joins the Clinch River within the corporate limits of Clinchport. The drainage area of Clinch River above the lower limit of the reach studied is 1,126 square miles.

The principal residential and commercial development of Clinchport is on the flood plain of the river, and there are considerable commercial and residential developments on land along Stock Creek. Railroads and highways cover much of the remaining flood plain. Much of this land has been inundated by floods of the past, and a substantially greater area is within reach of the greater floods of the future.

Floods

The March, 1963 flood on Clinch River was a large flood about 2 feet higher than the flood in February, 1961. Regional Floods on the Clinch River and Stock Creek in the vicinity of Clinchport are based upon floods experienced on streams within 90 miles of the community, a number of which are larger than any known floods on the two streams. This indicates that greater floods than those experienced so far may reasonably be expected in the future. Based upon the magnitude of floods that have occurred on neighboring streams, a Regional Flood may occur on Clinch River that would be generally 6 to 7 feet higher than the March 12, 1963 flood. On Stock Creek a Regional Flood would be 4 to 19 feet higher than the February, 1961 flood.

Maximum Probable Flood determinations indicate that floods could occur on Clinch River in the vicinity of Clinchport about 17 to 19 feet higher than the March, 1963 crest. A Maximum Probable Flood on Stock Creek would be 9 to 23 feet higher than the February, 1961 flood. Floods of these magnitudes could be expected to occur only rarely.

Floods on Clinch River, Russell County, Virginia (September 1960)

This report relating to the flood situation along Clinch River in Russell County, 244 to 314 miles above the mouth of the stream. In the 70-mile reach of the river there are seven communities situated on or near the flood plain--St. Paul, Castlewood, Carterton, Carbo, Cleveland, Artrip, and Swords Creek.

Watershed and Flood Plain

Through much of Russell County the banks of the river are 15 to 20 feet above the stream bed, although narrow first bottoms overflow will occur in some places at 7 to 10 feet above the river bed. Along the steep section of the river from Lewis Creek to Nash's Ford there are many sheer rock bluffs rising from the river as much as 500 feet. The flood plains shift from one side of the river to the other and they are rarely as much as 800 feet in width. One of the widest flood areas is on the left bank at Cleveland where overflow in 1957 spread out for 400 to 800 feet through the business section.

Within the Russell County limits, eight tributaries of consequence flow into the Clinch River. The largest of these is Little River entering from the south side five miles downstream from the community of Swords Creek.

Development on the flood plain in the 70-mile reach investigated is largely limited to homes and business places in the communities and to the steam plant of the Appalachian Electric Power Company near Carbo. Past large floods such as the record one in 1957 inundated portions of the business and residential sections of the towns and parts of the steam plant area. Existing developments in Carbo and Carterton are generally above the level of such floods.

Floods

The greatest flood in the past 100 years on the Clinch River above Carterton, Virginia, occurred on January 30, 1957. The Regional Flood on the Clinch River is based on floods experienced on streams generally within 90 miles of Russell County, many of which are larger than any known flood on the upper Clinch River. This indicates that greater floods than those experienced so far may reasonably be expected on the river. Based on the magnitude of floods that have occurred on neighboring streams, future floods may occur on the Clinch River in Russell County 4 to 8 feet higher than the 1957 flood.

Maximum Probable Flood determinations indicate that a flood could occur on the Clinch River in Russell County 7 to 17 feet higher than the 1957 flood. Floods of this magnitude would not be expected to occur frequently.

Floods on Clinch River and Stony Creek, Dungannon and Fort Blackmore, Virginia (May 1964)

This report relates to the flood situation along Clinch River and its tributary, Stony Creek, in the vicinity of Dungannon and Fort Blackmore, Virginia. It has been prepared by TVA at the request of the Mayor and Town Council of Dungannon.

Watershed and Flood Plain

Dungannon and Fort Blackmore are located on the Clinch River some 230 miles above the mouth of the river in the northeast corner of Scott County. Both towns are situated on the right side of the river. Dungannon's corporate limits lie between Miles 236.5 and 237.5, while the unincorporated town of Fort Blackmore is built on the combined flood plains of Stony Creek and the Clinch River near Mile 227.5 to 228.0. This investigation covers the Clinch River flood plain from Mile 224.6 upstream to 238.0 and the Stony Creek flood plain from the mouth upstream to Mile 3.8. The total area of the Clinch River watershed above the confluence with Stony Creek is 852 square miles. The Stony Creek watershed adds 41.5 square miles.

The corporate limits of Dungannon follow the right side of the Clinch River for approximately 1 mile, but most of the city is above flood danger. Fort Blackmore is situated near the confluence of Stony Creek and the Clinch River. Homes and stores in the community are affected by backwater from the river as well as by floods on the creek. Except for these localities, most of the flood plain of the river and Stony Creek in the reach investigated is in agricultural use.

Floods

The largest flood in 105 years of record on the Clinch River in the vicinity of Dungannon and Fort Blackmore occurred in February 1862. This overflow covered wide areas of the flood plain to depths up to 10 feet. The greatest known flood on Stony Creek was that of January 28, 1918. The creek on that date submerged the flood plain in Fort Blackmore to depths up to 5 feet.

A Regional Flood on the Clinch River in the Dungannon and Fort Blackmore vicinity, based upon floods experienced within 75 miles of this locality, would be generally 1 to 3 feet higher than the 1862 flood level. Along the lower 1.6 miles of Stony Creek at Fort Blackmore, a headwater Regional Flood would be 1 to 1.5 feet above the 1918 flood. In the lower 0.3 mile of the creek, backwater from the Regional Flood on the Clinch River would be as much as 6 feet higher than the actual 1918 flood level.

Maximum Probable Flood determinations indicate that floods could occur on the Clinch River in the Dungannon and Fort Blackmore vicinity 6 to 13 feet higher than the 1862 flood. A headwater Maximum Probable Flood on Stony Creek in the lower 1.6 miles would be 3 to 8 feet higher than the 1918 headwater flood. At Fort Blackmore along the lower one-half mile of Stony Creek, backwater from a Maximum Probable Flood on the Clinch River would be as much as 15 feet higher than the 1918 flood level in this reach.

Floods on Clinch River and Tributaries, St. Paul, Virginia (May 1964)

This report of the flood situation along the Clinch River in the vicinity of St. Paul and Castlewood, Virginia, has been prepared by TVA at the request of the Mayor and Town Council of St. Paul.

Watershed and Flood Plain

Floods in the vicinity of St. Paul and Castlewood are chiefly the result of high water on the Clinch River, which drains 590 square miles above Castlewood.

In the past, floods on Lick Creek have caused only minor damage in St. Paul.

Much of the commercial development in recent years at St. Paul and residential development in both St. Paul and Castlewood are located in the flood plain of the Clinch River. These commercial and residential areas have all been inundated during large floods. The main highway through St. Paul and the highway crossing the river at Castlewood are blocked by overflow and local traffic is interrupted in both towns during periods of high water.

At St. Paul, the many buildings on the flood plain, the fill that has occurred, and the highway bridge have materially encroached upon the natural waterway that was once available for flood flows. As a result, flood heights are higher than they would be under prior natural conditions.

Floods

The largest known flood on the Clinch River in the vicinity of St. Paul occurred in February 1862. The water level which occurred in January, 1957, was one foot below this 1862 flood at St. Paul. However, 9 miles upstream above Carterton the 1957 waters exceeded the height of the water in 1862.

The Regional Flood (derived from consideration of the largest floods known to have occurred on streams whose watersheds have similar physical characteristics and are located in the same general geographic region as that of St. Paul) would crest 6.3 feet higher than the 1957 flood. The Maximum Probable Flood would crest 15.1 feet higher than the 1957 flood.

Floods on Powell River and South Fork Powell River, Big Stone Gap, Virginia (April 1965)

This report, prepared by TVA, relates to the flood situation along Powell River (principal tributary of the Clinch River) and the South Fork of the Powell River in the vicinity of Big Stone Gap, Virginia.

Watershed and Flood Plain

Big Stone Gap is located at the confluence of the Powell and the South Fork of the Powell Rivers 63 miles above the Tennessee-Virginia state line and 178 miles above the mouth of the Powell River in Norris Reservoir. The Big Stone Gap corporate limits extend for 3.68 miles along Powell River, and from the mouth to Mile 3.64 along the South Fork of the Powell River.

This investigation covers the Powell River from Mile 175.2 to Mile 180.3, and the South Fork of the Powell River from the mouth to Mile 6.1. The total drainage area of the Powell River above the lower limit of the reach studied is 157 square miles.

Most of the business and residential development of Big Stone Gap is on high ground between the two rivers and on the north side of the Powell River, but there are important commercial and residential developments on land along both the Powell and the South Fork of the Powell Rivers. Portions of this land have been inundated by floods of the past, and a substantially greater area is within reach of the greater floods of the future.

Floods

The largest flood of record (124 years) on the Powell River and its South Fork at Big Stone Gap occurred January 28, 1918. This flood was as much as 12 feet over the riverbanks below the junction of the two rivers, and the overflow along the Powell River reached widths up to 1600 feet.

Regional Floods on Powell River and South Fork Powell River in the vicinity of Big Stone Gap are based upon floods experienced on streams within 75 miles of the community, a number of which are larger than any known floods on the two streams. This indicates that greater floods than those experienced so far may reasonably be expected in the future. Based upon the magnitude of floods that have occurred on neighboring streams, a Regional Flood may occur on the Powell River that would be generally 2 feet higher than the January 1918 flood. On the South Fork of the Powell River a Regional Flood would be about 4 feet higher than the January, 1918 flood.

Maximum Probable Flood determinations indicate that floods could occur on the Powell River in the vicinity of Big Stone Gap about 14 feet higher than the 1918 flood crest. Maximum Probable Floods on the South Fork of the Powell River would be about 10 feet higher than the January 1918 flood.

Floods on Powell River and Callahan Creek, Appalachia, Virginia (November 1964)

This report, prepared by TVA at the request of the Council of the Town of Appalachia, relates to the flood situation along Powell River and Callahan Creek.

Watershed and Flood Plain

Appalachia is located on the Powell River three miles above Big Stone Gap, Virginia. Callahan Creek, a tributary with a drainage area of 28.9 square miles, joins the Powell River within the corporate limits of Appalachia. The corporate limits extend 1.36 miles along Powell River, and from the mouth to Mile 0.48 along Callahan Creek. This investigation covers the Powell River from Mile 181.60 to Mile 184.80 and Callahan Creek from the mouth to Mile 1.76. The drainage area of Powell River above the lower limit of the reach studied is 108 square miles.

Much of the residential development of Appalachia is on high ground above flood danger, but most of the commercial and some residential development are along the narrow flood plain of the Powell River. The Callahan Creek flood-plain lands are occupied by commercial and residential development, railroads, and highways. Portions of this land have been inundated by floods of the past and a substantially greater area is within reach of the greater floods of the future.

Floods

The flood which occurred on January 28, 1918, was the largest known for the Powell River and Callahan Creek in the vicinity of Appalachia. The height of the water on May 12, 1963 was only two feet lower than the 1918 flood.

Regional Floods on Powell River and Callahan Creek in the vicinity of Appalachia are based upon floods experienced on streams within 60 miles of the community, a number of which are larger than any known floods on the two streams. This indicates that greater floods than those experienced so far may reasonably be expected in the future. Based upon the magnitude of floods that have occurred on neighboring streams, a Regional Flood may occur on Powell River that would be generally 6 feet higher than the March, 1963 flood. On Callahan Creek a Regional Flood would be about 4 feet higher than the March, 1963 flood at the upper limit of the study near Andover and about 12 feet higher near the mouth.

Maximum Probable Flood determinations indicate that floods could occur on Powell River in the vicinity of Appalachia about 15 feet higher than the March, 1963 flood crest. A Maximum Probable Flood on Callahan Creek would be about 5 to 17 feet higher than the March, 1963 flood.

Floods on Middle Fork Holston River and Staley Creek, Marion, Virginia (May 1961)

This report, prepared by TVA at the request of the Town Council of Marion, relates to the flood situation along the Middle Fork of the Holston River and Staley Creek near Marion, Virginia.

Watershed and Flood Plain

Marion is located on both sides of the Middle Fork of the Holston River 40 miles above its junction with the South Fork, and Staley Creek with its center near the mouth of Staley Creek. The Middle Fork of the Holston River flows generally westward through the 5.2-mile reach of river covered by this report. The region is mountainous, and bottom lands subject to flooding along the river vary up to 0.25 mile in width. Bottom lands along the creek are narrow, seldom exceeding 1,000 feet in width. Through most of the reach of the river and of the creek, homes and business establishments are on the flood plains on both sides of the streams and are subject to overflow during large floods. Some 3.5 miles of the river are within the corporate limits of Marion, and much of the development is on the flood plain. However, a substantial part of the residential, commercial, and industrial growth of the area has been in the flood plain of Staley Creek.

Floods

The greatest flood known to have occurred in 102 years of record for the Middle Fork of the Holston River in the vicinity of Marion was in March 1867. This flood overtopped the banks 2 to 8 feet spreading to a width of 500 feet. Records on Staley Creek are available for only a 45 year period. The record flood occurred on August 4, 1947, when waters up to 5 feet in depth caused damage to homes and businesses in Marion. The flood of January 29, 1957, came within 3 feet of the March 1867 crest on the Middle Fork of the Holston River at the Seven Mile Ford gage.

Flood damages that would result from recurrences of such floods as that of 1867 on the Middle Fork of the Holston River and August, 1947 on Staley Creek would be substantial under present-day conditions of development. Such floods would inundate much of the flood plain, destroying crops, flooding homes and business places, and damaging roads.

Regional Floods on the Middle Fork of the Holston River and Staley Creek are based upon floods experienced on streams within 75 miles of Marion,

many of which are larger than any known floods on these streams. Based upon the magnitude of floods that have occurred on the neighboring streams, a Regional Flood may occur at Marion under present conditions on the Middle Fork of the Holston River 3 to 12 feet higher than the January 1957 flood. Similarly, the Regional Flood on Staley Creek would be 2 to 9 feet higher than the August, 1947 flood.

Maximum Probable Flood determinations indicate that floods could occur on the Middle Fork of the Holston River at Marion 9 to 28 feet higher than the 1957 flood. A Maximum Probable Flood on Staley Creek could reach stages 4 to 14 feet higher than in 1947.

Floods on Big Moccasin Creek and Little Moccasin Creek, Gate City, Virginia (May 1967)

This report, prepared by TVA at the request of the Mayor and Council of Gate City and the Lee, Norton, Scott, Wise Planning and Economic Development Commission, relates to the flood situation along Big Moccasin Creek and Little Moccasin Creek in the vicinity of Gate City.

Watershed and Flood Plain

Gate City is located along Little Moccasin Creek, a tributary of Big Moccasin Creek which flows into the North Fork of the Holston River 10 miles above its confluence with the South Fork of the Holston River near Kingsport, Tennessee. Big Moccasin Creek has a drainage area of 94.7 square miles, about equally divided between Scott and Russell Counties. Little Moccasin Creek has a drainage area of 10.1 square miles, all of which is in Scott County.

Much of the residential and commercial development of Gate City is located on the flood plains of Little Moccasin Creek. Weber City residential and commercial developments are located on land along Big Moccasin Creek. Portions of this land have been inundated by floods of the past, and a substantially greater area is within reach of the greater floods of the future. Several highway and railway bridges which cross both creeks would cause floodwater constrictions and increased water heights during a Regional Flood.

Floods

The largest flood of record occurred on Big Moccasin Creek in the vicinity of Gate City on March 12, 1963. High waters occurred on Little Moccasin Creek on this same date but were 2 to 4 feet below the flood of May 30, 1927.

Regional Floods on Big Moccasin and Little Moccasin Creeks in the vicinity of Gate City are based upon floods experienced on streams within 60 miles of the city, a number of which are larger than any known floods on the two streams. Based upon the magnitude of floods that have occurred on neighboring streams, a Regional Flood may occur on Big Moccasin Creek in the reach investigated that would be from 8 to 20 feet higher than the March, 1963 flood.

Maximum Probable Flood determinations indicate that floods could occur on Big Moccasin Creek that would exceed the 1963 flood in the vicinity of Gate City by 11 to 22 feet, averaging 16 feet higher. The Maximum Probable Flood on Little Moccasin Creek would be 5 to 12 feet higher than the March, 1963 flood, averaging 10 feet higher in Gate City.

Floods on Laurel and Beaverdam Creeks, Damascas, Virginia (June 1967)

Watershed and Flood Plain

Flood problems at Damascus are the result of excess water flowing in two streams, Laurel Creek and its tributary, Beaverdam Creek, which enters Laurel Creek within the town limits of Damascus. Flooding of parts of the city may result from overflows from either or both of these creeks. A part of Damascus along Beaverdam Creek is subject to flooding by water which leaves the channel at a moderately low flood stage and flows down one of the main streets for a considerable distance before returning to the creek.

Floods

According to the best available information, the flood of May, 1901 is the largest known to have occurred on both Laurel and Beaverdam Creeks in the vicinity of Damascus since settlement of the town. The record was approached by the flood which occurred in mid-August, 1940, the latter being about one foot lower. The floods of March, 1955; April, 1956; and January 1957, all approached the 1940 flood height.

TVA has prepared a table of relative flood heights of the 1901 flood, the 1957 flood, the Regional Flood (based upon floods experienced on streams within 75 miles of the community), and the Maximum Probable Flood.

Floods on Guest River, Norton, Virginia (May 1958)

Watershed and Flood Plain

The Guest River, a tributary of Clinch River, has a drainage area at the lower end of Norton of 48.9 square miles. The river is relatively shallow so the river banks are overtopped at stages 4 to 10 feet above the stream bed. The city limits include 4.0 miles of the Guest River resulting in a highly developed flood plain.

Floods

The largest flood known to have occurred at Norton was on January 28, 1918. The water covered the flood plain on the Guest River to widths ranging from 100 to 800 feet. The maximum probable flood discharges will be about 4 times the discharge during the January 1918 flood. Floods of this magnitude are expected to occur only rarely.

APPENDIX VII

Soil Conservation Service Watershed Work Plans

Roanoke Creek Watershed, Charlotte County, Virginia (April 1959)

This watershed work plan was prepared with the Southside Soil Conservation District, Charlotte County Board of Supervisors, and the towns of Keysville and Drakes Branch, with the Soil Conservation Service and the Forest Service participating.

Summary of Plan

The Roanoke Creek Watershed, consisting of 141,900 acres, lies in the eastern half of Charlotte County. The towns of Keysville, Drakes Branch, and Charlotte Court House, the county seat, are included in the watershed. Other smaller communities include Saxe, Randolph, and Cullen. Present land use of the watershed is 31,942 acres cropland (including permanent hay), 12,941 acres pasture land, 90,803 acres woodland (all privately owned), 4,240 acres idle and brush, and 1,974 acres miscellaneous. Due to flooding, little of the flood plain is in crop production.

The major problems in the watershed are: erosion of the uplands; inundation of the flood plain; flood damage to highways, railroads, buildings and bridges, farm roads and similar fixed improvements; inadequate water supply for the town of Keysville; and anticipated need for additional municipal water for the town of Drakes Branch.

The plan is for an accelerated land treatment program; seventeen floodwater retarding structures (earth dams), three of which are dual-purpose structures including two for municipal water storage (200 acre-feet for Keysville and 2,350 acre-feet for Drakes Branch) and one for irrigation water; and 55.6 miles of channel improvement. It is anticipated that the plan will be completed in five years at a total cost of $2,306,355.

Supplement No. 3

Supplement No. 1 of the work plan, executed in March, 1960, defined in greater detail the responsibilities of various sponsoring local organizations. Supplement No. 2 of the work plan executed in January 1961 changed the location of floodwater retarding structure No. 4A and added channel improvement.

The purpose of Supplement No. 3 to the work plan is to reduce the amount of non-agricultural water management storage in dam No. 72A. Recent changes in a local industry in the town of Drakes Branch have greatly reduced the town's water requirements.

Gap Run Watershed, Rockingham County, Virginia (July 1959)

This watershed work plan was prepared by the Shenandoah Valley Soil Conservation District with the assistance of the Soil Conservation Service, the U.S. Forest Service and the Virginia Division of Forestry.

Summary of Plan

The Gap Run Watershed comprises 5,130 acres in the eastern portion of Rockingham County. Located on the watershed is a small rural community, Yance (locally called Berrytown). Present land use of the watershed is 3,950 acres of forest land, 667 acres of cropland, 165 acres of pasture, and 438 acres miscellaneous.

Flooding and swamping from overland flows in Berrytown is the primary problem on the watershed. This problem will be reduced by accelerating the land treatment program and by installing a diversion, two wire-basket type grade control structures, a drop inlet for grade control, and an approach channel to the drop inlet, and by channel improvements below Berrytown. It is anticipated that the plan will be completed in three years at a total cost of $33,436.

Buffalo Creek Watershed, Prince Edward County, Virginia (October 1959)

This watershed work plan for Buffalo Creek Watershed was prepared by the Piedmont Soil Conservation District with the Soil Conservation Service and Forest Service participating.

Summary of Plan

The watershed comprises an area of approximately 74,700 acres lying in the western third of Prince Edward County. The town of Farmville, the villages of Pamplin and Prospect, and Hampden Sydney College are included in the watershed. In 1958 the land was used as follows: 52,290 acres in woodland, 13,070 acres in crop rotation, 4,105 acres in grassland, 4,485 acres in idle land, 750 acres miscellaneous, including roads, homesteads, towns, and streams.

The major problems in the watershed are: erosion of the uplands (although in recent years much has been done to alleviate the situation a considerable quantity of sediment is still being produced and deposited in the stream channels); scouring, deposition and swamping on the bottomlands; and flooding damage to crops and pasture, fences, farm roads and bridges, public highways, and other improvements in the flood plain. These problems will be reduced by the acceleration of the land treatment program and by the installation of nine floodwater retarding earth dams and 2,548 miles of channel improvement. It is anticipated that the plan will be completed in five years at a total cost of $1,369,673.

Marrowbone Watershed, Henry County, Virginia (October 1959)

This work plan for the Marrowbone Watershed was prepared by the Blue Ridge Soil Conservation District and Henry County Board of Supervisors with the Soil Conservation Service and Forest Service participating.

Summary of Plan

Marrowbone watershed as set forth in this plan drains 19,300 acres in Henry County. The present land use distribution is 4,150 acres of cropland, 2,123 acres of grassland, 11,580 acres of woodland and 1,447 acres miscellaneous and idle. The town of Ridgeway is the only town within the watershed boundary. There are also the settlements of English Village, Mason Heights, Glen Court, and Marrowbone Heights which are newly-created housing developments.

The major problems in the watershed are: flooding of highways, bridges, and farm roads, and sheet erosion of the uplands. The plan provides for an accelerated land treatment program for watershed protection; 17.77 miles of roadside erosion control; land treatment for flood prevention; one floodwater-retarding structure; and 4.56 miles of channel improvement. It is anticipated that the plan will be completed in five years at a total cost of $253,534.

Leatherwood Creek Watershed, Henry and Franklin Counties, Virginia (March 1960)

The work plan for watershed protection and flood prevention for the Leatherwood Creek Watershed was prepared by the Blue Ridge Soil Conservation District and the Henry County Board of Supervisors, the sponsoring organizations.

Summary of Plan

The watershed covers an area of 43,800 acres located in Henry and Franklin Counties. Approximately 16 percent of the watershed is in cropland, 8 percent in grassland, 70 percent in woodland and 6 percent idle and miscellaneous. There are no incorporated towns in the area but included are the settlements of Woodlawn Heights, Chatmoss Corporation, and other thickly settled areas along the tributaries.

The major problems in the watershed are the erosion of the uplands with resultant sediment damages and the flood problem on the flood plain. Over 600 acres of crops and pastures, highways and farm fences are intermittently damaged by floods and some of the bridges are occasionally made impassable.

These problems will be helped by the acceleration of the land treatment program and the installation of five floodwater-retarding structures (earth dams) and 16.18 miles of channel improvement. It is expected that the plan will be completed in five years at a total installation cost of $726,580.

Beaver Creek Watershed, Albemarle County, Virginia (March 1960)

The work plan for watershed protection and flood prevention for the Beaver Creek watershed was prepared by the Thomas Jefferson Soil Conservation District and the Albemarle County Board of Supervisors, the sponsoring organizations.

Summary of Plan

The watershed covers an area of 7,010 acres, located in Albemarle County. The town of Crozet is located on the southern boundary of the watershed. The present land use is 2,519 acres of woodland, 2,615 acres of grassland, 1,518 acres of cropland, and 358 acres miscellaneous. There are 126 acres of bottomland in the Beaver Creek Watershed that are subject to flooding.

The major problems in the watershed area are: erosion of the uplands; flooding, scouring and overbank deposition of the flood plain; flooding of farm roads, bridges, and other fixed improvements on the flood plain; and inadequate water supply for Albemarle County. Frequent flooding prevents the proper management of the highly productive soils of the flood plain. Beaver Creek overflows its banks on an average of twice a year, causing varying damages depending on depths of flooding and seasons.

The plan provides for an acceleration of the land treatment program for watershed protection and one multiple-purpose dam for flood prevention and county water storage (1600 acre-feet for domestic use). It is anticipated that the plan will be completed in three years at a total cost of $214,827.

Muddy Creek Watershed, Buckingham County, Virginia (September 1960)

This watershed work plan was prepared by the Robert E. Lee Soil Conservation District and the Buckingham County Board of Supervisors, the sponsoring organizations.

Summary of Plan

The Muddy Creek Watershed, consisting of 7,450 acres, is located in the north central section of Buckingham County. Approximately 16 percent of the watershed is in cropland, 14 percent in grassland, 65 percent in woodland, and 5 percent idle and miscellaneous.

The major problems in the watershed are the erosion of the uplands with resultant sediment damages and the flooding of flood plain lands. These problems will be helped by the acceleration of the land treatment program and the installation of two floodwater retarding structures (earth dams) and 5.9 miles of channel improvements. It is expected that the plan will be completed in three years at a total installation cost of $154,615, and a benefit-cost ratio of 1.49 to 1.00.

Little River Watershed, Louisa County, Virginia (May 1961)

The work plan for watershed protection and flood prevention for the Little River watershed was prepared by the Thomas Jefferson Soil Conservation District and the Louisa County Board of Supervisors, the sponsoring organizations.

Summary of Plan

The watershed covers an area of approximately 30,500 acres located in Louisa County. Approximately 15 percent of the watershed is in cropland, 11 percent in grassland, 71 percent in woodland, and 3 percent idle and miscellaneous.

The major problems in the watershed are the erosion of the uplands with resultant sediment damages and the flooding of flood plain lands. Most of the flood plain soils of the watershed are potentially productive. The main limiting factor is the high water table and frequent flooding caused by the swamped-out condition of the flood plain and the clogged channel.

These problems will be helped by the acceleration of the land treatment program and the installation of four floodwater retarding structures and 8.8 miles of channel improvement. The land treatment program (watershed protection and flood prevention) has a benefit-cost ratio of 1.0 to 10.0. The floodwater retarding structures (four earth dams constructed to provide sediment storage for the 50-year evaluation period of the project and to provide floodwater storage) have a benefit-cost ratio of 1.5 to 1.0. It is expected that the plan will be completed in five years at a total installation cost of $603,853, and a benefit-cost ratio of 1.4 to 1.0.

Beautiful Run Watershed, Madison County, Virginia (March 1962)

The work plan for watershed protection and flood prevention for the Beautiful Run Watershed was prepared by the Culpeper Soil Conservation District, the sponsoring organization.

Summary of Plan

The watershed is comprised of an area of approximately 13,800 acres located in Madison County. Of the total watershed, 23 percent is in cultivation, 37 percent pasture, 38 percent woodland, and 2 percent idle and miscellaneous. There are no towns or villages located in the watershed; however, there are a number of small rural communities located on the perimeter of the watershed.

The major problems in the watershed are: the erosion of the uplands and flooding, scouring and overbank deposition of cropland and pasture in the flood plain. These problems will be reduced by the acceleration of the land treatment program and the installation of nine flood water retarding structures and 4.78 miles of channel improvement.

The land treatment measures included in the plan will improve hydrologic cover conditions and decrease runoff, erosion, and sediment production. The nine earth dams will each have a sediment storage capacity equivalent to the estimated sediment accumulation for a 50-year period, and a combined sediment storage capacity of 350 acre-feet with a total sediment pool surface area of 54.3 acres.

It is expected that the installation of the works of improvement will be completed in five years at a total installation cost of $377,510 and will have a benefit-cost ratio of 1.2 and 1.0.

White Oak Run Watershed, Madison County, Virginia (May 1962)

The work plan for watershed protection and flood prevention for the White Oak Watershed was prepared by the Culpeper Soil Conservation District and the town of Madison, the sponsoring organizations.

Summary of Plan

The watershed comprises an area of approximately 11,130 acres. It is located in the central portion of Madison County and includes a small part of the town of Madison. The approximate land use is 27 percent pasture, 27 percent in cultivation, 41 percent woodland, and 5 percent idle and miscellaneous.

The major problems in the watershed are: the erosion of the uplands; flooding, scouring and overbank deposition of cropland and pasture in the flood plain; flooding of highways, farm roads, a furniture factory, and other fixed improvements upon the flood plain; and an inadequate water supply for the town of Madison. These problems will be reduced by the acceleration of the land treatment program in combination with 5.3 miles of stream channel improvement and the installation of one multiple-purpose floodwater retarding structure (earth dam), providing 500 acre-feet of non-agricultural water management storage for the town of Madison. It is anticipated that the plan will be completed in three years at a total installation cost of $275,329.

Johns Creek Watershed, Craig and Giles Counties, Virginia (September 1962)

This watershed work plan for Johns Creek Watershed was prepared by the Natural Bridge Soil Conservation District and the Craig County Board of Supervisors, the sponsoring local organizations.

Summary of Plan

The Johns Creek Watershed as set forth in this plan drains 65,000 acres, about 85 percent of which is in Craig County, with the balance in Giles County. The present land use of the watershed is 4,470 acres cultivated, 4,470 acres pasture, 55,410 acres forest land, and 650 acres idle and miscellaneous. There are 1,346 acres of flood plain in the watershed of which

40 percent is devoted to cultivated crops, 37 percent in pasture and 23 percent in woods, idle, and miscellaneous.

The major problems in the watershed are: erosion of the uplands; flooding, scouring, and overbank deposition of the flood plain; flooding damage to crops, pasture, fences, and other fixed improvements on the flood plain. This is primarily an agricultural watershed that has a history of frequent damaging floods. Portions of the flood plain are inundated two or three times each year.

The monetary value of the damages will be reduced approximately 90 percent by the acceleration of the land treatment program in combination with 17.8 miles of stream channel improvement and the installation of four floodwater retarding structures (earth dams). It is anticipated that the project will be completed in five years at a total installation cost of $657,394.

Horse Pasture Creek Watershed, Henry County, Virginia (January 1963)

This watershed work plan for Horse Pasture Creek was prepared by the Blue Ridge Soil Conservation District and the Henry County Board of Supervisors, the sponsoring local organizations.

Summary of Plan

Horse Pasture Creek Watershed as set forth in this plan drains 17,380 acres in Henry County. The present land use of the watershed is 3,487 acres cultivated, 2,190 acres pasture, 10,954 acres forest land, and 749 acres idle and miscellaneous. The area benefited includes 742 acres of flood plain.

The major problems in the watershed are: erosion of the uplands; flooding, scouring and overbank deposition of the flood plain; and flooding of highways, bridges, and farm roads. Portions of the flood plain are inundated each year and some years more than once. Some farmers report losing as many as three crops in five years. These small frequent floods practically eliminate productive use of approximately 115 acres or 21 percent of the flood plain land. In addition to the above acreage which is now idle, an additional 269 acres is flooded frequently enough to seriously limit its use for high-level production of hay and pasture.

Damages will be reduced 94 percent by the acceleration of the land treatment measures and four floodwater retarding structures (earth dams) in

combination with 6.6 miles of channel improvement. It is anticipated that the project will be completed in five years at a total installation cost of $46,336 and a benefit-cost ratio of 1.9 to 1.0.

Upper North River Watershed, A Portion of the Potomac River Basin, Augusta County and Rockingham County, Virginia (October 1963)

The work plan for Upper North River Watershed was prepared by the Shenandoah Valley Soil Conservation District with the North River Land and Water Conservation Association participating.

Summary of Plan

The watershed, consisting of 67,961 acres, lies in the northwestern part of Augusta County and the southwestern part of Rockingham County. Approximately 11.3 percent of the watershed is cropland; 8.2 percent is pasture; 79.1 percent is forest land; and 1.4 percent is in miscellaneous uses such as stream channels and roads, or is idle. Approximately 47,759 acres of Federally-owned forest land located in the upper reaches of the watershed are administered as a part of the George Washington National Forest by the United States Forest Service. The flood plain contains 3,787 acres, and has a land use distribution as follows: 35 percent in crops; 40 percent in open pasture; 23 percent in woodland; and 2 percent in miscellaneous uses such as roads and channels.

The major problems in the watershed are: streambank erosion; flooding, scouring and overbank deposition of the flood plain; flooding of highways, farm roads, homesteads, and other fixed improvements upon the flood plain; and future water storage needs for the city of Staunton and Augusta County.

This plan is designed to give relief from these conditions. The planning and application of land treatment practices will be accelerated. The measures included in the plan will improve hydrologic cover conditions, increase infiltration and decrease runoff, erosion, and sediment production. The structural measures included in the plan consist of three floodwater retarding structures and 12 miles of stream channel improvement. The plan also proposes streambank and channel stabilization measures consisting of walls, groins and wiers of wire-basket type on six miles of the North River and tributary channels in the George Washington National Forest. It is anticipated that the project will be installed within a period of five years and have a total installation cost of $1,844,795.

Supplement No. 2, October 1961

The original plan provided only for watershed protection and flood prevention measures. Supplement No. 1 of the work plan executed in October 1961, allowed the city of Staunton to become one of the sponsoring local organizations.

The purpose of Supplement No. 2 to the work plan is to incorporate a supply of municipal water for the city of Staunton in Structure No. 76 and to provide an adjusted cost estimate for Structure No. 10. The city of Staunton wanted the addition of 616 acre-feet of storage in Structure No. 76. The installation cost estimate for Structure No. 10 has been adjusted from $165,589 to $222,367 due to unanticipated difficulties encountered in obtaining fill material near the damsite.

Supplement No. 3, October 1963

The purpose of Supplement No. 3 to the work plan is to provide for the inclusion of Structure No. 59 for flood prevention. The inclusion of Structure No. 59 as a flood prevention measure was found to be necessary to more adequately meet the needs and desires of the sponsoring local organizations.

Lower North River Watershed, A Portion of the Potomac River Basin, Augusta County and Rockingham County, Virginia (November 1963)

This watershed work plan for Lower North River was prepared by the Shenandoah Valley Soil and Water Conservation District, the sponsoring local organization.

Summary of Plan

The Lower North River Watershed as set forth in this plan drains 204,588 acres in Augusta and Rockingham Counties. The land use distribution for the watershed at present is 93,140 acres of woodland, 69,750 acres of pasture, 27,760 acres of cropland and 13,938 acres of idle and miscellaneous uses. There are 7,434 acres of flood plain which were used for the economic evaluation in the watershed. Of this area 30 percent is devoted to cultivated crops, 48 percent to pasture, and 22 percent is in woods, idle, and miscellaneous uses.

The major problems in the watershed are: the erosion of the uplands; flooding, scouring, and overbank deposition of cropland and pasture in the flood plain; and future domestic and industrial water storage needs for the area. The Lower North River Watershed has a history of frequent flooding, with severe damaging floods occurring at 10 to 15-year intervals. Seven thousand four hundred and thirty-four acres of flood plain land are susceptible to flooding from the 10-year frequency event. Sheet erosion on the uplands, road cuts and fills, and idle land are the main sources of sediment. This sediment is deposited on crop and pasture land during the frequent flooding of the flood plain acres.

The monetary value of the damages will be reduced approximately 79 percent by the acceleration of the land treatment program in combination with 10.53 miles of stream channel improvements and the installation of 17 flood water retarding structures. It is anticipated that the project will be completed in 10 years at a total cost of $5,319,044 and a benefit-cost ratio of 1.6 to 1.0.

South Anna River Watershed, Albemarle, Hanover and Louisa Counties, Virginia (January 1964)

This watershed work plan for the South Anna River Watershed was sponsored and prepared by the Thomas Jefferson and Hanover-Carolina Soil Conservation Districts, the Louisa County Board of Supervisors and the towns of Louisa and Mineral.

Summary of Plan

The South Anna River Watershed as set forth in this plan drains 234,000 acres of which about 70 percent is in Louisa County, 23 percent in Hanover County, 3 percent in Albemarle County, 2 percent in Orange County and the remaining 2 percent representing a narrow strip of Fluvanna and Goochland Counties along the southern boundary of the watershed. Present land use consists of cropland, 41,000 acres; pasture, 38,190 acres; forest land, 142,500 acres; idle land, 7,860 acres; and miscellaneous land, 4,450 acres. The flood plain contains 10,014 acres and its present use is: 10 percent cultivated crops, 9 percent improved pasture, 11 percent native pasture, 2 percent miscellaneous use, and 68 percent woods, brush, and idle.

The major problems in the watershed are: erosion of the uplands, flooding, scouring and overbank deposition of the flood plain, flooding of highways and bridges, undependable source of water for the towns of Louisa and

Mineral; and recreation for the population of the Richmond Area. This area is subject to damaging floods any season of the year; however, records indicate that more than 60 percent of the floods occur during the growing season. In recent years the constant flooding has forced the landowners to remove higher income crops from these productive bottom lands. This has resulted in more than 60 percent of the flood plain now being classified as woodland, brush and idle, providing only some periodic poor grazing.

The average annual monetary value of the damages will be reduced approximately 90 percent by the accelerated land treatment program in combination with the structural measures. The land treatment measures are designed to increase moisture absorption and reduce runoff. The structural measures consist of 26 retarding structures (earth dams), 108.26 miles of channel improvement, and 3 multiple-purpose dams with storage capacities as follows: Dam 3, irrigation - 390 acre-feet; Dam 22, municipal water supply - 394 acre-feet; Dam 39, recreation - 2,501 acre-feet. It is anticipated that the project will be completed in 10 years at a total installation cost of $5,946,303.

Little Falling River Watershed, Appomattox, Campbell and Charlotte Counties, Virginia (March 1964)

This watershed work plan for Little Falling River was prepared by the Robert E. Lee Soil Conservation District, the Appomattox County Board of Supervisors and the Campbell County Board of Supervisors, the sponsoring local organizations.

Summary of Plan

The Little Falling River Watershed has a drainage area of 27,700 acres, of which about 87 percent is in northeastern Campbell County, 11 percent is in southern Appomattox County and 2 percent is in the extreme northwest corner of Charlotte County. The present land use in the watershed is 4,660 acres cultivated; 1,547 acres in pasture, 20,153 acres in forest land; 1,082 acres idle and 258 acres in miscellaneous uses. The area studied includes 1,166 acres of flood plain land.

The major problems in the watershed are: sheet erosion of the uplands, road cuts fills and idle land, flooding, scouring and overbank deposition of the flood plain; and flooding of highways, bridges and farm roads. Portions of the flood plain are inundated each year and in some years even more often. Some

of the farm operators reported losing as many as three crops in five years. The relatively small frequent floods have seriously limited the productive use of about 300 acres of the flood plain land for high value crops. It is anticipated that the project will be completed in three years at a total installation cost of $423,945 and a benefit-cost ratio of 1.5 to I.0.

Willis River Watershed, Buckingham and Cumberland Counties, Virginia (August 1964)

This watershed work plan for the Willis River Watershed was sponsored and prepared by the Robert E. Lee Soil and Water Conservation District, the Buckingham County Board of Supervisors, and Cumberland County Board of Supervisors.

Summary of Plan

The Willis River Watershed as set forth in this plan drains 176,700 acres of which approximately 50 percent is in Buckingham County and 50 percent in Cumberland County. Present land use consists of cropland, 15,836 acres; pastures, 18,810 acres; idle land, 3,053 acres; forest, 136,357 acres; and miscellaneous land, 2,644 acres. The flood plain of the watershed contains 7,528 acres and has the following land use distribution: 7 percent cropland; 4 percent improved pasture; 7 percent native pasture; I3 percent idle; 2 percent miscellaneous; and 67 percent woodlands.

The major problems in the watershed are: erosion of the uplands; flooding, scouring, and deposition on the bottom lands; and flood damage to highways and bridges. Portions of the flood plain are inundated numerous times each year. In some sections the flooding is so frequent that the landowners have very limited use of some of their most productive land. The most frequent floods are not small in the area affected. The 2-year event inundates 57 percent of the flood plain and the 10-year event floods 86 percent of the bottom land acreage.

This plan consists of land treatment measures in the upland areas designed to increase moisture absorption and reduce runoff, 111 floodwater retarding structures (earth dams) and 14.91 miles of stream channel improvement. The average monetary value of the damages will be reduced 88.2 percent by the accelerated land treatment program in combination with the structural measures. It is anticipated that the project will be completed in five years at a total cost of $1,919,736.

Dry Run Watershed, A Portion of the Potomac River Basin, Page County Virginia (October 1964)

This watershed work plan for Dry Run, Page County, Virginia was prepared by the Shenandoah Valley Soil and Water Conservation District and the Town of Luray, the sponsoring local organizations.

Summary of Plan

The Dry Run Watershed as set forth in this plan drains 9,000 acres in Page County. Present land use in the watershed is 1,249 acres cultivated, 2,765 acres of pasture and hayland, 4,386 acres of forest land, and 600 acres in miscellaneous uses and idle. A portion of the town of Luray is located in the downstream area of the watershed.

This is primarily an agricultural watershed with a history of frequent, damaging floods. The major problems in the watershed are: the erosion of the uplands; flooding, scouring, and overbank deposition of cropland and pasture; damage to fences, roads and bridges; damage to homes and other improvements in the flood plain; and an inadequate water supply for the town of Luray. Damages will be reduced 88 percent by the acceleration of land treatment measures, 0.77 miles of stream channel improvements, one multiple-purpose floodwater retarding structure (earth dam) providing 450 acre-feet of non-agricultural water management storage for the town of Luray, and one single-purpose, floodwater retarding earth dam. It is anticipated that the project will be completed in three years at a total installation cost of $694,465.

Cherrystone Watershed, Pittsylvania County, Virginia (February 1965)

This watershed work plan for Cherrystone Watershed, Pittsylvania County, was prepared by the Pittsylvania Soil and Water Conservation District, the Pittsylvania County Board of Supervisors, and the town of Chatham, the sponsoring local organizations.

Summary of Plan

The Cherrystone Watershed as set forth in this plan drains 29,400 acres in Pittsylvania County, Virginia. Present land use in the watershed is 5,069 acres cultivated; 2,539 acres in pasture; 17,811 acres of forest land, and 4,161 acres in miscellaneous uses and idle. The town of Chatham, county seat of Pittsylvania County, is located in the flood plain near the center of the watershed.

The Cherrystone Watershed has a long history of frequent flooding, with severe damaging floods occurring at 5 to 10-year intervals. The major problems in the watershed are: the erosion of the uplands; scouring, deposition, and swamping on the bottomlands; flooding damage to business property, crops, and pasture, fences, farm roads and bridges, public highways, railroads and other improvements in the flood plain; and an inadequate water supply for the town of Chatham. Average annual direct damages will be reduced almost 98 percent by the acceleration of land treatment measures, one multiple-purpose earth dam, providing 850 acre-feet of non-agricultural water management storage for the town of Chatham, two single-purpose, floodwater retarding earth dams, and 5,555 miles of stream channel improvements. It is anticipated that the project will be completed in five years at a total installation cost of $870,244.

Stewarts Creek-Lovills Creek Watershed, Surry County, North Carolina, and Carroll County, Virginia (February 1965)

This watershed work plan was developed by the New River Soil and Water Conservation District, Surry Soil and Water Conservation District, town of Mount Airy, N. C., and the Surry County Watershed Improvement Commission, sponsoring local organizations.

Summary of Plan

This is a plan for watershed protection and flood prevention of the 72,000 acre Stewarts Creek-Lovills Creek Watershed. Approximately 41,000 acres are in Carroll County and 31,000 acres are in Surry County, North Carolina. Present land use of the watershed is 52 percent woodland, 18 percent cropland, 22 percent grassland, 2 percent orchards, 1 percent idle, and 5 percent urban and miscellaneous. Practically all of the 2,807 acres of flood plain is open crop or pasture land, with the exception of 291 acres of Lovills Creek which are within the urban area of Mount Airy.

The major problems in the watershed are: erosion of the uplands; flooding, scouring, and overbank deposition of cropland and pasture in the flood plain; and flooding of highways, farm roads, and other fixed improvements upon the flood plain. Average annual flood damage to crop and pasture exceeds $28,500. Sediment deposits have damaged 238 acres, and 30 acres have been damaged by flood plain scour. Floodwater damages to private improvements exceed $15,000 annually. Public roads and bridges and other public improvements are being damaged at the average rate of $3,000 per year. At

present, about ten million dollars worth of fixed improvements are located in the flood plain on Lovills Creek.

This plan is designed to give relief from these conditions. Conservation land treatment, the basic element of the project, will be emphasized during the entire eight-year installation period. Three floodwater retarding structures and a multiple-purpose structure providing 964 acre-feet of storage water for the town of Mount Airy are planned. In addition, 118,800 feet of channel improvement is planned. The total project has a cost of $2,395,849, with a benefit-cost ratio of 2.0 to 1.0.

APPENDIX VIII

Proposed Draft of Land Use Legislation

The material presented in this Appendix was prepared by Professor Douglas A. Yanggen of the University of Wisconsin under a project jointly sponsored by the Water Resources Council, the Corps of Engineers of the Department of the Army, the Soil Conservation Service of the Department of Agriculture, the Department of Housing and Urban Development, and the Tennessee Valley Authority.

I. Title

This act may be cited as the "Flood Hazard Area Management Act" of_____.

I. Comments: Title

The title provides a brief and convenient means for identifying the act. As the title suggests, the act is intended to establish a program for broad "management" of flood-prone areas and not only regulation. Management contemplates study, planning, and plan implementation through several implementing techniques including regulation. Draft A authorizes a state agency to undertake studies, planning and regulation. Additional powers might be given the agency such as the power to construct protective works or purchase flood-prone areas for wildlife, recreation or other uses. But it is assumed that local units or the federal government, in most instances, now have necessary power to construct recommended protective works. In addition, other state agencies, such as a state conservation agency, may have sufficient powers to negotiate recommended purchases for wildlife or park purposes.

II. Statement of Legislative Finding, Policy, and Purposes

(1) The legislature finds that (A) recurrent flooding of a portion of the state's land resources causes loss of life, damage to property, disruption of commerce and governmental services, and unsanitary conditions, all of which

are detrimental to the health, safety, welfare, and property of the occupants of flooded lands and the people of this state; and, (B) the public interest necessitates management of flood-prone lands and waters as interrelated and scarce resources, in a manner consistent with sound land and water use management practices which will prevent and alleviate flooding threats to life and health, and reduce private and public economic losses.

(2) The policy and purposes of this act are not to prohibit but rather to guide development of the flood hazard areas of this state consistent with enumerated legislative findings: to provide state coordination and assistance to local units in management of flood hazard areas; to coordinate federal, state, and local management activities for flood hazard areas; to encourage local governmental units to manage flood-prone lands including the adoption, enforcement, and administration of land use regulations; and to provide the Land and Water Commission, herein established, with authority necessary to carry out a comprehensive flood hazard area management program for the state.

II. Comments: Statement of Finding, Policy, and Purpose

The statement of legislative finding, policy, and purpose is largely self-explanatory. Several features may be noted:

(1) The act finds that the public interest requires management of flood-prone lands in a manner consistent with sound land and water use management practices which will protect life and health, reduce private and public economic losses, and minimize social disruption.

(2) The purpose of the act is not to prohibit development of flood hazard areas but to insure that development takes place in a manner compatible with sound land and water use management practices.

(3) The purpose of the act is to encourage local management of flood hazard areas including adoption of regulations.

(4) The purpose of the act is to authorize a state agency to establish and carry out a comprehensive flood hazard area management program for the state including coordination of federal, state, and local activities.

III. Definitions

Unless the context otherwise requires, the following definitions apply throughout this chapter:

(A) "Commission" means Land and Water Commission.

(B) "Coastal Hazard Area" shall mean the area adjoining an ocean or _____ which has been or may hereafter be covered by flood waters or subject to erosion damage.

(C) "Commission Flood Hazard Areas," "Commission Coastal Hazard Areas," "Commission Floodway Fringe Areas," and "Commission Floodway Areas" shall refer generally to "Flood Hazard Areas," "Coastal Hazard Areas," "Floodway Fringe Areas," and "Floodway Areas" that have been delineated as regulatory areas by commission order.

(D) "Flood" shall mean the condition existing when the waters of any watercourse, lake, or ocean temporarily rise to an unusual height above the normal level of such watercourse, lake, or ocean.

(E) "Flood of__ Year Frequency" shall mean a flood magnitude expected to recur on the average once in every__ years.

(F) "Floodway Fringe" shall mean the area adjoining a watercourse, not lying within a floodway which has been or may hereafter be covered by a regulatory flood.

(G) "Floodway" shall mean the channel of a watercourse and adjacent land areas which are required to carry and discharge the flood water of the watercourse of a regulatory flood without substantially increasing flood heights.

(H) "Flood Hazard Area" is to be construed as a general term to refer to "Coastal Hazard Areas," "Floodway Fringe Areas," and "Floodway Areas."

(I) "Flood Proofing" shall mean any combination of structural and nonstructural additions, changes, or adjustments to properties and structures, primarily for the reduction or elimination of flood damage to lands, water and sanitary facilities, structures, and contents of buildings.

(J) "Obstructions" shall mean any dam, wall, wharf, embankment, levee, dike, pile, abutment, projection, excavation, channel rectification, bridge, conduit, culvert, building, wire, fence, rock, gravel, refuse, fill, structure or matter in, along, across, or projecting into any channel, watercourse, or regulatory flood hazard area which may impede, retard or change the direction of the flow of water, either in itself or by catching or collecting debris carried by such water, or that is placed where the flow of the water might carry the same downstream to the damage of life or property.

(K) "Artificial Obstruction" shall mean any obstruction which is not a natural obstruction.

(L) "Natural Obstruction" shall mean any rock, tree, gravel, or other matter that has been located by a nonhuman cause.

(M) "Person" shall mean any natural person, firm, partnership, association or corporation, but does not include governmental units.

(N) "Regulatory Flood" shall mean [options] (I) A flood of __ year frequency (2) A flood which can be reasonably expected for that region.

(O) "Structure" shall mean anything constructed or erected on the ground, or attached to the ground, including, but not limited to the following: docks, dams, fences, mobile homes, sheds and buildings.

(P) "Subdivision" means the partitioning or dividing of a parcel or tract of land by the proprietor or by his heirs, executors, administrators, legal representative, successors or assigns for the purpose of sale, or lease of more than one year, or for building development, where the division creates [3] or more parcels of land each of which is [10] acres or less in area: or where [3] or more parcels of land each of which is [10] acres or less in area are created by successive divisions within a period of [10] years.

(Q) "Watercourse" shall mean any depression two feet or more below the surrounding land serving to give direction to a current of water having a bed and well-defined banks where the drainage area above the same is [one square mile] or more in extent, provided that it shall, upon rule or order of the commission, also include other

generally and specifically designated areas where substantial flood damage may occur.

III. Comments: Definitions

The definitions are an essential part of the statute. The following commentary explains and highlights some of the definitions:

(B) "Coastal Hazard Area" is used to apply to all areas, adjacent to an ocean or other large body of water which may be covered by storm, hurricane, tidal, seiche, or other floodwaters. It also includes areas which may be subject to erosion damage due to flood, wave, or current action. Applicable language should be inserted in the blank_____, at the option of the state, such as "Lake Michigan" if the state is bordered by that lake.

(C) "Commission Flood Hazard Areas" refers to areas flooded by a flood of specified frequency or magnitude which has been delineated as regulatory areas by commission order through the use of maps, flood elevations, flood profiles, or other techniques.

(D) "Flood" is defined to include conditions existing when water temporarily rises to an unusual height above the normal level for such watercourse, lake, or ocean. It will not include conditions in which diffused surface water not part of a watercourse, damages property. The definition must be read in conjunction with the definition of watercourse (See definition Q). It is to be noted that the definition of watercourse set out in definition (Q) is very broad and may be extended even further in specific instances by the commission through rule or order.

(E) "Flood of___Year Frequency" is a description of the expected recurrence interval for a given sized flood based upon statistical probability and is an indirect measure of the size or magnitude of the flood. Large floods are less frequent, and smaller floods are more frequent. However, frequency is defined as a long-term statistical probability, and, a flood likely to occur on the average of only once in

one hundred years may occur the next year after a flood of similar size or may not occur again for several hundred years. A state should designate the desired recurrence interval in the blank___. A one hundred year frequency is a common figure.

(F) "Floodway Fringe" includes the area adjacent to a lake or watercourse, outside of a floodway, which may be subject to flooding by the regulatory flood. The floodway fringe areas include not only those areas which have been covered by flood waters (historic flood of record) but those which may be hereafter covered (calculated flood).

(G) "Floodway" refers to the channel and adjacent land area of a watercourse which are necessary to pass the regulatory flood without substantially increasing flood heights. The statute does not define "substantial" increases in flood heights. Standards for floodway delineation must be tailored to each physical situation. A determination of permissible increases in flood heights is left up to the agency to decide, utilizing expert judgment. The permissible increases in a given instance may depend upon the effects of the increases upon existing or reasonably anticipated future development, the characteristics of the stream including susceptibility of bank areas to erosion, the desires of the local unit, and other factors.

(H) "Flood Hazard Area" is a generic term used to include more precisely defined flood hazard areas. See definitions (B), (F) and (G).

(J) (K) (L) "Obstruction," (J), is defined comprehensively. "Artificial Obstruction," (K), and "Natural Obstruction," (L), are each defined since the regulatory provisions of the statute apply only to artificial obstructions. See Section V of the statute.

(M) "Person" is broadly defined to include all private developers of flood hazard areas. The regulatory provisions of Sections V and VI of this statute are linked to this definition of "person." The definition does not include governmental units. Special regulatory provisions for

governmental uses in flood hazard areas are set out in Section VII of the statute.

(P) "Subdivision" as herein defined establishes the scope of commission plat review under Section IX of this statute. Other broader or more restrictive definitions of subdivision might be utilized. Figures are included in blank spaces,___, for the purposes of illustration. Such figures will provide regulation of most divisions of lands other than a single division.

(Q) "Watercourse" is broadly defined to include rivers and streams and most lesser channels for conveyance of water. It will include both natural and artificial channels. It is not limited to rivers or streams which flow continuously but will include arroyos and canyons where flooding is brief and infrequent but often severe.

The definition is further broadened by allowing the agency to designate areas as "watercourses" not meeting the liberal general definition. For example, in special circumstances the agency might, by order designate regulatory areas which are periodically subject to high velocity "sheet flow" although not confined to a "bed" or "well-defined" banks in a depression two or more feet deep, or regulatory areas along watercourses with drainage area less than a square mile. The agency has power to designate as flood hazard areas practically any area where surface waters may threaten substantial damage.

IV. Land and Water Commission

A Land and Water Commission for management of flood-prone areas is hereby established within the department of _____ for the purposes of planning, coordinating, and regulating all activities concerning managment of flood hazard areas, flood control, flood damage prevention, shore erosion and the construction of dams, dikes, levees, and reservoirs.

IV. Comments: The Land and Water Commission

The agency responsible for management of flood-prone areas will be dealing with interrelated land and water

management problems and is therefore designated "The Land and Water Commission." The agency has been designated a "commission" for the purposes of simplicity but could be organized as a committee, department, or other form. Membership, organization, and form would depend upon present state practice and preference.

The act might alternatively vest powers in an existing water resources agency, if one exists, or create a new one. If an agency already exists within the state with broad water resources planning and implementation powers, it would be preferable to vest this agency with additional power for management of flood hazard areas to prevent fragmentation of functions.

The act vests broad powers in the agency, including "planning, coordinating, and regulating" functions. Regulations should be viewed as one of a number of tools for promoting sound management of flood hazard areas. Therefore, the agency is to be concerned generally with flood control, flood damage prevention, control of shore erosion, and problems involving the construction of dams, dikes, and reservoirs.

V. Permits Required for Structures, Artificial Obstructions, and Channel Modifications

(A) It shall be unlawful for any person to erect, construct, or alter any dike, dam or levee, or to erect, construct to alter any structure or artificial obstruction in any lake, ocean or watercourse, or to alter or modify any lake, watercourse, or coastal shore area without written permission of the commission.

(B) In addition, it shall be unlawful for any person to erect, construct or alter any structure or artificial obstruction, subject to the qualification set out in Subsection VIII, (C) (3), in any regulatory flood hazard area without written permission from the commission.

(C) Failure to comply with Subsections (A) and (B) and erection, construction, or alteration of any artificial obstruction or modification of any watercourse, lake, or coastal shore area without written permission of the commission shall constitute a public nuisance. The commission may seek the removal of such nuisance pursuant to Section VI or XI of this act.

V. Comments: Permits Required for Structures, Artificial Obstructions, and Channel Modifications

This section requires permits in all instances for artificial obstructions in or modifications of watercourses, lakes, or coastal shore areas and for erection of new or alteration of existing artificial obstructions in commission flood hazard areas. The section must be read in conjunction with the definition of "obstruction" §III (J), "structure" §III (O), "watercourse" §III (Q), and "commission flood hazard areas" §III (C).

This section, as drafted, attempts to resolve somewhat conflicting policies. On the one hand regulation of land owners for most classes of uses such as residences, commercial establishments, and industries seems equitable only in flood hazard areas which are specifically designated by agency order. The land owners then have notice of the exercise of regulatory jurisdiction. On the other hand, detailed flood hazard area delineation may be decades away for some of these areas. Some flood-prone areas may be substantially developed by the time the flood hazard areas are adequately evaluated and regulations imposed.

This section attempts to strike a compromise between a position which would require specific delineation of all flood hazard areas prior to regulation and a position which requires no delineation prior to regulation. The statute (paragraph one) requires that permits be obtained for uses which by their nature are presumptively located in watercourses, lakes, or oceans, or in flood hazard areas. These include obstructions in channels and channel modifications, and uses which are presumably located in channel areas such as dikes, dams, and levees. Many states now regulate certain classes of obstructions in watercourses, and dikes, dams, and levees. This statute would need to be meshed with existing statutes and regulatory procedures. Preferably, review functions would be integrated in one agency.

While permits are required for proposed artificial obstructions, channel modifications, dikes, dams, and levees

wherever these uses or alterations to existing uses are proposed, permits for other classes of artificial obstructions or structures are required only where an area has been designated as a "commission" flood hazard area.

It is to be noted that the operation of the statute is largely prospective although the statute requires a permit for alteration of any structure or obstruction in a watercourse or regulatory flood hazard area. An agency might more specifically define "alteration" by administrative rule.

Some statutes broadly declare that existing obstructions to flow are public nuisances (e.g., Ind. Ann. Stat. 27-1117 [Supp. 1969]). It would appear that attempts to abate existing obstructions under such statutes have been practically nonexistent. Generally courts have been unreceptive to attempts to abate existing uses which have been declared public nuisances and which do not have substantial nuisance-like characteristics.

This statute (paragraph C) declares unlawfully erected or altered artificial obstructions or modifications of a watercourse, lake or ocean to be public nuisances. The commission may seek an injunction to order the removal of the obstruction or modification under powers granted by Section VI or Section XI of this act. Section XI more broadly authorizes the agency to seek injunctive relief or abatement for existing uses which are in fact public nuisances under the common law or general laws of the state.

VI. Penalties

(A) Any person violating the provisions of this act shall be guilty of a misdemeanor and may be fined, in addition to any costs, expenses, or damages, not more than_____for each offense. Each day of continuing violation, thirty days after notification of the violation, will be deemed a separate offense.

(B) The commission may, in accordance with the laws of_____, maintain an action in the_____ court to enjoin any violation of this act.

(C) The commission may maintain an action to order the abatement of any public nuisance including, but not limited to, nuisances defined by Section V (C) of this act which adversely affect the efficiency or unduly restricts the capacity of any watercourse or floodway or in any other manner interfere with the effectuation of this act. The commission may obtain a court order directing the removal or elimination of such public nuisance or authorizing the commission to remove or cause to be removed such public nuisance at the expense of the owner.

VI. Comments: Penalties

The penalty provisions are largely self-explanatory. They are intended to be severe enough to enforce compliance with the act. A five hundred dollar fine is suggested as one possibility. In addition, each day of continuing violation more than thirty days after notification of the violation may be deemed a separate offense. The thirty day period will allow removal of the violation or initiation of a suit to contest the alleged violation.

The commission may also seek a court injunction for abatement of public nuisances at the expense of the owner. Such nuisances could include those defined by Section V, public nuisances at common law, or nuisances under the general laws of the state.

Existing acts authorize sanctions similar to those set out in Draft A. A number of existing acts declare that any obstruction placed within established encroachment lines without a required permit shall constitute a nuisance and may be enjoined or abated as such.[1] Violations of the acts are declared to be misdemeanors with fines ranging from a maximum of fifty[2] to one thousand dollars[3] and jail sentences from a minimum of ten days[4] to one year.[5] Each day after conviction may be considered a separate offense[6] if the violation continues.

VII. Commission Powers to Develop Management Plans for Flood Hazard Areas

(A) The commission shall make or arrange for a comprehensive study and investigation of all areas of the state affected by floods; determine the best

combination of methods for managing these areas through flood hazard regulations, flood warning systems, flood insurance, public acquisition, tax adjustment policy, channel improvements, levees, reservoirs, and other practical methods; adopt and establish a comprehensive or master plan to minimize flood damages in all areas of the state subject to floods; and prepare and periodically revise a schedule for implementation of the management plan.

(B) The commission is authorized, as the representative of the state of _____ to cooperate with, aid, negotiate, and enter into agreements with local units of government, authorized agencies representing any one or more states, and authorized agencies of the federal government, for the purposes of flood data collection, delineation of flood hazard areas, other surveys and planning, participation in flood insurance programs, construction of flood control works and shore protection, and regulation of uses in flood hazard areas. If otherwise required by law, agreements or compacts shall become effective only after legislative approval.

(C) The commission shall initiate a comprehensive program for the delineation of regulatory flood hazard areas in the state. The commission shall prepare a list of flood hazard areas to be studied and recommend the order in which such studies shall be undertaken. The list shall be reviewed at least annually by the commission. In establishing and revising the list, the commission shall consider:

1. The degree of danger to lives and property from flooding;
2. The rate and type of development taking place in flood hazard areas;
3. The ability and willingness of the political subdivision having jurisdiction over the area to make use of the data; and
4. Other considerations pertinent to the situation.

VII. Comments: General Commission Powers to Develop Management Plans for Hazard Areas

(A) The commission is directed to make a comprehensive study of flood-prone areas and to prepare a comprehensive management plan. Regulations will play a part in implementing the plan.

(B) The commission is authorized to cooperate, aid and negotiate with all levels of government to manage flood hazard areas.

(C) The commission shall initiate a program for delineation of flood hazard areas. The statute sets out factors for commission consideration in establishing priorities for delineations. The degree of flood danger and development pressures are prime considerations. A priority list for delineating hazard areas will assist federal agencies and local units as well as the state agency in selecting study areas.

VIII. Commission Powers to Regulate Flood Hazard Areas

(A) Management of Flood Hazard Areas Shall be a Joint State-Local Responsibility.

Management of flood hazard areas shall be the joint responsibility of the commission and the following local units:_____. The commission and local units shall cooperate in all phases of studying, delineating, planning, and managing flood hazard areas.

(B) Commission Power to Adopt Regulations for Local Units in the Event Local Units do not Adopt and Enforce Regulations Consistent with Minimum Standards.

(1) When, in the opinion of the commission, need exists in an area for regulation and sufficient data has been developed within the area for a local unit to reasonably delineate flood hazard area limits and to establish a flood hazard area regulatory program, the commission shall notify the local unit and require, by order, that the local unit adopt land use ordinances which meet or exceed the minimum standards of the commission. The commission shall specify a reasonable period of time for adoption of local regulations. In the event that a local unit fails to adopt adequate ordinances within this period or fails to adequately enforce ordinances at any time, the commission shall delineate, by order, commission flood hazard areas, and shall, by administrative rule, establish regulations for these areas. The commission shall administer the regulations until adequate local ordinances are adopted and enforced. Costs of adoption, administration, and enforcement may be charged to the local unit as a special service and collected in the_____court.

(2) In determining the need for local regulation and sufficiency of data for an area, the commission shall consider the severity of the flooding threats to persons and property, the rate of development, the urban or rural nature of the area, and other relevant factors. The commission may establish varying standards for the sufficiency of data. Where the public interest necessitates immediate regulation, the commission may require adoption of interim regulations based on limited data until comprehensive studies are undertaken. The commission may, over a period of time require upgrading of data and regulations.

(C) Commission Approval of Local Regulations.

(1) The commission shall adopt general or special rules setting minimum standards for the content, administration, and enforcement of local ordinances. Local ordinances may include encroachment limits, zoning, subdivision regulations, building codes, housing codes, and other land use regulations.

(2) All local flood hazard ordinances or ordinances containing provisions relating to flood hazards proposed subsequent to the date of this act, whether prepared pursuant to a commission order or independently, shall be submitted by local units to the commission for review and approval prior to adoption. All regulations in existence prior to the date of this act shall be submitted for review and approved by _____. If the commission determines that the ordinances will provide effectively administered and enforced regulations which meet or exceed minimum commission standards, the commission shall approve the ordinances. Amendments to local ordinances, as they relate to flood hazards, must be submitted to the commission for review prior to adoption. The commission may require that local units submit special exceptions and variances, as they relate to flood hazards, to the commission for review prior to issuance.

(3) In the event that local ordinances for commission flood hazard areas are approved as meeting minimum commission standards and the regulations are effectively administered, permits from the commission for development shall not be required for uses specified in Section V (B) of this statute. However, commission approval shall continue to be necessary for uses specified in Section V (A) of this statute including dams, dikes, levees, channel modifications, obstructions in channels and public uses specified in Section X.

(4) The commission may contribute up to__ annually to local units for the administration of local regulations which meet minimum commission standards.

(D) Commission Procedures for Regulation of Commission Flood Hazard Areas.

(1) The commission may designate, by order, the following commission flood hazard areas: "Commission Coastal Hazard Areas;" "Commission Floodways" and "Commission Floodway Fringes." The orders shall designate boundaries for the commission flood hazard areas. The commission shall base the boundaries upon the regulatory flood. The determination of the regulatory flood discharge and floodway boundaries shall take into account the effects of probable future developments. The position of the lines shall, in so far as practical, equitably affect properties and interests depending upon topography, existing uses and probable future uses; shall be interdependent throughout the reaches of the waterway; and shall conform with the requirements of the federal government imposed as conditions for the construction of flood control projects.

(2) The commission shall establish, by rule, categories of uses which may be allowed as of right, prohibited, or conditionally allowed in commission flood hazard areas, and shall establish, by rule, standards for evaluating permits and conditions which may be attached to issuance of permits. The rules may prohibit the location of damaging obstructions in floodway areas; require flood protection for uses in hazard areas through elevation, flood-proofing, or other techniques; require adequate provision be made for internal drainage; require adequate water and sewage facilities be provided; and establish other restrictions to promote sound management and use of flood hazard areas. Rules shall also establish procedures for obtaining permits.

(3) No order or rule shall be issued under Subsection (D) (1) or (D) (2) until notice of such proposed order or rule has been published three times, at weekly intervals, in a newspaper having general circulation in the area involved and a public hearing has been held in the area. The notice shall specify a hearing date at least one week from the date of the last publication. Any person or local unit of government aggrieved by an order or rule of the commission may appeal such order or rule within thirty days from the date of the entry of the order or rule to the court of_____. Service of notice of appeal shall be made upon the chairman of the commission.

(E) Permits.

(1) Any person desiring to erect, construct, locate, relocate, or alter a structure or obstruction in any commission flood hazard area or for another activity requiring a permit as specified in Section V of this statute shall file a written application with the commission setting forth material facts, including any information which the commission may require. The commission, acting as a body or through a designated administrative official shall, within___days reject or approve the application upon such terms and conditions as it may prescribe. Grounds for refusal shall be stated in writing. The commission or designated officer shall take into account the legislative findings and policy of this act and particularly the suitability of the area for the proposed use, the threat to loss of lives and property, the effect of the proposed use on floodway capacity, the effect of similar encroachments, and other factors material to minimization of flood damage and threats to health and safety while allowing, so far as practical, reasonable use of the land.

(2) Any person or governmental unit aggrieved by issuance of a permit or refusal to grant a permit may apply within thirty days to the commission for reconsideration and a public hearing. The commission shall, within thirty days, reconsider the application and within said thirty days period shall either issue a written decision granting in whole or part the relief sought in the application for reconsideration, or shall set the matter for hearing. The decision shall set forth the commission's findings and conclusions. The commission shall, within thirty days of the hearing, issue a decision.

VIII. Comments: Commission Powers to Regulate Flood Hazard Areas

The drafted statute envisages a joint state-local cooperative effort for regulation of flood hazard areas. Preceding sections of the statute, such as Section VII authorize a broader joint state-local delineation and planning role.

A. Management of Flood Hazard Areas Shall be a Joint State-Local Responsibility.

The statute makes clear that regulation of flood hazard areas is to be a joint state-local responsibility. The blank,_____, allows a state to designate classes of local governmental units as the responsible cooperating regulating bodies. Counties may be the logical units for

rural areas, and cities and villages may be designated for urban areas. But a state might wish to vest responsibility for regulating rural areas in towns or special districts. It would seem preferable to select local units which have broader land use control functions, sufficient geographical area to provide effective control, and available technical administrative personnel.

The statute directs the commission and local units to cooperate in carrying out studies. Responsibility for the studies is placed upon both the commission and local units. The commission or local unit may arrange for studies by the commission, local unit staffs, consulting firms, or federal agencies. A joint state-local program for study of hazard areas may be most satisfactory for several reasons: First, local units often have information which, if combined with further information at the state level, may allow sophisticated evaluation of hazards. The local unit may have records of flood damage to public buildings or facilities, photos of flood inundation, and other historic flooding information. Detailed topographic maps prepared for sewer and water or road building will be useful in calculating flood heights and in determining regulatory flood hazard areas. Second, state agencies may be in a position to efficiently analyze data gathered at the local levels through a data bank and computer programs. Floodway areas may be identified and the effect of specific proposed encroachments evaluated by preparation of water surface profiles. Local, state, and federal efforts can be coordinated by the state agency.

B. Commission Power to Adopt Regulations for Local Units in the Event Local Units do not Adopt and Enforce Regulations Consistent with Minimum Standards.

The commission is directed to notify a local unit when the need exists for regulation in the local unit and sufficient technical information is available to establish a flood hazard area regulatory program. The commission is to require, by order, that the local unit adopt regulations by a date specified in the order. If a local unit fails to enact

regulations within the specified time period, the commission shall adopt regulations for the area. Cost of delineation, adoption and enforcement may be charged to the local unit.

The commission is allowed broad discretion in determining the need for regulation in an area and the sufficiency of data. The commission may apply varying standards which take into account all relevant factors. The commission may require adoption of interim regulations where the public interest warrants adoption of an immediate program.

Power to vary standards seems important. For example, an urban or rural unit might be required to adopt single district ordinances based upon limited data, where the need for immediate regulation is great. Such a single district approach or interim regulation might be required in a developing urban fringe or rural recreation area. An ordinance for use with such a single district approach is set out in a later section of Part I. Applications for proposed development are considered upon a case by case basis at which time specific flood hazards are evaluated and flood hazard adjustments are required for proposed use.

More often, the commission will require adoption of regulations only if adequate information is available to delineate floodway and floodway areas. An ordinance for such an approach is also set out in Part I. This more detailed approach is desirable so that effects of encroachment need not be evaluated on a case by case basis. Such a case by case evaluation requires special administrative expertise which often may be lacking at the local level.

The commission is authorized to require updating of data and methods over a period of time. This power seems essential since conditions within a watershed will change and more detailed flood information may be generated over a period of time. A single district or interim approach may be justified if only limited data is available. With the generation of more specific data, more sophisticated regulation may be necessary.

C. Commission Approval of Local Regulations.

The commission is directed to adopt general and special rules setting minimum standards for the content, administration, and enforcement of local ordinances. These rules would likely set different specifications for interim, single district, and two district approaches. The rules could require encroachment limits, zoning, subdivision regulations, building codes, housing codes, and other land use regulations.

All local regulations adopted subsequent to the date of the act must be submitted for review and approval. Existing regulations adopted prior to the date of the act must also be submitted to the commission for approval by a date specified in the statutes. Amendments to all ordinances must also be submitted for approval. The commission must approve the ordinances if the commission determines that the ordinances will provide effectively administered and enforced regulations which meet or exceed minimum commission standards. The commission may also require submission of special exceptions and vacancies for commission approval prior to issuance at the local level.

Comprehensive control of local ordinances will assure minimum state-wide competency in ordinance content, administration and enforcement. Local units may prefer local regulations and local administration rather than state regulation for several reasons. (1) Administration at the local level may be speedy and efficient. (2) Local units may prefer to retain control of land uses to aid in implementing local land use plans and to assure that adequate weight will be given to local needs and desires. (3) If the state agency must adopt and administer regulations for an area where a local unit has failed to comply with agency orders to adopt or enforce regulations, the agency may charge the local unit for such services. (4) The commission may contribute a sum of money specified in the statute to local units for the administration of regulations which meet minimum commission standards. Such an incentive is authorized by Wisconsin Statutes 144.26 §§(3) (b)4., (4) (1967), for special county zoning of shoreland areas. Up to $40,000 a

year may be made available to the counties for administration of regulations which meet or exceed minimum state standards.

D. Commission Procedures for Regulation of Commission Flood Hazard Areas.

The statute establishes procedures for delineation of commission flood hazard areas. The commission must designate boundaries for the areas although the statutory language is broad enough to allow the commission some latitude to either map or designate boundaries by elevation. Boundaries shall be based upon the regulatory flood discharge and the boundaries shall consider both existing land uses and the effects of probable future development. Position of boundary lines shall equitably affect riparian properties depending upon the discharge capabilities of various properties, existing uses, and probable future uses. The statute provides that the lines should be established with recognition of the interdependence of flood flows throughout a waterway and shall conform with requirements of the federal government imposed as conditions for the construction of flood control projects.

Generally, existing statutes require an agency to establish encroachment limits and specify guidelines for the agency. Some of the language of the existing acts appears in the Draft. The Connecticut statute is quite explicit:

> The Commission, in establishing such encroachment lines, shall base their location on the boundaries of the area which would be inundated by a flood similar in size to one or more recorded floods which have caused extensive damages in such area or on a size of flood computed by accepted methods applicable generally throughout the state or a region thereof. The determination of the size of the flood and the boundaries of the inundated area shall take into consideration the effects of probable future developments. The position of the lines may vary from the boundaries of inundated area so as to

> minimize the area of land to be regulated when a portion of the inundated area does not contribute to the flood-carrying capacity of the waterway. The position of the lines shall, insofar as practical, equitably affect riparian properties and interests depending upon existing topography and shall be interdependent throughout the reaches of the waterway, and shall conform with the requirements of the federal government imposed as conditions for the construction of flood control projects.[7]

The Iowa statute specifies further criteria for establishment of flood plain limits or regulations:

> In establishing any such limits or regulations, the council shall avoid to the greatest possible degree the evacuation of persons residing in the area of any floodway, the removal of any residential structures occupied by such persons in the area of any floodway, and the removal of any structures erected or made prior to July 4, 1965 which are located on the flood plains of any river or stream but not within the area of any floodway.[8]

The Nebraska statute is notable in that it specifies that

> [t]he location of the encroachment lines shall be the estimated outer boundary of the floodway of a one hundred year frequency flood, as determined from the available date.[9]

One Massachusetts Act specifies that encroachment lines are to be established or reestablished "in accordance with sound engineering principles . . . ."[10]

It should be added that Iowa is unique among the states in that land owners are required to seek flood plain permits although no lines have been mapped in the area.[11] Evidently the land owner is left to his own devices to discover whether he is in a flood plain area.

The statute requires that the commission shall establish, by rule, classes of uses which will be allowed as of right, prohibited, or conditionally allowed in commission flood hazard areas. These rules may resemble, in some respects, a local zoning ordinance. The statute requires that rules establish standards for evaluating permits and conditions which may be attached to issuance of permits. The statute specifies several important matters to be considered in the rules, including preservation of floodway capacity, protection for uses in flood hazard areas, provision for internal drainage, and provision for adequate water and sewer facilities. Rules shall also establish procedures for obtaining permits for proposed flood hazard area uses.

The statute provides an appeal procedure, as of right, within thirty days of a commission order for any person or local unit aggrieved by the order. Each state statute should be written to conform to the state appeals procedure for appeals from state administrative agencies.

Commission orders and rules designating commission flood hazard areas and setting development standards for these areas shall not be adopted for an area until public hearing has been held in the affected areas. The statute does not require written notice to land owners for designation of commission flood hazard areas.

The statute provides that any person or local governmental unit aggrieved by an order or rule may appeal such order or rule within thirty days from the date of entry of the order or rule. Appeal is to the appropriate court specified by the state in the statute.

E. Permits.

The commission or a specified commission officer to whom responsibility has been delegated shall consider all applications for proposed land uses or alterations of existing uses which require written permission by this statute. This includes not only proposed structures and obstructions in commission flood hazard areas, but also proposed construction of, or alterations to, all dikes, dams,

levees, obstructions in watercourses, and channel straightening wherever located.

The commission may require the applicant to submit information with his written application to aid the commission in evaluating the specific flooding threat at the site and the possible effects of the proposed use on other lands or the public welfare.

The commission or a designated administrative official may reject or approve the application upon such terms as it may prescribe. Grounds for approval or rejection shall be stated in writing. Considerations for the commission or officer are generally described in the statute.

Any person or governmental unit aggrieved by the decision may apply within thirty days of approval or rejection to the commission for reconsideration of the application. The commission shall reconsider the application and within thirty days of petition either issue a written decision or set the matter for hearing. The commission shall issue written decisions within thirty days of hearing.

Any person aggrieved by issuance of a permit application or refusal to grant a permit may, within a stated number of days of final disposal of the permit application, appeal to a designated court.

IX. Commission Powers to Regulate Subdivisions of Land

A. Commission approval shall be required, subject to the qualification contained in Subsection (C), for the subdivision of any lands lying wholly or partially within (1) a commission flood hazard area; (2) any flood hazard area delineated by a local ordinance; (3) all lands within five hundred feet of a river, stream, watercourse, lake or ocean; and (4) any other area subject to possible flooding threats, designated by the commission.

B. The commission shall adopt rules for the platting of subdivisions. The rules shall specify platting procedures and plat specifications. The rules may require (1) that the subdivider submit engineering and other information to the commission that will aid in determining the

flood threat; (2) that reasonable fill or other improvements be provided to assure that the subdivided area will be suited for the proposed use; (3) that the subdivider provide necessary flood protection for road, sewer and water facilities; and (4) that all flood hazard areas be clearly shown and labeled on the plat.

C. Nothing in this act shall limit the power of a local government to adopt or continue in force local subdivision regulations. If the commission determines that the subdivision regulations of a local unit meet or exceed minimum commission standards for content, administration, and enforcement, the commission shall no longer require commission approval of subdivisions for lands in that local unit. The commission shall, by rule, establish minimum standards for local subdivision regulations.

IX. Comments: Commission Powers to Regulate Subdivisions of Land

The statute delegates the commission broad powers to adopt rules for the platting of subdivisions. Several existing statutes impose special requirements for the subdivision of land in flood-prone areas. A California act requires disclosure by a subdivider of physical limitations on the land.[12] An Illinois act[13] requires the Department of Public Works and Buildings to evaluate and file a flood hazard report on a map, plat, or subdivision, submitted for recording and located within 500 feet of certain drains or watercourses. A Michigan Act,[14] specifies a variety of requirements which must be met prior to plat approval for a subdivision subject to flood threats. These requirements include deed reservations for flood hazard areas and preservation of floodway capacity.

Broad subdivision control powers such as those authorized by Draft Alternative A may be justified for several reasons: (1) The regulations are entirely prospective. (2) The subdivider may reasonably be required to supply information which will be needed by the commission in evaluating the specific flood threat on the land. Costs of the necessary surveys may be, to some extent, reflected in the sale price of the land. (3) The regulations will assure that adequate building sites and facilities are provided to prevent

victimization of buyers of subdivided lands and to assure that sufficient floodway areas will be maintained to prevent damaging obstructions to flow.

Commission approval shall ordinarily be required for subdivision plats lying wholly or partially within a commission flood hazard area; any flood hazard area delineated by a local ordinance; all lands within five hundred feet of a river, stream, watercourse, lake or ocean; and other areas designated by the commission. Therefore, broad geographical jurisdiction is given to the agency to require submission of plats in areas subject to flooding whether or not the area is specifically designated by commission order. Such broad geographical jurisdiction is considered desirable since subdivision control appears to be a particularly promising approach to regulation of many new uses in both rural and urban flood-prone areas.

However, the broad agency review powers do not prevent adoption and enforcement of local subdivision regulations. And, if local regulations meet minimum state standards, state-level review will be unnecessary. Important distinctions are to be noted between the regulation of platting and regulation of general uses in commission flood hazard areas. The commission has direct responsibility for regulation of platting and shall allow exclusive local review only if such local review meets minimum state standards. In contrast, commission regulation of most uses in commission flood hazard areas is possible only after the commission has directed the local unit to regulate the area and the local unit has failed to comply.

The commission is given broad discretion to adopt rules for platting of subdivisions. The rules shall specify platting procedures and plat specifications. The rules may require improvement of lands, protection for road, sewer and water facilities, labelling of flood hazard areas, and filing of restrictive deed covenants.

X. Regulation of Public Uses

(A) All state departments, agencies, local units of government, and public utilities, prior to any expenditure of funds for, or construction of, buildings,

structures, roads, bridges, or other facilities in regulatory flood hazard areas, areas subject to local flood hazard regulations, and other locations which may be subject to flood damage shall submit the specifications of such facilities to the commission for review and approval and shall furnish such additional information as the commission may reasonably require for its review in order to avoid the uneconomic, hazardous, or unnecessary use of flood hazard areas in connection with such facilities.

(B) With respect to existing publicly owned facilities which have suffered flood damage or which may be subject thereto, the commission may require conspicuous marking of past and probable flood heights so as to assist in creating public awareness and knowledge of flood hazards.

(C) Where economically feasible, departments, agencies, and local units of government responsible for publicly owned facilities shall apply floodproofing measures to existing facilities in order to reduce potential flood damage.

X. Comments: Regulation of Public Uses

Normally local units of government operating in governmental capacities and the state are not subject to local land use controls. The statute requires state departments, agencies, and local units of government, proposing to locate public facilities in areas which may be subject to flooding, to submit permit applications to the commission. This act follows, in many respects, Ohio Revised Code Annotated §1521.14 (Page Supp. 1968). For several reasons a special section has been set out in the statute to require commission approval for public facilities. First, it may be undesirable and politically unacceptable to authorize local units to regulate state and local governmental units although local units might assume regulatory functions for most other uses in flood hazard areas. Therefore, regulation of public use is set apart from other functions which might be exercised by the local units. Second, it is advisable to specially emphasize regulation of public uses such as bridges which, if inadequately designed, may cause serious increases in flood heights and velocities with resulting damage to other public and private property. Third, the statute extends the geographical jurisdiction for commission regulation of proposed public uses to

commission flood hazard areas, areas subject to local flood hazard regulations, and "other locations which may be subject to flood damage." This was felt justified because governmental units, when installing uses such as bridges, roads, and other facilities, often have available more flood hazard information than private developers or are capable of generating such information. And, these uses may cause particularly serious problems. Fourth, special requirements are felt desirable for public uses. For example, the commission may require a local unit to mark past and probable flood heights to increase public awareness of flood problems. The statute also generally requires governmental units to floodproof existing facilities where economically feasible to reduce flood damages. No comparable requirements are imposed upon existing private uses.

XI. Miscellaneous Commission Powers

A. The commission shall adopt administrative rules, pursuant to methods provided by law, for the transaction of its business and for the administration and exercise of its powers and duties.

B. The commission, its agents, engineers, surveyors, and other employees may enter upon any lands or waters of the state subject to procedures required by law for the purpose of undertaking any investigation, examination, survey, or other activity authorized by this statute.

C. The commission may purchase or condemn and remove or cause to be removed structures or obstructions, both artificial and natural, in watercourses, or oceans, other flood hazard areas, which increase flood hazards or constitute a hazard to life or property. Purchase or condemnation shall not be necessary for removal of public nuisances as specified in Section VI of this act. Purchase or condemnation shall be pursuant to procedures specified in_____of the laws of the state of_____.

XI. Comments: Miscellaneous Commission Powers

(1) The commission is directed to adopt rules and regulations for transaction of its business and for the administration and exercise of its powers and duties. Other sections of the statute require that the commission adopt general rules establishing minimum standards for local

regulations (Section VIII), specifying classes of uses which will be permitted, prohibited or conditionally allowed in regulatory flood hazard areas (Section VIII), specifying the conditions which may be attached to the issuance of permits for uses (Sections VIII), and establishing rules for subdivision of land (Section IX).

The commission may wish to adopt a variety of procedural rules concerning submission of permit applications for various classes of proposed uses, concerning procedures for subdivision of lands, and concerning a variety of other matters. Interpretive rules may more precisely define the terms of the statute and the agency functions. For example, the agency may wish to enumerate factors to be taken into account in evaluating permit applications including permissible backwater effects for proposed floodway or channel uses.

It is assumed that most states will have statutes which provide procedures for adoption of administrative rules and regulations including hearing and publication requirements. A state without such a statute is strongly recommended to adopt sections similar to those found in the Revised Model Administrative Procedure Act.[15]

The authors of this statute favor adoption of administrative rules by the commission wherever necessary to clarify the statute, agency policies, and procedures. Widespread publicity for all administrative rules is also strongly favored.

(2) The commissions and their authorized agents are authorized to go onto waters and lands to carry out the investigations and other activities authorized by this statute.

(3) The commission is authorized to condemn, where necessary, and to remove existing structures or obstructions which constitute a threat to life or property. The commission may utilize these powers to remove natural obstructions or other existing obstructions which would not be public nuisances and subject to removal under the terms of Section V of this statute or might use the powers

to remove nuisance-like uses. Condemnation procedures are not specified. A state may refer to condemnation procedures authorized for state agency eminent domain proceedings in other statutory contexts.

FOOTNOTES FOR APPENDIX VIII

1. Conn. Gen. Stat. Rev., Sec. 25-4c (Supp. 1967); Wash. Rev. Code Ann., Sec. 86.16.090 (1962); Wis. Stat., Sec. 87.30(2) (1967).

2. Conn. Gen. Stat. Rev., Sec. 25-7f (Supp. 1967).

3. Pa. Stat. Ann., Title 32, Sec. 687 (1967).

4. Conn. Gen. Stat. Rev., Sec. 25-7f (Supp. 1967).

5. Pa. Stat. Ann., Title 32, Sec. 687 (1967).

6. Iowa Code Ann., Sec. 455A.39 (Supp. 1969); Laws of Neb. 68. Ch. 1, Sec. 12 [1967].

7. Conn. Gen. Stat. Rev., Sec. 25-4b (Supp. 1967).

8. Iowa Code Ann., Sec. 455A.35 (Supp. 1969).

9. Laws of Neb. 63. Ch. 1, Sec. 3, [1967].

10. Mass. Acts and Resolves 459, Ch. 548 [1961].

11. Iowa Code Ann., Sec. 455A.35 (Supp. 1969).

12. Ill. Stat. Ann., Ch. 115, Sec. 13 (Supp. 1969).

13. Cal. Gen. Law 43, Act. 112, Sec. 20a [Derring 1937].

14. Mich. Stat. Ann., Sec. 26.430 (Supp. 1969).

15. National Conference of Commissioners on Uniform State Laws, Revised Model State Administrative Procedure Act, Subsection 2-8 (1961), set out in Appendix to 2 F. Cooper, State Administrative Law 797 (1965).

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