ELEVATED HOUSING:

FLOOD PROTECTION THROUGH RAISING EXISTING STRUCTURES

RESEARCH REPORT NO. 186

LEGISLATIVE RESEARCH COMMISSION
Frankfort, Kentucky

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Prepared by:

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Legislative Research Commission
Frankfort, Kentucky
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FOREWORD

House Resolution 37 of the 1980 General Assembly recognizes the pervasive nature of flood problems for many communities in the Commonwealth, and directs the Legislative Research Commission to "conduct a study of the possible incentives for flood proofing, including income tax deductions and other measures consistent with federal insurance administration regulations." This research report concludes that elevation of existing residential structures is the only measure, other than relocation, which is consistent with federal insurance administration regulations. Analysis of the economics of elevation indicates that for many homes benefits would exceed costs, so that a program to assist homeowners to elevate their homes would be a sound public policy. The report recommends low interest loans through the Kentucky Housing Corporation as the primary source of assistance, supplemented through the use of state and local government federal revenue sharing allocations.

This report was prepared by William Wiley. The advice of Mr. Harry Beckett, U.S. Army Corps of Engineers, Huntington, West Virginia; Mr. Jeffery L. Peterman, P.E., Booker Associates, Inc., Lexington, Kentucky; and Mr. Tom Hawkins, Federal Emergency Management Agency, Atlanta, Georgia, on flood proofing programs and techniques is gratefully acknowledged.

Vic Hellard, Jr.
Director

The Capitol
Frankfort, Kentucky
October 1981

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SUMMARY

House Resolution 37 of the 1980 General Assembly states that the need to be near river transportation and the lack of other suitable land historically has led to extensive development in flood prone regions of the state. This type of development has intensified in recent years, as Kentuckians have moved back to their home state to take advantage of the coal boom. While guiding future flood plain development to avoid flood hazards is extremely important, it is equally important to find ways to protect existing flood prone homes. For this reason, HR 37 directs a study of the "possible incentives for floodproofing, including income tax deductions and other measures consistent with federal insurance administration regulations."

Before a study of incentives could properly be undertaken, it was necessary to determine what economic factors already affect flood prone homes. Only by knowing the present costs of flood damage and flood protection techniques could it be determined how great an incentive must be offered and whether the state can and ought to bear the costs.

Current Federal Insurance Administration Regulations do not permit insurance rate reductions for any type of residential flood protection other than elevation of homes above the hundred-year flood level. Other techniques, such as attempting to waterproof masonry surfaces and providing bulkheads for windows and doors are not effective enough to warrant rate reductions. This study, therefore, was limited to comparing the costs of elevating a home to those of not elevating.

Costs of elevating include, in most cases, a second mortgage on the home and flood insurance costs at reduced rates. Costs of not elevating include federal flood insurance premiums at a subsidized rate, and flood damage to the value of a structure and household goods above the limited amount of subsidized flood insurance which can be purchased. This flood damage may be "pre-paid" through the purchase of additional insurance at higher actuarial rates when available. The relative costs of elevating or not elevating a home are greatly affected by the prevailing interest rates and the expected rate of inflation.

An important conclusion of this study is that for a low value home the cost of elevating will exceed the savings. This result can be attributed in large part to the low cost of subsidized federal flood insurance. (Since the text of this report was prepared, federal flood insurance rates have been raised 60% in the case of structural coverage, and 43% in the case of contents coverage.) Based on the rates which prevailed prior to October 1, 1981, the benefits of elevating a home began to outweigh the costs when value reached about $26,000. Thereafter, the more valuable the home, the greater the economic benefit of elevation. (The new insurance rates will tend to reduce this $26,000 break-even point, but the new lower figure has not been determined.) From a purely economic standpoint, there are many households in Kentucky that could benefit from a decision to elevate. Kentuckians living in lower value houses, those below the approximate figure of $26,000, or whatever figure is accurate under the new insurance rates, might not benefit in a purely economic sense. In terms of safety and comfort they would obviously be beneficiaries.

Income tax credits could be used as an incentive, but are not recommended. This is because taxes are related to income. The income tax credit method offers the least potential assistance to those Kentuckians who would

need it the most. A second problem would be monitoring tax credits through the Department of Revenue and determining that elevations conformed to federal insurance administration regulations. A third problem is that budgetary impacts could not be determined until after the fact.

The most attractive method to provide incentives would be through Kentucky Housing Corporation mortgage subsidy bonds, since the Kentucky housing Corporation can consistently lend money at below market rates, and the Corporation has extensive experience dealing with loan eligibility relating to income guidelines. Interest rates might be so high, however, even at KHC rates, that demand for loans would be low. In this event, loan interest or principal could be written down by grants provided through the Kentucky Housing Corporation, or at the local government level through Community Development Block Grants. In either case the source of grant money would probably be federal revenue sharing with state or local governments, since state revenues are presently so scarce as to require cutbacks in existing programs.

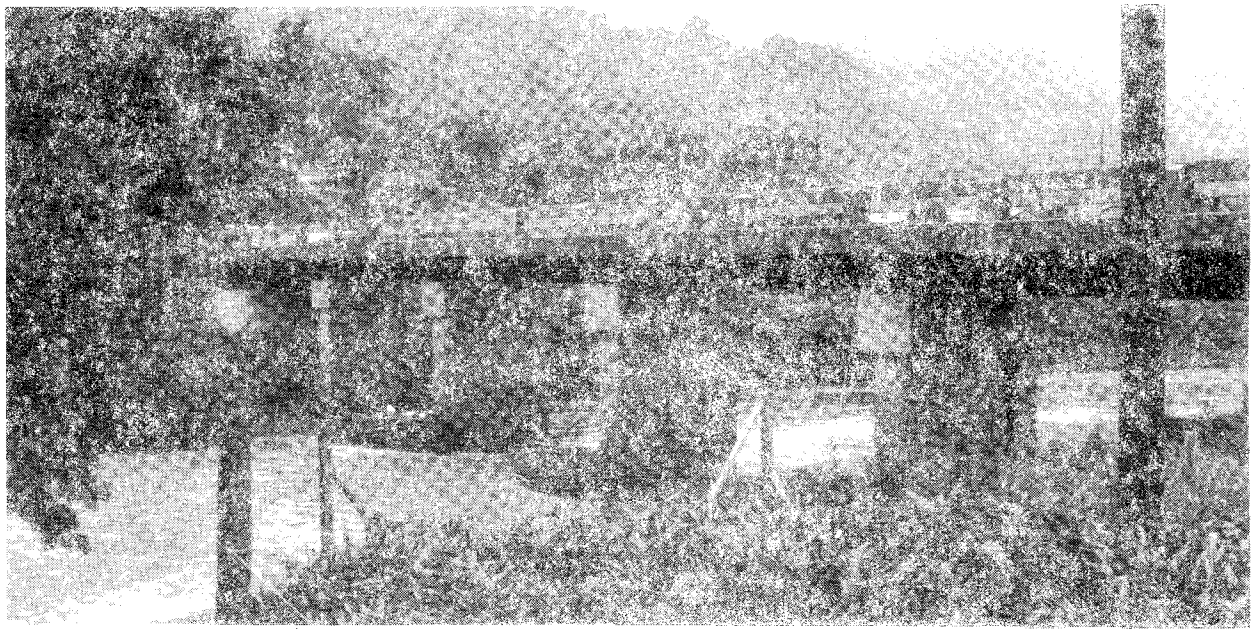
It should be understood that any program of incentives for elevation of homes will not reach lower income Kentuckians without heavy subsidies, and that renters probably will not be willing to pay higher rates to live in houses elevated above the hundred-year flood level.

CHAPTER 1

INTRODUCTION

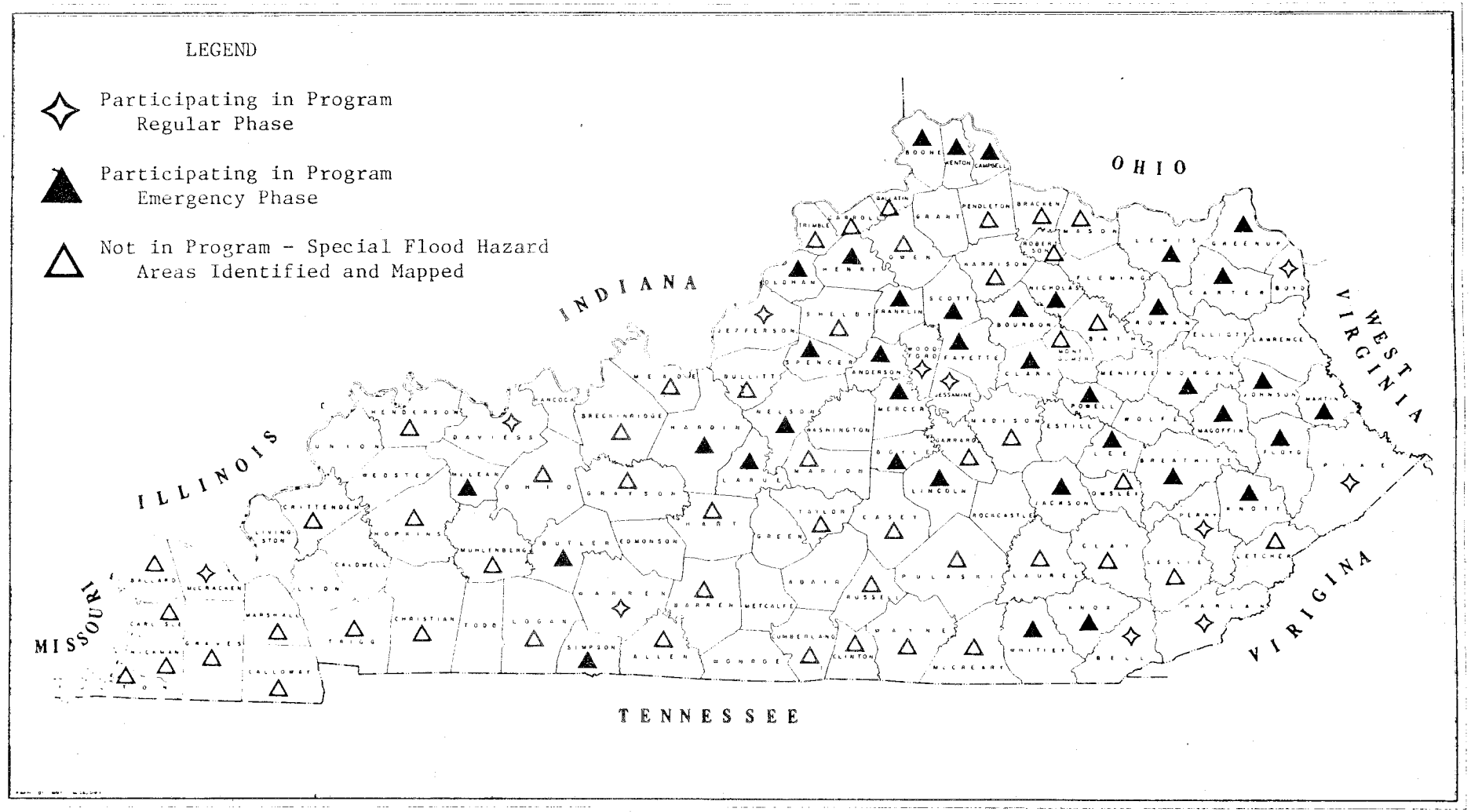
The hazard of floods to existing homes is a pervasive problem throughout Kentucky. As of April, 1981, the Federal Insurance Administration had identified and mapped 210 flood hazard areas, located in ninety-nine counties throughout the state. (See Figure 1 for a graphic presentation of the location of flood hazard areas within the counties.) Development of housing and commercial and industrial structures within these flood hazard areas is common because land adjacent to rivers and streams is often the most suitable for development. River front land tends to be level, which makes it more economical for development than more rugged terrain away from the river or stream bank. Historically, it may have been developed because the river was a path of commerce. The pressure to develop the flood plains today is especially acute in such areas as Eastern Kentucky, where there is little land to develop other than that within the narrow flood plains along rivers and streams. Recent population increases in Eastern Kentucky, due to the resurgence of the coal industry, have led to the construction of thousands of new housing units, and many of these have been built in the flood plain.[1] Development in flood plains of Eastern Kentucky was largely responsible for the extremely high losses caused by the April, 1977 flood. [illegible] the most recent severe flooding occurred, in January to June and July, 1984, in Pike and McCoffin Counties.

Flood plain development may have been most feasible in a given location at some time in the past, but changes in the environment could make such land less suitable for development today. These changes include the cutting of forests, strip mining, or increased urban development itself, all of which increase run off and flood levels. Development within the flood plain may also obstruct flood ways, thereby increasing flood levels. Examples might include a large commercial building which blocks the flow of flood waters, or a bridge with multiple piers which catches flood debris as it moves downstream until it builds to the point of damming the flow.



Bridge in Harlan, Kentucky With Multiple Piers Susceptible to the Accumulation of Flood Debris.

FEDERAL FLOOD INSURANCE PROGRAM



STATUS OF
UNINCORPORATED COUNTY AREAS

Actually, in Eastern Kentucky, land uses as they affect flood levels may be offsetting one another. Strip mining tends to increase run off, but the reforestation of land previously used for cultivation or pasture tends to reduce it.[3]

Once human settlements are in place within a flood plain, the problem becomes that of how to protect them or, more precisely, how to protect them economically. Approaches to protecting human settlements within flood plains can be conceived of within two broad categories: structural measures and non-structural measures. Structural measures include physical changes designed to protect more than the single home by changing the depth of flooding, such as dams, levees or flood walls. Nonstructural measures include physical changes to protect the individual structure, such as flood proofing, elevation above flood levels or relocation, or programmatic changes to protect more than the individual structure, such as flood plain zoning and building restrictions. The focus of this report is on non-structural changes to protect existing individual homes.

Mitigation of flood hazards must be considered within the context of the National Flood Insurance Program. It is only through this program, with the purchase of low cost flood insurance, that the residents of flood prone areas can gain a measure of financial protection. It is also through this program that flood plain management is promoted on a national basis, and sanctions are imposed upon communities which refuse to properly control flood plain development. In the context of the present study, if one wants to become eligible for lower cost flood insurance, it is the National Flood Insurance Program which establishes acceptable criteria for the flood proofing of existing homes in Kentucky.

The National Flood Insurance Program was created in 1968, and is presently administered by the Federal Insurance Administration (FIA), within the Federal Emergency Management Agency (FEMA). Federal law requires FEMA to notify every flood prone community in the nation of its flood prone areas. The FIA initially publishes a "Flood Hazard Boundary Map" and sends it to the community. This map identifies special flood hazard areas, those areas which are subject to a base flood, or flood with a probability of occurrence once in a hundred years. Upon receipt of the Flood Hazard Boundary Map, the community is eligible to join the first, or emergency, phase of the National Flood Insurance Program. Entry into the emergency phase of the program enables all residents of the community to purchase up to $35,000 of flood insurance for their home, and up to $10,000 of insurance for the contents of their homes at subsidized rates, regardless of flood risk. Eligibility for insurance carries with it certain program requirements for the community. The community must require development permits for all proposed construction, and must review permits to assure that proposed building sites are reasonably flood free. In addition, for flood prone areas, the community must require proper anchoring of structures, use of construction materials and methods that will minimize flood damage, and adequate drainage for new subdivisions.[4] It is of obvious benefit to a community to join the National Flood Insurance Program, because of the subsidized insurance benefits which become available to the citizens. But there are also sanctions of substantial impact which are levied on a community that fails to qualify for the Emergency Program within one year of receipt of the Flood Hazard Boundary Map. By law, federal agencies may not approve grant money, mortgage backing (FHA, VA), direct loans, flood disaster relief or any other taxpayers' funds to support the purchase, construction or improvement of property located in flood prone areas. [USCA 4003(a)(4) and 4106(a)]

The second phase of the National Flood Insurance Program is the regular program. The community should enter the program within six months of receipt of the Flood Insurance Rate Map (FIRM), also provided by the FIA. This map shows elevations within special flood hazard areas, and outlines risk zones, based upon variations between floods which have a 10% probability of occurring in any year and those which have a 1% probability of occurring (the hundred-year flood).

Once a community has entered the regular program, an individual may purchase additional insurance at actuarial rates to insure that part of his property which is not covered by the limited subsidized insurance available in the emergency program. If the homeowner can demonstrate that his home is above the base flood level, he may purchase all of his insurance at actuarial rates which will be below the subsidized rates of the emergency program.

The regular program requires that all new or "substantially improved" buildings be elevated or flood proofed above base flood levels. Substantial improvement is defined as "repair, reconstruction or addition to a structure the cost of which equals or exceeds 50 percent of the market value of the structure either before the improvement is started or the damage has occurred." Since the renovation of a flood-damaged home often involves "substantial improvement," the thrust of the National Flood Insurance Program is to promote the elevation of existing homes above the base flood level. This can also be seen in the current (1981) Flood Insurance Manual of the National Flood Insurance Program, which permits the extension of insurance coverage to include the cost of elevation if a single-family house has been flood-damaged in excess of 50 percent of its market value.[5] Unfortunately, this provision has not been implemented, apparently due to cost considerations. Structures built or "substantially improved" after the community enters the regular program and which fail to meet this elevation requirement can be declared by the local government to be in violation of local law and therefore ineligible for flood insurance. In addition, if a building in the flood zone in a community in which flood insurance is available is not insured, it does not qualify for any financial assistance, including a mortgage loan at a financial institution insured by an agency of the federal government. It would be possible to repair and insure a home after a flood and not to elevate it above the base flood level, so long as repairs did not constitute a "substantial improvement," but such a home would not qualify for lower cost insurance at actuarial rates until elevation occurred.

In addition to elevation requirements relating to new construction and "substantial improvement," the National Flood Insurance Program specifically sets the standards by which flood proofing, broadly defined, of existing residential structures in communities covered by the National Flood Insurance Program must be accomplished in order to qualify for actuarial, or low cost, insurance rates. While such techniques as sealing of masonry walls, installation of bulkheads at window and door openings and installation of gate valves in drain lines are acceptable under the National Flood Insurance Program for commercial structures, the only acceptable technique for existing residential structures, other than relocation, is elevation above the base flood level.[6]

Booker Associates, Inc., in their Kentucky Flood Protection Manual (1981), discuss sealing residential structures built on solid concrete slab foundations. They caution that all masonry walls will leak except for poured concrete walls in excellent condition. Techniques to reduce permeability include waterproof coatings or the use of a waterproof plastic shield between masonry layers.[7] The U.S. Army Corps of Engineers advises that for the types

of residential structures and depths of flooding commonly found in Kentucky, attempting to waterproof exterior surfaces will not work: raising the structure in place is the only practical means of flood proofing.[8] For those homes built on a concrete slab foundation, elevation is not an alternative. Owners have no recourse but to seal their homes or, where feasible, to build dikes around them. While it should not be the policy of state government to discourage any attempts by individuals to protect themselves from floods, this study will be confined to an examination of the economic, social and engineering factors involved in a decision to elevate. This approach is adopted because of the recognized limitations of sealing techniques and because elevation and relocation are the only techniques through which a homeowner can become eligible for flood insurance at the less expensive actuarial rates under the National Flood Insurance Program.

The costs of elevation will also be compared to those of relocation, to determine when it is more advisable to attempt moving a structure.

As economic analysis will demonstrate in Chapter IV of this study, houses with low value or certain structural faults would simply not merit elevation or relocation. There is recognition in federal law also that the most logical alternative for certain frequently flooded homes is to demolish the structure and dedicate the land to a use unaffected by frequent flooding. There are appropriations under federal law to fund this alternative.[9]

CHAPTER II

ELEVATING AN EXISTING STRUCTURE

The specific actions necessary to elevate an existing structure in place are as follows:

Disconnect all plumbing, wiring and utilities which cannot be raised with the structure.

Place steel beams and hydraulic jacks beneath the structure and raise to the desired elevation.

Extend existing foundation walls, or construct a new foundation.

Lower the structure onto the extended or new foundation.

Adjust walks, steps, ramps, plumbing and utilities and regrade the site as desired.

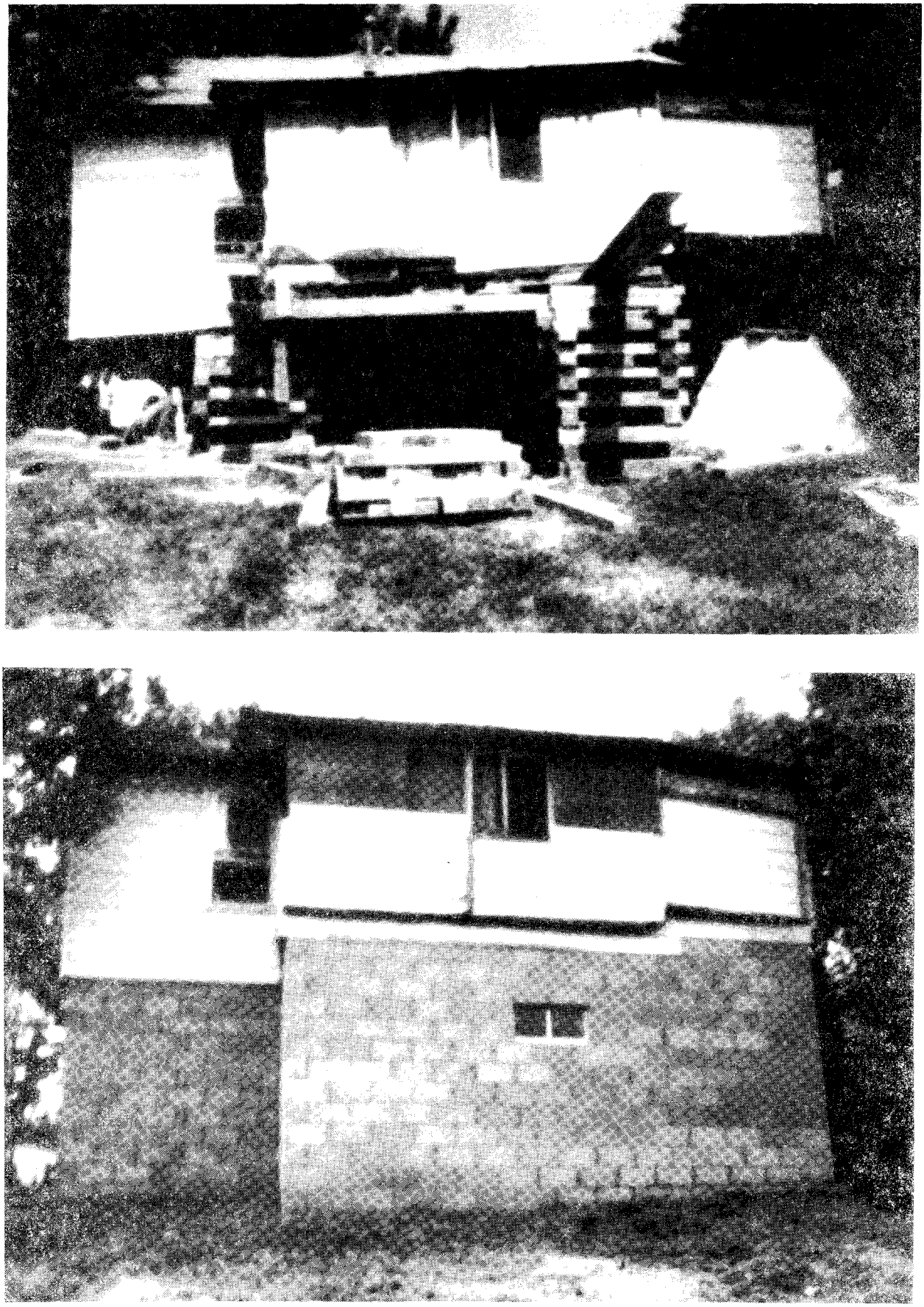
Reconnect all plumbing, wiring and utilities.

Insulate exposed floors to reduce heat loss, and protect plumbing, wiring, utilities and insulation from possible water damage.[10]

Given this basic technology, nearly any residential structure can be elevated in place, but it is not feasible to raise every structure. There are economic, safety and aesthetic factors which should influence the decision to elevate any particular structure.

Height

Viewed purely in terms of the technology available, a house can be elevated to a height of twelve feet or more, but elevation to such heights might not be safe and would be neither economical nor attractive. There is a variance of professional opinions about how high a structure should go. Booker generally suggests that an elevated foundation of concrete blocks not be over three feet high, while elevations on concrete piers can go as high as eight feet. Booker also reports that the weight of a structure gives resistant force. Therefore a two-story brick can be raised higher than a one-story frame.[11] The Hydrologic Engineering Center, Institute for Water Resources, U.S. Army Corps of Engineers, reports that houses have been raised successfully to nine feet. The example it cites was raised on concrete blocks with steel posts.[12] Thirteen homes were recently raised on concrete blocks in Irvine, Kentucky. Elevations ranged from 1.3 to 8.1 feet.[13] In its Report on Tug Fork, West Virginia, Kentucky and Virginia (1970), the Huntington District Corps of Engineers reported that stability analysis of typical residential structures in Matewan, West Virginia, indicated that raising a house more than six feet would require replacement of foundation walls with those of heavier cross section.[14] A consultant report written for the Corps in 1980 dealing with elevations in the same flood plain indicates, however, that it is possible, though aesthetically unpleasing, to raise a house up to twelve feet on a single row of concrete blocks. While it is recommended for elevations above



Home in Irvin, Kentucky During and After the Process of Elevation in Place. This home probably would not qualify for elevation under the recommendations contained in this study due to its low initial value.

eight feet that earth be placed under and adjacent to the house, it is only after twelve feet that a double row of concrete blocks at the base of the foundation is recommended to support the additional loading.[15]

Type of Structure

In order for elevation to be feasible, the house must be on a basement or foundation with crawl space. Raising a house on a basement does nothing to the protect the basement, however, and after the elevation the basement should not be used for storage of items susceptible to flood damage. Attempting to waterproof basements through use of sealers and bulkheads at windows and doors is not feasible without significant supplementary structural modifications to strengthen the substructure.[16] When the house is raised sufficiently to allow access under the new elevation, the old basement may be filled in. While a house constructed on a slab could be raised, the technical difficulties and expense involved are such that no one recommends it. The structure which presents the least difficulty is the frame house on a raised foundation. Masonry homes, or homes with brick veneer present more difficulties and expense, because more secure underpinning is needed, but the consensus of authorities is that they can be raised. While the age of a house does not affect feasibility or cost, the condition of the house is an important factor in determining whether elevation is feasible.[17] The costs of elevation are more directly related to condition and perimeter configuration than age or value.[18] The Corps of Engineers, therefore, does not recommend elevating houses in "dilapidated" condition. For the purposes of this study, a "dilapidated" house is one which has significant structural problems, so that elevation could not be attempted without repairs to the floor joists, or the studs, for example. Such repairs significantly increase the cost of elevating a house which has low value to begin with. Costs could exceed the value of the house, and elevation would simply become economically unfeasible.[19] In addition, estimating the cost of elevating a "dilapidated" house is difficult.[20]

The perimeter configuration of a house also affects the difficulty of elevation. A square house or a rectangle with no "L's" or offset sections is easiest to raise. If the perimeter of the house is more complex it can still be raised, but costs increase because of the need for additional bracing or possible sectioning in the elevation process.

Safety

Raising a house to a point above the base flood level does not mean that the residents will never be endangered by floods. It simply means that they will be above the flood level expected to occur on an average of once in every hundred years. (It might, of course, occur two years in a row). If there is a higher flood, they will be at least partially under water. If they are under water, or if they are isolated by water, the residents may want or need to evacuate. For this reason, "access to and from the structure during high water should be insured when raising walks, steps, ramps, and when regrading the site."[21] Another factor is potential danger from movement of flood waters. If the house will stand in water of low velocity, there is little danger. But as velocity increases, the foundation will be placed under more stress and soil around the foundation may be eroded. For this reason, one author advises that "if average velocity of overland flow is more than six

feet/sec., erosion protection would be required."[22] Another advises that elevations should not occur in the actual flood way, nor should elevation impair the capacity of the flood plain to pass floods.[23] These restrictions are also built into the federal law on flood protection. [USCA 42 Sec 4103(c).]

It should be apparent that deciding whether a flood prone house should be raised, to what elevation and by what method involves many technical questions relating to such things as expected flood heights and velocities. Also of concern might be soil resistance to erosion and orientation of the house to the path of the flood. It would be difficult, even in a technical manual, to advise a homeowner on the engineering factors bearing on an elevation decision without actual on-site evaluation. It is certainly not the intent of this general study to offer technical advice to any individual homeowner on the wisdom or safety of elevating his house. Such advice is best left to a professional employed by and responsible to the homeowner.

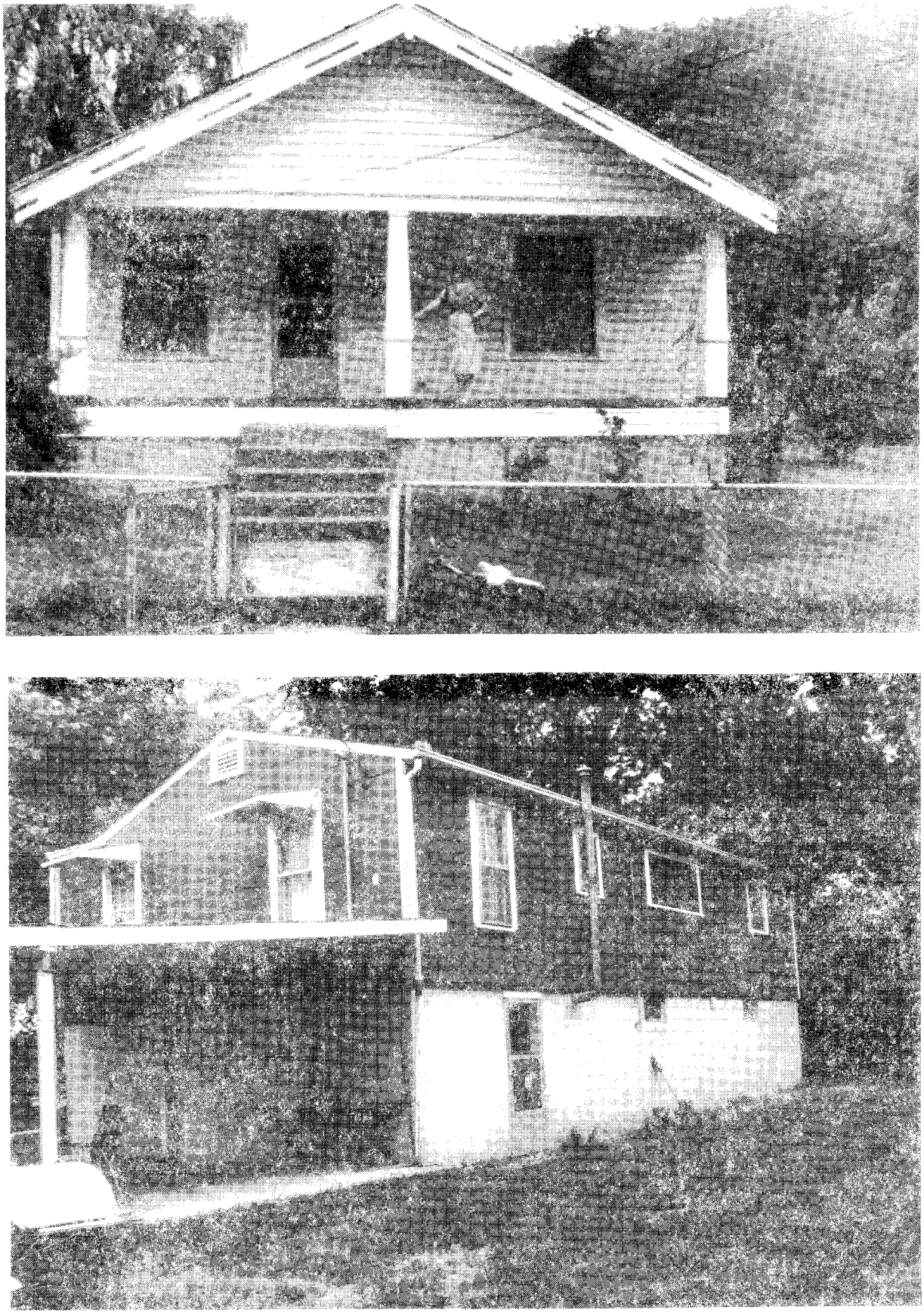
Experience with Elevation in Kentucky

Raising a house in place and constructing a new foundation under it is not a new technique in Kentucky. Elevations have been performed for a number of years in various communities, both with and without the use of government assistance. As reported in the Lexington Herald on July 7, 1981, WPA workers raised an office building in Salyersville four feet nearly fifty years ago after a depression-era flood. In Harlan, Kentucky, homes have been raised, with the assistance of Small Business Administration loans, after floods in 1963, 1969 and 1977. Homes have also been raised in Harlan without government assistance, but, according to a local contractor who performs this type of work, elevations by individuals without government assistance ceased when interest rates hit 9.5%.[24] As mentioned earlier, thirteen homes were raised in Irvine, Kentucky, beginning in 1980. In this case, all costs were paid by the federal government through a combination of 407 Disaster Relief Funds and Community Development Block Grant funds. All of these structures have been elevated on concrete block foundations.

Unfortunately, many structures raised in the past have been flooded after elevation. Examples include the office building in Salyersville and many of the homes in Harlan. (See picture, p. 11.) At the time these structures were raised, the Flood Insurance Rate Maps now available in many areas of Kentucky were not available. Possibly these homes were not raised enough to exceed the elevation of the waters at the base flood level. Basing future elevations on the data provided by a Flood Insurance Rate Map should prevent most flooding after elevation. According to the Kentucky Department for Natural Resources, Flood Insurance Rate Maps are available to twelve Kentucky counties and sixty incorporated cities now in the regular phase of the National Flood Insurance Program. More will be forthcoming.[25]

Relocating a Structure as an Alternative

While it may be technically possible to raise a house more than eight feet on concrete blocks, it is at this point that relative costs should make one consider moving the house rather than elevating it.[26] Moving a house involves the same basic technology as elevating it, except that after raising,



Homes Elevated in Marion, Kentucky. The home at the top was raised 50 inches by the owner in 1964. The woman on the porch points to the level of flood waters in 1977. The home at the bottom was raised 56 inches in 1971 with the assistance of a Small Business Administration loan. Flood waters reached 8 inches above the first clapboard in 1977.

the house is placed on a truck and transported to a new location for placement on its foundation. While the exact break-even point is different for single and two story houses or split levels, for basement and no basement, and for brick or frame, elevation costs continue to rise after the break-even point and so exceed the cost of relocation.[27] There are certain assumptions made for the general case, however, which may not be met in specific cases - structures which are to be moved no more than one mile, for which a new housing site is available along an existing road with utility services, and for which connecting to a public water supply system and a public sewerage system is possible, for example. If public water and sewerage are not available, costs will increase by approximately $2,500 for a well and $1,500 to $2,500 for on-site sewerage facilities.[28] Given the increasing costs and scarcity of suitable building sites in flood prone Kentucky communities, it may be that the relocation option is seldom available to Kentucky residents. If the option is available, however, and if relocation is no more costly than elevation cost figures developed in this study, then any incentives determined to be useful for elevation purposes should also apply to relocation.

CHAPTER III

ECONOMIC CONSEQUENCES OF ELEVATING STRUCTURES - DEVELOPING A METHOD FOR MEASUREMENT

The task set forth in HR 37 is to discover incentives for flood proofing existing housing. Before one can accurately determine what incentives are needed in a given situation, it is first necessary to determine what economic factors are already present. Existing costs of maintaining a home without flood proofing must be shown, as must costs associated with flood proofing, which in this case means elevation.

Assuming no assistance from the government, if an individual decides to elevate his home, he must pay the actual costs of the elevation, which in most cases would involve borrowing the money. Therefore, he must assume annual principal and interest payments. In addition, he should continue to carry flood insurance, with premiums determined at actuarial rates, to protect himself against the remote possibility that a flood will exceed the hundred-year flood level. Important factors bearing on the cost of elevation, therefore, are the initial cost of elevation and the interest rate at which the money must be borrowed. Another factor is the cost of insurance for both the structure and contents of the house. Over the life of a mortgage, the value of a home and furnishings should rise. This increasing home and contents value should be protected by increasing the amount of flood insurance purchased. The rate of inflation is very important for determining total annual costs over the lifetime of a mortgage.

If an individual decides not to elevate his home, he must pay the costs of not elevating. These costs, for a home constructed prior to the effective date of the regular flood insurance program, include the cost of flood insurance, at subsidized rates, for up to $35,000 of housing value and $10,000 of contents value. If the home is valued at more than $35,000 and the contents at more than $10,000, then additional costs are the expected annual damage to the housing and contents value above the subsidized insurance limits. These costs could be paid under the regular insurance program in the form of additional insurance premiums at actuarial rates, since the actuarial rates approximate actual damage.

By making assumptions about interest rates and rates of inflation in the economy, one can project with reasonable accuracy just what the annual costs associated with elevating a home are during the life of a mortgage. Similarly, one can determine the annual costs if elevation does not occur. Subtracting the costs of not elevating from the costs of elevating give one the net economic benefit, or loss, from a decision to elevate above the base flood level. The net economic benefit or loss determines whether it is better, economically, to elevate a home, or to pursue some other alternative. The fact that elevation might be a good economic decision in terms of the life of a mortgage does not mean that a homeowner will want to or be able to afford elevation. It may be that he cannot afford the initial annual costs of elevation even if it can be demonstrated that it is best in the long run to take this action. Conversely, the indication that it is not best in a purely economic sense doesn't mean he won't do it. He may think he has no alternative.

Making a determination of annual costs and comparing costs and benefits over the life of a mortgage are both important, then, for determining whether the state should promote housing elevation by offering incentives, and deciding what level of incentive must be offered to the homeowner to induce him to elevate. Presumably, if it is demonstrated that the long-term costs of elevation are greater than the long-term benefits, the state should not seek to promote it. If costs which would make elevation economically unsound can be attributed to variable factors, such as interest rates, which the state can manipulate, then strategies to manipulate these factors would be in order.

A model has been developed for this study to determine the net cost or benefit of elevation for a variety of houses located at various elevations within designated flood zones. The purpose of this model is to gain some basis for stating either that elevation would or would not be good public policy. In the absence of any other evidence on the subject, such an attempt is necessary. The model does not pretend, at least in its present form, to provide all the criteria for any policy which might be developed. As will be seen as the model is developed, it is too loosely constructed for that. Its purpose, instead, is to serve as an aid to understanding.

Variables and assumptions used in the model developed for this study are as follows:

* The estimated current costs of elevating houses of varying area, number of stories, and exteriors (frame or brick) have been provided by the U.S. Army Corps of Engineers, Huntington, West Virginia.[29] These estimated costs have been developed in the Tug Fork project, which includes three flood prone Kentucky counties on the border of West Virginia. Wages have been assumed at Davis-Bacon rates. (See Appendix 2.) Perimeter configurations are assumed to be four-sided, either square or rectangular. Foundations are to be constructed of concrete blocks, the most economical approach and the most popular in Kentucky.

* Estimates of annual flood damage have been generated from insurance premium rates found in the Federal Insurance Administration rate manual for the National Flood Insurance Program.[30]

* Values of existing houses have been estimated at three levels per square foot: $20/square foot for a low value home; $25/square foot for a home of medium value; and $30/square foot for a high value home. A second story is assumed to add 50% to the value of a one-story house. Two thousand five hundred dollars is added for brick surfacing at 1,200 square feet or below, and $3,000 is added for brick at more than 1,200 square feet.

* Annual inflation estimates have been set at 7% and 9%. Obviously, other estimates could be used. Predicting long-term rates of inflation is difficult, given the state of the economy in recent years. Interest rates have been set at 6%, 9% and 12%. Obviously, 6% and 9% are subsidized rates. Even 12% is a subsidized rate in the current market, but it may become a market rate in the foreseeable future. Current market rates have not been used, because of the demonstrated reluctance or inability of consumers to mortgage property at these rates.

* The $35,000 and $10,000 maximums for subsidized emergency insurance for structure and contents, respectively, are assumed to escalate at 3% annually. Empirical data on which to base this assumption is scanty. In 1968 the flood insurance program began with a maximum of $17,500 for structural coverage. This was doubled in 1973 to $35,000, and there has been no change since. If maximum coverages were never raised, inflation would reduce the real value of existing coverages to an insignificant level in the future. Three percent seems to be a safe assumption for real growth.

* Flood depth levels before and after elevation are measured at the first floor level. Analyses are not run on houses with basements because you cannot elevate a basement. After elevation, basements are frequently filled in because of their flood vulnerability.

* Mortgages are assumed to be at constant interest rates for a thirty-year term.

* Both elevated and unelevated homes are covered by flood insurance. Elevated homes are insured to full value, and unelevated homes are insured to full value or maximum value allowed under subsidized rates, whichever is less.

* Elevations are assumed to occur in two-foot increments, since eight-inch concrete blocks are commonly used. Flood depth is measured in even feet. Three blocks produce an even increment of two feet. Obviously, one foot increments cannot be achieved with eight-inch blocks.

The actual calculations performed to arrive at the net benefit or cost of elevation are as follows:

1. Pre-elevation structural insurance costs are calculated. Structural value in thousands, up to $35,000, is multiplied by $2.50, the rate per $1,000 coverage for emergency insurance coverage, which is constant in the FIA rate manual. (Effective October 1, 1981, the rate was raised to $4.00, but calculations do not reflect this new rate.)

2. Pre-elevation contents insurance costs are calculated. Contents value in thousands, up to $10,000, is multiplied by $3.50, the rate per $1,000 coverage for emergency insurance coverage, which is constant in the FIA rate manual. (Effective October 1, 1981, the rate was raised to $5.00, but calculations do not reflect this new rate)

3. Annual uninsured structural damage is calculated.

This damage occurs if elevation does not take place. Structural value in thousands, minus $35,000, is multiplied by the actuarially determined insurance rate appropriate to the flood depth of the house, taken from the FIA rate manual.

4. Annual uninsured contents damage is calculated. This damage occurs if elevation does not take place. Contents valued in thousands, minus $10,000, is multiplied by the actuarially determined insurance rate appropriate to the flood depth of the house, taken from the FIA rate manual.

5. After-elevation structural and contents insurance costs are calculated.

6. Annual costs of a thirty-year mortgage are calculated, using the Corps-provided elevation costs and the interest rate which has been selected.

7. After-elevation structural and contents insurance costs are added to mortgage costs to determine the first year cost of elevation.

8. Pre-elevation structural and contents insurance costs are added to annual uninsured structural and contents damage to determine the first-year cost of not elevating.

9. The cost of not elevating is subtracted from the cost of elevating to determine the net benefit or cost of elevating in the first year.

10. The inflation rate which has been selected is applied to structure and contents value for the second year of the mortgage. A 3% inflation factor is applied to the maximum levels of structural and contents insurance available in the emergency insurance program for the second year of the mortgage.

11. The calculation performed in step 10 is repeated for each year of the mortgage. Inflation is compounded.

12. Costs of elevating and not elevating are each totaled for the thirty-year period. The total cost of not elevating is subtracted from the total cost of elevating to determine the net benefit or cost over the life of the mortgage.

Results Derived from Calculations Performed

The calculations described above were performed on five houses of differing size and value. The dimensions of these houses and the values and costs associated with them were as follows:

Type	Sq. Ft. 1st Floor	Structural Value	Contents Value	Elevation Cost, 2 ft.	Elevation Cost, 4 ft.
1-story frame	900	$18,000	$ 6,300	$5,800	$ 7,500
1-story frame	900	26,000	9,100	5,800	7,500
2-story frame	1,200	45,000	15,750	6,190	8,190
1-story brick	1,600	43,000	14,000	7,300	10,500
1-story brick	1,600	51,000	16,800	7,300	10,500

Four different flood zones and several different flood depths within each zone were assumed. The zones selected were A4, A10, A16, A20. Depths within each zone were limited to those for which insurance rates were available in the FIA rate manual. For Zone A4, rates were available only to a depth of -1 foot. For zone A10, rates were available to -2 feet, and for zones A16 and A20 rates were available to a depth of -3 feet. Since elevations were assumed

to occur in two-foot increments, houses which were one foot and three feet below base flood level prior to elevation were one foot above base flood level after elevation, while houses two feet below base flood level were elevated to two feet above base flood level. Three interest rates, 6, 9, 12, and two rates of inflation, 7% and 9% were used. Costs for each of the five houses in zone A4 were calculated for one flood depth (-1) and six combinations of interest and inflation rates, yielding a total of thirty cases. In zone A10, there were five houses times two depths times six combinations of interest and inflation, yielding sixty cases. In similar fashion, houses in zones A16, and A20 yielded ninety cases each. Calculations were performed, therefore, on 180 combinations of house type, flood depth and interest-inflation combination.

CHAPTER IV

RESULTS OF THE METHOD

Cost-Effectiveness of Elevation is Directly Related to Housing Value

If a house is of relatively low value, the model indicates that, in purely economic terms, elevation is not recommended. As the initial value of the home increases, it makes better economic sense to elevate.

In the case of the $18,000 home, there was only one instance in which elevation made good economic sense. This case was in zone A4, at a depth of minus one foot, with loan interest set at a subsidized rate of 6% and inflation estimated at 9%. The net gain over thirty years was $280. By raising interest to a near market rate of 12% and maintaining all other variables at the same value, the gain disappeared and the net loss was $8,678. (See Table 1A.)

Elevation made less sense as the zone number increased. In zone A10, the best case was at an initial depth of minus 2 feet, where the loss was $2,582. (Table 1B.) In zones A16 and A20, the best cases were at an initial depth of minus three feet, where the losses were $1,722 and $4,010 respectively. (Table 1C.)

Within any flood depth, elevation generally made better sense in the lower zones. As the zone number increased, net cost tended to escalate. The reason for this general trend probably relates to flood frequency. Zone designation is directly related to the difference between the lower depth of the flood of ten-year frequency and greater depth of the flood of hundred-year frequency. One zone interval equals .5 foot in flood depth. Thus in zone A4, there is a two-foot difference in flood depth between the ten-year flood and the hundred-year flood. By the same token, in zone A20, there is a ten-foot difference between the ten-year flood and the hundred-year flood.

A house sitting at two feet below the hundred-year flood level in zone A4 is right at the ten-year flood level, while the same house in zone A20 would be eight feet above the ten-year flood level. The house in zone A4 will be flooded more frequently and will suffer more damage; consequently, it would make more sense to elevate it. After elevation, the house in zone A4 is relatively more protected than a comparable house in zones A10, A16 or A20, because floods greater than the hundred-year flood will not be much higher than the hundred-year flood in zone A4, but will be relatively higher in zones A10, A16, or A20. Thus, both the pre- and post- elevation flood risks favor elevation of a house in zone A4 over one in zones A10, A16, or A20. These relationships can be seen in the insurance premium rates taken from the FIA rate manual and reproduced in Table 6. Below the level of the base flood, insurance premiums tend to decrease as zone increases. At and above the base flood level they tend to increase with flood zone. Exceptions are seen at initial depths of minus one and minus two feet, where premium rates increase from zone A16 and A20. Premiums for contents also increase, but only at a depth of minus one foot. These two inconsistencies in the insurance premium rates account for exceptions to the general rule that elevation is more economical in the lower designation flood zones. For example, at an initial depth of minus one foot, benefits may increase or losses decline from zone A16 to zone A20. (See Tables 3A, 4A and 5A.)

TABLE 1A

THIRTY-YEAR COSTS OF ELEVATION

1 STORY X FRAME BRICK 900 SQ. FT. 1ST FLOOR $18,000 VALUE $6,300 CONTENTS VALUE

-1 FT. BELOW BASE FLOOD +1 NEW ELEVATION $5,800 COST TO ELEVATE

		ZONE 4			ZONE 10			ZONE 16			ZONE 20		
INTEREST	INFLATION	ELEVATED	UNELEVATED	B(COST) BENEFIT	ELEVATED	UNELEVATED	B(COST) BENEFIT	ELEVATED	UNELEVATED	B(COST) BENEFIT	ELEVATED	UNELEVATED	B(COST) BENEFIT
6	7	13,889	8,155	(5,734)	14,538	7,029	(7,509)	15,288	6,954	(8,333)	16,374	7,101	(9,272)
6	9	14,402	14,683	280	15,074	11,182	(3,891)	15,852	10,981	(4,871)	16,983	11,459	(5,523)
9	7	18,171	8,155	(10,016)	18,820	7,029	(11,791)	19,569	6,954	(12,615)	20,655	7,101	(13,553)
9	9	18,684	14,683	(4,001)	19,355	11,182	(8,173)	20,134	10,981	(9,153)	21,264	11,459	(9,805)
12	7	22,848	8,155	(14,693)	23,497	7,029	(16,467)	24,246	6,954	(17,292)	25,332	7,101	(18,230)
12	9	23,361	14,683	(8,678)	24,032	11,182	(12,850)	24,811	10,981	(13,830)	25,941	11,459	(14,482)

TABLE 1B

THIRTY-YEAR COSTS OF ELEVATION

1 STORY X FRAME ___ BRICK 900 SQ. FT. 1ST FLOOR $18,000 VALUE $6,300 CONTENTS VALUE

-2 FT. BELOW BASE FLOOD +2 NEW ELEVATION $7,500 COST TO ELEVATE

		ZONE 4			ZONE 10			ZONE 16			ZONE 20		
INTEREST	INFLATION	ELEVATED	UNELEVATED	B(COST) BENEFIT	ELEVATED	UNELEVATED	B(COST) BENEFIT	ELEVATED	UNELEVATED	B(COST) BENEFIT	ELEVATED	UNELEVATED	B(COST) BENEFIT
6	7	-	-	-	17,558	8,384	(9,174)	17,648	7,848	(9,799)	18,442	7,843	(10,599)
6	9	-	-	-	18,072	15,489	(2,582)	18,163	13,825	(4,337)	18,987	13,837	(5,150)
9	7	-	-	-	23,095	8,384	(14,711)	23,185	7,848	(15,336)	23,979	7,843	(16,136)
9	9	-	-	-	23,609	15,489	(8,119)	23,700	13,825	(9,874)	24,524	13,837	(10,686)
12	7	-	-	-	29,143	8,384	(20,758)	29,232	7,848	(21,384)	30,027	7,843	(22,184)
12	9	-	-	-	29,656	15,489	(14,167)	29,748	13,825	(15,922)	30,572	13,837	(16,734)

TABLE 1C

THIRTY-YEAR COSTS OF ELEVATION

1 STORY X FRAME ___ BRICK 900 SQ. FT. 1ST FLOOR $18,000 VALUE $6,300 CONTENTS VALUE

-3 FT. BELOW BASE FLOOD +1 NEW ELEVATION $7,500 COST TO ELEVATE

		ZONE 4			ZONE 10			ZONE 16			ZONE 20		
INTEREST	INFLATION	ELEVATED	UNELEVATED	B(COST) BENEFIT	ELEVATED	UNELEVATED	B(COST) BENEFIT	ELEVATED	UNELEVATED	B(COST) BENEFIT	ELEVATED	UNELEVATED	B(COST) BENEFIT
6	7	-	-	-	-	-	-	18,957	9,090	(9,866)	20,043	8,721	(11,321)
6	9	-	-	-	-	-	-	19,521	17,799	(1,722)	20,652	16,642	(4,010)
9	7	-	-	-	-	-	-	24,494	9,090	(15,403)	25,580	8,721	(16,858)
9	9	-	-	-	-	-	-	25,058	17,799	(7,259)	26,189	16,642	(9,547)
12	7	-	-	-	-	-	-	30,542	9,090	(21,451)	31,628	8,721	(22,906)
12	9	-	-	-	-	-	-	31,106	17,799	(13,307)	32,237	16,642	(15,594)

TABLE 2A

THIRTY-YEAR COSTS OF ELEVATION

1 STORY X FRAME ____ BRICK 900 SQ. FT. 1ST FLOOR $26,000 VALUE $9,100 CONTENTS VALUE

-1 FT. BELOW BASE FLOOD +1 NEW ELEVATION $5,800 COST TO ELEVATE

		ZONE 4			ZONE 10			ZONE 16			ZONE 20		
INTEREST	INFLATION	ELEVATED	UNELEVATED	B(COST) BENEFIT	ELEVATED	UNELEVATED	B(COST) BENEFIT	ELEVATED	UNELEVATED	B(COST) BENEFIT	ELEVATED	UNELEVATED	B(COST) BENEFIT
6	7	14,413	14,346	(67)	15,116	11,076	(4,040)	15,935	10,883	(5,051)	17,124	11,326	(5,797)
6	9	15,148	24,104	8,955	15,854	17,181	1,326	16,677	16,798	121	17,873	17,754	(119)
9	7	18,695	14,346	(4,348)	19,398	11,076	(8,322)	20,216	10,883	(9,333)	21,406	11,326	(10,079)
9	9	19,430	24,104	4,674	20,136	17,181	(2,955)	20,958	16,798	(4,160)	22,155	17,754	(4,401)
12	7	23,372	14,346	(9,025)	24,075	11,076	(12,999)	24,893	10,883	(14,010)	26,083	11,326	(14,756)
12	9	24,106	24,104	(2)	24,813	17,181	(7,632)	25,635	16,798	(8,837)	26,832	17,754	(9,078)

TABLE 2B

THIRTY-YEAR COSTS OF ELEVATION

1 STORY X FRAME ____ BRICK 900 SQ. FT. 1ST FLOOR $26,000 VALUE $9,100 CONTENTS VALUE

-2 FT. BELOW BASE FLOOD +2 NEW ELEVATION $7,500 COST TO ELEVATE

INTEREST	INFLATION	ZONE 4 ELEVATED	ZONE 4 UNELEVATED	ZONE 4 B(COST) BENEFIT	ZONE 10 ELEVATED	ZONE 10 UNELEVATED	ZONE 10 B(COST) BENEFIT	ZONE 16 ELEVATED	ZONE 16 UNELEVATED	ZONE 16 B(COST) BENEFIT	ZONE 20 ELEVATED	ZONE 20 UNELEVATED	ZONE 20 B(COST) BENEFIT
6	7	-	-	-	18,082	15,085	(2,997)	18,177	13,530	(4,647)	19,043	13,536	(5,506)
6	9	-	-	-	18,817	25,747	6,929	18,912	22,457	3,545	19,782	22,495	2,713
9	7	-	-	-	23,619	15,085	(8,534)	23,714	13,530	(10,184)	24,579	13,536	(11,043)
9	9	-	-	-	24,354	25,747	1,392	24,449	22,457	(1,991)	25,319	22,495	(2,823)
12	7	-	-	-	29,667	15,085	(14,582)	29,762	13,530	(16,231)	30,627	13,536	(17,090)
12	9	-	-	-	30,402	25,747	(4,654)	30,496	22,457	(8,039)	31,366	22,495	(8,817)

TABLE 2C

THIRTY-YEAR COSTS OF ELEVATION

1 STORY X FRAME ____ BRICK 900 SQ. FT. 1ST FLOOR $26,000 VALUE $9,100 CONTENTS VALUE

-3 FT. BELOW BASE FLOOD +1 NEW ELEVATION $7,500 COST TO ELEVATE

INTEREST	INFLATION	ZONE 4 ELEVATED	ZONE 4 UNELEVATED	ZONE 4 B(COST) BENEFIT	ZONE 10 ELEVATED	ZONE 10 UNELEVATED	ZONE 10 B(COST) BENEFIT	ZONE 16 ELEVATED	ZONE 16 UNELEVATED	ZONE 16 B(COST) BENEFIT	ZONE 20 ELEVATED	ZONE 20 UNELEVATED	ZONE 20 B(COST) BENEFIT
6	7	-	-	-	-	-	-	19,604	17,225	(2,379)	20,793	16,145	(4,648)
6	9	-	-	-	-	-	-	20,346	30,373	10,026	21,543	28,078	6,535
9	7	-	-	-	-	-	-	25,141	17,225	(7,916)	26,330	16,145	(10,185)
9	9	-	-	-	-	-	-	25,883	30,373	4,490	27,079	28,078	998
12	7	-	-	-	-	-	-	31,188	17,225	(13,963)	32,378	16,145	(16,232)
12	9	-	-	-	-	-	-	31,930	30,373	(1,557)	33,127	28,078	(5,049)

TABLE 3A

THIRTY-YEAR COSTS OF ELEVATION

1 STORY ____ FRAME X BRICK 1,600 SQ. FT. 1ST FLOOR $43,000 VALUE $14,000 CONTENTS VALUE

-1 FT. BELOW BASE FLOOD +1 NEW ELEVATION $7,300 COST TO ELEVATE

INTEREST	INFLATION	ZONE 4 ELEVATED	ZONE 4 UNELEVATED	ZONE 4 B(COST) BENEFIT	ZONE 10 ELEVATED	ZONE 10 UNELEVATED	ZONE 10 B(COST) BENEFIT	ZONE 16 ELEVATED	ZONE 16 UNELEVATED	ZONE 16 B(COST) BENEFIT	ZONE 20 ELEVATED	ZONE 20 UNELEVATED	ZONE 20 B(COST) BENEFIT
6	7	18,686	27,492	8,806	19,399	19,353	(45)	20,232	18,930	(1,301)	21,445	20,072	(1,372)
6	9	19,878	43,159	23,280	20,592	29,150	8,557	21,425	28,434	7,008	22,638	30,409	7,770
9	7	24,075	27,492	3,416	24,789	19,353	(5,435)	25,621	18,930	(6,691)	26,834	20,072	(6,761)
9	9	25,268	43,159	17,891	25,981	29,150	3,168	26,814	28,434	1,619	28,027	30,409	2,381
12	7	29,962	27,492	(2,469)	30,675	19,353	(11,321)	31,508	18,930	(12,577)	32,721	20,072	(12,648)
12	9	31,154	43,159	12,005	31,868	29,150	(2,718)	32,700	28,434	(4,266)	33,914	30,409	(3,504)

TABLE 3B

THIRTY-YEAR COSTS OF ELEVATION

1 STORY ____ FRAME X BRICK 1,600 SQ. FT. 1ST FLOOR $43,000 VALUE $14,000 CONTENTS VALUE

-2 FT. BELOW BASE FLOOD +2 NEW ELEVATION $10,500 COST TO ELEVATE

		ZONE 4			ZONE 10			ZONE 16			ZONE 20		
INTEREST	INFLATION	ELEVATED	UNELEVATED	B(COST) BENEFIT	ELEVATED	UNELEVATED	B(COST) BENEFIT	ELEVATED	UNELEVATED	B(COST) BENEFIT	ELEVATED	UNELEVATED	B(COST) BENEFIT
6	7	-	-	-	25,593	29,508	3,915	25,688	25,644	(44)	26,568	25,714	(854)
6	9	-	-	-	26,785	46,670	19,884	26,880	40,018	13,137	27,761	40,151	12,390
9	7	-	-	-	33,344	29,508	(3,835)	33,439	25,644	(7,795)	34,320	25,714	(8,605)
9	9	-	-	-	34,537	46,670	12,132	34,632	40,018	5,385	35,512	40,151	4,638
12	7	-	-	-	41,811	29,508	(12,302)	41,906	25,644	(16,262)	42,786	25,714	(17,072)
12	9	-	-	-	43,004	46,670	3,665	43,099	40,018	(3,081)	43,979	40,151	(3,828)

TABLE 3C

THIRTY-YEAR COSTS OF ELEVATION

1 STORY ____ FRAME X BRICK 1,600 SQ. FT. 1ST FLOOR $43,000 VALUE $14,000 CONTENTS VALUE

-3 FT. BELOW BASE FLOOD +1 NEW ELEVATION $10,500 COST TO ELEVATE

INTEREST	INFLATION	ZONE 4 ELEVATED	ZONE 4 UNELEVATED	ZONE 4 B(COST) BENEFIT	ZONE 10 ELEVATED	ZONE 10 UNELEVATED	ZONE 10 B(COST) BENEFIT	ZONE 16 ELEVATED	ZONE 16 UNELEVATED	ZONE 16 B(COST) BENEFIT	ZONE 20 ELEVATED	ZONE 20 UNELEVATED	ZONE 20 B(COST) BENEFIT
6	7	-	-	-	-	-	-	27,139	35,051	7,911	28,352	32,343	3,990
6	9	-	-	-	-	-	-	28,332	56,259	27,927	29,545	51,592	22,047
9	7	-	-	-	-	-	-	34,890	35,051	160	36,104	32,343	(3,760)
9	9	-	-	-	-	-	-	36,083	56,259	20,175	37,296	51,592	14,295
12	7	-	-	-	-	-	-	43,357	35,051	(8,306)	44,571	32,343	(12,227)
12	9	-	-	-	-	-	-	44,550	56,259	11,708	45,763	51,592	5,829

TABLE 4A

THIRTY-YEAR COSTS OF ELEVATION

1 STORY ____ FRAME X BRICK 1,600SQ. FT. 1ST FLOOR $51,000 VALUE $16,800 CONTENTS VALUE

-1 FT. BELOW BASE FLOOD +1 NEW ELEVATION $7,300 COST TO ELEVATE

INTEREST	INFLATION	ZONE 4 ELEVATED	ZONE 4 UNELEVATED	ZONE 4 B(COST) BENEFIT	ZONE 10 ELEVATED	ZONE 10 UNELEVATED	ZONE 10 B(COST) BENEFIT	ZONE 16 ELEVATED	ZONE 16 UNELEVATED	ZONE 16 B(COST) BENEFIT	ZONE 20 ELEVATED	ZONE 20 UNELEVATED	ZONE 20 B(COST) BENEFIT
6	7	19,196	34,293	15,097	19,910	23,600	3,690	20,742	23,045	2,302	21,955	24,546	2,590
6	9	20,615	52,974	32,359	21,328	35,278	13,950	22,163	34,371	12,210	23,374	36,864	13,490
9	7	24,585	34,293	9,708	23,299	23,600	(5,698)	26,131	23,045	(3,086)	27,345	24,546	(2,798)
9	9	26,004	52,974	26,969	26,717	35,278	8,560	27,550	34,371	6,821	28,763	36,864	8,101
12	7	30,472	34,293	3,821	31,385	23,600	(7,584)	32,018	23,045	(8,972)	33,231	24,546	(8,684)
12	9	31,890	52,974	21,083	32,604	35,278	2,674	33,436	34,371	934	34,650	36,864	2,214

TABLE 4B

THIRTY-YEAR COSTS OF ELEVATION

1 STORY ____ FRAME X BRICK 1600 SQ. FT. 1ST FLOOR $51,000 VALUE $16,800 CONTENTS VALUE

-2 FT. BELOW BASE FLOOD +2 NEW ELEVATION $10,500 COST TO ELEVATE

INTEREST	INFLATION	ZONE 4			ZONE 10			ZONE 16			ZONE 20		
		ELEVATED	UNELEVATED	B(COST) BENEFIT	ELEVATED	UNELEVATED	B(COST) BENEFIT	ELEVATED	UNELEVATED	B(COST) BENEFIT	ELEVATED	UNELEVATED	B(COST) BENEFIT
6	7	-	-	-	26,103	36,944	10,841	26,198	31,867	5,668	27,078	31,960	4,881
6	9	-	-	-	27,521	57,400	29,878	27,617	48,998	21,381	28,497	49,164	20,667
9	7	-	-	-	33,854	36,944	3,089	33,950	31,867	(2,082)	34,830	31,960	(2,870)
9	9	-	-	-	35,273	57,400	22,126	35,368	48,998	13,629	36,248	49,164	12,915
12	7	-	-	-	42,321	36,944	(5,376)	42,416	31,867	(10,549)	43,297	31,960	(11,336)
12	9	-	-	-	43,740	57,400	13,660	43,835	48,998	5,162	44,715	49,164	4,448
		-											

TABLE 4C

THIRTY-YEAR COSTS OF ELEVATION

1 STORY ___ FRAME X BRICK 1,600 SQ. FT. 1ST FLOOR $51,000 VALUE $16,800 CONTENTS VALUE

-3 FT. BELOW BASE FLOOD +1 NEW ELEVATION $10,500 COST TO ELEVATE

INTEREST	INFLATION	ZONE 4 ELEVATED	ZONE 4 UNELEVATED	ZONE 4 B(COST) BENEFIT	ZONE 10 ELEVATED	ZONE 10 UNELEVATED	ZONE 10 B(COST) BENEFIT	ZONE 16 ELEVATED	ZONE 16 UNELEVATED	ZONE 16 B(COST) BENEFIT	ZONE 20 ELEVATED	ZONE 20 UNELEVATED	ZONE 20 B(COST) BENEFIT
6	7	-	-	-	-	-	-	27,649	44,229	16,579	28,862	40,670	11,808
6	9	-	-	-	-	-	-	29,068	69,502	40,434	30,281	63,609	33,328
9	7	-	-	-	-	-	-	35,401	44,229	8,828	36,614	40,670	4,056
9	9	-	-	-	-	-	-	36,819	69,502	32,683	38,032	63,609	25,576
12	7	-	-	-	-	-	-	43,867	44,229	361	45,081	40,670	(4,410)
12	9	-	-	-	-	-	-	45,286	69,502	24,216	46,499	63,609	17,109

TABLE 5A

THIRTY-YEAR COSTS OF ELEVATION

2 STORY X FRAME BRICK 1,200 SQ. FT. 1ST FLOOR $45,000 VALUE $15,750 CONTENTS VALUE

-1 FT. BELOW BASE FLOOD +1 NEW ELEVATION $6,190 COST TO ELEVATE

INTEREST	INFLATION	ZONE 4 ELEVATED	ZONE 4 UNELEVATED	ZONE 4 B(COST) BENEFIT	ZONE 10 ELEVATED	ZONE 10 UNELEVATED	ZONE 10 B(COST) BENEFIT	ZONE 16 ELEVATED	ZONE 16 UNELEVATED	ZONE 16 B(COST) BENEFIT	ZONE 20 ELEVATED	ZONE 20 UNELEVATED	ZONE 20 B(COST) BENEFIT
6	7	16,467	23,962	7,495	16,729	17,250	521	17,252	16,789	(462)	18,251	17,813	(438)
6	9	17,738	36,570	18,831	18,000	25,188	7,187	18,523	24,407	5,883	19,522	26,136	6,613
9	7	21,037	23,962	2,925	21,299	17,250	(4,048)	21,822	16,789	(5,032)	22,821	17,813	(5,008)
9	9	22,308	36,570	14,261	22,570	25,188	2,618	23,093	24,407	1,313	24,092	26,136	2,043
12	7	26,028	23,962	(2,065)	26,290	17,250	(9,039)	26,813	16,789	(10,023)	27,812	17,813	(9,999)
12	9	27,299	36,570	9,270	27,561	25,188	(2,373)	28,084	24,407	(3,677)	29,083	26,136	(2,947)

TABLE 5B

THIRTY-YEAR COSTS OF ELEVATION

2 STORY X FRAME BRICK 1,200 SQ. FT. 1ST FLOOR $45,000 VALUE $15,750 CONTENTS VALUE

-2 FT. BELOW BASE FLOOD +2 NEW ELEVATION $8,190 COST TO ELEVATE

INTEREST	INFLATION	ZONE 4 ELEVATED	ZONE 4 UNELEVATED	ZONE 4 B(COST) BENEFIT	ZONE 10 ELEVATED	ZONE 10 UNELEVATED	ZONE 10 B(COST) BENEFIT	ZONE 16 ELEVATED	ZONE 16 UNELEVATED	ZONE 16 B(COST) BENEFIT	ZONE 20 ELEVATED	ZONE 20 UNELEVATED	ZONE 20 B(COST) BENEFIT
6	7	--	--	--	20,784	25,649	4,864	20,784	22,523	1,739	21,260	22,366	1,106
6	9	--	--	--	22,055	39,414	17,359	22,055	34,114	12,058	22,531	33,834	11,303
9	7	--	--	--	26,830	25,649	(1,181)	26,830	22,523	(4,306)	27,306	22,366	(4,939)
9	9	--	--	--	28,101	39,414	11,313	28,101	34,114	6,012	28,577	33,834	5,257
12	7	--	--	--	33,434	25,649	(7,785)	33,434	22,523	(10,911)	33,910	22,366	(11,544)
12	9	--	--	--	34,705	39,414	4,708	34,705	34,114	(591)	35,181	33,834	(1,347)

TABLE 5C

THIRTY-YEAR COSTS OF ELEVATION

2 STORY X FRAME ___ BRICK 1,200 SQ. FT. 1ST FLOOR $45,000 VALUE $15,750 CONTENTS VALUE

-3 FT. BELOW BASE FLOOD +1 NEW ELEVATION $8,190 COST TO ELEVATE

		ZONE 4			ZONE 10			ZONE 16			ZONE 20		
INTEREST %	INFLATION	ELEVATED	UNELEVATED	B(COST) ENEFIT	ELEVATED	UNELEVATED	B(COST) ENEFIT	ELEVATED	UNELEVATED	B(COST) ENEFIT	ELEVATED	UNELEVATED	B(COST) ENEFIT
6	7	-	-	-	-	-	-	21,569	30,202	8,633	22,568	28,460	5,891
6	9	-	-	-	-	-	-	22,840	47,113	24,272	23,839	44,155	20,316
9	7	-	-	-	-	-	-	27,615	30,202	2,587	28,614	28,460	(154)
9	9	-	-	-	-	-	-	28,886	47,113	18,226	29,885	44,155	14,270
12	7	-	-	-	-	-	-	34,219	30,202	(4,017)	35,218	28,460	(6,758)
12	9	-	-	-	-	-	-	35,490	47,113	11,622	36,489	44,155	7,665

Table 6

National Flood Insurance Program

Annual Rates Per $100 of Insurance

Single-Family Residential Dwelling Units

One Floor/No Basement

Elevation of Lowest Floor Above or Below Base Flood Elevation	Basic Rates for Building Coverage First $35,000 of Coverage Zones			
	A4	A10	A16	A20
+3 or more	.05	.05	.05	.05
+2	.05	.05	.05	.08
+1	.05	.07	.10	.15
0	.12	.16	.19	.23
-1	.48	.31	.31	.34
-2	*	.55	.47	.48
-3	*	*	.70	.64
-4 or lower	*	*	*	*

* Submit to the National Flood Insurance Program for rating.

Source: Federal Emergency Management Agency, National Flood Insurance Program, Flood Insurance Manual, adopted from p. RA1 10.

In terms of the model we are using, the break-even point in determining whether elevation will pay off is near $26,000. As can be seen in Table 2A, zone A4 at a depth of one foot below base flood, there are two interest rate and inflation rate combinations which will yield a benefit, and one that nearly breaks even. The one with an interest rate of 12% and an inflation estimate of 9%, is near market conditions. There is one favorable combination in zone A10, an interest rate of 6% and an inflation estimate of 9%. If we move to Table 2B, we can see that at an initial depth of minus two feet, there are now two favorable combinations in zone A10, one in zone A16 and one in zone A20. Table 2C indicates an additional favorable combination in zone A16 and one in zone A20. Although figures cannot be demonstrated for depths of minus two and three feet in zone A4 and minus three feet in zone A10, because insurance rate data is not available, we may assume from the general trends in our results that as depth increases in zones A4 and A10, the economic feasibility of elevation is heightened.

A significant increase in the value of the house creates a marked difference in the cost effectiveness of elevation. In the case of the $43,000 single-story brick home in zone A4, at a beginning depth of one foot below flood level, five of six interest-inflation combinations yield a net benefit for elevation. (See Table 3A.) Once again, as we move to progressively higher zones, benefits diminish. In zone A10 only two combinations are cost effective. In zones A16 and A20 there are also two cost-effective combinations, but these provide smaller benefits than those in zone A10.

It is interesting to note that for the house of higher value, in nearly all cases the benefits of elevation rise as the initial depth below base flood increases. Thus the $43,000 house in zone A16, at an interest rate of 6% and an inflation estimate of 7%, yields a net loss of $1,301 when raised two feet to overcome an initial elevation of minus one foot. (Table 3A.) The same house raised four feet to overcome an initial elevation of minus two feet yields a loss of only $44 (Table 3B), and yields a net gain of $7,911 if raised four feet to overcome an initial depth of minus three feet (Table 3C). This same pattern holds in nearly all interest and inflation estimates. If the same observation is made for the $18,000 house, however, the results are the opposite. In most cases, the net loss increases as the initial depth below the hundred-year flood level increases. This pattern seems to be reversed only when the inflation estimate is high in relation to the interest rate. See for example, 6% interest and 9% inflation in Tables 1A, B, and C. It would appear that when the initial value of the house is low, the greater cost of elevating to four feet instead of two overshadows the benefits of escaping the deeper floodwaters. But the cost increment of elevating the more expensive house is slight when compared to the value differences between the houses. (For raising two feet, compare elevation costs of $5,800 and $7,300 to housing values of $18,000 and $43,000 respectively). If the initial values of the houses are high, the housing values protected far outdistance the cost of elevation.

There are rather dramatic increases in cost effectiveness of elevation when two houses of equal dimensions but differing values are compared. The $43,000 single-story brick house and the $51,000 single-story brick house are identical in dimensions and cost of elevation, but one is valued at $25 per square foot and other at $30 per square foot. There is a proportional difference in the value of contents, since content value is a percent of structural value. Notice, however, that in zone A4, at an initial elevation of minus one foot, an interest rate of 6% and an inflation estimate of 7%, the net benefit of elevating two feet for the $43,000 house is $8,806, while the benefit for the $51,000 use is $15,097. (See Tables 3A and 4A.) Similar improvements may be seen in other cases by examining Tables 3B and 4B and 3C and 4C.

Benefit increases are also dramatic when comparisons are made among increasing initial depths below the hundred-year flood level. For example, if the $43,000 house in zone A16 is examined at an interest rate of 6% and inflation of 7%, the net loss of elevation beginning at minus one foot is $1,301, while the net gain beginning at minus three feet is $7,911 (Tables 3A and 3C). This is a difference of $9,212. If the same cases are examined for the $51,000 house, the initial figure is a net benefit of $2,302 and the second figure is a net gain of $16,579 (Tables 4A and 4C). This is a difference of $14,277. A valid generalization would be that the greater the value of the house, assuming there are no extraordinary conditions affecting the cost of elevation, the greater the net benefit (or the less the net loss) of elevation.

The Role of Interest and Inflation

The cost of money, the interest rate, plays a major role in the willingness of a potential buyer to purchase a house. Not only does the interest rate affect the consumer propensity to purchase, it may also push him out of the market by raising monthly costs to a level which he cannot afford. Assuming a potential purchaser can afford the monthly payments relative to a given

interest rate, his perception of what is happening to the economy may determine what his decision will be. If he determines that the economy will be inflationary during the term of his loan, he may decide that paying a high interest rate is sensible because the value of the home he buys and his wages will escalate while his monthly payment will remain constant. In time, the amount of his mortgage payment will not seem so burdensome and his asset, the home, will have an inflated value. In simplest terms, it is good to be a debtor during an inflationary period. Conversely, if the consumer expects a low rate of inflation, he will think very carefully about committing himself to a high interest loan. He will wait until interest rates drop to a level he can afford, or until interest rates are in line with his expectations about the rate of inflation in the economy.

The decision to elevate a home is much like the decision to purchase, in that the expenditure is a major one which usually must be financed, and the homeowner must determine whether his investment will pay off. An examination of the combinations of interest rates and rates of inflation in our model indicates that the long-range wisdom of deciding whether to elevate is greatly affected by these factors. A generalization which will hold in all cases, is that the higher the expected rate of inflation relative to the interest rate, the greater the benefit (or the lower the loss) of a decision to elevate.

For example, for a two-story house of $45,000 value, in zone A4 and one foot below the hundred-year flood level, the benefit of elevating at a subsidized 6% interest rate with an expected 7% rate of inflation is $7,495. If we hold the interest rate at the 6% level but raise our inflation expectation to 9%, the net benefit is increased by more than two-and-one-half times, to $18,831. If we take the same house under the same conditions, raise the interest rate to a near market 12% and maintain the inflation at 7%, which, under current conditions, is a low expectation, the net benefit becomes a net loss of $2,065. If the inflation rate is set at 9%, the loss becomes a net benefit of $9,270 (Table 5A). Therefore, in purely economic terms, whether it is best to elevate a house above the hundred-year flood level depends not only on the cost of elevation, which includes the interest rate, but on how accurately the homeowner can predict the rate of inflation.

There are several qualifications to the assumptions of the model being used which should be discussed. First is that of escalating values. The model assumes that both houses that are elevated and those that are not will escalate at the same rate. Given consumer acceptance of the appearance of elevated houses, it seems reasonable that their value will escalate, because they will be easy to maintain, and they can be sold with the reasonable expectation that they will be free of flood damage in the future. One might likewise anticipate that the value of unelevated houses will not escalate so rapidly, since they will be subject to flood damage. Because of expectations of flooding, maintenance and improvements might be neglected. The condition of such housing would thus deteriorate. Deteriorated condition and expectation of flood would both act to reduce the market value of the house. In terms of the model, then, the cost of not elevating would decline because both insurance costs and costs for uninsured damage would decline with the decline in value. Costs of factors not in the model would also decline because less would be spent on maintaining and improving an unelevated house than on an elevated house. Whether this analysis is more accurate than the one found in the model probably depends on the frequency of flooding. People tend to forget the results of a flood several years after its occurrence, and to ignore the probability of flood when deciding whether to maintain, improve or purchase property. If flooding is frequent, however, there will be less tendency

to forget it. If a person expects that he might be flooded once every several years, he might adopt a "what's the use" attitude and actually quit maintaining his property. In this case, the property would most certainly deteriorate and value would not escalate along with other real estate values.

If values of unelevated houses do not escalate according to assumptions of the model, the costs of not elevating will be lower and the net benefits of elevation will be reduced or the expected losses will be increased. This will lead to different conclusions than the model currently indicates. But such results would simply be a factor of the model itself, and perhaps would not change our conclusions about the benefits of elevation in the real world. In reality, if the value of unelevated houses does not rise because of their flood prone character, what the homeowners really have are "wasting" assets. Since a house purchase is the greatest investment that most individuals ever make, by allowing his property to remain flood prone, the homeowner is watching his most costly investment decline in value relative to other houses he might purchase or other investments he might make. Instead of the costs of maintaining the house as shown in the model, he has the costs of a diminishing asset in the real world. Thus one could make a forceful argument for elevation regardless of whether the assumption of escalating value built into the model is correct.

A second qualification is that the assumption of constant rates for subsidized federal flood insurance and the expectation that maximum allowable coverages for this subsidized insurance will rise at 5% annually may both be false. In fact, as reported in the Commerce Clearing House Urban Affairs Reports (June 4, 1981), the Federal Emergency Management Agency is proposing to increase the rates for one hundred dollars of structural value from twenty-five cents to forty cents, and for one hundred dollars of contents value from thirty-five cents to fifty cents. These are proposed increases of 60% and 43% respectively. The justification for this proposal is that the Federal Insurance Administration "has determined that the general public now bears too great a share of the burden for subsidized insurance rates. In addition, FIA has determined that it is necessary to take action to bring the national flood insurance program closer to a self-supporting basis and to create a sounder financial basis for the program."[31] If subsidized insurance rates are increased, or if maximum insurance coverages do not rise, either event will increase the costs of not elevating a home. It is conceivable that both possibilities could occur. Regardless of what steps are taken in this direction, the net result would be to increase the attractiveness of elevation.

Two final qualifications should be mentioned. The first is that even if it can be demonstrated that elevation makes sense in purely economic terms, the homeowner may not be able to afford the monthly payments necessary to pay for elevation. Perhaps this is simply a restatement of the reason for this study. If elevation is a reasonable alternative but people cannot afford it, what assistance can be given to make it affordable?

Second, there may be cases where elevation is not economically beneficial but a homeowner will do it anyway. Not all purchase decisions are purely economic decisions. People buy Buicks when a Chevrolet would do simply because they enjoy the added luxury. A person may buy a new appliance because of some annoying feature of the old one, even if it is still servicable and attractive. By the same token, a person might elevate a home, even if it is clearly not beneficial in purely economic terms, simply because he dreads going through another flood. In an area where few flood-free housing sites are available, elevation may be the only alternative.

Elevating New Construction

The focus of this study has been on elevating existing structures, and cost analysis has been limited to the act of disconnecting an existing house from its utilities, raising it, providing a foundation, lowering it on that foundation and reconnecting the utilities. As we have seen, elevating an existing house involves considerable expense, and this expense is for the purpose of undoing and redoing what has already been done. The logical question to ask would be how much elevation would cost if it occurred when the house was originally constructed. This question has been considered in Elevated Residential Structures, a guide manual published by the Federal Insurance Administration in 1977.

This manual contains the example of a one-story, no-basement house with a value of $25,000. It is located in flood zone A8, and must be constructed on columns six feet high in order to be above the base flood level. The cost at the time of construction is estimated at $2,458. By comparison, the cost to elevate this house after construction in 1980, using figures supplied by the Army Corps of Engineers, Huntington, West Virginia District, is approximately $9,500. Even allowing for inflation from 1977 to 1980, the cost difference is striking.

Raising this sample house at the time of construction involves considerable savings in insurance premiums over those applicable at ground level. The premiums, which approximate expected annual damage, are reduced from $1,503 to $103. By amortizing the cost of elevation with the mortgage over a thirty-year period at an interest rate of 9%, the net annual savings are estimated at $1,186.

Houses elevated at construction can be placed on fill, or wood posts, concrete or wood pilings or the concrete block foundations common in Kentucky. For elevations of only a few feet, fill is probably the most economical, but after about three feet, the costs of fill escalate rapidly and other techniques become more economical.[32]

The conclusion reached in Elevated Residential Structures is "that the savings realized over the lifetime of a structure by building on a raised foundation are considerable and dramatic when compared with the one-time increase in construction costs for an elevated foundation."[33] The Kentucky Department for Natural Resources, in its 1977 report, The Floods of April, also recommended "that future structures in the unprotected flood plain be elevated above the expected flood level."[34] Moreover, this conclusion is built into federal law, in that a community, upon entering the regular phase of the National Flood Insurance Program, must require that all newly constructed or substantially improved homes be elevated above the base flood level. It should be the policy of every flood prone community in Kentucky to enter the regular phase of the National Flood Insurance Program and to have the foresight to conscientiously enforce the requirements for elevation of new construction. By adopting such a policy, the effects of flooding can be mitigated for future generations. Failure to do so will be self-defeating, and as we have seen, increase future costs for all concerned.

CHAPTER V

GENERALIZATIONS DERIVED FROM ANALYSIS

The purpose of the foregoing analysis has been to examine the economic factors operating on homes that are vulnerable to flood, and thereby to determine whether it is economically advisable to elevate homes above the level of the hundred-year flood. The following generalizations have been derived by examining the results of the model.

* The elevation of certain flood prone homes makes economic sense under near market interest rate conditions. Therefore, in terms of cost and benefit, a housing elevation program would be a reasonable public policy.

* Elevation of a low-cost house is probably not beneficial, in purely economic terms, even under the most favorable conditions of a subsidized low-interest loan. Subsidized federal flood insurance, a valuable asset for homeowners located in flood prone areas, is a major factor in reducing the net benefits of elevation.

* The greater the value of the house, the greater the probability that elevation will be cost effective. In terms of the model used in the present study, and prior to the October 1 increase in federal flood insurance rates, the point at which elevation is economically viable was approximately $26,000.

* As frequency of flooding increases, the cost effectiveness of elevation increases. Frequency is indicated by the flood zone designation within the flood plain. A low zone designation indicates more frequent flooding than a high zone designation.

* As depth below the hundred-year flood level within any flood zone increases, the economic benefit of elevation increases. These results are derived by examination of houses at -1, -2, and -3 initial elevations. If figures were available for greater depths, it is probable that the same conclusions would be reached.

* Interest costs and rates of inflation have great bearing on the net benefits or costs of elevation. The benefits of elevation are increased if the rate of inflation rises in relation to the rate of interest.

The conclusions of the economic analyses presented in this study are that there are many cases in which elevation of homes above the base flood level would be a good investment. Furthermore, potential changes in the National Flood Insurance Program which might make this insurance more expensive would increase the number of homes for which elevation would be a good investment.

Ultimately, the General Assembly must decide whether the public good in elevation of homes above the hundred-year flood level is sufficient to justify the expenditure of public funds. If it is determined that there is sufficient justification, then it must be determined how much to spend and on whom, and a way must be found to raise the money.

How Much to Spend, and on Whom

Inseparable from the question of how much should be expended is the question of who should be assisted. The lower the income of the person to be assisted, the greater the assistance needed. In the case of other government programs designed to assist persons in the purchase of housing, a lower income limit is set, below which an individual is deemed unable to afford a home which satisfies the criteria of the particular housing program. An upper income limit is also set, above which it is deemed inappropriate to offer public assistance. Within this range, people are assisted in purchasing homes suitable to their need and which they can afford. Lower and upper limits must also be set in a housing elevation program. Assuming a particular house is of sufficient structural quality and value to justify elevation, it must be decided, at the lower income limits, how much the homeowner must pay and how much the state will subsidize, and it must be decided, at the upper limit, how high income can be before it is inappropriate for the state to offer a subsidy.

Just as programs to assist persons in purchasing homes are subject to the pressure of rising interest rates, so will be programs to assist in the elevation of homes. As interest rates rise, people will be forced out of the market unless subsidies are increased. By the same token, as interest rates drop, more people will be able to enter the market. Conceivably, interest rates could drop to the point where little governmental assistance would be needed.

The costs estimated by the U.S. Army Corps of Engineers for elevating homes in the Tug Fork flood plain in Eastern Kentucky/West Virginia - $5,800-$10,500 - are close to what one would pay for a new car today. Since the initial outlays for a new car or for elevating your home are similar, one might ask why the state should consider offering incentives for such a program. Yet there are important differences which should be considered. It should be understood that elevation is not a common expense like purchasing a car, but usually is an unexpected one that must be carried in addition to any other more common debts which the homeowner may have incurred. It is in the tradition of government in this country to assist those who are faced with emergency situations beyond their control. Most people who have purchased homes in the flood plain did not have sufficient information at the time of purchase to make accurate predictions about flood vulnerability.

A second difference lies in the alternatives available. If a homeowner cannot afford a new car, at least he can purchase a used car for half the price, and still have mobility. The homeowner cannot finance elevation of his home at a reduced price, however, unless he is able to do the work himself or has some special relationships with contractors and suppliers. Thus, while owning a car is within the reach of people of lower income, paying for housing elevation requires a higher income, unless substantial subsidies are offered.

Finally, the impact of the National Flood Insurance Program on state flood protection policies may soon change. Presently the homeowner can insure at a federally subsidized rate to cover losses incurred because of his inability to finance elevation of his home. The flood loss is transferred to the general taxpaying public. An easy way, therefore, for the state to approach the flood problems of its lower income citizens is to encourage them to purchase federal flood insurance and thereby shift part of the financial burden to states paying higher per capita taxes than Kentucky. However, given the

present trend toward cutting federal expenditures, it is very possible that at least part of these flood losses will soon be shifted back to the homeowner through higher insurance rates. A move in this direction will increase the need for and benefit of state attempts to subsidize elevation for its lower income citizens.

Because such variables as income, family size, family debt, interest rates, and other housing options would all help determine whether a family could afford elevation and how much assistance they should be given, it would be extremely difficult and restrictive to set strict guidelines in statutory language. A more flexible approach would be to assign responsibilities for making decisions on assistance to an experienced administrative body. The Kentucky Housing Corporation has experience in housing assistance programs. In its case, the income range of persons to be assisted is loosely defined in the statutes and is specifically determined by policies adopted by the board of the Kentucky Housing Corporation. The General Assembly could leave decisions on whom to assist up to an administrative body, or it could specify the range of income levels of persons it wished to assist, and allow an administrative body to make individual determinations within the range of income levels.

How to Raise the Money

If the State wishes to assist homeowners to elevate their homes by providing incentives, there are two basic things it can do. It can provide money through several avenues, or it can secure below market interest rates for borrowers. The State might provide money through income tax credits or deductions. It could appropriate money to the housing development fund of the Kentucky Housing Corporation, and allow the Corporation to provide grants or loan write-downs, or it might provide grants from its federal revenue sharing allocation. The State can secure below market interest rates by authorizing bonding capacity to the Kentucky Housing Corporation, which can issue tax free mortgage subsidy bonds when market conditions are optimal.

The State can use its powers in combination, or add them to the financial resources which might be available to local governments. For example, it might combine tax credits or appropriations with low interest loans provided through the Kentucky Housing Corporation. It might also couple Kentucky Housing Corporation loans with federal grant money available to cities through Community Development Block Grants or other federal grant programs. The State might also add its own revenue sharing dollars to low interest KHC loans in order to bring program costs to the levels homeowners can afford.

If the State would appropriate money or use federal revenue sharing for elevation grants, or if local governments would allocate federal grants to housing elevation, then persons of very low income could be assisted. If grants or appropriations are not available and the State must depend upon loans through the Kentucky Housing Corporation, then the income range of persons to be assisted will be determined by the interest rates which prevail at the time bonds are issued.

CHAPTER VI

ALTERNATIVES

Income Tax Credits

House Resolution 137 specifically addresses itself to the possibility of income tax deductions as a method of providing financial incentives for the elevation of existing housing. There are several considerations which should be kept in mind before examining the possible use of income tax deductions. The first relates to budgeting. There is no way to predict how many people will take advantage of a tax credit, so costs are indeterminable. The second relates to administration. The individual income tax for one year would usually be less than the amount of assistance needed for elevating a home. Therefore, tax credits would have to be spread over a number of years, and taxpayers "tracked" over the period during which credits would be earned. The third relates directly to the questions discussed above of who can be assisted and how much assistance should be offered. People pay income tax in proportion to their income. The less income a person makes, the greater his need for assistance, but the less assistance possible through income tax deductions or credit. Conversely, the more income a person makes, the greater the opportunity to assist him through income tax deductions or credits, but the smaller his need. The people who need governmental assistance the most are the most difficult to assist in any substantial way through tax deductions. The possibilities for assistance through tax deductions can be more clearly understood by examining Tables 7 and 8.

Table 7 indicates the taxes which are paid by individuals with net incomes ranging from $3,000 to $20,000 annually, or, using the short form, adjusted gross incomes of $3,000 to $8,000. It can be seen that the most assistance which can be offered to an individual of $8,000 net income is $280, or $240 if he takes two tax deductions. If there are more family members than two, the tax declines further and the assistance possible through tax credits declines. The individual with a family and a net income of $8,000 would probably need more than $240 annual assistance if he were to elevate his home at a minimum cost of $5,800. If income were doubled, to a net figure of $16,000, we can see that the individual with two tax deductions could be assisted to, at most, $720. It is almost certainly the case, however, that this individual would not need all of his potential assistance through the tax system, while his less fortunate counterpart would have a shortage of potential tax credit assistance.

Examination of Table 8 reveals what it actually costs to elevate the homes discussed in our model on a yearly or monthly basis for fifteen- or thirty-year terms. Assuming one can get a 12% loan, it costs, in round figures, $60 a month to amortize a $5,800 mortgage over a thirty-year period, and $70 a month to amortize it over fifteen years. A $7,500 loan would cost $77 or $90 a month for thirty or fifteen years respectively. A person of $8,000 net income with two tax deductions could be assisted through tax credits no more than $20 a month. Whether he could shoulder the remaining $50 or $70 a month necessary to amortize a $5,800 or $7,500 loan in fifteen years would depend on the extent of his other debts, but it is immediately apparent that he would have difficulty. If his net income were $16,000, he could be assisted as much as $60 a month, which would be two-thirds of the cost of a

TABLE 7

KENTUCKY INCOME TAXES

TAX ON NET INCOME - KRS 141.020				SHORT FORM, TAX ON ADJUSTED GROSS INCOME KRS 141.023	
CUMULATIVE INCOME	TAX ON INCREMENTS	CUMULATIVE TAX	CUMULATIVE TAX, 2 CREDITS	CUMULATIVE TAX	CUMULATIVE TAX, 2 CREDITS
$ 3,000	20/$1,000	60	20	46.50	6.50
$ 4,000	30	90	50	69.75	29.75
$ 5,000	40	130	90	103.00	63.00
$ 6,000	50	180	140	146.25	106.25
$ 7,000	50	230	190	196.25	156.25
$ 8,000	50	280	240	246.25	206.25
$ 9,000	60	340	300	-	-
$10,000	60	400	360	-	-
$11,000	60	460	420	-	-
$12,000	60	520	480	-	-
$13,000	60	580	540	-	-
$14,000	60	640	600	-	-
$15,000	60	700	660	-	-
$16,000	60	760	720	-	-
$17,000	60	820	780	-	-
$18,000	60	880	840	-	-
$19,000	60	940	900	-	-
$20,000	60	1,000	960	-	-

TABLE 8

YEARLY AND MONTHLY MORTGAGE PAYMENTS, BY MORTGAGE AMOUNT, INTEREST, AND TERM

INTEREST LEVEL	MORTGAGE AMOUNT	30 year YEARLY	30 year MONTHLY	15 year YEARLY	15 year MONTHLY
6%	$ 5,800	$ 417	$ 34.75	$ 587	$ 48.91
9%	$ 5,800	$ 560	$ 46.66	$ 705	$ 58.75
12%	$ 5,800	$ 716	$ 59.66	$ 835	$ 69.58
15%	$ 5,800	$ 880	$ 73.33	$ 974	$ 81.18
6%	$ 6,190	$ 445	$ 37.08	$ 627	$ 52.25
9%	$ 6,190	$ 598	$ 49.83	$ 754	$ 62.83
12%	$ 6,190	$ 764	$ 63.66	$ 893	$ 74.41
15%	$ 6,190	$ 939	$ 78.27	$1,040	$ 86.63
6%	$ 7,300	$ 526	$ 43.83	$ 739	$ 61.58
9%	$ 7,300	$ 705	$ 58.75	$ 888	$ 74.00
12%	$ 7,300	$ 901	$ 75.08	$1,051	$ 87.58
15%	$ 7,300	$1,108	$ 92.33	$1,226	$102.17
6%	$ 7,500	$ 539	$ 44.91	$ 759	$ 63.25
9%	$ 7,500	$ 724	$ 60.33	$ 912	$ 76.00
12%	$ 7,500	$ 926	$ 77.16	$1,080	$ 90.00
15%	$ 7,500	$1,138	$ 94.83	$1,260	$104.97
6%	$ 8,190	$ 589	$ 49.08	$ 830	$ 69.16
9%	$ 8,190	$ 791	$ 65.91	$ 998	$ 83.16
12%	$ 8,190	$1,011	$ 84.25	$1,181	$ 98.41
15%	$ 8,190	$1,243	$103.56	$1,376	$114.63
6%	$10,500	$ 755	$ 62.91	$1,063	$ 88.58
9%	$10,500	$1,014	$ 84.50	$1,278	$106.50
12%	$10,500	$1,296	$108.00	$1,512	$126.00
15%	$10,500	$1,593	$132.75	$1,764	$146.96

$7,500 loan at 12%, amortized over fifteen years. He would not need, nor would we expect the state to offer, this level of assistance. The example illustrates the problem with tax credits as an incentive for elevation.

It might be argued that persons in the ten to twenty thousand dollar net income range should be those targeted for assistance through tax credits. It would appear that taxpayers in this income range could receive meaningful assistance in this manner. If this approach is taken, however, the policy question remains of how or whether to assist homeowners with less than $10,000 net income, whose needs are likely greater than those in the higher income range.

A Tax-exempt Mortgage Bond Issue

The Kentucky Housing Corporation now has the authority to issue tax-free revenue bonds and in fact has issued bonds nearly to the limit of its bonding capacity ($700 million), as established by the legislature. The greatest part of KHC's lending activity has been in providing mortgage money for low and middle income single-family homes. The Corporation does have the legal capacity to lend for multi-family housing and housing rehabilitation, and does operate in these areas, as well as in single-family housing. Mortgage revenue bonds could be issued by the Corporation for purposes which would include financing elevation of homes. The only act necessary on the part of the legislature would be to raise the bonding capacity of KHC so that it could raise the necessary funds. If the Kentucky Housing Corporation were to enter the field of home improvements for flood protection, it would probably do it in the context of a general issue for home improvement. This approach would give the Corporation more uses for the money raised, and allow it to gain experience and test the demand for elevation loans prior to the commitment of large sums of money. Testing demand would be very important, as it is not known how many homes in Kentucky are suitable for elevation, and how many homeowners would choose elevation.

There is some data on suitability and attitudes which would encourage an elevation program. For example, the minutes of the February 26, 1981, meeting of the Harlan Flood Mitigation Subcommittee indicate that 1,200 Harlan County homes might be candidates for elevation. An additional 1,800 homes might be suitable for relocation if suitable sites could be found.[35] The December 18, 1980, minutes of this Subcommittee indicate that elevation of structures would be a popular alternative in Harlan, the most popular, in fact, of the structural modification techniques. It should be remembered that elevation is not a new technique to Harlan, but has been used at least since the early 1960's. Homeowners would not accept a new or increased mortgage for flood-free housing at current market rates, but would with some incentive or reduced interest rate. It was the opinion of the members of the Subcommittee that renters would not pay more rent for flood-free housing.[36] Thus the degree of home ownership might have a significant impact on the demand for housing elevation loans. Booker Associates found in their 1977 Study of the Stewart Creek Watershed in Hopkins County that older residents who had lived in their homes fifteen years or more tended to favor elevation. Those who lived in the higher risk areas, however, favored moving out of the flood prone area.[37]

The general approval of elevation indicated by the Harlan and Hopkins County survey and opinion data should be qualified by a review of recent experience in flood rehabilitation efforts. The Department for Local Govern-

ment (now Community and Regional Development), in administering federal disaster relief money after the 1978 floods, found it practical to elevate only about 10% of one hundred and thirty homes assisted. Perhaps a program focused specifically on elevation or relocation would have resulted in a higher percentage, but it may also be the case that a variety of factors, including the nature of existing housing and the scarcity of suitable building sites would constrain any housing elevation or relocation program.

A bond issue for home improvement and elevations would be subject to a number of restrictions in order to be economically feasible, satisfy federal law and be attractive to investors. For example, the Federal Mortgage Subsidy Bond Act of 1980 will not permit an interest spread of more than 1% between the rate at which the Housing Corporation borrows money and the rate which it charges its borrowers. This 1% difference probably would not be sufficient to meet the administrative costs of the Corporation. Thus a supplement from the reserves of the Corporation or an appropriation from the state would be necessary to make a bond issue feasible.

Other restrictions include restriction of loans to owner occupants, and a $15,000 limit on loan amount. Landlords desiring to protect property for their tenants would not be able to use the Corporation as a source of funding. The restriction on loan amount would not be a hindrance in most cases, but elevation costs of some homes, when combined with other necessary property improvements, could exceed $15,000.

The maximum term on bonds to finance improvement or elevation of existing housing would be fifteen years. This means that mortgages would have to be amortized over a fifteen-year term rather than the thirty-year term used in our model. As Table 8 illustrates, however, monthly payments for a fifteen-year loan are not drastically higher than those for a thirty-year loan. In fact, when the loan is amortized more rapidly, less interest is paid and the total costs of elevation are reduced. This makes elevation a more economic alternative. Another consideration, however, is that any increase in monthly payments will push some homeowners out of the market. The fifteen-year limit will mean that some homeowners will need additional subsidy if they are to elevate their homes.

Currently interest rates in the tax-exempt bond market are high, simply because interest rates are high in all markets. A recent home improvement bond issue of the New Jersey Mortgage Finance Agency cost that agency 13.5% interest, and the agency's borrowers will have to pay 14.5% for their loans. In addition, the state had to contribute one million dollars to meet costs above those covered by the interest spread. Discussions with Kentucky contractors who elevate homes revealed that when private market interest rates were around 8 to 9%, many persons financed housing elevations without government assistance. When interest rates rose above 9.5%, however, this private market activity ceased. If this experience can be generalized, it appears that the Kentucky Housing Corporation would have to wait for more favorable market conditions before going to the bond market. Otherwise the degree of subsidy required to make loans attractive to consumers would be very costly.

It is assumed that most of the homes to be elevated would already be mortgaged. The bond issue would have to guarantee a second mortgage, as security to lenders, on these homes. Without the second mortgage guarantee, the rate to the borrower would rise. If there were not a mortgage already, the borrower would offer a first mortgage.

after the 1982 session of the General Assembly, may or may not have the bonding capacity to issue bonds for housing elevation. Interest rates in both the private and public money markets may remain high in the future, making it difficult to support any housing programs, or they may return to the more moderate rates of the recent past, making it less difficult to provide assistance to those who need it. Therefore, a sensible approach to program design at this time is to work in broad outlines, attempting to identify and provide basic resources, and to take the necessary legislative actions to allow state and local governments to react flexibly to changes which may occur in the economy and in federal programs relating to our needs.

Recommendations

This study has been prepared at a time when serious revenue shortfalls are being experienced by state government and existing programs are being cut back. It would be ignoring reality, therefore, to suggest that large sums be appropriated for housing elevation programs. The future of federal grants for local and state governments is uncertain, but it is more likely that federal money than state money will be available for housing elevation. While the Kentucky Housing Corporation is presently subject to higher than ordinary interest rates, it remains the most effective tool for long-range programming because of its consistent ability to lend at below market rates. It should be viewed as the primary and continuing source of housing elevation funds; other revenue sources, state and federal, should be integrated with KHC programs as they become available. In this general context the following recommendations are offered:

1. The General Assembly should give the Kentucky Housing Corporation additional bonding capacity for the specific purpose of housing elevation, within a more general program of home improvement.

    a. The Corporation should be given enough additional bonding capacity to allow it to achieve economies of scale in its operations. Up to $5 million of this bonding capacity should be set aside for elevation, and program efforts should be reviewed during the 1984 legislative session.

    b. The Kentucky Housing Corporation should require that all assisted homes be raised in accordance with the standards of the National Flood Insurance Program, so that they will qualify for flood insurance premiums at the unsubsidized actuarial rate. This provision will require the use of the flood insurance rate maps prepared by the Federal Insurance Administration. These maps are not yet available for all flood prone communities, and a community would be ineligible for flood mitigation assistance until it received its map.

2. The elevation program should be limited to houses of sufficient quality and value to justify elevation. Techniques similar to those used in this study, coupled with field inspections by qualified personnel, should be used to determine those homes for which elevation is a practical alternative.

    a. It should be required that houses, after elevation, meet certain quality standards relating to plumbing, structural integrity, electrical wiring and general state of repair. Standards should not be

so high as to deny elevation to homes providing safe and sanitary housing generally acceptable in areas in which they are located.

b. In determining which homes qualify for elevation, there should be flexibility to accommodate the values and supply in local housing markets, changes in the national economy as they affect housing, and changes in the costs of the National Flood Insurance Program.

3. Kentucky Housing Corporation programs should be integrated, through cooperation with the Department of Community and Regional Development, with local government community development programs. The Department of Community and Regional Development, as the administering agency for future federal community development block grants, should encourage local governments to request funds for housing elevation in their applications for federal grants.

   a. Community development funds can be used to write down principal or interest on elevation loans. Write-downs of various sorts will make it possible to reach many homeowners who otherwise could not afford to elevate their homes.

   b. Community development directors can provide technical assistance to homeowners to ensure that their elevation plans will satisfy the requirements of the National Flood Insurance Program and the criteria of the bond issue which provides the funds.

   c. Community development directors can provide the field service which the Kentucky Housing Corporation would need to ensure and confirm compliance with the restrictions of its bond issues.

   d. In those communities which do not have local personnel qualified to administer an elevation and home improvement program, the Department of Community and Regional Development can provide technical assistance to ensure program compliance.

4. If the State of Kentucky can write down principal or interest on elevation loans, possibly using federal funds, it should do so directly through the Kentucky Housing Corporation, and not indirectly through income tax credits.

   a. It is not possible to determine the budgetary impact of tax credits without some program experience. Appropriations to the Kentucky Housing Corporation would be definite in amount and would allow consideration of housing elevation funds in the context of the total budget.

   b. Use of tax credits would require offering the credits on a multiple year basis if they are to have any real value to the homeowner. If there are to be program controls, the Department of Revenue would be put in the position of identifying and tracking tax returns over a number of years. Some homes might be elevated with KHC assistance, and some not. For those not assisted by KHC, there would be a problem of confirming that elevation actually took place. Monitoring tax returns in this fashion is not really a revenue function, and adds a third party to an administrative process which should be limited to the Kentucky Housing Corporation and the local government community development program.

5. KHC assistance for housing elevation should be offered to homeowners who meet the Corporation's existing guidelines for mortgage assistance. Current guidelines establish maximum income levels of $17,500 for a single individual and $18,500 for a married couple. One thousand dollars is added for each child, and $1,500 is added for certain counties in eastern Kentucky. These guidelines will enable the program to reach those at the lower end of the market who could not proceed without assistance, and will limit the program at the upper end at income figures generally accepted in public policy discussions.

FOOTNOTES

1. Kentucky Department for Natural Resources and Environmental Protection, The Floods of April (Frankfort, Ky., 1977), p. 136.

2. Kentucky Department for Natural Resources and Environmental Protection, p. 151.

3. Kentucky Department for Natural Resources and Environmental Protection, p. 147.

4. Federal Emergency Management Agency, Questions and Answers on the National Flood Insurance Program, (Washington, D.C., 1980), p. 12.

5. Federal Insurance Administration, Flood Insurance Manual, National Flood Insurance Program (Washington, D.C., January, 1981), p. GR 13.

6. Federal Insurance Administration, p. GR 17.

7. Booker Associates, Incorporated, Kentucky Flood Protection Manual (Lexington, Ky., 1981), p. 3-3.

8. Department of the Army, Huntington District, Corps of Engineers, Report on Tug Fork (Huntington, W. Va., 1970), p. 55.

9. Conversation with Mr. Tom Hawkins, Federal Emergency Management Agency, Atlanta, May, 1980. Pursuant to U.S.C.A. 42, Sec. 4103(a), Congress had appropriated $5.4 million in 1980 for purchase of frequently flooded homes.

10. William K. Johnson, Physical and Economic Feasibility of Non-Structural Flood Plain Management Measures (Davis, California: The Hydrologic Engineering Center, U.S. Army Corps of Engineers), p. 21.

11. Booker Associates, Inc., pgs. 4-29, 4-34, 4-39.

12. Johnson, p. 28.

13. Data provided by Mr. Winford Winkle, Community Development Program Administrator, Irvine, Kentucky, 1981.

14. Department of the Army, p. 55.

15. Dames and Moore, Consultants, Flood Proofing Cost Study, Tug Fork River Valley (Washington, D.C., 1980), p. 3-2.

16. Dames and Moore, p. 3-2.

17. Dames and Moore, p. 2-4.

18. Department of the Army, p. 52.

19. Department of the Army, p. 94.

20. Dames and Moore, p. 2-4.

21. Johnson, p. 21.

22. Dames and Moore, p. 3-9.

23. Shelton R. McKeever, Flood Proofing, Example of Raising a Private Residence (Atlanta, Georgia: Department of the Army, South Atlantic Division, Corps of Engineers, 1977), p. 7.

24. Conversation with Chester Engle, Harlan, Kentucky, Contractor, June 15, 1981.

25. Kentucky Department for Natural Resources and Environmental Protection, National Flood Insurance Program, Summary of Kentucky Participation, Second Quarter, 1981, Frankfort, Kentucky: 1981.

26. Dames and Moore, p. 3-11.

27. Dames and Moore, figure 3-8.

28. Dames and Moore, pgs. 3-10, 3-11.

29. Data provided by Harry Becket, Huntington District, U.S. Army Corps of Engineers, 1981.

30. Federal Insurance Administration, Flood Insurance Manual, pgs. RA1 10, 11, 18 and 19.

31. Urban Affairs Reports, No. 687 (Chicago: Commerce Clearing House, Inc., June 4, 1981), p. 6.

32. Federal Insurance Administration, Elevated Residential Structures (Washington, D.C.: 1977), pp. 4-7, 4-8.

33. Federal Insurance Administration, Elevated Residential Structures, p. 4-3.

34. The Floods of April, p. 159.

35. Minutes, Harlan Flood Mitigation Subcommittee Meeting, Harlan, Kentucky, February 26, 1981, p. 3.

36. Minutes, Harlan Flood Mitigation Subcommittee Meeting, Harlan, Kentucky, December 18, 1980, pp. 3-5.

37. Booker Associates, Incorporated, Report on Non-Structural Flood Plain Management Alternatives (Lexington, Kentucky, 1977), p. 18.

38. Conversation with Dorothy Williams, Single-Family Programs Director, Kentucky Housing Corporation, June 24, 1981.

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80 BR 1046

GENERAL ASSEMBLY

COMMONWEALTH OF KENTUCKY

REGULAR SESSION 1980

House Resolution No. 37

March 13, 1980

The following bill was reported to the Senate from the House and ordered to be printed.

A CONCURRENT RESOLUTION directing a study of incentives to encourage floodproofing.

WHEREAS, the stream system and waterways of the Commonwealth are among the most extensive of any state in the union; and

WHEREAS, historically for many reasons, including the need to be near water transportation routes and the lack of other available land, housing and businesses have located in areas subject to flooding; and

WHEREAS, over the years as development has intensified in the flood prone areas, the damages and losses from periodic flooding have increased; and

WHEREAS, there is a need to protect property currently located within the flood plain in order to keep to a minimum flood losses and damages, and to prevent hardships due to relocation of residents residing in these areas;

NOW, THEREFORE,

Be it resolved by the House of Representatives of the General Assembly of the Commonwealth of Kentucky, the Senate concurring therein:

Section 1. That the Legislative Research Commission is directed to conduct a study of the possible incentives for floodproofing, including income tax deductions and

other measures consistent with federal insurance administration regulations.

Section 2. That the study, along with any recommendations, shall be reported to the appropriate interim joint committees not later than December 1, 1980.

Section 3. Staff services to be utilized in completing this study are estimated to cost $7000. These staff services shall be provided from the regular Commission budget and are subject to the limitations and other research responsibilities of the Commission.

APPENDIX 2

COSTS* TO RAISE STRUCTURE IN PLACE ($1,000)
ONE STORY,** NO BASEMENT, RESIDENTIAL OR COMMERCIAL

Linear Feet	Size	2'		4'		6'		8'	
		Frame	Brick	Frame	Brick	Frame	Brick	Frame	Brick
120	10x50-20x40-30x30	5.8	6.8	7.5	9.5	9.4	11.5	11.2	13.4
140	20x50 - 30x40	5.8	6.9	7.8	9.8	9.8	11.9	11.8	15.0
160	20x60-30x50-40x40	6.3	7.3	8.5	10.5	10.7	12.8	13.0	15.2
180	30x60 - 40x50	6.7	7.7	9.2	11.2	11.7	13.8	14.3	16.5
200	30x70-40x60-50x50	7.1	8.1	10.1	12.0	12.6	14.7	15.6	17.8
220	40x70 - 50x60	7.4	8.4	10.6	12.6	13.4	15.5	16.8	19.0

Source: Data provided by U.S. Army Corps of Engineers, Huntington District, West Virginia. Derived on Dames & Moore Floodproofing Report, 30 April, 1980. See Bibliography.

*Davis-Bacon wage rates are assumed.

**For two-story structures, multiply by 1.05.