Session No. 12

Course Title: Breaking the Disaster Cycle: Future Directions in Natural Hazard Mitigation

Session Title: Preparing Local Hazard Mitigation Plans; Participation in Hazard Mitigation Planning

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Time: 150 minutes + 15 minute break

Objectives:

12.1 Understand the format and content of local hazard mitigation plans
12.2 Describe the relationship between hazard mitigation plans and land use plans
12.3 Describe the basis for hazard assessment and vulnerability analysis
12.4 Identify best practice criteria for preparing local hazard mitigation plans
12.5 Participate in an exercise to plan for citizen participation in local hazard mitigation planning

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Scope:

This session describes the making of a hazard mitigation plan. The first part of the session describes briefly the key components of a hazard mitigation plan. This is followed by a discussion of the importance of integrating the hazard mitigation plan with a community's land use or comprehensive plan and a more detailed discussion of a hazards analysis and vulnerability assessment. Finally, students will take part in an exercise that requires them to develop a strategy for the public participation component of a hazard mitigation plan for a fictitious community.

Reading:

Instructor and Student Reading:

Burby, Raymond, et al., 1998. Ch. 4. Integrating Hazard Mitigation and Local Land Use Planning; Ch. 5 Hazard Assessment: The Factual Basis for Planning and Mitigation; and Ch. 6. Managing Land Use to Build Resilience, pp. 85-201. *Cooperating with Nature: Confronting Natural Hazards with Land Use Planning for Sustainable Development*.

Burby, Raymond, et. al., 1998.Ch. 8. The Vision of Sustainable Communities, and Ch. 9. Policies for Sustainable Land Use, pp. 233-291. *Cooperating with Nature: Confronting Natural Hazards with Land Use Planning for Sustainable Development*. Washington, D.C.: Joseph Henry Press.

Godschalk, David R., Sam Brody, and Raymond Burby. 2003. "Public Participation in Natural Hazard Mitigation Policy Formulation." *Journal of Environmental Planning and Management*, 46:5, 733-754.

Godschalk, David R., et al., 1999. Ch. 3. Florida After Hurricane Andrew, pp 103-160, *Natural Hazard Mitigation: Recasting Disaster Policy and Planning.*

Platt, Rutherford. 1999. Ch. 8. The Bay Area: One Disaster after Another, pp. 241-276. *Disasters and Democracy: The Politics of Extreme Natural Events*.

Handouts:

Overheads:

12.1 Format of Pitt County, North Carolina Hazard Mitigation Plan
12.2 Hazards Assessment
12.3 Vulnerability Analysis for Pitt County
12.4 Indicators of Hazard Mitigation Success
12.5 Hazards Assessment for Pitt County, North Carolina
12.6 Best Practice Criteria

General Requirements:

The instructor presents a lecture during the first part of the session. In the second part, the instructor engages the class in a discussion of hazard mitigation planning, focusing on public participation.

Remarks:

In previous classes, students examined the damages caused by natural hazards and the federal programs that exist to mitigate such hazards. In this session, students will develop an understanding of local hazard mitigation planning and the key components of local hazard mitigation plans.

Objective 12.1 Understand the format and content of local hazard mitigation plans
The primary goal of a hazard mitigation plan is to reduce a community's vulnerability to natural hazards. The specific focus of a plan depends on the nature and extent of the threat posed by natural hazards. That is, some will focus on a single hazard (e.g., earthquakes), while others may focus on multiple hazards (e.g., landslides and flash floods). For example, the hazard mitigation plan for Pitt County, North Carolina focuses on reducing exposure to flooding, since flooding was identified as the natural hazard most likely to impact the greatest number of citizens and the greatest land area. In addition, flooding was the only natural hazard where the area of impact could be predicted. In 1999, flooding from Hurricane Floyd rendered some 3,375 dwelling units uninhabitable and caused over $300 million in damages (Pitt County, 2000). Its hazard mitigation plan was adopted to reduce the county's vulnerability to future flooding (*Figure 12.1: Format of Pitt County, North Carolina, Hazard Mitigation Plan*).

In general, a hazard mitigation plan consists of four components: (1) a systematic assessment of the natural hazards faced by a community, (2) an analysis of the nature and extent of a community's vulnerability to natural hazards, (3) a strategy to minimize the community's vulnerability, and (4) a method of implementing, monitoring and evaluating the plan. Each of these components is described briefly below.

Hazard assessment
The hazard assessment involves identifying the hazards facing a community and analyzing these hazards in terms of likelihood, magnitude, and potential impact (*Figure 12.2: Hazards Assessment*). This requires an assessment of the:

- *Type* of natural hazards that threaten the community,
- *Frequency and strength* of each hazard,
- *Likelihood* of occurrence (probability),
- *Areas at risk*, and the
- *Impacts* on the community.

Most communities are aware of their disaster history and can identify the most hazard-prone areas. That is, they know which areas suffer from flooding, high winds, earthquakes or wildfires, which neighborhoods have suffered the worst damage, and which businesses have been hardest hit. This knowledge can be used to identify existing areas that are subject to the greatest risk of damage from a natural hazard. Some of these areas may already have been mapped. For example, Flood Insurance Rate Maps (FIRMS), which delineate floodplains, are available for most communities under the National Flood Insurance Program. Identifying the hazards that threaten the community and mapping the areas that are most vulnerable can help guide policies and prioritize mitigation actions.

Identifying future areas of risk is more problematic. Boundaries of hazard-prone areas can change over time. For example, an increase in the amount of impervious surfaces (roads, driveways, parking lots) in a watershed could lead to increased stormwater runoff,

which in turn could cause flooding in areas formerly considered outside the floodplain. Many FIRMS are old and out-of-date.

Vulnerability analysis
A vulnerability analysis involves determining the community's present and future vulnerability to the hazards identified in the hazards analysis. Vulnerability is a measure of the risk or likelihood of various types and strengths of hazards occurring in specific areas and the amount and quality of development in those areas.

The hazards assessment is used to identify areas of greatest risk. The vulnerability analysis involves conducting an inventory of those areas, putting these areas on a map, and identifying existing policies that may reduce vulnerability (*Figure 12.3: Vulnerability Analysis*).

Mitigation strategy
The mitigation strategy consists of a set of policies, initiatives and regulations—based on the findings of the hazards assessment and vulnerability analysis—that are designed to reduce a community's vulnerability to natural hazards. That is, once a community has identified and inventoried vulnerable areas and determined whether existing policies will increase or decrease vulnerability to natural hazards, it can begin to set priorities for mitigating the threats posed by such hazards. The priorities could be based on criteria such as cost-effectiveness, (number of people, houses, or jobs protected per dollar invested), savings in tax revenues, reduction in environmental contamination, or whether or not the action will achieving multiple objectives.

Thus, each community is unique, and their approach to addressing the threat of natural disaster varies considerably. Some typical approaches to reducing vulnerability include:

- Relocating or protecting critical facilities and infrastructure located in hazard-prone areas,
- Acquiring and relocating vulnerable homes and businesses,
- Relocating and prohibiting unsafe land use activities,
- Strengthening existing development, and
- Maintaining and restoring mitigation functions of the natural environment

Implementing, monitoring and evaluating a hazard mitigation plan

Implementation
Local governments have developed a variety of planning and investment tools such as zoning, impact fees, and subdivision exactions, to protect natural areas, including areas vulnerable to natural hazards. For example, some communities use their subdivision regulations to restrict or prohibit development in areas with steep slopes, wetlands, floodplains or other sensitive lands. Sometimes developers will be granted higher densities in return. Other communities have acquired houses or vacant property in hazard-prone regions to keep people out of harm's way. Some other tools include:

- Transfer of development rights or TDRs. This would allow the development rights in a natural hazard area (the sending area) to be transferred to an area less prone to natural hazards (the receiving area). Thus, the transferred rights would be used to increase the allowable density in the receiving area.

- Restrictions on public investments in hazard areas. Communities could discourage development in hazard-prone areas by choosing not to invest public money for infrastructure (e.g., roads, sidewalks, water and sewer lines) in such areas. This would increase the private cost of development in hazard areas.

- Increasing public awareness about natural hazards. Greater awareness about the threats posed by natural hazards might discourage people from putting themselves in harm's way. For example, if consumers knew in advance that the house they were thinking of buying was located in a floodplain and would likely suffer flood damage in the near future, they might choose to buy a house on higher ground. Unfortunately, many home-buyers are not made aware of the threats posed by natural hazards until after they buy the house or until very late in the buying process (Godschalk, 1998).

Monitoring and Evaluation

It is difficult to measure the success of hazard mitigation efforts. Why? Because for a valid measurement to occur, a community would have to compare damages incurred with and without the hazard mitigation actions. And the events being compared would have to be of the same strength, duration and location. This seldom occurs. Other tools are available, however, to estimate the effectiveness of the hazard mitigation strategy.

Certain indicators can be used to quantify the effectiveness of hazard mitigation programs or actions. That is, to determine whether the community has increased or decreased its vulnerability to natural hazards. In addition to measuring a community's progress toward achieving its mitigation goals, the indicators also can be used to set performance goals for a community, e.g., reducing the percentage of homes in the floodplain by 10 percent per year. Finally, the indicators can help build support for mitigation programs by showing tangible benefits (*Figure 12.4: Indicators of Hazard Mitigation Success*).

Objective 12.2 Describe the relationship between hazard mitigation plans and land use plans

A hazard mitigation plan identifies areas of a community that are vulnerable to natural hazards, the likelihood of hazards occurring, the potential losses to people and property, and the strategy and implementation tools for reducing a community's vulnerability to such hazards. Similarly, a land use plan identifies current land uses in a community, the goals and objectives of the community regarding preferred future uses, and a strategy for achieving those goals.

A hazard mitigation plan can be prepared as a stand-alone, single-purpose document or it can be incorporated into a community's land use plan or its comprehensive plan. Free-standing plans are useful because they can focus attention on the need and the methods to

address the threat of natural hazards. Such plans, however, should not stand in isolation, but should be integrated with a community's comprehensive plan and linked with community decisions about land use and infrastructure spending. That is, they should be linked with land use plans, subdivision regulations, building codes, stormwater management plans, and the capital improvements plan or CIP. The CIP could include a strategy to protect public facilities from disruptions, for example through seismic retrofitting of public buildings such as schools or fire departments.

Alternatively, a hazard mitigation plan could be incorporated as a chapter in a local land use plan or comprehensive plan. This advantage of this approach is that it highlights mitigation as a necessary component of all other government operations and calls for integration of mitigation into the day-to-day decision making processes. On the other hand, inserting the hazard mitigation plan into other local plans may not be the best option in communities that use their land use or comprehensive plans only as general guides for local policy-making. In these localities, the mitigation plan may become "lost" and not given the visibility and credibility it needs to be fully implemented.

In either case, either as a stand-alone document or part of the comprehensive plan, the hazard mitigation plan should be comprehensive, addressing all hazards faced by a particular community, and multi-objective, combining mitigation with other objectives such as creating more open space or wildlife habitat, minimizing economic disruptions, and protecting the tax base. For example, buyout programs in Arnold, Missouri and Darlington, Wisconsin moved buildings out of the path of floods and connected their river corridors to larger existing greenways and trails (Schwab, 1998). In addition, a hazard mitigation plan should focus on the long-term and be internally consistent, that is, reducing risk to one type of natural hazards should not increase risks to others. For example, elevating homes to reduce their vulnerability to floods may make them more susceptible to earthquake damage. Finally, a hazard mitigation should not be seen as an impediment to the growth and development of a community. On the contrary, incorporating mitigation into decisions related to the community's growth can result in a safer, more resilient community.

Whatever its place in the planning arena, the local hazard mitigation plan should be treated as an evolving document that changes from year to year as the community's experience with hazard mitigation grows and as resources become available. By its very nature, planning is a dynamic process, and the plan produced should not be viewed as a static, unchanging document. As the community's needs change, so must its hazard mitigation plan.

Objective 12.3 Describe the basis for hazard assessment and vulnerability analysis
To plan for natural disasters and reduce losses, a local government needs to know the types of natural hazards that threaten the community, frequency and strength of the hazards, areas of the community that are most at risk, probability that the hazards will occur, and the impacts to the community when they do. That is, it needs to prepare a *hazards assessment*. In addition, a community will need to assess its capability to

manage a disaster. The hazards assessment should include an analysis of the following elements:

- **Type** - Communities may experience several different types of natural hazards. Some are more likely to occur than others. Different hazards call for different mitigation measures. The preferred approach is to consider all the hazards that threaten the community and focus on those that pose the greatest risk.

- **Frequency and strength** - Some hazards tend to occur at certain times of the year. For example, along the Atlantic coast, nor'easters occur in winter, hurricanes in late summer and early fall. Others, such as earthquakes and tornadoes, are more unpredictable. In addition, the strength of a natural hazard varies as well. For example, a hurricane may pack strong winds when it hits the coast, but lose some of its punch when it reaches the mountains. Each community should assess the relative frequency and strength of each type of hazard that occurs in its area.

- **Areas at risk** - Certain areas, such as floodplains, earthquake fault zones and steep slopes, are more hazard-prone than others. Many of these areas are readily identifiable. The mitigation plan should identify the areas that are most vulnerable to natural hazards.

- **Probability** - In addition to identifying the types of hazards that affect a community, their relative frequency and strength, and the areas of greatest risk, a mitigation plan should estimate the likelihood of each type of hazard occurring in its area. This will allow each community to rank each hazard in terms of its relative threat and focus mitigation efforts on those hazards that pose the greatest risk.

- **Impact** – Finally, the mitigation plan should estimate the impacts each hazard is likely to have on the local area, including the social, economic and environmental impacts. For example, flooding that affects only farmland in low-lying areas will have a different impact than an earthquake that affects the downtown or a hurricane that knocks out a community's infrastructure (water and sewer plant, roads, power lines). The hazards assessment should consider present as well as future impacts.

(Figure 12.5: Hazards Assessment for Pitt County, North Carolina).

Communities vary in their vulnerability to natural hazards and in their capacity to mitigate their impacts. Some face risks from several types of natural hazards, such as earthquakes, landslides and wildfires, while others suffer primarily from a single type of hazard, such as flooding. Some are subject to seasonal hazards that occur in relatively predictable areas, while in other communities, disasters can strike anytime. Also, communities vary in the amount of development that has occurred in hazard-prone locations and in their approach to mitigation, e.g., structural or nonstructural.

In developing a strategy to reduce the risk of natural hazards, a community will need to determine its present and future vulnerability to such hazards. This *vulnerability analysis*

examines the likelihood of various types and strengths of hazards occurring in a community and the amount and quality of development in that area. The assessment should include an inventory of people and property at risk and an estimate of the cost of damage to critical facilities (e.g., a hospital or waste treatment facility) and highly vulnerable residential, commercial, industrial and public facilities. The inventory must portray the amount of existing development at risk, which can be achieved by overlaying each hazard area over the existing land use map.

As discussed in Session 5, Congress created the Community Rating System (CRS) in 1994 in an effort to encourage communities to adopt floodplain management measures that go beyond the minimum requirements established under the National Flood Insurance Program or NFIP. Under the CRS, communities that adopt certain activities to lower their flood risk can receive discounts on flood insurance premiums. CRS awards points for different activities implemented: the greater the number of points earned, the greater the premium discount. Communities can earn points for conducting a flood hazard assessment if the assessment includes an inventory of the number and types of buildings subject to flooding

The vulnerability assessment involves identifying areas of greatest risk, conducting an inventory of those areas, putting these areas on a map, and identifying existing policies that may reduce a community's vulnerability. These four actions or steps are described below.

1. **Identify current and future areas of greatest risk**
   The first step in conducting a vulnerability analysis is to identify those areas in the community that are subject to the greatest risk of damage from a natural hazard. In addition, a community's local comprehensive plan should be a good source of information on future trends and conditions, such as whether future growth is likely to occur in areas highly vulnerable to natural hazards.

2. **Conduct inventory of people and properties in vulnerable areas**
   Once the areas of greatest risk have been identified, the next step is to estimate the number of people and buildings and the value of those buildings located in the hazard-prone areas, and the number of people and buildings that will be there in the future if current growth and land use patterns remain unchanged.

3. **Prepare map showing areas identified above**
   This step involves preparing a map that shows the areas of highest risk and that marks the critical facilities, major employers, repetitively damaged structures, and infrastructure in those areas. Maps can identify boundaries of natural hazard areas such as floodplains and earthquake zones and pinpoint the location of vulnerable buildings or facilities. Areas prone to flooding that are not included on the FIRM should be marked on the map. Areas subject to other hazards should also be identified.

4. **Analyze policies, programs and ordinances that may affect vulnerability**

A community's existing policies and programs may, either intentional or not, increase or decrease its vulnerability to natural hazards. For example, extending water and sewer lines into floodplains will encourage development in flood-prone areas, while a plan to create a greenway or open space in earthquake fault zones could preclude development in such areas. Communities should identify current policies that weaken or contravene hazard mitigation efforts and those that enhance them, including land use plans and regulations, subdivision regulations, open space policies, transportation plans, watershed protection ordinances, and stormwater management plans. In addition, a community should identify areas where new policies are needed to reduce current and future risks of hazards.

Objective 12.4 Identify best practice criteria for preparing local hazard mitigation plans

In many ways, the "best practice" criteria for preparing a hazard mitigation plan are the same as for any plan: involve the public, develop goals and objectives, set priorities for action, develop an implementation strategy, and monitor and evaluate the effectiveness of the plan. There is no single model for preparing a hazard mitigation plan. Each community must choose the process and plan format that best serves their needs. However, to meet the requirements established under the Disaster Mitigation Act of 2000, a local hazard mitigation plan must include the elements, and follow the planning process, as specified in 44 CFR 201.6. That is, each plan should include mitigation goals, a solid fact base, (e.g., a hazards assessment and vulnerability analysis), a strategy for reducing the jurisdiction's vulnerability, and it should be integrated with other plans and policies (e.g., the land use plan) in the community (*Figure 12.6: Best Practice Criteria*). In addition, the plan must describe the public participation process and how the plan will be monitored, evaluated and updated.

Community agreement over a mitigation approach must be built on a foundation of public support, which starts with public awareness (Burby, 2000:6). *Public participation* can help raise awareness of the threats posed by natural hazards in a community and focus attention on the need to implement a plan to mitigate such hazards. The "public" may include business owners, neighborhood groups, elected officials, public health officials, nonprofit organizations, and people who are most directly affected by natural hazards, e.g., people living in the floodplain. Participation may mean attending public meetings, seminars or hearings, or participating in task forces, committees, or a community visioning exercise. In any case, through their participation, key stakeholders may feel more committed to a plan and its implementation. Indeed, some analysts have suggested that the participatory process is as important as the outcome (Mileti, 1999:6).

Unfortunately, except for a relatively brief period (e.g., 6-12 months) immediately after a natural disaster strikes, citizens often lack interest in getting involved in preparing a hazard mitigation plan (Godschalk, 2003). Elected officials, may lack interest or commitment to hazard mitigation planning because the threat of being struck by a natural hazard often seems too remote or unlikely.

Through the public participation activities, a community sets mitigation *goals and objectives*. The objectives could include safeguarding critical facilities, developing an early warning system and evacuation plan, and discouraging further development in hazard-prone areas. Setting goals and objectives can be controversial and may require the use of a facilitator or mediator.

Once a community has developed its goals and objectives, which will be based in large part on the hazards assessment and vulnerability analysis, it can begin to set priorities for action. That is, assuming it cannot address each goal at once, a community must decide whether it should focus its efforts, for example, on mitigating the threat of natural hazards in the most vulnerable residential areas, protecting areas with the highest population density, protecting major employers, or safeguarding emergency facilities, e.g., hospitals. The plan should address existing development in hazard-prone areas and it should include mechanisms to steer future development away from such areas.

In any case, the priorities should reflect the community's goals and be incorporated into its *implementation* strategy. The implementation strategy will include the policies and programs needed to achieve the community's goals and objectives and should assign responsibility for implementing the plan. Such policies could include, for example, acquiring hazard-prone areas or zoning such areas for very low-density development or prohibiting the use of public funds for infrastructure in hazard-prone areas. The implementation policies should be internally consistent as well as consistent with other policies or plans the community has adopted.

Finally, a community should *monitor and evaluate* the effectiveness of its hazard mitigation plan. The evaluation should include recommendations for whatever modifications are necessary to improve the effectiveness of the plan. The indicators shown in Figure 12.4 can be used to help measure a plan's impact.

Objective 12.5 Participate in an exercise to plan for citizen participation in local hazard mitigation planning

The instructor leads the class in a discussion of the key elements of a hazard mitigation plan, focusing on public participation. Using the scenario provided below, the instructor will ask the class to identify and discuss briefly the key components of a public participation strategy for the town's hazard mitigation plan, for which a consultant was recently hired to prepare.

You might first ask the class to identify some of the key issues that need to be addressed in a hazard mitigation plan for the community described below. Then, when the focus turns to public participation, the instructor could ask questions such as:

> Why is public participation necessary?
> Who should be part of the process (who is the "public")?
> How will the public be involved (e.g., charrettes, public meetings)?
> How will the results of the public participation be incorporated into the plan?

The instructor should also lead a discussion of issues such as:

Stakeholder identification
Who are the major stakeholders? Major stakeholders could include the business community, university administrators, hospital staff, public safety agencies, planning staff, or homeowners in hazard areas? How will these stakeholders be involved in the public participation process?

Intergovernmental coordination
How will the planning process be coordinated with FEMA regional office and with the State hazard mitigation office?

Information needed
What type of information will be needed for the participation process: the number and use of properties in the hazard areas? Costs of mitigation? Mitigation program and tools?

Organization
How would you recommend organizing for citizen participation in the mitigation planning process (e.g., a task force, committee, advisory group, etc.)?

The Scenario
Pacifica, California (pop 16,500) lies along the coast of Northern California. Although it lies relatively close an earthquake fault zone, it had not experienced a major earthquake in over 100 years. Residents never thought of their town's vulnerability. Two years ago, that began to change, following a powerful earthquake that devastated the small town. Its downtown, which recently underwent a major revitalization, was particularly hard hit, as several buildings were destroyed or severely damaged, water and sewer service was disconnected, streets buckled, and electric lines were severed. Downtown business were out of commission for nearly a month. As a result, many were forced to close. Many relocated to other areas. Residential areas were damaged as well: many homes were rendered uninhabitable by the quake.

In recent years, the community's location along the coast, its small town atmosphere, small but well-respected hospital, and local university have attracted scores of newcomers, particularly those seeking a quiet, attractive place to retire. Traditionally, Pacifica's downtown has served as the business, social and cultural, center of the community. Most new development, however, was occurring on the outskirts of town, where the hills provide greater views. Some of the most severely damaged homes were located in a new, upscale subdivision called Pleasant Ridge. A few homes toppled off their foundations and fell into a ravine. Pleasant Ridge is located a few miles from town, adjacent to an earthquake fault zone.

Despite the damage from the earthquake, most residents remain upbeat and seem committed to rebuilding their community, particularly the downtown. Still, as a small

town with limited resources, Pacifica continues to struggle to get back on its feet. It can ill-afford to suffer another devastating earthquake.

Recently, the town hired a nationally-recognized planning consultant to develop a hazard mitigation plan. It would like the plan to reflect the wishes, desires and ideas of the community.

Figure 12.1. Format of Pitt County, NC Hazard Mitigation Plan

Section 1	Introduction and Executive Summary
Section 2	Hazard Mitigation Strategies
Appendix A	Hazard Identification and Analysis
Appendix B	Assessment of Vulnerability
Appendix C	County Capability Assessment
Appendix D	Evaluation of County Policies and Ordinances
Appendix E	Project Schedule

Figure 12.2. Hazards Assessment

- *Type* of natural hazard that threaten the community
- *Frequency and strength* of each hazard
- *Areas* at risk
- *Likelihood* of occurrence (probability)
- Possible *impacts* on the community

Figure 12.3. Vulnerability Analysis

Key steps include:

- Identify current and future areas of *greatest* risk
- Conduct inventory of people and properties in vulnerable areas
- Prepare map showing vulnerable areas
- Analyze policies, programs and ordinances that may affect vulnerability

Figure 12.4. Indicators of Hazard Mitigation Success

Housing:

- Number or percentage of households living in unsafe areas
- Number of repetitively damaged structures
- Percentage of households with insurance against natural hazards

Businesses

- Number of businesses in unsafe areas
- Number of repetitively damaged structures
- Number of businesses with insurance against natural hazards

Infrastructure and critical facilities

- Number and square footage of critical facilities (hospitals, police and fire stations, schools, etc) located in hazard-prone areas
- Number of these that have been protected against damage from natural hazards
- Number of repetitively damaged facilities
- Number of infrastructure facilities (roads, bridges, sewage treatment plants, water treatment plants) located in hazard-prone areas
- Number of these that have been protected against damage from natural hazards

Natural Environment

- Number of unsafe land use activities (e.g., junkyards or chemical storage facilities) that take place in hazard-prone, environmentally-sensitive areas such as floodplains
- Number of commercial or industrial facilities in hazard-prone, environmentally-sensitive areas that have undertaken mitigation measures to reduce the likelihood of the release of hazardous materials
- For flood-prone areas, number of acres of wetlands and floodplains lost

Source: adapted from *Hazard Mitigation in North Carolina: Measuring Success* (2000).

Figure 12.5. Hazard Assessment for Pitt County, North Carolina

Hazard Type	Probability	Potential Area Impacted	Potential Impacts	Hazard Index (Combined)
Hurricane	Moderate	Medium	Moderate	High
Flood	Moderate	Medium	High	High
Tornado	High	Small	Low	Moderate
Nor'easter	Moderate	Medium	Moderate	High
Thunderstorm	Moderate	Small		Low
Severe Winter Storm	Low	Medium	Moderate	Moderate
Wildfire	Low	Small	Low	Low
Earthquake	Low	Small	Low	Low
Landslide	Low	Small	Very Low	Low

Source: Keeping Natural Hazards from Becoming Natural Disasters, North Carolina Division of Emergency Management, 1998, pg. 19

Figure 12.6. Best Practice Criteria

- Involve the public
- Develop clear goals and objectives
- Develop fact base (hazards assessment and vulnerability analysis)
- Set priorities for action
- Link with other plans and policies
- Develop implementation strategy
- Monitor and evaluate plan effectiveness

Literature Cited

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