Appendix C. Alternative Mitigation Actions

This appendix includes a discussion of alternative mitigation actions for all hazards.

Alternative Flood Mitigation Actions

In Coshocton County, flooding is caused by development in naturally occurring floodplains, therefore the following discussion of alternative flood hazard mitigation actions presents different possible property protection actions that can be taken to mitigate hazards and evaluates their feasibility based on characteristics of the flood hazard, characteristics of the affected structures, and accepted uses of the action.

There are several different categories of flood hazard mitigation measures possible for the neighborhood and structures within the flood hazard areas. The following mitigation measures were considered when deriving recommendations.

Acquisition

Acquisition involves the municipal government purchasing and demolishing or moving (referred to as **relocation**) structures in the floodplain. The land is permanently deed-restricted for open spaces uses in order to restore the natural and beneficial functions of the floodplain. Structures that have been repetitively flooded, or experience floods with high flood depths, velocities greater than five feet per second, or long duration tend to be the best candidates for acquisition. Acquisition is considered to be one of the most effective flood mitigation measures because it entirely removes structures from the pathway of floods. Acquisition is an effective mitigation measure, but can be damaging to intact neighborhoods. It is cost-effective for structures with high flood vulnerability, however, the process of obtaining the homeowner's approval, managing the implementation of the project, and accessing funding to complete the project is sometimes difficult. After obtaining the elevations of structures in the hazard areas, municipalities and the County will have to further consider the appropriateness of acquisition as a strategy based on considerations listed in the table below.

Table C.1. Additional Considerations for the Acquisition Option

Historic Property?	Historic properties are community assets which should be saved if possible. Further investigation into other options should be made. See the historic property matrix below.
Attached/Semi-Detached Housing or other Closely spaced structure?	Acquiring one attached or semi-detached structure while leaving the other should be avoided. Attempt to acquire all at risk properties or find other alternative.
Adjacent to Open Space? Won't leave a "hole" in neighborhood/streetscape?	This criterion is related to the previous criterion. Acquiring a patchwork of homes is undesirable without a long-term plan to acquire a cohesive block of structures. Acquiring structures that are

	adjacent to open space is the preferred mitigation option.
In poor condition?	Structures that are in poor condition are also more suitable for acquisition and demolition.
County or Municipality Able to Maintain the Property?	When structures are acquired using federal funding, the jurisdiction acquiring the property is required to maintain the property as open space in perpetuity. The jurisdiction acquiring the parcel must decide whether to maintain it as a greenway/park or allow it to revert back to natural area or to be maintained by other residents.

Barriers

Barriers built of soil, called "berms", or concrete or steel, called "floodwalls" keep floodwaters from reaching a building. To be effective, earthen berms require three horizontal feet for each vertical foot. Concrete or steel floodwalls on the land of the property owner are flood barriers for properties that require only two feet or so of flood protection.

Dry Flood proofing

Dry flood proofing entails making all areas falling below the BFE impervious to water. Walls can be coated with a waterproofing compound or plastic sheeting. Openings such as doors, windows, sewer lines, and vents, are closed, either permanently or with removable shields. Dry flood proofing is appropriate for buildings on sound slab foundations that are subject to less than three feet of flooding. Most building walls and floors are not strong enough to withstand the hydrostatic pressure from more than three feet of water. However, this method does not remove the structure and its contents out of the path of floods.

Elevation

Raising a building above the BFE is the best on-site property protection method. Water flows under the building, causing little or no damage to the structure or its contents. Alternatives are to elevate on continuous foundation walls (creating an enclosed space below the building) or elevate on compacted earthen fill, which can be more costly than elevating on an open foundation or continuous foundation walls. If raised eight or more feet, the lower area can be floodproofed and used for parking or storage.

Elevation is suitable where flood depths are less than 10 feet and have low velocity (less than 5 feet per second), and in areas that are not prone to ice floes or in "off-channel areas that have minimal potential for damage from floating debris. Elevation is not suitable for areas with long-duration flooding, since accessing the structures would be difficult or unsafe in flood situations.

The most common elevation methods include:

- Elevating in place using solid walls, piles, or post foundations (see table below for more information on appropriate uses of foundation types);

- Filling in the basement and replacing the space with an elevated first floor; and
- Abandoning the first floor and building a second floor.

Factors like foundation type, soil type and bearing capacity, weight of the house and lateral forces on the house from water (and other natural hazards such as winds and earthquake), condition of house, and height of the proposed elevation above the grade affect the actual method for elevating a specific house. These methods are best determined by the property owner and engineer on a case-by-case basis. Table C.2 shows broad guidelines for selecting one elevated foundation versus another.

Table C.2. Elevation Methods Based on Existing Foundation Types and Other Conditions

Condition	Existing Foundation Type			
	Basement	Crawlspace	Slab-on-grade	Open
Poor Soil				●
House is heavy or has lateral wind/earthquake /water forces	●	●		
Flood velocity greater than 5 ft/sec				●
Recommended Foundation Type for Elevated Structure	Solid Walls	Solid Walls	Solid Walls	Piles, piers, posts

Politically and socially, elevation may be the most feasible option because it leaves neighborhoods intact, allows residential structures used primarily for water-related recreation activities like fishing and boating to remain near the water, and prevents damage from floods.

Structural Projects

Dikes, levees, dams, channelization, channel widening, stream realignment, seawalls, groins, and jetties are structures located away from the flood vulnerable structures. Structural projects have fallen out of favor as mitigation options because they tend to be expensive to build and maintain and can often increase flooding downstream or on the opposite side of the waterway. Furthermore, FEMA's mitigation programs emphasize nonstructural measures for mitigation of flood hazard. These projects tend to be disruptive to the environment and can fail or be overtopped in sufficiently large flood events. Politically and administratively, structural projects require additional studies, public input, and can sometimes take a long time to implement.

Wet Flood proofing

Wet flood proofing entails letting flood waters inside the structure and moving any asset like furniture or household appliances out of harm's way. Wet flood proofing avoids the problems of pressure from floodwaters presented by dry flood proofing. Wet flood proofing is usually used for basements and garages and is not used for one-story houses because the flooded areas would be the living areas.

Property Protection Decision Matrix

Mitigation measures need to be evaluated based on the flooding conditions at the site and the characteristics of the structure. The recommended mitigation measures described in Section Three were determined in part by using the Property Protection Decision Matrix below. Structure information for analysis of appropriate mitigation measures may be collected from the Coshocton County tax assessment database. After first finding information about foundation types in the tax database, planners can use the estimated depth of flooding for each structure and the decision matrix to identify appropriate mitigation measures. Properties that are at or above BFE (other than those with basement foundations) are not considered in the following decision matrix because they are considered to be outside of the regulatory floodplain and are of low mitigation priority compared to other flood structures.

Table C.3. Property Protection Decision Matrix

First Floor Flood Depth	First Recommendation	Second Recommendation
Slab		
<2 feet	Barrier	Dry Flood proof
>2 feet	Elevate	Relocate/Acquire
<9 feet	Relocate/Acquire	Relocate/Acquire
Crawlspace		
>0 feet	Elevate	Elevate
>9 feet	Relocate/Acquire	Relocate/Acquire
Basement		
>0 feet	Elevate, fill in basement	Relocate/Acquire
>9 feet	Relocate/Acquire	Relocate/Acquire
Pier / Pilings		
>0 feet	Elevate	Elevate
>9 feet	Relocate/Acquire	Relocate/Acquire

Another important consideration in certain areas is flood mitigation for historic properties. Historic properties are assets that help define communities and should be preserved where feasible. The table below presents additional considerations about the impact of hazard mitigation alternatives on historic properties. Although no properties listed on the national

list of historic properties are within the flood hazard area, local officials must further consider the impact of mitigation options like acquisition and demolition or relocation on local historic resources.

Table C.4. Considerations for Historic Properties

Hazard Mitigation Alternative	Reduction of Risk	Level of Impact to Historic Properties
Acquisition & Demolition	High	High
Relocation	High	Medium – High
Elevation	Medium	Medium
Dry Flood proofing	Low – Medium	Low – Medium
Wet Flood proofing	Low	Low
Stream Channel Improvements	Low	High (archeology)
Levees & Floodwalls	Medium	Medium

Flood Mitigation Strategy Priorities

From the following discussion, the STAPLE+E can be used to rate the options, as noted in the example table below. Methods receive a "1" or "fair" as the default rating if there are particularly notable poor or good potential consequences of the method.

Type of Mitigation Action	Prevention	Property Protection				Emergency Services Measures	Structural Options	Natural Resource Protection	Public Information Programs
Action	Floodplain Ordinance*	Acquisition and Relocation	Elevation	Dry Flood proofing	Wet Flood proofing	Warning/Evacuation	Flood Control Projects (i.e., Dams)	Storm water Management	Public Outreach to Homeowners
Social	2	0	2	3	3	2	1	2	2
Technical	3	3	3	1	2	0	1	1	0

Administrative	1	1	2	2	2	1	0	0	1
Political	1	1	2	2	1	2	1	1	1
Legal	1	0	2	1	1	2	1	2	3
Economic	3	1	2	2	2	2	0	1	2
Environmental	3	3	3	3	3	3	0	1	3
Totals	12	9	16	14	14	12	4	8	12

Where 0 = Poor, 1 = Fair, 2= Good, 3=Excellent
* Only applicable if no floodplain ordinance has been adopted

From this example evaluation (assuming a floodplain ordinance exists), the preferred mitigation options are in order of priority:

1. Elevation
2. Dry flood proofing (tied with wet flood proofing)
3. Public outreach (tied with warning/evacuation)
4. Acquisition/relocation
5. Storm water management
6. Flood control projects

Alternative Severe Weather Mitigations Actions

There area a number of mitigation actions that can be used to mitigate wind and weather hazards. Unlike flooding, these hazards affect the entire County, and there is no particular geographical hazard zone that may experience wind/weather damage more than other areas within the County. Therefore, wind and weather mitigation strategies usually involves identifying actions that affect individual structures with known/assumed vulnerability, particular critical facilities, or can reach the entire County, usually through public education, improving County implementation capabilities, or strengthening regulations.

The following is a list of wind hazard mitigation strategies with information about their suitability for use in Coshocton County. These strategies are technically feasible in Coshocton County and should be used in combination with each other. Other than regulations, most of these measures should be implemented by property owners with assistance from County and municipal governments.

Regulations

Properly constructed buildings are essential to resisting the force of winds and weather to structures, since ordinary construction methods produce a house that will stand up to 110 mph tornadoes and other wind storms. Model building codes are designed using wind-speed maps (see Figure 1.4) produced by the American Society of Civil Engineers (ASCE) based on a constant probability of occurrence in different parts of the county. These design wind speeds are high enough to resist the majority of tornadoes and other strong winds if the building is constructed properly. Building codes are also important to preventing collapse of buildings under heavy snow loads. (Source: Natural Hazard Mitigation Insights, Institute for

Business and Home Safety) Most jurisdictions within Coshocton County already have building codes in place.

Building Strengthening

Manufactured home tie-downs: Manufactured homes (or "mobile" homes) are some of the most vulnerable structures to high winds, having thin walls that cannot withstand wind pressure and wind-blown projectiles. Manufactured homes have large surface area relative to their weight, making them susceptible to overturning. Furthermore, many manufactured homes are not adequately installed. Manufactured homes properly tied down with the correct number of anchors and the correct ground anchor for the soil type can reduce the vulnerability to high wind damages. Education and inspection programs can aid upgrading units to resist anticipated wind loads.

Coshocton County has a number of manufactured home parks and structures for which tie-downs may be appropriate. Manufactured homes installed on permanent foundations, especially double-wide manufactured homes on permanent foundations, are significantly less vulnerable to wind hazards than other manufactured homes and should be considered to have lower mitigation priority. The County or concerned property-owners will have to identify which manufactured homes are in need of tie-downs.

Retrofitted tie-downs cost about $1000 to $1500 to install. For low-income property owners, this can be a significant cost, and the County and municipal governments should assist with loans and grants where possible.

Retrofits: Building retrofits like safety glass, roof bracing, structural connectors, or storm shutters are methods of strengthening existing structures. Not every structure will need such measures. Buildings that were built to modern codes should be sturdy enough to withstand most strong winds. Therefore, buildings built before codes were in place are likely more susceptible to wind and snow damage and should be considered to have greater mitigation priority than those built to code. The County tax assessment database can be used to identify buildings built before municipalities used codes.

Landscaping

Structures, especially their roofs, can be protected by creating buffer spaces around buildings. Simply by pruning back overhanging or dead branches from trees, property owners can prevent damage to their property from falling limbs during strong winds.

On the other hand, planting tall trees on usually northern exposures serves as windbreak to strong winds, snow, and cold weather. The typical windbreak has several components:

Dense conifer trees to reduce wind velocity;

Tall broadleaf or conifer trees to extend the area of protection; and

Low shrubs to trap snow, provide wildlife habitat and/or provide aesthetic value.

A "living snow fence" can be created with a windbreak with a density of 70 – 80 percent of multiple rows of dense conifer trees. A "field windbreak" to spread snow across cropland should have a density of 25 to 35 percent with one or two rows of mixed broadleaf or pine trees. Most farmstead or livestock windbreaks can be achieved with a density of 40 to 60 percent by planting multiple rows of conifer and broadleaf trees. The most effective

protection is obtained by orienting windbreaks perpendicular to the prevailing wind. Windbreaks designed for winter protection are generally located north and west of farmsteads, livestock concentration areas, working facilities or other areas to be protected. Although often overlooked, protection from northeast storms should be considered when designing a windbreak (Source: NebGuide, Cooperative Extension, Institute of Agriculture and Natural Resources, University of Nebraska-Lincoln, http://www.ianr.unl.edu/pubs/forestry/g1304.htm) Also, planting evergreen trees and shrubs as windbreaks can reduce winter heating costs. (Source: EPA, http://www.epa.gov/reg3esd1/garden/heat.htm)

Because most structures can benefit from simple attention to landscaping and vegetation matters, mitigation action items should focus on actions that will affect/reach all residents/properties in the County.

Warning Systems

Warning system like sirens can be used to alert residents when tornadoes or other hazards threaten vulnerable areas. Manufactured home parks (both for permanent residents and recreational/camping sites) are especially vulnerable to severe storms and residents may need the extra time to reach adequate shelter that sirens or NOAA weather radios may provide.

Sheltering

For extreme wind events like tornadoes and hurricanes, mitigation measures center on protecting residents from the storm. This is an especially important objective for manufactured housing since ordinary, in-house protection measures like basements or in-house safe rooms are not available. For manufactured home parks, community shelters can help protect residents and visitors from severe storm events. A community shelter is defined as a shelter that is designed and constructed to protect a large number of people from a natural hazard event. Community shelters include stand-alone shelters – separate buildings (i.e., not within or attached to any other building) designed to withstand high winds and the impact of windborne debris during tornadoes, hurricanes, or other extreme-wind events. Internal shelters, i.e., rooms or areas within or attached to larger buildings are designed to be structurally independent of the larger building and to provide the same wind and missile protection as a stand-alone shelter. These shelters are intended to provide protection during a short-term high-wind event (i.e., an event that lasts no more than 36 hours) such as a tornado or hurricane. They are not recovery shelters intended to provide services and housing for people whose homes have been damaged or destroyed by fires, disasters, or catastrophes.

Both stand-alone and internal community shelters may be constructed near or within school buildings, hospitals and other critical facilities, nursing homes, commercial buildings, disaster recovery shelters, and other buildings or facilities occupied by large numbers of people. Stand-alone community shelters may be constructed in neighborhoods where existing homes lack shelters. Community shelters may be intended for use by the occupants of buildings they are constructed within or near, or they may be intended for use by the residents of surrounding or nearby neighborhoods or designated areas. (Source: FEMA 361, Design and Construction Guidance for Community Shelters, http://www.fema.gov/pdf/firma/361_ch01.pdf).

Public Information and Education

Wind and weather hazards can affect the entire County, and many of the mitigation measures presented can be economically implemented by property owners, public information and education are essential to mitigating wind and weather hazards.