

ALTERNATIVE ASSESSMENT OF COMPLETED MITIGATION

ACTIONS:

“ESTABLISHING LONG-TERM
COST-EFFECTIVENESS OF
FEMA BUYOUTS...”

BY: ESTHER WHITE

Appendix E-5-1

Enhanced Portion: Assessment of Mitigation Actions

Commonwealth of Kentucky Enhanced Hazard Mitigation Plan: 2013 Version

Kentucky Emergency Management (KYEM)

University of Kentucky, Martin School of Public Policy and Administration

Hazard Mitigation Grants Program (UK-HMGP)

Establishing Long-Term Cost Effectiveness of FEMA Buyouts: A Loss Avoidance Study of the Acquisition/Demolition of 22 Properties in Shepherdsville, Kentucky

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Salt River
Shepherdsville, KY
(Google Earth image)

Table of Contents

Executive Summary	3
Introduction	4
Literature Review	8
Overview	8
Literature Review	8
Conclusions	9
Methodology	10
Post-Project Cost Effectiveness Overview	10
Data Collection	11
Analysis	12
Results	14
Conclusions	14
Limitations	15
Recommendations	16
Works Cited	18
Acknowledgments	18
Appendix A: Photos	19
Appendix B: Maps	30
Appendix C: Flood Hazard Data	32

Executive Summary

Kentucky has 1500 square miles of surface water and 1500 miles of navigable waterways. Fifty-one of the 120 county seats are located on rivers, and over 25 percent of the state's population lives along waterways.¹ Not surprisingly, flooding is the most common natural hazard in Kentucky, and many structures have been built over the years in floodplain areas. Although many local ordinances have been enacted across the State in recent years to limit new construction in these areas, existing structures still experience frequent flood damages. These structures are required by the federal government to maintain flood insurance, and the National Flood Insurance Program (NFIP) provides a subsidized insurance program for existing structures in special flood hazard areas. Repetitive repairs are an ongoing expense for property owners, but also for all taxpayers through NFIP subsidies.

Through hazard mitigation funding, the Federal Emergency Management Agency (FEMA) mitigation grant programs work with state and local governments to eliminate repetitive flood losses to residential and commercial structures. Although mitigation funds may be used to elevate, relocate and rebuild these structures in some cases, the best mitigation approach is often shown to be acquiring flood prone property and demolishing the damaged structures for the sole purpose of returning the natural floodplain areas to green space.

At all levels of government, the provision of funds for mitigation projects is a recurring policy issue as budgets are tightened. It is imperative that public funds are used in the most cost effective manner possible and that evidence of a positive return on investment be utilized to maintain mitigation programs. At the federal level, reducing flood claims paid through the NFIP is also a priority. Long term cost effectiveness is a critical consideration in budget preparation and the allocation of scarce resources.

FEMA conducts loss avoidance studies in order to examine the return on investment for acquisition/demolition projects. The study presented here analyzes an acquisition/demolition project implemented in Shepherdsville (Bullitt County), Kentucky utilizing FEMA, state, and local mitigation funds. The buyout was conducted in 1998 following the major floods which inundated the state in 1997. To analyze the long term cost effectiveness of the buyout, this study considers the actual damages incurred in 1997 and estimates damages which would most likely have occurred in subsequent flood events had the project not been executed. These avoided losses are the project's benefits. Comparing expected damages (benefits) to the initial mitigation funds investment (inflated to 2011 dollars) will yield a ratio utilizing the formula:

$$\text{Benefits/Costs} = \text{Level of Cost Effectiveness (Return on Investment)}$$

The resulting ratio is an indicator of the return on investment and long term cost effectiveness of the mitigation effort. As a percentage, the result indicates return on investment. A 100 percent return means that, for each dollar invested, one dollar in savings is generated for each subsequent flood event.

The analysis of Shepherdsville's buyout project shows an average return on investment to be 245 percent. This means that an estimated savings of \$2.45 in property damages for each dollar invested has been realized since the project's implementation. These returns indicate that this project has been cost effective over the period of record.

¹ Kleber, John E. *The Kentucky Encyclopedia*. University of Kentucky Press. 1992.

Introduction

The Robert T. Stafford Disaster Relief and Emergency Assistance Act was passed in 1988 as an amendment to the Disaster Relief Act of 1974. This Act established the statutory authority for federal disaster response, particularly for programs administered by FEMA. FEMA's mission, as stated on its website at fema.gov, is to:

*Support our citizens and first responders to ensure that as a nation we work together to build, sustain, and improve our capability to prepare for, protect against, respond to, recover from, and mitigate all hazards.*²

FEMA defines mitigation as “the effort to reduce loss of life and property by lessening the impact of disasters.”³ Through mitigation efforts, FEMA contributes both quantitative economic benefits and qualitative societal benefits to communities across the nation that may suffer from the devastating effects of storm events. A 2005 study conducted by the Multi-Hazard Mitigation Council found that, for each dollar invested in mitigation activities, an estimated four dollars (over the useful life of the project) are saved in response and recovery efforts following a disaster.⁴

FEMA's Hazard Mitigation Assistance program is one method used to meet the mitigation goals of the organization through distribution of federal monies to communities nationwide for implementation of mitigation projects such as detention/retention basins and other drainage improvement projects; acquisition/demolition, elevation, or relocation of flood prone structures; and construction of residential or community tornado safe rooms. There are two primary funding sources in the Hazard Mitigation Assistance program. The Hazard Mitigation Grant Program provides grants to states following a Presidentially-declared disaster. Available funding for mitigation projects is determined based upon a percentage of the total federal Public Assistance and Individual Assistance payments for the disaster, typically 15 to 20 percent of that amount.⁵ States must provide a 25 percent match for these project funds. In Kentucky, the state Division of Emergency Management supplies 12 percent, and the local government contributes 13 percent of the total project costs. The second funding source is the Pre-Disaster Mitigation grant program, an annual funding opportunity for communities to finance mitigation projects. The project funds are provided with a 75 percent federal and 25 percent local cost share. Local shares may be met with cash and/or in-kind contributions for both of the Hazard Mitigation Assistance programs.

FEMA defines the land area of the base flood (100 year flood level) of rivers and streams as special flood hazard areas. If a property lies within this area, the local floodplain management ordinances and property owners must comply with NFIP regulations including maintaining flood insurance.⁶ Flood hazard areas are mapped by FEMA and published as Digital Flood Insurance Rate Maps.

FEMA makes the acquisition and demolition of flood prone structures, particularly those in mapped special flood hazard areas, priority mitigation projects. An acquisition/demolition project entails the

² www.fema.gov/about/index.shtm. Accessed March 11, 2011.

³ www.fema.gov/government/mitigation.shtm. Accessed March 11, 2011.

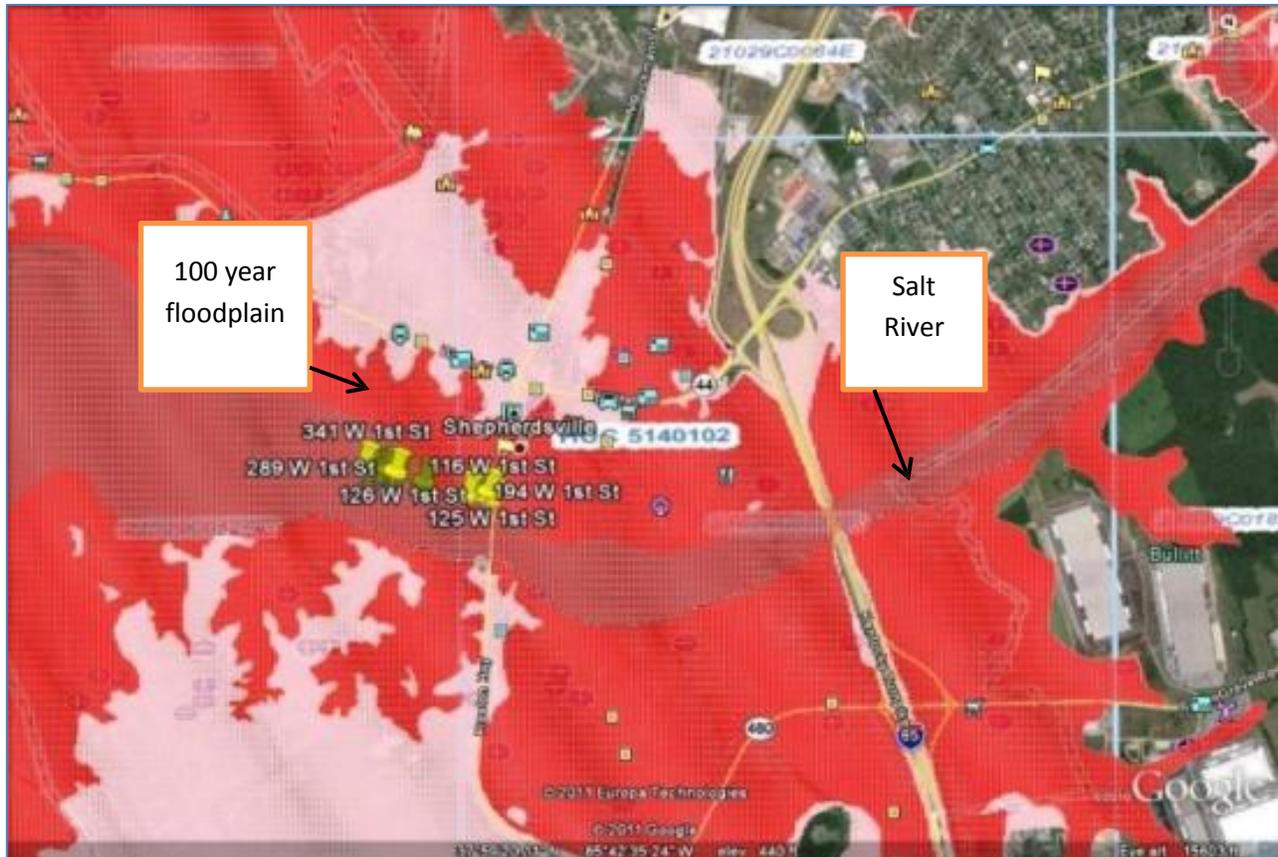
⁴ www.floods.org/PDF/MMC_Volume1_FindingsConclusionsRecommendations.pdf. Multi-Hazard Mitigation Council is part of the National Institute for Building Science.

⁵ FEMA assists in recovery efforts by funding Individual Assistance, provided to individuals and businesses which have incurred damages during a disaster event and do not have insurance coverage and Public Assistance, which aids State governments in recovery efforts such as debris removal and repairs to public property (see fema.gov).

⁶ www.fema.gov/plan/prevent/floodplain/nfipkeywords/sfha.shtm.

purchase of land and structure, demolition of the structure, removal of utilities, and deed restriction of the land as green space for perpetuity. The green space is returned to the natural floodplain and may be used with limitations for community recreational purposes if so desired by the local government. FEMA considers this type of mitigation to be 100 percent effective against future property damages.

Figure 1. Google Earth image of project area with flood hazard area shown.



This study focuses upon the acquisition and demolition of a cluster of flood prone residences along West First Street in Shepherdsville, Kentucky following the devastating flood of 1997, one of the worst in the State's history. The Google Earth image shown here is overlaid with FEMA's National Flood Hazard Layer (shown in red) and shows the location of these properties (indicated by yellow pins).

Over the first few days of March, 1997 more than a foot of rainfall inundated northern Kentucky and extreme southern Indiana, causing over 500 million dollars in damages, the loss of more than 14,000 homes, and 33 deaths.⁷ The Ohio River at Cannelton Lock in Indiana reached a record level of 52.3 feet, 10.3 feet above the normal flood stage of 42 feet, on March 8th.

⁷ www.crh.noaa.gov/lmk/?n=top10flash.

In Shepherdsville, the flooding occurred as backflow from the Ohio River surged into the Salt and Rolling Rivers (See Figure 2), adding to the swollen Floyds Fork River which empties into the Salt in Shepherdsville. The Salt River in Shepherdsville crested at 40.9 feet, 8.9 feet above the flood stage of 32 feet, on March 3rd, causing the worst flooding there since March 1964. The Salt River Basin remained flooded from backflow until March 11th.⁸ According to a report from the National Climatic Data Center, ninety percent of downtown Shepherdsville was under water, and flood waters reached the rooftops in several places. One thousand people were evacuated from their homes by boat. Property damages in Bullitt County exceeded \$30 million.⁹ The 1997 flood spurred disaster declaration number DR1163, covering 92 Kentucky counties and leading to the availability of \$16 million in FEMA hazard mitigation funds.



Figure 2. Confluence of Salt and Rolling Rivers near Shepherdsville KY¹⁰

The City of Shepherdsville was granted funds to acquire and demolish homes in nine different areas of the city which were heavily damaged by the flood waters. The West First Street area, which was comprised mainly of low- and moderate-income residents with few resources to rebuild or relocate, included 20 homes which suffered substantial damage and two vacant lots. Under the NFIP, substantially damaged dwellings must either be elevated to at least one foot above the base flood elevation or demolished. This created a financial crisis for many of the homeowners. The FEMA mitigation funds allowed the property owners to recover their losses and relocate to homes outside of the floodplain. Vacant lots were purchased in order to maintain contiguous green space.

Most of the West First Street project area now comprises Frank E. Simon Park. Although the area has flooded several times since 1997, flood waters rise and recede naturally without the threat of damage to homes. The following photos were taken in Simon Park March 1 and 10, 2011 with the river approximately 20 and 25 feet, respectively. The second photo is visual confirmation that the home sites within the floodplain flooded with a 100 year flood event.

⁸ www.crh.noaa.gov/lmk/?n=flood97.

⁹ www.ncdc.noaa.gov/oa/ncdc.html.

¹⁰ <http://geology.com/lakes-rivers-water/kentucky.shtml>. Site indication inserted by author.



Tree line indicates the location of former home sites.

Figure3. Simon Park March 1, 2011. Source: UK Hazard Mitigation Grant Program



Tree line indicates the location of former home sites.

Figure4. Simon Park March 10, 2011. Source: Bullitt County EMA

Literature Review

Overview

The literature review focuses upon loss avoidance studies conducted in various parts of the country and the methodologies employed to establish the return on investment for acquisition projects. Eastern Missouri, Washington, Florida, Minnesota, Iowa, and Alabama are a few of the state governments which have worked with emergency management agencies at the state and federal levels to produce analyses which help establish the long term cost effectiveness of acquisition programs.

Literature Review

Prior to FEMA approval of an application for mitigation funding, each project must be assessed for cost effectiveness through Benefit Cost Analysis (BCA). (Security, 2010) There are primarily two types of analyses of which FEMA approves:

- The Full Data analysis, which compares the first floor elevations of structures to the base flood elevation and associated discharges. The analysis establishes the likelihood of the depth of floodwaters at various levels of flood events and the expected value of damages related to those depths; and
- The Damage Frequency Assessment, which utilizes actual quantified damages from past events to establish a frequency of occurrence and the probability of future flood damages at various levels of flood events.

FEMA's BCAs compare benefits to costs. Costs counted are all construction and non-construction costs for materials, labor, equipment, and legal and design fees. Additionally, the cost of annual maintenance must be considered. Benefits are established either through use of the flood hazard data particular to the area or by quantifying past damages through insurance claims, receipts, agency records, etc. (URS Group, Inc., 2009) Benefits divided by costs return a ratio, and positive ratios of 1.0 or higher are deemed cost effective.

Similarly, the BCA methods may be employed to establish post-mitigation cost effectiveness with a loss avoidance study. The City of Centralia, Washington used the Full Data method of assessment to find a positive return on investment for the elevation of 35 homes through the Hazard Mitigation Grant Program following floods in 1997 – losses avoided were in excess of \$2 million during a December 2007 flood. (WA, 2008) Likewise, Birmingham, Alabama analyzed 735 acquisitions and found that over \$60 million was saved from 1996 to 2000. (AL, 2000)

In 2000, the City of Austin, Minnesota developed an analysis of 163 properties acquired with mitigation funds. These properties had been acquired over time since severe flooding occurred in 1978. Their methodology followed the Damage Frequency Assessment format of analysis and included damage to structure and contents, displacement costs, and FEMA Individual Assistance and Public Assistance expenses in the areas, which include infrastructure cleanup and emergency services costs. Austin concluded that a savings of \$6.5 million had been realized over twenty years of buyout efforts. (V, 2001)

In Eastern Missouri, a 2009 study also used this method, but included loss of function costs associated with businesses, rental properties, lost wages, and loss of public services. Their conclusion focused upon the aggregate return on investment from losses avoided during flood events in the spring (34 percent

return) and summer (178 percent return) of 2008. (URS Group, Inc, 2009) Iowa's analysis utilized the same methodology and established \$99 million in avoided losses from the acquisition /demolition of 703 structures. (Management I. H., 2008)

In some instances, such as the loss avoidance study the State of Florida conducted in 2009, accurate damage data is unknown and must be estimated. Florida employed the National Institute of Building Science's statistic of four dollars saved for every mitigation dollar spent in order to arrive at losses avoided. This study combined acquisition/demolition projects with major drainage projects completed since 1992 (Hurricane Andrew) to establish overall cost effectiveness of the State mitigation program. (Management F. D., 2009)

Most of the reports included tables which pointed out disaster-related repetitive costs not reflected in the study. These varied from the disruption of a community's economic base to human pain and suffering, to response and recovery efforts including evacuation, shelter, and public health issues.

The loss avoidance study literature reviewed was consistently detailed in its methodology reporting, validating the results with strong credibility. In the Florida study, however, a lack of accurate data threatened the validity of the results.

Conclusions

Although it would seem obvious that removing a structure from a flood prone area will mitigate future damages, quantifying those avoided losses is the basis for structuring and maintaining public policy in the use of natural floodplain areas. Through loss avoidance studies, the long term cost effectiveness of mitigation projects can be quantified and an estimated return on investment determined.

The BCA methodologies that FEMA requires may be used both in the pre- and post- determinations of a project's benefits. Choosing the best analysis method depends upon the availability of data. If flood hazard data is available, the Full Data method may be used. If not, actual damages must be determined from insurance claims and other sources. The primary difference between pre- and post- analyses is that the initial BCA utilizes expected values of future damages based upon actual current and recent events, and the loss avoidance study uses the additional expected damages avoided during subsequent flood events in the project area after mitigation.

FEMA has published several reference materials which offer specific guidance for analyzing the cost effectiveness of mitigation projects. All of the literature reviewed employed the FEMA guidance, standard values, and methodologies to establish cost effectiveness through the use of loss avoidance studies. None of the available literature on loss avoidance studies found that the acquisition projects were not cost effective. Furthermore, no study methodology accessed for this review explores the effect of other variables.

Methodology

Post-Project Cost Effectiveness Overview

As demonstrated by the literature review, establishing a project’s long-term cost effectiveness is ordinarily done through a loss avoidance study. Calculating the long term cost effectiveness of an acquisition/demolition mitigation project involves determining the benefits (losses avoided) and costs given a flood event.

This loss avoidance study utilized FEMA’s Full Data BCA 4.5.5 software to determine the expected values for damages which most likely would have occurred during three 100 year flood events in the project area since 1997. Full Data analysis compares flood hazard data to structural data for the flood prone area in question. Flood hazard data is published by FEMA in flood insurance studies and focuses upon the riverine elevation and associated discharges at the 10, 50, 100, and 500 year flood event levels. Structural data is ordinarily provided from local Property Value Assessment files and elevation certificates. The pivotal variables in the analysis are the base flood elevation, which is the 100 year flood level, and the lowest finished first floor elevation of the structure. If the first floor elevation is less than the base flood elevation, the structure can be expected to flood with a 100 year event.

The table below illustrates the probabilities for the frequency of and the recurrence intervals¹¹ for flood events at certain levels. A 500 year flood, such as the 1997 event in Shepherdsville, has a 0.2 percent chance of occurring in any given year.

Table 1. Source: <http://ga.water.usgs.gov/edu/100yearflood.html>

Recurrence intervals and probabilities of occurrences		
Recurrence interval, in years	Probability of occurrence in any given year	Percent chance of occurrence in any given year
100	1 in 100	1
50	1 in 50	2
25	1 in 25	4
10	1 in 10	10
5	1 in 5	20
2	1 in 2	50

The Full Data module generates two tables that estimate the expected damages to a property given a certain flood event level. These tables display the results of the software’s depth to damage function, a comparison of the expected damages given the depths of flooding. One table demonstrates the estimated depths, and the other gives an estimated percentage of damage relative to the depth. By

¹¹ The average number of years between floods of a certain size. Source: <http://ga.water.usgs.gov/edu/100yearflood.html>.

entering the flood hazard and structural data for 109 West First Street, tables were generated which provided expected values for damages incurred during a 100 year event. According to the calculations, at a depth of 1.78 feet, damages to the building would have been 32.1 percent of the building's replacement value, and contents would have been damaged at approximately 17.9 percent if the structure had remained in place.

Data Collection

The methodology employed for the Shepherdsville study began with the selection of a data set. Files for mitigation projects are archived at the University of Kentucky Hazard Mitigation Grant Program office. The Shepherdsville project file was used to obtain relevant data for the loss avoidance study.

Following the 1997 floods, many buyout projects were implemented with mitigation funds statewide, but not all of these buyout areas have experienced subsequent flooding. Although Shepherdsville purchased 58 properties in various locations throughout the city, this study focuses upon a cluster of 22 parcels which were located in the flood hazard area on West First Street along the banks of the Salt River. This area frequently floods with localized heavy rainfall and/or backflow from the Ohio River, making it a good site for post-mitigation analysis. The project site is now Frank E. Simon Park and offers a playground, walking paths, fishing, and a baseball field.

FEMA does not require BCAs for properties which lie within a special flood hazard area and have been determined by a local official to be substantially damaged. Substantial damages are "sustained by a structure whereby the cost of restoring the structure to its before damaged condition would equal or exceed 50 percent of the market value of the structure before the damage occurred."¹² Nineteen of the 20 structures in the data set were substantially damaged during the 1997 flood, and no pre-mitigation BCAs were conducted. Although one structure was 39 percent damaged, no BCA was in the file. The remaining two parcels were vacant lots. Although a post-mitigation analysis could have utilized the pre-mitigation BCA data as inputs, the lack of available BCA data necessitated the establishment of estimated damages through other means. Establishing subsequent events and creating a depth to damage model in the BCA software provided expected damages given the depths of flood waters with a 100 year flood event.

Total project costs were compiled from the receipts and invoices archived in the file and included the purchase price, demolition, lead and asbestos testing and abatement, closing costs, and appraisals. Total 1997 benefits were calculated for each structure as:

$$(Purchase\ Price^{13} \times Percent\ of\ Substantial\ Damage) + Value\ of\ Contents^{14} = Total\ Benefits$$

Example: $(70,000 \times .7) + 50,704 = 99,704 = Total\ Benefits\ for\ 109\ West\ First\ Street$

The sum of benefits for the 22 properties went into the final benefit/cost (return on investment) ratio as:

$$Sum\ of\ Total\ Benefits / Total\ Inflated\ Project\ Costs = Return\ on\ Investment$$

¹² www.fema.gov/plan/prevent/floodplain/nfipkeywords/sd.shtm.

¹³ Fair market value was used to estimate building replacement value based upon square footage of the structure.

¹⁴ FEMA standard value for contents is 100 percent of the structure's building replacement value. This standard was applied to the appraised value for 19 of the 22 parcels; the two vacant lots had no contents, and an estimated value of \$5000 was used for the contents of the garage at 156 West First Street.

The final ratio was converted to a percentage to demonstrate return on investment.

The determination of subsequent flood events in the project area proved to be difficult as no consistent written flood records were kept locally following the buyout. Since the structures were located in the 100 year floodplain, it was assumed that flood damages would occur at the 100 year event level. The Bullitt County Emergency Management Agency Deputy Director confirmed flooding in the area in May 2010, thus establishing one subsequent event. A site visit in March 2011 confirmed another event. Next, a query at the National Climatic Data Center site produced 20 flood events in Bullitt County which had been reported since 1997. Of those, five were determined to have occurred in the immediate project area, and one of the five was established as a 100 year event. Thus, three 100 year events were used to estimate subsequent avoided losses.

Analysis

To determine expected damages for each of the three events, the FEMA BCA Full Data module was used. The module required first floor elevations and flood hazard data. Actual first floor elevation is unknown; however, a reasonable estimate was determined based upon historical flood depths for past 100 and 500 year events and a photograph of a home in the area published in the 2004 Flood Insurance Study for Shepherdsville that indicated the depths at 100 and 500 year events.

Using the depth damage function of the software, it was determined that damages begin occurring with the 40 year event. However, this study is only concerned with the expected damages at the 100 year event level. The BCA model established that, at the approximate 100 year event level, flood depths would be 1.78 feet. The table and accompanying graph below include starting, ending, and relevant intermediate results generated by the BCA software for the West First Street structures.

Estimated Flood Depths Before Mitigation	
<u>Recurrence Interval (Yr)</u>	<u>Flood Depth (ft)</u>
1.11	-19.48
40.0	-1.13
96.44	1.78
400.0	6.25
644.31	7.70

Table 2. BCA 4.5.5 Depth to Damage Function Results

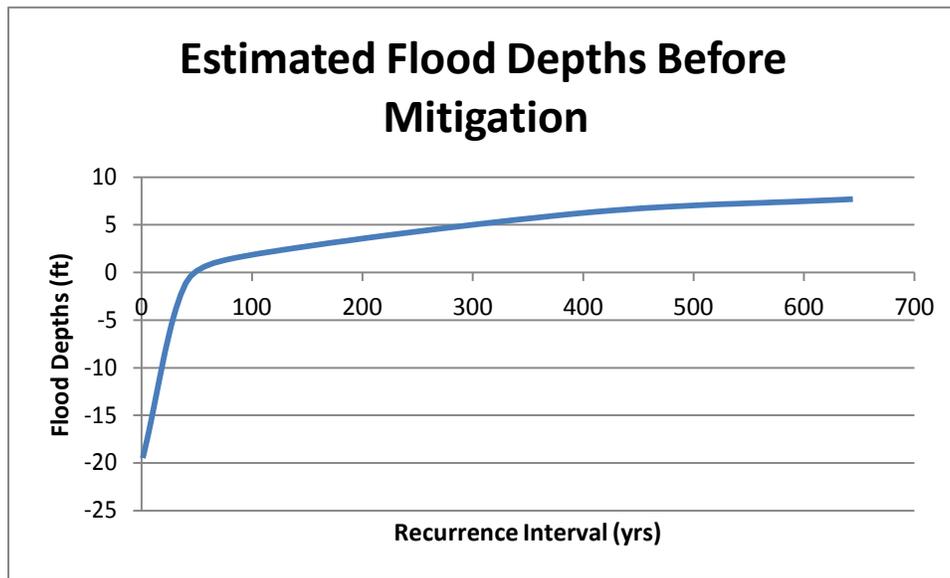


Figure 4. Estimated flood depths relative to flood event levels.

The depth to damage function also generates a table of expected damages relative to the building replacement value for the building and contents given various levels as shown in the following table.

Expected Damages (%) Before Mitigation			
Recurrence Interval (Yr)	Flood Depth (ft)	ED (%) Building	ED (%) Contents
1.11	-19.48	N/A	N/A
40.0	-1.13	2.5	2.4
96.44	1.78	32.1	17.9
400.0	6.25	58.6	31.5
644.31	7.70	67.2	35.7

Table 3. Expected damages (ED) relative to flood event levels.

From this function, damages to the building and contents of a structure in the project site during a 100 year flood event are estimated to be 32.1 percent and 17.9 percent of the building replacement value, respectively.

These expected values were applied to the original project costs and benefits. Then each figure was inflated to the year of the event using the Bureau of Labor Statistic’s inflation calculator located at

http://www.bls.gov/data/inflation_calculator.htm. The following table displays the results of this step of the analysis.

Expected Damages (Benefits) & Costs by Flood Event			
Flood Events 1999-2011	ED (Benefits)	ED Inflated	Costs Inflated
5/3/1997 (500 yr flood)	1,292,215	N/A	
7/20/1999 (100 yr flood)	493,863	512,633	
5/2/2010 (100 yr flood)	493,863	670,964	
3/9/2011 (100 yr flood)	493,863	680,974	1,291,027
Totals		3,156,786	

Table 4. Expected damages (ED) inflated for each flood event used in the analysis.

Results

Dividing the total benefits from the four flood events by the inflated project cost yields a return on investment of 245%.

Benefits & Costs of Flood Events & Return on Investment		
Flood Events 1999-2011	Total Benefits	Total Costs
5/3/1997 (500 yr flood)	1,292,215	
7/20/1999 (100 yr flood)	512,633	
5/2/2010 (100 yr flood)	670,964	
3/9/2011 (100 yr flood)	680,974	1,291,027
Total Benefits	3,156,786	
Return on Investment	245%	

Table 5. Return on investment.

This indicates that an estimated savings of \$2.45 in property damages for each dollar invested has been realized over the four flood events which were analyzed. These returns indicate that this project has been cost effective over the period of record.

Conclusions

The facts surrounding the initial proposal to implement an acquisition/demolition project along West First Street point to a sound decision. The damages sustained by the properties during the 1997 flood were extensive, rendering most of the homes unlivable. The residents were primarily of low- to moderate- incomes and did not have the financial resources to relocate or rebuild to NFIP requirements.

Given the damages and local ordinances which would prevent new construction in the area, the likelihood of selling the properties at a reasonable market value was low.

All buyouts funded by FEMA mitigation grants are voluntarily transacted by the homeowners. No use of eminent domain authority is permitted. Local governments and emergency management agencies have a responsibility to protect the citizens from harm. Thus, the mitigation project proposed by the City of Shepherdsville at the owners' requests was an opportunity for the residents to start over in a safer location.

The NFIP provides federally-subsidized flood insurance for properties in the special flood hazard area. This subsidy is funded by taxpayer dollars, so repetitive flood claims can add up to substantial costs over the years. Removing the structures from an area of high risk for flooding also eliminated the recurring NFIP claims, thereby creating NFIP savings at the federal level in addition to the 245 percent return on investment.

The project is deemed cost effective by FEMA standards, making the buyout a win/win situation for all stakeholders from the federal level down to each individual citizen.

Limitations

The methodology for determining the long term cost effectiveness of this particular project was based upon the actual costs and damages during the 500 year flood in 1997 and expected values for costs and damages during three subsequent 100 year flood events had the project not been implemented. The scope of this loss avoidance study included only these expected damages and did not consider other potential benefits and costs as the examples in the table below illustrate.

Benefits Not Counted	Costs Not Counted
Avoided Water Rescues	Loss in Property Taxes from Purchased Properties
Other Emergency Dispatches Avoided	Park Construction
Public/Individual Assistance Payments	Ongoing Maintenance of Park
Avoided Displacement Costs	
Avoided Loss of Rental Income	
Socioeconomic Benefits of Recreational Facility	
Reduction in NFIP and other Insurance Premiums Paid	
Potential Gain in Property Taxes from Relocated Homeowners	
Avoided Compromised Health (Mold, Mildew, etc.)	
Avoided Potential Deaths/Injuries	
Avoided Damages from Events < 100 year	

Table 6. Benefits and costs not considered in this study.

Accuracy in determining cost effectiveness using FEMA's BCA software depends upon the accuracy of the data. In a best case scenario, a Hydraulic and Hydrological study for the project area would yield the most accurate flood hazard data. These studies must be conducted by an engineer utilizing models developed specifically for predicting flow characteristics in a given area. In many cases, the local government does not have the financial resources to contract an engineering firm for a study. The flood hazard data from FEMA's flood insurance studies then becomes the best available data. These data may actually change over time due to construction in the area which may increase storm water runoff, drainage improvements, and other potential natural changes in the river basin.

Furthermore, a lack of actual first floor elevations affects the overall accuracy. In the case of the Shepherdsville buyout, most of the homes were substantially damaged and an initial BCA was not required in order to determine cost effectiveness. Therefore, the need to have a surveyor determine first floor elevations was eliminated. In order to estimate subsequent damages for this study, however, a first floor elevation had to be estimated based upon photographic and historic evidence, thus affecting overall accuracy.

Recommendations

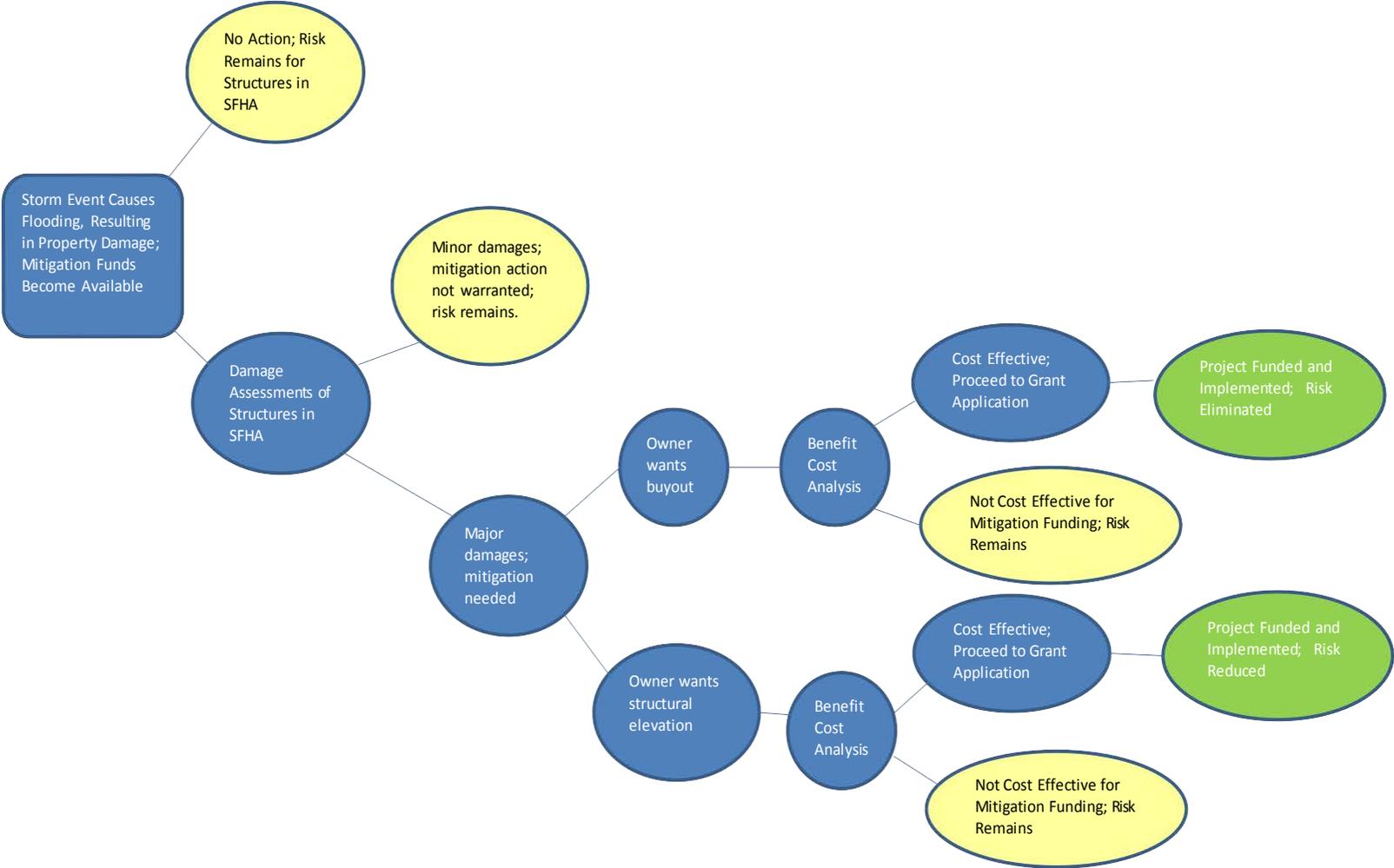
The results of loss avoidance studies are used by various agencies concerned with flood risk at the local, state, and federal levels to assist in mitigation project decisions and the allocation of funding. Emergency management agencies, city planners, floodplain managers and other local officials in the public sector and realtors, home buyers, bankers, and insurance companies in the private sector all depend upon the best available data regarding flood risk. When flooding occurs and homeowners request assistance, decisions must be made regarding the most effective approach to mitigating future risk.

In the public administration arena, variables both simple and complex affect budgeting decisions. Public policy, politics, societal needs, and fiscal stewardship are a few of the many complex factors that may influence the allocation of funds. Funding for mitigation projects should be justified, with the benefits going to the overall public good. In the case of the 1997 Shepherdsville buyout, the return on investment formula employed in the loss avoidance study indicates a good return for the citizens. The conversion of damaged structures to a public park has proven to be an effective use of the natural floodplain surrounding the river. Therefore, the decision to provide the necessary financial resources to execute the project was a sound one.

However, the intensity of a variable's influence varies from jurisdiction to jurisdiction and with economic fluctuations, disasters, and other extraordinary circumstances, so the decision to provide mitigation funding may not always be the most feasible choice. Determinations should be made regarding the costs versus benefits to the public at large and the opportunity costs of choosing to fund mitigation projects over other potential allocations such as education or law enforcement. The ratio returned through BCA may also be used to compare the relative cost effectiveness of several proposed mitigation projects in order to allocate funds most efficiently.

The decision tree on the next page illustrates a typical decision making process that a local official might follow regarding applying for FEMA and state mitigation funds for flood-damaged structures given the local choice to allocate funds to mitigating flood risk. If preliminary assessments and benefit cost analysis indicate cost effectiveness, then a proposal should be pursued so that the flooding risk is mitigated or removed entirely.

Decision Process for Mitigating Flood-Damaged Property with FEMA Mitigation Funds



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Les Bandy, Deputy Director, Bullitt County Emergency Management Agency

Brian Gathy, Program Coordinator, UK Hazard Mitigation Grant Program

Emily Frank, Planning Grants Manager, UK Hazard Mitigation Grant Program

Sarah McQueen, Capstone Reviewer

Jill Thompson, Capstone Reviewer

Appendix A: Photos

The following photos from the archived file show some of the damaged homes on West First Street after the 1997 flood.

Shepherdsville, Kentucky
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Acquisition/Relocation Structures



Parcel 1 - 109 West First Street

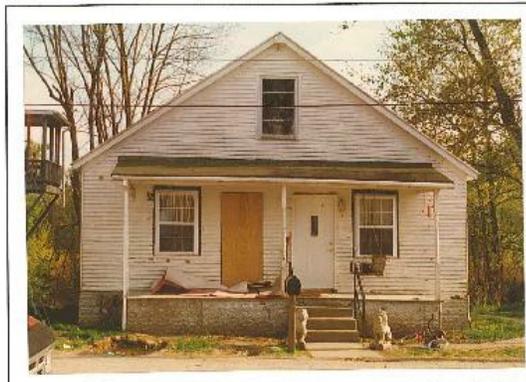


Parcel 2 - 116 West First Street

Shepherdsville, Kentucky
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Parcel 3 - 126 West First Street



Parcel 4 - 134 West First Street

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Acquisition/Relocation Structures



Parcel 5 - 156 West First Street



Parcel 6 - 194 West First Street

Shepherdsville, Kentucky
Hazard Mitigation Grant Program
Acquisition/Relocation Structures



Parcel 9 - 209 West First Street



Parcel 10 - 238 West First Street

Shepherdsville, Kentucky
Hazard Mitigation Grant Program
Acquisition/Relocation Structures



Parcel 11 - 265 West First Street

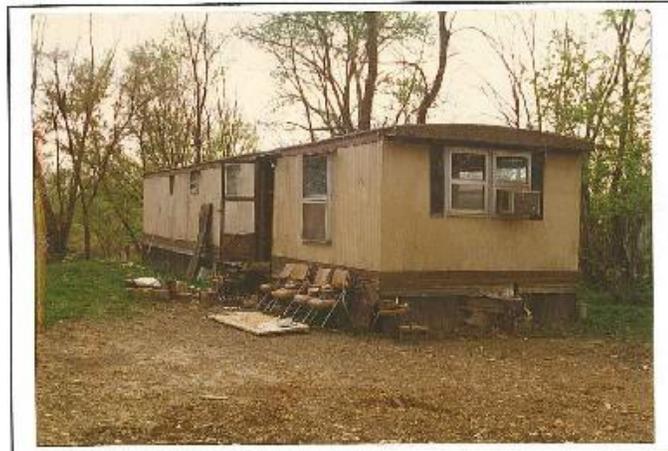


Parcel 12 - 283 West First Street

Shepherdsville, Kentucky
Hazard Mitigation Grant Program
Acquisition/Relocation Structures



Parcel 15 - 290 West First Street

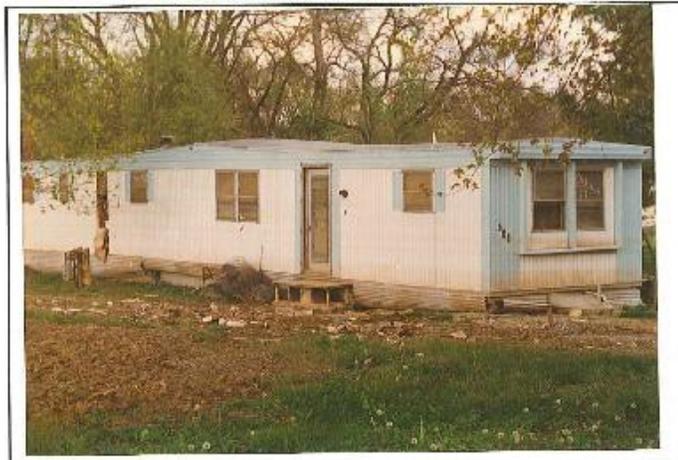


Parcel 16 - 290A West First Street

Shepherdsville, Kentucky
Hazard Mitigation Grant Program
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Parcel 17 - 301 West First Street



Parcel 18 - 301B West First Street

Shepherdsville, Kentucky
Hazard Mitigation Grant Program
Acquisition/Relocation Structures



Parcel 19 - 312 West First Street



Parcel 20 - 320 West First Street

Additional Photo of Flooding in Frank E Simon Park March 10, 2011



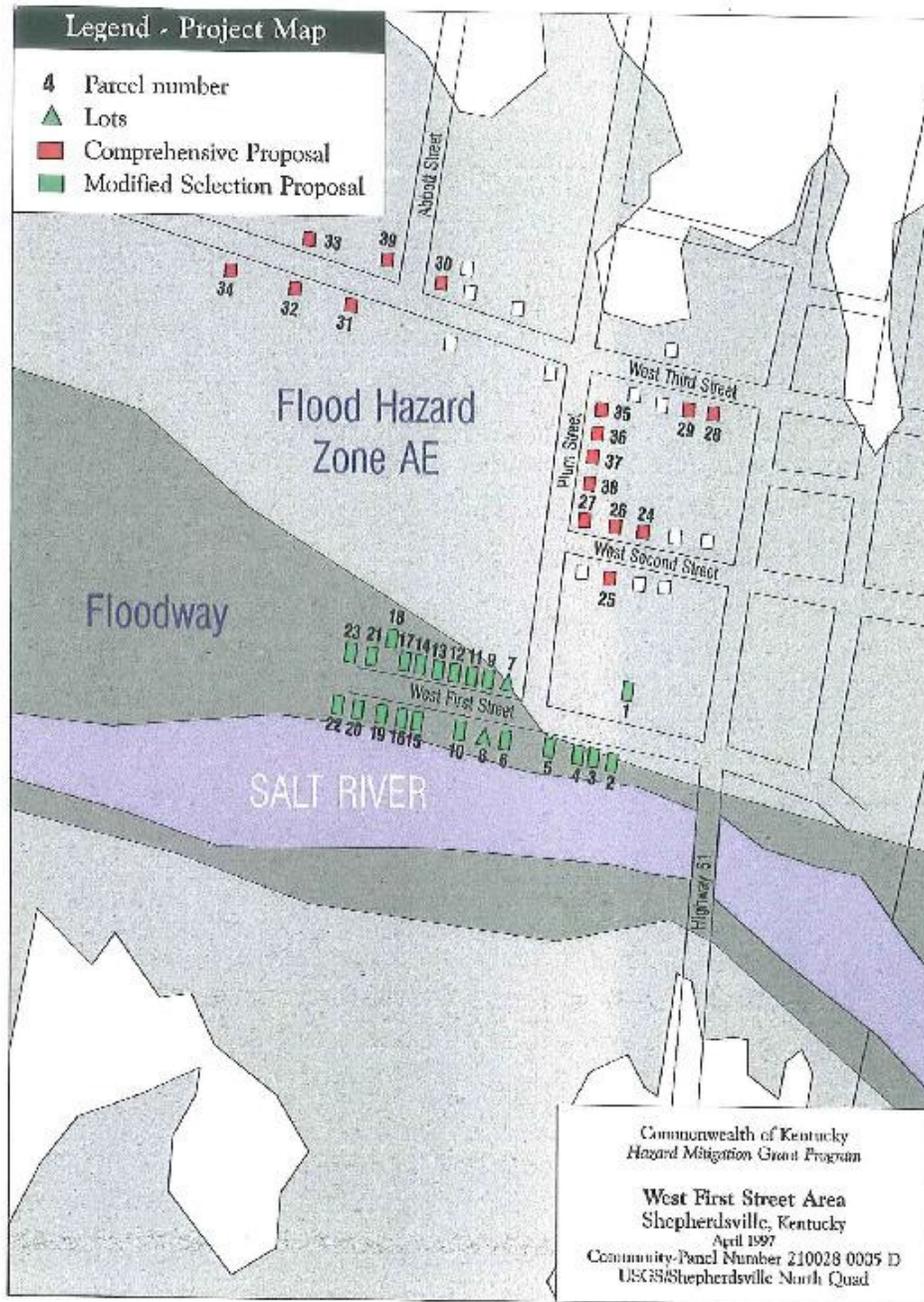
Additional Photo of Flooding in Frank E Simon Park March 10, 2011



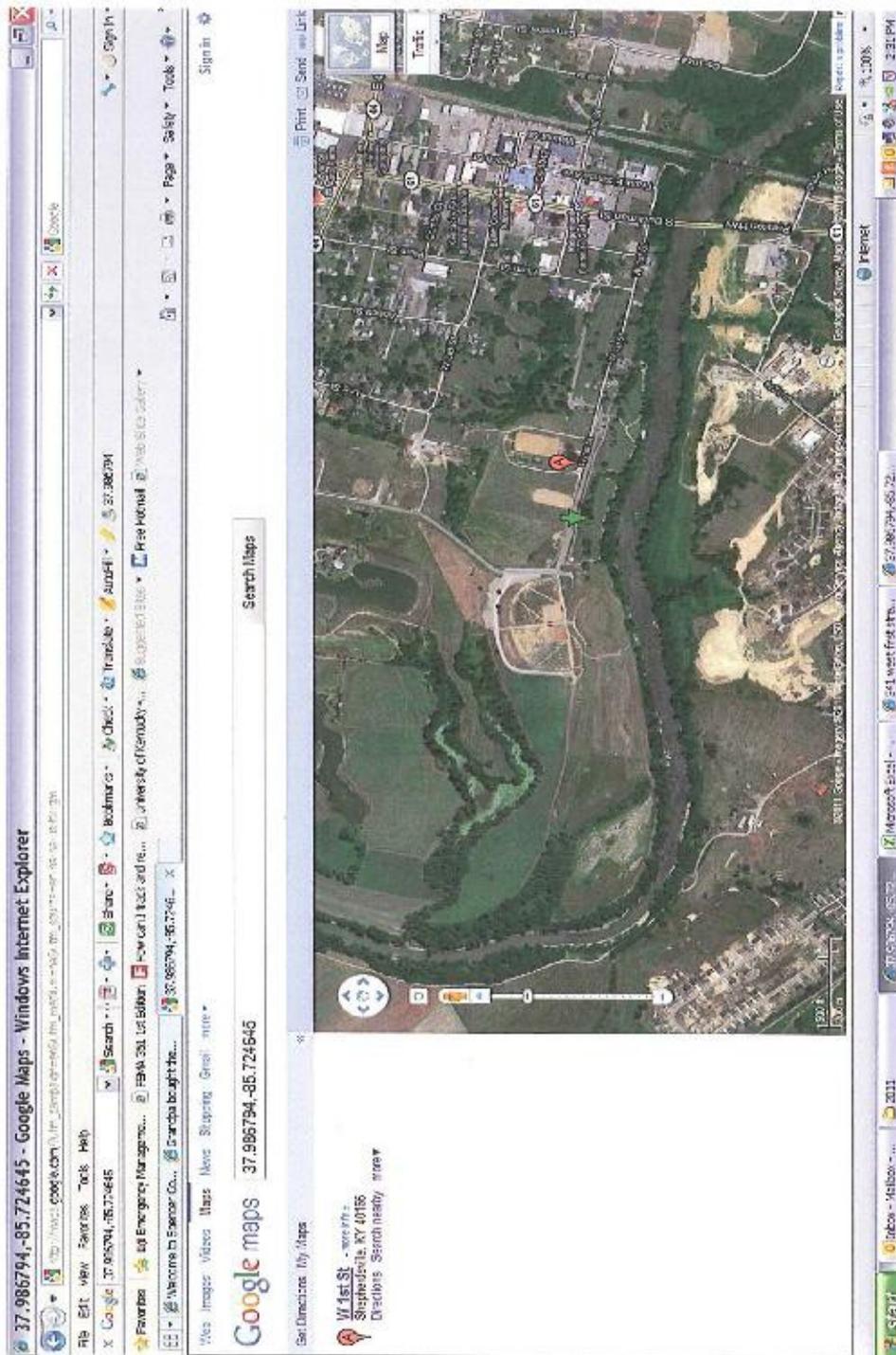


Additional Photo of Flooding in Frank E Simon Park March 10, 2011

Appendix B: Maps

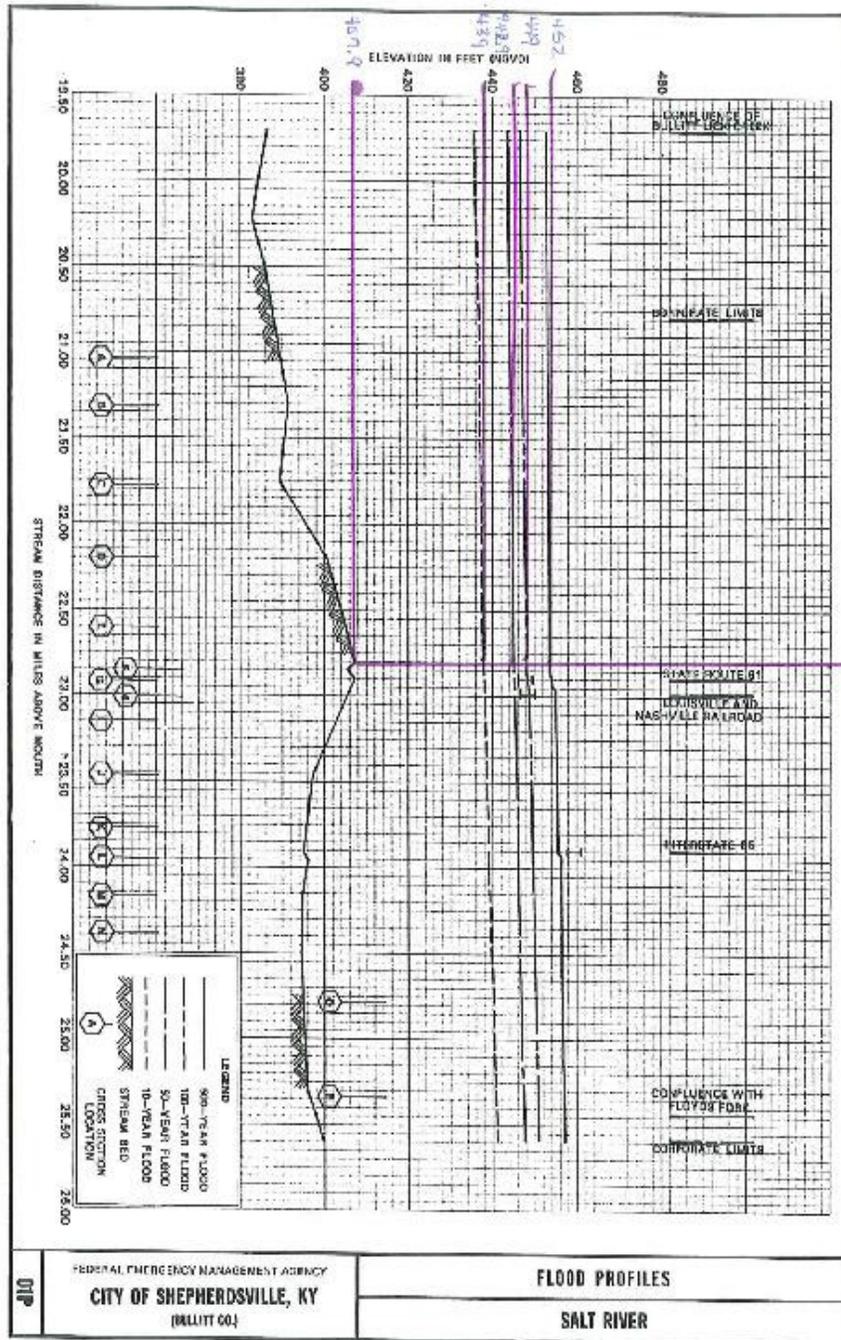


Map 1. Project Area



Map 2. Google Map Image of Frank E. Simon Park

Appendix C: Flood Hazard Data



Flood Profile from 2004 Shepherdsville Flood Insurance Studies shows estimated riverine elevations at 10, 50, 100, and 500 year flood event levels.

TABLE 1 - SUMMARY OF DISCHARGES

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (SQ MILES)	PEAK DISCHARGE (CFS) ¹			
		10-YEAR	50-YEAR	100-YEAR	500-YEAR
SALT RIVER above Rolling Fork (mile 11.4) * at Shepherdsville USGS gaging station down- stream side of State Route 61 bridge (mile 22.90)	1,256	39,900	60,100	71,000	101,600
above Floyds Fork	904	32,500	50,800	59,900	86,200
FLOYDS FORK at mouth	284	23,600	41,600	49,200	70,000

¹cubic feet per second

3.2 Hydraulic Analyses

Analyses of the hydraulic characteristics of flooding from the sources studied were carried out to provide estimates of the elevations of floods of the selected recurrence intervals.

Cross sections were located at regular intervals along the stream length and at a significant changes in ground relief and land use or land cover. Digitized sections from aerial photographic mapping at a scale of 1:1200 with 2-foot contour interval (References 4 and 5) were used to obtain these data and were supplemented by field measured channel sections at a number of locations.

All bridges were field surveyed to obtain elevations and structural geometry. These data were supplemented by as-built drawings from the State Highway Department. Water-surface profiles were developed using the HEC-2 step-backwater computer model (Reference 6). Profiles were determined for the 10-, 50-, 100-, and 500-year floods.

Roughness coefficients (Manning's "n") depend on such factors as type and amount of vegetation, channel configuration, and water depth. Field inspection at each cross section provided estimated values. In conjunction with this approach, known roughness factors for comparable streams in adjacent watersheds were considered. In addition, flood high-water marks from 1964 were reproduced to verify the roughness values for the Salt River. Manning's roughness coefficients developed for both the Salt River and Floyds Fork were 0.050 for channel roughness and 0.060 for overbank roughness in the study reach of Shepherdsville.

Because of the Ohio River backwater effect on the Salt River at the downstream limit of Shepherdsville, an in-depth study was made of the Salt River basin to determine required starting elevations at the mouth of the Salt River at the time of each of the four frequency floods. Therefore, in lieu of starting with elevations obtained by the slope-area method at the

Excerpt from 2004 Shepherdsville Flood Insurance Study shows estimated discharges at the 10, 50, 100, and 500 year flood event levels.