The Jackson Flood of 1979

A Public Policy Disaster

Rutherford H. Platt

In April 1979, the Pearl River in Mississippi inflicted damage estimated at one-half billion dollars in the city of Jackson and surrounding areas. Most property damage accrued to development built in the floodplain since the previous major flood in 1961. This development was encouraged by public investment, including a U.S. Army Corps of Engineers flood control project completed in 1968 which proved unreliable. Issues for national flood policy posed by the Jackson experience include the need for (1) land use regulations as concomitants to flood control structures, (2) improved coordination between different levels and units of government sharing jurisdiction over floodplains, (3) consideration of inter-jurisdictional effects in the allocation of flood protection resources, (4) location of vital public services outside floodplains, and (5) revision of post-disaster recovery policies to encourage mitigation of future losses.

In April 1927, the lower Mississippi River reclaimed its alluvial valley. Levees were breached in some two hundred locations and eighteen million acres in six states were inundated. The estimated cost of flood damage inflicted on the largely agricultural region was $284 million, or $1.12 billion in 1979 dollars. This flood, according to Hoyt and Langbein (1955, p. 261), was a turning point in national flood policy:

> Few natural events have had a more lasting impact on our engineering concepts, economic thought, and political policy in the field of floods. Prior to 1927, control of floods in the United States was considered largely a local responsibility. Soon after 1927, the control of floods became a national problem and a federal responsibility.

In succeeding decades, this national commitment substantially took the form of federal investment approaching $14 billion in the construction of projects to control floodwaters: dams, reservoirs, levees, channel modifications, floodwalls, and shore protection works. Among the hundreds of such measures approved and funded by Congress over the years was a local levee and channel straightening project on the Pearl River in the vicinity of Jackson, Mississippi. This project, prompted by a disastrous series of floods in 1961, was begun in 1964 and completed in 1967 at a federal cost of $8 million and a local share of $1 million. The Jackson area was declared to be safe from a "Standard Project Flood."[1]

A decade later, in April 1979, the Pearl River experienced a new flood of record, adding five feet to its previous record flood stage. The new Jackson levee was outflanked, and damage to property in the city (including areas not behind the levee) was estimated to reach $500 million or at least fifty times that of the 1961 floods. While such estimates tend to be haphazard,[2] Jackson was unquestionably devastated. Nearly 2,000 dwellings and 298 commercial structures containing 730 businesses were flooded (French et al. 1979, Table 4-6). About 6,400 persons were driven from their homes within the city of Jackson, as compared with 1,200 in 1961. (Statewide 18,000 persons applied for disaster assistance in the thirty-six counties declared disaster areas by the President.) A new $54 million sewage treatment plant in the floodplain at the city's southeastern corner was substantially damaged. Other vital public services—water supply, electrical power, telephone, fire protection—were curtailed and threatened with collapse. Heroic efforts were required to preserve the city from even worse disruption.

The Jackson experience was not unique. During 1979, President Carter issued thirty major disaster declarations

---

Dr. Platt is associate professor of geography and planning law at the University of Massachusetts, Amherst, and is a member of the Illinois Bar. He serves as consultant to various federal agencies on floodplain management and was a member of the National Science Foundation External Working Group on Flood Loss Reduction.

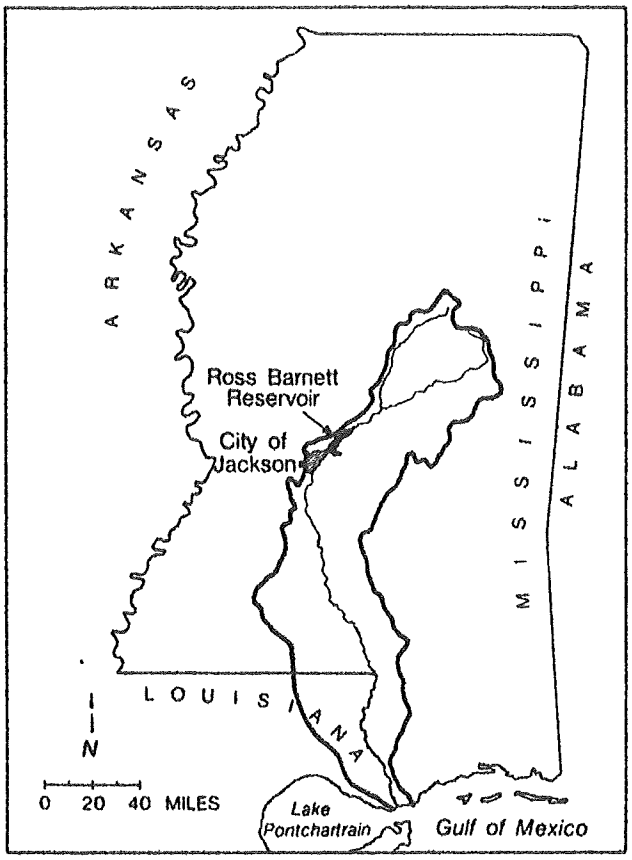

Figure 1. The Pearl River Basin, Mississippi and Louisiana

concerning floods in 18 states, 369 counties, and 2 territories. The federal government committed about $1.2 billion to assisting the victims of these floods. Overall, the nation suffers an average annual flood cost of $3.5 billion, according to the U. S. Water Resources Council, and that toll is rising.

One may be tempted from afar to attribute the Jackson disaster to overreliance upon structural flood control, which indeed was partly at fault. However, the causes of Jackson's agony were more complex than that, as indeed our national flood policy is more complex today than it was a decade ago. Just as pathologists perform autopsies to determine the cause of death, so resource managers must dissect natural disasters to learn from experience. This article, then, is a post-mortem on the 1979 flood at Jackson, Mississippi, which may prove to be another turning point in U.S. flood policy.

The setting and flood history

The Pearl River extends about 240 miles from its headwaters in east-central Mississippi to its mouth at the Gulf of Mexico, draining 8,760 square miles of predominantly rural land. Jackson, the capital of Mississippi, is situated on the west side of the Pearl River about one-third of the distance from its source (Figure 1). The watershed of 3,110 square miles above Jackson normally generates an average April flow of 20,000 cubic feet per second (cfs) past the city. Jackson was founded on a rolling upland overlooking the Pearl, but has expanded onto the adjoining floodplain, as well as into the ravines of some eleven tributary creeks. These ravines, which dissect much of the city's land, experience a twofold flood hazard—from local flash floods and from "backwatering" of the Pearl. East of the river the natural floodplain extends as far as two miles in width and is bounded by low hills. The floodplain is swampy and wooded, substantially unusable except where local or private drainage efforts have been undertaken.

Jackson has a long history of flood losses. Prior to 1979, the flood of record at Jackson occurred in March 1902, after a rainfall which locally reached seven inches in eighteen hours. The newpapers reported: "[I]t is a case of 'water, water, everywhere. Never before was Jackson so fearfully deluged" (cited in U.S. Army Corps of Engineers, 1973). In December 1961, the Pearl nearly equalled its 1902 performance, cresting at 37.2 feet (272.1 feet mean sea level (m.s.l.) with a considerably smaller discharge of 66,100 cfs (Table 1). Some twelve hundred persons were forced to flee from their homes, mostly in the backwatered creek ravines.

The paradox that a smaller discharge had nearly equalled the record 1902 flood in depth ("stage") was explained in a contemporary newspaper account (*The Clarion Ledger*, December 27, 1961, p. 1):

> At the turn of the century, the railroads, highways and earth improvements now in the area were absent and the water had a wider, less obstructed area over which to travel.

This perception however in no way influenced subsequent policies with respect to additional encroachments on the floodplain. Over the next two decades, public and private investment in floodprone areas on both sides of the Pearl would expand enormously. As in most U.S. metropolitan areas, the lack of effective

Table 1. Pearl River floods at Jackson, Mississippi historic and hypothetical

Date	Discharge	Stage
March 31, 1902	85,000 cfs	37.5 ft.
Dec. 21, 1961	66,100 cfs	37.2 ft.
April 16, 1979	90–130,000 cfs	43.25 ft.
Bankfull	15,000 cfs	25 ft.
I.R.F. (100 year)*	102,000 cfs	39.8 ft.
S.P.F.*	207,100 cfs	42.9 ft.
(Height of levees)		(43.5 ft.)

* See note 1.

Sources: U.S. Army Corps of Engineers, *Flood Plain Information—Pearl River-Neely Creek*, 1973; 1979 data from City of Jackson, Planning Department.

sanctions against expansion of investment at risk was attributable in part to the lack of any areawide public entity having both the legal power and the will to effectuate suitable land use controls. Local public authority in the Jackson metropolitan area, as elsewhere, is fragmented both spatially and functionally among a variety of governmental bodies. Also, the federal and state governments which do have jurisdiction over the entire area in question refrained from asserting their influence to restrain floodplain encroachment. Comprehending the causes of the Jackson disaster thus requires unraveling of the roles of the respective public authorities in whose collective lap responsibility lies. A brief summary of the local actors follows. While the individual entities are peculiar to the Jackson context, counterparts are found in most U.S. metropolitan areas.

The institutional context

The Pearl River floodplain at Jackson is under the jurisdiction of two counties, four municipalities, and two special districts (Figure 2). The City of Jackson, with 205,000 people in 1976, borders the west side of the Pearl for eighteen undulating miles. The wider expanse of floodplain east of the Pearl is divided among the municipalities of Flowood, Pearl, and Richland, with remaining unincorporated land under the jurisdiction of Rankin County (Figure 2 and Table 2). Flowood, with a very small population, has for many years been an enclave for several industries in steel fabricating and building materials. Pearl and Richland are more typical suburban and highway business communities, which grew rapidly after 1960 due to improved highway access to Jackson and construction of the flood control levees. Unincorporated portions of the floodplain opposite Jackson remain largely undeveloped.[3]

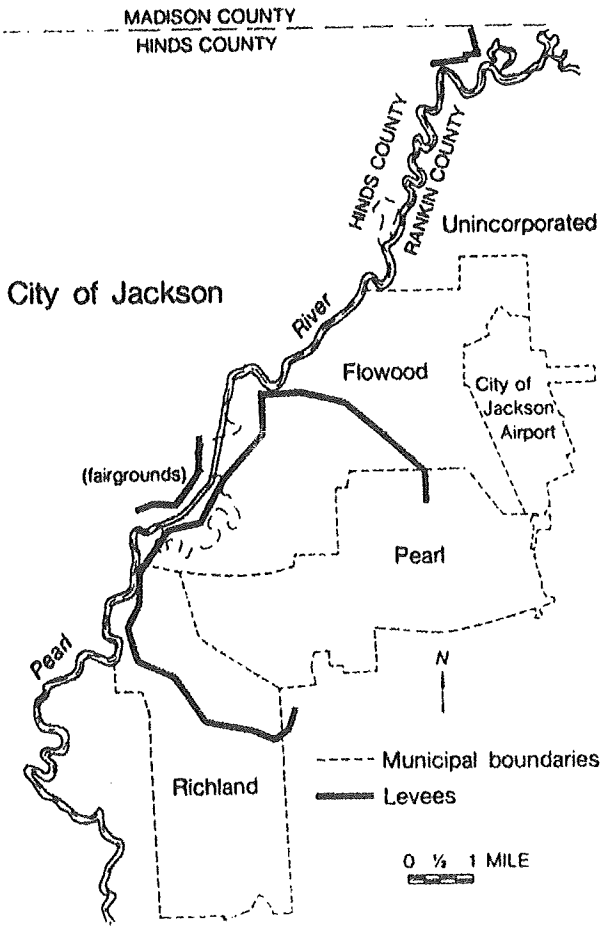

Figure 2. Political jurisdictions—vicinity of Jackson, Mississippi

Table 2. Population growth, Jackson, Mississippi and vicinity, 1960–76

	1960	1970	1976
City of Jackson	144,422	153,968	205,100[a]
City of Pearl	5,081	9,623	15,750
Town of Flowood	486	404	540
City of Richland	[d]	2,563	3,320
Jackson SMSA[b]	221,000	258,906	293,600
Jackson Metro Area[c]	254,271	288,643	327,300

a. Includes annexation of new territory containing 36,295 persons between 1970 and 1976.
b. Includes Hinds and Rankin Counties.
c. Includes Hinds, Rankin, and Madison Counties.
d. Not incorporated in 1960.
Source: Jackson City Planning Board, *Economic Analysis: Jackson Metropolitan Area*, Appendix Table A2.

Two special districts of importance to flood management in the vicinity of Jackson are the Pearl River Valley Water Supply District and the Rankin-Hinds Urban Flood and Drainage Control District. The former was authorized by the state legislature in 1958 for the purposes of:

> . . . preservation, conservation, storage, and control of the waters of the Pearl River and its tributaries and its overflow waters for domestic, municipal, commercial, industrial, agricultural, and manufacturing purposes, for recreational uses, for *flood control*, timber development, irrigation, and pollution abatement. . . .[4] [Emphasis added.]

The water supply district created under this authority encompasses the entire Jackson Standard Metropolitan Statistical Area plus two additional counties immediately upstream on the Pearl. The major function of the district has been the construction of three-mile-long Ross Barnett Dam just above Jackson, the largest nonfederal dam in the U.S. The dam impounds a reservoir with a surface area of 43,000 acres extending forty miles upstream.

Despite the reference to "flood control" as a statutory purpose, the Ross Barnett Dam and Reservoir were not designed to control floods. The pool level has been maintained within a foot or two of maximum capacity to afford recreation benefits to shoreline property owners

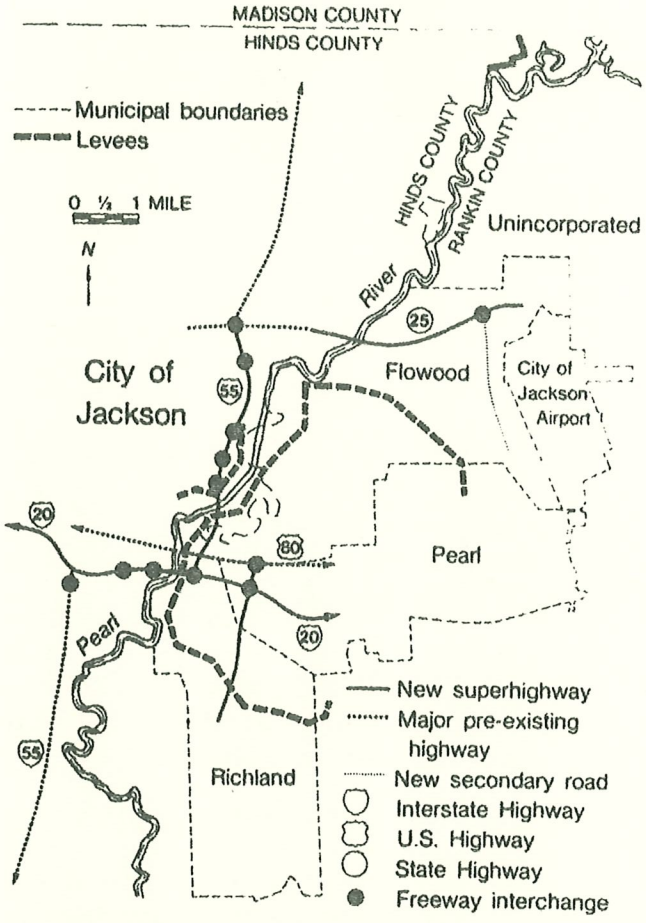

Figure 3. Highway construction in the Pearl River floodplain, 1963–71

whose lease payments on shore front lots help finance the district. Some degree of flood reduction however could be achieved if the pool were lowered in time to store floodwaters arriving from upstream. The district's decision not to lower the pool level prior to the April 1979 storm generated much subsequent controversy and litigation.[5]

The Rankin-Hinds Urban Flood and Drainage Control District was established by the two counties for which it is named shortly after the 1961 flood. Its purpose was to serve as local sponsor for a federal flood control project authorized by Congress in 1960.[6] Like its counterparts across the nation, the district was required to provide land and easements for the project, and after its construction to operate and maintain the facilities. Between 1964 and 1967, the U.S. Army Corps of Engineers constructed a 1.5-mile levee on the Jackson side protecting 420 acres and a 10.3-mile levee on the Rankin County side which nearly encircles 5,870 acres. The river was channelized for five miles, including a 2.3-mile cutoff between the levees (Figure 2). The federal cost was $8 million and the local share was $1 million, funded from assessments on "benefited" land (which by implication was deemed safe for development).

The flood control project was touted as the ultimate solution to flood problems in the Jackson area. At groundbreaking ceremonies in 1964, the Jackson Daily News (August 27, 1964, p. B-10) reported the project would:

> . . . mark the end of the devasting [sic] floods which almost annually have inundated thousands of acres, forced hundreds from their homes, and threatened to destroy major industries vital to the economy of both Rankin and Hinds counties.

Later, at the dedication of the project, the president of the Rankin-Hinds Urban Flood and Drainage Control district stated: "[T]his project will make many, many acres of valuable land secure for home, business, and industrial use" (*The Clarion-Ledger*, November 8, 1967, p. 1). On the same occasion, Major General Thomas H. Hayes of the U.S. Army Corps of Engineers declared: "[T]here is no reason why the project should not give indefinite protection from flooding to the area."

Public policies: trial by water

Before the flood: building for disaster

Most of the structures damaged by the 1979 flood did not exist in 1961. The period between the floods was characterized by massive public and private investment within and just outside the area flooded in the earlier event. This occurred on both sides of the river, although most of the 1979 damage transpired on the Jackson side. In the absence of any countervailing restraints, public investment in levees, highways, bridges, and other facilities attracted private enterprise into floodprone locations. In particular, a network of new highways, interchanges, and bridges was constructed in or near the floodplain subsequent to the 1961 flood (Figure 3). These in turn served to attract new shopping centers, apartment complexes, and industrial growth into floodprone locations (Figure 4). Other public or quasi-public facilities in the Jackson floodplain include sewage ponds, a new water treatment plant, several electrical substations, and new public facilities in the "fairgrounds" area behind the levee, including the Mississippi Natural History Museum and Trade Mart next to the Coliseum. Jackson's new sewage treatment plant was constructed in the floodplain near the city's southern border. East of the Pearl, the Jackson Municipal Airport was significantly enlarged between 1963 and 1971 with the construction of new runways and expansion of terminal facilities at the edge of the floodplain. New sewer, water, and electrical facilities serve areas of Flowood, Pearl, and Richland behind the levee. The flood control project itself completes the list of public investments tempting development into the Pearl floodplain.

Public land use controls were virtually nonexistent in the Pearl floodplain before the 1979 flood. Jackson in 1969 zoned its entire floodplain for residential, commercial, and industrial uses (Figure 5). Neither the Pearl

River nor its tributaries were identified as constraints upon development. Nor was any distinction made between land inside or outside the levees. (As it happened, the 1979 flood also made little note of this distinction.)

The schism between physical reality and public policy regarding floods was reflected in the Corps of Engineers' flood plain information report for Jackson published in 1973. On the one hand, the report contained a detailed (and prophetically accurate) projection of potential flood hazards to existing development. But it did not call into question Jackson's planning and zoning policies which allowed further encroachment upon floodplains. The following laconic statements contrast sharply with the graphic evidence of existing and potential peril:

> Essentially all of the flood plain developments in the Jackson urban area are protected from flood damage by a system of levees constructed by the U.S. Army Corps of Engineers and completed in 1968. However in the northern sector of the city, portions of several subdivisions infringe upon flood lands. (U.S. Army Corps of Engineers 1973, p. 3.)

> The Jackson Planning Board is in the process of developing zoning ordinances for flooding within the Jackson City limits while Hinds County is interested in developing zoning ordinances for the remainder of the county. Rankin and Madison have not initiated any zoning projects for flood protection. (U.S. Army Corps of Engineers 1973, p. 6.)

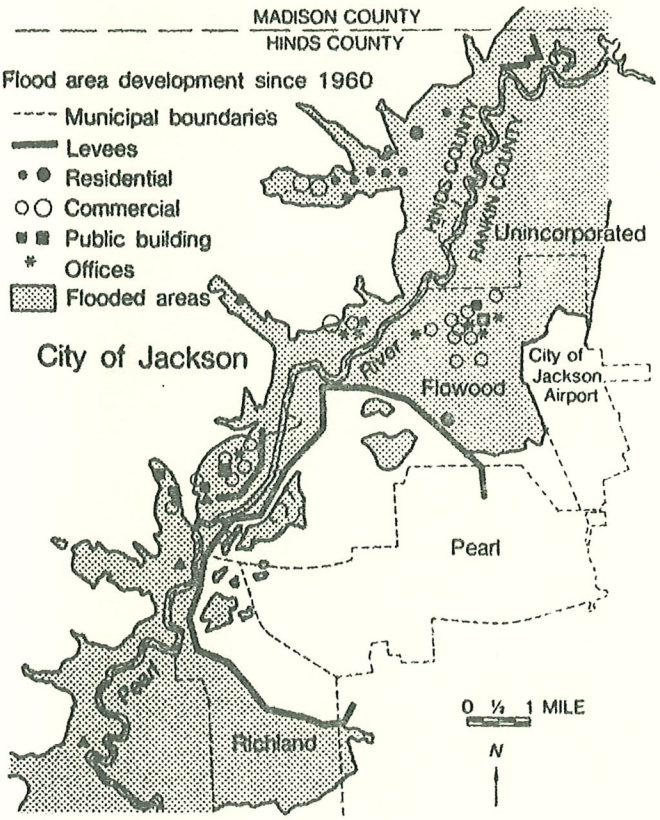

Figure 4. Post-1960 private development in areas flooded by Pearl River—April 1979 ("Residential" refers to entire subdivisions; "Commercial" includes shopping centers and freestanding structures.)

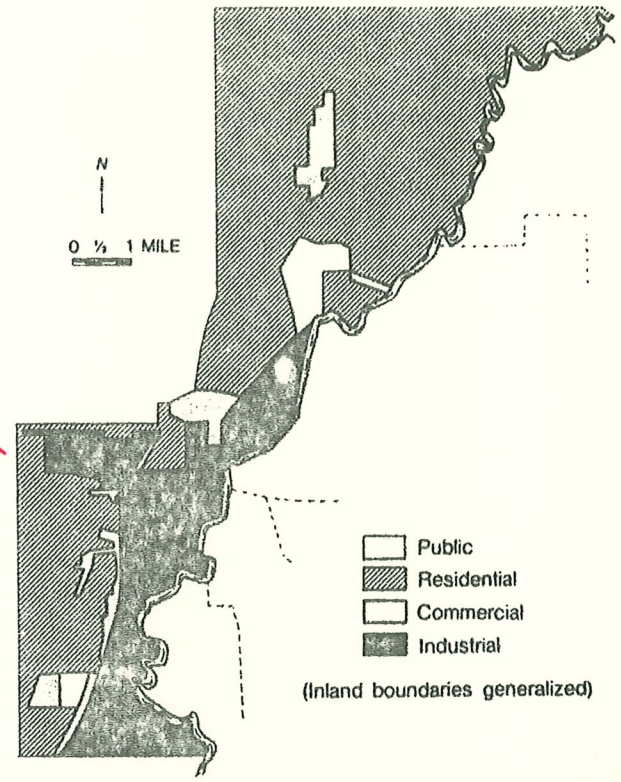

Figure 5. 1969 Land use zoning for areas adjoining Pearl River in Jackson, Mississippi

This was wishful thinking. Neither Jackson nor Hinds county adopted a floodplain zoning ordinance until after the 1979 disaster. Apparently, the writers of the Corps report felt it was not a federal responsibility to comment upon the zoning policies of local governments (although the federal taxpayers would be called upon to bear heavy costs ensuing from the failure of these policies in the 1979 flood). Local adoption and enforcement of appropriate restrictions on further floodplain encroachment should have been a condition precedent to federal involvement in the levee project.

Public regulation of floodplains east of the Pearl was, if possible, even more lax than in Jackson. None of the four jurisdictions in question had any form of floodplain building controls prior to the 1979 flood. In 1978, the Central Mississippi Planning and Development District (C.M.P.D.D.), the A-95 review agency for the region, prepared a "General Land Development Plan" for Rankin County. The plan advised the county to adopt and enforce zoning regulations which, among other concerns, would" . . . restrict development in such areas as flood plains which cannot support the more intense land uses without proper precautions" (C.M.P.D.D.

1978). This advice was not heeded prior to the 1979 flood.

These words of caution to Rankin County were not directed to Flowood, Richland, and Pearl. A map of recommended future land use which accompanies the 1978 plan depicts all land encircled by the Corps levee in Rankin County as suitable for industrial, commercial, or residential use. This places total reliance upon the future integrity of the levee. Floodprone land north and south of the area protected by the levee is also proposed for future development (some of which was underway at the time of writing). The recommended plan appears to conform with the intentions of the Rankin county governments adjoining the Pearl River. Since 1970, development of the floodplain both within and outside the Rankin County levee has been widespread, albeit at a different pace in each municipality (Table 2).

Thus the regional planning agency, like the Corps of Engineers, viewed its role as limited to the identification of areas subject to flooding. If no one cared to act upon such information, it was no concern to the planning agency or the Corps. A crucial deficiency in the land use planning process is evident: extra-local entities which perform studies on a regional basis are not empowered to carry out their own recommendations. Local governments which do have legal power are free to ignore the recommendations of such studies. The extra-local planners are even constrained from advocating their views forcefully or publicly in many cases out of fear of political reprisals. The result is a paralysis of public efforts to achieve rational use of land.

During the flood: the politics of high water

The "Easter Flood" at Jackson was both an "Act of God" and manmade. Extreme weather conditions made flooding at Jackson inevitable, but the levels of flooding and flood damage were unquestionably influenced by human actions and non-actions, both public and private. It has already been noted that the floodplain is a mosaic of public authorities at the local level. As augmented by state and federal authorities, the framework for public response to the disaster as it unfolded was incredibly complex. Not surprisingly, much went wrong—exactly what and why has fueled public debate and several lawsuits ever since. The intent here is not to levy blame but to summarize those findings and observations by many investigators (including the author) which offer lessons for public policy elsewhere. The major issues considered here are (1) inadequate or conflicting flood predictions, (2) poor coordination between public authorities, (3) unreliability of the levee system in Jackson, and (4) protection of one side of the river to the possible detriment of the other.

At the outset, nature provided plenty of raw material. For a week before Easter 1979, massive storm systems rolled across the south central states. Thunderstorms, hail, tornadoes, and record rainfall battered Texas, Louisiana, Oklahoma, Arkansas, Mississippi, Missouri, and Alabama. In Wichita Falls, Texas, a giant tornado leveled much of the city. Nearly twenty inches of rain fell during a thirty-six hour period at Louisville in the upper Pearl River watershed. Jackson received ten inches during the week with four inches in one hour-long deluge. This caused flash flooding in most of Jackson's creeks leading to the Pearl River. Homes and businesses in ravines were flooded and many streets were impassable (*Jackson Clarion-Ledger* 1979).

Exasperating as these conditions were, the National Weather Service on April 12 warned of greater flooding to come. However, no one knew how high the water would rise or how wide an area should be evacuated. On April 13, the *Jackson Daily News* reported: "Officials of Ross Barnett Reservoir say upstate rains have not even begun to filter into the Jackson part of the river." The dilemma facing the city was succinctly stated (*Jackson Daily News*, April 13, 1979, p. 14):

> Rain from nine key counties around Jackson is expected to pour into the reservoir Saturday or Sunday. The reservoir dam is not a flood control device and must release the water it accumulates. It is the reservoir's release that will help determine the level of the river in the next few days.

This appraisal was correct; the next few days were indeed fraught with confusion regarding the ultimate level and timing of the flood crest. Discharge from Ross Barnett Dam was increased drastically to 100,000 cfs and fluctuated thereafter. The National Weather Service on April 12 estimated the river would crest at 36 feet. Each successive day brought higher estimates as the river continued to rise. It finally exceeded all predictions, cresting at 43.25 feet on April 17.

It is evident that each extra foot of flood level cost many million dollars in additional property damage, some of which might have been avoided through timely removal of household furniture, vehicles, and so forth. The inaccuracy of official announcements regarding the flood crest provoked a storm of public outrage from homeowners who felt they could have saved some of their possessions. City officials blamed federal agencies for providing misleading and inaccurate data. The U.S. General Accounting Office (GAO) subsequently verified that conflicting flood estimates were issued by three federal agencies: the Corps of Engineers, the National Weather Service, and the U.S. Geological Service, and none were correct (GAO 1979, p. 18).

Conflicting stream runoff estimates also played havoc with the operation of Ross Barnett Dam whose operators sought to maximize storage while protecting the integrity of the dam. This delicate balancing process was hampered by inadequate information about the amount

of upstream runoff expected to reach the reservoir. Downstream communities in turn were given little or no advance warning of larger releases from the dam, which impaired their ability to take effective emergency action.

During the period of rising floodwaters, feverish efforts by the National Guard, prisoners, and volunteers sought to reinforce the levees and protect vital public facilities. Convoys of dumptrucks brought sand from nearby quarries for emergency dikes around the city's water plant, sewage treatment plant, and an electrical substation (Figure 6). Many thousand sandbags were lined along the tops of the levees and used to plug "boils" or leaks which developed.

Problems soon arose in the coordination of flood fighting efforts among various jurisdictions and public authorities. Emergency activities under the control of the mayor of Jackson functioned smoothly. However, water soon began to pour into the area behind the Jackson levee from two sources: a low point where the levee joined a highway embankment and a sewer trunk line which conveyed flood waters under the levee. Efforts to plug these leaks and pump out intruding water were stymied by an apparent lack of coordination between personnel of the city, the Corps, and the Flood Control District. The levee was abandoned with resultant costly flooding of many businesses and public buildings (GAO 1979, pp. 20–23, and local interviews by the writer) (Figure 7).

With the loss of the Jackson levee, sandbagging efforts were concentrated along the 10.3 mile levee east of the Pearl. Different sections were under the direction of the Corps, the National Guard, and municipal authorities. Disputes arose regarding the allocation of resources, and water threatened to break through at various locations. Amid darkness and swirling floodwaters, the work was dangerous (personal interview with Horace Lester, Sr., Nov. 27, 1979). Ultimately, the east bank levee held with

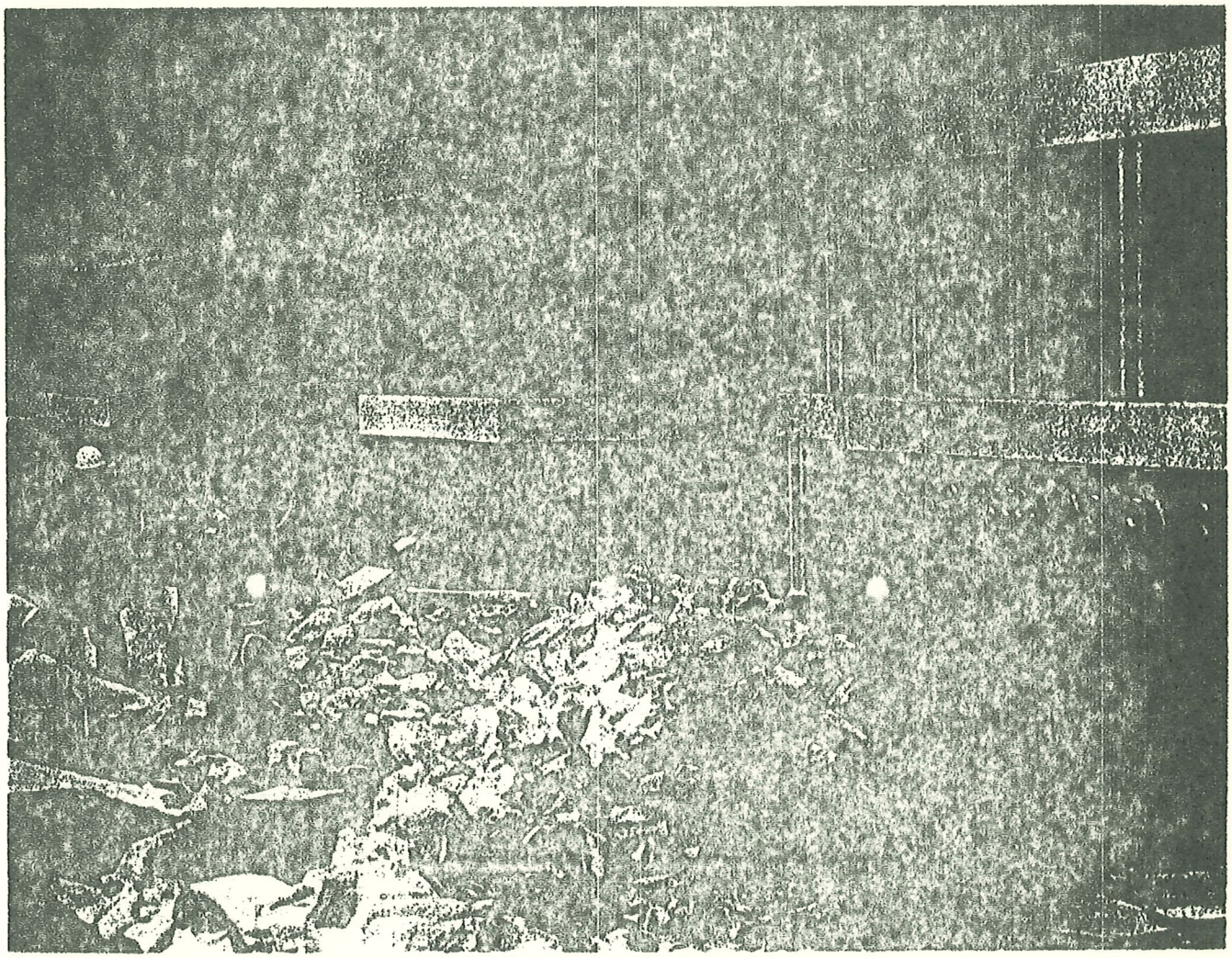

Figure 6. Key public facilities in floodplain, such as this substation and computer center of Mississippi Power and Light, required costly sandbagging. Many were disabled. (Photo by the author)

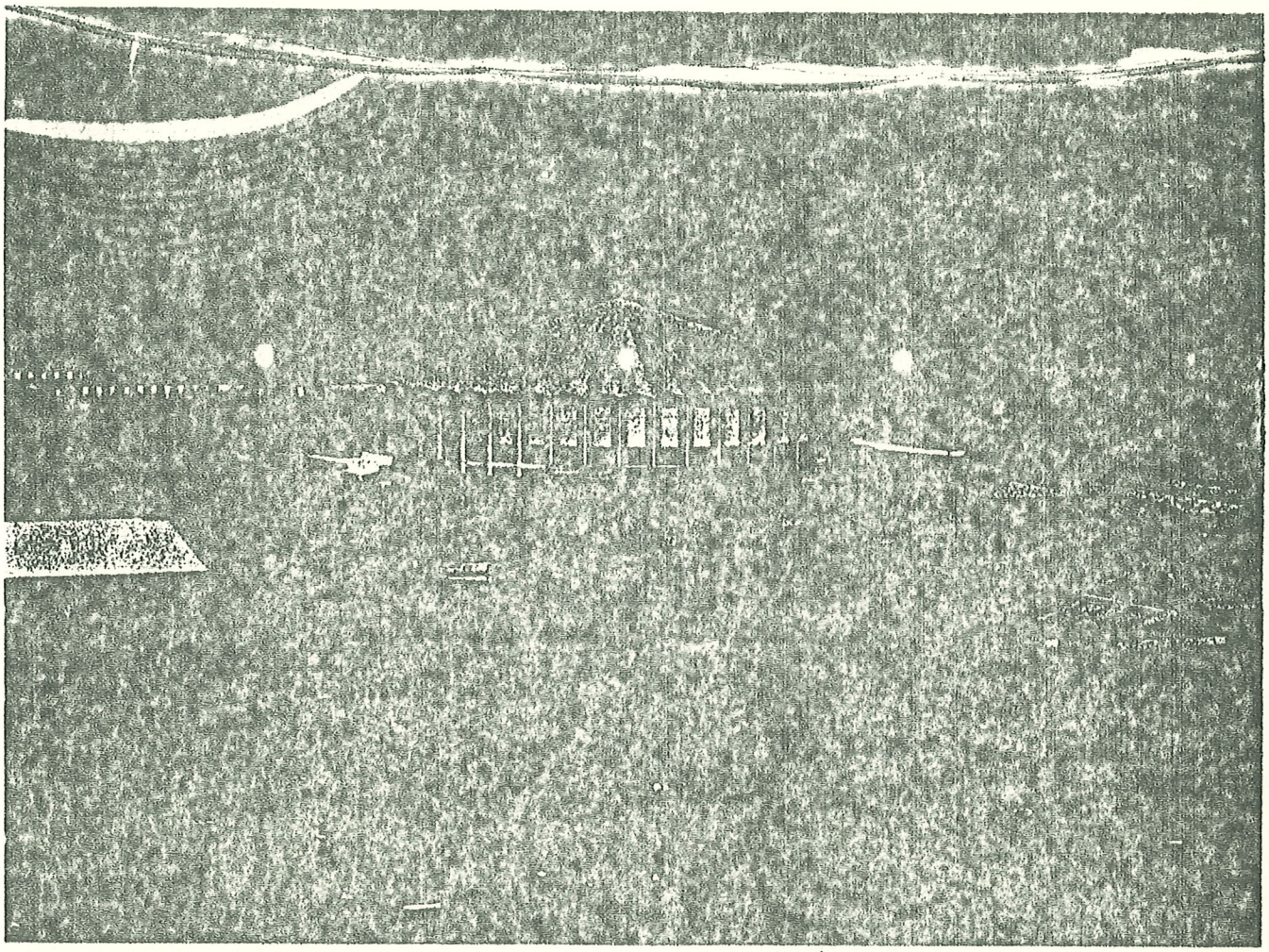

Figure 7. Flooding behind the Levee in Jackson: The Mississippi Coliseum, State Fairground, Ramada Inn were among many damaged public and commercial buildings. (Photo by the author)

floodwaters cresting a few inches below its reinforced rim. Some 3,500 residents of Flowood and Pearl were soon able to return while 6,400 Jackson residents confronted up to ten feet of water in their homes and many months of cleaning up.

Interjurisdictional questions abound. Did the failure of the Jackson levee relieve pressure on the Rankin County levee sufficiently to save it? Did the successful reinforcement of the latter, surrounding a sparsely developed area of natural floodplain, serve to impose greater flooding upon densely urbanized areas of Jackson? What would have been the amount and distribution of losses if the levees had met with opposite fates, or if both had been abandoned? These concerns highlight a critical question for disaster planning nationally: to what extent can or must federal and state officials "play God" in choosing between communities and property owners in the allocation of public flood protection resources?

After the flood: how to avoid future losses?

Even before the flood crest reached Jackson, the recovery process began with a "Major Disaster Declaration" by President Carter on April 16. The declaration covered thirty Mississippi counties in the Pearl River Valley. Within two days, federal disaster centers opened in six locations and began to process applications for federal loans, grants, and insurance benefits. Over the next year, the federal government allocated some $145 million to the recovery of Mississippi from the Pearl River flood.

The swiftness and generosity of the federal response left unanswered a major public policy question which accompanies any natural disaster: how can future losses from a repetition of the event be reduced? Whether federal aid would help to reduce the exposure of property and lives to future flood losses or simply be used to restore the status quo was a question little raised amid

the more dramatic news of the flood itself. State and local authorities wanted federal aid promptly and without strings attached.

Congress, however, has attached one string to disaster assistance. Section 406 of the Federal Disaster Relief Act of 1974 (P.L. 93-288) states:

> As a further condition of any loan or grant made under the provisions of this Act, the State or local government shall agree that the natural hazards in the areas in which the proceeds of the grants or loans are to be used shall be evaluated and appropriate actions shall be taken to mitigate such hazards, including safe land-use and construction practices.

Non-federal authorities thus must agree to mitigate the effects of natural hazards as a condition to receiving any federal disaster assistance. This policy is augmented by Executive Order 11988 issued by President Carter on May 24, 1977,[7] which requires all federal agencies ". . . to avoid direct or indirect support of floodplain development wherever there is a practicable alternative, . . ." Emergency rescue and relief actions are excluded but the policy extends to long-term recovery assistance.

The immediate aftermath of a flood is not ideal for a systematic review of hazard mitigation opportunities. The first order of business for all public authorities is to get things back to normal as quickly as possible. Yet this is exactly when private and public decisions determine the pattern of long-range recovery. In the absence of alternatives, disaster assistance usually serves to restore the status quo and to set the stage for the next disaster.

The Pearl River flood did however inspire a limited federal effort to promote hazard mitigation. The Federal Insurance Administration (FIA)[8] undertook (1) a survey of flood victims in several communities (excluding Jackson) to determine willingness to relocate out of the floodplain, (2) seminars on floodproofing commercial and institutional structures in Jackson, and (3) negotiations with the Small Business Administration (SBA) regarding the allocation of disaster loans in identified flood-prone areas. The latter initiative led to agreement by SBA to incorporate FIA recommendations regarding flood hazard mitigation into its disaster loan approvals. Where FIA recommends that no reconstruction take place on the damaged site, SBA will extend relocation assistance to the victim. (Normally, SBA loans are used to rebuild homes and businesses *in situ*.)

The National Flood Insurance Program (NFIP) administered by FIA is potentially a vehicle for reducing future losses in the wake of a flood. If a structure insured under the program is damaged by more than 50 percent of its pre-flood value, it may only be rebuilt in conformity with current land use and building restrictions—even those passed after a flood in response to Section 406 of the Federal Disaster Reflief Act. Also, Section 1362 of the National Flood Insurance Act (P. L. 90-448, Title 13), authorizes federal purchase of property subject to chronic flooding, with title to the land to be conveyed to local authorities for retention as open space.

FIA was unable, however, to substantially influence the pattern of post-flood recovery in Jackson. Its own authority was limited by the small proportion of damaged properties covered under the National Flood Insurance Program. With only 1,510 policies in the city of Jackson, NFIP requirements regarding floodproofing and elevation of damaged structures receiving insurance benefits were not widely operative. Also FIA lacked funds with which to acquire insured properties "substantially damaged beyond repair" under Section 1362 of the National Flood Insurance Act.

Except for SBA, other federal agencies did not noticeably contribute to the cause of mitigation. A disaster assistance center in Jackson visited by the writer immediately after the flood initially lacked a map of the flood hazard area; applicants for assistance were not informed as to the level of risk inherent to their particular locations.

Formal compliance with the hazard mitigation requirements of Section 406 began with the appointment of a State Hazard Mitigation Coordinator five weeks after the flood. The effort to develop a state hazard mitigation plan in accordance with Section 406 was clouded by confusion as to what the law intended. State and federal officials together tried to muddle through in the development of a hazard mitigation plan.[9]

Acquisition of floodprone property and relocation of flood victims was undertaken on a pilot program basis in Canton, Mississippi, upstream from Jackson. A grant of $5 million to the state under Section 407 of P.L. 93-288 (the Federal Disaster Relief Act) funded relocation of sixty-five to seventy low-income families. It is planned to elevate fifty-five to sixty moderate-income homes in the Hightower section of Jackson which experiences chronic flooding.

Aside from this modest effort, relocation was actively discouraged in Jackson. The local Board of Realtors perhaps influenced public sentiment with a circular issued after the storm stating:

> Those who have had their homes or businesses damaged by the flood should remember one basic fact: *the market value of real property does not automatically diminish because of a natural disaster such as a flood.* There was value before . . . there will be value after the waters are gone and the area has returned to normal. Oftentimes the damage done is not as great as it first seemed.
>
> We strongly urge those affected property owners not to sell under pressure, emotional or otherwise. Now is the time to hold on. The sun has a way of shining after a storm. [Emphasis original.]

A field check six months after the flood disclosed that most of the two thousand flooded dwelling units had been restored and reoccupied.[10] Flood hazard mitigation for Jackson has been accomplished or proposed largely through means other than relocation. In March 1980, the city adopted a floodplain zoning law in response to newly revised Flood Insurance Rate Maps provided by the Federal Insurance Administration. This qualified the city for participation in the "regular" phase of NFIP, and property owners are reportedly applying in large numbers for the enlarged flood insurance coverage which this status provides.[11]

Proposals for three upstream flood control dams originally recommended by the Corps in 1968 have been revived. According to an official of the Pearl River Basin Development District, a proposed dam at Edinburgh (sixty miles upstream) would have reduced the crest at Jackson by four or five feet (*Jackson Daily News*, April 18, 1979, p. 13). In July 1979, a delegation of Mississippi mayors and congressmen urged the Corps of Engineers to expedite a $500,000 basin study to evaluate the need for the proposed dams, additional levees in Jackson, and improvement of flood warning systems in cooperation with the National Weather Service and the U.S. Geological Survey (*Jackson Clarion-Ledger*, July 29, 1979, p. 1).

Implications for national policy

The Pearl River flood of April 1979 bears many lessons for public policy on floods nationally. Six issues suggested by this experience are: overconfidence in structural flood control, failure to restrain floodplain encroachment, location of vital public facilities, need for pre-disaster contingency planning, need for post-disaster hazard mitigation, and need for improved coordination among public authorities.

Overconfidence in structural flood control. The boundless optimism of public officials during the 1960s concerning "elimination of the flood threat" from Jackson through levees was obviously misplaced. First, the flood control project was not intended to protect newly developing areas in northeastern Jackson. Second, the levee system itself proved faulty. Whether or not the flood waters actually overtopped the Jackson levee (it was a matter of inches), the fairgrounds area behind the levee was completely inundated. This resulted from defects in the design of the project, and possibly from human error in the withdrawal of pumps at an early point in the flood fight. Third, the formidable Ross Barnett Dam may have appeared to the general public to be capable of controlling the Pearl River. While officials made no such claim, no effort was made to deter new residential development, including mobile homes, in the floodplain just below the dam. The question of pool elevation was not a public issue until after the flood. Operators of major dams throughout the nation face a similar dilemma—to serve the interests of shoreline owners and other recreationists by maintaining a high water level, or to maintain flood storage capacity with lower levels. Planners should keep a wary eye on upstream dams, federal or state, with this issue in mind.

A provocative question concerning the levees is why the flood crested above the estimated "standard project flood" despite a considerably smaller discharge (130,000 versus 207,000 cfs) (Table 1). As in 1961, bridges, buildings, and highways impeded the flow of the river, backing it up into creek ravines. Yet these were in place or planned when the levees were constructed. The levees were designed in light of existing hydraulic conditions of the floodplain at Jackson. Could the calculations have been faulty?

The point cannot be overstated that the engineering quirks which worsened the effects of the flood in Jackson were not unique. Flood control structures fail if their design limits are exceeded, or if design or operational errors occur. Development of natural floodplains behind levees risks catastrophic losses in the event of structural failures as in Jackson. "Protected" floodplains should be used with caution; if development is unavoidable, the use, design, and elevation of buildings should anticipate occasional major floods.

Failure to restrain floodplain encroachment. Public authorities at all levels of government abdicated responsibility for preventing development in hazardous areas. Jackson's zoning map of 1969 designated all land bordering the Pearl within the city as suitable for development. That invitation allowed widespread residential and commercial development in areas flooded in 1961 and identified as still hazardous in the 1973 Corps flood plain information report. In Rankin County, development both within and outside the levee has been totally unfettered by flood considerations. Construction of an office park outside the levee in Flowood continued in December 1979 on a site flooded in April.

Public neglect on both sides of the Pearl thus tolerated substantial enlargement of investment and lives at risk. This experience highlights the importance of requiring local land use controls to limit unnecessary development in hazardous areas. Authority to manage floodplains through zoning and other regulations is virtually ubiquitous among the fifty states, and such measures have been upheld repeatedly by many state courts (Kusler 1976a, b). Failure to use such authority to avert future losses may be legally actionable.[12]

Location of vital public facilities. Public services and facilities were seriously damaged by the Pearl River Flood. Only through emergency efforts did Jackson manage to avert citywide loss of electricity, water, telephone, and other services. Its new sewage treatment plant was totally disabled. Several electrical substations were flooded out, and a key facility serving downtown

Jackson was saved only by erection of an emergency earthen dike at a cost of $1 million (Figure 6).

Regulations construing Executive Order 11988 require "critical actions" such as the siting of vital public facilities to be outside the 500-year floodplain if possible. The Jackson experience highlights the wisdom of this policy.

Need for pre-disaster planning. The flood caught all public authorities in the Jackson area unprepared to varying degrees. The City of Jackson's Emergency Operations Center in a downtown basement was flooded out. The loss of the Jackson levee was attributed by GAO to a lack of preparedness by the city, the flood control district, and the Corps (GAO 1979, p. 23).

The Pearl River Valley Water Supply District was criticized (and sued) for an alleged lack of a contingency plan to draw down the reservoir in advance of the flood crest (Lester 1979). The district replied that it in fact had an emergency plan but that it was misled by faulty predictions of flood discharge by the National Weather Service.[13] In any event, the need for review of contingency operating plans for non-federal dams is indicated.

The Jackson experience highlights the need for realistic disaster contingency plans. Such plans must address *inter alia* the respective functions of each public authority, the allocation of emergency resources, and the means of communication between neighboring communities, between functional agencies (e.g., public works departments and special districts), and between civilian and military authorities. Ultimately, cost-benefit studies should be undertaken to determine the most efficient emergency actions for a particular floodprone area without regard to political boundaries.

Another element of pre-disaster planning should be to identify those structures or parcels of land which should not be rebuilt in the event of a major flood. These would logically include property in the designated floodway or property which has suffered multiple flood losses. Similarly, contingency plans should also identify those structures which should be floodproofed or elevated in the event of flood damage.

Emergency planning has long been left to public works officials, police, civil defense authorities, or no one. The management of floods and other natural disasters should be incorporated into community and regional comprehensive planning programs.

Need for post-disaster mitigation. The Pearl River flood, among many during 1978–79, influenced the Carter administration to initiate a new approach to federal post-flood disaster assistance. A directive issued by the Office of Management and Budget on July 10, 1980,[14] ordered thirteen federal agencies to execute an interagency agreement whereby their post-flood efforts would be coordinated with each other under the leadership of the Federal Emergency Management Agency (FEMA). The agreement was executed December 18, 1980. In the event of a major flood, FEMA will send to the scene a "hazard mitigation team" to assess and report upon opportunities for reducing future flood losses through the recovery process. Such teams are to be established by each FEMA regional office and are to be interagency and interdisciplinary, with participants from state and local governments. Upon the submission of a hazard mitigation report (normally within fifteen days), all federal agencies will attempt to administer their assistance efforts consistently with the report. Alternative packages of benefits will be offered to victims to encourage voluntary relocation, floodproofing, or other mitigation actions. This process is intended to influence post-flood recovery decisions while not delaying important federal benefits such as flood insurance, disaster loans, and grants.

Need for improved coordination among public authorities. The Pearl River disaster points emphatically to the need for better coordination among all levels and units of government which share jurisdiction over common floodplains (Platt et al. 1980). This statement applies to circumstances preceding, during, and following a flood event. In the Jackson case, local governments scarcely communicated with each other or with the special districts upon which their protection depended. Federal agencies issued conflicting estimates of flood crests. The Corps built a flood control project and produced a flood plain information report yet failed to work closely with state and local governments in the development of floodplain management regulations. The post-flood recovery phase was replete with contradictory policies and actions among the multitude of public participants.

Technically, the Rankin-Hinds Urban Flood and Damage Control District was a vehicle for cross-stream cooperation regarding flooding in the Jackson area. The district however was limited in its function to the operation of the levee system, and even this ultimately proved to benefit only one side of the river. The Pearl experience indicates the importance of developing intergovernmental institutions and arrangements which can anticipate and resolve flood-related conflicts before the deluge arrives.

Floods and planning

Public authority to plan and zone land use is predicated constitutionally on protection of the "public health, safety, and welfare." Yet for decades the exercise of these powers in the United States gave little heed to genuine physical threats to public safety such as floods. Planning attention instead was directed to such concerns as augmenting the local tax base, segregation of land uses, and protecting the appearance and sanctity of upper income residential neighborhoods. During its formative years (1920–40), zoning was perhaps overly

influenced by the Garden City vision of the ideal community where the principal threat to peace and tranquility was "density" (e.g., Unwin 1912; Mumford and Osborn 1971, pp. 274–275), not a tempestuous environment. The U.S. Supreme Court, for instance, in its 1926 landmark zoning decision *Euclid* v. *Ambler Realty Co.*[15] went beyond the facts of the case to denounce apartments as a destroyer of communities:

> . . . it is pointed out that the development of detached house sections is greatly retarded by the coming of apartment houses which has sometimes resulted in destroying the entire section for private house purposes.[16]

For decades, however, the practice of planning and zoning—and therefore the courts—gave little consideration to the destructive nature of floods. In a seminal 1959 law review article, Dunham could cite little case law to support his argument that floodplain zoning is constitutional (1) to protect the unwary from unwise investment in flood-prone locations, (2) to protect upstream and downstream parties from increased flooding due to floodplain encroachment, and (3) to protect the public from the expense and effort of rescuing and rehabilitating the victims of floods. A national survey by Murphy (1957) disclosed only forty-nine examples of local floodplain regulations, inspiring his comment that ". . . attention given to floodplain zoning—the most discussed method of regulating land use in floodplains—has been mostly verbal and in the published literature."

Thus floodplain managment, despite the extensive flood experience of the 1930s and 1950s, was still not an integral component of comprehensive planning and zoning by the 1960s. Jackson's zoning map of 1969 (Figure 5) typified the irrational disregard of natural hazards in local planning and zoning practice until very recently.

By the late 1960s, courts finally were presented with opportunities to take note of floods as a proper object of public planning and land use regulation, as in the words of a 1968 Iowa Supreme Court opinion: "A river uncontrolled may at flood state become a devil, a destroyer of life and property, a disrupter of transportation and commerce vital to the state and its citizens."[17] In 1972 the Supreme Courts of Massachusetts[18] and Wisconsin[19] upheld floodplain and wetland regulations respectively. These landmark decisions have been widely cited in support of the view that public land use restrictions in floodplains and wetlands are valid and necessary.

The National Flood Insurance Act of 1968 gave new impetus to nonstructural responses to floods, including floodplain zoning. The National Flood Insurance program (NFIP) ties the carrot of federally sponsored flood insurance at low rates to the stick of community floodplain management restrictions. The latter must be adopted by local governments in compliance with federal minimum standards or flood insurance is not obtainable for property within the community. With various refinements described elsewhere (Platt 1976, 1978), the program has elicited widespread adoption of floodplain management measures. In a nationwide survey recently conducted by Burby and French (1981), it was found that among 798 responding communities in the regular phase of NFIP, 84 percent had minimum elevation requirements in floodplains, 77 percent had floodplain zoning, and 68 percent had floodproofing requirements.[20]

Thus considerable progress has been made in the adoption of local floodplain management measures. It remains to be seen whether these will be regarded as token gestures to qualify for federal flood insurance, or whether they will in fact lead to avoidance or reduction of future losses. Much depends upon the extent to which floodplain management is incorporated into the total community and regional planning process. The Jackson flood provides many lessons regarding the location and design of public facilities, the need for better forecast and warning systems, the role of public information and pre-disaster planning, the importance of coordination between adjoining governments and between levels of government, and above all, the need for public restrictions upon the development of land in identified flood hazard areas.

Author's note

This study was funded in part by a grant for "quick response" research on natural hazards from the Natural Hazards Research and Applications Information Center, University of Colorado, Boulder with funding from the National Science Foundation.

The author received assistance from many persons, including helpful comments on an earlier draft of this paper. Special thanks are extended to Mayor Dale Danks, Jr. of Jackson, Horace Lester, Sr., Charles E. Moak, Willard Inman, Raymond J. Burby, Stephen French, Richard Francaviglio, Glenn L. Audsley, George Phippen, Richard W. Krimm, and Gilbert F. White. William Nechamen prepared the maps.

Notes

1. The "Standard Project Flood" (SPF) is a design standard defined by the Corps of Engineers as "a major flood that can be expected to occur from a severe combination of meteorological and hydrological conditions that is considered reasonably characteristic of the geographical area in which the study is located, excluding extremely rare combinations." The "Intermediate Regional Flood" is the same as a "100 year flood," i.e., flood of a magnitude having a one percent chance of occurring in any year.
2. This estimate was made by Mayor Dale Danks, Jr., of Jackson, who admitted to the writer in an interview, November 28, 1979, that it was "pretty rough." No study has since attempted to calculate the damage more precisely.
3. Although physically non-contiguous to Jackson, the airport is legally under that city's corporate jurisdiction as well as ownership. This arrangement was allegedly devised to allow the sale of alcoholic beverages, otherwise illegal in Rankin County.
4. Mississippi Laws, 1958, Chapter 197, section 2.
5. At the time of writing, the operation of Ross Barnett Dam was the subject of litigation. The writer takes no position on the issue.

6. P. L. 86-645. The project was authorized in 1960, but the 1961 flood prompted its execution.
7. This executive order superceded E. O. 11296 on the same subject issued in 1966 by President Johnson.
8. FIA originated as a unit of the Department of Housing and Urban Development in 1968. It was transferred to the Federal Emergency Management Agency in 1979.
9. An immediate issue involved the reconstruction of some two hundred bridges across the Pearl River substantially damaged by the flood. FDAA maintained that it would only provide money out of the President's Disaster Fund to restore the bridges to their pre-flood condition. State officials, invoking Executive Order 11988, argued that the bridges should be rebuilt with sufficient clearance that they would not again become obstructions to a major floodflow. The state's proposal would cost an estimated $75 million more than mere replacement. During the three months following the flood while the state and FDAA wrangled on the question, most of the bridges were in fact replaced by county and local authorities to pre-flood standards. According to one Mississippi official, "You cannot wait ninety days and expect people to do without bridges. Mitigation must begin the minute the water peaks." (Telephone interview with Willard Inman, Mississippi State Flood Insurance Coordinator, March 27, 1980.)
10. Coincidentally, on the day of this check the Pearl was again in flood (reaching 33.5 feet as compared with 43.25 feet in April). Owners of recently refurbished homes close to the river were reported to be anxious. One was quoted as saying, "I'd leave town tomorrow if I could. I hate that reservoir. I hate it." (*Jackson Clarion-Ledger*, November 29, 1979, p. 1A).
11. As of April 1981, Jackson and Hinds County are enrolled in the regular phase of the National Flood Insurance Program. Rankin County, Flowood, Pearl, and Richland are all in the emergency phase with flood insurance studies in progress. The disparity in timing of floodplain maps for the east and west sides of the Pearl prompted Mayor Danks of Jackson to complain that FIA was planning for "only half a river." (Personal interview, November 28, 1979.)
12. In April 1981, the Department of Justice filed two civil suits in Louisiana to recover $93 million in federal flood insurance payments. The suits are directed against local public authorities, private developers, and others, alleging "willful and negligent" management of flood problems.
13. Letter to the writer from Charles E. Moak, General Manager of Pearl River Valley Water Supply District, June 11, 1980.
14. This directive was based in part upon recommendations made in a report by the writer for the U.S. Water Resources Council, "Options to Improve Federal Nonstructural Response to Floods" (December 1979).
15. 272 U.S. 365 (1926).
16. 272 U.S., at 372.
17. *Iowa Natural Resources Council* v. *Van Zee*, 158 N.W.2d 111, at 118.
18. *Turnpike Realty Co.* v. *Town of Dedham*, 284 N.E.2d 891.
19. *Just* v. *Marinette County*, 284 N.W.2d 761.
20. As of November 15, 1980, there were 5,571 communities enrolled in the regular phase of NFIP (which requires full-scale floodplain management) and 11,386 communities in the emergency phase (where management requirements are minimal). Burby and French also found significant floodplain management activity in some emergency phase communities, apparently exceeding NFIP requirements.

References

Burby, Raymond J., and French, Steven P. 1981. Coping with floods: the land use management paradox. *Journal of the American Planning Association* 47, 3: 289–300.

Central Mississippi Planning and Development District. 1978. *General land development plan*, (prepared for Rankin County, Mississippi). Jackson: the District.

Dunham, Allison. 1959. Flood control via the police power. *University of Pennsylvania Law Review* 107: 1098–1132.

French, Steven P.; Miller, Todd L.; Burby, Raymond J.; and Moreau, David H. 1979. *Managing flood hazard areas: a field evaluation of local experience*. Chapel Hill: Center for Urban and Regional Studies, University of North Carolina.

General Accounting Office. 1979. *Improvements being made in flood fighting capabilities in the Jackson, Mississippi area*. CED-80-36. Washington: U.S. General Accounting Office.

Hoyt, William G., and Langbein, Walter B. 1955. *Floods*. Princeton: Princeton University Press.

Jackson Clarion-Ledger. 1979. The great flood. Jackson, Mississippi: *Jackson Clarion-Ledger*.

Kusler, Jon A. 1976a. *A perspective on flood plain regulations for flood plain management*. Washington: Office of the Chief of Army Engineers.

———. 1976b. *Statutory land use control enabling authority in the fifty states*. Washington: Federal Insurance Administration.

Lester, Horace, Sr. 1979. Easter flood, 1979—Jackson, Mississippi. Unpublished memorandum.

Mumford, Lewis, and Osborn, Frederic J. 1971. In *The letters of Lewis Mumford and Frederic J. Osborn*, ed. Michael Hughes. New York: Praeger Publishers.

Murphy, Francis C. 1957. *Regulating flood-plain development*. Research Paper No. 56. Chicago: University of Chicago, Department of Geography.

Platt, Rutherford H. 1976. The national flood insurance program: some midstream perspectives. *Journal of the American Institute of Planners* 42, 3: 303–313.

———. 1978. Coastal hazards and national policy: a jury-rig approach. *Journal of the American Institute of Planners* 44: 170–180.

———., et al. 1980. *Intergovernmental management of floodplains*. Program on Technology, Environment and Man Monograph No. 30. Boulder: Institute of Behavioral Science, University of Colorado.

U.S. Army Corps of Engineers. 1973. *Flood plain information: Pearl River-Neely Creek, vicinity of Jackson*. Mobile, Ala.: Mobile District, U.S. Army Corps of Engineers.

Unwin, Raymond. 1912. *Nothing gained by overcrowding*. London: P.S. King and Son for the Garden Cities and Town Planning Assn.