Executive Summary

HAZARD MITIGATION IN NORTH CAROLINA:
Measuring Success

Sustainable Housing
Sustainable Business
Sustainable Infrastructure
Sustainable Environment

February 2000

Hazard Mitigation in North Carolina

Measuring Success

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Hazard Mitigation in North Carolina - Measuring Success, is a collaborative effort of the North Carolina Emergency Management Division, the Federal Emergency Management Agency, and Durham Technologies, Inc.

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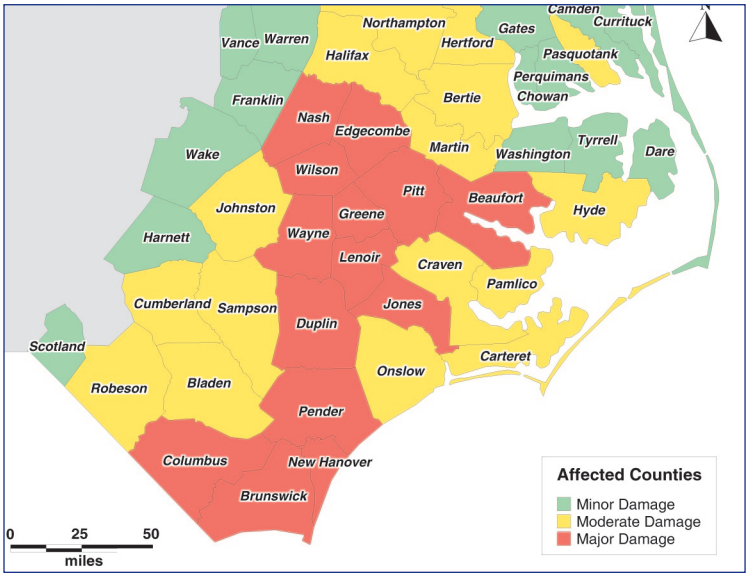
Executive Summary

On September 15 and 16, 1999, Hurricane Floyd struck the coast of North Carolina near Cape Fear. It moved north through the state, creating widespread inland flooding and coastal damage that led to the loss of life, destruction of homes, businesses and infrastructure, loss of livestock and crops, and a disruption of commerce.

The scope of the flooding was unprecedented. Sixty-seven counties sustained damages, with the most significant losses occurring in the economically distressed counties in eastern North Carolina. Scores of communities were inundated – Princeville, Greenville, Tarboro, Kinston, Rocky Mount, and others.

Hurricane Floyd was the latest in a string of natural disasters to strike the state of North Carolina. Since 1995, six hurricanes and two major ice storms have impacted the state, causing billions of dollars in damages and economic and environmental losses. Every sector of society and every sector of North Carolina's economy has been directly or indirectly impacted by natural disasters in the past five years.

Figure 1. Counties Most Affected by Hurricane Floyd



Hazard Mitigation: Measuring Success

Hurricane Floyd presents a unique opportunity to examine the role of mitigation programs and initiatives in reducing damages and economic losses from this event. For the past decade – and particularly since Hurricane Fran – hazard-prone communities across the state have developed and carried out a range of programs to reduce their vulnerability to natural hazards. In North Carolina, four interrelated strategies have been used to reduce potential losses from natural hazards:

- comprehensive mitigation planning, the ongoing process of identifying hazards and vulnerabilities, and developing plans and implementation strategies to reduce the impacts of those hazards

- hazard avoidance strategies, which are designed to remove threatened structures from hazard-prone areas through land use planning, and through the acquisition or relocation of hazard-prone structures and areas

- strengthening buildings and infrastructure, which is designed to protect property from the effects of hazards through in-place elevation of structures, relocation of hazard-prone structures, or floodproofing

- maintaining natural environmental features, including dunes, maritime forests, vegetation, and wetlands that reduce flood, wind, and wave impacts

A fundamental question becomes, *how effective are these mitigation tools and techniques in reducing losses from natural disasters?*

Hazard Mitigation in North Carolina: Measuring Success examines this issue. It is the second in a series of publications prepared by the North Carolina Emergency Management Division (NCEMD) that captures and presents the unfolding role of hazard mitigation in North Carolina, and how mitigation is becoming an integral feature of sustainable communities.

Measuring Success – An Executive Summary, highlights the major themes of the report, with an emphasis on the case studies that identify – quantitatively – the losses that have been avoided as a result of the implementation of mitigation strategies in North Carolina.

The first section introduces the concept and practice of sustainable communities, the role of the Hazard Mitigation Planning Initiative (HMPI) in implementing a community-based mitigation program, and a framework and methodology for measuring the success of mitigation programs in North Carolina.

The following sections examine three of the four integral aspects or dimensions of a sustainable community – Housing, Business, and Infrastructure (the fourth element is Environment). A series of case studies is presented that show how losses have been avoided in Hurricane Floyd through a combination of mitigation measures.

Measuring Success – An Executive Summary concludes with a discussion of a process and framework for integrating quantitative measures into the HMPI.

Figure 2. Business Impacts

Damages to the infrastructure – including the transportation system – caused delays in business resumption. This cement plant in Lenoir County was shut down for two weeks.

Creating Sustainable Communities In North Carolina

Since Hurricane Fran in 1996, the state of North Carolina, in partnership with other state agencies and FEMA, has channeled over $110 million into Hazard Mitigation Grant Program (HMGP) projects that are designed to minimize future losses of lives and property due to disasters.[1] Over $80 million alone was utilized for in-place elevation and acquisition/relocation or "buyouts" of flood-prone properties. The recovery from Hurricane Floyd will add significantly more resources to the implementation of hazard mitigation programs in communities across the state.

While North Carolina's hazard-prone communities have benefited from the buyouts and other mitigation projects, what has been lacking in many instances is a community-based planning process that links mitigation policies and programs, and a vision for improving the quality of life. The NCEMD is addressing this void through the HMPI, a statewide program that is intended to reduce community vulnerability to natural hazards; promote sustainable development; and provide a model for future communities that wish to participate in this initiative. Following Hurricane Floyd, NCEMD established a new HMGP policy that requires local governments to participate in HMPI.

"The long-term goal of HMPI is to promote a local capacity to develop and carry out mitigation strategies that are fully integrated into daily decisions and routines of government and business"

Building Local Capacity

The long-term goal of HMPI is to promote a local capacity to develop and carry out mitigation strategies that are fully integrated into daily decisions and routines of government and business. This will take time. The NCEMD is taking a phased approach that features the following:

- designation of demonstration communities
- emphasis on interdisciplinary technical assistance
- emphasis on a regional, data-driven approach to planning
- promoting local government accountability in the expansion of the HMPI

Integrating Hazard Mitigation and Sustainable Communities: Measuring Success

One of the long-term goals of the HMPI is to promote institution building and local capacity to carry out mitigation strategies. With technical support from the HMPI partners, NCEMD is carefully cultivating a planning process in communities across the state. The technical assistance teams help to gauge community needs, identify mitigation priorities, provide technical training, and examine the role and value of risk reduction in the context of other community goals.

In examining options and trade-offs between mitigation strategies, community leaders will consider several factors: cost; compliance with regulations (i.e., land use, environmental); effectiveness of the strategy in reducing future losses; the value of the strategy in achieving other community goals (i.e., natural resource conservation, open space, housing, etc.); and the political risk inherent in the strategy (i.e., will the strategy alienate key constituencies?).

To assist community leaders in answering these questions, *Measuring Success* addresses three fundamental issues:

1. How effective are the most widely used mitigation tools – including acquisition/relocation of hazard prone properties and in-place elevations – in reducing losses?

Figure 3. Integrating Hazard Mitigation and Sustainable Communities
Measuring Success identifies four dimensions of sustainable communities, including indicators for measuring progress.

2. How can communities utilize indicators to measure progress in reducing actual or potential disaster losses?

3. How can communities gauge the progress that is being made toward institutionalizing mitigation in their communities?

In the following section, *Measuring Success* examines the losses avoided as a result of the implementation of two widely used mitigation tools in North Carolina: acquisition/relocation, and in-place elevation of flood-prone structures. The ability to quantify the short-term and long-term savings to businesses, homeowners, and local government from the adoption of mitigation programs is clearly important. This information can be used at least three ways:

1. To establish performance goals and objectives for a local hazard mitigation plan that is carefully integrated with the community's comprehensive plan.

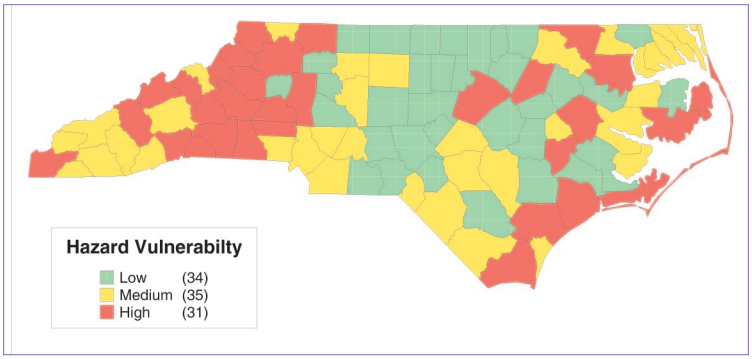


Figure 4. Community Vulnerability

The NCEMD has developed a Community Vulnerability database that is used in conjunction with a database on Institutional Capability to prioritize communities for participation in the HMPI.

2. To measure progress in achieving the goals. The use of results oriented indicators (i.e., reduction in losses due to acquisition of flood-prone properties) will show the cause and effect relationship between the adoption of mitigation measures and desired outcomes.

3. To develop an outreach program that incorporates quantitatively-based information on losses avoided as a result of the implementation of mitigation programs. This information can be valuable in constituency building efforts with business and government leaders.

Sustainable Housing

Hurricane Floyd will be remembered for its impact on the housing sector in North Carolina. The flooding left approximately 9,000 homes in eastern North Carolina either destroyed or with major damage. Moreover, the hurricane struck a region that is among the most economically distressed in the state. According to a ranking system developed by the North Carolina Department of Commerce, ten of the state's most economically distressed counties are located in the 67-county impact area of eastern North Carolina.[2]

Vulnerability of Housing to Hurricane Floyd

A combination of factors has contributed to Hurricane Floyd's impact on housing in eastern North Carolina.

Figure 5. Housing Vulnerability

One of the most important elements of a long-term strategy to create sustainable communities is housing vulnerability reduction. Thousands of homes, like these in Lenoir County, were submerged in Hurricane Floyd.

Vulnerability of Housing Stock. Of the 9,000 homes that were destroyed or left with major damage, the vast majority were located in the 100-year floodplain. Many communities - including Belhaven, Washington, Kinston, and Greenville - were developed in the floodplain during the eighteenth and nineteenth centuries, with trade, commerce and residential development tied to the waterfronts. Community identity and a "sense of place" is shaped by the activities that take place on the water.

Lack of Flood Insurance Coverage. Of the 45,000 houses that were flooded in Hurricane Floyd, an estimated 50 percent are uninsured. Furthermore, nearly one-half of these flood-damaged and uninsured homes were occupied by low-income households.[3]

Vulnerability of the Population. Hurricane Floyd impacted a vulnerable population. The region has a higher than average poverty rate. Of the 66 counties that were most affected by Floyd, five counties have poverty rates as much as 15 to 20 percent higher that the state's average.

In summary, Hurricane Floyd caused unprecedented damages to houses, businesses and infrastructure in eastern North Carolina. Arguably, one of the most important elements of a long-term strategy to create sustainable communities in North Carolina is housing vulnerability reduction. The following sections highlight the strategies of three communities that have implemented programs to reduce the impact of future floods on housing.

Case Study: Beaufort County — Protecting Houses by Elevation

The Town of Belhaven (population 2,244) and the City of Washington (population 9,300), were settled in the late eighteenth century in the floodplains of the Pamlico River in Beaufort County. The rural economy is based on agriculture, light manufacturing, and retail trade. Over the past 20 years, the population and economic growth in these two communities has been stagnant, with per capita incomes falling well below the state average.[4]

Communities at Risk

The history of Belhaven and Washington has been shaped by the flood hazard. During the past 70 years, moderate and severe floods have occurred on 12 occasions. Eighty percent of the City of Washington is located in the mapped floodplain, while almost 90 percent of Belhaven is flood-prone.

Although Belhaven is 40 miles inland from the coast, it has been flooded by hurricane and tropical storm surges and rains on six occasions from 1996 to 1999. On July 12 and 13, 1996, Hurricane Bertha drove a 5.4-foot storm surge through Belhaven. Only two months later, Hurricane Fran produced 6.8-foot

"One of the most important elements of a long-term strategy to create sustainable communities in North Carolina is housing vulnerability reduction"

floodwaters, damaging 60 percent of the town's homes. Tropical Storm Josephine (October, 1996) and Hurricane Bonnie (August, 1998) caused additional flooding in Belhaven and Washington, with storm surges reaching up to six feet above the base flood elevation (BFE).

The storms have been costly to these jurisdictions. In Belhaven, for example, Hurricane Fran caused flood damage to 735 of the Town's 980 residential structures, with an average of $10,000 in damages per structure for a total of approximately $7,350,000. Since 1996, the National Flood Insurance Program (NFIP) has paid out repetitive flood losses of approximately $4,892,919 on 355 claims to 143 property owners, for an average payment of $13,782.[5]

Mitigation Strategy: Elevation of Flood-Prone Structures

Following Hurricane Fran, local officials in Washington and Belhaven concluded that the best strategy for reducing future flood losses in these jurisdictions was to selectively elevate flood-prone structures above the BFE. Relocation was not considered a viable option since

Figure 6. Elevation In-Place

These photos show a house in Belhaven prior to elevation, with the 5-foot flood water line indicating how high the flooding would have reached if the house had not been elevated.

it would involve moving most of the homes and businesses more than ten miles from the downtown area.

In the Spring 1998, Belhaven, and Washington and Beaufort County launched a multi-year program to elevate a total of 550 houses and acquire another 14. Table 1 provides the breakdown of the program by jurisdiction. In total, the project budget was over $12 million.

When Hurricane Floyd struck the coast of North Carolina, 47 houses had been elevated – 15 in Washington and 32 in Belhaven. Fourteen houses had been acquired and demolished, all in Washington. The hurricane caused major flooding in both communities. Floodwaters reached almost 9 feet in Washington and over 7 feet in Belhaven. FEMA inspected over 460 damaged homes in Belhaven and another 850 in Washington.

With the level of flooding caused by Floyd, every house that was elevated or acquired by the program would have been inundated by the floodwaters. Without these mitigation measures in place, flooding would have been over 5 feet deep in several homes. It is estimated that over one-third of the elevated homes would have been substantially damaged. Given the relatively low property values in the region, it is likely that these substantially damaged homes would have been demolished and replaced.

The losses avoided by elevating and acquiring the flood prone properties in Washington and Belhaven are estimated to be over $3 million, as reflected in Table 1. The reduction in the repair and replacement cost of damaged homes accounted for almost two-thirds of the avoided losses. The building/replacement cost estimates were based on the average construction costs of the region and damage formulas developed by FEMA. For Belhaven and Washington, the average construction cost ranged from $40 to $65 per square foot, depending on the type and quality of the home. The NCEMD also customized the flood damage formulas to reflect the local building conditions of Beaufort County.

"The losses avoided by elevating and acquiring the flood prone properties in Washington and Belhaven are estimated to be over $3 million"

Table 1 – Housing Vulnerability Reduction in Beaufort County

	Mitigation Tool		
Jurisdiction	Elevations	Acquisitions	Budget
Town of Belhaven	379	0	$7,453,335
City of Washington	60	14	$2,040,667
Beaufort County	106	0	$2,526,776
Total	*545*	*14*	*$12,020,778*

Housing Vulnerability Reduction in Beaufort County

Table 2. Losses Avoided from Hurricane Floyd – Belhaven and Washington

	Number of Structures	Building	Contents	Displacement	Total
Washington					
Elevations	15	$657,000	$103,000	$186,000	$946,000
Acquisitions	14	$412,000	$86,000	$103,000	$601,000
Total	*29*	*$1,069,000*	*$189,000*	*$289,000*	*$1,547,000*
Belhaven					
Elevations	32	$662,000	$320,000	$344,000	$1,326,000
Total	*61*	*$1,731,000*	*$509,000*	*$633,000*	*$2,873,000*

Cities of Washington and Belhaven
Losses Avoided from Hurricane Floyd

Over $500,000 in losses associated with damaged contents were avoided due to the mitigation actions. Content losses were computed using the value of the building contents and special damage formulas developed by FEMA. For Beaufort County, the value of the building contents is assumed to be worth 30 percent of the replacement cost of the home.[6]

It is estimated that over $500,000 in content loss was avoided. It is assumed that the contents are valued at 30 percent of the replacement cost or $20 per square foot, whichever was higher.[7]

Of the losses that were avoided during this flood, approximately 20 percent of the savings are attributed to the reduction in expenses associated with the disruption and displacement of the household while their flooded homes were being repaired. Average displacement expenses were estimated at $1250 per month per household. The relatively high estimate for displacement costs is due to the fact that many of the homes were damaged far beyond repair, and would have to be replaced. For these cases, families are assumed to be displaced for one year as their homes are being rebuilt.

In summary, the elevations in Belhaven and the combination of elevations and acquisitions in Washington have begun to pay dividends in the form of losses avoided following Hurricane Floyd. The next section examines the experience in Kinston, which in the span of three years was inundated by three hurricane driven storms.

Case Study: Kinston-Lenoir County Acquisition Project — Sustainable Redevelopment

The City of Kinston, situated on the banks of the Neuse River, is the county seat and retail and manufacturing center of Lenoir County. For the past three decades, Kinston's population and economy have been stagnant due to a combination of factors: an eroding tax base, reduced educational opportunities, increasing numbers of low- to moderate-income families, and a declining ability of local government to provide affordable services.

A Community At Risk To Flooding

Compounding the economic distress in Kinston-Lenoir County is the community's vulnerability to flooding. Much of the City of Kinston is located in the 50-year floodplain. When the flooding from Hurricane Floyd inundated the county on September 15-16, 1999, Kinston was in the midst of recovering from Hurricane Fran, which struck three years earlier.

Figure 7. Elevated Properties in Belhaven

"The centerpiece of the recovery and redevelopment strategy for Kinston-Lenoir County is the acquisition of 420 residential structures, three mobile home parks, and 68 vacant lots"

Figure 8. Kinston Sewer Plant

Waste water treatment plants, such as Kinston's, are vulnerable to floods. In the redevelopment following Hurricane Floyd, emphasis will be given to minimizing the effects of future floods on these facilities.

Hurricane Fran, which dumped 16 inches of rain in the Neuse River Basin in September 1996, caused major flooding and economic disruption. More than 400 homes, dozens of businesses, and public infrastructure sustained major flood damages, with total losses estimated in the tens of millions of dollars. The community also experienced major environmental problems, caused in part by the failure of the sewage treatment plant, which resulted in major spills of raw and partially treated sewage into the Neuse River. In short, the unprecedented property damage and economic losses, coupled with the substantial social, economic, and environmental problems, created enormous challenges for local officials who have accepted the responsibility for developing a recovery strategy for Kinston-Lenoir County.

Acquisition/Relocation Strategy

The recovery effort for Kinston-Lenoir County following Hurricane Fran was guided by two objectives: 1) To substantially and permanently reduce flood hazards in Kinston-Lenoir County; and 2) To revitalize existing residential neighborhoods and business development in a long-term effort to empower citizens to be self-sufficient, and in the process to improve their quality of life.[8]

The centerpiece of the recovery and redevelopment strategy for Kinston-Lenoir County is the acquisition of 420 residential structures, three mobile home parks, and 68 vacant lots. The goal is to permanently eliminate repetitive flood hazards and public safety risks in Kinston-Lenoir County.

The acquisition project, among the largest ever undertaken, is a multi-year effort that will cost approximately $31 million, of which $15 million will be funded through the Hazard Mitigation Grant Program, $12 million in Community Development Block Grant (CDBG) funds and HUD Disaster Recovery Initiative (DRI) funds, and $4 million in state funds.

Improving the Quality of Life

At the outset, the goal of this initiative has been to improve the quality of life of the citizens of Kinston-Lenoir County through a multi-objective approach to hazard mitigation and sustainable development. The strategy has been to integrate and leverage federal, state and community-based resources to carry out programs that not only move families out of the floodplains, but also addresses affordable housing, employment, job training, the economical use of renewable resources, and self-sufficiency.

"Over $1.1 million in losses associated with damaged contents were avoided due to the buy-out program"

Figure 9. Kinston Buy-Out

This Kinston house was flooded during Fran, acquired and vacated with HMGP funds, and subsequently flooded in Floyd.

Hurricane Floyd: An Opportunity to Measure Losses Avoided Through the Acquisition of Flood-Prone Properties

"The losses avoided through acquisition of flood prone properties in Kinston is estimated to be over $6 million"

On September 22, 1999, the Neuse River crested at 38.6 feet, or 11 feet above normal river levels, and the citizens of Kinston-Lenoir County once again experienced the full impact of torrential rains and flooding – the byproducts of Hurricane Floyd. The flooding from Hurricane Floyd (and Hurricane Dennis), which crested over three feet higher than Hurricane Fran, is considered to be between a 50-year and a 100-year flood event.[9] The extent of flooding was greater than Hurricane Fran, notably on the south side of town, where more than 400 homes sustained major flood damages.

Business losses were higher in Hurricane Floyd. The central business district and outlying business areas were submerged under several feet of water, causing damages to an estimated 200 businesses. Recovery efforts for homes and businesses were slowed by damages to infrastructure – including roads, bridges and the flooding of the town's two wastewater treatment plants.

Approximately 100 of the houses in the three-phase acquisition program for the City of Kinston had been acquired and vacated prior to Hurricane Floyd. With the flooding that occurred, over 95 percent of the acquired homes would have been inundated, with over 75 percent of the acquired homes being substantially damaged (locally defined as having 5 feet or more of water in the homes). In some houses, the flooding would have been over 10 feet high. As with Washington and Belhaven, the relatively low property values of the Kinston area would have led to the demolition and replacement of the substantially damaged homes, contributing to an existing housing shortage.

As reflected in Table 3, the losses avoided through acquisition of flood prone properties in Kinston is estimated to be over $6 million. The reduction in the repair and replacement cost of flooded homes accounted for almost one-half of

Table 3. City of Kinston Losses Avoided in Hurricane Floyd

Depth of Flooding	Number of Structures	Losses Avoided			
		Building	Contents	Displacement	Total
Less than 2 ft.	15	$184,000	$65,000	$59,000	$308,000
Between 2 and 5 ft.	12	$596,000	$127,000	$183,000	$906,000
Greater than 5 ft.	74	$3,117,000	$931,000	$1,125,000	$5,173,000
Total	*101*	*$3,897,000*	*$1,123,000*	*$1,367,000*	*$6,387,000*

City of Kinston
Losses Avoided in Hurricane Floyd

the avoided loss. The building repair/replacement cost estimates were based on the average construction costs of the region, and damage formulas developed by FEMA. For Kinston, the average construction cost is assumed to be $45 per square foot.

Over $1.1 million in losses associated with damaged contents were avoided due to the buy-out program. Of the losses that were avoided, approximately 25 percent of the savings are attributed to the reduction in "displacement costs" – defined as the costs that are allocated to households to support them while their homes are being repaired. Average displacement expenses were estimated at $1250 per month per household.

The program costs related to the acquisition and relocation of the 100 homes in the city of Kinston was approximately $2.1 million. The avoided losses from this single event were substantially higher than the total program cost to date. Of the 150 houses that remain to be acquired in Kinston as part of the three-phase buyout program, 99 were damaged in the September floods, with 84 of these classified as substantially damaged.[10]

Kinston's Urban Growth Plan: Linking Redevelopment and Mitigation

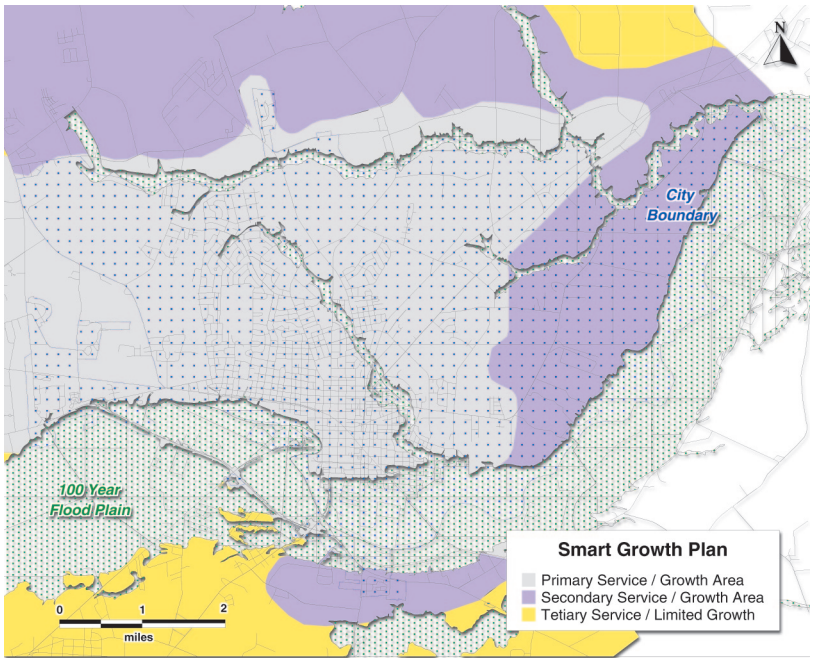
Hurricane Floyd clearly demonstrated that acquisition and relocation (or demolition) of flood-prone properties will reduce damages and losses from future floods. The savings in losses that were avoided in the City of Kinston is conservatively estimated to be approximately $6 million.

Building on the tangible progress from the buyout program, the City of Kinston is entering a new phase of community planning and redevelopment, a process that is guided by the following principles:

- mitigation needs to be fully integrated into the planning and redevelopment process
- disaster resistance and economic revitalization can be achieved through "smart growth" and "smart rebuilding" practices
- smart growth policies and rebuilding practices should be embodied in an officially adopted urban growth plan

"Hurricane Floyd clearly demonstrated that acquisition and relocation (or demolition) of flood-prone properties will reduce damages and losses from future floods"

Figure 10. Kinston Smart Growth Plan



- disaster recovery programs can be an important "implementation vehicle" for the City of Kinston's *Urban Growth Plan.*

On October 10, 1999, the Kinston city council officially adopted the Greater Kinston Urban Growth Plan, which will guide the land use planning process for the next twenty years. The Plan is comprehensive, as it links and integrates policies and programs that address Housing and Residential Development, Economic Development, Public Facilities and Utilities, Agriculture and Rural Development, Parks and Open Space, and Natural Resources and the Environment.

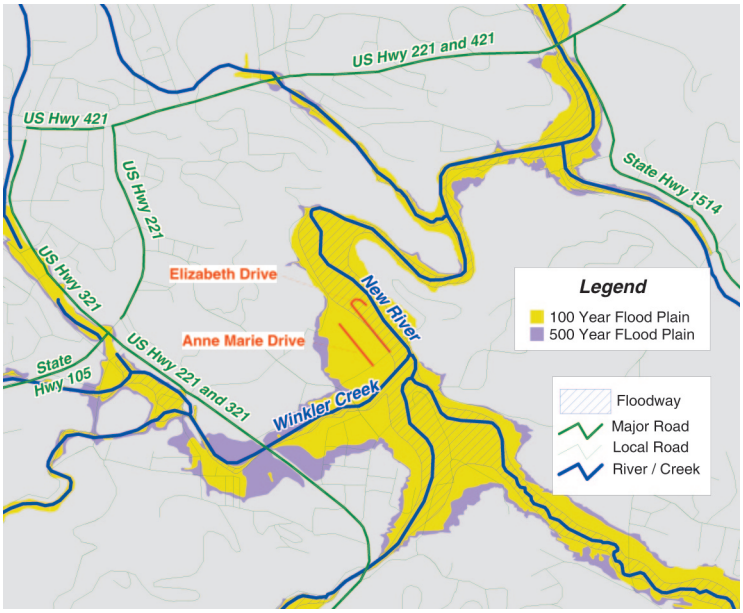
One of the central goals of the Plan is to encourage the economic and social revitalization of downtown Kinston through policies and programs that promote affordable housing and investment in downtown businesses. As one key local official notes,

"*…what we are trying to do is manage growth in a way that we achieve several complementary goals …from moving families out of the floodplain…increasing the livability of the downtown area of Kinston… …to enhancing the tax base in the City…*".

Robert Clarke, Planning Director, November 10, 1999

Case Study: Boone's Acquisition and Relocation Initiative — An Example of Pursuing Multiple Objectives

Figure 11. Elizabeth and Anne Marie Drive



In the mountains of northwestern North Carolina, the Town of Boone is pursuing a multi-objective approach to flood hazard mitigation.

In the past two decades, Boone and surrounding areas has flooded approximately 15 times.[11] Development pressures have contributed to Boone's flooding problem. As with other mountain communities, there is a diminishing inventory of suitable building sites.

Consequently, much of the new development, particularly commercial, has taken place in areas mapped

as floodplains. One of the most vulnerable areas to flooding is the Anne Marie and Elizabeth Drive neighborhood, a cluster of 30 homes and a nursing home, located near the confluence of three major tributaries that form the South Fork of the New River.

In 1997, the Town of Boone, and the residents of the flood-prone neighborhood, made a commitment to address the problem of repetitive flooding. *A Flood Hazard Mitigation Plan* was prepared that was guided by the following goals:[12]

- create a framework so that the town can help residents obtain the maximum flood mitigation assistance
- create a framework to prioritize implementation of elements of the Flood Hazard Mitigation Plan
- maximize opportunities to achieve multiple community goals
- maximize opportunities to convert land uses to those that do not support residential land use
- maximize opportunities to educate and position flood-prone residents to protect themselves

The principal recommendation of the *Flood Hazard Mitigation Plan* was the acquisition and relocation of thirty homes and 86 residents from the Anne-Marie and Elizabeth Drive neighborhood, and the nursing home. A phased approach was adopted, and the project was launched in the Fall 1996 with the acquisition of 30 homes and two residential lots for $2.3 million.

A Multi-Objective Approach to Hazard Mitigation

At the outset of the planning process, the Town of Boone – in partnership with the NCEMD, North Carolina Division of Community Assistance and FEMA – recognized the opportunity to use the Flood Hazard Mitigation Plan as a vehicle to address several community objectives:

- reduce flood hazards
- develop an open space park
- provide affordable housing

Projections of Losses Avoided in a 100-Year Flood

The residential area of Ann Marie and Elizabeth Drive has not been flooded since the acquisition and relocation of the 30 houses. However, most of these homes were in an area that is expected to be flooded every 25 years. If the Town of Boone was

Table 4. Losses Avoided in 50-Year Flood – Town of Boone.

Area	#	Program Cost	Losses Avoided			
			Building	Contents	Displacement	Total
Elizabeth Drive	15	$1,019,000	$1,087,431	$379,203	$225,383	$1,692,017
Ann Marie Drive	15	$1,278,400	$623,480	$355,004	$210,175	$1,188,659
Total	*30*	*$2,297,400*	*$1,710,911*	*$734,207*	*$435,558*	*$2,880,676*

Losses Avoided in 50-Year Flood
Town of Boone

"The losses avoided in one 50-year event would pay for the Boone acquisition project"

exposed to its own "Hurricane Floyd" – a 100-year storm – the 30 homes would have been inundated with approximately 7-10 feet of floodwaters. Flooding at this level would substantially damage the homes. Using an analysis similar to the one utilized for the City of Kinston and Beaufort County, it is estimated that a 100-year flood in Boone would cause losses of over $3.2 million. Approximately $1.8 million would be used to repair and/or replace the damaged homes, with the remaining funds earmarked for the replacement of damaged contents and to cover temporary living expenses while the homes are under repair. Table 4 depicts losses avoided in a 50-year event. In essence, the losses avoided in one 50-year event would pay for the Boone acquisition project.

Summary

The analysis of losses avoided in Kinston, Belhaven, Washington, and Boone as a direct result of two mitigation techniques – acquisitions/relocation and elevation make a compelling case for the role and value of mitigation as an integral feature of a long-term strategy to promote sustainable communities. In the communities that were flooded in Hurricane Floyd - Kinston, Belhaven and Washington – the savings are estimated to be approximately $9 million. When a similar analysis is applied to the Town of Boone for a hypothetical flood event (comparable to the intensity of Hurricane Floyd), the losses avoided are also significant, estimated to be over $3 million.

Table 5. Return on Investment in Mitigation – Belhaven, Washington and Kinston

Area	#	Average Cost	Losses Avoided				B/C
			Building	Contents	Displacement	Total	
Washington							
Elevation	15	$25	$657	$103	$186	$946	2.48
Acquistion	14	$37	$412	$86	$103	$601	1.17
Belhaven							
Elevation	32	$20	$662	$320	$344	$1,326	2.11
Kinston							
Acquistion	101	$42	$3,897	$1,123	$1,367	$6,387	1.51
Total	*162*	*$36*	*$5,628*	*$1,632*	*$2,000*	*$9,260*	*1.61*

Return on Investment in Mitigation
Belhaven, Washington and Kinston

Sustainable Business

Hurricane Floyd had a significant economic impact on eastern North Carolina. The findings of a recent study, *Economic Impact Assessment of Hurricane Floyd* (Economic Development Administration), found that:

- approximately 96,500 businesses were impacted by Hurricane Floyd, with nearly 80 percent of these classified as small business (1-9 employees)

- an estimated 75 percent of small businesses shut down at least temporarily as a result of Hurricane Floyd

- while many businesses suffered economic losses from direct floodwater damage, more than twice as many businesses surveyed indicated that business disruption occurred as a result of indirect economic impacts (i.e., loss of electric power)

- in several impacted counties, the central business district (CBD) became the "victim", with as many as 75 percent of businesses sustaining moderate to major damages

In view of the continued vulnerability of business to natural hazards, the HMPI has incorporated business risk reduction as an integral component of community-based strategies to build safe and sustainable communities. The long-term goal of sustainable business is to balance economic growth with strategies to reduce business vulnerability and minimize environmental impacts. The following case study highlights the efforts of one small business owner to incorporate mitigation into business recovery.

Figure 12. Flooded Shopping Center

The ability of business to recover following a disaster is often dependent on the condition of roads, bridges and other infrastructure that support the day-to-day operations of business. Public-private partnerships provide a forum for the two sectors to coordinate risk assessment and risk reduction initiatives.

"Approximately 96,500 businesses were impacted by Hurricane Floyd, with nearly 80 percent of these classified as small business"

Case Study: Masonboro Marina — Retrofitting to Withstand the "Worst" Hurricane Event

In 1965, Mr. George Lowe purchased four acres of waterfront property on the Intracoastal Waterway for $24,000. In the 1970's, Mr. Lowe secured a loan from the Small Business Administration (SBA) to start a marina business. The money was used to dredge the waters for the marina, and construct docks to accommodate 107 boat slips. Sheds were constructed on the land, and machinery was installed to support a boat repair business.

In 1984, Hurricane Diane struck the North Carolina coast with winds estimated at 110 miles per hour. The docks and sheds were destroyed. In 1990, Mr. Lowe secured another SBA loan for $275,000 to rebuild the dock and supporting infrastructure, only to have Hurricane Fran come through and cause substantial damage. Waters rose to 13 feet above base flood elevation and destroyed 89 of the 107 boats that were moored at the marina.

Following Hurricane Fran, Mr. Lowe resolved to rebuild a sustainable marina that would withstand the "worst case scenario" hurricane event. Another SBA loan for a total of $505,000 was acquired to build a new dock system and clubhouse. Priority was given to incorporating wind and flood resistant features into the design and construction of the new facilities. For example, 14 inch pilings (with eight steel rods) were used to support the pier instead of 12 inch pilings (with 4 steel rods) as called for in North Carolina building code. Cement floating docks were installed. The new clubhouse was anchored by pilings that extended from the rooftop to 20 feet in the ground. Steel bracing secures the clubhouse throughout and the roof is sealed and anchored. The lower level of the club house contains only picnic tables, which can easily be moved in a flood event.

Figure 13. Business Vulnerability

The winds and storm surge from Hurricane Fran created havoc with the Masonboro Marina in 1996. Rebuilding efforts incorporated structural mitigation measures to prevent future storm damage.

Hurricane Floyd – Putting the New Marina to a Test

The Masonboro Marina reopened on June 23, 1999. Three months later, Hurricane Floyd struck. Water levels were approximately two feet below the 13 foot level expe-

"The investment of $75,000 in mitigation was recouped in one disaster – Hurricane Floyd. Losses were minimal, and there was no business interruption"

"The long-term goal of sustainable business is to balance economic growth with strategies to reduce business vulnerability and minimize environmental impacts"

rienced in Hurricane Fran. This time, the buildings and supporting infrastructure performed as expected. The concrete dock, and the equipment that was secured to the marina, did not sustain any damages. The elevated utilities performed well, and the hurricane shutters prevented any interior wind-related damage to the clubhouse and office equipment.

Most importantly, there was no business interruption as a result of a major hurricane event. From a business standpoint, this is critical. The marketability of marina space is a function of at least three factors: rental fees and supporting services, accessibility, and safety. During Hurricane Floyd, the Masonboro Marina performed extremely well, as expected. Given the vulnerability of the southern coast of North Carolina to hurricanes and storm surge, the investment in mitigation feature in the rebuilding of the marina is proving to be a sound business decision. Losses are avoided, business continuity is enhanced, and equally important, the owners and operators can enjoy a greater peace of mind before, during and after natural hazard events.

Figure 14. A Disaster-Resistant Business

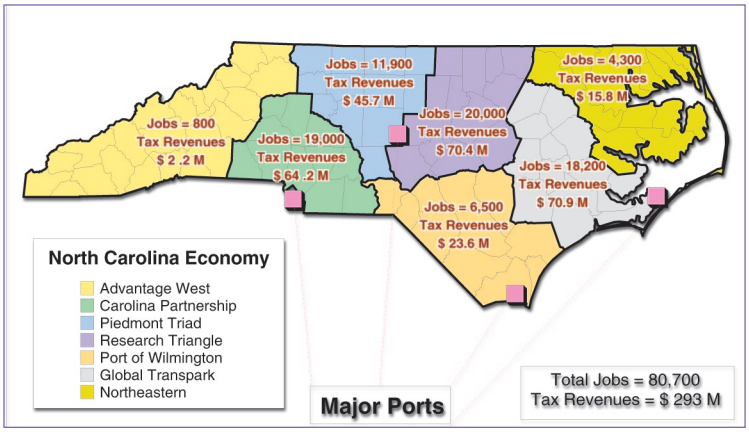
The new marina re-opened three months prior to Hurricane Floyd. The elevated air conditioners and heat pump, and the retrofitted marina and clubhouse survived intact, with only superficial damages.

Sustainable Infrastructure and Critical Facilities

The third element of sustainable communities – Infrastructure and Critical Facilities – encompasses a wide range of services that are essential to our daily routines, at home and at the workplace. For this reason, when there is an interruption in water, power, transportation, or communication services, our lives are disrupted, our productivity is jeopardized, and priorities quickly shift to restoring these vital services.

Often overlooked is the important role and contribution of port facilities in a national and regional transportation system. The next case study examines the mitigation measures that have been adopted for the North Carolina Ports System (NCPS).

Figure 15. North Carolina Ports System – Contribution to the State's Economy



Case Study: Port Of Wilmington — Protecting a Vital Commercial Lifeline

The NCPS is a key component of the state's economic development strategy and transportation infrastructure. The NCPS combines modern facilities and storage capacity at four locations: the port facilities at Wilmington and Morehead City, and the inland terminals in the Piedmont Triad and Charlotte.

The combined operations provide 80,000 jobs and nearly $300 million in tax revenues statewide. Furthermore, the operations of the NCPS are entirely self-supporting.

The Port of Wilmington is a major entry point for goods shipped to and from the southeastern U.S. This strategic location is a major advantage for the port system from an economic perspective. From a hazard vulnerability perspective, the port's location in an active hurricane corridor presents a major challenge for its owners and operators.

Exposure to Hurricanes

Since 1995, the ports at Wilmington and Morehead City have been impacted by six hurricanes, with losses estimated to be approximately $2.2 million.[13]

The estimated losses from the six most recent hurricanes includes direct damages to facilities (i.e., warehouses, roof damage, flashing damage), indirect economic losses (business interruption), and damages to equipment. These estimates do not include economic impacts related to lost wages for truckers and longshoremen, capital related income losses (i.e., loss of productivity, services or sales) and loss of rental income.

Considering the wind speed and storm surge from the hurricanes, losses could have been considerably higher had the State Port at Wilmington not undertaken extensive mitigation and preparation measures, in coordination with federal, state and local authorities.

Investment in Planning and Mitigation

A port is a system of many components – the channel, concrete wharfs, container cranes, mobile cranes, gantry cranes, specialized warehousing, intermodal railroad facilities, automated cargo tracking systems, automated fumigation systems, and scores of other components that must interact and function for the system to work on a daily basis.

Preparedness and mitigation planning for the Port of Wilmington - an active participant in FEMA's *Project Impact* initiative brings together a multitude of federal, state, local, and private sector organizations, each with its own role.

Risk Analysis. The purpose of the risk analysis is to assess the hurricane hazard in the southeastern coast of North Carolina, the "return periods" of hurricane events at various intensities, the design requirements for critical components of the port system, and identification of options for reducing risk through the adoption of mitigation measures.

Mitigation Initiatives. The North Carolina State Ports Authority (NCSPA) has worked with its partners to undertake a series of measures that are designed to eliminate or minimize the hurricane losses and ensure business continuity. Among the mitigation measures that have been implemented: 1) securing of gantry cranes and mobile cranes to ensure they do not topple over;

Table 7. Hurricane Losses at the Port of Wilmington

Hurricane	Year	Category	Losses
Bertha	1996	2	$112,000
Fran	1996	3	$680,000
Bonnie	1998	2	$600,000
Dennis	1998	2	$265,000
Floyd	1999	3	$585,000
Irene	1999	2	$0
Total			*$2,242,000*

Hurricane Losses at Port of Wilmington 1996-1999

2) non-structural mitigation measures to secure sensitive equipment; 3) structural reinforcement of buildings, including wind resistant roofing; and 4) structural reinforcement of electric power and telecommunications system.

Warning. The NCSPA continues to work closely with the National Weather Service (NWS), NCEMD and the New Hanover County Emergency Management Agency to coordinate hurricane tracking and forecasting information with local data to assess the potential impacts of hurricanes on the port system and surrounding areas. This coordination is critical to the implementation of the *Hurricane Plan for the Port of Wilmington*.

Plan Implementation. The *Hurricane Plan* is implemented in phases, depending on the hurricane conditions. Based on lessons learned from previous hurricanes, the NCSPA has instituted a comprehensive list of protective actions (i.e., positioning of equipment and cargo) that are implemented in phases. The objective is to minimize the exposure and reduce losses from the hurricane.

Losses Avoided from the NCSPA Mitigation and Planning Initiative

The mitigation efforts taken during the past five years have made a difference in minimizing the losses from the past five hurricanes, The potential losses for the port can be extensive. To replace a single crane or to repair a severely damaged berth would cost over $5 million, which is more than the total losses from the past six hurricanes.

Figure 16. NCSP Mitigation

As part of the hurricane planning initiative, the State of Port of Wilmington has undertaken non-structural mitigation measures to secure the 115-ton gantry cranes, shown here.

In assessing losses avoided, it is important to factor the lost revenue from damaged facilities. For example, the lost revenue from a single berth at the port can be more than $500,000 per week. If repairs took two months, the potential losses from the interruption of services could approach $2 million.[14]

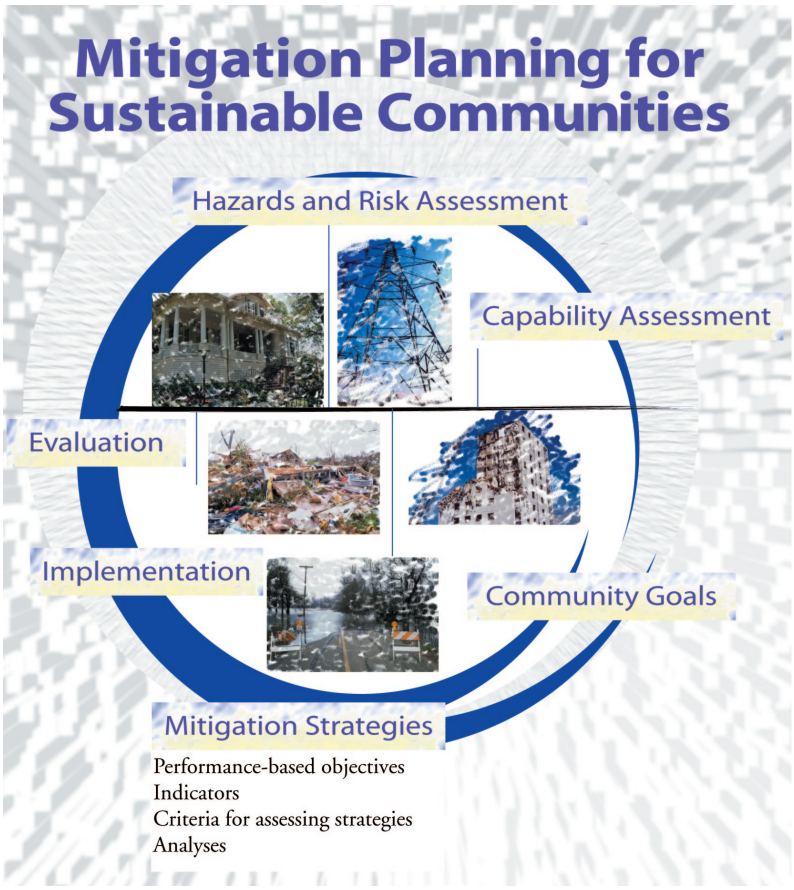
Finally, the average cost to "secure" the two North Carolina ports – Wilmington and Morehead City – and to staff them with emergency crews is approximately $32,000 per hurricane. The return on this investment is difficult to measure; however, it is clear that the efforts have paid dividends in the form of increased preparedness and coordination among federal, state, local and private sector groups that have a role and responsibility for warning, response and recovery from a hurricane.

Measuring Mitigation Success: Implications for Sustainable Communities

An underlying theme of *Measuring Success* is that any vision or theory of sustainability must include consideration of the long-term safety and survivability of communities and their citizens. In North Carolina, among the most disaster-prone states in the nation, a strategy to promote community sustainability must be directly linked with strategies to reduce the vulnerability of communities to hurricanes, storm surges, flash floods, riverine floods, nor'easters, tornadoes, wildfires, earthquakes, and winter storms.

The final section of *Measuring Success* outlines a process and framework for integrating a quantitative approach to measur-

Figure 17. Mitigation Planning for Sustainable Communities



"A fundamental challenge for mitigation policy makers and practitioners is how to articulate, in quantifiable terms, the benefits of adopting mitigation measures"

ing mitigation success into the HMPI.

As reflected in Figure 17, the starting point for the integration of hazard mitigation into a sustainable community initiative is an understanding of community risk. Understanding risk is central to making informed decisions on where to direct land use; how to design and build critical and public facilities, infrastructure, housing, and commercial buildings to withstand the effects of natural disasters; and how to prioritize mitigation strategies to effectively reduce risk in hazardous areas.

As outlined in the HMPI workbook, *Keeping Natural Hazards from Becoming Natural Disasters*, the next important step in the planning process is the community capability assessment, which evaluates the community's institutional capabilities, political willpower and technical capacity to implement mitigation strategies.

The input from the hazards and risk analyses, coupled with the capability assessment, provide a technical foundation for the next step in the planning process: establishing community goals. The four dimensions of sustainable communities that are set forth in *Measuring Success* – Housing, Business (including Agriculture), Infrastructure and Critical Facilities, and the Environment – can serve as a useful framework for establishing goals and a community vision of sustainability.

Incorporating Risk Analysis into the Local Mitigation Plan

A fundamental challenge for mitigation policy makers and practitioners is how to articulate, in quantifiable terms, the benefits of adopting mitigation measures. Advances in hazards analyses and risk assessment offer new opportunities to measure mitigation success. A simplified process for incorporating risk analysis into local mitigation plans and implementation strategies involves four steps:

1. *Identify performance-based objectives.* While goals and vision statements describe long-term conditions and outcomes, performance-based objectives represent short performance targets that, if achieved, will assure that communities are making progress towards the stated goals.

2. *Establish indicators.* To measure the effectiveness of hazard mitigation strategies, it is necessary to establish indicators that will enable communities to gauge the value added of mitigation in reducing community vulnerability to natural hazards. Indicators should measure changes in **outcomes** (i.e., losses avoided to a community's housing stock as a result of acquisition and relocation of hazard-prone properties).

3. *Identify criteria for assessing mitigation strategies.* Mitigation has

many dimensions – political, legal, technical, financial, environmental – and this complexity needs to be factored into a matrix of criteria against which to assess potential mitigation strategies.

The ability to quantify losses avoided from mitigation is a powerful tool for assessing mitigation options. *Measuring Success* presents a methodology for calculating losses avoided from the adoption of mitigation measures. This information can be used by policymakers to analyze and compare the parameters of potential savings and losses avoided, and use this data in weighing mitigation options in achieving stated objectives.

4. *Incorporate strategies into the local mitigation plan*. The local mitigation plan can be used to integrate the mitigation priorities and strategies of the community, addressing sustainable housing, infrastructure and critical facilities, business, and the environment.

Develop a Capacity to Implement Mitigation Strategies

The recovery period following Hurricane Floyd marks a new phase in the institutionalization of hazard mitigation in North Carolina. New groups and organizations in the public, private, voluntary and research sectors are becoming directly involved in mitigation initiatives.

Continued progress toward capacity-building and the institutionalization of mitigation in North Carolina will be a function of leadership, coordination, management, and implementation.

Leadership Role of Local and State Government. Leadership and vision are very important aspects of capacity, and capacity-building. Under the HMPI and *Project Impact*, communities across the state will continue to share the lessons learned in building "mitigation constituencies", marketing mitigation, and implementing loss reduction strategies.

At the state level, the Governor has been the focal point of a high visibility campaign to draw attention to the fundamental issues at stake in the redevelopment of North Carolina, and specifically the need to re-evaluate development policies and development practices of the past in light of the recurring losses from hurricanes and flooding.

To address the critical and immediate needs of the victims of Hurricane Floyd, the Governor has prepared a State Emergency Package that focuses on four critical areas:

- Crisis Housing Recovery Assistance
- Crisis Economic Recovery
- Public Health and Environment
- Local Government Support

Over $800 million in state funds is proposed to support the

"The recovery period following Hurricane Floyd marks a new phase in the institutionalization of hazard mitigation in North Carolina"

implementation of programs under these four areas. Programs address a wide range of needs, from supplemental assistance for an estimated 30,000 homeowners with uninsured damage from Hurricane Floyd, to funding support to cleanup the eight junkyards in the 100-year floodplain of the Neuse River Basin.[15] In short, post-disaster redevelopment efforts in North Carolina are supported by unprecedented state resources.

Coordination Role of the Hazard Mitigation Planning Initiative. The HMPI will continue to play a pivotal role in the institutionalization of hazard mitigation in North Carolina, including:

- coordination with FEMA's *Project Impact* to ensure that community strategies are integrated, and that programs and resources are optimized

- integration of technical expertise in hazards and risk assessment, hazard mapping, land use planning, training, and hazard mitigation

- serving as the critical link between state and local government agencies to develop community capacity, to develop strategies and priorities, and to implement risk reduction measures that can foster sustainable development

- recruiting additional partners – including state and federal agencies, universities, professional associations, and non-profit organizations – that can provide new ideas, resources, and expertise to support the continued expansion of the HMPI.

Management Role of the North Carolina Emergency Management Division. In addition to its leadership role, the NCEMD has a major responsibility for the management of programs and initiatives to effectively implement mitigation measures across the state.

A message of *Measuring Success* is that management decisions on the selection of mitigation priorities and strategies will be facilitated by the availability of accurate, accessible data on hazards assessment, and an understanding of the effectiveness of mitigation strategies in reducing future losses.

Implementation Role of State and Local Government, Business and Non-Profit Organizations. The pace of progress toward capacity building and the institutionalization of hazard mitigation in North Carolina will be a function of the capacity to implement mitigation programs.

Evaluate Progress

Finally, an important aspect of a long-term initiative to create safe and sustainable communities is to evaluate progress. Progress can be evaluated at least two levels: institutional and program. Among the indicators of institutional progress:

- *the number of full-time professional staff that are devoted to the implementation of mitigation policies and programs at the state and local level* (at the NCEMD, for example,

there has been an increase of 150 percent in the number of professionally trained staff to work in the field of hazard mitigation)

- *Increases in state and local government policies, programs and resources to support hazard mitigation*

- *Increases in the integration of mitigation principles and practices into the programs, policies and "agendas" of professional associations and non-government organizations*

- *Intangible indicators of institutional progress* (for example, the leadership and proactive role of the Governor and state legislature in promoting mitigation in the redevelopment of North Carolina).

In summary, *Hazard Mitigation in North Carolina – Measuring Success* provides a framework for developing sustainable communities in North Carolina, and general guidance on how to incorporate "indicators of progress" into the mitigation planning process. The unifying theme of the document is that mitigation successes can be measured, and the results of the analyses can be used in establishing or refining mitigation goals, priorities and implementation strategies. Simply stated, it is increasingly important that public and private officials be able to demonstrate the effectiveness of mitigation programs in reducing community vulnerability to natural hazards and other perils.

FOOTNOTES

1. For a more comprehensive discussion of state and federal mitigation programs, refer to *Hazard Mitigation Success* in the State of North Carolina, August, 1999, available from the NCEMD.

2. Economic Impact Assessment of Hurricane Floyd for North Carolina, Economic Development Administration, February 2000, p. 3-8.

3. Ibid, p. 3-8.

4. *Land Use Plan, City of Washington*, *March 1998*, Holland Consulting Planners, pp. 1-13.

5. FEMA Flood Insurance Administration, Summary of NFIP Repetitive Losses, Claims by the State of North Carolina, Town of Belhaven, September, 1999.

6. These assumptions are consistent with the assumptions that are used by the communities in the cost-benefit calculations that were conducted as part of the application for HMGP funding.

7. Ibid.

8. "Call Kinston Home": A City of Kinston Residential Revitalization and Redevelopment Initiative, Kinston Community Development Corporation, March 1999.

9. Http://nc.water.usgs.gov

10. Damage inspection report, Kinston Building Department, October, 1999.

11. *Flood Hazard Mitigation Plan*, Anne-Marie and Elizabeth Drive Neighborhood, Town of Boone, 1996.

12. Ibid

13. Estimates provided by Karen Fox, Director of Public Affairs, North Carolina State Ports Authority (NCSPA)

14. Information furnished by Karen Fox, Director of Public Affairs, NCSPA.

15. *Hurricane Floyd Relief - State Emergency Funding Package*, Recommendations to the General Assembly, The Honorable James B. Hunt Jr. December 10, 1999.