

CHAPTER V

THE PERCEPTION AND ADOPTION OF ALTERNATIVE FLOOD DAMAGE REDUCTION MEASURES

It is illuminating to examine not only the way in which flood plain dwellers perceive the flood hazard but the ways in which they can deal with flood loss. The theoretical range of choice available for a flood damage reduction program was outlined in the opening pages. This chapter will examine in detail the portion of that theoretical range of choice perceived by either respondents or technical personnel as applicable to the conditions of LaFollette and the other study sites. These might be considered the practical range of choice.

These alternatives may be reviewed under six major groupings: bearing the loss, emergency actions, changes in structure or land elevation, changes in land use, flood control and abatement, and insurance. Many alternatives have both individual and community variants, often quite different, though not mutually exclusive, and in general distinguishing the major responsibility or capability for effectuating the alternative between the individual manager and community in its broadest sense.

Respondents and technical personnel may perceive alternatives, perception being the specific indication by word or deed of an awareness of some alternative action without interviewer's suggestion.¹ The array of perceived alternatives might be thought of as the perceived range of choice. Perceived alternatives can be adopted. Adoption is the partial or complete installation of any action. Figure 13 attempts to present schematically these relationships.

The Practical Range of Choice at LaFollette

Bearing the loss.--The most common human adjustment to flood hazard is for an individual to bear the loss when it occurs.

¹Reference might be made to the five-stage scheme used by rural sociologists and others to describe the adoption of new ideas and practices. Perception might be considered akin to the first three of these stages: awareness, interest and evaluation, while adoption describes the final stages of both trial and adoption. See Herbert F. Lionberger, Adoption of New Ideas and Practices (Ames: Iowa State University Press, 1960), pp. 22-23.

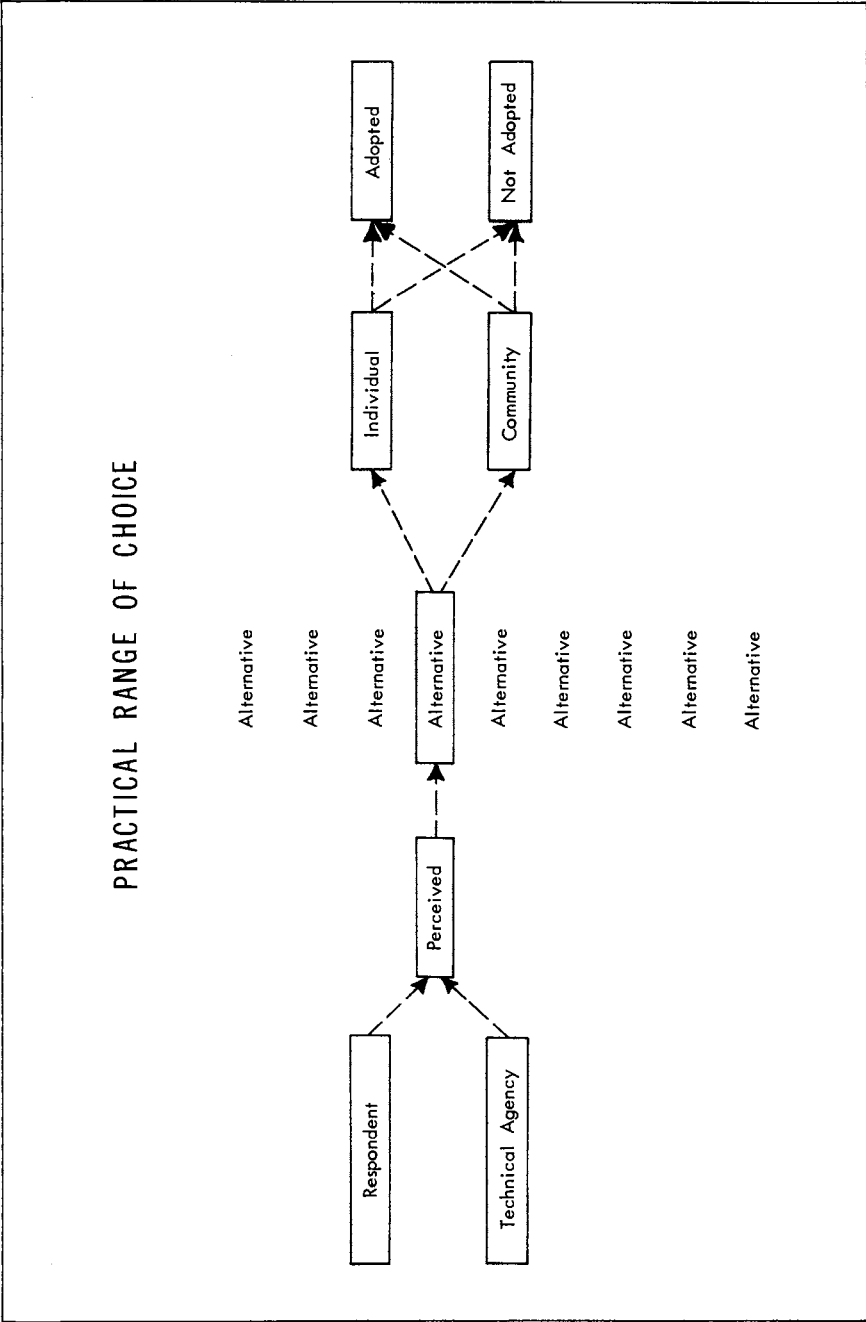


Fig. 13. ---Variants of the Perception and Adoption of a Single Alternative

In general such losses may or may not have been expected, but even where some losses are expected, their frequency or magnitude is often underestimated.

The individual bearing of losses can result in reducing flood damages only from the broad view of the community. This is the case when the sum of the individual losses is less than the expenditures of the community on measures designed to prevent such losses.

Though the expectation of future losses does not reduce flood damages for the individual directly, it is a necessary condition that encourages the search for other alternatives.

Therefore, a comprehensive flood damage reduction program would attempt to insure that no manager suffered an unexpected loss. It would do this by providing information regarding the magnitude and frequency of such losses.¹ To date, the only authoritative effort at informing managers as to potential flood loss is the TVA volume, Floods on Big Creek, the limitations of which have already been discussed.

That a considerable effort to inform managers might be required is indicated by Table 20 which shows that both now and in the past a majority of LaFollette managers do not expect to bear losses by virtue of their failure to perceive a flood hazard.

While one might logically infer that if a respondent does not expect a flood, he does not expect a flood loss, the converse is not necessarily true for some managers do expect to avoid losses when a flood occurs. Since there were no questions asked of respondents that distinguished between the expectation of a flood and of bearing a loss, the 45 respondents who expect a future flood might include all those who expect to bear a loss as well as some who do not. Of these 45, 22 have adopted some minimum action designed to reduce flood damage, 15 others perceive such actions but have not adopted any, and 7 either fail to perceive any actions or have rejected them.

Presently, upwards of 45 managers expect to bear a loss and this might be compared with 46 who held a similar expectation when they made their original decision to locate on the flood plain. Since the two sets of data are statistically independent, they suggest an addition to the certainty-uncertainty hypothesis. This would say that the expectation of bearing a loss is a function

¹A comprehensive flood damage reduction program is presented in the companion study. As the final program depends heavily on still uncompleted economic analysis, reference to it is of a general rather than specific nature.

of the location of an urban place on the certainty-uncertainty scale, and if such location were approximately constant through time, then the number of persons expecting to bear a loss would also be constant through time.

TABLE 20
EXPECTATION OF BEARING A FUTURE FLOOD LOSS

Actions	At Time of Original Decision to Locate on Flood Plain		At Present Time	
	Number	Per Cent	Number	Per Cent
Bear unexpected loss	56	54.9	40	38.1
Uncertain .....	...	...	20	19.0
Might bear expected loss	46	45.1	45	42.8
Total	102	100.0	105	99.9
Might bear expected loss and:				
Adopted minimum action to reduce loss .....	...	...	22	48.9
Perceived minimum action to reduce loss	15	32.6	15	33.3
No action perceived or action rejected	23	50.0	7	15.6
Action not ascertained	8	17.4	1	2.2
Total	46	100.0	45	100.0

From the overall view, flood losses in LaFollette have been modest. A generous estimate of \$97,000 accounts for the damage from the 1950 flood as estimated by TVA. From the interviews only one in five respondents recalled having any loss at all (compare with the 50 per cent who experienced the flood) and for only one in ten these losses exceeded \$150.

Related to the alternative of bearing a loss are the relief activities of the community, for these activities make bearing the loss a more attractive alternative. They tend to mitigate some of the physical suffering and discomfort related to floods and their monetary assistance for rebuilding and refurbishing structures seems to place a ceiling on losses, particularly those of the lower income flood plain manager. The conscience of the community seldom permits any flood victim to be completely destitute. The net impact of relief activities on flood damage reduction is somewhat speculative, but from a community point of view they tend to increase the toll of flood losses.

The Red Cross, the major community organization charged with relief activities, has no specific plan for coping with disasters in LaFollette.¹ A minister serves as local representative and assistance in case of disaster would have to be improvised according to established national guides. No assistance was rendered after the 1950 flood, and in any event no respondent indicated that the prospect of obtaining relief consciously entered his decision-making.

Emergency actions. --Almost all floods involve a series of emergency responses. These generally are in three directions: (1) flood fighting involving either keeping the water out or hastening it through the establishment; (2) the temporary evacuation of men and material from the path of the flood; (3) the re-scheduling of activities, mainly economic, to minimize disruptive and damaging flood effects.

The complexity of the responses varies considerably, depending on prior thought and preparation and the quality of the flood warning.

A comprehensive emergency plan for reducing flood damage in LaFollette might start with extending the warning period to provide the maximum of two hours that a year-round warning system with radar equipment might provide.² Given a two-hour warning prior to major floods, an organized community might first see to the evacuation of persons from the flood plain, the disconnection of utilities (a major source of damage), and other measures designed for the protection of equipment. Then, depending on the height of the flood and the location of an establishment, an attempt might be made to keep the water out of well-constructed brick buildings and to remove or elevate machinery and goods in others. Materials such as sand bags for flood fighting would be provided beforehand and individual establishments would have semi-formal plans for flood fighting and the removal or elevation of goods from the path of the flood.

Some emergency actions are widely perceived and acted upon, others dimly perceived and even rejected. A quotation from the TVA report might convey the quality of the emergency actions undertaken during the 1950 flood:

¹Interview with Mrs. Abbie Houston, Director of Home Services, Knoxville Chapter, American Red Cross.

²The Weather Bureau suggests that the maximum warning that might be provided would be between one and two hours for a flood of the size of the 1950 flood. (Personal communication to G. F. White from William E. Hiatt, U.S. Weather Bureau, Hydrologic Services Division, July 27, 1961.)

Although the high stage of the creek flood occurred after closing time, many merchants had been alerted by the surface water flood accompanying the intense downpour. As a result they had been busily engaged in trying to block out the water with bags of flour, feed, fertilizer, old rags and other handy materials. Some closed their doors and stuffed cotton under them to keep out the water. These expedients were successful at a number of stores along the south side of Central Avenue where the water reached only the front of the stores. Here the water was one foot to eighteen inches deep on the street side of the stores but 5 to 6 feet lower under the buildings. Realizing this, the merchants simply tore out their wooden vestibules or cut holes in the floor near the front of their stores and let the water drain out as fast as it seeped in.

On the north side of Central Avenue, on the east side of Tennessee Avenue and elsewhere in the business section the situation was more complicated. Water completely surrounded these buildings, entering not only through the front and back but in some cases coming up through the wooden floors. As a result sand bagging operations were of little value.¹

The experience described in the previous paragraph weighs heavily on the perception of emergency actions today. The measures undertaken then were rudimentary, improvised, but effective for many establishments. Managers were quick to acquaint interviewers with their successful experiences in flood fighting pointing to an ever-ready supply of flour sacks in grocery stores or to holes that were drilled in the vestibule floors to drain water to the basements. Table 21 summarizes the perception of emergency actions to be employed in some future flood. In the case of emergency actions their perception implies adoption, for adoption in the formal sense must await a future flood.

Commercial and residential managers have markedly different perceptions of emergency action alternatives. Whereas 81.9 per cent of the commercial respondents perceived at least one emergency action that they might undertake, only 23.7 per cent of the residential managers did likewise.

This difference is in keeping with the differences between both structures and resources available to the two groups. The commercial respondents are housed mostly in brick buildings, and have available manpower and transport. In contrast, the residential managers reside in wooden structures and lack both manpower and transport to plan for the elevation or removal of their furnishings.

Thus it was not surprising to find that the most common action cited by the residential group (although of doubtful worth as a flood damage reduction measure) was to "get out."

¹TVA, Floods on Big Creek, pp. 16-17.

TABLE 21

PERCEPTION OF EMERGENCY ACTIONS

Actions	Commercial		Residential		Total	
	Number	Per Cent of Respondents	Number	Per Cent of Respondents	Number	Per Cent of Respondents
Actions perceived not requiring prior preparation:						
Elevation and removal of goods	35	53.9	2	5.3	37	36.0
Flood fighting	33	51.6	2	5.3	35	34.3
Protection of equipment ..	8	12.7	5	13.1	13	12.9
Actions perceived requiring prior preparation:						
Stock materials for flood fighting	12	18.8	..	..	12	11.5
Community warning system .	1	1.6	1	2.8	2	1.9
Total, at least one of the above	54	81.9	9	23.7	63	60.5

To help people "get out" was the role perceived by the LaFollette Rescue Squad, a recently organized group of volunteers equipped with boats, ambulances, and emergency equipment of all types, and whose headquarters is located on the flood plain. The Rescue Squad recently evacuated, during a minor flood, several residents who live right alongside the creek. The only other community organization with a perceived role in flood damage reduction was the Fire Department whose pumper had assisted merchants in clearing basements of water in 1950.

It would be quite possible for the combined forces of the Fire Department and Rescue Squad to provide considerable strength for an emergency flood plan that would go far beyond the evacuation of persons and would include the disconnection of utilities, elevation of furnishings, and assistance to the merchants in the elevation and removal of stock. Such plans, which have been instituted elsewhere in the nation, depend considerably on an adequate warning. A comprehensive radar system or a more limited program involving the cooperation of the fire control radio network of the State Forestry Division could provide such a warning.

The major obstacle to such a program is that not only do few persons perceive the need for an improved warning system but

there is actually serious opposition to one. In part people feel they are protected, citing the fire department, the radio, and Rescue Squad as sources for early warning. Paradoxically, while some are convinced they have ample warning, others doubt the efficacy of any warning system on a stream whose rate of rise is as fast as that of Big Creek. When questioned as to the desirability of an improved warning system 28 respondents rejected it out of hand.

Another obstacle to more refined emergency actions lies in the progressive atrophy of any disaster preparations with time. A number of commercial respondents cited to interviewers their immediate post-flood stocking of sand bags, then gradually getting rid of the sand and saving the bags, until now they were even uncertain as to the location of the bags.

Structural change and land elevation.--One of the most ancient of man's responses to flood hazard is the design and construction of his structures to minimize damage or the elevation of his site above the flood. Somewhat paradoxically, the application of modern architectural and engineering skills to the design of such structural innovations has been quite limited. A revival of interest in this approach to flood hazard reduction is discussed comprehensively in a recent work by Sheaffer.¹

A comprehensive flood damage reduction program in LaFollette would consider the elevation on block foundations of the older wooden homes in the flood plain as well as provide for the elevation of the sites of new buildings. If site elevation would not prove practicable for new buildings a considerable variety of architectural techniques would be available for virtually flood-proofing such buildings depending upon the magnitude and frequencies of floods to be encountered.

In the older commercial buildings minor openings can be bricked shut and temporary bulkheads placed across permanent openings. Backup valves, pumps, and tuckpointing would help control seepage. For almost all commercial ventures, some reorganization of contents can minimize damage. The comprehensive program would make available information as to sources of specialized equipment, their use, and installation.

Although the formal application of architectural and engineering skills has lagged, it would appear from the LaFollette data that managers do give thought to reducing flood damages by changes in the structure, organization of contents, and in the

¹J. Sheaffer, Flood-Proofing: An Element in a Flood Damage Reduction Program (Chicago: University of Chicago, Department of Geography Research Paper No. 65, 1960).

design of new structures or remodeling. Table 22 indicates the range and participation in the perception and adoption of such actions.

TABLE 22
PERCEPTION AND ADOPTION OF STRUCTURAL CHANGE
AND LAND ELEVATION ACTIONS

Actions	Commercial		Residential		Total	
	Number	Per Cent of Respondents	Number	Per Cent of Respondents	Number	Per Cent of Respondents
Individual structural and elevation actions adopted:						
Brickwork and other measures to keep water out	3	4.5	..	..	3	2.8
Sump pumps and water disposal	3	4.5	3	7.9	6	5.7
Reorganization of contents	4	6.0	..	..	4	3.8
Land elevation	5	7.5	1	2.6	6	5.7
Sub-total	15	22.5	4	10.5	19	18.1
Individual structural and elevation actions perceived:						
			Not ascertained			
Community structural and elevation actions adopted:						
Land elevation of municipal building	2	3.0	..	..	2	1.9
Sub-total	2	3.0	..	..	2	1.9
Community structural and elevation actions perceived:						
Miscellaneous actions	3	4.5	3	7.9	6	5.7
Sub-total	5	7.5	3	7.9	8	7.6
Total, at least one of the above actions ..	19	28.4	6	15.8	25	23.8

The actions themselves range from the minimum provision of a sump pump or bricking up a basement window, to such relatively complex actions as the installation of terrazzo flooring to facilitate cleanup or the replacement of subfloor wiring to prevent shortcircuits of key motor units in a millwork shop.

Any actions taken appear to be home grown with no evidence that they were inspired by or involved any considerable technical advice, although a few persons undertaking these minimal actions did possess some construction skills. The one exception was the construction of the variety store built over the creek on steel piles; this having been done on the basis of advice sought from TVA engineers.

The major tools that a program of flood damage reduction might use to effect structural and land elevation changes were not perceived at all by respondents. The elevation of existing houses by jacking them up and replacing their foundations was not considered by residential respondents who in the main perceived no possible structural changes that they might undertake. The commercial respondents also seemed totally unaware of the use of bulkheads in permanently installed frames as a major tool for keeping water out of solidly constructed buildings. This is not surprising considering the small number of such installations found in the entire country.

Six respondents perceived various minor changes that the community might install or pay for and two respondents claimed credit for the elevation of the municipal building (constructed in 1950) one foot higher than the projected grade.

As to the willingness to consider structural changes, the following question was posed to commercial respondents:

If you found that at the cost of several hundred dollars you could make some small changes to the building that would protect your stock from most floods, would you make these alterations?

Almost half the respondents replying answered in the affirmative and seven others indicated that they would consider it but that they needed the approval of landlord, owner, or the like. An equal number felt they knew of sources where funds might be borrowed for such a purpose.

The question was not posed to residential respondents as there are no small changes that might protect them from flood hazard. Preliminary data from the companion study indicate that the question might prove unrealistic for many commercial managers as well. The cost of protecting stock would be considerably in excess of several hundred dollars. Thus the response is at best interpreted as providing a measure of the maximum number of managers that might be interested in flood proofing, being in this case no more than 50 per cent.

Changing land use.--A most effective, albeit costly, flood damage reduction alternative is a dramatic change in land use by

the permanent evacuation of the flood plain. In a somewhat less drastic fashion, a variety of regulatory means are at hand to encourage or mandate a shift in land use from high to low flood damage uses.

A comprehensive flood damage reduction program would utilize the regulatory powers of the LaFollette City Commission to amend the present zoning ordinance to provide a floodway zone for the unobstructed flow of water and a flood fringe zone in which new construction would be prohibited unless elevated above a given flood level. Non-conforming uses in these areas would be eliminated through time and new construction controlled by the issuance of building permits. These powers would be reinforced by the application of the loan activities of the FHA and VA in such manner as to inhibit an increase in damage potential. Finally, information would be available that would enable managers to evaluate the benefits of complete evacuation from the flood plain.

Since the 1950 flood there have been extensive changes in land use, but unfortunately not in the direction of reducing flood damage. In that time 15 new commercial structures or additions and at least 2 new homes have been built in the overflow area of the 1950 flood. There was also 1 case of a structure being demolished and the land shifted to an open use--a parking lot.

While it is relatively easy to measure the increase in encroachment upon the flood plain, it is difficult to obtain data on those who left the flood plain because of their assessment of flood hazard. Using the only 2 available city directories, 15 flood plain dwellers who had moved between 1955 and 1959 within LaFollette were identified.¹ Four of these moved to other locations on the flood plain, 5 could not be located, and of the remaining 6, none had considered floods in deciding to evacuate the flood plain.

In the course of the study, only 1 individual was found in the entire town who had moved off the flood plain because of a fear of floods. (She is actually on the fringe of the flood plain but does not know it.) Of the 11 respondents with concrete plans for moving off the flood plain, only 1, a residential respondent, indicated that flood problems had entered into the decision.

In summary, then, the decade following the 1950 flood has seen intensified use of the flood plain and no major compensatory movement towards reduction of damage potential by shifts in land use or voluntary evacuation.

¹LaFollette City Directory, 1956, 1960 (Chillicothe, Ohio: Mullin-Kille Company, 1956, 1960), *passim*.

At present, the governmental financing policies that would serve to reduce flood damage potential in other areas are not operative. Although both the FHA and VA have adopted policies in this area that would discourage an increase in construction of new residences in the flood plain, neither agency has had an opportunity in recent years to put such policies into practice.¹ What construction goes on, and there is a new residence now under construction along the creek, is financed by private capital, bank loans, or by the purchase of materials on credit. Much real estate that changes hands in LaFollette is by contract, and auction sales are common.

The major legal control in LaFollette on land use is the present zoning ordinance passed in 1947 and not revised since.² Using a common format it provides for residential, local and general business districts, light industry, and industry districts. Enforcement through the years has been spotty, there being no official Municipal Building Inspector as provided for in the ordinance, the chores being shared by the City Recorder and the Street Superintendent. Building permits are issued for only some of the new construction and only in cases of strong complaint or flagrant violation might they be denied. Non-confirming uses are commonly found even in new construction.

An amendment to the present zoning ordinance has been pending for a considerable time, having been passed on first and second reading in August of 1960, but still awaiting final action. The amendment, its purpose, and some of the considerations involved in its drafting can be best presented in the words used by the LaFollette Planning Commission itself:

A study of the available flood data suggests that there is a need for maintaining at least a minimum "floodway" for Big Creek. The purpose of the floodway is to assure that flood waters which can be reasonably expected may be accommodated within the limits of the stream and its flood plain. This suggestion is based upon two major considerations. First, land fill, structures and other restrictions to the flow of water placed in the stream or on the flood plain could cause increased flood elevations upstream

A second consideration on the need of a floodway is that areas subject to flood are hazardous to life and property. Authorities agree that the really dangerous flood areas are those covered by two or more feet of water and located in

¹Communication from Charles M. Johnson, Veterans' Administration, Nashville, Tennessee, and interview with Gray McCarroll, Federal Housing Administration, Knoxville, Tennessee, July 13, 1961.

²LaFollette City Commission, Zoning Ordinance of City of LaFollette (LaFollette: City of LaFollette, 1947).

the main stream of the flood plain where water velocities are likely to be high

To meet this problem it is recommended that the zoning ordinance designate a floodway sufficient to pass floods down Big Creek without unduly increasing flood heights upstream, and within which flooding is dangerous to life and property. Areas where flood waters tend to eddy and would not materially help the flow of water through the area would not be included in the floodway.

The three categories of floods have been considered as to their applicability for this purpose. It is believed that the maximum probable flood is too large . . . the maximum flood of record is considered low The regional flood is considered a more reasonable basis for determining elevations and delimiting a floodway.

. . . . Assuming that structures and/or earth fills would be built to cover the entire fringe area just outside the floodway . . . the regional flood height for Big Creek would be increased about 2 feet It is not possible to have a reasonable floodway through LaFollette which would not increase the height of large floods unless the creek channel was widened.

Within the floodway district subdivision of land would not be permitted and all buildings for human habitation would be prohibited. Agriculture, recreation, parking and other open-type uses not damaged by floods would be permitted . . . filling of land would be prohibited.

Outside the floodway all legal uses would be permitted, provided that the first floor of structures is above the elevation subject to flood. Land could be filled or foundations of structures raised to these elevations.¹

The initiative for the amendment comes from the joint program for flood damage prevention of the TVA and the Tennessee State Planning Commission which supplies professional planning services to LaFollette through the LaFollette Planning Commission. Out of 97 communities with completed TVA flood hazard studies some 25 have already adopted regulations based on these studies and numerous other regulations are in various stages of study or adoption.²

Since the floodway amendment is the major form of community action pending before LaFollette the circumstances surrounding the proposal might be examined with some care.

On the surface, it would appear that there is much that would favor its passage. A number of creekside managers expressed strong concern over the alleged encroachment activities of their neighbors. Figure 14 records their attitudes in a generalized diagram. Five of the 13 managers who perceived of the floodway as a flood loss reduction alternative are located at creekside, and include a number of civic-minded and influential men.

¹LaFollette Planning Commission, pp. 3-4.

²Communication from Local Flood Relations Branch, TVA, July, 1962.

COMPLAINTS OF ENCROACHMENT (Highly Generalized)

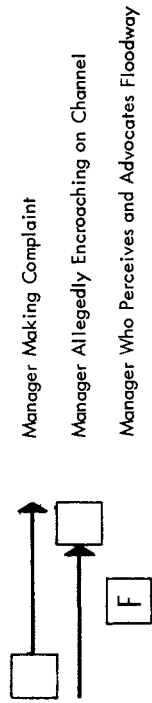
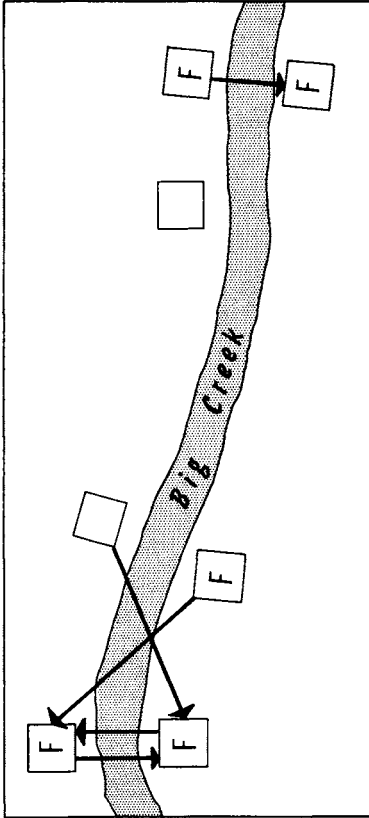


Fig. 14

TABLE 23

FLOODWAY ATTITUDE AND STRUCTURE DATA

Item	Commercial		Residential		Total	
	Num-ber	Per Cent	Num-ber	Per Cent	Num-ber	Per Cent
Attitudes by floodway respondents:						
Perceive floodway	4	44.4	..	..	4	30.8
Approve floodway	1	11.1	2	50.0	3	23.1
Dubious about floodway ..	3	33.3	2	50.0	5	38.5
Attitude not ascertained.	1	11.1	..	..	1	7.7
Total	9	99.9	4	100.0	13	100.1
Attitudes by non-floodway respondents:						
Perceive floodway	9	14.5	..	..	9	9.4
Approve floodway	28	45.2	22	64.7	50	52.1
Dubious about floodway ..	17	27.4	10	29.4	27	28.1
Attitude not ascertained.	8	12.9	2	5.9	10	10.4
Total	62	100.0	34	100.0	96	100.0
Floodway structure data:						
Structures extending 50% or more into floodway:						
Constructed: Pre-1945 .	5		4		9	
1943-1950.	4		5		9	
Post-1950.	3		1		4	
Total	12		10		22	

The general attitude towards the floodway proposal is also favorable (see Table 23). Although a larger proportion of floodway respondents are dubious over the proposal compared with those whose establishments are out of the proposed floodway, given the small numbers, this proportion is not significant. More important, no substantial overt opposition to the proposal could be found in the entire town. The only case of heated verbal opposition was initiated by the study itself, when one respondent outspokenly in favor of the proposal was shown the map of the proposed floodway. When to his surprise he found that a vacant lot he owned was included in the proposal, he quickly reversed himself. However, despite the unanimous support for the proposal evidenced by influential managers, interviewers found managers alluding to the opposition of others. While ostensibly supporting the proposal himself, each of these managers would attribute opposition to some other, and particularly one who was suspected

of having designs on the creek for further encroachment.

Therefore, while the overt opposition appears negligible, the perceived opposition appears large to certain of the decision-makers. Given the political balance outstanding in LaFollette at the time, a perceived opposition, even if not real, is enough to slow down any decision, especially when it concerns a proposal the fruits of which are only tenuous. The tenuous nature of the proposal lies not in its intrinsic merit, for there is strong feeling for preventing encroachment. The uncertainty lies in the previous experience with other regulation, in an unsureness whether passage of the ordinance would ever involve effective enforcement or be a paper gesture.

Another simpler explanation as to failure of passage of the proposal favored by some informed persons was that it was merely oversight. As support for this explanation, the study found that a number of officials and others actually thought that the ordinance had been passed. If this simpler explanation is valid, then an external nudge might be all that would be required to secure passage.

Leaving aside the decision-making aspects of the proposal and speculation as to whether its passage would lead to its enforcement, certain beneficial actions have already resulted from the discussion of the ordinance and the presentations of the TVA and the Tennessee State Planning Commission in this regard.

The interest generated at the time led to the temporary withholding of at least two building permits, leading in one case to negotiation that resulted in placing the variety store on piles rather than solid fill, and in the other case to the manager's plan for fill being held in abeyance. In another action, the LaFollette Housing Authority is using the proposed floodway line to guide its construction of a housing project for the aged that will overlook the creek. Thus, while formal passage of the ordinance has lagged and formal enforcement would always be in doubt, the flood hazard report and the floodway amendment proposal would appear to be informal inhibitors to encroachment.

As a final observation on land use in LaFollette it might be noted that, although there has been considerable flood plain expansion in the past decade, the continuance of such in the future would appear to be severely limited by non-flood related considerations. Highway-oriented sites are becoming increasingly attractive to local business men. The shirt factory has concrete plans to move off the flood plain and this would remove the major source of monetary damage potential. The future relative decline of LaFollette would inhibit any considerable economic expansion

and the supply of attractive flood plain sites is quite limited.

Flood control and abatement.--The most prevalent method of flood damage reduction is the use of various engineering and land treatment works to restrain or control flood waters.

A comprehensive flood damage reduction program would subject to a variety of economic and engineering feasibility tests the potential of engineering works for reducing flood damages in LaFollette. Practically these would center around an upstream reservoir and a series of channel improvements including the elimination of the bottleneck created by the Central Avenue crossing.

The only actual flood control measures adopted in LaFollette have been the sporadic clearing of the channel. Channel clearing, consisting of bulldozing debris from the rock base, clearing brush, and building up the banks, has been done in 1948, 1951 and 1956. According to local reports \$790 was spent on the 1951 work and \$960 on the 1956 work. While townsfolk appear to be considerably impressed with the efficacy of such work, TVA data suggest that the effect of such clearing on the 1950 flood would be negligible. In addition to the community sponsored channel clearing, two riparian managers claim that they regularly keep their property free of brush and debris.

Levees have never been seriously considered by many in LaFollette. The old LaFollette Coal and Iron Company elevated right-of-way acts as a partial levee between Central Avenue and Beech Street. (See pattern of 1950 flood on Fig. 2.) The Corps of Engineers Report discusses both levees and channel improvements as follows:

Channel rectification to the extent which would be necessary appears impractical due to the cost of rock excavation involved and the fact that a number of buildings for which flood protection is desired, would have to be demolished. Protection by means of a system of levees or walls is also considered impractical due to physical limitations of right-of-way. The most feasible method of control seems to be by means of a reservoir above the city.¹

A reservoir above the city for water supply purposes has been considered in reports by two engineering firms, the present 28-foot dam having proved inadequate. The Corps Letter Report, using data from an early engineering study for water supply, estimated that (in 1961) a dam that might completely control the 1950 flood and pass safely a considerably larger one would cost \$1,125,000. Assuming a twenty-year return period for the 1950

¹Letter Report on Flood Conditions . . . , p. 3.

flood, the Corps estimated that this project would return but 24 cents for every dollar of cost.

During the period of the study, there was lively interest in a flood control dam as an appendage to a water-supply dam that might be constructed with the help of the Area Redevelopment Administration. However, judging from local accounts since that time this has been dropped and a dam to be built with an A.R.A. grant will provide only water supply storage.¹

One further action that might be considered to reduce flood damages is the replacement of the Central Avenue Viaduct, the constriction of which in 1950 raised flood heights behind it an estimated 5.5 feet. Although clearly recognized by the townspeople for its constricting effect, and despite major highway improvements in 1961 along Central Avenue, its replacement has never been considered by the State Highway Department which maintains Central Avenue as part of State Route 63. The resident engineer claimed that he had never seen a copy of the TVA Flood Report and showed little interest in its data regarding the viaduct's flood constricting effects, being only concerned with its vehicle-carrying function.

Despite the general reluctance of technical personnel to support flood control and abatement measures, on either engineering or economic grounds, these form the most common alternatives perceived by LaFollette residents. This finding is in keeping with experience across the country.

Table 24 summarizes this perception. One out of every five respondents has taken action, either individually or in a social role to encourage flood control activity. Two out of three respondents perceive the desirability of flood control measures.

The large number of individuals perceiving the desirability of channel improvements appear strongly influenced by what might be called the heightened reality of channel improvements.

Fifteen miles to the south of LaFollette, at Lake City, a recently completed channel improvement project of the Corps of Engineers bears continuous witness to the potential of channel improvement. The dredging of the creek on all three occasions created quite a stir in a town where nothing that stirs goes unnoticed. How impressive this is, was brought home to the study group in the following way. While the study was going on, a riparian manager hired a bulldozer to build up the banks and fill low spots in preparation for more intensive use of his land.

¹The LaFollette Press, August 24, 1961.

From that day on respondents cited the bulldozer's operations as a new creek dredging effort that would reduce the flood hazard, when actually the converse is more probable.

TABLE 24
PERCEPTION AND ADOPTION OF FLOOD CONTROL
AND ABATEMENT ACTIONS

Actions	Commercial		Residential		Total	
	Number	Per Cent of Respondents	Number	Per Cent of Respondents	Number	Per Cent of Respondents
Individual actions adopted:						
Cleared and cleaned riparian channel	2	3.1	..	..	2	2.0
Contributed financially to channel clearing	2	3.1	..	..	2	2.0
Encouraged and promoted community action in:						
Role as public officials	11	17.2	..	..	11	10.8
Association with public officials	3	4.7	..	..	3	2.9
Urging action by public officials	4	6.2	2	5.3	6	5.8
Total, at least one of above ...	20	31.3	2	5.3	24	23.5
Community actions perceived:						
Channel improvement	46	70.7	14	38.9	60	59.4
Enlargement of Central Avenue Viaduct	15	24.8	1	2.8	16	16.0
Upstream reservoir	14	21.5	1	2.8	15	4.7
Levee	8	12.3	2	5.3	10	10.1
Total, at least one of above ...	52	81.4	16	42.1	68	67.5

Insurance.--From the individual point of view, insurance is an effective way of dealing with flood damages by spreading the risk in time and space. From a national point of view insurance adds to the toll of flood losses,¹ for in addition to the

¹An exception might be an insurance scheme which was so administered as to encourage the reduction of flood damage potential to the extent that this reduction in damage exceeded the costs of administration.

total flood losses are the costs of management that in the case of fire insurance creates a ratio of premiums to paid losses of 2:1.¹

Insurance is only obtainable under special conditions. Local insurance agents in LaFollette were ignorant of these conditions and advised clients that insurance was unobtainable. One agent had kept a file of newspaper discussions on flood insurance for several years.

A comprehensive flood damage reduction program might consider insurance for certain managers. Insurance might prove a viable alternative for an extremely large establishment such as the shirt factory or for branch establishments of regional or national firms who might secure comprehensive policies with ease for all branches. Insurance would probably be prohibitive for all other managers.

Despite the difficulty of securing insurance 21 respondents thought they were covered by insurance through their existing policies. Considering the number of managers who shared this misconception up until the 1950 flood, this is a very high figure. The net effect of managers believing they are covered by insurance when they are really not is to reduce the likelihood that such managers would adopt more realistic damage reduction alternatives.

The Perception and Adoption of Alternatives at LaFollette

Three questions should be raised concerning the alternatives perceived and adopted by technical personnel and LaFollette flood plain managers: (1) How does the practical range of choice of technical personnel compare with that of the flood plain managers? (2) Is there any discernible order in the perception and adoption of alternatives? (3) How does the perception and adoption of alternatives relate to the other flood characteristics studied?

The practical range of choice of technical personnel and flood plain managers.--A comparison of the range of choice of flood plain managers and technical personnel suggests important similarities and differences. The major similarity lies in the overlap of such ranges of choice when these are organized under

¹National Academy of Sciences, National Research Council, Committee on Fire Research, A Study of Fire Problems (Washington: National Academy of Sciences-National Research Council Publication No. 949, 1961), p. 33.

major categories of action. Flood plain managers and technical personnel perceive some variant of alternative in every major class of damage reduction measures.

The main difference lies in the quantity and quality of these perceptions. Among flood plain managers, knowledge concerning alternatives that are perceived as most effective in reducing flood damages by some technical personnel is thinly diffused and its quality is at best sketchy. Thus only a minority of LaFollette managers would bear an expected loss, foresee the substantial gains that might be made by a community flood warning system, the stockpiling of sandbags, the use of the organized manpower and transport of the Rescue Squad, or the enlargement of the Central Avenue Viaduct. Conversely such measures deprecated by technical personnel, as the clearing of brush and debris from the channel, the mistaken belief in insurance coverage, and the efficacy of improvised flood-fighting are held in high esteem by many managers.

Both the perception of technical personnel and respondents are weighted heavily by experience and observation. Technical people draw on the experience of a hundred communities. LaFollette managers draw only on several at best. Professional flood-fighters have seen towns earnestly barricade their doorways with flour sacks and rags, only to be overwhelmed by an additional foot of water. In LaFollette, such action was successful in 1950, and for managers who perceive no larger flood than suffered in the past, these improvised measures are a sufficient solution to an occasional problem.

That flood problems are occasional is at times forgotten by technical personnel who are always preoccupied with some flood problem, somewhere. For many technical people, aspects of flood damage reduction have been the focus of much of their working life and they consistently bring to bear on them all their reasoning powers. In contrast, the flood plain manager only focuses a small portion of whatever bounded rationality he possesses on flood problems. Flood hazard, even when perceived, is but one of a host of problems requiring solution, and except for those moments of disaster, is quickly submerged beneath the requirements of paying the rent or hiring help. The flood of 1950 lasted for two weeks on the pages of the LaFollette Press, yet for technical personnel it is of a genre of concern that finds it the focus of several reports and provides source material for the greater portion of two books.

It is therefore not surprising to note the differences between alternatives perceived by technical personnel and by flood plain managers. Despite the casualness and improvisation employed

by managers in searching and evaluating alternatives, one is nevertheless struck by the variety and ingenuity displayed in the process.

The ordering of perceived alternatives.--In reviewing the perception of alternatives, it appears that managers do not perceive a range of alternatives in a random manner, but rather as if such alternatives were spaced along a continuum ranging from no perception to adoption.

Using Guttman scaling techniques, the perception of alternatives appears to pass through a hierarchy of no perception, common perception, uncommon perception, and adoption. The perception or adoption of any one of the grouped alternatives in either its individual or community variants advances an individual's ranking on the scale. The path an individual respondent might choose to obtain such ranking is shown on Figure 15 along with the numbers of respondents that qualify at each stage.

A scale implies a hierarchy of values, that is, an individual who adopts an alternative also perceives at least one common and one uncommon individual or community alternative. It should be noted that within each group of common or uncommon alternatives, all are considered equal, that is, the perception of a channel improvement is neither higher nor lower on the perception scale than the perception of a levee. A further assumption is that individual and community variants are also equal and an individual might perceive, for example, a common individual variant and an uncommon community variant.

The test of a scale is the ability to reproduce the individual's characteristics from its final score or classification. In this scale an individual who is an adopter must possess at least one common or uncommon perception, and uncommon perceivers must have at least one common perception. If they do not, then in the practice of scaling they are in "error."¹ There are six

¹A few notes concerning scaling may be in order. Each classification of a respondent might be considered as a score ranging from 0,1,2,3--and 3 representing adoption. A score of 3 would then indicate or reproduce the other items leading to adoption--a common perception or an uncommon perception. The coefficient of reproducibility is a measure of the success one would obtain by reproducing the components of perception-adoption from the final score. For the LaFollette data it is 96.1%. This is quite high and should be interpreted in the light of two other considerations.

First is the construction of the scale itself. Anyone who had installed a structural change provided *prima facie* evidence of perceiving structural change. There are nine individuals who only qualified as adopters in this manner, and for these, they scale correctly by definition.

Secondly, all coefficients of reproducibility should be

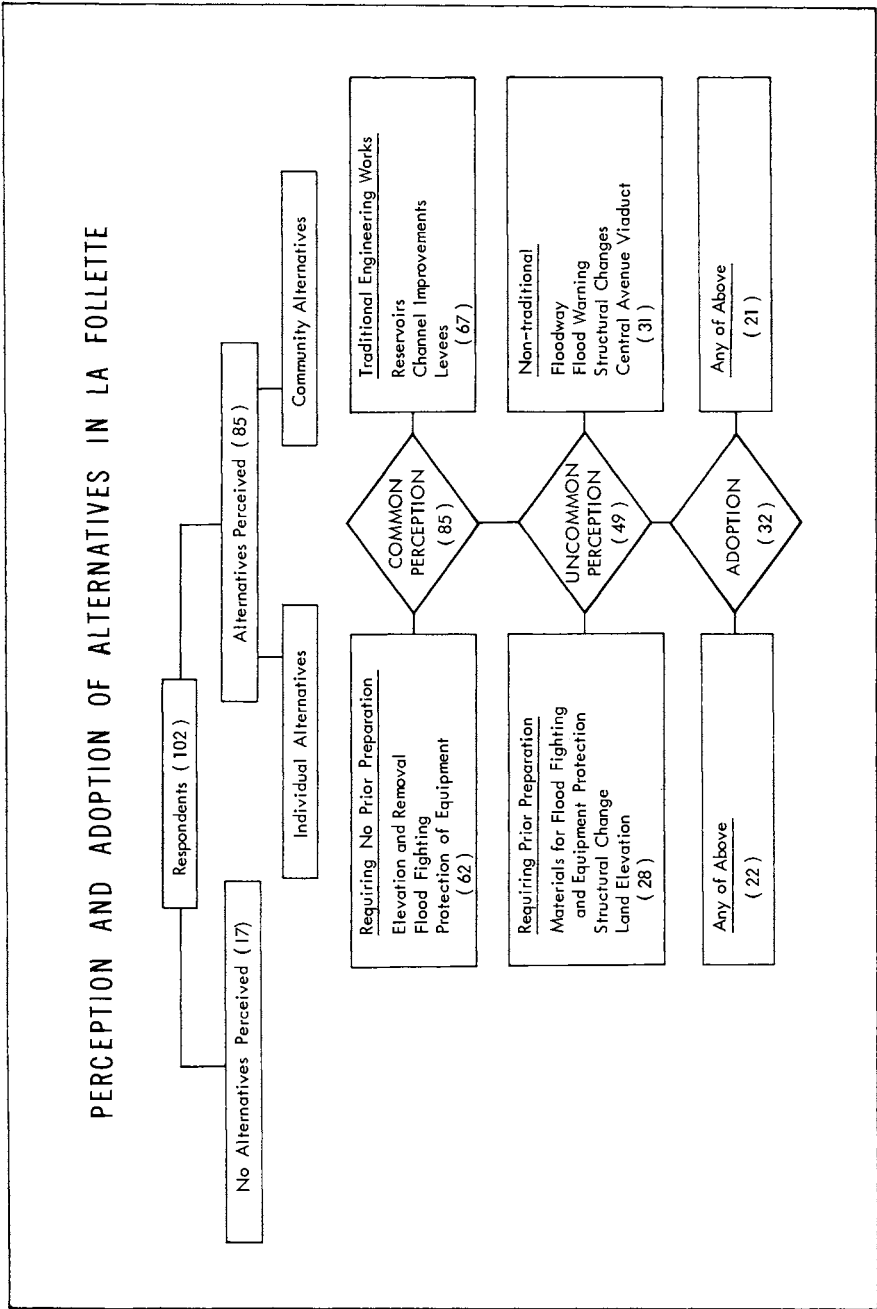


Fig. 15

respondents with error, five of whom are residential respondents. This reflects the weakness of applying the scale to residential respondents. For example, unlike the commercial respondents, the elevation and removal of goods would be an uncommon perception for them.

It is not, however, the ranking of the alternatives themselves in a hierarchy that is important but the existence of the scale itself. It implies that managers who are adopters have not become so without a more intensive canvas or awareness of alternatives and that they possess a wider range of choice. Of the 46 respondents who perceived at least one uncommon alternative, 31 went on to become adopters. This may be compared with the 43 respondents who perceived only common alternatives, and only 3 of whom became adopters.

The relationship of perception-adoption to previously studied flood characteristics.--Adoption, which represents the higher end of the perception-adoption scale, is also associated with various flood characteristics that have been previously studied. These are summarized in Table 25.

The adoption of an alternative is associated with the expectation of a flood in the future, and its related variable of interpretation. The low values of ϕ indicate that the relationship is weakened considerably by the substantial number of non-adopters who expect a flood and a much smaller number who don't expect a flood because of the perceived effectiveness of their adopted alternative. Adoption is not significantly associated with experience, although most adopters have had experience.

Adoption is associated with a number of minor variables, minor in the sense that only a small number possess these characteristics. Recalled knowledge of the TVA report and of \$150 or more flood damage is associated with adoption but an above average score on the flood concern test is not.

Perception and adoption in LaFollette, a summary.--In LaFollette, while many managers might bear a loss, less than 40 per cent actually expect to bear future losses.

compared with a measure called minimum marginal reproducibility which for this data is 67.6%. This means that if instead of the individual scores, only the modal frequency of yes or no for each class was used to predict the components for every individual, then this would insure 67.6% correctness. Thus the difference between the minimum reproducibility and the coefficient of reproducibility is a measure of the gain to be gotten by using an individual's score as a predictor, the gain coming in part because of the effect of the scale.

A more lucid discussion can be obtained from Allen L. Edwards, Techniques of Attitude Scale Construction (New York: Appleton-Century-Crofts, Inc., 1957), pp. 184-197.

TABLE 25

FLOOD CHARACTERISTICS ASSOCIATED WITH THE ADOPTION
OF SOME FLOOD DAMAGE REDUCTION ALTERNATIVE
(2 x 2 Contingency Tables)

Characteristics	Significance Level	Value of ϕ
Major characteristics:		
Affirmative future flood expectancy.	.001	.35
Flood interpretation of floods constant or increasing in time .....	.02	.25
Flood experience	Not significant	
Minor characteristics:		
Recall damage in excess of \$150 ....	.001	.33
Recall having seen TVA report .....	.001	.33
Evidence above-average flood concern	Not significant	

Many managers learned in the course of the 1950 flood that it was possible to keep water out of buildings by improvised emergency measures and that losses could be reduced in others by the elevation and removal of goods. However, with some exceptions, they have given little thought to the possibility of a future flood in which such measures might prove ineffectual. Residential managers have done even less, their prime concern being to leave the premises in case of flood. The potential for an organized warning and evacuation service in LaFollette is not perceived by respondents.

Similarly, while some managers have adopted a variety of minor measures designed to reduce flood damage by structural and land elevation changes in their establishments, none share with technicians the more recent sophisticated techniques of flood proofing.

In changing land use, the direction has been mainly towards increasing flood damage potential, although the first steps have been taken toward regulation.

The most popular alternative would be some community sponsored flood control activity. This feeling is not shared by technical personnel either on engineering or economic grounds or both. Insurance is actually non-existent, but the illusion of being covered by insurance is fairly widespread.

There is a clear order in the perception and adoption of alternatives. Managers who adopt some alternative would appear to possess a wider range of choice than the manager who does not. They are also more inclined to expect a future flood and to

interpret floods in such manner as would lead them to that expectation.

The Perception and Adoption of Alternatives
at the Reconnaissance Sites

The abbreviated interview used at the reconnaissance sites does not permit the delimitation of the entire range of choice. However, an attempt was made to classify those adopted and perceived alternatives that were recorded for each respondent on a fourfold scale as in LaFollette but in terms of the particular range of choice that would appear to be practicable for these areas. This is presented on Table 26 and has been shown graphically on Figure 8.

TABLE 26

DISTRIBUTION OF RESPONDENTS ON SCALE OF PERCEPTION-ADOPTION
OF FLOOD REDUCTION MEASURES AT LAFOLLETTE
AND RECONNAISSANCE SITES

Sites	None		Perceived				Adopted	
	Num- ber	Per Cent	Common		Uncommon		Num- ber	Per Cent
			Num- ber	Per Cent	Num- ber	Per Cent		
Darlington, Wisconsin .....	..	..	..	..	2	15.4	11	84.6
Aurora, Indiana .....	..	..	..	..	..	..	15	100.0
LaFollette, Tennessee	17	16.7	36	35.3	17	16.7	32	31.4
El Cerrito- Richmond, Cal..	5	50.0	3	30.0	1	10.0	1	10.0
Watkins Glen, N.Y.	1	12.5	5	62.5	1	12.5	1	12.5
Desert Hot Springs, Cal...	11	73.3	2	13.3	1	6.7	1	6.7

A survey of the kinds of alternatives adopted at the various sites, while lacking the detail of the LaFollette data, might prove useful.

Aurora, Indiana.--The outstanding and effective flood damage reduction alternative in Aurora is the widespread and elaborate elevation and removal of goods, furnishings, and the like. Respondents, when quizzed as to how high a serious flood would have to come, reply that they are more concerned with time than with height. Given enough time, they felt prepared to cope with any size flood below second floor elevation. The second floor elevation is

crucial, for many managers commonly elevate to the second floor.

Structural changes observed include the raising of floor levels, use of water-resisting floor materials, sump pumps, and back-up valves.

Near Aurora is Lawrenceburg, a town protected with a ring levee. Aurora had been studied for a similar levee project but failed to pass the test of economic feasibility. While some younger respondents perceived levees as a viable community alternative, the memory of the levees that failed at Lawrenceburg in 1937 is still strong. The interviewers encountered a considerable skepticism as to the value of levees, bordering on a "levee-phobia." Given the limited number of respondents, it is only speculation as to how widespread are such feelings. However, residents at Aurora might reasonably be willing to suffer the greater frequency of flooding rather than hazard the danger of a rare catastrophic event caused by the overtopping of a levee.

Darlington, Wisconsin.--Flood plain managers at Darlington also make common use of emergency measures of elevation and removal. However Darlington cannot avail itself of the developed Ohio River forecast system, as Aurora does, so it has with some pride developed a local warning system in conjunction with the Weather Bureau. Expected warning is 6 to 8 hours and local managers have informal plans for the elevation and removal of goods and furnishings. Tanks at the bulk oil plant are kept reasonably full and vats at the creamery are filled to prevent flotation.

Permanent structural changes in the form of floor and stock elevation are common. The local auto dealer maintains flood insurance on his stored vehicles; sump pumps and sewer valves are common. Considerable interest has been generated in flood control but a feasible levee plan of the Corps has met with only limited interest. The Soil Conservation Service has upstream work in progress and some managers see in this rather than in a levee, hope for reducing damages. Others do not want to see any part of the relatively narrow flood plain sacrificed for levees and still others may oppose the levee for reasons similar to those of respondents in Aurora.

El Cerrito-Richmond, California.--El Cerrito-Richmond presents the contrast of the widespread failure of residential respondents to adopt flood damage reduction alternatives and the complex system of adjustments installed by the leading industrial flood plain manager, appropriately a manufacturer of pumps. This complex of adjustments includes (1) a retaining wall, (2) sand-bagging, (3) plant fabricated redwood bulkheads with rubber seals for all major doors, (4) permanent elevation of all materials

subject to damage, (5) mobile and permanent sump pumps that can be operated under flood conditions to control any seepage, (6) outlets for all internal drainage elevated above flood levels, (7) annual inspection of all emergency and structural measures. The type of adjustments adopted for the plant represents a national policy, and the bulkheads were originally designed for the St. Louis plant, which was inundated at one time by 40 feet of water.

Having failed to qualify for protection by a federal project, the community has done a certain amount of work in clearing brush from the channel and building an intermittent foot-high asphalt embankment.

Watkins Glen, New York.--Except for one installed sump pump there were no alternatives adopted by the respondents in Watkins Glen.

Most of the community perceived itself protected by the levees and concrete cribbing along the creek. None of the managers appeared to be aware of the internal weakness of the earthen levees which are actually spoil heaps. The only respondent concerned with the conditions of the levees at all was bothered by their unsightliness as a background for her flower garden.

Desert Hot Springs, California.--Here, too, perception and adoption is almost non-existent. The only alternative adopted was the reported elevation and landscaping of a new home so as to facilitate drainage.

The main portion of the town is partially protected by a concrete lined flood control channel designed to bypass the town with the runoff from Blind Canyon. In addition, as a conscious process, the asphalt streets are constructed with high crowns, deep gutters and with slope conforming to the alluvial fan in order to facilitate runoff.

The perception-adoption scale and the certainty-uncertainty hypothesis.--The data in Table 26 and the descriptive material just presented indicate that levels of adoption appear to respond to greater certainty and to shrink as uncertainty increases. The only anomaly, the low number of adopters at El Cerrito-Richmond is the result of the failure to include the industrial plants in the formal interview. For towns of intermediate certainty such as LaFollette or El Cerrito-Richmond, the hypothesis would suggest that examples of adoption of elaborate alternatives for flood damage reduction would exist side by side with establishments whose managers perceive few, and adopt even less, alternatives. This is certainly the case at El Cerrito-Richmond.

Decision-Making and the Perception and Adoption of
Alternative Flood Damage Reduction Actions

What generalizations about decision processes might be made from this review of perception and adoption at the six towns?

Rationality in flood plain management.--The evidence overwhelmingly bespeaks a boundedly rational decision-making process once the analyst frees himself from the assumption that common knowledge of past floods means expectation of future floods, and that the expectation of future floods implies the expectation of bearing a loss. It is only in areas of high certainty that there is widespread expectation of bearing a future loss and because flood plain managers are rational they do something about it. In areas of intermediate certainty probably no more than 40 per cent of the managers actually expect to bear a future loss (for all the involved reasons that have been presented), but these managers also appear to do something about it. Therefore, the first generalization that emerges from the study is that those managers who actually expect to bear a future loss try to do something about it.

The prison of experience.--However, the urge to do something about the flood may not be fully realized, being limited by the bounds of a manager's rationality. The outstanding limit to his rationality, that is, the choice of the best means of reducing his expected losses, is that he is a prisoner of his experience. (Here experience is being used in an expanded sense, including the experiencing of a flood as well as the events surrounding it.) First, his expected losses are products of his experiences, few managers showing any ability to visualize losses or floods greater than commonly experienced. Secondly, much of human response to flood hazard reflects a satisficing or learning process. If experience has shown that rags and flour sacks keep the water out, they will suffice again. It is only in areas of great certainty, where elaborate adjustments have evolved by repeated experiences, that one feels that experience has been not a prison, but a teacher. There, if engineering works are rejected, the choice lies in a risk preference for the more frequent but less ambiguous risk. Everywhere else the predominance of personal experience acts as a prison, denying to flood plain managers the accumulated experience of other managers in other places.

Latent opportunities and the atrophy of time.--Except for areas of high certainty, it is only at the moment of flood and shortly after that the full attention of the manager is brought to bear on the flood problem. The atrophy of interest in flood damage

reduction alternatives with time from the last flood is a well known phenomenon to technical personnel and politicians. However, the data also suggest that despite the atrophy of intense interest, there is a considerable latent interest that is willing to seize opportunities long after a passage of a flood to reduce personal hazard, when those opportunities are either self-perceived or brought to the manager's attention.

Most of the structural changes appear to come about in that manner. An old building may not be elevated, but when a new addition is constructed another foot of fill is added. Normal remodeling provides new opportunities for flood damage reduction. An expansion provides the opportunity for a complete internal re-organization of stock.

It should also be noted that these latent opportunities in no way reflect optimal adjustments. One foot is a convenient number and three structures at different sites in LaFollette were elevated one foot despite the variation in hazard. The latent opportunity is seized upon, but in a casual manner almost as an afterthought.

The use of economic criteria in the flood hazard evaluation process.--An initial hope of the study was to provide further insight into the role economic criteria play in individual decision-making, in view of their important role in community decision-making through the benefit-cost ratio. The findings to date are mixed and inconclusive. No evidence was uncovered in the study that indicates a responsiveness in land values or rents toward flood hazard. In LaFollette rent might actually show an inverse trend increasing with flood hazard. Where expenditures for flood damage reduction have taken place these have been modest and with little sign of maximizing benefits in excess of cost.¹ Lastly, the decision to locate seems little affected by flood hazard information.

On the other hand, there is evidence that monetary damages do affect the adoption of flood loss reduction alternatives. Where perceived future losses or experienced past losses are great the

¹Here might be noted a question raised by a number of scholars. How does one tell *ex post* that a manager has not attempted to "maximize" albeit ineffectually, because he lacks skill, information, or foresight? In reply it may be stated that while the admittedly meagre findings do not preclude the judgment that less-than-optimal actions are really unsuccessful optimally-intended actions, neither do they encourage the view. Quite relevant are the instances where managers considering or having just considered flood loss reduction measures showed little interest in the improved flood hazard data proffered to them by interviewers.

motivation for expending money and effort in reducing future damage is stronger and there is an association between substantial past damage and flood damage reduction activity.